Forest Practices Board

Reforestation in the Interior Douglas-fir Subzone: Are Reforestation Choices Meeting Objectives?

SPECIAL INVESTIGATION

SEPTEMBER 2020

FPB/SIR/53

TERRITORIAL ACKNOWLEDGMENT

This special investigation took place within the traditional territories of the Nsyilxcən, Secwepemctsín, Tsilhqot'in, Sḵáẖimcets, Nłeʔkepmxcín, and Dakelh speaking Peoples. The Forest Practices Board would like to recognize the importance of their historical relationship with the land that continues to this day.

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BOARD COMMENTARY

The Interior Douglas-fir (IDF) biogeoclimatic zone occurs in southern BC, covering approximately five percent of the province. The zone contains dry-belt fir ecosystems, often dominated by Douglas-fir trees of mixed age and size with a grassy understory. These ecosystems are ecologically and climatically complex and require very particular silviculture strategies to ensure successful regeneration and to satisfy the wide range of values they contain.

Licensees are increasingly looking to the IDF as a source of timber, now that salvage logging in beetle-killed pine forests is nearing completion. Wildfires in 2017 damaged extensive areas of the IDF and government and licensees are grappling with strategies to salvage the damaged timber, reforest salvaged areas, and address resource objectives.

This special investigation found that site-level practices met the current legal requirements for reforestation in the *Forest and Range Practices Act* and that, more recently, the species being planted has shifted away from primarily lodgepole pine to more resilient mixed species, which is positive. However, over 60 percent of the cutblocks examined were in poor and marginal condition and licensees may not be creating/regenerating resilient stands, which may have negative implications for future timber and non-timber values.

The Board found examples where reforestation is only meeting minimum targets and where licensees are not using best management practices that could improve reforestation success. For example, there is an over-reliance on clearcutting as a silviculture system, which is not appropriate for dry-belt-fir stands, as young trees do not regenerate well without the shade and shelter of overstory trees. More use of partial cutting systems may increase the likelihood of successful reforestation and promote more resilient ecosystem structure, which will be critical in the face of increasing risks posed by climate change.

Reforestation practices that may be successful in other areas of the province are not effective in dry-belt fir stands—ecosystem-specific knowledge is required across all aspects of forest management, including choice of silviculture system, logging system design, site preparation, planting, and beyond. Investigators observed that there appears to be a systemic gap in the knowledge and experience required to successfully manage and reforest these complex sites.

Climate change introduces additional uncertainties on how to manage for incremental drought, heat, species migration and emerging forest health

concerns. The IDF is expected to nearly double in size over the next 60 years, and many current dry-belt fir ecosystems will become grasslands.[1] Expected ecological shifts emphasize the importance of climate change monitoring and management adaptation to set realistic expectations for these future forests. Long-term timber production in some dry-belt fir ecosystems may not be feasible or realistic in the future. Climate change will also increase wildfire risk. Strategies will be needed to increase ecosystem resilience, such as requiring stand structures that are more likely to regenerate, resist insects and disease, and survive the effects of wildfires.

The Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) has put significant effort into developing materials on best practices, expectations, and goals for reforestation in the dry IDF ecosystems. However, the Board found that licensees are not widely or consistently implementing the materials. More needs to be done to ensure government's expectations are achieved, rather than relying almost exclusively on policy guidance. Legal requirements may be necessary in some cases.

To improve reforestation practices in dry-belt fir ecosystems, the Board makes the following recommendations under section 131(2) of the *Forest and Range Practices Act*:

1. FLNRORD should promptly re-assess the long-term reforestation objectives for the dry IDF, and update them based on the likely consequences of climate change.
2. FLNRORD should update reforestation standards to reflect the updated objectives, using a combination of legally required direction and best management practices (guidance) so that the public can be confident that the objectives will be achieved.

In addition to these recommendations, it will be necessary for government, the Association of BC Forest Professionals, and industry to raise awareness of the importance of good forest management in dry-belt fir ecosystems in BC. The Board encourages FLNRORD to implement a program of extension and training for foresters and operators practicing in dry-belt fir ecosystems, to ensure that reforestation achieves the desired objectives. Professional and industry associations can assist by making their members aware of training and development materials that are available. Given the level of uncertainty and risk in dry-belt fir ecosystems, effectiveness monitoring and adaptive management will be required to assess whether objectives are being met, and adjust practices if needed.

[1] Projecting future distributions of ecosystem climate niches: uncertainties and management applications uncertainties (Wang et al). This is just one reasonably likely scenario.

The Board requests that government respond to these recommendations by February 1, 2021, indicating:

a) that it accepts the recommendations and describes how it is addressing or has addressed them; or
b) that it partially accepts the recommendations and provides reasons why; or
c) that it is not accepting the recommendations, and provide reasons why.

If government accepts or partially accepts the recommendations, the Board requests that it update the Board on its progress in addressing them within 12 months of publication of this report.

EXECUTIVE SUMMARY

In 2018, the Board started work on a field-based special investigation to examine whether an appropriate mix of tree species is being maintained in the dry Interior Douglas-fir biogeoclimatic subzones of southern BC and the potential implications for both timber and non-timber values if it is not. The investigation examined tree species composition trends, assessed licensee compliance with reforestation requirements and assessed the effectiveness of reforestation choices and government direction in establishing and maintaining resilient stands.

With assistance from the staff of the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) and forest professionals with expertise in reforestation in dry-belt fir stands, the Board selected four case-study districts in BC. Selection criteria included representation of dry-belt fir ecosystems, reforestation activities, tenure types, species conversions and non-timber resource values. In each case-study district, investigators assessed whether, and to what extent, licensees are planning and implementing practices for the establishment and maintenance of resilient stands. In the field, investigators spent five days in each district assessing the condition of reforested cutblocks and examining how well licensees are implementing the *Forest and Range Practices Act* (FRPA) requirements for reforestation.

The investigation found that licensees' reforestation choices shifted from establishing lodgepole pine monocultures to establishing more mixed species stands over the investigation period (2007-2019), with the intent of establishing resilient stands to meet timber and non-timber resource objectives. While the trend is encouraging, investigators found that licensees were generically regenerating to pre-harvest mature stand species composition without considering site-specific tree species application, reflecting a lack of critical thinking regarding longer-term stand development.

On the ground, licensees complied with FRPA reforestation requirements, but more than 60 percent of the cutblocks sampled were in poor or marginal stand condition due to poor health, low stocking, and/or competing vegetation—this result appears to be driven by ineffective application of silviculture treatments, forest cover retention, species choices and placement at the site level. One of the main factors contributing to poor stand condition was that licensees were not following best management practices for reforestation in dry-belt fir stands. Given the stand conditions observed, it is likely that many of these stands will not be healthy beyond free growing,

potentially compromising forest yields and forest cover requirements for resources such as wildlife habitat and forage production.

FLNRORD recognized the challenges of reforestation in dry-belt fir stands and is working on several initiatives to improve guidance and incentives to licensees. However, these initiatives are not being developed consistently between districts and will not contribute to the establishment of resilient dry-belt fir stands within the province until they are implemented. The initiatives include revised objectives, strategies, expectations, administrative procedures, best management guidelines, appraisal incentives and stocking standards. While the revised stocking standards improve reforestation options, they rely on effective implementation, emphasizing the importance for licensees to follow best management practices.

The investigation found that FLNRORD direction was aptly focused but not fully implemented at the district level. While FLNRORD's provincial, regional and district reforestation objectives are broadly consistent, there are few tactical plans that link provincial and regional objectives with management unit (local) targets. Furthermore, climate change is having dramatic effects on dry-belt fir ecosystems, which raises questions about the management goals for many sites in the IDF. There are currently no formal effectiveness monitoring or reporting mechanisms in place to assess whether provincial goals and management unit objectives and targets for species composition and longer term stocking are being met.

The investigation concludes that licensees complied with FRPA reforestation requirements but are not implementing the best management practices that would maintain an expected mix of tree species on dry belt-fir stands, potentially affecting mid-term timber supply expectations and forest cover requirements for non-timber resources. FLNRORD initiatives are intended to address the challenges faced by licensees and, with timely development and implementation, should serve to help improve reforestation practices in dry-belt fir stands in the short term. However, given the expected impacts of climate change, the Board is concerned about what this means for future timber supply and other forest values.

BACKGROUND

Characteristics of dry-belt fir ecosystems

The Interior Douglas-fir (IDF) biogeoclimatic zone occurs in southern BC, covering approximately five percent of the province. The zone is characterized by a cool temperate climate and contains dry-belt fir ecosystems (dry belt),[2] which are ecologically and climatically complex and require intricate silviculture strategies to ensure successful regeneration and to satisfy the wide range of values associated with these ecosystems.

Dry-belt fir ecosystems in BC's southern interior support a number of different uses and values, including timber, range, wildlife, species and plant communities at risk, recreation and visual quality. Douglas-fir is the most common tree species in the dry belt, often occurring in stands with trees of mixed ages and sizes with a grassy understory (see Figure 1).

The historical natural disturbance in the IDF was frequent, low intensity forest fires that did not typically harm the larger Douglas-fir trees, due to their thick bark. As a result, mature Douglas-fir stands are often un-even aged with open canopies. Some crown fires and selective planting have created mixed stands of Douglas-fir, lodgepole pine, and ponderosa pine. Lodgepole pine is a widespread seral species[3] at higher elevations, whereas Ponderosa pine occurs on dry sites (warm slopes) in the wetter subzones, but it is most common in the hotter and drier lower elevation subzones. The growing season is warm, dry and relatively long (three to five months) and summertime drought is common. Winters are cool with little snow to provide thermal cover and nighttime frost occurrences are common. As a result, regenerating Douglas-fir often rely on the shelter provided by forest cover to survive.

The factors that most influence the types of wildlife species in the dry belt are the relatively short, cool winters and extensive Douglas-fir forests with variable canopy closure.[i] Dry belt ecosystems are characterized by topographic variability and a diversity of overstory and understory vegetation, which provides a wide range of habitat niches for species at risk and other wildlife requiring trees for nesting, feeding, roosting, denning and cover year-round. Low elevation, south-facing aspects attract many animals during winter, and serve as winter range for many ungulates, including mule deer, white-tailed deer and bighorn sheep.

[2] Dry-belt fir ecosystems include even and un-even aged Douglas-fir leading stands in the following biogeoclimatic subzones: IDFdk, IDFxh, IDFxm, IDFdw and IDFxw.

[3] Refers to species that are eventually replaced by other species through succession.

The primary agricultural use of dry-belt fir stands is forage production. These stands provide most of the forested summer ranges for cattle in the province, and support spring and fall ranges and wintering areas, particularly in grassland areas. Pine grass is the principal forest understory species in the dry belt and the primary species to consider for vegetation competition when planning reforestation regimes.

Past and current forest practices

In the 1950s and 1960s, with the advent of mechanical skidders and logging trucks, diameter-limit cutting became common practice. This method was economically efficient, but problematic for stand structure, stocking control and regeneration. It focused on removing the highest quality trees with little focus on regeneration, which, when combined with a policy of fire suppression, left a legacy of poor quality and often overstocked residual stands.

From 1980 to 2000, mountain pine beetle affected virtually all pine trees over 40 years of age, resulting in substantial harvesting to salvage lodgepole pine. Harvesting methods included some retention of Douglas-fir and aspen, but clearcutting with reserves was mainly used, often leaving insufficient shelter for Douglas-fir regeneration. Regeneration after pine salvage logging was predominantly natural, with fill planting of lodgepole pine.

Over the past two decades, there has been little harvesting in Douglas-fir leading stands in the IDF and virtually none in designated mule deer winter range. The practical results of this situation may be the loss of relevant forest management and operational experience, potentially leading to a lack of understanding and implementation of best management practices as harvesting in these types of stands increases.

WHAT IS A RESILIENT FOREST?

