Catchment Area Analysis:

Drax's Williams Lake and Meadowbank Pellet Facilities

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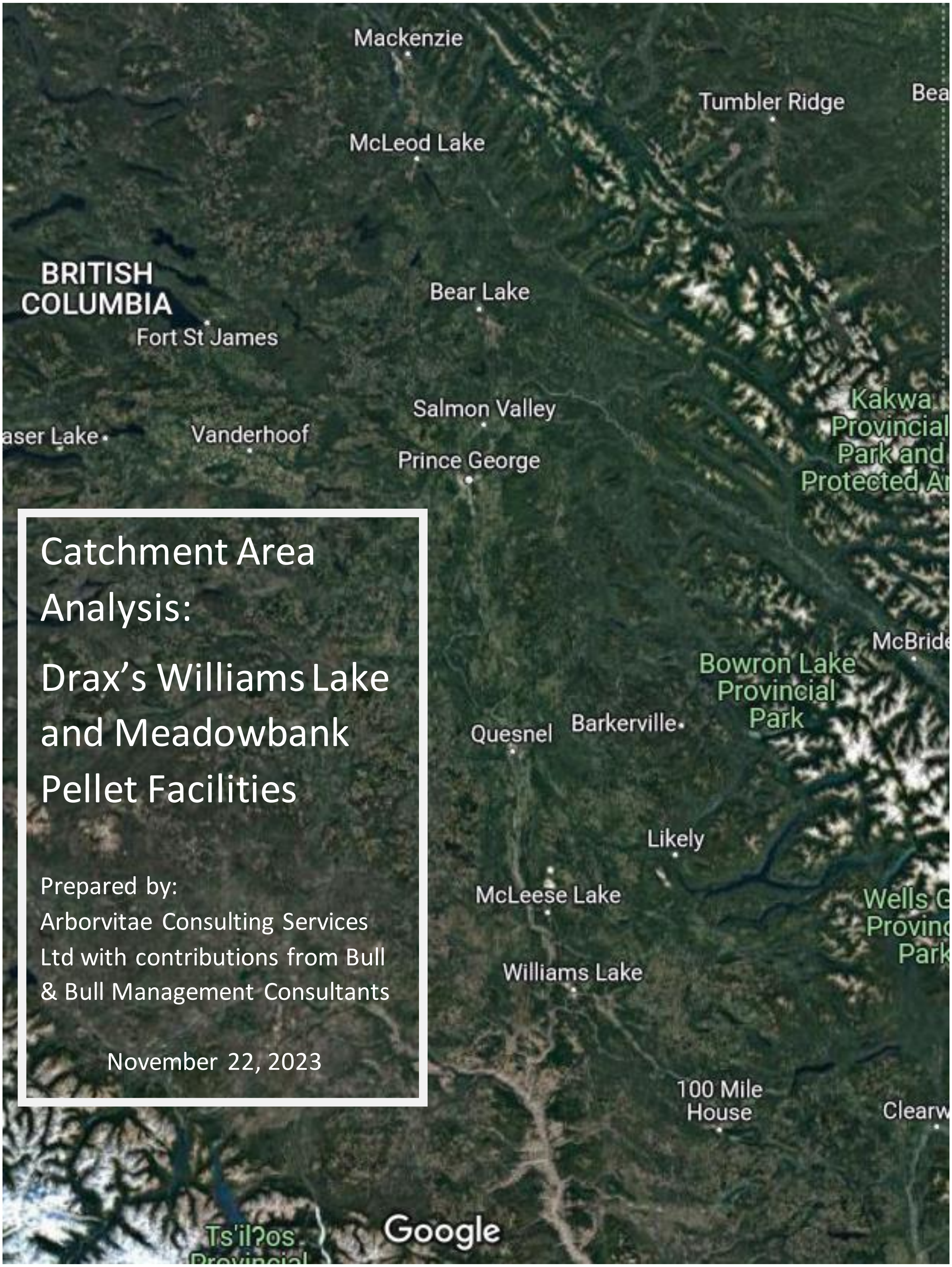

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5. Jim Thrower (Westwood Fibre Resources, Kamloops, BC) assisted in summarizing and interpreting the forest inventory data and local market conditions; and
6. Brad Bennett provided advice and insight regarding the regional pellet industry.

The cover picture shows a view of the catchment area in Google Maps

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Executive Summary

Drax Group plc is large energy company headquartered in the UK that generates increasingly decarbonized energy in the UK. Drax's portfolio of energy generation facilities include biomass, power production, and Drax both produces its own pellets and purchases pellets from other producers. Drax is committed to a zero-carbon future and aims to become carbon-negative itself by 2030. With this in mind, Drax wishes to ensure that the fibre procurement for the pellets it uses is not having a detrimental effect on forests, how they are managed, and on other aspects of the forest industry. This includes an interest in ensuring that fibre procurement contributes to its overall goal of becoming carbon negative.

Drax commissioned this study to provide evidence on how it is meeting its forest commitments related to fibre procurement by its Meadowbank and Williams Lake pellet plants, located in the Interior region of British Columbia (BC). The catchment areas of the two mills, which are the areas where their fibre originates, overlap considerably and so this analysis evaluates the impacts of fibre procurement on the combined catchment area for both mills.

Historically, the forest landscape in this catchment area (CA) has been subject to repeated natural cycles of disturbance by fire and insect pests, followed by natural regeneration. The forest species are predominantly coniferous, with extensive areas of fire-origin stands of pure pine, and spruce and fir stands in higher elevation areas. Mixed stands are most common in the ecological transition zones. The harsh climate, particularly cold winters, results in relatively slow growth rates, with natural-origin stands requiring between 80 to 120 years to reach maturity.

This study was conducted in two phases. The first phase was a retrospective assessment that provided a detailed quantification of how the forest developed between 2002 – 2020, examining growth, losses to insects and fire, harvesting and renewal. The year 2002 was chosen as the starting point because there was a fairly complete forest inventory for that date which was also close to when the pellet facilities became substantial players in the forest industry.

Phase 2 updated the Phase 1 work to 2022 and examined how the forest could be expected to develop from 2022 to 2043. The key variable for the projection was the future fire regime, about which there is a lot of uncertainty as climate change has begun to have a major influence on fire weather and wildfire in the catchment area. The projection was undertaken using a spatial forest model. Phase 2 also included an analysis of the forest carbon balance from 2002 – 2043 using the Carbon Budget Model developed and maintained by Natural Resources Canada.

The CA consists of five Timber Supply Areas: Mackenzie, Prince George, Quesnel, Williams Lake and 100 Mile House. The CA is 22.6 million ha, representing 24% of BC. Provincial land comprises 96% of the CA, and private and federal land were excluded from the analysis since they play very minor roles in the regional forest sector. The area of forest within the CA is 12.7 million ha but the area available for timber harvesting is only 5 million ha, since much of the area is non-forested, non-productive forest, inoperable, or reserved from harvesting to maintain ecological, social or cultural values.

The larger forest area includes substantial amounts of old forest – 37% of the forest is 140 years of age or older; 140 years is the age that the provincial government considers Interior forests to be considered "old". Much of this old forest is on low productivity and inoperable sites, such as the sub-alpine areas, as well as in parks and reserves.

The factor with the greatest influence on the forest between 2002 and 2020 was the mountain pine beetle (MPB). The outbreak, enabled by climate change, killed the majority of mature lodgepole pine in the interior. The CA was among the hardest hit areas of BC; 81% of the lodgepole pine volume in Quesnel was killed between 1999 and 2014, equivalent to 90 million m3 of timber. BC authorized a massive salvage effort, increasing allowable cuts and directing that harvesting must prioritize dead trees killed by the MPB. High levels of harvest took place between 2002 and 2011 until the salvage effort began to wind down and the Chief Forest had begun to bring down AACs to reflect the losses of mature timber that had occurred. By 2018 or 2019, the salvage harvest was largely completed and the harvest level fell below pre-MPB levels.

More recently, in 2017, 2018 and 2021, BC experienced several very severe fire years that have led to further losses of timber. These have not yet been factored into AACs – and neither have the much worse fires that occurred in 2023.

Mainly due to the MPB, the amount of growing stock in the CA declined throughout the 2002 – 2020 period from roughly 2.2 billion m3 to 1.3 billon m3. The losses were mainly in the lodgepole pine stands. The losses were mainly experienced in the mature age classes (80 140 years) – the amount of old forest declined to 2011 and then rose slightly.

As of 2022, the AACs and harvest levels are declining, with further decline already scheduled. As the supply has shrunk, some mills have closed, including the Pacbio mill in 2022. The reduced amount of residual fibre from sawmills had led the two pellet facilities to shift to a higher percentage of forest-based feedstock. Some of this feedstock is slash that is left at the landing after the primary harvest – it can be chipped or ground and brought to the pellet plant. The pellet facilities are also taking low-grade roundwood for which there is no other user – it is chipped at the pellet plant.

For the forest projections, the planned AACs were used to set the harvest level, with adjustments based on recent performance. Old growth areas that have been deferred from harvesting were assumed to be permanently unavailable for harvest. Two fire scenarios were developed. In Scenario 1, the average area burned between 2002 and 2022 was assumed to burn in 2023, thereafter the annual area burned would be equal to the annual average since 1919 (when modern record keeping began). This scenario, referred to as the "Drop" scenario, proposed a very modest fire regime which now looks unrealistic in light of the 2023 fire year. Scenario 2 made the same assumption regarding the 2023 fire regime; thereafter the area burned declined linearly over ten years until the long-term average fire regime is reached (i.e. the average area burned between 1919-2022).

Under both scenarios, the amount of growing stock continued to drop between 2023-27 before beginning a recovery. The recovery was greater in Scenario 1, however the amount of growing stock only reached he 2016 level by 2042. In Scenario 2, the 2042 level of growing stock only reach the 2021 levels. In both scenarios, the amount of old volume increases throughout the analysis period while the amount of mature volume declines substantially – in Scenario 1 it declined from 925 million m^3 in 2001 to 515 million m^3 in 2042. The amount of thrifty volume declined between 2001 and 2012 and then began a steady increase thereafter.

The full target harvest was not achieved in either Scenario, with worse results in Scenario 2. In Scenario the Quesnel and Prince George harvests came up short in 2023-27, while in Scenario 2, harvesting could not meet the target level in 100 Mile House (52%), Prince George (48%) and Quesnel (40%) during this period. Lesser harvest shortfalls also occurred in the three TSAs in the 2028-2032 term. If the future fire regime is more severe than was modelled here, the future harvest will be lower than modelled here.

The amount of carbon in the CA forest declined steadily from 2002 to 2022 as the losses from MPB and, later from wildfire, reduced the amount of live timber in the CA. Thereafter, the forest became a sink in Scenario 1, as losses of carbon under the historical fire regime were exceeded by sequestration levels. In Scenario 2, the forest carbon balance did not change appreciably between 2023 and 2042. Clearly, if the future fire regime is more severe than modelled here, the future harvest will be lower than projected which will put more pressure on the forest and the forest sector.

A summary of this report's key findings is provided in the tables below:

Is there any evidence that bioenergy demand has caused the following?	***Analysis Findings***
Deforestation?	***There is no evidence that bioenergy demand has caused deforestation.*** Deforestation data were unavailable specifically for the catchment area however the federal government tracks deforestation by ecozone as part of the national Greenhouse Gas Inventory report it prepares each year. The majority of the catchment area is in the Montane Cordillera ecozone; Natural Resources Canada reports that the Montane Cordillera ecozone has 31,128,000 ha of forest, 580,000 ha of wooded land and 481,000 ha of Other land with tree cover. The Forest Management Landbase in the catchment area is roughly 14 million ha, which is equivalent to 45% of the forested area in the Cordillera ecozone. The Canadian Forest Service reports that between 2001 and 2020, the area of forest in the ecozone declined by a total of 63,560 ha, which is a 0.22 % reduction of the forest area. Most deforestation in the ecozone during this period occurred because of conversion to agriculture (24%) and mining (31%); urban expansion (20%) was also an important contributing factor. The ownerships on which the deforestation occurred were not specified, however the majority of the conversion to agriculture and urban expansion would have occurred on private land. Forestry was also a meaningful contributor to deforestation (15%), primarily through the construction of forest roads. Forestry was estimated to have led to the loss of 467 ha of forest per year in the ecozone. Moreover, the rate of deforestation from all sources, especially forestry, has been declining from 2001 to 2020. Because the catchment area is about half the size of the ecozone (which extends to the southern border of BC in the interior), deforestation due to forest roads in the CA is estimated at between 200 and 250 ha/year. Much of the Mackenzie TSA falls within the Boreal Cordillera ecozone, where deforestation was only 3,793 ha during the 2001-2020 period. This represents 0.02% of the forest area in the ecozone. Because the

Is there any evidence that bioenergy demand has caused the following?	*Analysis Findings*
	rate of deforestation in Boreal Cordillera, the 200-250 ha/year estimate for the CA is considered a fair (and perhaps conservative) estimate. Until 2019, the two Drax facilities relied on sawmill residual fibre for 80-95% of their furnish. The balance of their furnish came from other forest-derived fibre. From 2019 to 2021, both facilities have increased the fraction of furnish they derive from the forest, to roughly 33% in 2021. However, because the Drax' mills take the lowest quality fibre that few if any other facilities will use, Drax' demand for pellet feedstock does not drive any harvest activity. For this reason, bioenergy feedstock use has not contributed to deforestation.
A change in management practices (e.g., rotation lengths, renewal, species change in forest)?	***There is no evidence that bioenergy demand has caused changes in forest management practice other than reducing the amount of roadside burning of slash and low-grade wood.*** The mountain pine beetle infestation and the subsequent salvage effort has been the primary influence on forest management practices during the review period. The catchment area was particularly hard hit by MPB because its favoured food source, lodgepole pine, made up almost half of the forest volume prior to the onset of the outbreak. Because the amount of mortality was so extensive, the government significantly raised the allowable cut between 2001 and 2007, and maintained it at a elevated level until 2016. The Chief Forester directed most of the harvest to turn to salvaging the MPB-killed timber. Comprehensive mortality data were not available for the entire catchment area, however the Timber Supply Reviews provide a snapshot for some of the time periods in this analysis. For example, from 2010 to 2013 in Williams Lake TSA, 76% of the harvest volume was lodgepole pine, of which 78% was dead. The abundance of salvage material and its use in sawmills increased the supply of fibre available to the pellet mills; they benefited from these circumstances but did not drive them. Drax' bioenergy demand has not influenced forest management practices, other than to reduce the extent of roadside slash burning, because some roadside slash and some low-grade logs that would otherwise be left at roadside are being used as feedstock for pellet production.

Is there any evidence that bioenergy demand has caused the following?	***Analysis Findings***
Diversion of wood fibre from other uses or markets?	***There is evidence that bioenergy demand has led to limited amounts of hog fuel and sawdust being diverted from other users however there is no evidence that the impacts on other users are material.*** Timber markets are local, especially for low-valued timber that cannot profitably be transported far and pellet manufacturers use the lowest-quality fibre in the market. During the majority of the study period, the extensive salvage operations meant that there was a sufficient quantity of this low-grade material produced as a by-product from sawmilling that consumption by pellet mills did not divert wood fibre from other uses or markets. As the salvage effort wound down in 2019 and 2020, the supply of residual material from sawmills and other timber manufacturing fell with the decline in the overall rate of timber harvest. However, that shortfall is largely being taken up by recovery of fibre from slash and low-grade roundwood left by roadside that would other be burned. That recovery is achieved by hauling roundwood into the pellet plants for grinding on site or grinding the slash in the forest and hauling that material directly to the plants. Where there is no demand for pulp feedstock, pellet mills may use some pulpwood however in regions where there is demand from pulp mills, the pulp mills can afford to pay more for the feedstock than pellet mills and so the presence of the pellet mills does not divert feedstock from pulp mills. The presence of pulp mills in Prince George and Quesnel, and in Mackenzie (until 2020), creates demand for the pulpwood component of the harvest. Where pellet facilities are located far from pulp mills, pellet mills are the only users of the pulpwood component, giving them access to a greater share of the total harvest in these areas. Within the last 2-3 years in the catchment area, there has been some competition between pellet mills and pulp mills for hog fuel. Pulp mills use hog fuel from time to time to produce energy, and in this situation the pellet mills are competitive. However, the amount of volume concerned is small and has a negligible impact on pulp mills, and as mentioned above, the hog fuel is not part of the furnish used to make pulp.

Is there any evidence that bioenergy demand has caused the following?	*Analysis Findings*
	There has also been some competition between the Williams Lake pellet plant and the particleboard manufacturer located in Williams Lake for sawdust. Once again, the volumes involved are minor and the impact on the particleboard manufacturer is negligible. In summary, the Meadowbank pellet facility does compete with pulp mills for hog fuel, which the pulp mills use this to produce energy. It is not part of the feedstock used to make pulp. There is also some competition between the Williams Lake pellet plant and the particleboard plant there. The limited competition between pellet manufacturers and other mills in the catchment area for hog fuel and sawdust is not material to the operations of the other facilities.
An abnormal increase in wood prices?	***There is evidence that bioenergy demand for hog fuel and sawdust may have raised local prices for these products above what they would otherwise be, however there is no evidence of a detrimental effect on the other users.*** For almost all timber products, pellet manufacturers have not influenced prices in the catchment area because, as summarized above, there is only limited competition with other users for certain types of low-grade fibre. Timber prices in the catchment area have been most strongly influenced by lumber prices (which are influenced by US housing starts), the US:Canada exchange rate, and general economic conditions. Since 2020, the prices of lumber and composite products have been on a roller coaster, plunging in the March-May 2020 period before rising to record highs in September 2020, and even higher in May 2021 and March 2022. Lumber and composite prices declined significantly from March 2022 to the end of that year and have remained at very low levels since then. As discussed above, there is some competition between Meadowbank and Prince George pulp mills for hog fuel, and also between the Williams Lake pellet plant and a local particleboard manufacturer. The impact of this competition on prices is not discernible, given the macro factors listed above and the high degree of local variability in cost of the fibre. It is reasonable to expect that local prices for these types of feedstocks may be somewhat elevated by the competition however the extent of the impact appears to be minor.

Is there any evidence that bioenergy demand has caused the following?	***Analysis Findings***
A reduction in the volume of timber in the forest?	***There is no evidence that bioenergy demand has reduced the amount of live timber in the forest.*** The amount of live growing stock in the forest has declined significantly from 2000 to 2020 primarily due to the mortality caused by the MPB. Within the catchment area, the MPB killed an estimated 483 million m^3 between 1999 and 2014, representing 32% of the estimated 1495 million m^3 of timber in the catchment area in 1999. Wildfire has also reduced the amount of timber in the forest. Severe fire years have occurred in the catchment area in 2017, 2018, 2021 and especially in 2023. While the effect of the 2023 has not yet been assessed, the impacts of the fires in other years has impacted the availability of mature timber. In 100 Mile House, 12% of the Timber Harvesting Landbase (THLB) was within the perimeters of the 2017, 2018 and 2021 fires (Generally most but not all of the area within the perimeter of a wildfire will be burned – the amount of unburned area is highly variable). More than 5% of the THLB area of the Quesnel and Williams Lake TSA's was within the fire perimeters. During the analysis period, a high proportion of the timber that was harvested was dead, having being killed by the MPB (and by fire in more recent years). The use of fibre by Drax has meant that more of the timber that was harvested has been used, but it did not create any additional harvest activity. Drax' demand for low-grade timber has meant that in some harvest blocks, more dead timber is removed than would otherwise be the case. However, provincial government regulations require minimum amounts of residual live and dead timber to be left on site, and these requirements continue to be met and exceeded on many blocks. In conclusion, the demand for fibre from Drax has not impacted the volume of live timber in the forest, left in a block or compromised the productivity of harvest sites.
A reduction in the rate of carbon sequestration?	***There is no evidence that bioenergy demand has affected carbon sequestration levels. Natural disturbance and salvage have affected carbon sequestration rates in the catchment area – the sequestration rate is probably below long-term capability now but could be well above it in one to two decades, depending on natural disturbance levels.***

Is there any evidence that bioenergy demand has caused the following?	Analysis Findings
	There has been very little deforestation during the analysis period and harvest operations are monitored to ensure that site damage is minimized. Accordingly, the productive capacity of the land, and the long-term capacity of the forest to sequester carbon, has not changed. The major change in the catchment area affecting long-term sequestration capacity is that more land has been set aside for ecological and other reasons, so those areas will continue to add and store carbon until they are affected by a natural disturbance of some kind. In the short- and medium-term, the mortality of the mature lodgepole pine due to MPB, and the widespread fires of 2017, 2018, 2021, and 2023, has created a much younger forest which will have a more rapid growth rate owing to both its age and the impact of forest management (planting and spacing) and the use of improved seed. However this will be partially offset by The reduced levels of sequestration that will occur in stands that experienced substantial mortality but were not salvaged. In these stands, the stocking will have declined by as much as 50 or 60% so that the growth increment of the surviving trees in these stands will be well below potential. The MPB and the fires have affected the short- and medium-term rate of carbon sequestration in the forest. While no analysis has been done, one may surmise that the stands that have regenerated after the MPB, the salvage and the fires are too young now to be sequestering much carbon. However, within one or two decades, this will have changed and these stands will move into the range of ages of peak growth and peak carbon sequestration levels. Feedstock procurement by the pellet industry has not affected carbon sequestration levels in the forest.
An increase in harvesting above the sustainable yield capacity of the forest?	***Between 2000 and 2018, harvesting increased to salvage widespread beetle kill. Since then, the harvest has fallen below the long-term potential growth capacity of the forest. Pellet feedstock procurement has not influenced harvest levels.*** During the 1990s, the Annual Allowable Cut in the catchment area was roughly 19.5 million m^3/year. Harvest levels were likely fairly close to this level. However, in the early 2000's the Mountain Pine Beetle (MPB) outbreak reached the catchment area and began killing

Is there any evidence that bioenergy demand has caused the following?	*Analysis Findings*
	lodgepole pine, one of the two most important commercial timber species in the catchment area and the species that then accounted for the greatest total volume in the catchment area forest. Mortality throughout the catchment area occurred quickly and on a large scale, and the provincial Chief Forester raised AACs throughout the Interior to salvage as much dead timber as possible while it remained merchantable. From 2007 to 2010, the catchment area AAC exceeded 30 million m3/year. The AAC in the catchment area trended lower during the 2010-2018 period, while the harvest remained focused on salvage. Additionally, 2017, 2018, and 2021 were the worst fire years in BC's recent history (until 2023 exceeded them), leading to more salvage harvesting. In an effort to salvage the larges amounts of dead timber from the MPB and fires, the timber harvest exceeded the sustainable yield capacity of the forest for much of the analysis period. However, the mortality caused by the MPB and the fires has reduced the amount of timber that can be sustainably harvested in the short and medium terms. The AAC and the harvest levels during the analysis period are somewhat deceptive, since the AACs contain directives that a large portion of the harvest was to be the salvage of dead timber. Because the AAC and harvest contained very high levels of dead wood, the high harvest had a relatively low impact on the growth rate of the forest. Notably, Drax' sourcing for bioenergy does not drive forest harvesting so that the operations of the pellet mills have had no impact on harvesting levels. Historical growth figures are difficult to ascertain, as is the amount of dead and live wood harvested; accordingly it is difficult to compare with confidence the harvest of live timber with growth during the analysis period. Since the MPB mortality subsided in 2013, the amount of live growing stock in the forest has been fairly steady, showing a slight decline of 26 million m^3 (falling from 1319 million m^3 in 2013 to 1297 million m^3 in 2020). During this same period, fire accounted for an estimated loss of 42 million m^3, well above average historical levels. In the absence of the fire losses, the growth of the forest during this

Is there any evidence that bioenergy demand has caused the following?	*Analysis Findings*
	period would have been approximately 16 million m^3, or an average of roughly 2 million m^3/year. In conclusion, mortality caused by MPB and wildfire overwhelmed the growth of the forest, and the amount of live and dead timber harvested was well above long-term sustainable yields. During the analysis period, the timber harvest increased to salvage widespread beetle kill, but as of 2023, the AACs and harvest are well below the growth capacity of the forest to allow it to recover. Pellet feedstock procurement has not influenced harvest levels.
Negative impacts to biodiversity within the catchment area i.e., impacts to species or ecosystems of concern	***The procurement of feedstock for pellet production has not impacted the biodiversity within the CA.*** The procurement of feedstock for pellet production does not drive forest harvesting activities, nor does it affect road construction or other activities that could affect biodiversity. If the pellet facilities did not exist, harvesting practices would be no different or no less extensive than they are at present. The use of harvest slash and low-grade roundwood left at roadside for feedstock also does not affect biodiversity, since those piles of waste wood would otherwise be burned. In summary, Drax' activities have not negatively affected biodiversity within the catchment area.
Positive impacts to biodiversity. i.e., with utilization of specific fibre sources, or with the ability to conduct unique projects that require biomass recovery?	***The use of feedstock for pellet production has had some positive impacts on biodiversity.*** The range of forest management practices in the catchment area has expanded in recent years to include wildfire mitigation, habitat enhancements, fibre salvage and recovery, and the rehabilitation of degraded forest stands. These practices often have positive impacts in biodiversity. The surge in the amount of area burned by wildfire has led the province to spend substantial amounts of money on fuel and hazard reduction, especially around First Nations communities. These activities typically involve thinning or other operations to reduce fuel loadings and hey produce large amounts of low value fibre that Drax can use, which supports these operations. Drax is also able to use timber salvaged from wildfires and insect infestations – these operations permit the site

Is there any evidence that bioenergy demand has caused the following?	***Analysis Findings***
	preparation and planting to create a productive new forest. Similarly, some of the stands that have become degraded after the mountain pine beetle infestation have been treated to enable a productive forest to return. Finally, management is being applied in some areas to improve wildlife habitat. The common denominator of all of these types of projects is that they can improve biodiversity and forest health and that they generate low-grade fibre. Drax' ability to use this fibre supports these management actions.
Socio-economic Impacts i.e., employment, DE&I, GDP, marginalization, housing availability, etc..	***The use of feedstock for pellet production has not led to negative socio-economic impacts – rather it has provided additional employment for both forest workers as well as people working in the pellet facilities themselves. This additional employment has not been significant enough to detrimentally affect local housing availability or quality of life in the communities of the catchment area.*** Feedstock procurement within the catchment area has created employment in both the woodlands and in the pellet facilities themselves. During the last several years of the analysis period, Drax' two pellet facilities have increased the amount of low-grade feedstock derived from the forest. Some of this feedstock consists of chips or other forms of wood hat has been chipped or ground up at roadside and transported to the pellet mills. In other cases, low-grade roundwood is brought to the pellet mill where it is processed into a form tat can be used by the pellet facility. In all of these cases, there is employment created in the woodlands and trucking business. Whether these activities lead to new hires or provide more work for existing workers, there is a positive impact on employment and income. The Meadowbank pellet plant itself employs 44 people and 31 employees work at the Williams Lake facility – only part of the additional employment generated by pellet production. Employment created by pellet production is especially important now that the forest industry is shrinking as the harvest declines – the pellet facilities and the associated employment may enable workers laid off at other facilities to stay in the community. For example, in November 2022, Tolko announced the closure of a lumber mill in Wiliams Lake.