Resilient forests are those that can absorb and adapt to disturbances such as climate change, wildfire and attacks by insects and diseases. This will let them stay healthy and sustainable into the future. Resilient forest stands in the dry belt are predominantly well stocked, uneven-aged and contain species that have a strong ability to maintain their health through changing conditions, such as Douglas-fir, western larch, hybrid spruce and ponderosa pine.

The structure of dry-belt fir stands is a primary determinant of forest productivity and the risk of stand losses to insects and disease. Partial-cutting silvicultural systems were used in the past to provide shelter to seedlings during regeneration and were the preferred silviculture system for successful regeneration of Douglas-fir. Retained trees can mitigate losses caused by expected water deficits, frost and snow damage. In general, dry belt sites under shelter regenerate freely unless there is a lack of seed source due to spruce budworm or competition from grasses. Conversely, planting and natural regeneration after clearcutting may be at a higher risk due to frost, soil moisture deficits and brush/grass competition.[ii]

A common species for planting after logging is lodgepole pine because, in the short term, seedlings have a higher survival rate than other species, regenerate well in the open conditions following clearcutting and grow quickly above competing vegetation. However, in the long term, lodgepole pine can be a less resilient species because it is susceptible to drought and forest health agents and can produce lower quality stands that do not meet timber supply and other resource value expectations, particularly in the dry belt. Therefore, stands converted from Douglas-fir to lodgepole pine may be less resilient.

FIGURE 1. *A typical dry-belt fir stand, characterized by multi-layered forest cover and a grassy understory.*

Why we did this investigation

Forest licensees[4] have a legal obligation under the *Forest and Range Practices Act* (FRPA) to regrow stands of trees after logging. Reforestation efforts must result in successful regeneration of healthy trees to ensure a sustainable flow of economically valuable timber into the future and to maintain broader environmental and community values in BC's forests.

FRPA provides licensees with some latitude to achieve their reforestation obligations through reforestation methods, selection of tree species planted, and silviculture treatments. Companies have an economic incentive to use the flexibility provided under FRPA to meet these obligations in the least time possible and at the lowest cost. Issues may arise when short-term objectives are inconsistent with longer-term objectives for forest resources. For example, poor choices for tree species composition could result in lower value timber, as well as risks to wildlife through altered habitats, effects on other resource uses, and reduced resilience to insects, disease and the potential effects of climate change.

A focus on reforestation in the dry belt is timely, as licensees are increasingly focusing on dry-belt fir stands as a source of timber, now that salvage logging in beetle-killed pine forests is nearing completion. In addition, wildfires in 2017 damaged extensive areas of dry-belt fir forest and government and licensees are grappling with strategies to salvage

[4] Forestry licensees includes holders of agreements specified in the *Forest Act* and the Province's BC Timber Sales program (BCTS).

damaged timber, reforest salvaged areas and address resource objectives. Climate change introduces additional uncertainties on how to manage for incremental drought, heat, species migration and emerging forest health concerns associated with ecological shifting. The IDF is expected to increase in size by 91 percent (Table 1 and Figure 2; see Appendix C for more detail) over the next 60 years, with many current dry belt ecosystems becoming grasslands.[5] Expected ecological shifting emphasizes the importance of climate change monitoring and management adaptation to set realistic expectations.

Table 1. Predicted Ecological Shifts in the IDF

Loss / Gain / Change of Area in the IDF (%)		
2020s	**2050s**	**2080s**
-13/55/42	-22/100/78	-39/130/91

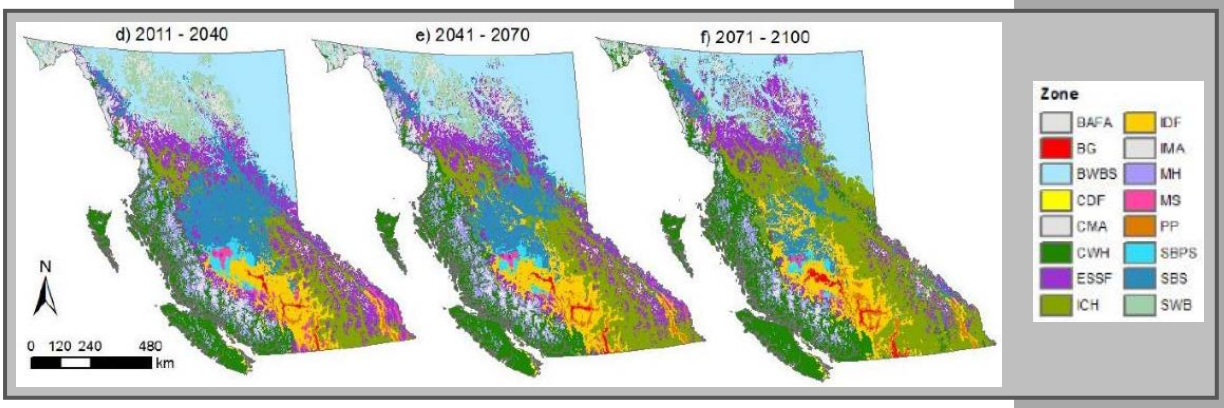

FIGURE 2. *Geographic distribution of ecological zones projected for 2020s (d), 2050s (e), and 2080s (f).*

Purpose

The purpose of this investigation is to assess whether an appropriate mix of tree species is being maintained in the dry belt and the potential implications for both timber and non-timber values if it is not.

This investigation examined pre- and post-harvest tree species composition and assessed:

- compliance with FRPA requirements for reforestation;
- effectiveness of reforestation choices in achieving long-term objectives for timber and non-timber values and resilience to forest health issues; and
- effectiveness of government direction.

[5] Projecting future distributions of ecosystem climate niches: uncertainties and management applications uncertainties and management applications (Wang et al). This is just one reasonably likely scenario.

Scope and approach

This special investigation included reforestation activities in dry-belt fir ecosystems in the Cariboo and Thompson-Okanagan natural resource regions in areas logged under FRPA between 2007 and 2017 (see Figure 3), including the Cariboo-Chilcotin (DCC), Cascades (DCS), Thompson Rivers (DKA) and Okanagan-Shuswap (DOS) natural resource districts.

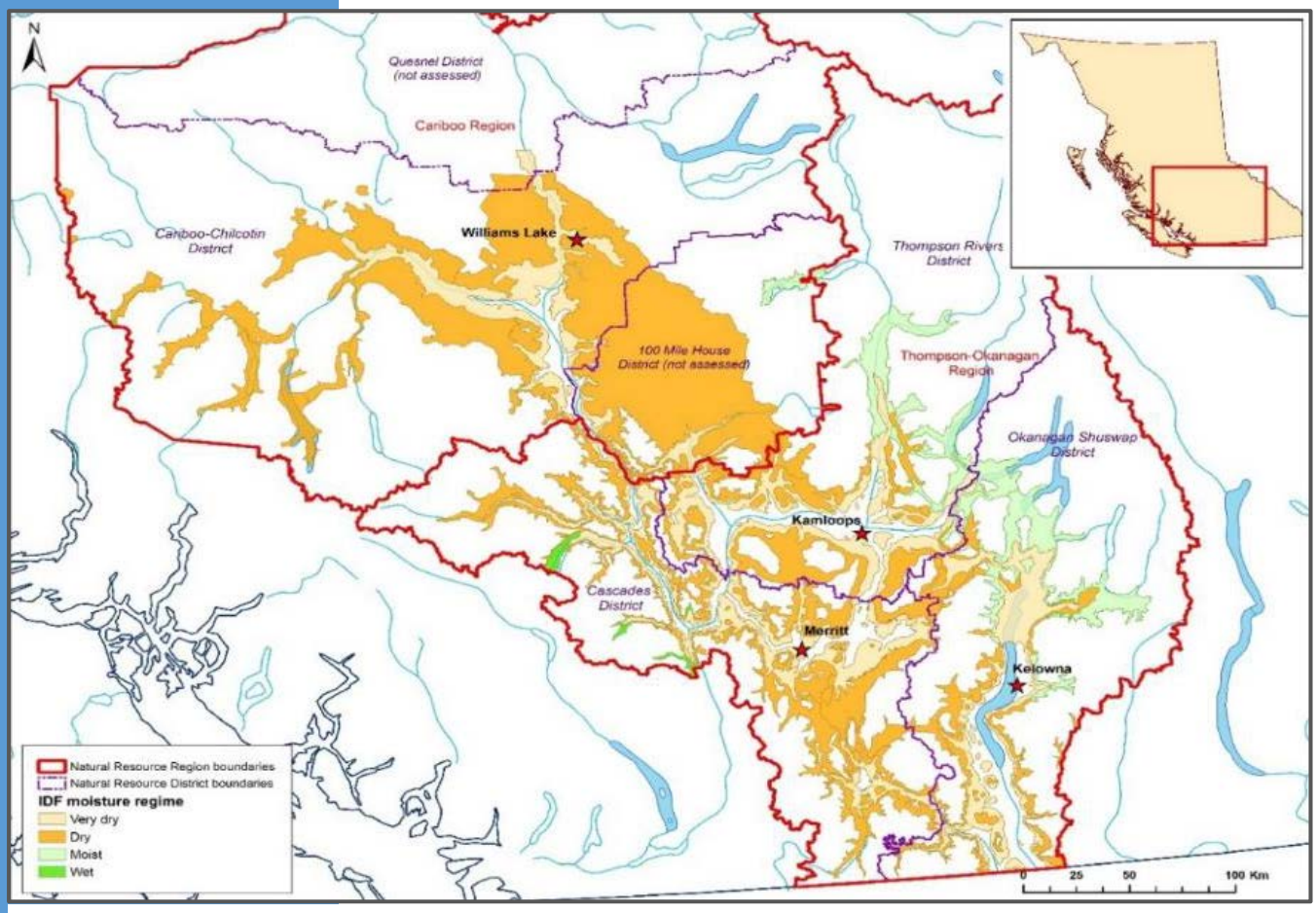

FIGURE 3. *Natural resource districts where silviculture practices were examined during this investigation and the distribution of IDF ecosystems (moisture regimes) within the districts. The dry belt includes the dry and very dry regimes, including the IDFdk, IDFdm, IDFxh, IDFxm, and IDFxw biogeoclimatic subzones, which were the focus of the investigation.*

This investigation examined approaches to reforestation in the dry belt in the four selected natural resource districts to assess compliance with FRPA requirements and the effectiveness of reforestation choices in achieving long-term objectives for timber and non-timber values.

Selection of case-study districts

Investigators used a case-study approach to examine four districts in the dry belt in BC.[6] Districts were selected with input from regional planners and silviculture specialists within the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD). The selected districts represent:

- a range of dry belt ecosystems,
- areas that rely strongly on the timber supply in the dry belt,
- a range of tenure types—area-based verses volume-based, large verses small,
- areas with potential species conversions, including cutblocks with a high proportion of lodgepole pine regenerated,
- a range of silviculture systems – clearcutting verses selection,
- areas where reforestation activities were completed and reported during the investigation period,
- districts with substantial harvest and silviculture activities, and
- areas associated with non-timber resource values such as wildlife, old growth, visual quality and range.

Investigation team

The investigation team included three professional foresters, of which two had specific expertise in silviculture practices in the dry belt. The team conducted field visits in the summer of 2018.

Provincial, regional and district level direction and planning

Investigators reviewed existing government objectives and direction for timber and non-timber values at the local, regional and provincial levels and the content of applicable forest stewardship plans.

Investigators conducted interviews with FLNRORD staff (in branch, region and natural resource district offices), as well as representatives from forest companies, universities, First Nations, ranches, including foresters, ecologists and silviculturalists.

Selection of field samples

Investigators examined FLNRORD databases in the four case-study districts to identify where harvest activities had taken place in the dry belt within the investigation period. Investigators prioritized sampling harvest activities where species conversions appeared to have occurred, less resilient species were regenerated (including lodgepole pine monocultures) and cutblocks

[6] The Board selected four districts as a sufficiently reasonable sample to identify potential factors affecting silviculture practices on the ground.

that were not sufficiently re-stocked (NSR) three years or more after harvesting. In the four case-study districts, approximately 59 300 hectares were harvested in dry-belt fir stands during the investigation period, of which 3250 hectares were converted to leading lodgepole pine and 15 400 hectares were regenerated to lodgepole pine monocultures.

From the above areas, investigators selected 154 cutblocks for sampling, totaling 3275 hectares, of which 1420 hectares were from cutblocks converted to lodgepole pine leading species and 1100 hectares were from cutblocks regenerated to lodgepole pine monocultures.

The sample included 69 cutblocks[7] where planning and practices were assessed, and 85 cutblocks where only operational planning was assessed. The selected cutblocks include a broad spectrum of dry-belt fir ecosystems, stand ages, tenure types and sizes, silviculture systems, resource interests and species composition (Table 2) that reflect timber harvest activities during the investigation period.

Table 2. Field Sample Summary

Forest District	# Licence	IDF Site Series					Stand Age (yrs)		Tenure Type		Silviculture System		Resources		
		dk	dm	xm	xw	xh	<5	5-10	Area Based	Vol. Based	CC	SEL	WUI	MDWR	Range
DCC	11	14	0	1	0	0	9	6	5	10	13	2	1	8	15
DCS	14	30	0	0	0	3	18	15	6	27	33	0	2	19	33
DOS/ DKA	16	6	5	0	9	1	12	9	6	15	19	2	1	10	19
Total	41	50	5	1	9	4	39	30	17	52	65	4	4	37	67

Field-based evaluation of practices

Overview

This investigation used a 'reconnaissance-level' approach, where investigators allocated five days of fieldwork to sample cutblocks in each case-study district to examine tree species composition, compliance with FRPA requirements, stand condition and consistency with resource objectives.

To identify areas warranting site assessments on the ground, investigators gathered and reviewed FLNRORD databases, operational plans and silviculture records to gain a better understanding of legal requirements, silviculture regimes, stand condition and land uses.

Tree species composition

Initial stand conversion comparisons were made at the cutting permit level, often averaging pre-harvest species composition over a number of cutblocks. To refine stand conversion comparisons, investigators compared pre-harvest species composition, recorded in timber cruises and site plans,

[7] Including BCTS and licensees.

with post-harvest species composition reported in silviculture surveys. Field inspections confirmed the information recorded in silviculture surveys.

Compliance with FRPA requirements

FRPA silviculture practice requirements include regeneration obligations, seed transfer, annual reporting and other forest cover requirements for non-timber resources inherent to the site. Investigators examined forest stewardship plans (FSPs), site plans and government orders to determine the forest cover requirements for each cutblock, including stocking standards and requirements for non-timber resources. Investigators compared the requirements with forest cover information in silviculture records to determine whether species composition conformed to stocking standards, considering stand densities, species composition and timeliness of activities. Field inspections later confirmed the information contained in site plans, recorded in silviculture surveys and reported in FLNRORD databases.

Stand condition and interpreting existing and/or potential risk to stand resilience

Stand condition assessments were completed using a line transect/ reconnaissance approach. Transect routes were designed to cover ecological and treatment unit variation and to provide an overall assessment of the efficacy of silviculture regimes.

The assessments used a checklist to record stand condition elements that may affect stand resilience. These elements included seedling health, competing vegetation, site treatments, retention levels, stocking levels and species composition. Investigators completed the checklist using visual observation; measurements were obtained if indicators were not clearly over or under the threshold values.

For each cutblock examined in the field, investigators assigned a ranking of poor, marginal or good stand condition based on professional opinion. Ranking considerations included the cumulative magnitude of existing impacts, potential risks identified at individual sites, and comparison of stand composition to applicable stocking standards.

The rankings reflect the existing and/or potential risk to stand resilience at the time, with poor and marginal stands representing a higher risk to stand resilience.

LEGISLATION, POLICY AND PROCEDURE FRAMEWORK

Reforestation strategies and practice requirements for reforestation in dry-belt fir stands are defined in a complex framework, including legal requirements, FLNRORD policy and procedures and the professional application of appropriate silviculture regimes, as summarized in Figure 4.

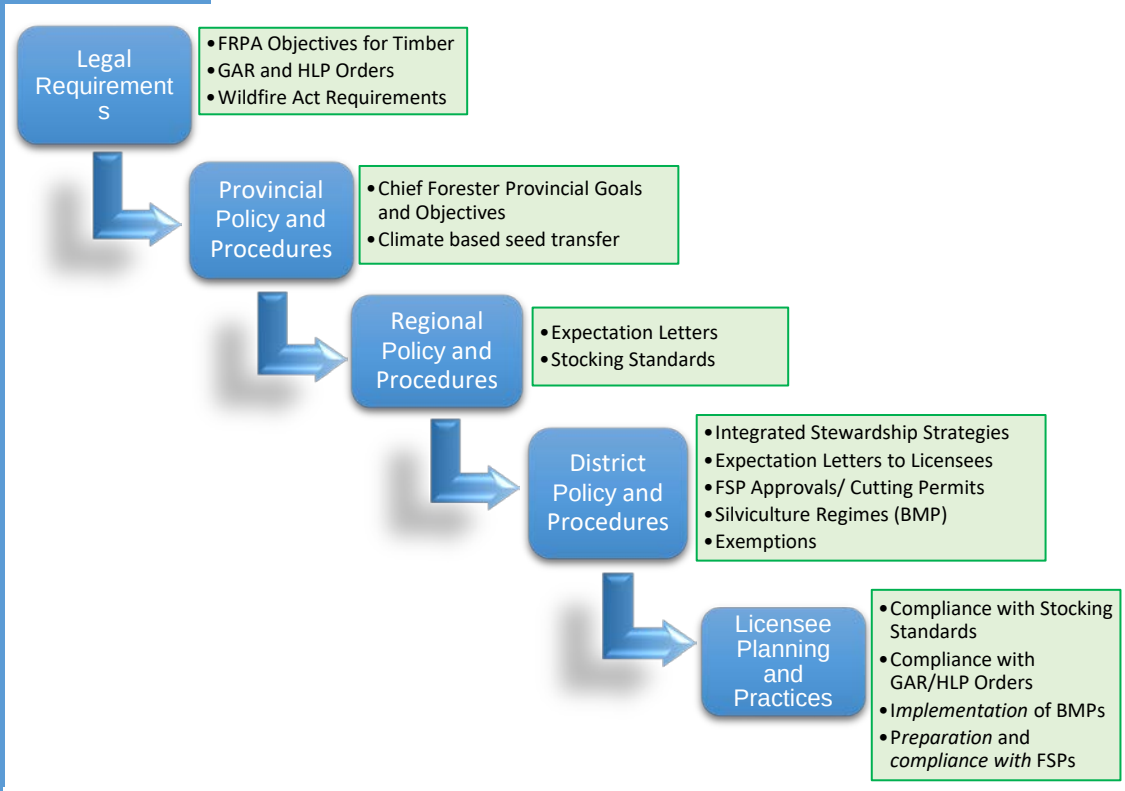

Figure 1. *Summary of the legislative, policy and procedure framework for silviculture.*

Legislation

FRPA requires most licensees to establish free-growing stands in the areas they harvest, consistent with regulations, chief forester standards, and commitments made in approved forest stewardship plans. A free-growing stand is a stand of healthy trees of a commercially valuable species, the growth of which is not impeded by competition from plants, shrubs or other trees. Once declared free growing, a stand is expected to meet timber and forest resource expectations to stand maturity.

In the *Forest Planning and Practices Regulation* (FPPR), the objectives set by government for timber are broad, focusing on maintaining or enhancing timber value.[iii] Licensees are not required to include results and strategies

in their FSP[iv] to achieve these timber objectives.[v] However, FSPs are required to include stocking standards[8] developed or approved by FLNRORD.[vi] FLNRORD must be satisfied that stocking standards are ecologically suitable and will meet timber objectives before it approves an FSP. Once approved in an FSP, a licensee is obligated to achieve the standards.

Higher level plan and *Government Actions Regulation* (GAR) orders may establish additional requirements in dry-belt fir stands. While higher level plan orders[9] do not specifically address post-harvest silviculture, they do require special attention to maintain the representative ecological characteristics if any silvicultural work is deemed necessary in ungulate winter ranges. For example, a mule deer winter range may be established under a GAR order,[10] which may include requirements for Douglas-fir retention and reforestation, stand structure and silviculture systems to maintain critical mule deer habitat. While higher level plans balance values and objectives, it can be difficult to manage for every objective on every hectare of ground. In such instances, FLNRORD can exempt a licensee from the requirements of an order (i.e., if forest health factors such as fire or insect damage prevent meeting the requirements).[vii]

The *Wildfire Act* specifies requirements to minimize the risk of forest activities contributing to the start or spread of wildfires. It includes requirements for hazard abatement that may conflict with coarse woody debris retention strategies intended to provide suitable growing sites for seedling establishment. This is more likely in in wildland urban interface (WUI)[11] areas and often in dry-belt fir stands, where the amount of coarse woody debris retention necessary for effective reforestation may elevate the fire hazard.

Government objectives, policies and procedures

Provincial

In 2017, the chief forester released a document, *Provincial Timber Management Goals, Objectives, & Targets*,[viii] which established provincial goals for tree species composition. The objectives and targets are to use and promote a mixture of species that are less vulnerable to the effects of climate change.

[8] Stocking standards means the stocking standards that apply when (a) establishing a free-growing stand, or (b) meeting the requirements of section 44 (4) [free growing stands generally].

[9] The higher level plan orders for the case-study districts included the Cariboo-Chilcotin Land Use Plan and the Kamloops Land Use Plan.

[10] The investigation sample included timber harvesting in mule deer winter range GAR orders U-5-002, U-3-003 and U-8-001. There were no other orders with stand structure or species composition requirements within the sample.

[11] An area where human development meets or is intermingled with forest and grassland fuel types.

These goals, objectives and targets provide context and guidance to planning for timber supply areas and area-based tenures. These are non-legal and intended to guide integrated stewardship strategies (ISS) in setting targets and strategies to achieve FRPA objectives at a management unit level.

CLIMATE BASED SEED TRANSFER

CBST is one of FLNRORD's first climate change adaptation policies intended to increase the ability of BC's forests and ecosystems to adapt, and respond to the impacts of climate change. The policy switches from geographic-based methodology for seed selection to climate-based methodology, including assisted migration. CBST is designed to promote healthy, resilient and productive forests and ecosystems through the matching of seed sources (seedlots) to climatically suitable planting sites.

DDM CONSIDERATION OF STOCKING STANDARDS

The Minister must approve the stocking standards in an FSP if the DDM is satisfied that the standards will result in stocking with ecologically suitable species that address immediate and long-term forest health issues, to a density or to a basal area that is consistent with timber objectives and timber supply analysis assumptions.

REGIONAL FSP EXPECTATIONS

DDM's expect that licensees will manage dry belt fir stands to maintain the existing structure and species composition of stands. Dry belt management will maintain the representation of Douglas-fir across the Region's dry belt ecosystems, and should enhance dry belt stands on regional landscapes for timber production, wildlife habitat, forest health, fire resiliency, forage production and range use. Stocking standards for dry belt fir stands must be consistent with these expectations.

In 2018, the *Chief Forester's Standards for Seed Use*[ix] were amended to provide licensees with the option to use climate based seed transfer (CBST).[12] The standards provide licensees with guidance on selecting seedlots for reforestation in dry-belt fir ecosystems.

To encourage consistency with provincial goals, objectives and targets, in 2012, the chief forester provided regional and district offices with guidance for assessing stocking standards when approving or extending FSPs, specifically that they must be consistent with timber objectives.