Is there any evidence that bioenergy demand has caused the following?	***Analysis Findings***
	While a number of the employees went to work at other Tolko operations, the presence of Drax' pellet mill in Williams Lake helped to maintain economic activity in the community. Pellet production provides a contribution to BC's GDP. Most of BC's pellet production is exported, with the UK being the top destination by weight shipped (42% of export quantity), followed by Japan (35%). Export volume has trended higher, doubling from 1.2 million tonnes in 2012 to 2.4 million tonnes in 2020 and 2021. In 2021, the value of pellet exports was $378 million, a decline from $426 million in 2020 as pellet prices fell.
Lack of adherence to the principles of Free, Prior and Informed Consent (FPIC) and issues with local First Nation Groups.	***Feedstock procurement has not undermined relations with First Nations in the catchment area or set back adherence to the principles of FPIC.*** None of the First Nations with traditional territory in the catchment area signed historic treaties so that many if not all of these First Nations retain their full Aboriginal rights. BC has been more active than any other province in advancing reconciliation, including through measures to provide economic benefits in the forest sector. BC as also been providing tenure options and increasing the level of consultation with First Nations related to forest management. In 2021, BC passed the Forest Amendment Act, which provides new tools that will enable government to reduce the timber harvesting rights of existing forest tenure holders, compensate them and then redistribute the timber harvesting rights to First Nations, communities and BC Timber Sales. In 2019, BC passed the Declaration on the Rights of Indigenous Peoples Act which establishes the UN Declaration on the Rights of Indigenous Peoples as the provincial framework for reconciliation. The UN Framework incorporates the principle of Free, Prior and Informed Consent (FPIC), such as in Article 19: *States shall consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to obtain their free, prior and informed consent before adopting*

Is there any evidence that bioenergy demand has caused the following?	Analysis Findings
	and implementing legislative or administrative measures that may affect them. Because Drax does not have forest tenure or undertake forest planning, the activities of Drax do not affect how FPIC is being brought into these processes. The BC government has issued First Nations Woodland Licences within the CA. In 2022, the BC government issued the largest FNWL yet to the Lheidli T'enneh First Nation in Prince George. The area under this licence is 217,312 ha. FNWLs have also been issued in Mackenzie (Kwadacha First Nation), Quesnel (?Esdilagh First Nation), Williams Lake (Esk'etemc First Nation), and 100 Mile House (Tsq'escenemc/Canim Lake Band). Drax can obtain feedstock directly or indirectly from these FNWLs, which supports the First Nations holding these licences. In Williams Lake, the largest harvest contractor, who supplies Drax among other mills, happens to be First Nation owned. First Nations are increasingly becoming involved in the forest sector and Drax does business with these companies and individuals, supporting them.

Impact of bioenergy demand on:	*Analysis Findings*
Volume of timber in the forest	Neutral. The volume of growing stock in the forest has declined significantly during the review period due primarily to the MPB, and secondarily due to extensive forest fires in 2017, 2018 and 2021, as well as ongoing spruce bark beetle infestations (very extensive fires occurred in 2023). Bioenergy demand has meant that the timber which has been harvested is used more fully, but it has not led to an increase in overall harvest or increased the amount of live timber removed from a given harvest block. The allowable cuts and the harvest levels have been declining in the catchment area since 2010 as the Chief Forester has been resetting AACs to allow the forest to regenerate and re-build the level of growing stock following the massive losses of timber caused by MPB and wildfire.
Timber growth rates	Neutral. Timber growth rates have declined due to the natural disturbance factors cited above, however the large area of regenerating forest is expected to cause the total amount of growth in the catchment area to increase over the next 20 years (perhaps unless wildfire and other disturbances continue to increase due to climate change). The use of fibre for pellet production has not impacted how harvests are conducted but somewhat more dead and low-grade timber is removed from each timber block than would be the case in the absence of demand for fibre from pellet mills. This happens more frequently on blocks close to the pellet plants compared with distant blocks that have higher haul costs associated with them. In other words, utilization has improved due to the demand for fibre for pellets. However, because there is so much dead and low-grade fibre in the blocks being harvested, the additional amount that is used for pellet production does not reduce the productivity of the sites. Provincial government regulations require minimum amounts of residual live and dead timber to be left on site, and these requirements continue to be met and exceeded on many blocks. An additional change brought about by the demand for bioenergy is that on some blocks, slash that has been brought to the landing is being ground or chipped and brought to Drax. In the absence of the pellet producer's demand, this would have either been burned or piled and left to decay. In conclusion, fibre procurement for pellet production has had no impact on forest growth rates.
Forest area	Neutral. The use of fibre for pellet production has had no impact on Crown forest area, since the procurement of fibre for pellets does not affect harvest

	levels or renewal approaches. The processing of roadside slash for use by Drax will free up a small amount of area for prompt renewal, and so by reducing the amount of area where the slash would have been left, there may be a marginal positive impact on future forested area.
Wood prices	Neutral. The market for wood that is below sawlog quality is quite variable within the catchment area. In the area around Prince George, there is a considerable amount of competition between the pulp mills and the pellet mills. In contrast, the Williams Lake pellet mill faces limited competition since the nearest pulp mills are far enough away that the cost of transporting low-grade fibre outweighs the price paid at the pulp mill gate. Where there is competition for this low-grade fibre, prices are higher. Accordingly, the presence of the Meadowbank and PacBio pellet facilities led to higher prices for low-grade fibre in the Prince George area. Competition was likely most acute for hog fuel, which is about equally desirable to pulp mills and pellet facilities. However, the pulp mills can usually afford to pay higher prices than the pellet facilities – an inability to compete at higher feedstock price levels was one of the reasons that Pacific Bioenergy gave for closing its pellet facility. Whether higher prices for low-grade wood are considered a positive or a negative depends on one's perspective. For buyers of this fibre, higher prices would most likely be seen as negative. For harvest contractors, higher prices are positive. One can also argue that a higher priced feedstock promotes innovation in the manufacturing process, which is healthy for the sector, as well as promoting greater use of forest-derived feedstocks, which would otherwise be burned at the landing or left to rot. For these reasons, the overall impact has been assessed as neutral.
Markets for solid wood products	Positive. Because the pellet mills rely so heavily on sawmill residuals for their furnish, and most of this residual fibre would have otherwise been burned or landfilled, pellet producers provide some support for the sawmills in the catchment area by buying sawmill residuals that would otherwise have been burned, land-filled or trucked further at higher cost. Because pulp mills can afford to pay more for low-grade fibre than pellet producers, pellet production has not diverted fibre from other uses. The pellet industry has also created demand for chipping and bush-grinding, which has fostered business opportunities and increased employment in the forest sector.

1 Introduction

1.1. Background

Drax Group is a British electrical power generation and supply company that runs Europe's largest biomass-fueled power station – the UK's largest decarbonisation project – supplying 7-8% of the country's electrical needs. Drax is among the world's largest single-point consumers of wood fibre and has committed to sourcing wood responsibly.

In accordance with Drax's initiative to monitor forest management and timber market trends in the jurisdictions where its supplier pellet mills operate, this report provides a review and assessment of the trends in management and wood products markets in the catchment area of two pellet mills in Williams Lake and Strathnaver, British Columbia (BC) that Drax acquired when it bought Pinnacle Renewable Energy in 2021. There was a third pellet mill that sourced fibre from many of the same Timber Supply Areas as the two Drax plants – this facility was owned by Pacific Bioenergy and was located in Prince George. The PacBio mill closed in 2022 but was in operation during the study period and the conclusions of this analysis will reflect the impacts of all three pellet mills' fibre procurement on the forest and the rest of the sector.

Pinnacle's first pellet plant was Meadowbank, located at Strathnaver 40 km north of Quesnel. It began operating in 1989 and was originally designed and built with the expectation that ninety percent of the fibre supply would be provided by the nearby Dunkley Lumber sawmill. With recent reductions in production at the sawmill, the pellet plant is receiving less than fifty percent of its fibre directly from Dunkley and has broadened its feedstock sourcing. The Williams Lake facility was Pinnacle's second mill, which started up in 2004. The annual capacity of the Meadowbank mill was recently expanded from 220,000 to 300,000 oven dry metric tonnes (ODMTs), while the Williams Lake facility can produce up to 240,000 ODMTs.

Pacific Bioenergy (Pacbio) was initially started as "Pellet Flame" in 1994, and it began bulk shipments to Europe in 1998. In 2005, as demand for pellets increased dramatically, the company constructed a new facility on the same site that began operations in 2007. The plant was expanded in 2010 and became very large, with an annual capacity of 500,000 ODMT. In 2018, Sumitomo Corporation purchased a 48% interest in Pacbio. In 2021, this facility announced it would close permanently, and it ceased operation in March 2022. Pacbio did not formally participate in this study.

1.2. Report Goal

The goal of this report is to understand the carbon effects of biomass demand. To do this, we identify and assess the impacts that sourcing biomass for the pellet plants has had on the forest, its management, and wood markets. This includes impacts on timber inventory, forest growth, forest removals, wood prices, forest management practices, and local wood fibre markets.

This report reviews the period 2002 to 2020, which coincides with an extensive outbreak of mountain pine beetle (MPB); the resulting mortality of large parts of the mature forest in the BC Interior, and especially in the catchment area, was the dominant factor affecting the forest and the industry during this period. The review period also covers a period of capacity growth of the Meadowbank and Pacbio pellet mills, as well as the start-up and operation of the Williams Lake plant, and so covers the period of the most significant potential impacts of fibre procurement by the mills.

1.3 Report Structure

The report is organized as follows:

- Description of the Catchment Area (Section 2): The geographic and socio-economic characteristics of the catchment area are described.
- Relevant Forest Legislation (Section 4): Approximately 96% of the forest in the catchment area is overseen by the provincial government, thus government policy is reviewed, including discussions of regarding Annual Allowable Cuts and how they are determined, forest planning and biodiversity protection requirements, species at risk, recent developments related to old growth and First Nations reconciliation.
- Description of the Current Forest in the Catchment Area (Section 5): This section describes the current state of the forest, both in area and volume terms, harvesting, old growth deferrals, and biodiversity protection measures.
- An Analysis of how the Forest has Changed between 2002 and 2020 (Section 6): An analysis of the 2002, 2010 and 2020 inventory data results in an analysis of how the volume of growing stock changed between 2002 and 2020, including changes by species composition. The role of harvest and natural disturbances is also assessed.
- Forest Projections 2023-2042 (Section 7): A discussion of the projected development of the forest over the next twenty years under two future fire regime scenarios.
- Forest Carbon 2002-2042 (Section 8): a discussion of the results of the forest carbon modelling done over the entire analysis period.
- Market Profile (Section 9): The markets for wood fibre in and around the catchment area are profiled and pricing trends are reviewed.
- Annex 1 provides a more detailed description of each of the Timber Supply Areas in the catchment area.
- Annex 2 describes how the analysis of the inventories was undertaken to estimate the changes in growing stock between 2002 and 2020.
- Annex 3 describes the analysis undertaken to prepare for the forest projections and the forest carbon analysis.

1.4 Project Consultants

Jeremy Williams, PhD, RPF (Ontario)

Dr. Jeremy Williams has extensive forest economics experience including reviews of timber markets, timber pricing including stumpage rates, timber product production costs, and rates charged by the Crown for property leases. Recent relevant experience includes reviewing forest management and timber markets in Nova Scotia, rental rates for Crown land in Ontario, preparing a Regional Risk

Assessment for BC against the SBP standard (in draft) and assessing forest carbon offset protocols for the Ontario government.

In addition to these projects, Jeremy has completed numerous business cases, economic evaluations and reviews. He is also very knowledgeable and experienced with respect to forest carbon pricing and accounting and has extensive experience working with and advising Indigenous communities and organizations.

Dr. Williams earned a B.Sc.F. from the University of Toronto's Faculty of Forestry (1979) and a Ph.D. in from the same Faculty with a specialization in Forest Economics (1986). He is a principal of ArborVitae Environmental Services Ltd. and a Registered Professional Forester with the Ontario Professional Foresters Association.

Gary Bull, Ph.D.

Dr. Gary Bull has a background in commerce as well as three degrees in forestry, specializing in economics and policy. He has an interest in global forestry policy issues and is an expert on forest and timber markets in Asia and ecosystem services markets. In British Columbia, he has focused his efforts on working on sustainable business development with First Nations communities and sustainable fibre supply.

Dr. Bull worked for the Food and Agriculture Organization of the United Nations before moving back to Vancouver and joining the Faculty of Forestry at University of British Columbia. Gary is currently a full professor and head of the Forest Resources Management Department at the Faculty. Gary's specialities include Aboriginal forestry, forest carbon finance, economics and international trade. Gary has been associated with SBP for several years and was selected to be a member on SBP's Standards Committee and Working Group on Carbon. He also sits on the External Review Panel of SFI and is a Director of Nature Bank.

Patrick Bryant, BSF, RPF (BC)

Patrick's roles with Forsite Consultants Ltd. include Strategic Planning Forester, Senior Forest Analyst, Analyst Team Lead, and Project Manager for a range of analytical and planning projects. He is a Registered Professional Forester in BC and holds a B.Sc. With over 20 years of experience in various positions for major forest licensees on the coast, Patrick chose to join the Forsite team in 2010 to continue broadening his exposure to resource management challenges. He offers a diverse background in operational, tactical and strategic aspects of the business and draws upon applied knowledge and skills involving silviculture, inventory, data management, technical/analysis and management. A few of Pat's recent projects include: facilitation and analysis for two BC pilot projects on Forest Landscape Planning, analysis for several Integrated Stewardship Strategies (Mackenzie, Prince George (ABC), Merritt, Cranbrook, and Invermere), and periodic assessments of established objectives throughout BC's Cariboo region (Quesnel, Williams Lake, and 100MH TSAs).

Katherine Gunion, MSc, MSFM, RPF (BC)

Kat is a Forest Analyst with Forsite Consultants Ltd. specializing in the area of forest modelling (Patchworks™) and analysis. She holds a Masters in Science and a Masters in Forest Management and is a Registered Professional Forester in BC. She is an expert in computer science and forest statistics, with a background grounded with significant operational forest management experience. Kat's broad experience ranging from operational surveys to highly technical analysis allows her to provide meaningful support to a range of forest planning, analysis, and inventory projects. A few of Kat's recent projects include: assessing CBST results for the Forest Improvement and Research, Integrated Stewardship Strategy for Prince George TSBs ABC, LiDAR sampling plans for TFLs 48 and 49; using LiDAR characteristics to assess UWR habitat in the East Kootenays, Timber Supply Analysis of Tanizul's Community Forest and First Nation Woodland License, and Amalgamation and Modelling of Alpac's Eastern Forest Management Units.

Cosmin Man, Ph.D., RPF (BC)

Cosmin Man is a scientist, forester, and specialist in the area of forest modeling and analysis. He brings a depth of database and modeling expertise that is grounded on operational forest management experience and understanding. This breadth of experience coupled with strong problem solving skills allows Cosmin to provide meaningful support to a range of forest planning and analysis projects including timber supply, habitat supply, integrated resource planning, and forest carbon management. Some of the recent projects include: Integrated Silviculture Strategies in BC Mackenzie (2016-2018), Cranbrook, and Invermere (2016-2019) TSAs, timber supply review for Sunshine Coast TSA (2020-2023), Weyerhaeuser Princeton tactical plan (2020 and 2022), and tree farm licence 52 forest carbon analysis (2021).

2 The Catchment Area

2.1 Extent

A catchment area is the region from which a forest products mill sources its wood fibre. This assessment examines the catchment areas of two central BC pellet mills owned by Drax Group PLC. The two pellet mills, known as the Williams Lake and Meadowbank facilities, are located in the towns of Williams Lake and Strathnaver, respectively. Strathnaver is 80 km south of Prince George and Williams Lake is another 160 km further south. These are both relatively large facilities –Williams Lake was upgraded in 2021 to increase its capacity to 240,000 tonnes/year (tpy) while Meadowbank, at 300,000 tpy, has also recently expanded its production capability. Since the catchment areas of these two pellet plants overlap extensively, this review treats the catchment areas of the mills as one large catchment area.

A third pellet facility, owned by Pacific Bioenergy, was located in Prince George and operated until it closed permanently in 2022. This was a very large facility with a capacity to produce 500,000 tonnes/year. It drew residual from the mills in and around Prince George but used a higher proportion of forest residuals than the two Drax mills. The impacts of its fibre procurement affected the catchment area forests from the beginning of the study period until it closed.

Fibre sourcing data provided by Drax Group indicates that between 2017 to mid-2021, 68% of the fibre used by the Williams Lake facility came from the Williams Lake Timber Supply Area (TSA), 13% from the Quesnel TSA, 8% from the 100 Mile House TSA and 2.5% from the Prince George TSA. Over the same period, Meadowbank drew 31% of its fibre from the Prince George TSA, 26% from Quesnel, 9% from Williams Lake and 8% from 100 Mile House. Twenty-five percent of Meadowbank's fibre was sourced from a category denoted as "blank" – this is primarily timber from private land, of which there is a considerable amount in and around Prince George. These data mean that the Prince George, Quesnel, Williams Lake, and 100 Mile House TSAs are all part of the catchment area.

Prince George is a major forest products processing centre, drawing timber from a very large area. It boasts four pulp and paper mills (all owned by Canadian Forest Products Ltd, or Canfor), three large sawmills within the community (owned by Canfor, Carrier Lumber and Lakeland Mills) and at least six more large sawmills within 80 km of the city.

Between 2015 and 2020, approximately 75% of the furnish used by Meadowbank was procured as residual material from sawmills (mostly sawdust and planer shavings). During this same period, the Williams Lake facility used mill residuals for roughly 95% of its furnish; it can draw from three sawmills in that community, owned by West Fraser, Tolko and Sigurdson Forest Products.

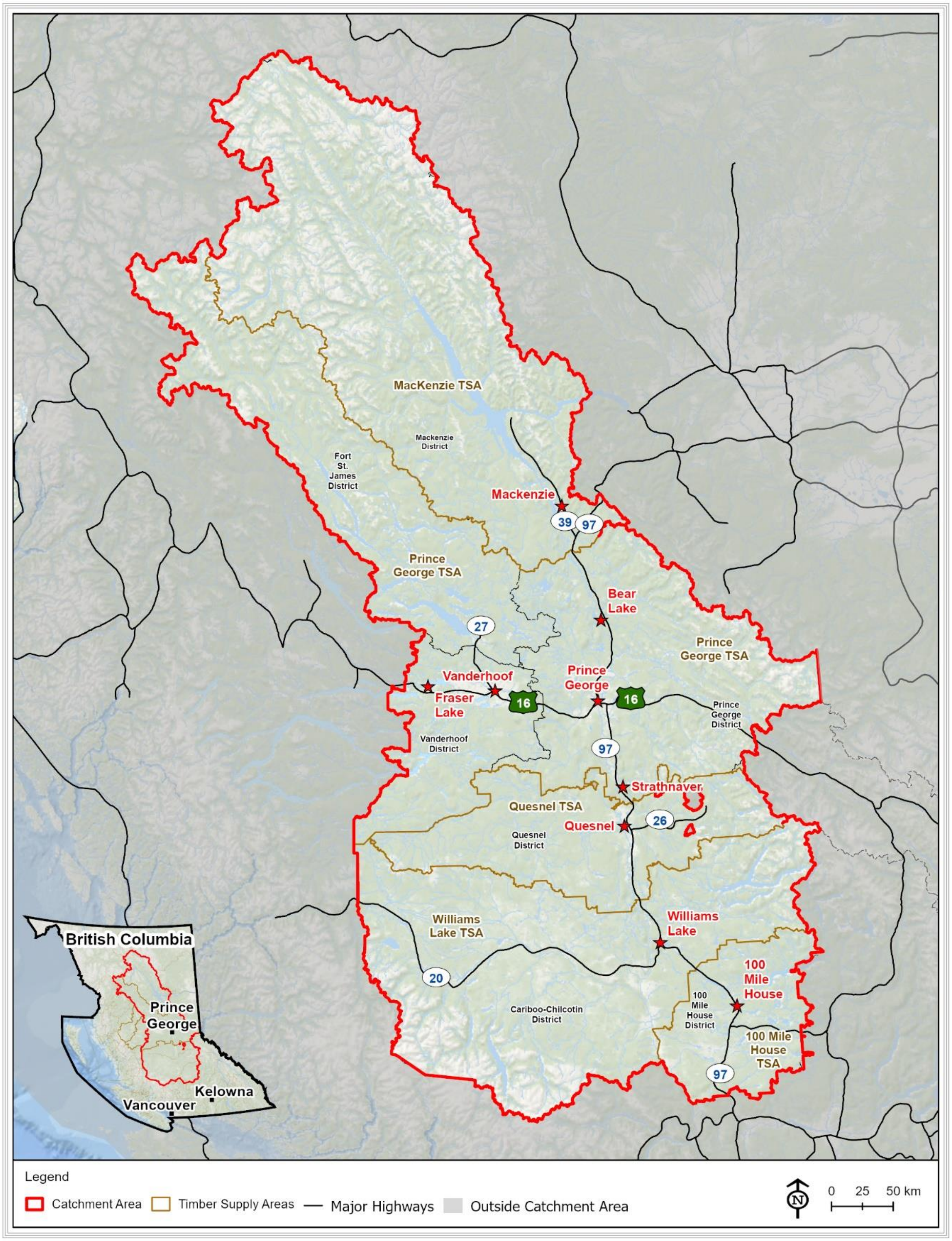

FIGURE 1. MAP OF CATCHMENT AREA.

It is general knowledge that the PacBio mill sourced a considerable amount of fibre as residual from the Dunkley sawmill, which draws from the southern half of the Mackenzie TSA. To capture this source in our assessment, the Mackenzie TSA was added to the catchment area, bringing it to a total of five TSAs (See Figure 1**Error! Reference source not found.**).[1] More than 90% of the furnish used by the Williams Lake facility originates in these TSAs, as does all of Meadowbank's (with the possible exception of the blank source). The mix of sources of fibre used by the PacBio mill is not known precisely however it is all but certain that the five TSAs we have identified supply more than 90% of its volume requirements. Minor amounts of fibre used by the three pellet mills may come from further afield, however these areas are not regular sources of supply.

The five TSAs are highly variable in size, as shown in Table 1. Prince George and Mackenzie are two of the largest TSAs in BC while 100 Mile House is one of the smaller ones. About 96% of the catchment areas is Crown land, which is public land under provincial jurisdiction. Most of the remaining area is owned privately, and there is some land under jurisdiction of the federal government that is primarily Indian Reserves. Indigenous communities in the area do not own substantial lands outright but do have forest management and timber harvesting rights on some areas.

Administrative Unit	Total Area (ha)	Crown Land (ha)	Private Land (ha)	Federal land (ha)
Prince George	7,965,555	7,580,508	353,521	31,526
Mackenzie	6,410,665	6,401,266	7,179	2,220
Williams Lake	4,933,664	4,673,187	189,894	189,894
Quesnel	2,046,758	1,946,743	94,604	5,411
100 Mile House	1,235,978	1,115,256	115,299	5,423
TOTAL	22,592,620	21,716,960	760,497	115,163
		96.1%	3.4%	0.5%

TABLE 1. LAND OWNERSHIP STATISTICS FOR THE CATCHMENT AREA.

Crown land includes all of the land under area-based tenures, which have some private land within their boundaries. However, since all of the area under tenure is managed as if it was Crown land, and governed by allowable harvest levels set by the province, its role in the forest and the timber supply is no different from that of Crown land.

Private and federal land contribute to the regional timber harvest however the forest inventory for these lands is not updated for depletions nor are there records of the amount of timber that originates from these ownerships. As a result, this study does not specifically consider these lands - however the extent of their contribution to the catchment area harvest and forest landbase is in line with their share of the total area. Activities on these lands do not affect the trends and conclusions identified in this report.

[1] The catchment area also includes portions of the very small Casacdia TSA, which was created in 2020 from a number of BC Timber Sales blocks scattered throughout the province. The area from the Cascadia TSA located within the catchment area has been combined with the Prince George TSA.

The city of Prince George is the largest community in the catchment area and is indeed the largest population centre in the central and northern Interior (the population in the most recent census (2016) was 74,000). Prince George is situated where the Nechako River enters the Fraser River. In addition, the two main highways in this part of the Interior – highway 97 which runs north south and the Trans-Canada highway 16 which runs east-west –intersect in Prince George. A main BC Rail line parallels highway 97 through the catchment area, including a spur line into Mackenzie.

To the west of the Fraser Valley lies the Coast Mountain range and the climate tends to be dry on the west side of the Fraser Valley. The Quesnel Highlands and Cariboo Mountains bound the Fraser Valley on the east, and the climate is wetter on that side. Mackenzie lies within the Rocky Mountain Trench, formed by the Peace River, which flows northward. The Trench consists of flat to gently-sloped terrain and runs north-from the height of land through the middle of the Mackenzie TSA. The Trench is bounded by the Rocky Mountains on the east and the Omineca Range to the west. Williston Lake, the 360-km long lake/reservoir created by the W.A.C. Bennett dam on the Peace River, runs southward from the dam down through Trench. Highways run along both sides of the reservoir however the northern third of the Mackenzie TSA is rugged and remote with little or no road access. Similarly, the northern arm of the Prince George TSA beyond Fort St. James is remote and sparsely populated.

Highway 97, which runs through the Fraser Valley and parallels the Fraser River, links many of the key communities in the catchment area. Proceeding south on 97 from Prince George, one passes through Quesnel (121 km south), Williams Lake (240 km south of Prince George), and 100 Mile House (326 km south of Prince George). Should one travel north from Prince George, Mackenzie is not far off highway 97, and is located 183 km distant. The height of land between the Mackenzie River watershed, which drains into the Arctic Ocean, and the Fraser River watershed, which empties into the Pacific Ocean, lies roughly midway between Prince George and Mackenzie.

Quesnel (12,064 people in 2016), Williams Lake ((10,500 people in 2016) and 100 Mile House (1,811 people in 2016) are the largest communities in their respective TSAs – there are numerous smaller towns and villages, many of which are located along or near highway 97 or the Trans-Canada. The part of the catchment area north of Prince George is much more sparsely settled.

The main communities all host forest products mills, with Prince George, Williams Lake, and Quesnel having significant clusters of mills. Williams Lake has three large sawmills, one veneer mill and associated plywood mill, and a number of smaller mills and facilities, as well as Drax' pellet plant. The Meadowbank pellet facility is located within the Quesnel TSA, as well as three large sawmills, three veneer /panel mills, and two pulp mills. The largest cluster is in and around Prince George, as discussed above. In contrast, there is one large sawmill and an OSB plant situated in 100 Mile House and one large sawmill left in Mackenzie, after a second sawmill and a pulpmill closed during the past two years.

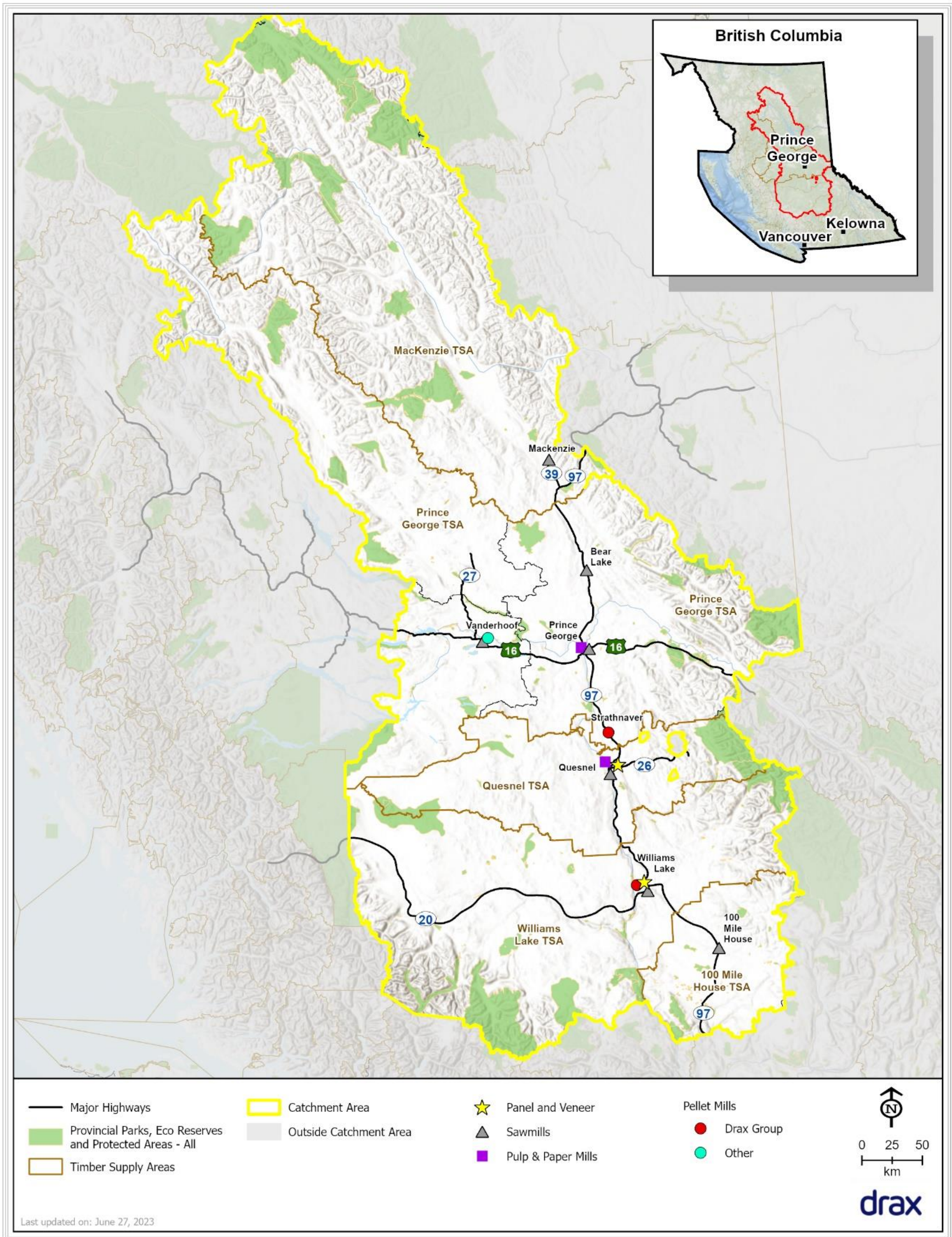

FIGURE 2. MAP OF FOREST PRODUCT MILL LOCATIONS IN CATCHMENT AREA.

2.2 Overview of First Nations

There are many First Nations and Indian Band communities with traditional territory in the catchment area. For some, the entirety of their traditional territory may be located within the catchment area however most First Nations' traditional territory overlaps part of the catchment area and land outside the catchment area. Many have Indian Reserves inside the catchment area. Maps of First Nations' traditional territory may not exist if the First Nation has not done the background research needed to establish historical occupancy and use. Many traditional territories overlap with those of other First Nations. However the website of the BC Treaty Commission includes an interactive map which shows the traditional territories of some First Nations (https://bctreaty.ca/map/).

Most of Canada is covered by treaties signed between regional groups of First Nations and the British Crown. Most of BC is an exception in that there were no historic treaties signed in much of the province. There are no historic treaties on the majority of the catchment area, however one historic treaty, Treaty 8, covers the northeast part of BC and overlaps with part of the Mackenzie TSA. Treaty 8 was signed in 1899 and was negotiated to help forestall issues related to miners taking part in the Klondike gold rush (BC Government 2023).

Those First Nations that are within (or largely within) the catchment area, as identified in the FLNRORD TSR Discussion Papers for each of the TSAs, are shown in Table 2.

Nak'azldi	Lhtako-Dene First Nation (Red Bluff band)	Xeni Gwet'in (Nemiah Valley
Takla Lake	?Esdilagh First Nation (Alexandria Band)	Tsq'secen
Tl'azt'en	Ndazkhot'en (Nazko Band)	Tsi Del Del (Alexis Creek)
Nadleh Whut'en	Tsilhqot'n National Government	Tsq'esatl'tem (Dog Lake)
Stellat'en	Esketemc (Alkali Lake)	Stwecem'c (Canoe Creek)
Saik'uz	T'exelc (Williams Lake)	Bonapart First Nation
Lheidli T'enneh	Tl'esqox (Toosey)	High Bar
Yekooche	Tl'etinqox (Anaham)	Kwadacha
McLeod Lake	Yunesit'in (Stone)	Tsay Keh Dene
Lhoosk'uz (Kluskus Band)	Ulkatcho	

TABLE 2. FIRST NATION COMMUNITIES LOCATED WITHIN OR LARGELY WITHIN THE CATCHMENT AREA TSAS: PRINCE GEORGE TSA (LIGHT BLUE), MACKENZIE (YELLOW), QUESNEL (GREEN), WILLIAMS LAKE (RED) AND 100 MILE HOUSE (PURPLE).

FLNRORD listed at least a dozen additional communities with traditional area that overlaps with the catchment area, in addition to the communities listed above in Table 2. There is a significant Indigenous presence in the regional population - the 2016 census recorded an Aboriginal population of 11,600 in Prince George, representing 16% of the population, and many of the outlying communities have higher Indigenous representation.

2.3 Development of the Catchment Area

First Nations lived, travelled, and traded within the catchment area for many years and archeological evidence from their settlements dating back 9,000 years has been discovered near Prince George.[2] The Europeans who first entered into the catchment area were scouting for fur trade routes and trading post locations.

Prince George is located on the site of a fur trading post established by Simon Fraser in 1807 on the traditional territory of the Lheidli T'enneh, a sub-group of the Carrier Dene. For millennia, Indigenous people had used the site, where the Fraser River joins the Nechako River, for gatherings and other purposes.[3] Trading posts were also established at the location of present-day Quesnel and in numerous other locations, many of which have persisted as communities within the catchment area.[4]

Prospectors began searching for gold along the Fraser River in the 1850's, migrating there as recent gold finds in California dwindled. The trail up the Fraser passed through 100 Mile House, Williams Lake, and Quesnel. The discovery of a large gold vein by Billy Barker in 1862 triggered a gold rush and more people than ever flooded into the area; the town of Barkerville was built almost overnight to support prospectors exploring around Barker's strike. However, by the 1880's, Barkerville, as well as the towns along the prospector's route, were in decline as the gold rush was over.

The next stage of development was stimulated by the construction of railways into the catchment area. The first major line was the Grand Trunk Railway (the precursor of CN Rail), which arrived in Prince George in 1914[5]. The Pacific Great Eastern Railway was chartered in 1912 with the aim of connecting Vancouver with Prince George. In the catchment area, the rail route followed the gold rush trail and stations were built at 100 Mile House and Williams Lake, reaching Quesnel in 1921. The construction of the railway led to the establishment of numerous mills to produce railway ties and other necessary timbers, as well as lumber for building homes, stores and the like. However, the leg to Prince George was not completed until 1952 and the rail line was used primarily to move logs and ore during the 1920's, 30's and 40's.

The community of Prince George was officially chartered in 1915. The town was chosen as the site of an army training camp when the Second World War broke out, and the camp housed up to 6,000 soldiers. Growth of Prince George was slow until after the Second World War, when a booming forest industry

[2] https://canadaehx.com/2021/04/07/the-history-of-prince-george/
[3] https://canadaehx.com/2021/04/07/the-history-of-prince-george/
[4] https://www.gov.mb.ca/chc/archives/hbca/post_maps/british_columbia.html
[5] https://www.princegeorge.ca/Things%20to%20Do/Pages/Learn%20about%20Prince%20George/HistoryofPrinceGeorge.aspx

brought prosperity and rapid growth, along with many newcomers from the prairies.[6] Between 1961 and 1981, Prince George grew from a rough mill town to a major manufacturing centre and the rail hub for northern BC. As it emerged as the regional hub, the economy of Prince George become more diverse as government, education and health services expanded, and the University of Northern British Columbia was established in 1990.

2.4 The Biogeography of the Catchment Area

This section describes the ecology of the catchment area, which varies both longitudinally and latitudinally. The first section describes the climate, a major controlling factor. Section 2 describes the land cover types in the catchment area, and then the forest is discussed in greater detail using the provincial biogeoclimatic zones as the basis for categorizing and describing it. British Columbia's Conservation Data Centre is an online resource that provides data regarding species at risk and ecosystems at risk. The species and ecosystems that are most threatened are designated as red-listed under the provincial system, and there are a number of red-listed ecosystems in the catchment area. These are presented and discussed, followed by a review of the measures that have been put in place in the provincial forest management system to protect and maintain key values, including biological diversity.

2.5 Climate

The majority of the catchment area falls within the Humid Continental Highlands Ecodivision, according to the ecological classification system developed for BC by Demarchi (2011). The exceptions include the northern half of the Mackenzie TSA, which lies in the Sub-Arctic Highlands Ecodivision and a small southern section of the 100 Mile House TSA in the Semi-Arid Steppe Highland Ecodivision.

The climate of the Humid Continental Highlands Ecodivision is characterized by strong seasonal cycles of temperature and precipitation, with a distinct cold and snowy winter. In 100 Mile House, average daily high temperatures are below freezing for December and January, with the average daily low is -14ºC in January, the coldest month. Summers are warm, however average daily highs reach only 23ºC in July and August. The vegetation is arranged in belts according to elevation, modified to some degree by aspect and precipitation levels.

The Fraser River runs south through the south-central part of the Prince George TSA, and bisects the Quesnel and Williams Lake TSAs. On either side of the Fraser is a series of plateaux, bordered by the Coast Mountains to the west and the Cariboo Mountains to the east. The west side of the Fraser River is within the rain shadow of the Coast Mountains and is drier, whereas the land east of the Fraser receives more precipitation. 100 Mile House TSA, which is southeast of Williams Lake, receives relatively abundant rain

The Mackenzie region is noticeably colder, with mean daily high temperatures below zero Celsius from November through to February. The average monthly low temperatures are sub-zero for seven months of the year, and the average high temperature is 22ºC in July, the warmest month, compared with -7ºC in January, the coldest month. The northern part of the Mackenzie TSA is especially cold. Three-

[6] https://www.thecanadianencyclopedia.ca/en/article/prince-george

quarters of the annual precipitation is snow. The biogeoclimatic zones in this area tend to be sub-arctic and sub-alpine in character.

Climate change has rendered the historical average temperatures obsolete. The summer of 2021 saw record high temperatures being set throughout BC, especially during the week of June 25 – July 1, when a "heat dome" set up and remained in place for the week. On June 27, Prince George set a record high temperature of 36.4°C, obliterating the previous record set in 1928 by seven degrees. On the same day, Quesnel reached 39.9°C and Mackenzie and Williams Lake recorded temperatures of 37°C. BC is also experiencing its worst recorded forest fire year in 2021, triggered by a combination of high heat, wind, and drought. While not every year will be like 2021, it is clear that the historical climate averages will not apply in future years.

2.6 Forest Overview

Within the catchment area, the general north-south climate gradient heavily influences tree species and growth conditions. The difference in precipitation on either side of the Fraser River is also a key factor affecting the character of the forest. At smaller scales, elevation, aspect, steepness and past disturbances all affect the forest cover so that there is a substantial amount of localized variation.

There is a greater diversity of tree species in the southern part of the catchment area. In the 100 Mile House TSA, BC FLNRO (2013) lists lodgepole pine and douglas-fir as the main species; secondary species include spruce, sub-alpine fir, western redcedar, western hemlock and a variety of deciduous species. Coniferous species dominate by far. The forests in Williams Lake TSA have a similar composition, with lodgepole pine and douglas-fir being more dominant on the drier west side of the Fraser River (BC FLNRO 2014). In Quesnel TSA, which is north of Williams Lake, douglas-fir is much less common so that the west side of the TSA is mostly lodgepole pine (BC FLNRO 2016). To the east of the Fraser, spruce and fir dominate with hemlock and deciduous species being minor components.

The Prince George TSA is much colder and moister than the southern part of the catchment area, and the species composition becomes less diverse – lodgepole pine, white spruce and sub-alpine fir are the main coniferous species and there is a higher proportion of deciduous species present (BC FLNRO 2016). The Mackenzie TSA is much more rugged than the rest of the catchment area. Its primary feature is Williston Lake, a 360 km long hydro reservoir within the Rocky Mountain Trench – a lower elevation area between the Rocky Mountains on the east and the Omineca Mountains to the west (BC FLNRO 2013).

The 2020 provincial forest inventory is used below to further describe and quantify the forests in the catchment area. Since the Catchment Area is very large, the imagery used in the provincial inventory has originated from a variety of assessments and projects conducted over the years. Most of the imagery has been obtained during the past five years – regardless of when it was obtained, the inventory is updated annually to account for growth as well as depletions due to logging and natural disturbances, especially fire and losses caused by the mountain pine beetle epidemic.

British Columbia's forest inventory does extend to Tree Farm Licences (TFLs) and to private land, however the TFL inventories are owned by the TFL-holding company. Since TFL's comprise only 2.3% of the catchment area, the consultants decided to omit them from consideration in this analysis. Private land accounts for 3.4% of the catchment area. The private land portion of the inventory is generally not updated regularly and the consultants have also omitted this ownership class from the analysis. The exclusion of the TFLs and private land will not affect the results and conclusions of this analysis, as the TFLs are managed for timber while some private land is also managed for timber while other private land is not, similar to the remaining Crown landbase.

The inventory sub-divides the landbase by cover type, including water. Figure 2 shows the area of the Crown forest landbase (CFLB) by main cover type in the entire catchment area (excluding TFLs). Most of the surface water is associated with the reservoirs of large hydro dams – there are relatively few natural lakes as the mountainous topography lends itself to rivers. There are 2.2 million ha of alpine land, representing 10.1% of the CFLB. As Table 3 shows, the Mackenzie and Williams Lake TSAs hold the majority of this area while there is very little in Quesnel and 100 Mile House (the majority of these latter two TSAs are in valley land and on plateaux). Rock, snow and exposed land represents 0.4% of the CFLB – these are non-forested and unproductive lands.

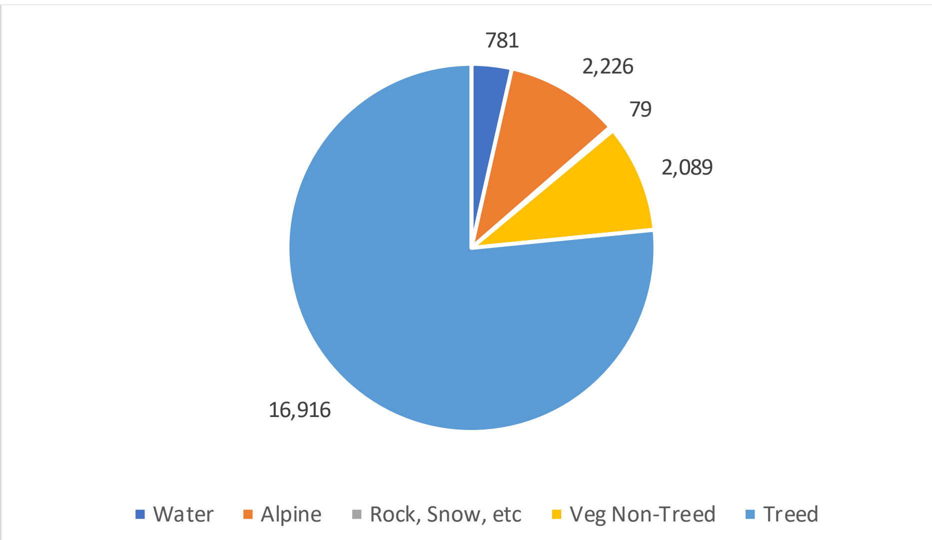

FIGURE 2. LAND COVER TYPES WITHIN THE CATCHMENT AREA (AREA FIGURES IN THOUSAND HA).

Approximately 9.5% of the land is vegetated but it is not considered forest (Veg Non-Treed in Table 4). Such areas include meadows and grasslands, wetlands, and dry savannah, which can have trees present but they are too sparse to be considered forest. The remaining 16.9 million ha is forested Crown land, which includes protected areas and inoperable areas as well as land that is available for timber harvesting. The forested area represents 76.6% of the landbase.

Land Cover	Prince George	Mackenzie	Williams Lake	Quesnel	100 Mile House	Sum
Water	298	230	157	38	58	781
Alpine	374	1,160	635	57	1	2,226
Rock, Snow, etc.	24	32	17	1	5	79
Veg Non-Treed	604	739	471	167	108	2,089
Treed	6,399	4,251	3,652	1,551	1,064	16,916

SUM	7,699	6,411	4,932	1,814	1,236	22,092

TABLE 3. LAND COVER AREA WITHIN THE CATCHMENT AREA (THOUSAND HA).

In addition to mapping general categories of vegetation cover, the British Columbia forest inventory classifies area based on ecological characteristics. The biogeoclimatic (BEC) classification system is a hierarchal system that uses climax vegetation communities to infer the combined ecological effects of climate and soil.[7] At the highest level, the regional level, the province is divided into 14 biogeoclimatic zones. These zones are large geographic areas with relatively uniform climate, i.e., similar regional climate or macroclimate. Zones are usually named after one, two or three of the dominant climax species. The names can also include another general distinguishing feature of the area such as geographic location (interior, coastal,) or ecotone (subboreal, boreal, montane).[8]

The catchment area is so large and varied that it includes area from 11 of the 14 provincial BEC zones. Figure 3 shows the proportions of area in the BEC zones, some of the smaller of which have been combined so that the figure is more legible.