Regional

Consistent with the provincial goals, objectives and targets, in 2016, the Cariboo regional office issued an expectation letter regarding the replacement of FSPs. The letter contains considerations for managing dry-belt fir stands.[x] The expectation letter is aligned with the chief forester guidance on the replacement of FSPs and is signed by district managers. Delegated decision makers (DDM)[13] are expected to engage with forest professionals to review standards for the management of dry-belt fir stands. Core elements applicable to FSP content include stocking standards, cutblock size, adjacency and stand level retention. Licensees are expected to manage dry-belt fir stands to maintain existing stand structure and species composition where possible.

[12] In 2019, the chief forester announced that the standards have been amended to update areas of use for seed, effective August 12, 2019.

[13] DDM means a person with authority to make statutory decisions with respect to forest and range resources under provincial legislation as amended from time to time.

In light of climate change, the regions are developing enhanced stocking standards to better align species choices, stocking density and obligation timeframes with expected changes brought about by a shift in climate and to minimize losses to emerging threats (insects, diseases and wildfire). The proposed standards limit the use of less resilient species in the dry-belt fir (i.e., lodgepole pine), promote the use of more resilient species (i.e., Douglas-fir and ponderosa pine), increase initial stand density to account for expected mortality and are more ecologically and topographically explicit in their application.

The Cariboo Region expectation letter was accompanied by *Dry Belt Fir Management Guidelines* (2016) that define dry-belt fir ecosystems and stand characteristics, articulate common silviculture principles and provide best management practice guidance to manage dry-belt fir stands for timber production. The expected outcomes are to maintain or enhance Douglas-fir representation, ensure healthy resilient Douglas-fir stands and maintain value through the mid-term timber supply.

District

District staff approve FSPs, issue cutting permits and can issue exemptions from legal requirements (GAR, higher level plan order, silviculture obligations) if warranted. FLNRORD provides guidance to licensees when approving FSPs and issuing cutting permits and may provide direction through district policies, procedures and expectation letters. Districts also work at the management unit level (timber supply area or landscape unit) to help develop integrated stewardship strategies (ISSs)[14] and best management practices for silviculture.

In a further effort to encourage consistency with timber objectives, district staff reported they are taking the following administrative and planning approaches and providing guidance to licensees.

1. DDMs are re-considering how to approach exemptions from free-growing stand obligations,[15] considering whether the applicant has demonstrated it used sound silviculture practices for managing dry-belt fir stands, prior to granting an exemption.
2. When issuing cutting permits, some DDMs are considering the application of silviculture practice reviews to provide a legal means to ensure proposed silviculture regimes are consistent with objectives for dry-belt stands.

[14] Note that ISSs are expected to transition to some form of landscape level plan or tactical plan as envisioned in proposed FRPA amendments, but will likely take several more years to be implemented.

[15] A DDM may issue exemptions from FPPR section 97.1 free-growing requirements where a licensee can demonstrate it met free-growing obligations to the extent practicable.

3. Recognizing that licensees face higher harvest and silviculture costs in dry-belt fir stands that often yield lower harvest volumes, FLNRORD is offering appraisal allowance incentives for adopting enhanced stocking standards, particularly in situations where insect infestations or wildfire have made it difficult for licensees to regenerate stands.
4. Providing guidance for best management practices to licensees who operate in dry-belt fir stands.
5. Developing ISSs and tactical plans to align district objectives and targets with provincial timber management goals. The Cascades Natural Resource District developed a pilot ISS in 2017.
6. Modelling specific changes in seasonal weather patterns and developing provincial climate change adaptation strategies (specific silvicultural strategies for dry-belt fir stands were not available at the time of this investigation).

Participants (industry and First Nations) are further engaged in discussing dry belt challenges through innovative forest society groups and sustainable forest management plans.

Licensee planning and implementation

Licensees must prepare FSPs, which include stocking standards, and must comply with the requirements of an approved FSP, as well as any other legal requirements included in GAR and higherlevel plan orders.

To meet requirements, licensees evaluate site conditions and develop harvest and silviculture plans to ensure stands achieve free-growing status. The plans may include site-specific best management practices.

Findings and observations

Are forest stands in dry-belt fir ecosystems being converted to less resilient species?

In the past, licensees focused harvesting activity on salvaging timber impacted by mountain pine beetle in lodgepole pine dominated stands, resulting in a large component of stands being reforested with lodgepole pine. Within the past decade, the focus has shifted to harvesting in mixed species and Douglas-fir dominated stands. Licensees have reacted by choosing a mixture of species for reforestation that includes less pine, more Douglas-fir and other more resilient species (see Figure 5).

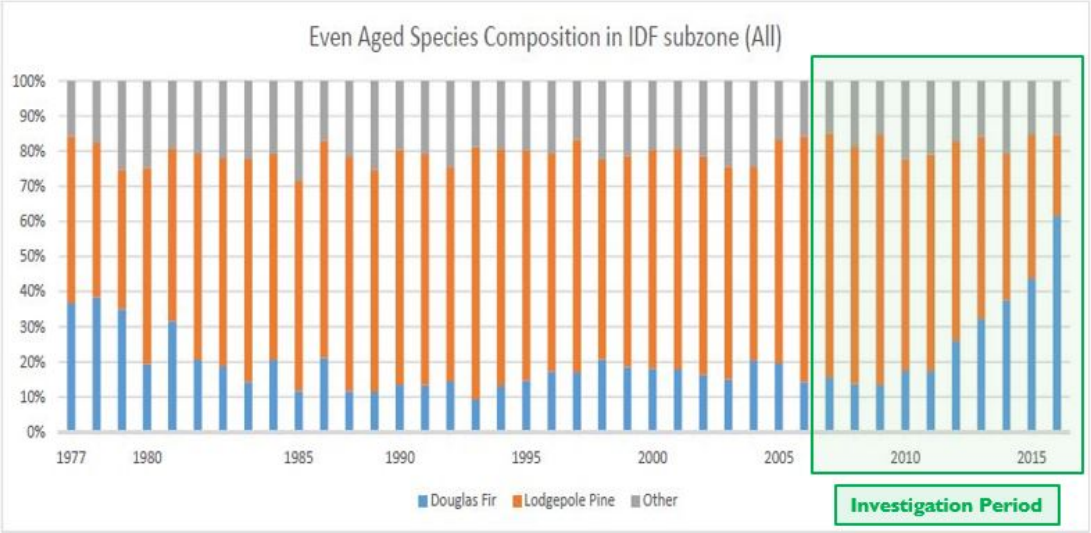

Figure 5. *Historic species reforestation choices in the dry belt ecosystems from government databases. Species selection has shifted away from lodgepole pine to mixed species over the past decade.*

Species conversions identified in FLNRORD databases

When comparing pre- and post-harvest species composition for areas reforested during the investigation period, the leading species conversion between districts ranged from 13 to 29 percent of the area reforested for an average of 17 percent for the combined districts (Figure 6).

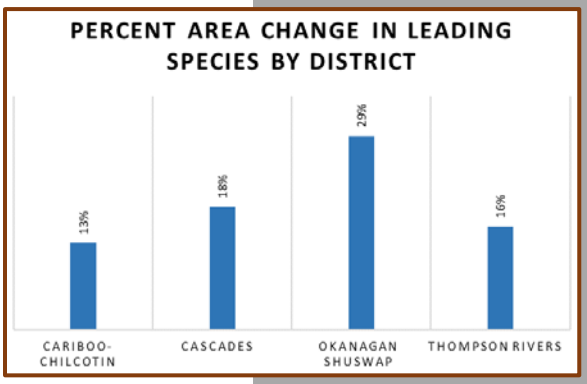

Figure 6. *Change In leading species for areas reforested over the investigation period.*

When considering whether reforestation converted stands to more resilient species, the results are mixed. Approximately 38 percent of the conversions were to less resilient species (conversions to lodgepole pine – other to Pl), 43 percent to more resilient species (conversions to Douglas-fir, larch or ponderosa pine – Pl to other) and 18 percent to species with similar resiliency (conversions from Douglas-fir to larch or ponderosa pine – other to other). Results were variable in all four districts (Figure 7), with the Cascades and Thompson Rivers natural resource districts showing the highest conversions to less resilient species, but most of these conversions occurred early in the investigation period and show a downward trend over the past five years.

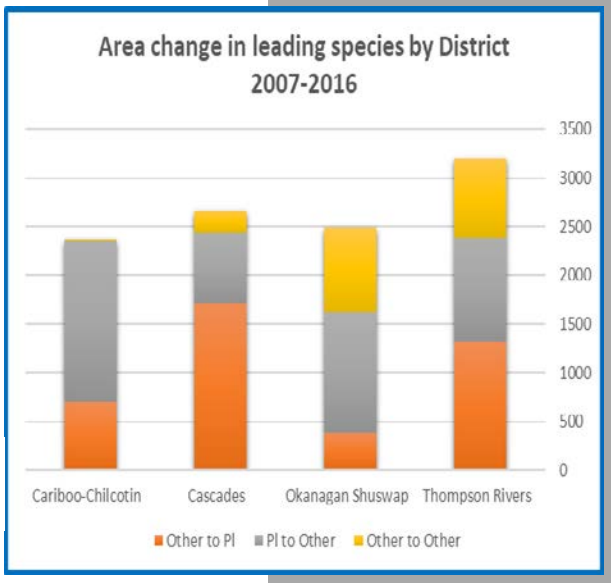

Figure 7. *Shifts in leading species over the investigation period.*

Finding

Conversions to less resilient species were variable over the investigation period but generally became less common over the last five years (Figure 8). In stands more than 5-years old, licensees converted cutblocks to less resilient species more frequently, but in stands less than 5-years old, conversions declined, with licensees establishing more mixed species stands using more resilient species. While the trend is encouraging, tree species composition is not the sole indicator of stand resilience and should be considered in conjunction with the application of best management practices for reforestation in dry-belt fir stands, as described in the following section.

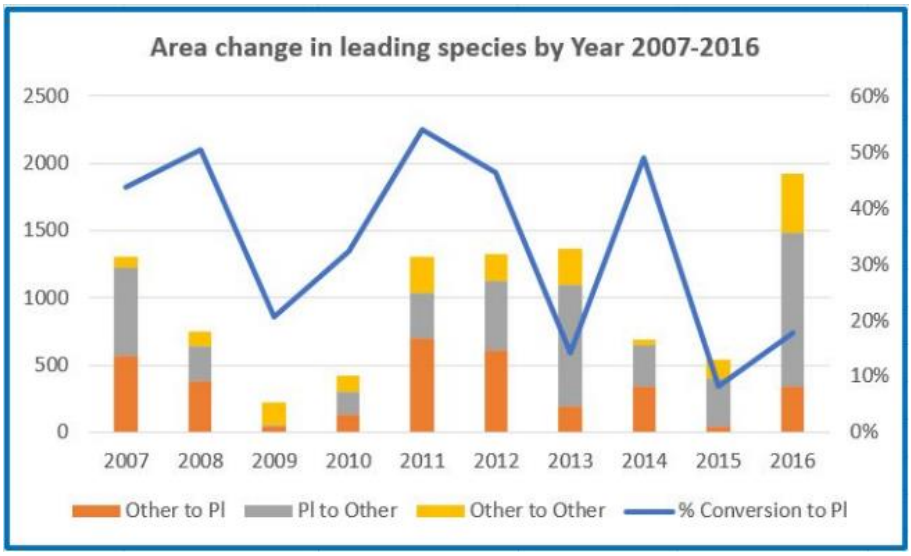

Figure 8. *The trend in species conversions over the investigation period, all case-study districts.*

Are current silviculture planning and practices effective in establishing resilient dry-belt fir stands?

Combined with the effects of climate change, the ecological complexity and climatic variation in the dry-belt fir stands can create challenges when reforesting harvested areas. The survival of tree seedlings depends on the preparation and implementation of detailed site prescriptions that clearly identify and plan for micro-variations in site ecology to help protect seedlings from frost, drought, cattle and other forest health agents. Investigators were concerned that planning and practices did not always adequately reflect site complexity or follow best management practices. Investigators found the following issues with stand condition, planning and practices.