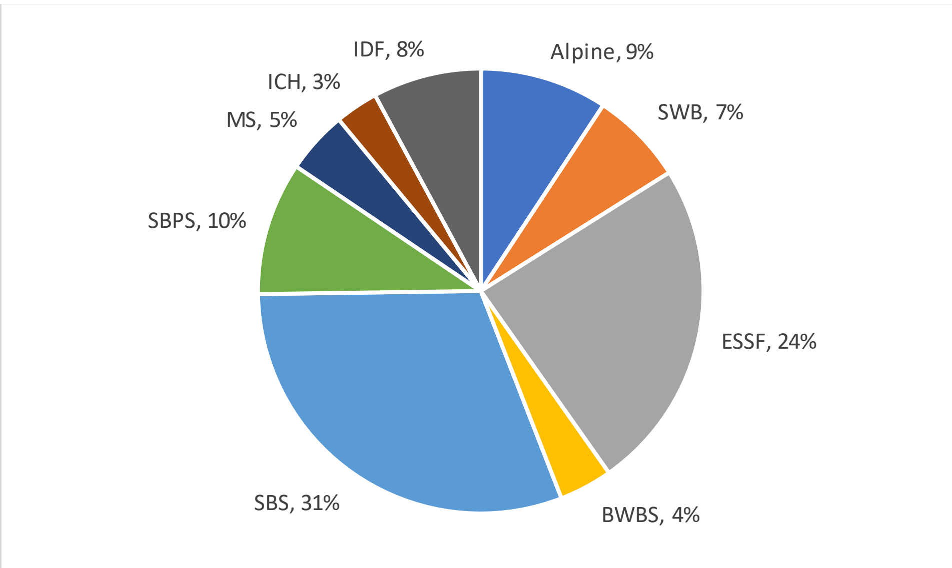

FIGURE 3. PROPORTION OF CATCHMENT AREA IN MAIN BEC ZONES.

Legend: SWB = Spruce Willow Birch, ESSF = Englemann Spruce- Sub-alpine fir, BWBS = Boreal White and Black Spruce, SBS = Sub-boreal Spruce, SBPS = Sub-boreal Pine – Spruce, MS = Montane Spruce, ICH = Interior Cedar-Hemlock, IDF = Interior Douglas-fir

The two largest zones are the ESSF (Englemann Spruce- Sub-alpine fir – 24%) and Sub-boreal Spruce (SBS – 31%) zones. The small amount of area in the Mountain Hemlock zone (MH) has been added to the ESSF figure, since ESSF is the continental (Cordilleran) subalpine boreal equivalent to the MH zone. (The

[7] https://cfcg.forestry.ubc.ca/resources/cataloguing-in-situ-genetic-resources/about-bec-and-bgc-units/
[8] For more detailed information on the BEC system see the BC Ministry of Forest BEC webpage or Meidinger, D. and J. Pojar. 1991. Ecosystems of British Columbia. BC Ministry of Forests, Victoria, BC. 330 pp.

ESSF zone has much colder and drier winters and a shorter growing season than the MH zone.) The ESSF and SBS zones have relatively harsh climates and are at the lower end of the productivity scale in the catchment area.

Spruce is the predominant species group in the catchment area. In addition to the ESSF and SBS zones, there is a significant area in the Boreal White and Black Spruce (BWBS – 4%), Spruce Willow Birch (SWB – 7%), Sub-boreal Pine - Spruce (SBPS – 10%), and Montane Spruce (MS – 5%) zones. In total, 81% of the catchment area is classified as being in a BEC zone with a significant spruce component. Pine is the other major species group in the catchment area, with lodgepole pine being the most important species. However, in terms of the BEC zones, it is only present in the SBP zone, in spite of the fact that it is more prevalent than the BEC zone area figures would indicate.

A small amount of area in the Williams Lake TSA has coastal characteristics, and the area in the Coastal Western Hemlock zone (CWH) has been added to Interior Cedar-Hemlock zone (ICH), much of which is described as an interior rain forest. There is also a considerable area of Interior Douglas-fir (IDF), which grows very differently from its coastal equivalent.

A substantial portion of the catchment area (9%) is in the alpine zone, which has few if any trees present. The area shown as alpine includes area from four BEC zones, including the Bunchgrass zone, which, while not alpine is untreed.

The variation in climate and forest cover within the catchment area is evident from the distribution of BEC zone area among the five TSAs, shown in Table 4. The majority of the area in the boreal BEC zones can be found in the Mackenzie TSA, which includes 96% of the BWBS zone, 64% of the Boreal Altai Fescue Alpine zone (the majority of the Alpine category), and 94% of the SWB zone, which is a far northern forest type. Most of the remaining area in these BEC zones is found in the Prince George TSA. The Prince George and Mackenzie TSAs also contain the majority of the ESSF and SBS area (70% of the SBS is in the Prince George TSA).

	Prince George	Mackenzie	Williams Lake	Quesnel	100 mile House	Sum	%
Alpine	295	1172	547	14	19	2047	9%
SWB	95	1405	0	0	0	1500	7%
ESSF	2255	2059	733	195	99	5341	24%
BWBS	33	820	0	0	0	853	4%
SBS	4730	954	280	573	242	6778	31%
SBPS	71	0	1327	638	103	2139	10%
MS	4	0	647	288	64	1003	5%
ICH	217	0	321	84	69	691	3%
IDF	0	0	1076	22	640	1738	8%
SUM	7699	6411	4932	1814	1236	22092	100.00%

TABLE 4. DISTRIBUTION OF BY AREA BY KEY BEC ZONE (THOUSAND HA)

In contrast, Williams Lake TSA, which is further south than Quesnel and further west than 100 Mile House, contains all of the Coastal Alpine, CWH, and MH area, as well as upwards of 60% of the IDF, SBPS, and MS zone area. These are all BEC zones characterized by relatively milder climates. Williams Lake TSA has representation of ten of the 14 provincial BEC zones, making it the most diverse TSA in the catchment area. It is transitional on a north-south gradient as well as on an east-west axis, giving it high diversity. In contrast, Mackenzie TSA has area from only five BEC zones, all representative of the near and far north.

Quesnel and 100 Mile House are also relatively diverse TSAs, but being the smallest, they have fewer BEC zones represented in them. Eighty-three percent of the area in the Quesnel TSA is sub-boreal and montane forest (SBS, SBPS, and MS). Half of 100 Mile House is in the IDF zone, and 25% is in the two sub-boreal zones (SBS and SBPS).

The ICH zone has garnered a great deal of international attention from conservation organizations, as it is reputed to be one of only two interior rain forests in the world. The forest in this zone is very productive and many parts of the zone have little road access. Area in this zone can be found in each of the TSAs except Mackenzie, with 75% of the ICH area in the catchment area being in the Williams Lake and Prince George TSAs.

As will be described in more detail below, the forests of the catchment area have been greatly affected by an outbreak of Mountain Pine Beetle (MPB), and endemic pest that occasionally experiences population explosions that lead to severe outbreaks. Such an outbreak started in southern BC in the early 1990's and, by about 2000, entered the catchment area from the southwest and started to cause noticeable mortality in the 100 Mile House and Williams Lake TSAs. It expanded fairly rapidly northwards, reaching Mackenzie TSA by 2004. The infestations peaked after about 5 years; FLNRORD estimated that the peak intensity of the infestation occurred in 2005 in Williams Lake, while in Mackenzie the apex occurred in 2009. The impacts of this outbreak continue to affect the forest and the forest industry and are discussed throughout this report.

3 Overview of Relevant Legislation

Forest management is governed by a wide range of legislation. There are a couple of federal laws that are relevant however most legislation is provincial since Canada's constitution gives the provinces jurisdiction over public lands and natural resources (other than those in National Parks, National Defense Bases, Indian Reserves, etc.)

3.1 The Forest Act and Forests and Range Protection Act (FRPA)

The provincial Forest Act and its regulations set out the forest management framework on Crown land, including the organization of the public forest estate, forest tenure, planning requirements, the process for annual allowable cut (AAC) determination, timber measurement and marking, and the setting of stumpage rates. The province is organized into 37 Timber Supply Areas (TSAs) - nine along the Coast, 15 in the South, and 13 in the North. Within each TSA there are multiple forestry tenures. Some grant rights to harvest timber in a defined area (i.e., area-based tenures) and other forms of tenure grant rights to harvest a set volume (i.e., volume-based tenures) from within a given TSA. Area-based tenures within the catchment area include Tree Farm Licences (TFLs), Community Forest Licences, Woodlot Licences and First Nations Woodland Licences (FNWL).[9]

While volume-based tenures supply the majority of the timber harvest in the catchment area, a substantial amount of TSA area has been shifted from volume-based tenures to Community Forest Licences and First Nations Woodland Licences during the past 20 years. These area-based tenures have been extended to more widely distribute the benefits of forestry and to provide for a variety of forest management approaches.

The Forest and Range Practices Act (FRPA) is the primary provincial legislation regulating forestry practices and planning on Crown land. Under FRPA, the Forest Planning and Practices Regulation (FPPR) identifies objectives set by government for timber as well as a wide range of environmental and social values including fish, wildlife, biodiversity, soils, water, and cultural heritage sites. These objectives must be addressed in Forest Stewardship Plans, which are the tactical planning documents required for Crown forests. The government may also establish orders under the Government Actions Regulation (GAR) or the Land Use Objectives Regulation for specific land uses such as ungulate winter range, wildlife habitat areas, critical habitat for fish and old growth management areas.

For example, the Quesnel Forest Landscape Planning Team (2023) reported that there are five GAR orders in place for the following: American White Pelican, Great Blue Heron, Mule Deer and Mountain Caribou (one order for each of the Eastern Herd and the Western Herd).

On Crown land, the provincial government regulates forest planning and operations, including the determination of the allowable harvest. Government approves all forest management plans on all tenures. On volume-based tenures, the Ministry of Forests, Lands, Natural Resource Operations and Rural Development's (FLNRORD) Chief Forester follows a rigourous process to establish the AAC (See Section 4.4) which is then allocated to eligible licensees. On Tree Farm Licences (TFLs), the oldest form of area-based tenure, the Chief Forester also sets the AAC. On other forms of area-based tenure, such as First Nations Forest Licences and Community Forest Licences, the plan preparer determines an allowable harvest and provides a rationale for its selection, which must be approved by the provincial government. The province also monitors the performance of the licensees in conducting their operations in a way that does not cause damage to the site and meets requirements associated with biodiversity conservation.

3.2 Annual Allowable Cut (AAC) Determination

British Columbia has a well-established approach to determining AACs. The Forest Act provides fairly detailed direction to the Chief Forester in terms of the factors that must be considered when determining the AAC.

In general, the AAC determination process starts with updating the forest inventory; next the landbase that can support commercial timber production is identified. This latter process, known as the "netdown", involves removing areas that are unavailable for timber harvesting from the landbase. The first stage of the netdown involves removing non-Crown land, Crown land not included in the AAC (e.g., Community Forests), roads, and non-forest lands. What is left is the Crown Forest Management

[9] There are no Tree Farm Licences, which is another form of area-based tenure, within the catchment area.

Landbase (CFMLB). However, not all of the CFMLB is available for commercial timber production, and the second stage of the netdown process begins. In this stage, areas that are netted out include, but are not limited to, unproductive forest areas, lands where timber harvesting is prohibited, such as parks and parts of ungulate winter ranges, areas that are inoperable due to topography or other factors, ecologically sensitive areas (such as Old Growth Management Areas or OGMAs), riparian areas and important recreational areas. What remains is the Timber Harvesting Landbase (THLB), which is the landbase used to calculate the AAC.

An AAC is determined by the provincial Chief Forester for the volume-based portion of each TSA and apportioned amongst the volume-based licence holders by the Minister of FLNRORD. The Chief Forester also determines the AAC for each Tree Farm Licence. The Act requires that the Chief Forester review and update the volume-based AACs and the AACs on the Tree Farm Licences at least every ten years. Due to the MPB infestation, AAC revisions occurred much more frequently during the past 20 years in much of the catchment area.

3.3 Overhauling the Forest Planning Process

British Columbia has been under considerable pressure to revise its approach to forest management to place a higher priority on maintaining and enhancing ecological values and reconciling with First Nations. The substantial loss of lodgepole pine in the Interior of BC due to the mountain pine beetle infestation and the more general loss of forest due to especially destructive fire years in 2017, 2018, 2021 and most likely 2023, has put tremendous pressure on the forest, the wood supply and the forest industry. Wood supply has declined significantly in the Interior, including in the catchment area, and is poised to decline further. Climate change has been a major contributing factor to these losses, prolonging the MPB outbreak which created large amounts of dead wood fuel that supported the extensive fires, which were also enabled by warmer and drier than average weather. The combination of all of these factors and pressures is forced a major re-assessment of forest management.

At this point, other than the reductions in AAC, the policy revisions have focussed on reconciliation with First Nations and elevating the importance of maintaining ecological values in forest management. To move towards these goals, a key approach has been to introduce forest planning at the landscape level with First Nations as part of the decision-making team. Currently, forest licensees prepare a Forest Stewardship Plan (FSP) which is a largely operational plan that applies to an individual licence area. FSPs do not consider the context of the licence area within the broader landscape, and there is no landscape level direction that they need to be consistent with. There is also no linkage between Strategic Land Use Plans, which already exist, and FSPs. As a result, cumulative impacts of access and of harvesting on watersheds and other key ecological geographies are not considered. A series of amendments has been made to the Forest and Range Protection Act to introduce landscape level forest planning – and the province has currently established four forest landscape planning pilot projects in BC, including one in Quesnel TSA[10]. The Forest Landscape Plans are intended to replace FSPs.

The introduction of these changes to planning has proceeded in stages.

A first stage was to bring in a set of amendments to FRPA through the Forest and Range Practices Amendment Act, 2019 (Bill 21, 2019), which was passed in spring 2019. Bill 21 was intended to improve the administration and transparency of forest stewardship planning by allowing initial legislative and regulatory changes including:

- Requirement that a Forest Operations Map depicting the approximate geographic location of proposed cutblocks and roads be prepared and made publicly available;
- Mandatory replacement timelines for Forest Stewardship Plans and Woodlot License Plans to facilitate adoption of the forest landscape planning framework;
- Amendment requirements for catastrophic timber damage; and
- An expanded definition of wildlife to make the term consistent with other legislation.

Further changes to FRPA were introduced in 2021 through Bill 23 - Forest Statutes Amendment Act. The government summary stated that the Act provided important improvements to forest and range management in the province that prioritize forest health and move forward on commitments to reconciliation. Key changes included:

- Introduction of the new Forest Landscape Planning (FLP) framework to clarify forest management objectives and improve transparency in forest planning and at a landscape scale;
- Alignment of FRPA with the Declaration on the Rights of Indigenous Peoples Act to strengthen government-to-government relations and shared decision-making opportunities in forest planning;
- Expanding provisions for wildfire management, including the addition of wildfire as a FRPA objective and new prescribed practices within Wildland Urban Interface Areas to safeguard B.C. communities against the threat of wildfire;
- Enhancing road management to protect public safety and the environment; and
- Improving the compliance and enforcement framework through enabling disclosure of information, the creation of 12 new fines and increasing nine others.

West Coast Environmental Law (WCEL) (2023) noted that with these changes, the Province has begun to transition away from operational forest stewardship plans and towards forest landscape plans, and

[10] The Quesnel Pilot is in a fairly early stage. The webpage for the pilot may be accessed at https://engage.gov.bc.ca/govtogetherbc/engagement/quesnelflp. A comprehensive overview of forest management in the Quesnel TSA has been prepared by the Pilot Project Team: Quesnel Timber Supply Area Forest Landscape Plan: Summary of Current Forest Management. The document provides much more detail regarding the forest and its management than this report can provide.

establish a forestry planning process shared by the Province and Indigenous governments, with involvement of communities and stakeholders. With the Province and First Nations effectively directing the development of the landscape plans, government will be re-asserting a stronger role in forest planning than it presently has, and First Nations will for the first time have a significant role. This is a stark contrast to the 1990's initiative that BC embarked on to develop Land and Resource Management Plans that had no Indigenous participation.

The timeframe for the implementation of these changes has not been specified, however it will be lengthy. In October 2021, the Forest Practices Board noted that the amendments from the Forest and Range Practices Amendment Act had yet to be implemented. Further changes have been outlined in the Modernizing Forest Policy publication (BC Government 2021). In particular, a series of changes will be made to ensure that the planned timber harvests are consistent with the harvest profile assumptions made in the AAC determination (e.g. species, size class, distance from mill), that the full AAC is used.

In February 2023, the province amended the Forest Practices and Planning Regulation to remove a clause that constrained the government's scope for protecting biodiversity and other values, as protective measures could not "unduly reduc[e] the supply of timber from British Columbia's forests".

WCEL (2023) notes that these amendments will only apply to new Forest Stewardship Plans – since the existing five-year plans can be extended for another five-years, it can be as long as a decade before these measures are implemented on the ground in some places. WCEL (2023) also noted that similar timber-biased language still appears in the Government Actions Regulation as a limitation on creating such things as wildlife habitat areas for species at risk, community watersheds, fisheries-sensitive watersheds, and several other environmental measures.

3.4 Forest Planning and Biodiversity

BC's rich biological diversity is important at all scales, ranging from the local to the international.

At a provincial level, British Columbia has an exceptionally wide range of geophysical and ecological conditions. Consequently, BC has the most biodiversity rich forests in Canada. This area under evaluation includes 13 ecoregions defined by the WWF (Figure 4: WWF Forest Ecoregions of British Columbia). More than 50,000 species (not including single-celled organisms) exist in BC, but only 3,808 of these have been assessed for their conservation status. Of the Canadian provinces and territories, BC is home to the richest diversity of vascular plants, mosses, mammals, butterflies and birds, and the largest number of endemic species of reptiles, beetles and amphibians found only in one province or territory. BC is known to have a majority of the global range for 99 species. Of the 3,808-native species in BC for which conservation status has been assessed, 233 species (6%) are of global conservation concern and 1,640 species (43%) are of provincial conservation concern. The BC Conservation Data Centre identifies species of provincial concern as red-listed, which are either extirpated, endangered, or threatened and are considered to be the most at risk, or blue-listed, which are considered to be vulnerable to human activities and natural disturbance. Listed species on Crown or private land are either protected under the provincial Wildlife Act or the Federal Species at Risk Act (SARA).

While there is considerable variability in the forest across the catchment area, other parts of BC are far more diverse. Scudder (2004) did not identify any biodiversity hotspots within the catchment area.

Similarly, Canning's overview of BC biodiversity (2000) does not identify any particular locations in the catchment area with noteworthy biological diversity.

What is most notable within the catchment area are the numbers of ungulates and large mammalian predators, notably wolves, coyotes, black and grizzly bear, and cougar. Lynx and wolverine are also present although the latter is rare. Ungulates include moose, mule deer, white-tailed deer, mountain goats, elk and caribou. The public discussion paper for the 2016 Prince George Timber Supply Review reported that 57% of bird species known to occur in BC and 45% of bird species known to breed in BC are found in the Prince George Timber Supply Area (BC Ministry of Forests, Lands and Natural Resource Operations 2016)

The Government framework for protecting biodiversity uses both the coarse and fine filter approaches. The coarse filter is applied at the ecosystem and landscape levels and aims to direct forest management so natural habitats and key ecological attributes are maintained at levels and distributions consistent with Natural Disturbance Regimes. The fine filter approach complements the coarse filter providing protection for critical habitat for individual species whose needs are known and not met with coarse filter practices. The fine filter is applied where species needs are well understood, and key ecological attributes can be identified. This applies mostly to Federally and Provincially listed species at risk. Examples within the catchment area include key habitat needs like natal pools for Tiger salamanders, old Growth closed canopy for Northern Goshawk nesting, and mature to old-growth coniferous forest with abundant lichens, or muskegs and peat lands intermixed with upland or hilly areas for Caribou.

For federally listed species, Recovery Plans focus on implementation of conservation for fine filter key attributes related to critical habitat. For provincially listed species, Government uses the Identified Wildlife Strategy (IWS) which identifies key habitat needs and provides policies, procedures, and mechanisms for their protection and sustenance. This coarse and fine filter framework is implemented through FSPs. Three of the objectives set by government in the FPPR are directly related to biodiversity, and others are indirectly related (e.g., wildlife, fish habitat in fisheries sensitive watersheds).

3.5 Species at Risk Legislation

A key aspect of biodiversity is species richness, and the loss of species is a key threat to the maintenance of biological diversity. Species loss may occur locally (extirpation) or through globally (extinction). Both the federal and provincial governments have legislation intended to protect species at risk (SAR). The Canadian Species at Risk Act (SARA) requires the federal government to identify SAR and develop recovery/conservation plans. If necessary, the federal government can take emergency action if a species is facing a critical situation or if there is provincial inaction. SARA only applies to federal lands within the province. British Columbia does not have a species at risk act however the provincial Wildlife Act requires habitat identification and enables the government to prepare and implement recovery plans for threatened and endangered species. The Wildlife Act provides protection on Crown and private land for both Federal and BC listed species and ecosystems.

Federal and provincial species at risk lists identify species that need protection.[11] BC is developing recovery plans for federal and BC listed species on an ongoing basis, and the province has expanded its

[11] https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre

inventory of sensitive ecosystems, developed regional conservation strategies and provided local governments and private landowners with workshops and conservation strategies.

3.6 Old Growth

Old growth timber is iconic in BC. People typically think of massive coastal spruce, cedar and douglas-fir when they think of old growth, however most of the old forest in British Columbia is much smaller and much less awe-inspiring. Which isn't to say it is unimportant. In BC, old growth intersects with biodiversity, including species at risk, social and cultural values, including reconciliation, and the industrial wood supply. Continued harvesting of old growth, growing pressure to conserve biodiversity and the rising importance of Indigenous values have combined to stimulate the provincial government to revamp the treatment of old growth.

Ecologists consider old growth forests to have additional characteristics besides an advanced age. The BC government notes that old growth forests typically have substantial number of standing dead trees or dead trunks, abundant large pieces of dead wood on the ground in various states of decay, and multiple layers of vegetation in the canopy.[12] Franklin and Spies (1986) add that old growth forests have a wide range of tree ages and sizes present, diverse species composition, and include many species for which it is the optimum habitat.[13] For now, however, the BC government uses 250 years as the threshold for old growth on the Coast and 140 years as the Interior region threshold.

Until recently, old growth forests were subject to provincial orders, and forest managers on Crown forests were required to identify and map old growth management areas (OGMAs), which function as protected areas. Other parts of the forest are subject to non-spatial OGMAs. The B.C. Forest Practices Board reported on a special investigation (2012) that it conducted regarding the management of old growth, and it found a number of significant shortcomings, including a lack of data and monitoring to sufficiently understand the old growth portion of the forest and whether required measures are being properly and consistently implemented. The Board noted in 2020 that while the province had made some efforts to address the issues documented by the FPB, many of these same weaknesses remained.

In July 2019, the provincial government commissioned a two-person panel to review the state of old growth management in BC. Both panel members were foresters, including a very well-respected Indigenous forester. Nine months later, the panel submitted its report to government, titled "*A New Future for Old Forests*". The report, publicly released in September 2020, identified a number of weaknesses in how old growth was being managed and conserved in BC and concluded that the management paradigm was outdated and that policy goals and objectives for old growth were not being achieved. A series of 14 recommendations was tabled, including a recommendation for the immediate deferral of harvesting "in old forests that were at very high and near-term risk of irreversible biodiversity loss". In 2020, the province began deferred harvesting selected old growth stands and began to designate "exceptionally large trees" for protection. More area has been identified for deferral; in

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[12] https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/old-growth-forests/old-growth-values

[13] Franklin, J. and T. Spies. 1986. The ecology of old-growth Douglas-fir forests. https://andrewsforest.oregonstate.edu/sites/default/files/lter/pubs/pdf/pub34.pdf

February 2023, the provincial government announced it was increasing the area of deferrals from the previously announced level of 1.7 million ha to 2.1 million ha, giving the government and First Nations time to work together and with stakeholders to develop a new management strategy.

The Council of Forest Industries (COFI) has warned that the deferrals would lead to the closure of between 14 and 20 sawmills, two pulp mills, and many smaller facilities. The concern was that the deferrals would exacerbate the pressures on wood supply; the provincial industry still relies on first-growth forest for the majority of its feedstock. While there have been a number of facility closures in BC over the last three years, they have not yet occurred to the extent mentioned by COFI.