Stand condition

In our field sample of 69 cutblocks, investigators observed a range of stand condition factors that caused them to question whether planning and practices were effective in establishing resilient stands. These elements included marginal stocking, seedling mortality and poor forest health caused by frost, drought, grass competition, cattle, wildlife and other insects and diseases, as described in more detail in Appendix A. Forty-four cutblocks (64 percent) were ranked as marginal to poor condition (Table 2) and were proportionately similar between districts.

Table 2. Stand Condition Summary for All Field Samples

Stand Condition Ranking Summary for Field Samples				
District	Stand Condition Rankings (number of cutblocks)			Total
	Poor	Marginal	Good	
DCC	4	4	7	15
DCS	9	15	9	33
DOS/DKA	4	8	9	21
Total	**17**	**27**	**25**	**69**

Factors that contributed to poor and marginal stand condition included the health of tree seedlings, the presence and persistence of competing vegetation (mainly grasses), the application of suitable site treatments, the retention of suitable trees and vegetation, stocking status and species composition that was not suitable for the site. While all factors contributed to marginal or poor stand condition, the main contributory factors were seedling health, competing vegetation and stocking status (Table 3).

Table 3. Summary of Stand Condition Factors

Stand Condition Summary for Poor and Marginal Cutblocks						
District	Stand Condition Factors (number of cutblocks)					
	Health	Competing Vegetation	Site Treatments	Retention Levels	Stocking Status	Species Comp
DCC	8	6	3	2	9	2
DCS	19	10	10	7	19	7
DOS/DKA	12	9	4	1	9	3
Total	**39**	**25**	**17**	**10**	**37**	**12**

Of primary concern to investigators were the 37 of 69 cutblocks field sampled, where stocking just met or did not meet minimum requirements due to seedling mortality caused by frost, drought, grass competition, cattle, wildlife and other pests and diseases. In 19 of these cutblocks, licensees met regeneration delay requirements and in the remaining 18 cutblocks, regeneration obligations were not yet due. Licensees may have difficulty meeting future obligations in these cutblocks if forest health issues and harsh environmental conditions persist, potentially requiring additional expenditures to prepare and replant the cutblocks to meet regeneration and

free-growing requirements. If requirements cannot be met, licensees may need to seek exemptions from obligations or propose other solutions to the FLNRORD.

On several cutblocks sampled, it was unclear whether the choice of silviculture regimes led to poor stand condition or whether poor stand condition is the result of changing climate thresholds, particularly on drier sites where soil moisture and growing season frosts may limit the viability of timber production. While there was insufficient information available during the investigation to determine where the attribution lies, periodic drought years are expected to occur more frequently as climate change progresses, requiring careful planning and application of silviculture regimes in drought prone areas.

Planning

Investigators found licensees often developed broadly prescriptive harvest and silviculture plans. In 22 cutblocks, site plans left decisions for vegetation-retention requirements to loggers and supervisors, who may or may not be qualified to determine the most effective way to retain forest cover. In five of these cutblocks, investigators found the opportunity to retain more resilient species in preferred locations was foregone.

In 36 cutblocks, silviculture prescriptions were broad and did not address site-specific factors. Site plans often focused on optimizing volume removal and were developed at the cutblock or cutting permit scale, placing reliance on field practitioners, such as loggers, equipment operators and tree planters to decide where and how to apply site-specific treatments, such as where to create more soil disturbance, choosing leave trees, where to retain coarse woody debris, where and how to apply site preparation or how to select tree species and microsites for tree planting.

This approach relies heavily on adequate training of practitioners or supervisors to ensure they understand the site level complexity in the dry belt in order to make treatment choices that complement both silviculture regimes and harvest efficiency. Without adequate training, optimal silviculture opportunities may be foregone, creating additional challenges for silviculturalists to meet regeneration requirements after harvesting.

Licensees were often undertaking planning using a relatively coarse approach to site assessment and planning, an approach that was commonly used for beetle salvage logging, but which does not work when harvesting healthy stands in dry-belt fir ecosystems. Site specific planning and practices that reflect ecological complexity at the site level are vital to ensure resilient stands are established in dry-belt fir ecosystems.

Practices

For the 44 cutblocks in marginal and poor condition, investigators found licensees were not always following best management practices (BMPs) for harvesting and regenerating dry-belt fir stands. Licensees often did not implement treatments that conformed to best management practices, such as:

- the use of selection silviculture systems,
- establishing more resilient species,
- reforesting at higher initial densities to account for anticipated losses, instead of managing to minimum stocking requirements,
- adopting enhanced stocking standards,
- planting within two years of harvest,
- planting tree species on ecologically optimal sites (cutblock and micro-sites), and
- using site preparation and managing stands at or above target stocking.

Investigators found that practices did not wholly conform to BMPs in more than 60 percent of the cutblocks sampled and may be contributing to the establishment of stands that do not meet objectives (see details and examples in Appendix A).

By following BMPs, licensees may be able to reduce costs by adapting harvest systems to operate more efficiently, carefully planning and coordinating harvest and silviculture activities to avoid re-treating underperforming areas, and using the appraisal incentives offered by the FLNRORD, including those for enhanced stocking standards.

Finding

Investigators found that the planning and implementation of silviculture regimes were not always consistent with BMPs and may not be effective in establishing resilient dry-belt fir stands. There are opportunities to better align harvest planning and practices with silviculture regimes to set the stage for effective reforestation and to improve the implementation of silviculture practices at the site level.

Since the investigation, recognizing that there are weaknesses with stand level planning and practices, the Thompson Okanagan Natural Resource Region has initiated a project to develop and revise best management practices for managing dry-belt fir stands. The BMPs will provide guidance to licensees in identifying drought prone areas and will detail treatment regimes designed to minimize losses to drought. FLNRORD plans to publish the BMPs in the near future.

Have licensees complied with legal requirements?

Compliance with reforestation requirements

Investigators found that most licensees met FRPA practice requirements. In the 154 cutblocks sampled, there were 3 cutblocks that did not meet regeneration requirements within the required period and 2 cutblocks that did not meet annual reporting requirements. These were one-off findings involving four licensees in two districts and did not represent a pattern. Otherwise, licensees met stocking standard requirements, species choices conformed to stocking standards, stocking standards in approved FSPs were consistent with those developed by FLNRORD and licensees met seed transfer requirements, taking advantage of climate based seed transfer opportunities in recent years. Practices were consistent between districts.

Compliance with other resource requirements and consistency of resource objectives

The primary resource interests most often associated with the case-study districts and hence, of concern to the investigators, were mule deer winter range, range use for cattle and wildfire protection in WUI.

Mule deer winter range compliance, stand condition and objectives

Investigators field sampled 37 cutblocks in mule deer winter range (MDWR) and found that licensees met GAR order requirements on all cutblocks, meeting either the forest cover retention, regeneration or exemption requirements (usually for forest health reasons) of the orders. However, investigators found that 29 of these cutblocks were in poor or marginal condition (Table 4), due primarily to poor health and grass competition, resulting in poor stocking (Table 5).

Table 1. Stand Condition Summary in MDWR

Stand Condition Ranking Summary for Field Samples in MDWR				
MDWR	Stand Condition Rankings (number of cutblocks)			Total
	Poor	Marginal	Good	
U5002 (DCC)	3	3	2	8
U3003 (DCS)	7	8	4	19
U8001 (DOS)*	3	5	2	10
Total	**13**	**16**	**8**	**37**

** There was no MDWR associated with DKA samples.*

Table 2. Stand Condition Factor Summary in MDWR

Stand Condition Summary for Poor and Marginal Cutblocks in MDWR						
MDWR	Stand Condition Factors (number of cutblocks)					
	Health	Competing Vegetation	Site Treatments	Retention Levels	Stocking Status	Species Comp
U5002 (DCC)	6	5	2	1	6	1
U3003 (DCS)	10	4	6	6	13	6
U8001 (DOS)*	6	6	4	1	6	2
Total	**22**	**15**	**12**	**8**	**25**	**9**

Investigators found that mule deer winter range objectives were not always consistent with timber objectives. The MDWR orders promote more Douglas-fir retention and regeneration, but some licensees focused on meeting the minimum retention and regeneration requirements of the Orders, instead of considering additional retention to meet timber objectives. While licensees met MDWR order requirements, investigators found that in nine cutblocks, licensees favoured regenerating lodgepole pine over Douglas-fir and, in eight cutblocks, did not retain all available Douglas-fir, missing the opportunity to provide shelter for regeneration. Note that these cutblocks were harvested prior to 2012 and subsequent harvesting has favoured the retention and regeneration of more Douglas-fir in MDWR.

Managing for mule deer winter range can be challenging because it focuses on the success of one species, while not necessarily meeting objectives for forest health, fire risk, and tree species diversity. MDWR management aims to produce a forest with a multi-layered structure and a tree species composition that favours Douglas-fir. Removing spruce, lodgepole pine, and deciduous components of the stand is the standard practice used on these ranges to increase the proportion of Douglas-fir. However, this approach may result in the establishment of Douglas-fir monocultures that are less resilient and may not address a number of other issues such as fuel loading, forest health, tree species diversity and other wildlife species.

Range Compliance, Stand Condition and Objectives

Sixty-seven of the 69 cutblocks field sampled fell within range tenures. Investigators found licensees complied with range requirements by protecting or mitigating effects to natural range barriers by referring plans to range tenure holders and taking appropriate measures to maintain barriers. Forty-three of these stands were in poor or marginal condition, and investigators found various degrees of cattle damage in 15 of these cutblocks, with damage being a significant factor affecting stand condition in only four of the cutblocks. Those forest tenure holders with less plantation damage stated they tended to work closely with range tenure holders to coordinate harvest and silviculture activities with grazing activities.

Conversely, those with more damage did not tend to work as closely with range tenures holders.

Investigators found that range objectives were not always consistent with timber objectives. Range tenure holders stated they were concerned that forest licensees are primarily focused on meeting timber objectives and not forage production objectives. That is understandable, as forest licensees are required to establish free-growing stands of timber under the FPPR and are not required to meet forage objectives. Therefore, they prescribe silviculture regimes aimed at meeting stocking standards without considering forage interests, often considering the presence of cattle a potential impediment to achieving free-growing requirements. The *Range Planning and Practices Regulation* even requires range agreement holders to remove cattle when they know cattle are interfering with the establishment of a free-growing stand.[xi] While legal requirements favor timber production objectives, range licensees contend that objectives can be achieved in a manner that better addresses forage objectives. They identified several approaches to planning, harvest and reforestation that would help align forage production objectives with timber objectives (Appendix B).

WUI compliance, stand condition and objectives

Investigators found licensees complied with *Wildfire Act* requirements by effectively assessing and abating slash. Investigators field sampled four cutblocks in WUI risk class 1 polygons[16] with a fire threat rating of high. Investigators found that coarse woody debris (CWD) retention was below abatement thresholds in all four cutblocks and licensees had not specifically prescribed CWD retention for silviculture purposes. One cutblock had forest health concerns (Douglas-fir bark beetle) that precluded leaving too much CWD and the licensee used site preparation to provide suitable growing sites. In another cutblock, the licensee addressed frost and drought concerns by site preparing and retaining vegetation. These two cutblocks were in good condition. In the other two cutblocks the licensees retained little CWD, did not site prepare and the cutblocks are now under-stocked due to losses from drought, frost and cattle damage, and are in marginal to poor condition. There were opportunities to retain more CWD in these two cutblocks to help reduce seedling losses, as fuel loading was below abatement thresholds. As such, there were no conflicts with fuel management objectives in these instances and stand condition was attributable to the application of stand treatments.

Investigators found that timber objectives were not always consistent with fuel management objectives, particularly in wildland urban interface areas.

[16] As identified on WUI Risk Class Assessment Maps when the BC Wildfire Service developed the Wildland Urban Interface Risk Class Framework to support initiatives related to wildfire risk reduction.

In dry-belt fir stands, it is a common silviculture practice to retain sufficient CWD to provide shelter for regenerating tree seedlings to limit frost, desiccation and cattle damage. However, the amount of CWD retained may exceed hazard abatement thresholds, increasing the wildfire risk. In WUI areas, where fire hazards and consequences are high, slash-retention levels required to meet silviculture strategies may exceed slash abatement thresholds required to reduce fire hazards. FLNRORD recognized this issue and, in response, is developing enhanced WUI stocking standards, permitting licensees to use these enhanced stocking standards when reforesting in interface areas, permitting "clumped" regeneration methods and reduced regeneration densities, and placing less reliance on coarse woody debris retention levels that would help meet current stocking standards.

Overall, investigators found that licensees complied with silviculture, MDWR, range and WUI requirements. However, timber and silviculture objectives are not wholly consistent with non-timber resource objectives. MDWR objectives can promote the establishment of Douglas-fir monocultures that are less resilient. Wildfire objectives, specifically in WUIs, can limit the retention of coarse woody debris that could help meet current stocking standards. Range objectives that promote forage production are not aligned with timber objectives that promote forest production.

Are FRPA objectives being met?

While compliance with silviculture and order requirements was high, the frequency of stands in marginal and poor condition observed by investigators raises concerns about whether timber supply and other resource objectives will be achieved.

While the investigation did not assess stands at or beyond free growing, current and emerging research shows that low stocking with less resilient species and poor forest health at free growing in dry-belt fir stands may mean that stands will not meet timber and other resource expectations after free growing (Mather et al).[xii] Timber supply reviews that assume shorter regeneration delays, full stocking and managed stand densities, are cause for concern because of the potential for broad-scale reductions in forest yield relative to projections.

Given the frequency and nature of practices that did not conform to best management practices and the resulting stand condition, investigators found licensees are not always ensuring that they are effectively managing reforestation at the site level in dry-belt fir stands. Plantations may not be performing to expectations and the resulting stand composition and structure may not be producing stands of healthy, well stocked resilient tree species at free growing. The implications may be two-fold; by establishing

less resilient stands, resource objectives (such as range and MDWR) may be compromised beyond free growing and timber supply expectations may not be met.

Is government providing clear reforestation objectives and direction to licensees?

FLNRORD objectives

Investigators found that regional objectives, guidance and standards were either consistent with provincial objectives or were moving towards consistency. The objectives are clear, but broad, and local targets and strategies are not always clearly linked to provincial objectives. The ISS process is intended to link management unit targets and strategies to provincial objectives and targets. However, three of the four districts investigated have not undertaken the ISS process and the one district that has is primarily focused on value added investments for incremental silviculture projects and does not address species choice objectives.

FOCUS OF THE ISS TACTICAL PLAN

The tactical plan explores three tactics:

1. Rehabilitation of MPB-impacted stands
2. Fertilization
3. Enhanced basic silviculture

The tactics focus on increasing volume, do not include a clear linkage to provincial species objectives and do not fully address stand resilience. The plan is not consistent with the intent of the ISS, which is "To provide guidance for the range of management options, not simply incremental silviculture treatments that were the main focus for previous strategies."

The ISS includes a tactical plan, which integrates reserve, harvest, and silviculture plans, provides operational direction and bridges strategic, forest-level analyses, and operational planning processes. At present, the plan focuses on achieving timber quantity objectives by prioritizing investment opportunities for intensive silviculture and enhanced basic silviculture,[16] but has not explicitly addressed species selection for regeneration in the dry-belt fir ecosystems and is not fully consistent with its initial intent.[17] Instead, FLNRORD relies on stand establishment decision aids (SEDAs), like those described in the Merritt Timber Supply Area Forest Health Strategy,[xiii] to provide guidance to licensees[18] regarding species selection for regeneration in dry-belt fir ecosystems. The SEDAs identify hazards for various forest health factors and recommend tree species to manage the hazards, but do not include considerations for drought and frost in dry-belt fir ecosystems and rely on stocking standards in approved FSPs when making species selections.

[16] The enhanced basic silviculture tactic includes increasing stand volume by planting stands at higher densities with improved seed.

[17] "The ISS process is meant to provide guidance for the range of management options, not simply incremental silviculture treatments that were the main focus for previous strategies."

[18] Refers to the Nicola-Similkameen Innovative Forest Society, which is comprised of BCTS and major licensees, holding Innovative Forest Practices Agreements (IFPAs) and carry out the requirements of those agreements through the consensus of the Society. http://www.nsifs.bc.ca/aboutthensifs.php

The other three districts investigated have other silviculture strategies[20] but are not developing ISSs at present. As such, there are currently no formal monitoring or reporting mechanisms in place to assess whether the FLNRORD's expected outcomes for Douglas-fir representation, stand resiliency and timber value through the mid-term timber supply are being met, nor to re-evaluate expectations if they are not.

FLNRORD has proposed changes to FRPA that would introduce forest landscape planning as a new mandatory tactical planning process across all of BC, but the legislation to make that change has not been tabled at the time of this report. In addition, there is a forest landscape planning pilot project planned to commence in the Thompson Rivers district in the near future, which is expected to include dry-belt fir ecosystems as a key value.

FLNRORD direction

Expectation letters

Investigators found that region and district expectation letters are aligned with provincial goals and expectations regarding dry belt management, but have not been applied consistently between regions and districts, and that expectation letters were issued for the Cariboo region, but not the Thompson-Okanagan region. However, the Thompson Rivers district is drafting an expectation letter to provide licensees with guidance on dry-belt fir reforestation.

Stocking standards

While the concept of free growing may be suitable for application in the dry belt, it relies heavily on having suitable stocking standards in place that reflect the ecological capacity of the sites to which they apply. Stocking standards are not spatially explicit for the selection of species and allow the potential for licensees to choose less resilient species at low densities for regeneration, which may not ensure the stands are healthy beyond free growing and, subsequently, value and volume expectations may not be met. Licensees may be inclined to use less resilient successional species to meet free-growing requirements at the earliest possible time, to save on reforestation costs and limit their obligations. This can result in stands with low stocking and emerging forest health concerns after free growing. Field samples indicate that a higher proportion of cutblocks regenerated with less resilient species were in poor condition (Table 6). Once a stand has met free-growing requirements, the government assumes that the stand will continue to grow until rotation with little or no maintenance. However, given the number of cutblocks in marginal and poor condition observed by investigators that conformed to stocking standards, it is questionable whether stand development expectations will be achieved.

[19] See the FLNRORD's website https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/silviculture/silviculture-strategy for a description of other silviculture strategies.

Table 3. Stand Condition Summary by Leading Species

Summary of Stand Condition by Leading Species				
Leading Species	**Proportion of Cutblocks in Stand Condition (%)**			**Total Cutblocks**
	Poor	**Marginal**	**Good**	
Lodgepole Pine	28	39	33	43
Douglas Fir	20	40	40	20
Other	17	33	50	6
Total	**25**	**39**	**36**	**69**

Investigators found that the stocking standards contained in approved FSPs were consistent with FLNRORD stocking standards for dry-belt fir stands in effect in each district at the time of approval. While FLNRORD is currently developing new stocking standards, few FSPs had been extended or renewed at the time of the investigation and those that had still contained older stocking standards. However, for the FSPs that were extended, several licensees stated that they committed to amending their FSPs to include the new stocking standards when they become available. FLNRORD expects that licensees will adopt these standards when they are implemented and that DDMs will consider them a required standard when approving or extending FSPs. These standards will change how legal requirements are measured, which may help establish more resilient stands in the future.

To adapt to climate change, FLNRORD is researching and developing new stocking standards for dry belt ecosystems. The new stocking standards enable a shift to more resilient species by providing more species choices (i.e., western larch, ponderosa pine, Douglas fir), limiting the use of less resilient species (lodgepole pine), increasing planting density to compensate for potential losses to forest health agents and extending the free-growing period requirements. Still, the standards under development do not include spatially explicit objectives. They do not identify where to grow certain tree species, where to regenerate mixed species nor how to combine species to optimize stand resilience. The standards provide a range of species choices with the expectation that practitioners will apply best management practices when making species choices at the stand level.

Investigators found that the focus of stocking standards is suitable for application in dry-belt fir stands, but they have limited value. The standards are not spatially explicit for species selection and rely on practitioners who may have economic disincentives or insufficient knowledge to implement silviculture regimes that will be effective in establishing resilient stands. Adherence to best management practices

when applying the standards is critical to establish resilient stands in dry-belt fir ecosystems.

Overall, investigators found that FLNRORD objectives and direction are moving towards promoting the establishment of resilient dry-belt fir stands but still require further development to clarify linkages to provincial objectives and climate change predictions, set management unit targets, improve consistency between districts and provide guidance on best management practices.

CONCLUSIONS

The investigation found that licensees tended to plant a mixture of more resilient tree species more frequently over the investigation period. While the trend is encouraging, the investigation found several stand condition and practice concerns that indicate an appropriate mix of tree species is not being maintained in the dry belt, and that has potentially negative implications for both timber and non-timber values.

Compliance with FRPA requirements

Licensees complied with the silviculture and other resource requirements of FRPA. When regenerating harvested areas, licensees met regeneration requirements, forest cover requirements contained in GAR orders and conformed to stocking standards.

Effectiveness of reforestation choices in achieving long-term objectives for timber and non-timber values and resilience to forest health issues

While species selection and silviculture practices improved over the investigation period, planners and practitioners did not always effectively apply best management practices when making key reforestation decisions. Investigators observed poor and marginal condition on over half of the cutblocks sampled, indicating resilient stands are not being regenerated in dry belt ecosystems. This means that the stands may not meet free-growing requirements and timber and other resource expectations beyond free growing, potentially compromising forest yields and forest cover requirements for resources such as wildlife habitat and forage production.

Effectiveness of FLNRORD direction

The investigation found that the government is not always providing clear objectives and consistent direction to licensees. Regional objectives, guidance and standards were broadly consistent with provincial goals, objectives and targets or were moving towards consistency. However, local targets and strategies for management units were not clear nor effectively

linked to provincial objectives for species composition, wildlife, forage production and forest health. There are currently no formal monitoring or reporting mechanisms in place to assess whether provincial goals and management unit objectives and targets are being met.

In their current form, stocking standards for dry-belt fir ecosystems permit licensees to regenerate less resilient species at low densities, over a short time period, which may not ensure stands are fully stocked and healthy beyond free growing. While FLNRORD is developing enhanced stocking standards to better align species choices, stocking density and obligation timeframes with expected climate shifts to produce more resilient stands, the application of standards relies on practitioners with adequate knowledge of best management practices in their application, a weakness identified in this investigation.

FLNRORD has identified several areas to help address reforestation challenges faced in the dry belt and is taking positive steps to improve direction to licensees. It is working on several initiatives, which include revised standards, objectives, strategies, expectations, administrative procedures, best management practice guidelines and appraisal incentives. When developed and implemented, these initiatives should help align practices with expected outcomes but still require further development to clarify linkages to provincial objectives and climate change predictions, set management unit targets, improve consistency between districts and provide guidance on best management practices.

The Board concludes that, while the species mix regenerated in the dry-belt fir stands is trending towards more resilient species, 60 percent of the stands sampled have issues that may prevent them from becoming free-growing resilient forests. Given the expected impacts of climate change, such as ecological shifting, increased drought risk, growing insect infestations and potential wildfires, the Board is concerned about what this means for future timber supply and for other forest resources.