There remains a great deal of controversy over old growth, starting with how much of it there is. According to studies released in 2020 and 2021 by Veridian Ecological Consulting, 8.2 per cent of B.C.'s productive forests are old, and only 2.7 per cent of its very productive forests are old.[14] In contrast, a study released in 2021 by Forsite Consultants suggests the amount of productive old growth is higher: 25 per cent of productive forest sites are old and 26 per cent of very productive forests are old.[15] Palmer (2022) notes that the difference between the figures relates to the way in which productivity was determined. Veridian used older data derived solely from aerial photographs (called the Visual Resource Inventory), while Forsite used the province's newer Provincial Site Productivity Layer (PSPL) data that uses measurements taken from the ground and specifically designed to calculate site productivity.

At the time of writing, the province, First Nations and stakeholders are continuing to discuss a longer-term management approach to old growth and the fate of the deferred areas. It is expected that a substantial proportion of the deferred old growth will come under permanent protection, but it is not known how much or what types of old growth are likely to be protected.

3.7 First Nations

As shown in Section 2.2, there are many First Nations that have traditional territory either fully or partially within the catchment areas. None of these First Nations signed historic treaties so that many if not all of these First Nations retain their full Aboriginal rights. BC has been more active than any other province in advancing reconciliation, including through measures taken to provide economic benefits in the forest sector. BC as also been providing tenure options and increasing the level of consultation with First Nations related to forest management.

At a high level, First Nations were interested in entering into treaties with the federal and provincial government in order to address matters such as Indigenous rights, self-government, land and resources, fishing and forestry. In 1990, the Nisga'a Tribal Council reached an agreement to negotiate a modern treaty with Canada and BC. One year later, BC established the British Columbia Treaty Commission to oversee the modern treaty process. In 2000, the Nisga'a Treaty was signed and came into force. The

[14] For the Veridian and Forsite analyses, forests on productive sites would reach a height of 20 m or more in 50 years, whereas forests on very productive sites would reach a 25 m height by age 50.

[15] Forsite's 2021 study was provincial in scope and is unrelated to the work they undertook for this catchment area analysis.

next modern treaty, with the Tsawwassan First Nation, came into force in 2009. Two other treaties have since been agreed to, with First Nations on Vancouver Island and the coast. Today, a number of First Nations are in various stages of negotiating modern treaties.

BC has also been proactive in creating opportunities for First Nations to manage forests and enter the forest industry. While many First Nations would have liked BC to move faster and more assertively, BC has been far ahead of other provinces in efforts to enable greater First Nations participation.

In 2003, the provincial government introduced some substantial regulatory changes to the forestry sector. One of these changes was the "redistribution" of 20% of the AAC from large tenures in the province. The redistribution provided the basis for the formation of BC Timber Sales and enabled timber allocations for small business, First Nations tenure, and new entrants. In all, 8.3 million m3 of AAC was re-distributed. The uptake among First Nations was substantial and by the end of September 2010, First Nations held 11.70 million m3/yr of allowable annual cut (AAC) within competitive and direct award forest tenures. This amounted to **13.9%** of the provincial AAC.

In 2010, a new type of tenure was created exclusively for First Nations: the First Nation Woodland Licence (FNFL). These licences allow First Nations to manage a suite of values including protection of culturally significant sites and the opportunity to market traditional botanical products. The provincial government also returns a portion of the stumpage paid by the community as a component of the provincial revenue sharing regime.

As of November 2023, the BC government has issued First Nations Woodland Licences within the CA. In 2022, the BC government issued the largest FNWL yet to the Lheidli T'enneh First Nation in Prince George. The area under this licence is 217,312 ha. FNWLs have also been issued in Mackenzie (Kwadacha First Nation), Quesnel (?Esdilagh First Nation), Williams Lake (Esk'etemc First Nation), and 100 Mile House (Tsq'escenemc/Canim Lake Band). In addition to FNWLs, First Nations may also hold Community Forest Licences and regular forest licences.

Another major event occurred in 2019, when BC passed the Declaration on the Rights of Indigenous Peoples Act which establishes the UN Declaration on the Rights of Indigenous Peoples as the provincial framework for reconciliation. The purpose of this Act is to "recognize and protect the rights of Indigenous peoples. It will create a clear process to make sure Indigenous peoples are a part of the decisions that affect them, their communities, and their territories - and it provides a path forward for everyone."[16]

The UN Framework incorporates the principle of Free, Prior and Informed Consent (FPIC), such as in Article 19:

States shall consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to obtain their free, prior and informed consent before adopting and implementing legislative or administrative measures that may affect them.

The inclusion of FPIC in the UN Declaration means that FPIC is also incorporated into BC's legislation.

[16] https://www.bcdripa.org/

There are some substantial First Nations forest businesses in the catchment area. For example, in Williams Lake, the largest harvest contractor, who supplies Drax among other mills, happens to be First Nation owned. First Nations are increasingly becoming involved in the forest sector and Drax does business with these companies and individuals, supporting them.

4 The Forest in 2022

4.1 Leading Species x Area

Table 5 shows the area by leading species by TSA. The data represent areas where the species composition has been identified. Areas that have recently been harvested and have been disturbed by other factors (especially fire) do not have a species composition attributed to them and this area has been placed in the "Non-forest" category. Non-forest also includes the alpine area, indicating that the area that has been disturbed and not yet been inventoried for species composition represents about 10% of the catchment area. (Reference disturbance data)

As discussed above, spruce and pine are the two principal species groups in the catchment area, with lodgepole pine being by far the most common pine species. In contrast, white spruce, black spruce and Englemann spruce are all common throughout the catchment area. Alpine fir is the other significant species, accounting for 21% of the catchment area. The majority of alpine fir-leading stands are located in the Mackenzie and Prince George TSAs. The low proportion of hardwoods in the forest is evident – birch is most common and can be mixed with aspen. Aspen is dominant in the Hardwoods species group. These primary species are representative of the boreal and sub-alpine nature of much of the catchment area.

Douglas-fir is found in the lower elevations in the southern portion of the TSA, where it becomes dominant on drier sites, while western red cedar is associated with areas that have a more coastal character.

Leading Species	Prince George	Mackenzie	Williams Lake	Quesnel	100 mile House	Sum	%
Non-forest	**1,013,241**	**1,643,749**	**1,191,765**	**260,817**	**130,938**	4,240,509	19
Alpine fir	**2,099,725**	**2,192,473**	**202,103**	**68,720**	**39,897**	4,602,919	21
Western Red Cedar	**35,695**	0	**47,444**	**8,951**	**3,578**	95,669	0
Birch	**555,142**	**295,421**	**171,301**	**115,272**	**103,741**	1,240,876	6
Douglas-fir	**132,104**	**133**	**785,303**	**126,714**	**453,846**	1,498,100	7
Hardwood	**47,870**	**0**	**27,621**	**7,900**	**23**	83,414	0
Lodgepole Pine	**1,406,733**	**782,192**	**2,014,611**	**775,576**	**315,170**	5,294,281	24
Spruce	**2,408,539**	**1,496,465**	**492,087**	**449,808**	**188,785**	5,035,684	23
Misc	**6**	**182**	**6**	**12**		207	0
Sum	7,699,055	6,410,614	4,932,241	1,813,771	1,235,978	22,091,659	100

TABLE 5. AREA BY LEADING SPECIES GROUP (HA).

4.2 Area x Age Class

Figure 6 shows the age class structure of the catchment area forest by leading species. The non-forest area has been removed and so the area shown in **Error! Reference source not found.**Figure 6 is less than the area shown in Table 5.

The youngest age class (0-25) is the regenerating forest, which includes areas harvested, burned (especially in the 2017, 2018, and 2021 fires), and areas where the Mountain Pine Beetle (MPB) killed the stand or at least enough of it so that the area was reclassified as young forest. The harvested conifer stands were replanted with improved growing stock, so that the next stand will develop more rapidly than a natural origin stand.

Stands that are between 26 – 75 years are juvenile and maturing stands that for the most part are not yet merchantable. They comprise a mix of planted stands and natural renewal and are in the fastest growth stage of their development. At ages between 76 and 150 years, stands in the CA may be considered mature. Although still growing, the growth rates of these stands are slowing and they are at a prime age for harvesting. Species age at different rates that can be differentiated by BEC zone; whereas BWBS can be considered to reach an “old” condition at age 100, stands in the ESSF, ICH, MS, SBPS, SBS classes exhibit old stand characteristics at 150 years. In the Interior, the provincial government classifies stands older than 140 years as “old growth”, in contrast to the Coast where the threshold is 250 years.

In the CA, 34% of the forest is older than 140 years, including 4% of the forest that is older than 250 years. This means that a large proportion of the forest in the catchment area meets the BC government age threshold for old growth. In many of these stands, particularly at lower elevations, the main canopy is beginning to experience break-up and the stands are in the process of becoming multi-aged as the understory trees develop and fill gaps created by mortality in the main canopy. In contrast, stands in the sub-alpine zone may maintain their structure for many more decades before the canopy begins to deteriorate. In the catchment area, much of the old growth is found in areas where it is difficult to harvest or the productivity is insufficient to justify harvest, which is the reason that they have been able to persist as long as they have.

Figure 9 shows that there has been a considerable amount of stand-initiating disturbance (harvesting and natural disturbance) during the past 25 years, as 15% of the area shown in Figure 4 is in the youngest age class. The relatively low proportion of area in the 26-50 and 51-75 year age classes reflects a long period without severe disturbance, when fire suppression was generally effective in preventing large fires. Figure 4 shows that there is a considerable amount of mature forest in the catchment area. As indicated above, a lot of the older forest is in the upper elevations, where the productivity is low, where disturbance is less common, and where there is poor accessibility for logging.

Figure 4 shows that the character of the young forest is very different from that of the old, which is heavily skewed towards spruce and alpine fir. There is a much lower proportion of pine in the old forest because:

1. Much of the pine that was mature and older was killed by the MPB;
2. Lodgepole pine sites are prone to fire, and so those forests tend to be younger than forests on other types of sites; and
3. Lodgepole pine is a shorter-lived species that spruce and fir, it has been succeeded in older stands by spruce and fir.

Figure 6 also shows that the birch component is pretty well absent from stands older than 150 years, whereas douglas-fir leading stands are found in all age classes but tend to skew older.

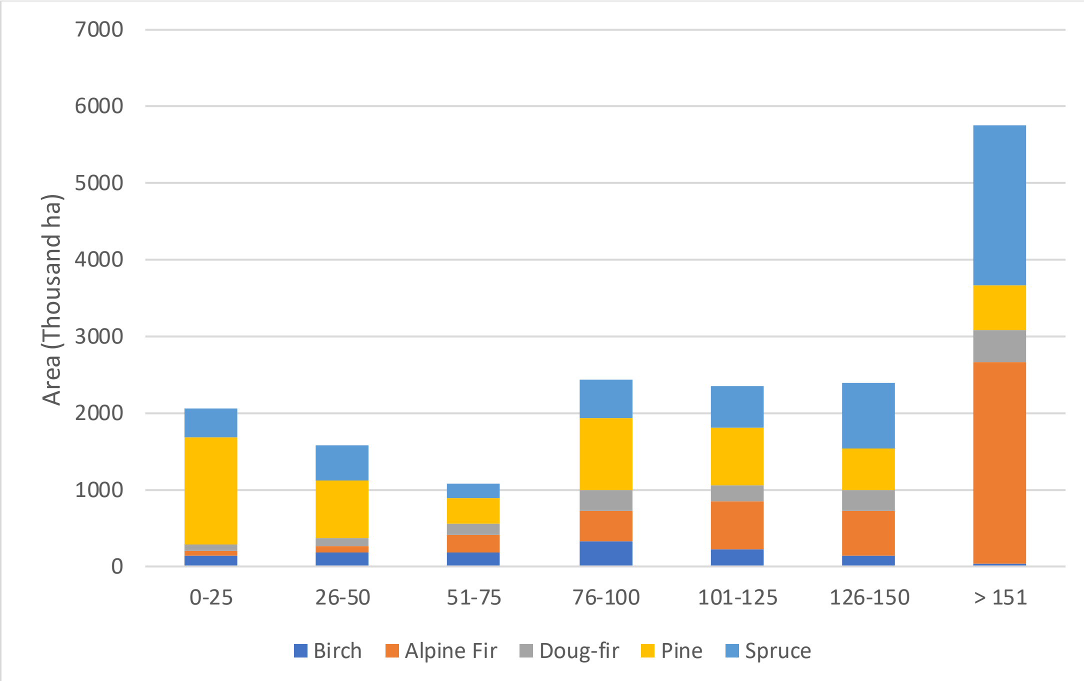

FIGURE 4. AREA X LEADING SPECIES X AGE CLASS

4.3 Old Growth Deferrals in the Catchment Area

Table XXOG shows the area of old growth harvest deferrals as of July 2023. These areas are described by the BC government as "Priority Deferral Areas" (BC Government 2023b) and they represent 6.1% of the total area in Table 5, or 7.6% of the area in Table 5 with the non-forest area removed.

The three classes of old growth are as follows:

Big-treed old growth is, as the name suggests, area with the largest trees of each forest type, as measured by height and diameter. The BC government (2023b) notes that these stands are naturally rare as they have been targeted for harvesting. The amount of area selected provincially is intended to reach a minimum threshold of 30% of the naturally expected amount of old forest, which is a minimum required to maintain the biodiversity associated with old forests.

Ancient forest is extremely old forest, older than 400 years in ecosystems with rare stand replacing disturbances and older than 250 years in ecosystem with more frequent stand replacing disturbance.

Remnant old ecosystems are old forest ecosystems where there is less than 10% of the area in the ecosystem is classed as old, which in the majority of the BC Interior is area 140 years or older.

It will be evident from the data that a number of deferred areas meet the criteria for two or even three of the old growth classes. Big treed area accounts for 95% of the total deferred area, while 7% qualifies as ancient and 21% is remnant old ecosystems.

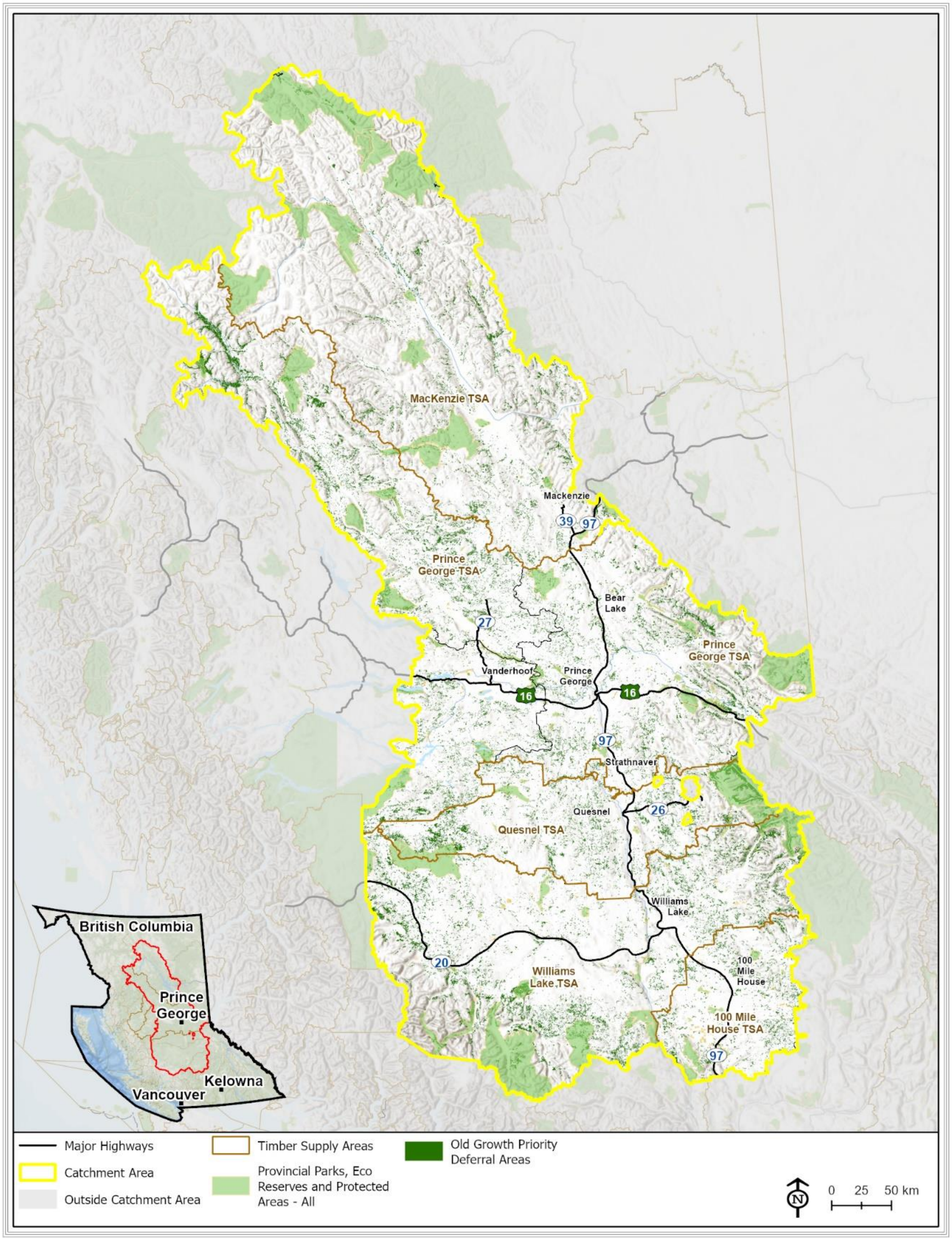

FIGURE 5. DEFERRED OLD GROWTH AREAS.

BEC Zone name	BEC Abbrev.	Big Treed	Ancient	Remnant Old Ecosystem	Total Area	% Total Area
Bunchgrass	BG	1,906	0	321	1,906	0.1%
Boreal White and Black Spruce	BWBS	61,298	5,229	891	64,157	4.7%
Coastal Western Hemlock	CWH	2,494	0	0	2,494	0.2%
Englemann Spruce- Sub-alpine fir	ESSF	203,003	399	33,565	205,060	15.1%
Interior Cedar-Hemlock	ICH	95,222	4,115	16,881	96,442	7.1%
Interior Douglas-fir	IDF	75,587	217	23,574	75,875	5.6%
Mountain Hemlock	MH	278	0	0	278	0.0%
Montane Spruce	MS	103,707	23,105	7,814	117,221	8.6%
Sub-boreal Pine – Spruce	SBPS	178,822	5,633	44,256	181,407	13.4%
Sub-boreal Spruce	SBS	565,377	57,987	156,613	609,623	45.0%
Spruce Willow Birch	SWB	0	4	1,010	1,015	0.1%
	SUM	**1,287,693**	**96,690**	**284,925**	**1,355,477**	

TABLE 6. AREA OF DEFERRED OLD GROWTH BY BEC CLASS AND OLD GROWTH CLASS (HA).

By far the largest proportion of the deferred old growth is in the sub-boreal spruce (SBS) BEC zone. The sub-boreal Pine and Spruce (SBPS) BEC zone holds 13.4% of the deferred old forest. The Prince George and Mackenzie TSAs hold more than 80% of the total SBS area, and given the remoteness of much of Mackenzie and the northern parts of the Prince George TSA, most of the deferred SBS old growth is likely to be in those two TSAs. In contrast, the SBPS area is concentrated in the three southern TSAs. The last major BEC zone with deferred old growth is the ESSF zone, which is generally located at relatively high altitudes and is consequently often difficult to operate in or consists of stands of marginal merchantability. It is to be expected that these three BEC zones would contain the majority of deferred old growth – in contrast, the old forest in the other BEC zones is less common, meaning that those areas are more likely to be permanently removed from the harvestable landbase.

4.4 AACs for the Catchment Area

Table 7 shows that in the most recent TSRs for the TSAs in the catchment area[17], the CFMLB is typically about 50% of the area within the TSA and the THLB is ranges from 19% in Mackenzie to 54% in 100 Mile House. As discussed, Mackenzie is mostly very rugged and less productive, and the northern part of the TSA has poor if any access. As a result, less than 20% of the total area is available for commercial forestry. Quesnel and 100 Mile House are at the other end of the spectrum, with less inoperable area and more productive forest.

TSA	Year of TSR	Total Area	CFMLB	THLB	% THLB
100 Mile House	2013	1,237,626	787,717	662,225	54%
Mackenzie	2023	6,410,643	2,996,248	1,228,877	19%

[17] As of July 2023, TSRs are under way for Quesnel and Mackenzie TSAs, however to date there has been little documentation produced in these processes.

Prince George	2016	7,965,496	5,096,789	3,070,301	39%
Quesnel	2016	2,077,293	1,375,613	1,020,699	49%
Williams Lake	2014	4,934,367	3,238,194	1,799,364	36%
TOTAL		22,625,425	13,490,561	7,772,998	34%

TABLE 7. NETDOWNS FOR THE TSAS IN THE CATCHMENT AREA (HA).

As mentioned above, the AAC's that are determined for each TSA exclude the allowable harvest from area-based tenures. Within the catchment area, Dunkley Lumber, Canadian Forest Products (Canfor) and West Fraser hold TFL's and the operations on these areas are excluded from the results in this study. Because TFLs account for less than 2.5% of the area within the catchment area, the omission of the TFLs does not materially affect the analysis results. The netdown process involves judgement. Some areas, such as parks and conservation reserves which have been legally designated, are readily identifiable in the forest inventory and are easily netted out. In contrast, designating which areas are inoperable is a judgement call on the part of the Chief Forester and these areas are not formally identified in the forest inventory. Many types of reserves, such as ungulate winter range and recreational zones, are partially available for harvesting and the netdown process involves a review of department guidance and discussions with staff. The area that is netted out for these purposes is also not recorded in the forest inventory.

As discussed, BC responded to the MPB infestation by greatly increasing the AACs in the interior TSAs to promote salvage harvesting of the beetle-killed pine. Figure 6 shows the AACs for the TSAs in the catchment area from 1990 to 2020. During the 1990's, the AAC was very steady at roughly 19.5 million m^3. This changed in 2001 when the BC Chief Forester raised the annual allowable cut (AAC) in Quesnel from 2.34 million m^3 to 3.24 million m^3, the first of a rapid series of increases in the catchment area TSA AACs that occurred during the next six years. Most of the TSAs in the catchment area had large volumes of mature lodgepole pine and by 2007, the AACs had been increased by roughly 50% in 100 Mile House, Williams Lake and Mackenzie, by 60% in Prince George and by 125% in Quesnel (Quesnel's AAC increased again in 2004 to 5.28 million m^3).

At the same time that the AACs were being increased, the harvest was being directed to salvage beetle-killed pine. For example, the 2007 increase in the Williams Lake TSA AAC from 3.77 million m3/year to 5.77 million m3/year, came with the stipulation that the harvest had to come from stands with at least 70% lodgepole pine located west of the Fraser River, which was the portion of the TSA hardest hit by the MPB.[18] In 2015, the AAC was re-set to 3 million m3/year, of which half was to consist of salvaged lodgepole pine. Note that in the base case model from 2015, the AAC was expected to be reset in 2025 to 1.4 million m3/year, where it would remain for fifty years.

[18] FLNRO. 2014. Williams Lake TSA Timber Supply Analysis Public Discussion Paper. January 2014.

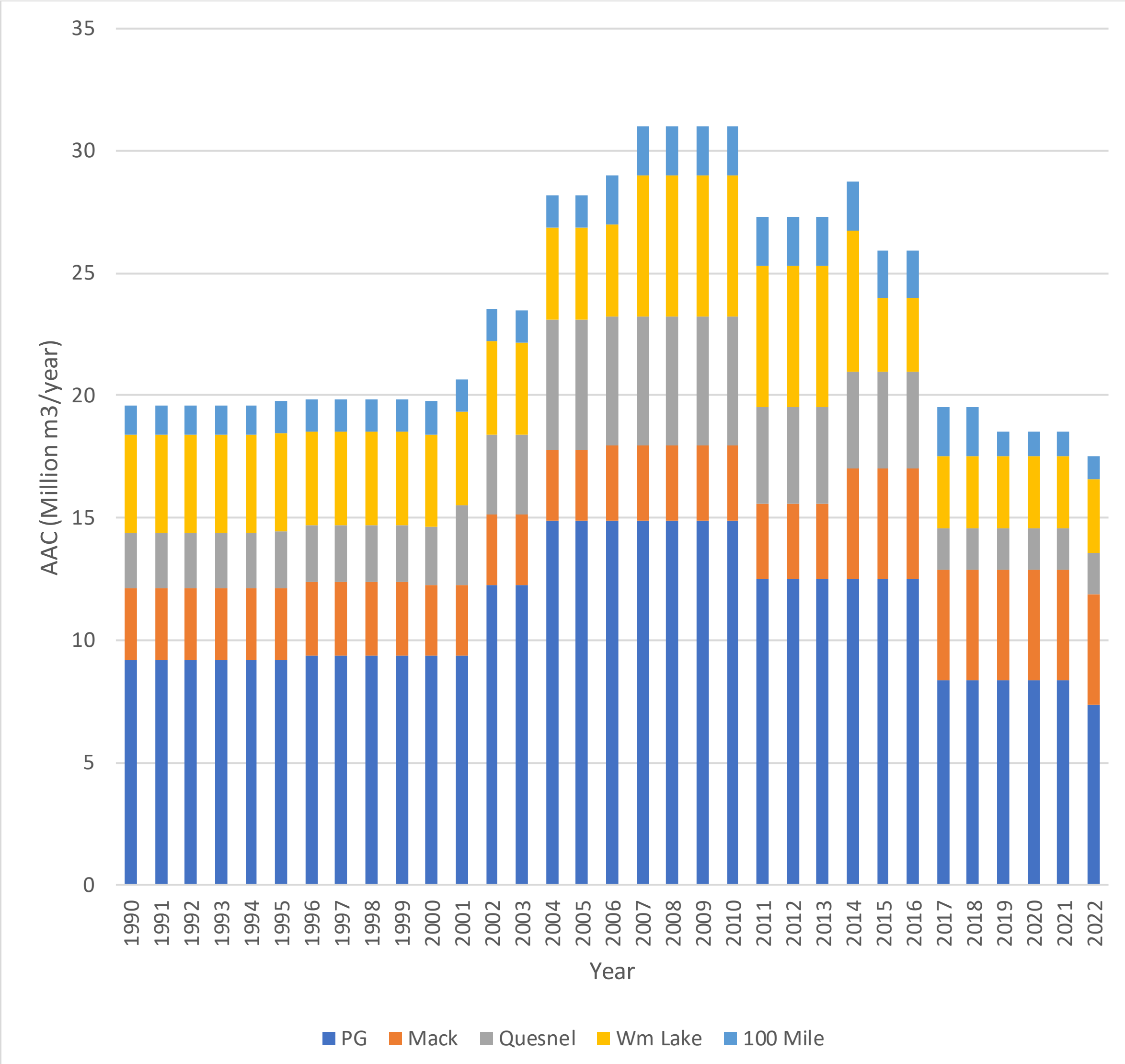

FIGURE 6. AAC HISTORY IN THE CATCHMENT AREA: 1990-2022.

Similarly, in 2011, when the AAC in Quesnel TSA was reduced to 4 million m3/year, 3.35 million m3/year was to consist of lodgepole pine. Between 2011 and 2015, 83% of the harvest was pine, most of it dead.[19] In 2016, more than 50% of the forest volume was estimated to be dead pine, with roughly 70% in pine-leading stands and 30% in spruce-leading stands. The TSR base case for Quesnel assumes that the AAC declines to 1.617 million m3/yr for 70 years, after which it increases to 2.139 million m3/yr.

The total AAC in the catchment area was at its highest from 2007-2010. By 2010, salvage harvesting began to wane in the southern parts of the catchment area and the AAC's began to decline in 2011 – this trend continues through to the present day so that the total AAC for the catchment area is now below the levels characteristic of the 1990's. In May 2023, the AAC for the Mackenzie TSA was reduced

[19] FLNRO. 2016. Quesnel TSA Timber Supply Analysis Public Discussion Paper. May 2016.

from 3 million m3/yr to 2.39 million m3/year.[20] AACs are expected to decline further during the next decade before stabilizing.

AACs calculated in one TSR process are not necessarily comparable to previous AACs. The TSR process only applies to the volume-based tenure lands, and this area has been shrinking over time in the catchment area as the provincial government grants tenure for community forests and First Nations Woodland Licences. There are also shifts that can occur in terms of what is considered operable, as the economics change and operational adjustments are made. In summary, there are many moving parts in a determination of the timber harvesting landbase in the catchment area and the applicable AAC; a detailed analysis is beyond the scope of this project.

The timber supply forecasts anticipate that by 2020 or so, the AACs will have bottomed out and will remain stable at this low level for between 50 and 70 years, barring another major disturbance. The total AAC for the catchment area will be 12.84 million m3/year during this period. Thereafter, it is expected that the managed stands will become the main source of timber and the AAC's will rise accordingly and the cumulative AAC in the catchment area will reach 19.43 million m3/year.

Of course, there will be policy factors as well as natural events that will alter the future wood supply flow. Climate change is expected to lead to higher temperatures and greater incidence of drought in the BC interior, which increases the potential for both fire and pest to cause higher losses than has historically been the case. The recently announced old growth deferrals will influence harvest levels, and if the price of carbon rises high enough, it may lead to less harvesting and more storage of timber (and carbon) on the stump.

4.5 Protection of Biodiversity in the Catchment Area

BC's forest management approach has become increasingly cognizant of biological diversity and as discussed in Section XXX, the province has been making changes to the FRPA and the associated FPPR to better protect biodiversity. The biodiversity of the CA was discussed in general terms in section XX.

Within the catchment area, there are a variety of land designations in place that contribute to the conservation of biodiversity. Some of these relate to forest management planning requirements while others are external to the forest planning process. The main example of the latter are protected areas that have been designated as provincial parks, reserves, protected areas and conservancies. These areas are an important part of the array of biodiversity conservation measures since unusual and /or very important areas are often designated as protected areas.

[20] https://news.gov.bc.ca/releases/2023FOR0027-000662

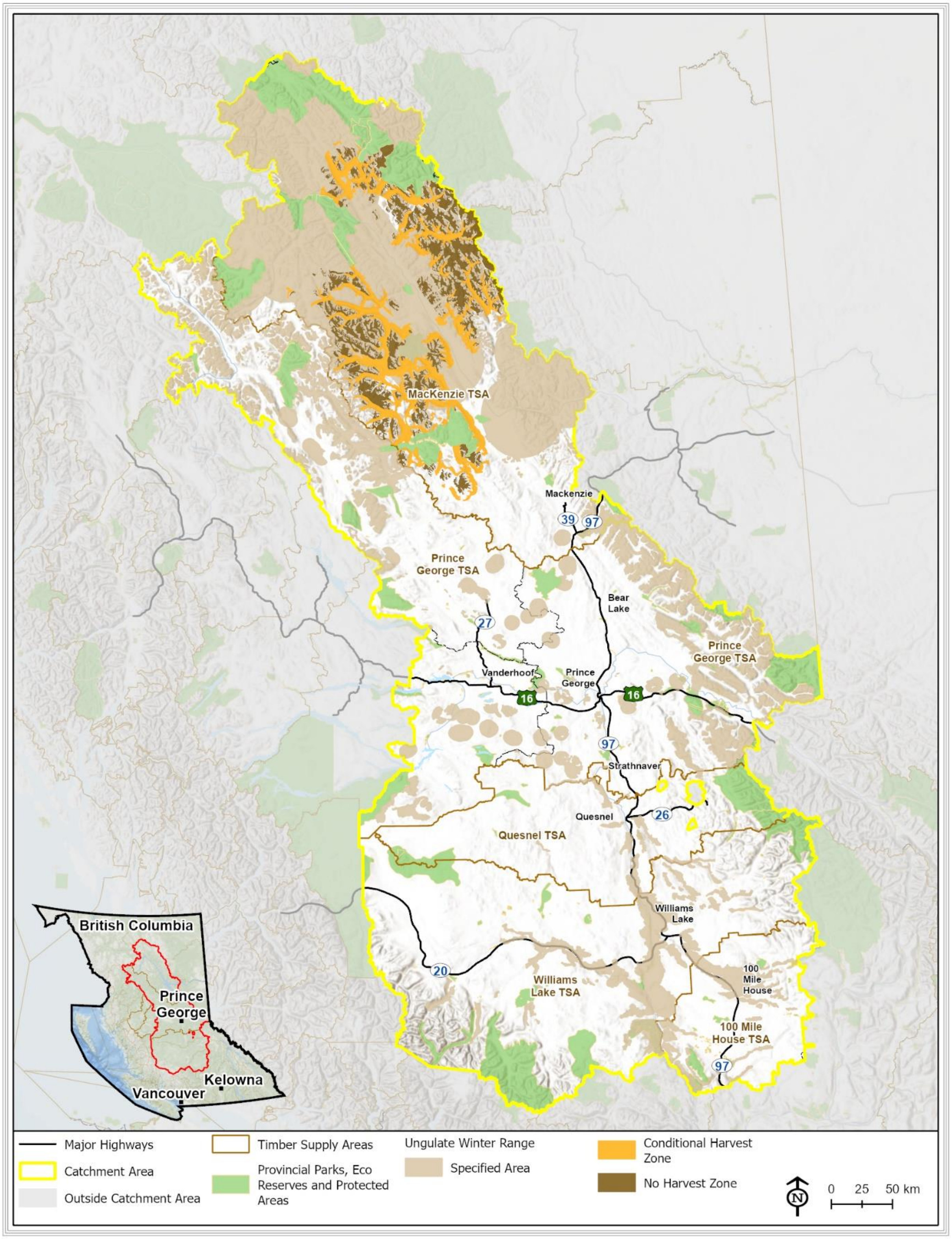

FIGURE 7. DESIGNATED UNGULATE WINTER RANGE AREAS.

Quantifying the areas is challenging because there is considerable overlap between the types of areas that are unavailable for harvesting. For example, inoperable areas are those forest areas that have trees of a merchantable size and species but the terrain is too steep or rugged to permit logging. Ungulate winter range, parks and reserves, and old growth management areas may all contain inoperable area, so that using the gross areas will double or triple count individual hectares. Similarly, substantial areas are identified as uneconomic to harvest – they may be too far from existing roads or require an unacceptable road-building expense to reach them, or they may be forests of low productivity or of species for which there are no markets. Uneconomic areas also overlap with many of the areas set aside for ecological reasons.

Accordingly, Table 7 provides an indirect picture of the extent of forest area that is not eligible for harvesting due to reasons ranging from ecological set asides to inoperability. Functionally, inoperable area contributes to biodiversity conservation as much as parks and conservation areas – while the areas may not have outstanding ecological significance, they also experience little human presence.

5 Forest Disturbance and Growing Stock 2002-2022

To contribute to the assessment of the impact of pellet fibre procurement on the forests of the catchment area, the annual change in the timber volume (also known as growing stock) in the catchment area forest was assessed between 2002 and 2020. This was done by working with forest inventories from 2002, 2010, and 2020 for the five timber supply areas in the catchment area. The consultants worked forward from the 2002 inventory to incorporate removals due to harvesting, fire and pests, and backwards from the 2020 inventory to estimate volumes by moving stands "backwards" along the growth and yield curves. The 2010 inventory was used as a checkpoint. Inventory standards evolved between 2002 and 2020 and adjustments had to be made to bring consistency to the estimates over the analysis period. Annex 2 provides a more detailed description of the process that was followed and some of the challenges involved.

The catchment area was greatly impacted by natural disturbance during the analysis period, which far outweighed the impact of harvesting. Figure 8 shows the volume killed by harvesting, wildfire and insect infestation. Two harvest systems were tracked – clearcutting with residuals and partial harvesting, which removes a lower proportion of the trees in a harvest block than clearcutting. Almost all of the harvest volume comes from clearcutting; relatively little partial harvesting takes place but the amount of it has been rising. Figure 8 shows that the MPB was the overwhelmingly dominant disturbance in terms of area and volume affected; it was responsible for almost all of the volume lost to IBM. (There is also a bark beetle infestation that is causing mortality but at a scale far below that of MPB.) The MPB infestation peaked in the catchment area during 2005 and 2006, and declined rapidly thereafter.

Harvest levels were elevated throughout the analysis period. The dip in harvesting during the global economic slowdown in 2008 and 2009 is evident, and after recovering, the harvest started to trend lower in 2015. Periodic fire losses are relatively significant – the combination of hotter and drier weather and abundant dead fuel in the wake of the MPB infestation paved the way for severe fire years in 2017 and 2018 (2021 saw even more area burned).

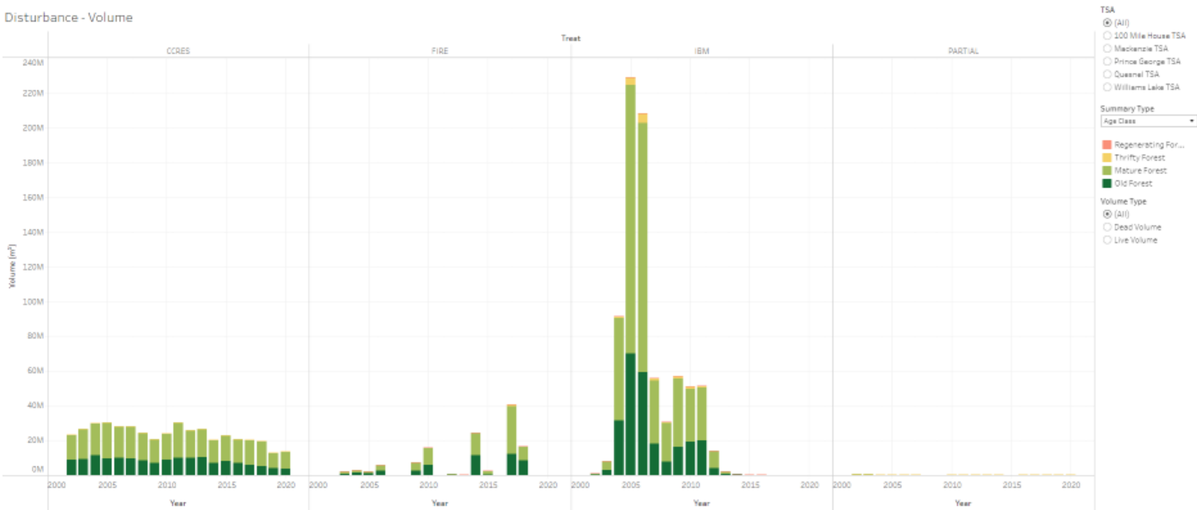

FIGURE 8. VOLUME KILLED BY DISTURBANCE (M3/YEAR) (CCRES = CLEARCUT WITH RESIDUALS, FIRE = WILDFIRE, IBM = INSECT-BASED MORTALITY, PARTIAL = PARTIAL HARVEST)

Figure 9 shows the amount of area affected by disturbance, by age class. The majority of area affected by the MPB and by harvesting is in the mature age classes, with notable amounts of old forest also affected. The disturbance in the younger forest is more obvious in the area statistics than in the volume data.

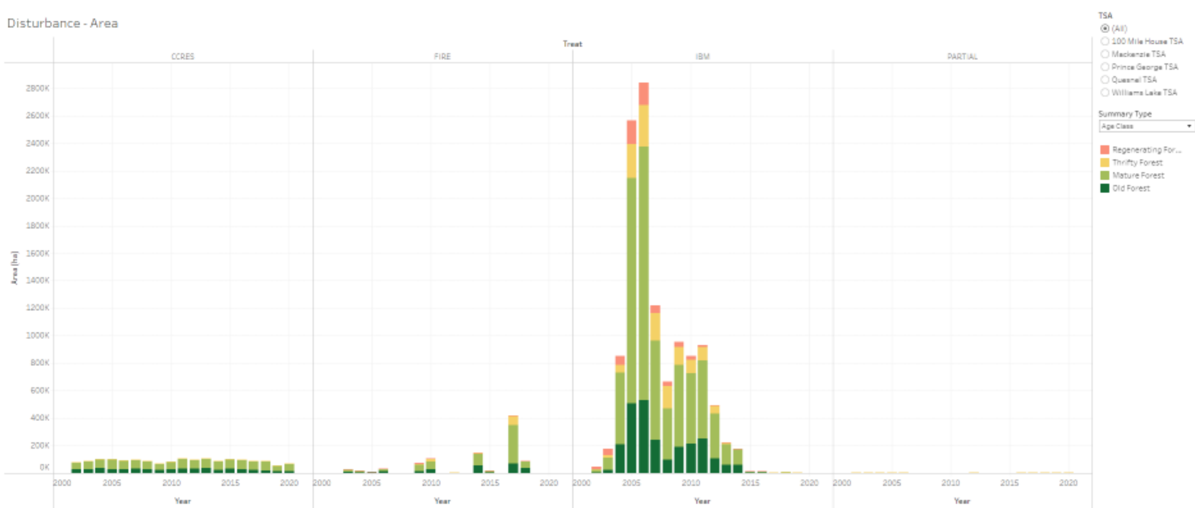

FIGURE 9. AREA AFFECTED BY DISTURBANCE (HA/YEAR) (CCRES = CLEARCUT WITH RESIDUALS, FIRE = WILDFIRE, IBM = INSECT-BASED MORTALITY, PARTIAL = PARTIAL HARVEST)

Harvesting levels are now below where they were at the peak of MPB and will continue to be at low levels for decades. Note that harvest volume includes both live and dead trees. Harvest areas have always included a component of older trees (the darker green section at foot of the bars in Figure 8 and in Figure 9), but this has been diminishing in both absolute and relative terms.

Since the MPB mortality subsided in 2013, the amount of live growing stock in the forest has been fairly steady, showing a slight decline from 1319 million m3 in 2013 to 1297 million m3 in 2020. The following figures show the overall effect on forest inventories in the five TSA's. Figure 10 shows that total growing stock (both live and dead) has declined from 2.26 trillion m3 in 2002 to 1.95 trillion m3 in 2020, a decline of just over 10%.

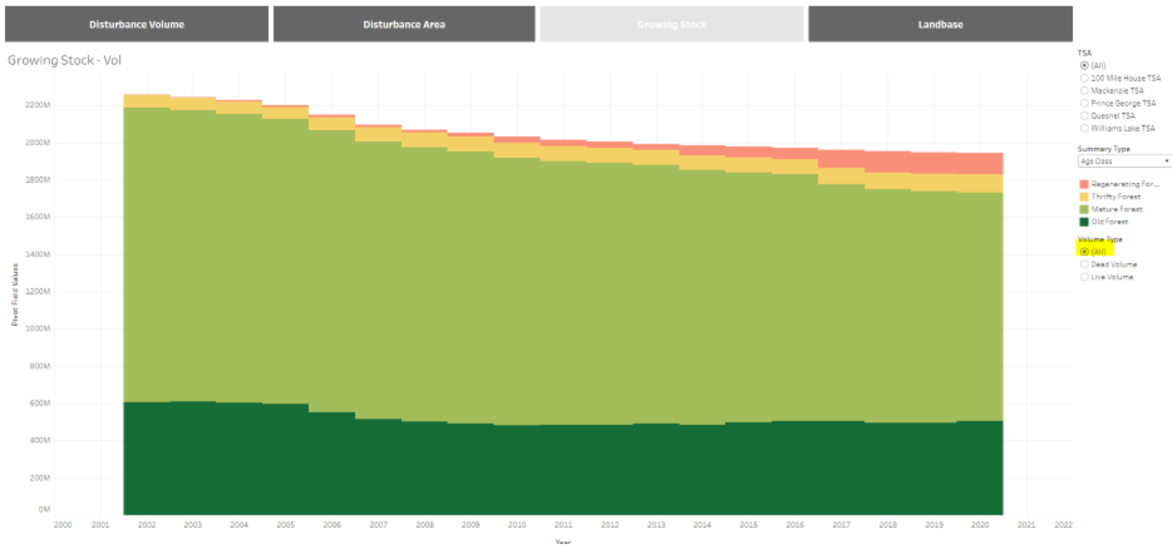

FIGURE 10. TOTAL GROWING STOCK (LIVE AND DEAD) BY AGE CLASS (2002-2020) (MILLION M3)

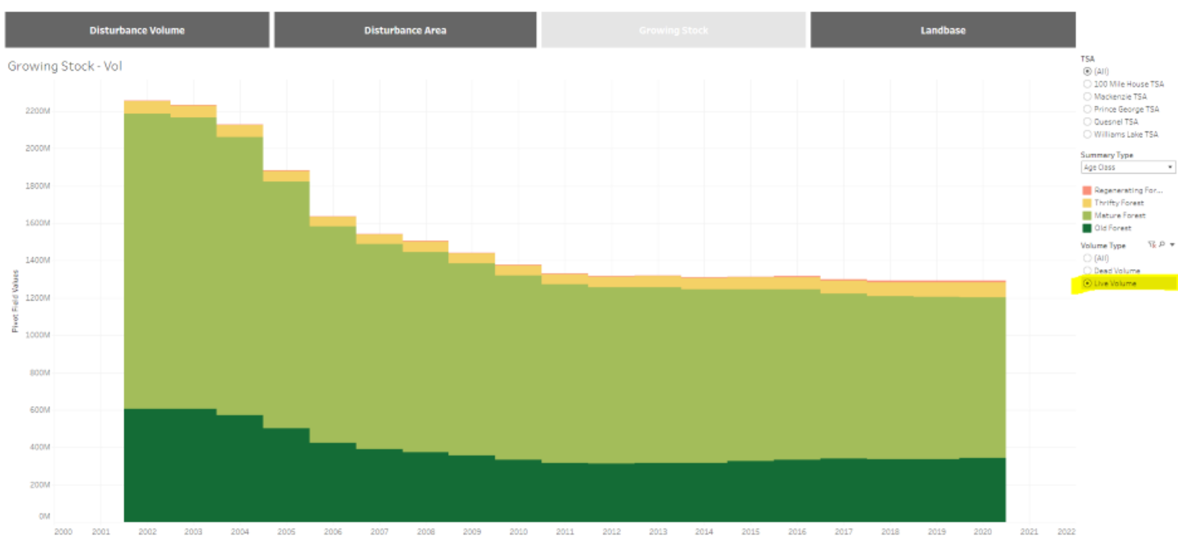

FIGURE 11. LIVE GROWING STOCK (2002-2020) BY AGE CLASS (MILLION M3)

However, the decline in the amount of live volume has been striking, as shown in Figure 11. Live volume fell from 2.26 trillion m3 in 2002 to 1.29 trillion m3 in 2020, whereas the amount of dead volume rose from zero to 651 million m3 in 2020.[21] Most of this decline took place between 2002 and 2011; since then, the decline has significantly diminished, in spite of increased fire incidence.

Within the general decline, Figure 11 shows that the 'live' 'Old Forest' class is no longer diminishing and has in fact increased since 2011. In Figure 12, the growing stock data reflects how the disturbances have focussed on lodgepole pine – its representation as part of 'live' inventory (the purple in Figure 12) is hugely diminished. The volume of spruce (brown) has also declined slightly during the analysis period, likely due bark beetle mortality, while the presence of other species has changed very little.