APPENDIX A: Examples of BMP Non-conformances

<table>
<tr><th colspan="3">BEST MANAGEMENT PRACTICE FINDINGS</th></tr>
<tr><th>BMP</th><th>Finding</th><th>Example</th></tr>
<tr><td>Use partial cutting systems where possible.</td><td>65 of 69 cutblocks field sampled were clearcut, of which 8 cutblocks were in healthy non-lodgepole pine stands.
Selection harvest, partial cutting or increased retention could have been utilized to serve as shelter to seedlings from frost and drought and to provide a seed source for natural regeneration.</td><td> 
A cutblock where the site plan states there is no Fd in the cutblock but harvest records indicate 25% of the harvested volume was Fd and frequent Fd stumps were observed during the field review. All Fd was harvested and no Fd was regenerated although it is a preferred species.</td></tr>
<tr><td>Monitor and regenerate immature layers in uneven aged stands.</td><td>In all three of the uneven aged stands sampled, the regeneration layer was not stocked due to pine grass ingress.
Natural regeneration was expected but did not occur due to competition from pine grass. Site preparation and prompt planting can help alleviate grass ingress and establish trees.</td><td> 
A cutblock where a strip selection silviculture system was used, was not site prepared and was left to naturally regenerate, resulting in very little regeneration due to grass competition.</td></tr>
<tr><td>Manage plantations above minimum stocking levels to help ensure tree survival beyond free growing.</td><td colspan="2">In 37 cutblocks, stocking was approaching or below minimum requirements, where performance beyond free growing may not meet expectations.
Stocking in these cutblocks was less than 100 stems per hectare above minimum stocking requirements. These stocking levels, if persistent to free growing, may mean that emerging forest health issues would prevent the cutblocks from meeting timber and other resource expectations beyond free growing.</td></tr>
</table>

APPENDIX B: Range and Timber Objectives

Range tenure holders stated they were concerned that forest licensees are primarily focused on meeting timber objectives and not forage production objectives. Forest licensees are required to establish free growing stands of timber under the FPPR and not required to achieve forage objectives under the *Range Planning and Practices Regulation* (RPPR). Therefore, they prescribe silviculture regimes aimed at meeting stocking standards without considering forage interests, often considering the presence of cattle as a potential impediment to achieving free growing requirements. This approach is supported in the RPPR, which requires range agreement holders to remove cattle when they know cattle are interfering with the establishment of a free-growing stand.[xiv]

While legal requirements favour timber production objectives, range licensees contend that objectives can be achieved in a manner that better addresses forage objectives. They identified several approaches that would help align forage production objectives with timber objectives.

- Reduce the number of stands converted to lodgepole pine, as the resulting stand structure is not ideal for forage production.
- Create more ground disturbance during harvesting or site preparation to promote natural regeneration and grass production.
- Conduct site preparation in a manner that limits hazards to cattle.
- Retain coarse woody debris in a manner that balances range use with reforestation needs.
- Increase retention when logging in pure healthy Douglas-fir stands, utilizing more selection harvesting systems.
- Require forest licensees to address forage maintenance objectives in operational plans.
- Change stocking standards to reduce inter-tree spacing to accommodate obstacle planting to limit cattle damage to seedlings.
- Provide tree planters with training on obstacle planting to minimize cattle damage.
- Consider range use habits in operational planning to accommodate habitual trails, resting areas and watering areas in reforestation strategies.
- Work closely with range tenure holders to coordinate range and forest activities.

APPENDIX C: Predicted Climate Shifting

Table 1. Predicted Shifts in Climate Envelopes for the IDF – Change, Elevation and Latitude Shifts

LOSS/GAIN/CHANGE OF CLIMATE ENVELOPE (%)			ELEVATION SHIFT (M)			NORTHWARD SHIFT (KM)		
2020s	2050s	2080s	2020s	2050s	2080s	2020s	2050s	2080s
-13/55/42	-22/100/78	-39/130/91	89	86	72	22	75	126

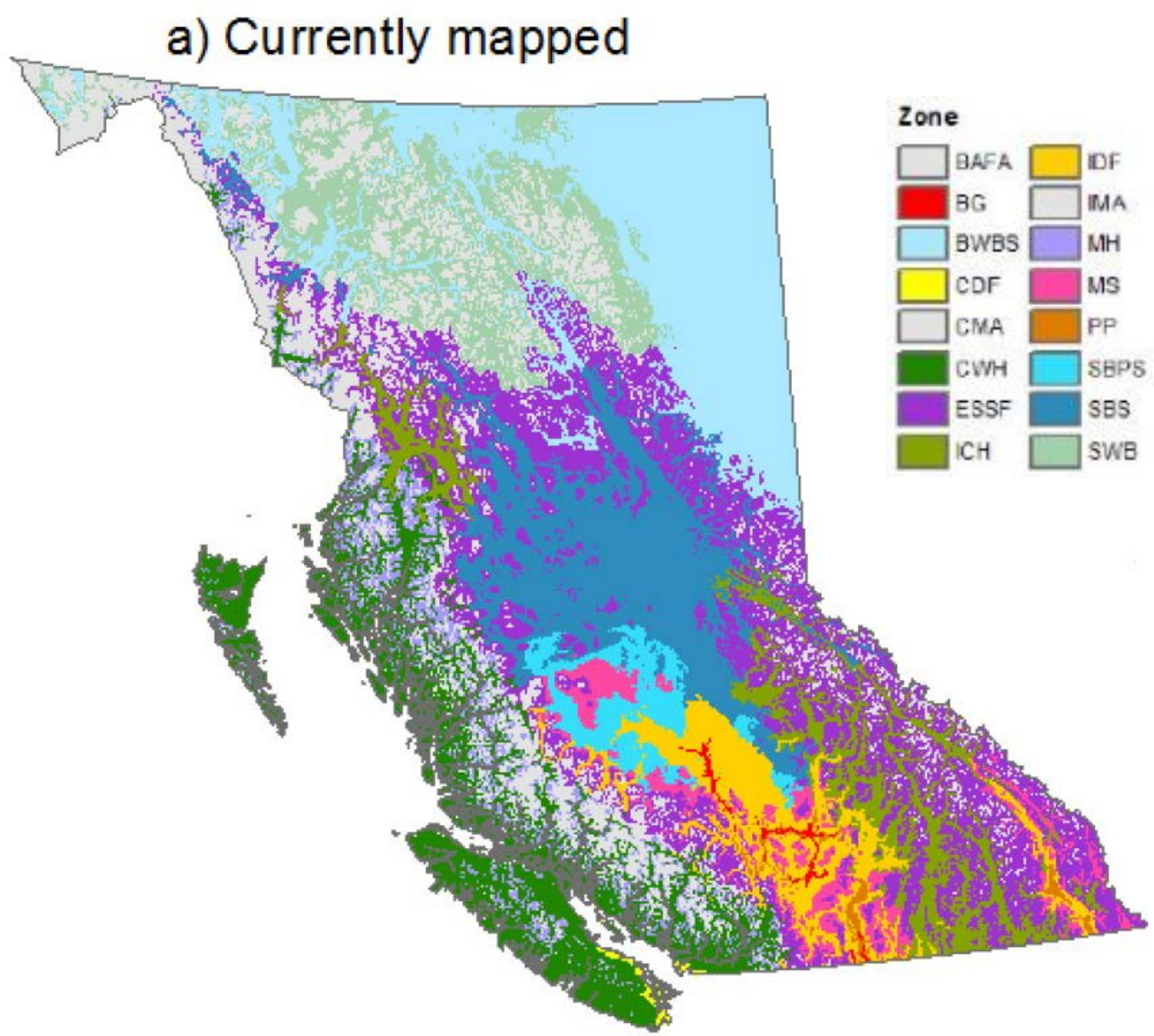

Figure 1. *Geographic distribution of ecological zones – current distribution.*

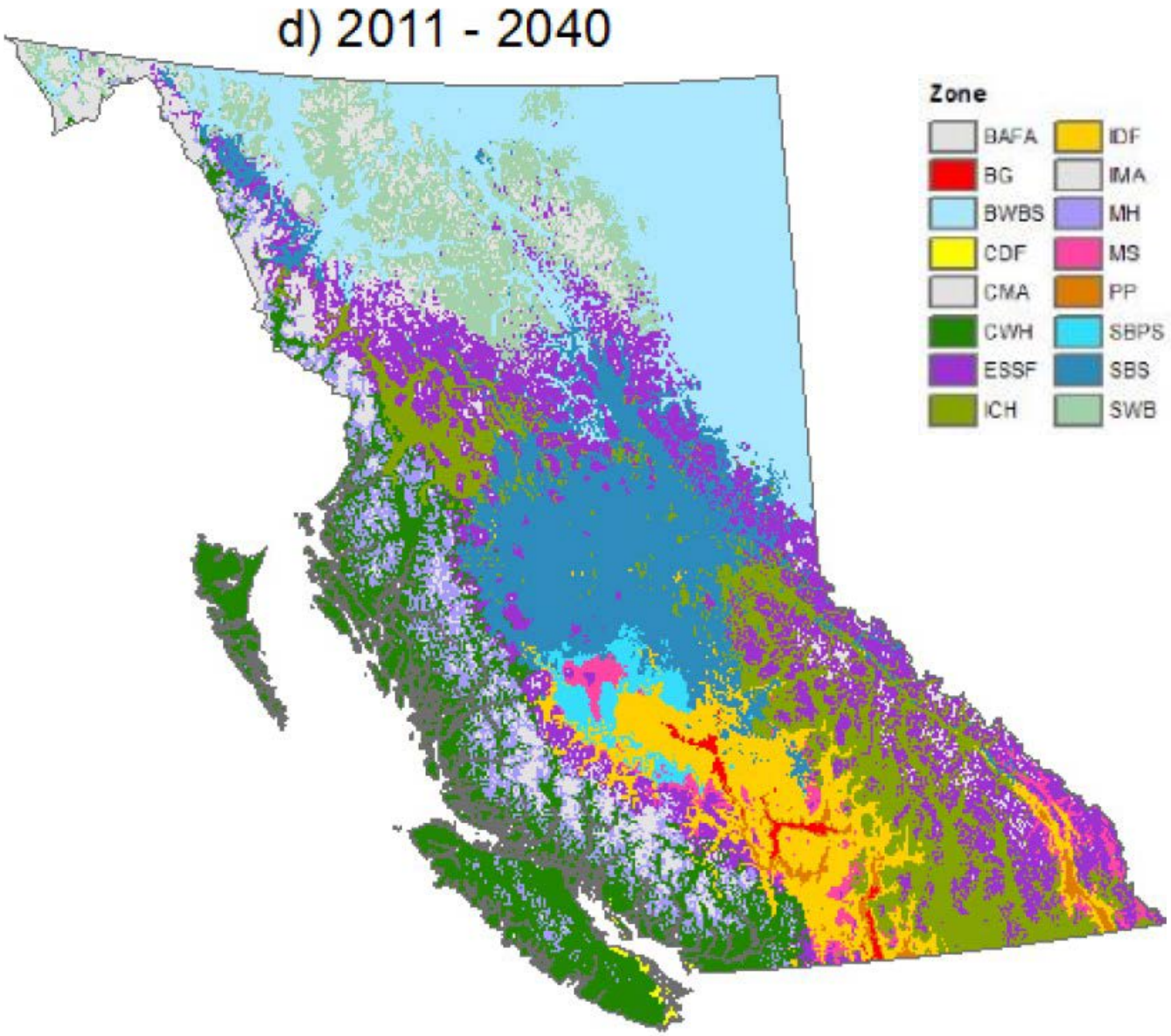

Figure 2. *Geographic distribution of ecological zones projected for 2011-2040.*

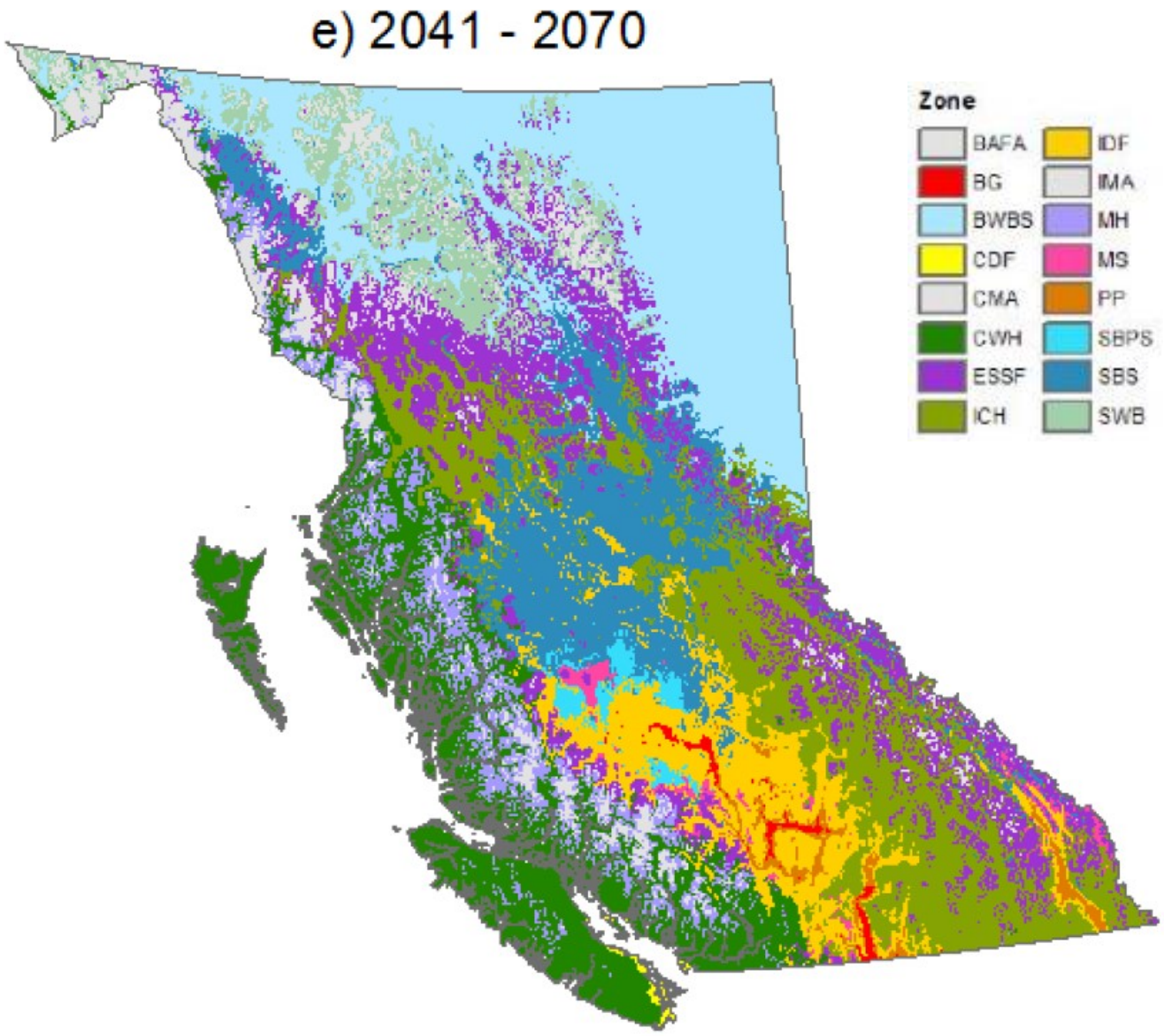

Figure 2. *Geographic distribution of ecological zones projected for 2041-2070.*

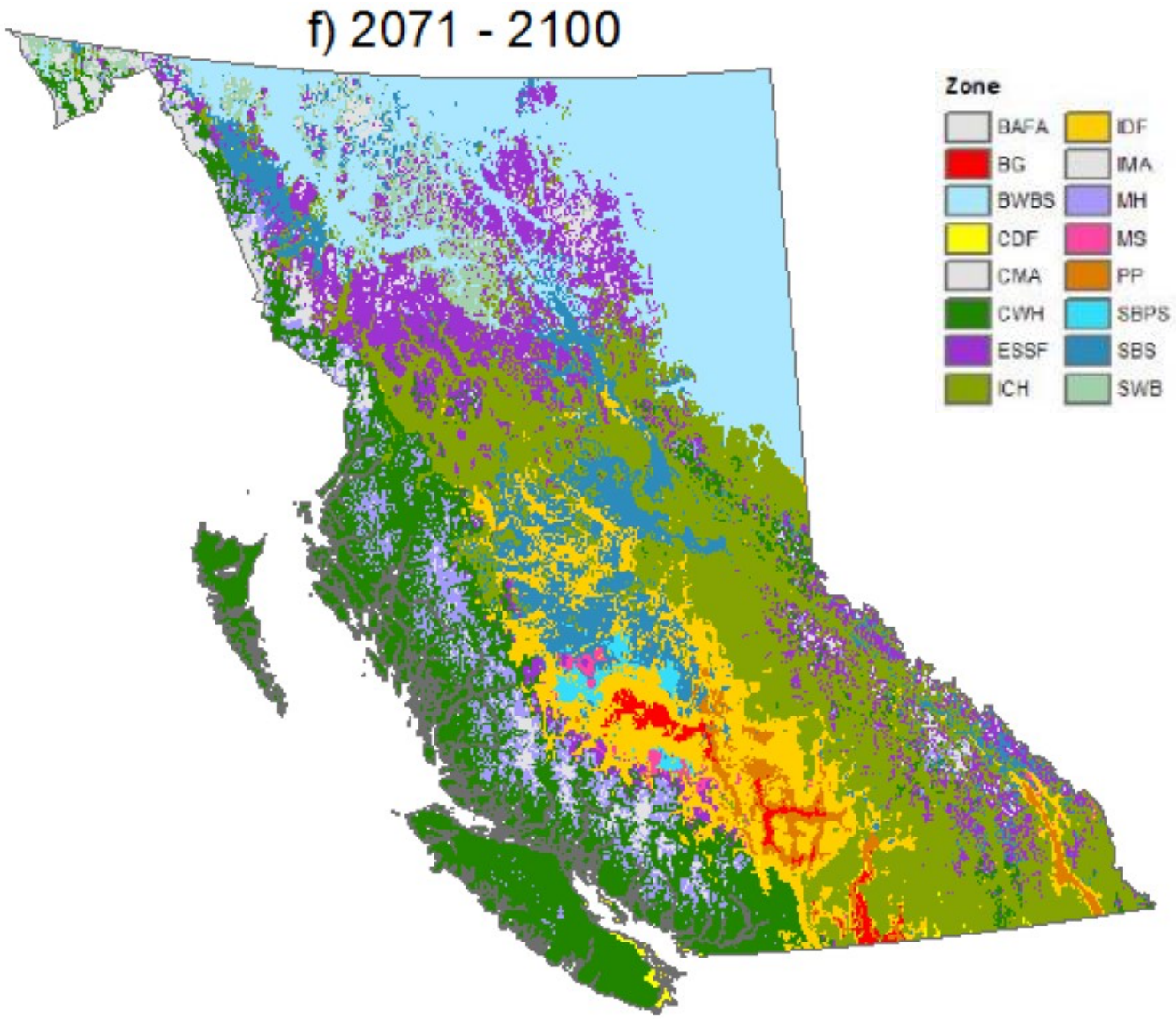

Figure 2. *Geographic distribution of ecological zones projected for 2071-2100.*

ENDNOTES

[i] Chapter 10: Interior Douglas-fir Zone by G.D. Hope, W.R. Mitchell, D.A. Lloyd, W.R. Erickson, W.L. Harper, and B.M.Wikeem

[ii] An extension note, by Day and Swift (2011), summarizes best management practices in the IDF zone.

[iii] Objectives set by government for timber

6 The objectives set by government for timber are to

(a) maintain or enhance an economically valuable supply of commercial timber from British Columbia's forests,

(b) ensure that delivered wood costs, generally, after taking into account the effect on them of the relevant provisions of this regulation and of the Act, are competitive in relation to equivalent costs in relation to regulated primary forest activities in other jurisdictions, and

(c) ensure that the provisions of this regulation and of the Act that pertain to primary forest activities do not unduly constrain the ability of a holder of an agreement under the Forest Act to exercise the holder's rights under the agreement.

[iv] A forest stewardship plan (FSP) is a key planning element in the FRPA framework and the only plan subject to public review and comment and government approval. In FSPs licensees are required to identify results and/or strategies consistent with government objectives for values such as water, wildlife and soils. These results and strategies must be measurable and once approved are subject to government enforcement. FSPs identify areas within which road construction and harvesting will occur but are not required to show the specific locations of future roads and cut blocks. FSPs can have a term of up to five years.

[v] Specifying results or strategies

12 (8) A person who is required to prepare a forest stewardship plan is exempt from the requirement to prepare results or strategies for an objective set by government for timber.

[vi] Stocking standards in FSP

16 (1) A person required to prepare a forest stewardship plan must ensure that the plan specifies the situations or circumstances that determine when section 44 (1) [free growing stands generally] or section 45 [free growing stands collectively across cutblocks] will apply to an area.

(2) In specifying a stocking standard under this section, a person who prepares a forest stewardship plan may consider the factors set out in section 6 [factors relating to stocking standards] of Schedule 1.

(3) A person required to prepare a forest stewardship plan must ensure that the plan specifies, for each of the situations or circumstances specified under subsection (1) where

(a) section 44 (1) (a) will apply, the regeneration date and stocking standards,

(b) section 44 (1) (b) will apply, the free growing height and stocking standards,

(c) section 45 (1) will apply, the regeneration date and the stocking standards, and

(d) section 45 (2) will apply, the free growing date and the stocking standards, as approved by the chief forester.

(4) A person required to prepare a forest stewardship plan must ensure that the plan specifies stocking standards for areas referred to in section 44 (4), and the situations or circumstances that determine when the stocking standards will be applied.

(5) A holder of a major licence that is a forestry licence to cut entered into under section 24.8 of the Forest Act or converted into a forestry licence to cut under section 24.9 of the *Forest Act* is exempt from this section.

[vii] GAR orders for MDWR by district include: DCC U-5-002, DCS U-3-003, DOS U-8-001 DKA None. A full list of government approved ungulate winter ranges, objectives, measures and maps can be found at: http://www.env.gov.bc.ca/wld/frpa/uwr/approved_uwr.html

[viii] Ministry of Forests, Lands, Natural Resource Operations and Rural Development, *Provincial Timber Management Goals, Objectives & Targets*, 2017. https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/silviculture/timbergoalsobjectives2017apr05_revised.pdf

[ix] Ministry of Forests, Lands, Natural Resource Operations and Rural Development, *Chief Forester's Standards for Seed Use*, 2004. https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/tree-seed/legislation-standards/chief-forester-s-standards-for-seed-use

[x] FSP Expectations Letter April 15, 2016 – Replacing Forest Stewardship Plans and Sustaining Dialogue About Forest Resource Stewardship in the Cariboo Natural Resource Region.

[xi] RPPR Removal of livestock

44 (1) A range agreement holder who knows that grazing livestock under the agreement will cause significant interference with the establishment of a free growing stand under section 29 [free growing stands] of the Act, must

(a) remove the livestock from the area, and

(b) not allow livestock to enter the area.

(2) If the minister is satisfied that sufficient measures have been taken to prevent interference with the establishment of a free growing stand from recurring, the minister may exempt a range agreement holder from the requirement of subsection (1) (b).

[xii] W. Jean Mather, Suzanne W. Simard, Jean L. Heineman and Donald L. Sachs, *Decline Of Planted Lodgepole Pine In The Southern Interior Of British Columbia*, 2010.

[xii] Martin Ponsioen, RFT, Ministry of Forests, Lands, Natural Resource Operations and Rural Development, *Merritt TSA Forest Health Strategy 2013/2014*, 2013. https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/forest-health/fh-strategies/merritt_tsa_cascades_forest_health_strategy.pdf

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PO Box 9905 Stn Prov Govt
Victoria, BC V8X 9R1 Canada
Tel. 250.213.4700 | Fax 250.213.4725 | Toll Free 1.800.994.5899
For more information on the Board, please visit our website at: www.bcfpb.ca