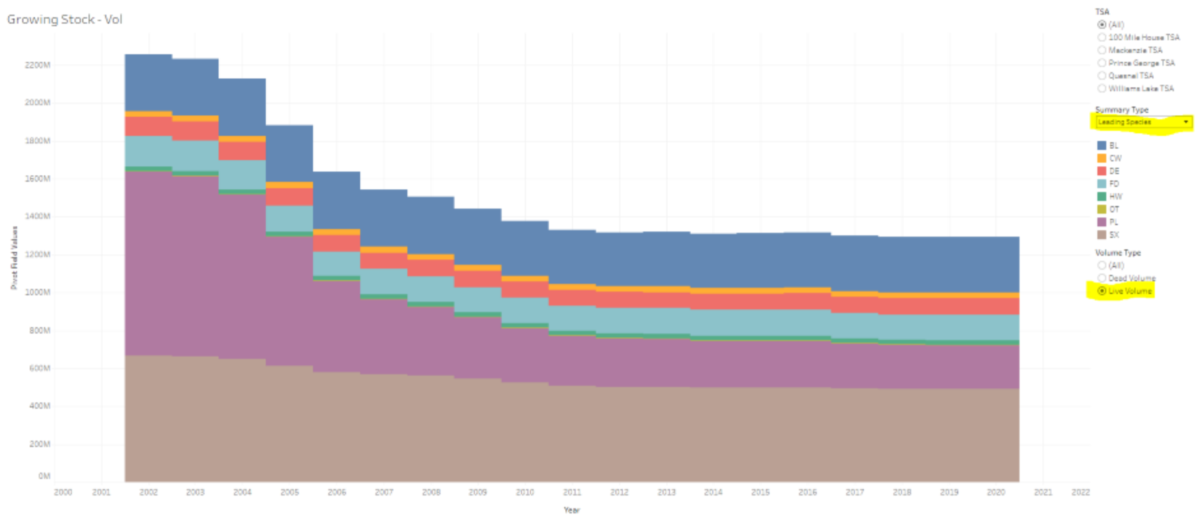

FIGURE 12. LIVE GROWING STOCK (2002-2020) BY LEADING SPECIES (MILLION M3)

Just to emphasize the impact of MPB, the following two figures compare the live:dead volume curves of lodgepole pine-leading stands, the MPB's preferred species, with that of spruce leading-stands, which are not a target species of MPB. Figure 13 shows a dramatic decline in the total volume of lodgepole pine leading stands, driven by a fall in the live volume from 973 million m3 in 2002 to 251 million m3 in 2020. Dead volume peaked in 2010 and then gradually declined due to salvage harvesting as well as losses to fire in 2017 and 2018. In contrast, there is a much smaller reduction in the live volume in spruce leading stands, as well as an increase in dead volume. Again, the majority of this mortality occurred between 2004 and 2009 – it represents mortality in the lodgepole pine component of the spruce-leading stands. Although spruce has been subject to bark beetle infestations in the catchment

[21] The 2002 forest inventory did not track dead standing timber and so a 2002 starting value of zero dead wood was used in the absence of means to make a credible estimate. However, the MPB infestation entered the catchment area from the south in the late 1990's. In 2000, aerial surveys in Quesnel conservatively estimated that MPB had killed 2 million m3 of pine and 5 million m3 more were attacked and expected to die. So, some amount of dead wood was present in 2002 and it was increasing, perhaps between 15 and 25 million m3 throughout the catchment area.

area, the live volume in the spruce leading stands has changed little between 2014 and 2020, as shown in Figure 14.

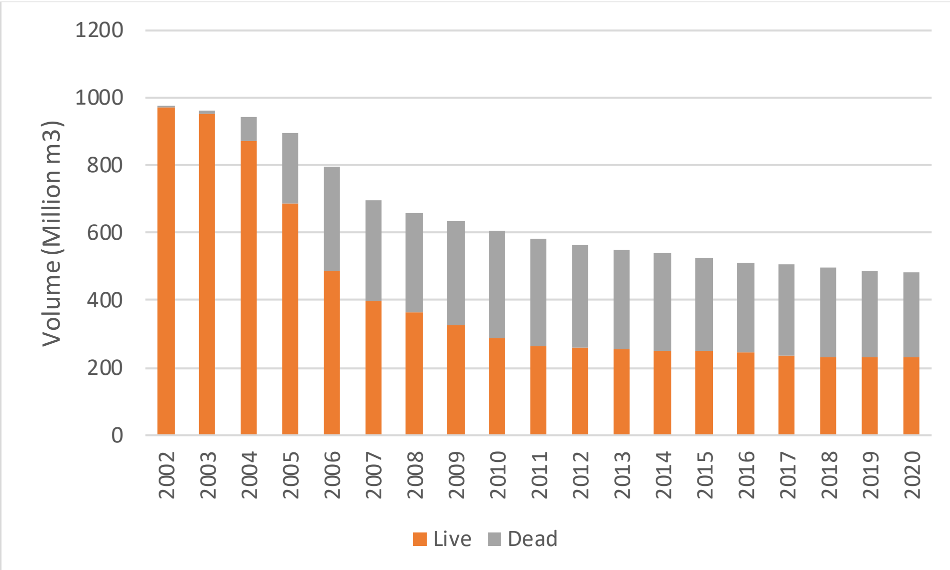

FIGURE 13. LIVE AND DEAD GROWING STOCK IN LODGEPOLE PINE LEADING STANDS: 2002 – 2020 (MILLION M3)

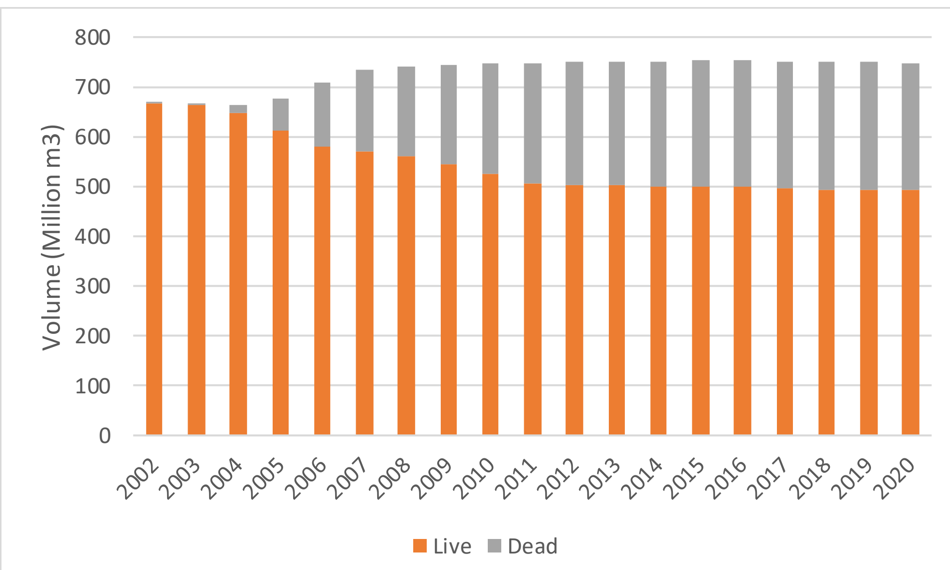

FIGURE 14. LIVE AND DEAD GROWING STOCK IN SPRUCE-LEADING STANDS: 2002 – 2020 (MILLION M3)

Figure 15 shows the losses of live volume due to harvest (70 million m^3), fire (42 million m3) and insects (4 million m^3) between 2013 and 2020 – they account for 116 million m^3 in aggregate. As the forest growing stock declined by 26 million m^3 during this same period, this indicates that the growth of the forest during this period would have been approximately 90 million m^3 in the absence of disturbance, or an average of roughly 11 million m^3/year.

As the young forest grows and reaches the ages of peak volume growth, the forest growing stock is scheduled to begin to increase again, barring further large disturbance.

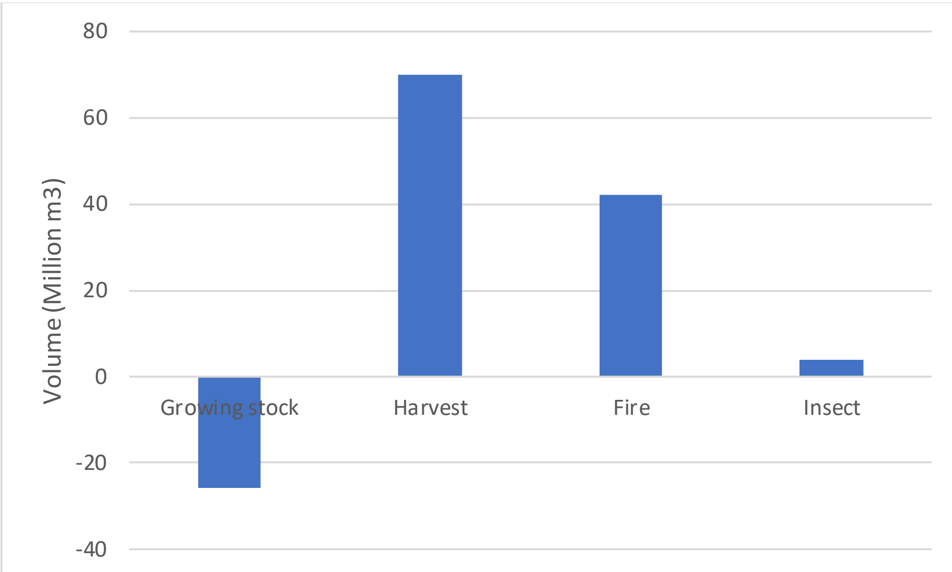

FIGURE 15. LIVE VOLUME, CHANGE IN GROWING STOCK AND TOTAL LOSSES (2013-2020).

Figure 16 shows the impact of disturbance on live and dead volume. The MPB killed live timber, and so all of the area in the bars in the IBM panel are green. Harvesting as well as fire killed some live timber but also removed a large amount of dead timber.

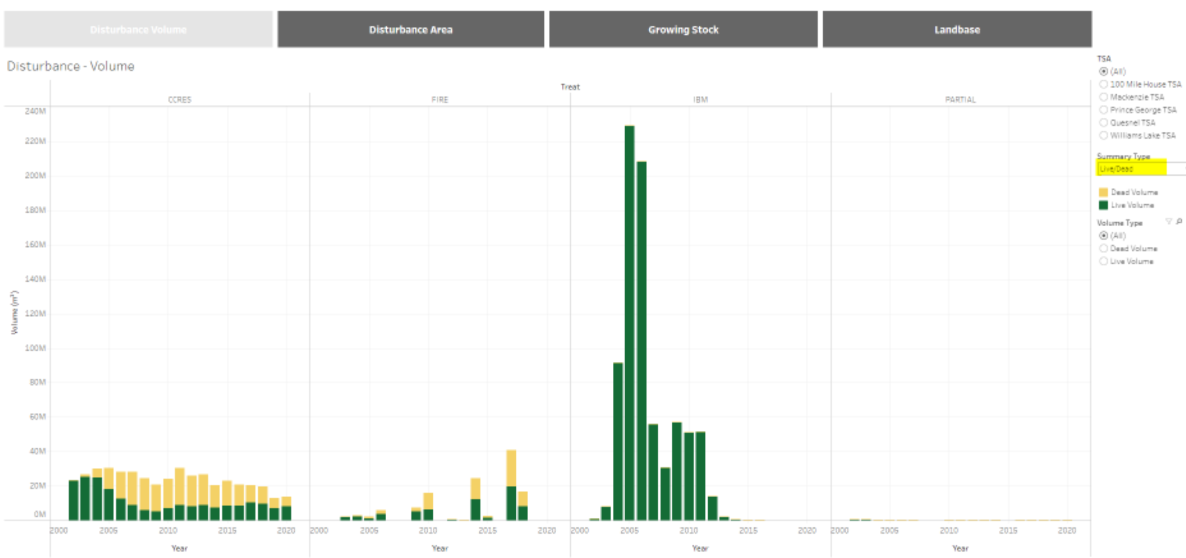

FIGURE 16. LIVE (GREEN) AND DEAD (YELLOW) VOLUME KILLED BY DISTURBANCE (M3), 2002-2020.

The large amount of salvage harvesting is indicated by the amount of dead wood cut from 2003 and 2004 onwards. The Chief Forester increased the AACs, as described above, and directed licensees to concentrate on salvage harvesting. Figure 17 shows that in many years the full AAC was harvested – the height of the bar represents the AAC and the grey zones in some of the bars indicate where the actual harvest fell short of the AAC – the grey represents the unharvested AAC amount.

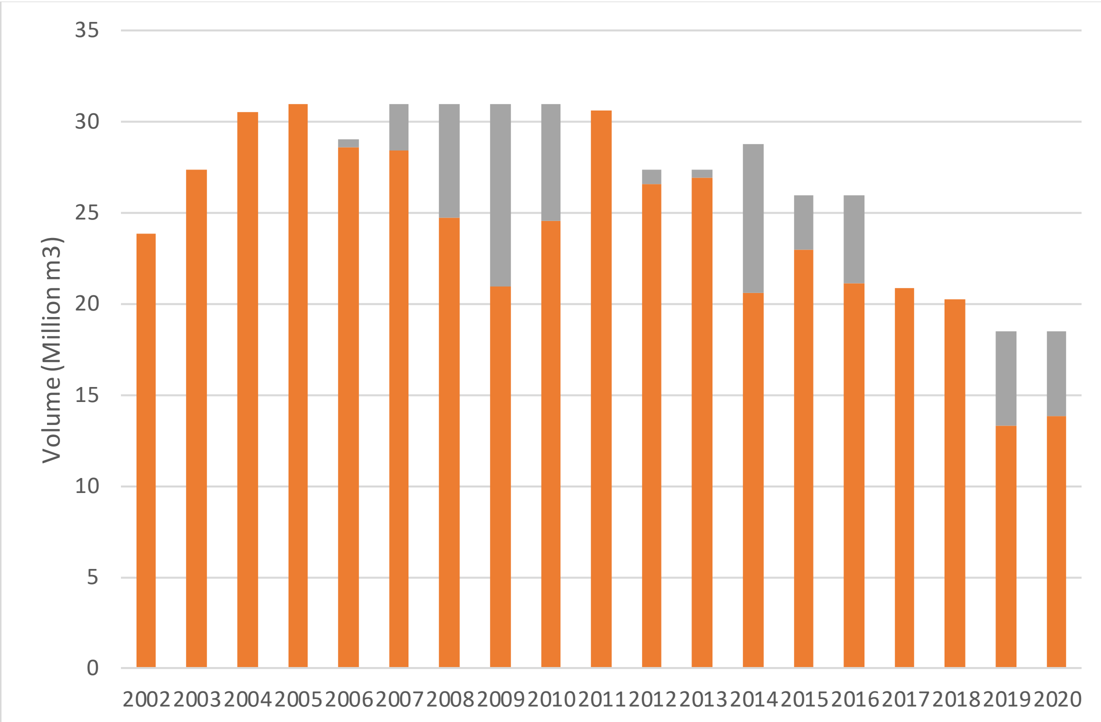

FIGURE 17. COMPARISON OF AAC VERSUS ACTUAL HARVEST VOLUME (MILLION M3/YEAR)

Companies realized that the dead timber had to be used before it deteriorated, and that once it has passed the point of merchantability the allowable harvest would decline significantly. Dealing with the impact of MPB required innovation in policy and methods for industry to deal with it. This includes different treatment of residual material in the forest, and closer relationships between sawmillers and users of residuals as sawmilling itself adjusted to using dead trees.

6 Forest Projection 2023-2042

6.1 Methodology

Because the catchment area forest has experienced so much loss of timber to insect infestation and fire during the past two decades, a projection of the development of the forest over the next twenty years was undertaken. A key question was how quickly the forest would begin to accumulate timber volume – the working hypothesis was that the growing stock in the forest would begin to increase during the 2023-2042 period as the renewing stands reached the ages of high volume growth (ages 30 and upward). Some of the young stands that are growing back after the natural disturbances were renewed naturally , whereas salvaged areas were planted. Most of the planted stock in BC is grown from improved seed so the planted stands are expected to grow more rapidly than the natural origin stands.

One assumption that was made in both scenarios is that the areas where old growth harvesting was deferred would be permanently removed from the harvesting landbase. It may turn out that harvesting may be allowed in the future in some of these deferred areas however the end point is not clear and it is all but certain that a substantial portion of the old growth deferrals will not be logged.

The projected future harvest levels were based on the future AACs determined in the Timber Supply Reviews (TSRs). From one TSR to the next, the expected future AAC does not change appreciably and so these expected AACs were considered reasonable. The actual harvest is typically less than the AAC. Based on past harvest performance, the actual harvest in the Quesnel, Williams Lake and 100 Mile House was set at 80% of the AAC. Because major mills have closed in Mackenzie, only half of the AAC was expected to be cut while in Prince George, the competition for wood as the AAC declined was expected to result in the full AAC actually being cut.

It quickly emerged that there was a great deal of uncertainty around the future level of wildfire. There is no question that climate change is leading to more days with higher fire risk and the large amount of area burned in 2017, 2018 and 2021 seems very likely to have at least been partially caused by climate change. On the other hand, the MPB epidemic created huge amounts of dead wood that would fuel wildfires and it seemed reasonable to surmise that the large amount of recent wildfire was partially attributable to the large amount of dead wood in the forest.

There is also the possibility that government will initiate a management response to the increased risk of fire, perhaps by undertaking fuel management practices, putting in fire breaks, and enlarging its fire fighting capability.

Two wildfire scenarios were developed based on historic fire information and potential fire management response in the next 20 years. In scenario 1, where it was assumed that the fuel created by the MPB was a dominant driver of the recent wildfires and that an effective fire management response would be made, the annual average area burned since 2002 would occur in 2023 followed by a sudden drop in 2024 to the historic annual average area burned since 1919 (the year when fire records started). In scenario 2, the fire management response was assumed to take a decade such that the annual average rate since 2002 would linearly decline by year 2032 to the historic annual average since 1919, and then be maintained until 2042 (end of the planning horizon). It was observed that the historic averages since fire records started aligned well with the range of natural variation using the fire disturbance intervals from the BC Biodiversity Guidebook[22]. Note that burn area objectives were pro-rated to the FMLB (area included in the analysis) using the factor between the gross area and area likely to burn (i.e., all forested area within the FMU regardless of ownership).

The forest projection analysis was undertaken using a spatial forest model (Patchworks). The projection started with the 2022 forest inventory and was guided the by assumed levels of wildfire and forest harvesting. No salvage harvest was assumed (in part due to the observation that fires have been getting more intense in recent years, in part because there was little data available to indicate how much area and volume would likely be salvaged). Patchworks analyzed the changes in the forest caused by the forecast depletion events as well as forest growth along appropriate yield curves, and generated an output data set that could be used for the forest carbon analysis.

In November 2023, BC's future wildfire regime looks much more likely to be worse than projected in this study. In 2023, BC wildfires burned roughly 2.8 million ha (the final tally of area will not be available until early 2024), more than twice the record amount burned in 2018. Most Canadian provinces experienced record fire years in 2023, so BC's experience was part of a much broader phenomenon.

Scenario 1, where the fire regime returns to historic levels in 2024 and stays there through 2042, looks wildly optimistic now. The response measures that have been most widely discussed do not seem to be able to be quickly applied over a wide enough area to meaningfully affect future fire losses. The implications of a much more active fire regime than anticipated point to a much lower future harvest, with salvaged timber making up a greater proportion of the wood supply. Accordingly, the presentation of the projection results will put more emphasis on Scenario 2, which now seems to be nearer to the future fire regime than Scenario 1.

6.2 Projection Results

One of the principal results of the forest projections is that the growing stock in the forest does begin to recover under both fire scenarios, and not surprisingly, the recovery is strongest in Scenario 1 (the Drop scenario), with the milder fire regime. However, as Figure 18 shows, the recovery only begins after 2026 as the growing stock continues to fall during the 2023-2027. Moreover, at the conclusion of the projection, the amount of growing stock in the forest has only just returned to 2016 levels.

Figure 18 also shows the amount of volume by age class. The age classes here have been amalgamated into four classes:

Regen – Regenerating forest that is 1-19 years old;

Thrifty – Juvenile forest in the ages of rapid development, between ages 20 – 69 years old;

Mature – Forest that is continuing to grow but at a declining rate – forest in this class is desirable for harvesting and is aged 70 years to old;

[22] BC Biodiversity Guidebook: https://www.for.gov.bc.ca/ftp/hfp/external/!publish/FPC%20archive/old%20web%20site%20contents/fpc/fpcguide/biodiv/biotoc.htm

Old – Forest that has generally stopped growing and may be more or less static or is developing into a multi-age stand as the canopy trees die. The threshold age is 140 for most forest types – see Annex 2 for more detail.

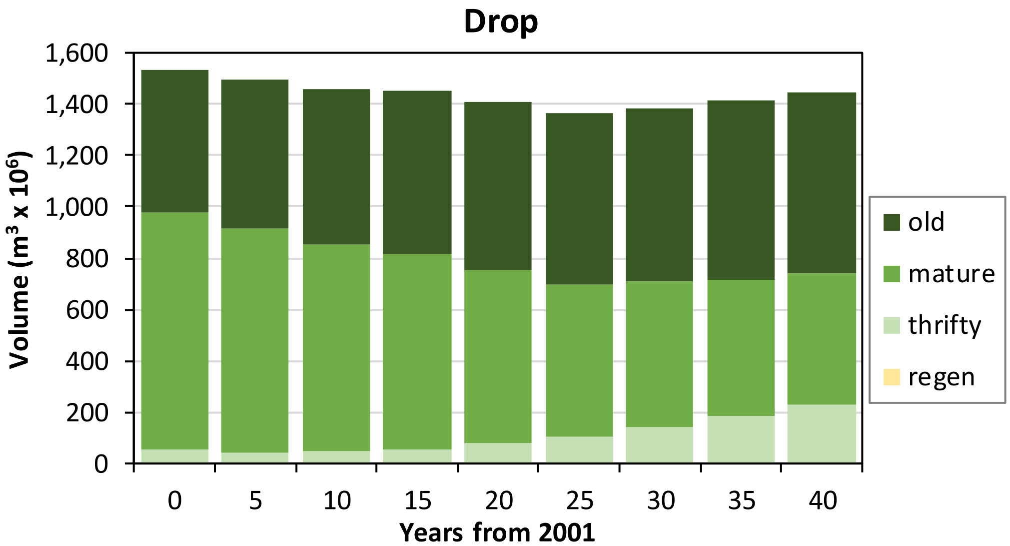

FIGURE 18. GROWING STOCK FROM 2001 TO 2042 IN SCENARIO 1 – THE "DROP" SCENARIO.

Figure 18 shows that in the "Drop" scenario, the amount of old volume increases throughout the analysis period while the amount of mature volume declines substantially, falling from 925 million m^3 in 2001 to 672 million m^3 in 2022 to 515 million m^3 in 2042. The amount of thrifty volume declined between 2001 and 2012 and then began a steady increase thereafter. The amount of volume in the regen class increased from 2001 to 2022 with the high level of disturbance, and declined thereafter as the amount of disturbance fell.

So under the "Drop" scenario, the high level of disturbance from 2001 to 2022 creates a "pulse" of young forest that would move through the age classes in the absence of higher levels of disturbance. Before long, the amount of mature volume should begin to expand as that pulse of younger forest becomes mature. At this point, the harvest volume may begin to recover somewhat.

In Scenario 2 (the "Linear Decline" scenario), the recovery in the growing stock also begins after 2027 but by 2042, growing stock volume has only reached the 2021 level (Figure 19). Even with the higher level of disturbance in this scenario, the patterns of volume by age class remain the same as in the "Drop" scenario, except that the loss of mature volume is greater in the "Linear Decline" scenario.

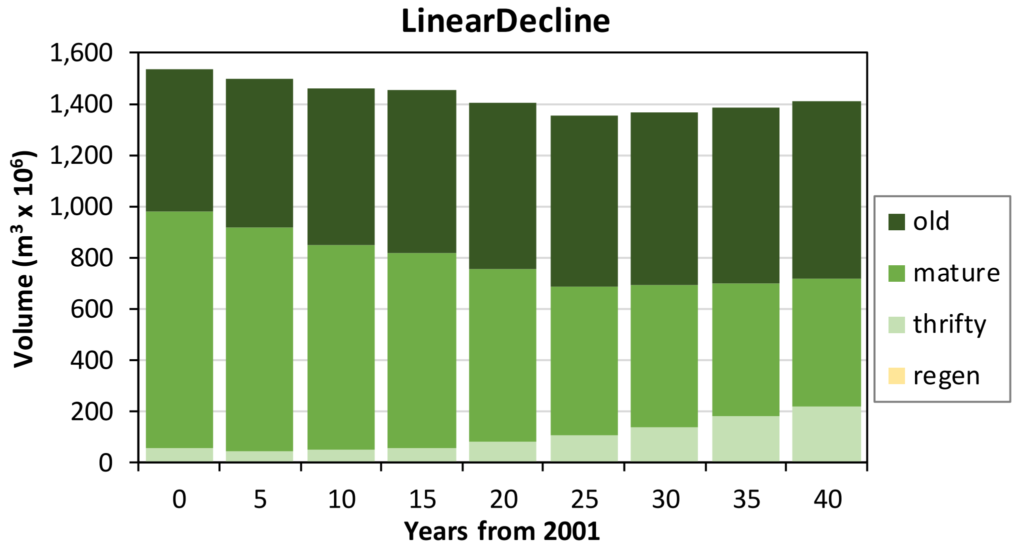

FIGURE 19. GROWING STOCK FROM 2001 TO 2042 IN SCENARIO 2 – THE "LINEAR DECLINE" SCENARIO

The harvest volume by species is shown in Figure 20 for the "Drop" scenario. The values shown are the annual harvest volume in the last year of the five-year period – the left-hand bar in the chart represents the harvest volume in 2007. The volume of dead wood harvested is also shown, and as described above, most of the timber harvested between 2008 and 2012 was dead.

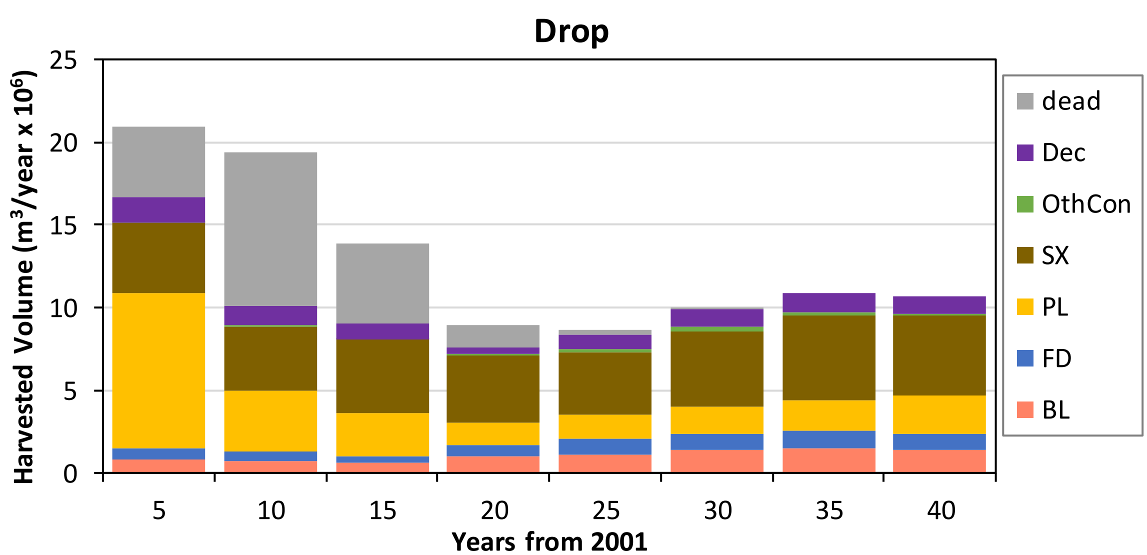

FIGURE 20. HARVEST VOLUME BY SPECIES UNDER THE "DROP" SCENARIO.

The declines in the harvest volume throughout the second decade of the analysis period represent the effects of the declines in AAC as well as the falling amount of MPB salvage available – most of the best and highest quality MPB salvage would have been harvested in the first decade of the analysis period. The harvest falls slightly from year 20 to year 25 reflecting the planned reductions in some of the AACs.

However, the model is only able to obtain roughly 80% of the target harvest in Quesnel and 59% of the harvest in Prince George in the 2023-2027 term. There is a lesser harvest shortfall in Prince George in the 2028-2032 term.

Figure 20 also shows the species composition of the timber harvest. The impact of the MPB infestation is evident from the large decline in lodgepole pine as a component of the harvest. By 2021, spruce is the main species harvested, and remains so through to 2042. Somewhat higher volumes of Fir species (BL) and Douglas-fir (DF) are harvested but they contribute only incremental volumes to the overall harvest.

Figure 21 shows the harvest volume by species in the "Linear Decline" scenario. The harvest data from 2001 to 2020 are the same in both figures – what stands out the most is that the harvest volume in the 2023-2027 period is much lower in the "Linear Decline" scenario than in the "Drop" scenario. This reflects the inability of harvesting to meet the target level in 100 Mile House (52%), Prince George (48%) and Quesnel (40%) during this period. Lesser harvest shortfalls also occurred in the three TSAs in the 2028-2032 term.

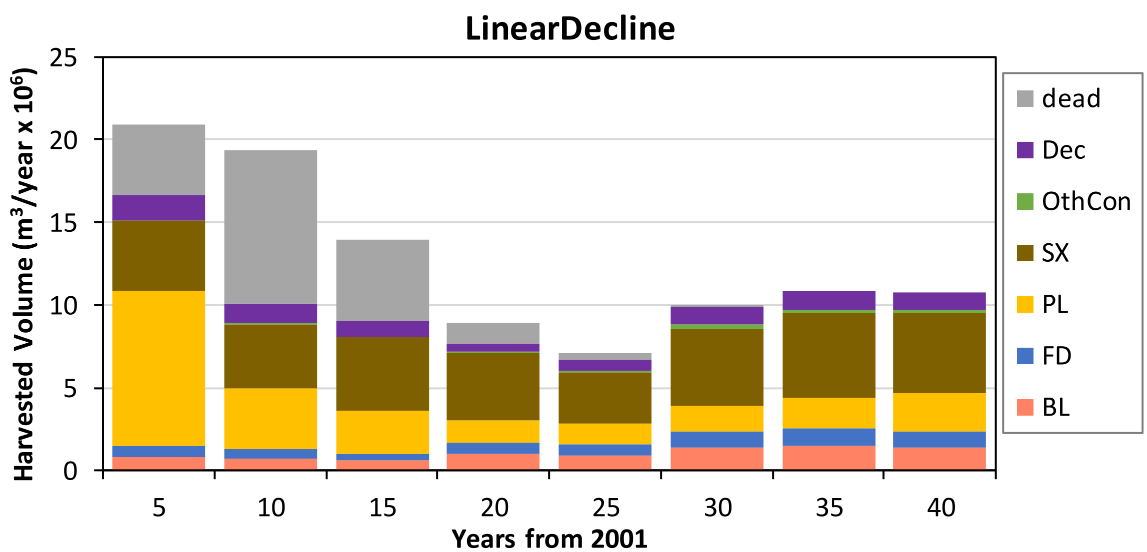

FIGURE 21. HARVEST VOLUME BY SPECIES UNDER THE "LINEAR DECLINE" SCENARIO.

The future fire regimes modelled in Scenarios 1 and 2 in this project appear to be too mild, especially if the fires in 2023 represent a threshold that has been crossed for fire in BC. Of note, the report titled "Summary of Current Forest Management" in the Quesnel TSA, published April 23, 2023 as part of the process of developing the Quesnel Forest Landscape (Quesnel is one of four pilots in BC), anticipated the frequency of wildfires to double, although the time frame was not specified.

This suggests that the future harvest from the CA will be lower than projected here, although the potential for higher levels of salvage harvesting is expected to mitigate the impact on Drax of a falling harvest.

7 Forest Carbon from 2002-2042

Drax' website states that "Tackling climate change is at the heart of our purpose and we are committed to helping the UK and the wider world to achieve its climate change targets." Drax has expressed its ambition to become carbon negative by 2030 and it is clearly of interest to examine the changes in forest carbon during the study period. The analysis was not intended to quantify how Drax affected the carbon balance in the catchment area however the analysis that was performed allows some broader conclusions to be drawn.

The focus of this CAA is on the forest within the catchment area and the carbon analysis included a retrospective analysis and a pair of scenarios over the 2023-2042 period. The retrospective analysis examined the changes in carbon within the forest between 2001 and 2022, as influenced by removals and growth. The two future scenarios are plausible alternatives based on what we feel are reasonable assumptions as to how the forest, the industry and the policy environment might evolve and what the future fire regime might be like.

The carbon analyses were done using the Carbon Budget Model (version CBM-CFS3), which has been developed by Natural Resources Canada (NRCan). NRCan began developing the original Carbon Budget Model more than 20 years ago and has worked continuously to improve it. The CBM can be applied to stand-level, regional- and national-scale analyses that meets Tier-3 standards for international reporting (Shaw et al, 2014). The model is used for national-scale carbon accounting and reporting in the managed forest area of Canada (Stinson et al., 2011) by Canada's National Forest Carbon Monitoring, Accounting and Reporting system (Kurz and Apps, 2006) and contributes to the national Greenhouse Gas inventory report submitted annually under the requirements of the United Nations Framework Convention on Climate Change (UNFCCC). The model is used globally by numerous countries and organizations and is well-supported.

CBM functions by taking forest inventory data, growth and yield curves, and past or planned harvesting and other disturbance data to project the forest through time, modelling the carbon flows during the simulation. The yield curves used in the analysis were specific to each FMU. The model relies on parameters that define rates of flux of carbon between pools, emissions into the atmosphere and sequestration, as well as how post-disturbance transitions. CBM has been parameterized for all of Canada's forest regions however the default parameters can be adjusted by the user if more locally appropriate data are available. Section 7.4 of Annex 3 describes in more detail how CBM operates and the data used to calibrate the model for this analysis.

Shaw et al. (2014) published the results of a comparison between CBM estimates and sample plot data collected through Canada's National Forest Inventory. The results showed that the model estimates of aboveground biomass and deadwood were generally accurate whereas the model's estimates of soil carbon had the greatest standard error associated with them. This is not surprising since soil carbon is difficult to measure in the field and not all of the pertinent soil characteristics are captured in the input data used by CBM (e.g. forest inventories).

The retrospective analysis was undertaken by putting the actual harvest, fire and MPB depletions through a forest model (Patchworks), using the 2002 inventory as the starting point. Patchworks analyzed the changes in the forest caused by the actual depletion events between 2002 and 2022, and generated an output data set that could be accepted by CBM for the carbon analysis.

The CBM input file for the 2023-2042 carbon analysis was the output file produced from the forest projections made with Patchworks for each TSA, as well as the initial inventory, growth curves and transition matrices. Forest projection and carbon analyses were run for each of the two fire regime scenarios that were modelled during the 2023-2042 term.

In this analysis, total forest carbon equals the sum of the carbon in the live aboveground biomass, live belowground biomass, dead above ground biomass, forest litter and the forest soil. The live above ground biomass consists of the living biomass in the trees, shrubs and forbs, and the live belowground biomass is the biomass in the live root systems. The dead aboveground biomass includes both standing and fallen deadwood that has not decayed /broken down to the point where it has become part of the litter layer. The litter layer includes dead leaves and biomass that are decaying and turning into soil, the soil pool includes the organic and inorganic carbon in the soil, including dead roots.

Carbon is continually moving between pools. For example, as live branches and trees die, they move into the deadwood pool and, if they are not harvested or burned, they will decay and eventually move into the litter and soil pools. Carbon enters the forest ecosystem through the growth of the live vegetation, and leaves either by being physically removed (e.g. as harvested timber) or being emitted into the atmosphere (through burning as well as decay processes). All of these carbon fluxes are modelled in CBM when the relevant disturbance information is provided.

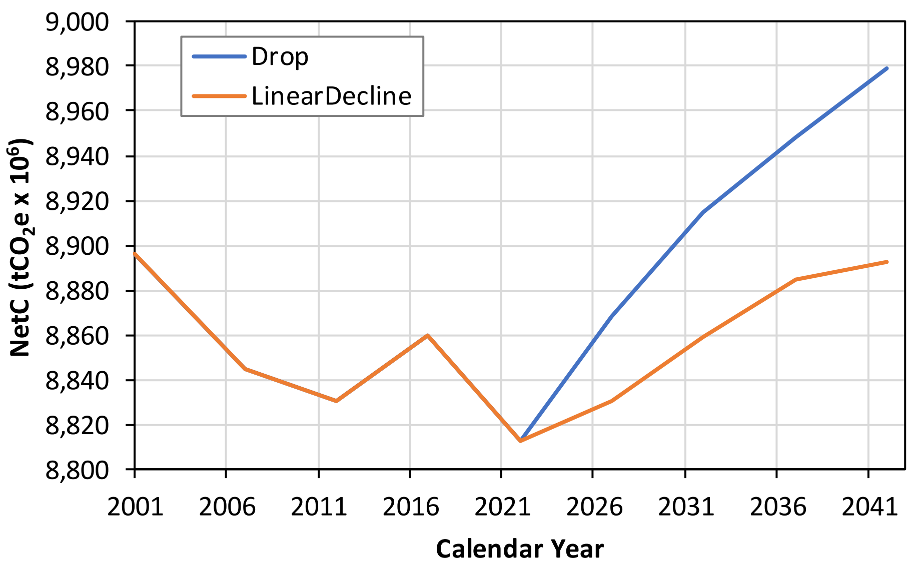

FIGURE 22. CHANGE IN NET FOREST CARBON (2001-2041).

Figure 22 shows the changes in the net forest carbon over the analysis period, with the two future scenarios shown separately. The decline that occurs between 2001 and 2021 is not nearly as severe, proportionally, as the loss of live growing stock during this period (See Figure 12). The loss of carbon (and growing stock) occurs due to mortality caused by MPB and the accelerated level of salvage harvesting. The impact of the severe fires in 2017, 2018 and 2021 is evident in the renewed drop between 2017 and 2022. But the trees that were killed by the MPB did not suddenly emit their carbon – instead there was a loss of growth (i.e. a reduction in the future increase in live biomass) and the standing live biomass became standing dead biomass. The immediate impact on forest carbon was slight. Fires that were severe enough to consume a substantial amount of timber would cause carbon emissions, however where the fire only killed trees rather than consuming them, the loss of carbon was less than one might think. This indicates where one of the significant modelling assumptions lies – the inventory contains estimates of fire severity but the extent that the biomass on a given hectare was consumed and its carbon emitted is only based on a visual assessment of imagery.

Figure 22 shows that in the future scenario where the fire regime returns to historic levels in 2023 (the Drop scenario), the amount of carbon in the forest is rebuilt between 2023 and 2042 (note the very severe fires of 2023 have not been incorporated into the analysis). By 2042, the amount of forest carbon is 8.98 billion tonnes CO_2e, which is slightly more than the 8.90 billion tonnes CO_2e present in 2001. The rebuilding occurs because harvest levels decline with falling AACs (and permanent mill closures) and fire levels decline. In addition, the renewal is entering its age of fastest growth on the large areas of forest killed by MPB and harvested during the 2010's.

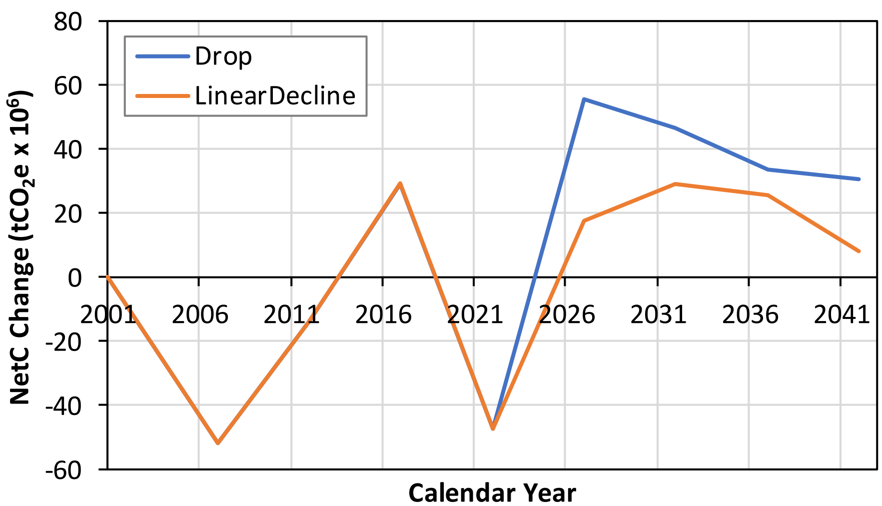

FIGURE 23. ANNUAL NET CHANGE IN FOREST CARBON STOCKS.

In contrast, in the scenario where the fire regime gradually reverts to its historic norms (Linear Decline), the forest carbon only recovers to 2001 levels by 2043. (We note that test scenarios with more extreme future fire regimes, such as the average area burned between 2001 and 2022, were not able to meet the ecological management goals and or the estimated timber harvest levels.) Figure 23 shows the net change in the amount of forest carbon by five-year period for both scenarios.

Figure 24 shows, for the scenario of an immediate drop in fire to historic levels, the amount of carbon in each of the main forest carbon pools over time. The dashed line in Figure 24 shows the Net C from one period to the next - it is essentially equal to the height of the bar, less the emissions from landfills.

Under this scenario, the above ground live biomass pool (AGB) experiences a substantial decline between 2001 and 2022, losing 137.4 million tonnes C (5.6% of the 2001 amount). Belowground biomass (BGB) decreases by a similar proportion, and the deadwood pool (Dead) declines by 6.9%. The decline in deadwood may seem surprising at first glance since the MPB caused high levels of mortality. It can partially be explained by the high levels of harvest which focussed on salvaging deadwood and the impacts of fire. It may also be that the estimates of deadwood in the inventory were not entirely accurate. In contrast, the litter and soil pools both show small increases.

The two live biomass pools continue to decline in the 2023-2027 period before beginning to increase through to the end of the simulation term. In contrast, the deadwood pool continues to decline throughout the 2023-42 term while the litter and soil pools increase throughout the 2023-42 period.

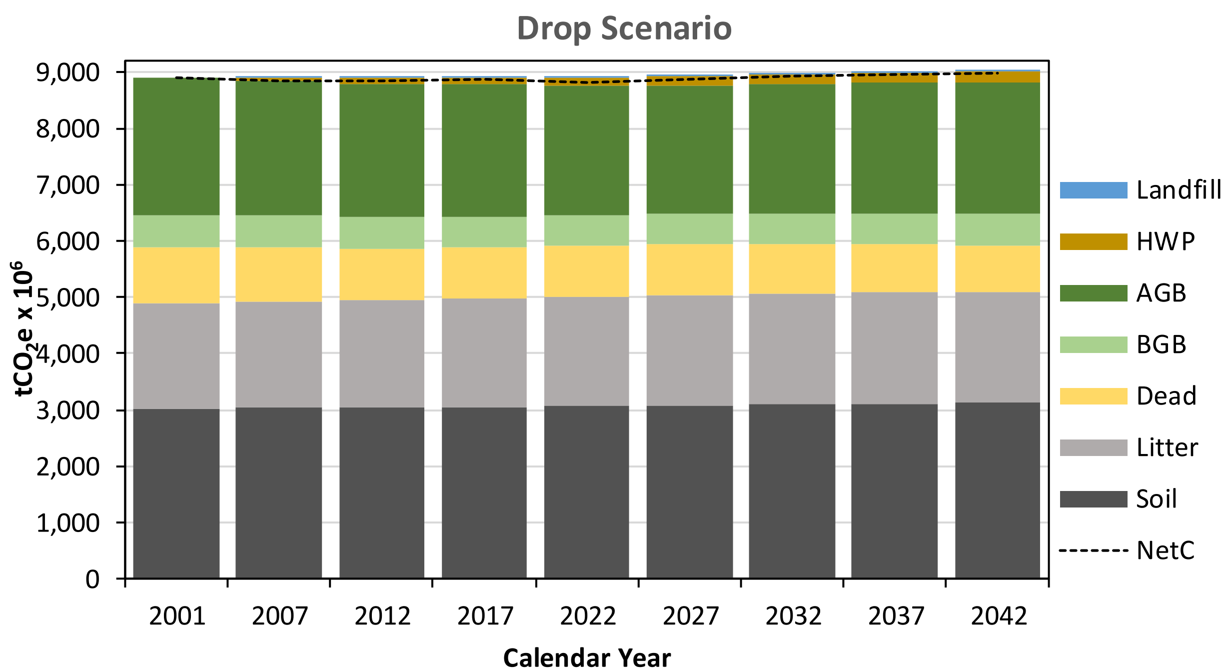

FIGURE 24. DISTRIBUTION OF CARBON IN THE IMMEDIATE DROP SCENARIO

The HWP pool was set at zero in 2001 and increased throughout the analysis period, as the production of HWP more than offset the emissions that arose through the disposal of HWP. By 2043, the carbon stored in HWP is equivalent to 2.2% of the Net C. The emissions from landfills are much lower, ranging from 4 to 9 million tCO_2e per five-year period. In sum, HWP less landfill emissions only provide a minor contribution to the Net C.

During the entire Drop simulation period, the aboveground and belowground biomass pools lost 3.8 and 3.6%, respectively, whereas the deadwood pool experiences a decline of 16.4%. In contrast, the litter and soil pools increase throughout the scenario, ending up with increases of 5.6 and 3.3%, respectively.

Figure 25 is the “Linear Decline” analogue to Figure 24. The values are identical in both scenarios for the first four terms and thereafter the effect of the higher level of fire in the “Linear Decline” scenario becomes apparent. With negligible increases in live biomass between 2023 and 2042, the aboveground and belowground live biomass pools decline by 6.1 and 6.0% during the 2001-2042 period.

The deadwood again experiences the greatest decline, however the extent of the reduction is not as large, at 13.7%. This can be attributed to the greater level of fire activity in this scenario, and the assumption that the fires consume all of the aboveground biomass. With less deadwood in the latter part of the analysis period, the increases in the litter and soil pools are 4.1 and 3.2% respectively.

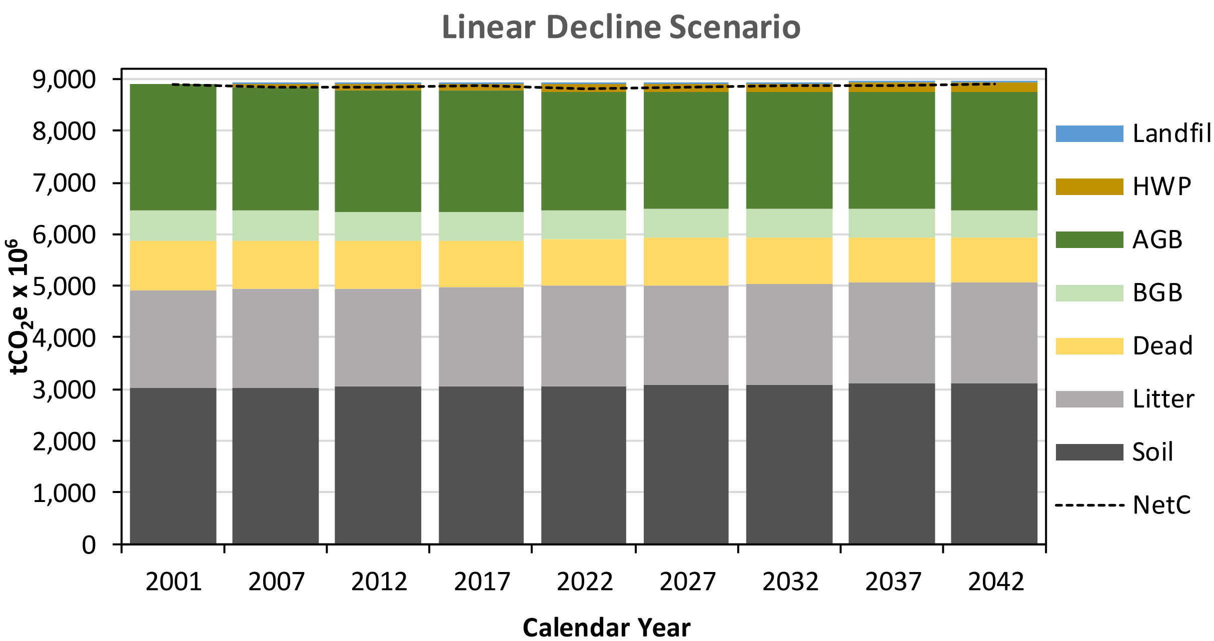

FIGURE 25. DISTRIBUTION OF CARBON IN THE GRADUAL DROP SCENARIO

The CBM allows the modelled clearcut harvest to be followed by slash pile burning, and this option was selected since this was the default practice during the 2001-2022 period, and remains so going forward. CBM assumes that the slash piles are fully burned, which is often but not always the case. Slash piles may not be burned when fire risk is high or when they are near communities that could be exposed to the smoke from the burning piles. While waste surveys are done and the locations of slash are mapped, post slash pile burning assessments are not done in a rigourous manner; hence the default assumption of complete consumption has been used.

The use of logging slash and otherwise unmerchantable logs is not captured well by either Patchworks or CBM, and so the use of this material by Drax is not reflected in the modelling. To accurately capture the impact of Drax' use of unmerchantable material from the forest, the location of each truckload of such material would need to be mapped and the amount of material removed subtracted from the estimated residual left at the landing.

The assumption that wildfire between 2023 and 2042 consumed the above ground biomass was based on observations that fire intensity has been increasing since the 1980's in western North America. There is little reliable data available that can be used to credibly predict the intensity of future fires, and by extension, the amount of timber within the perimeter of a wildfire that can be salvaged. These assumptions combine to reduce the amount of carbon estimated by CBM to be in the deadwood pool, and to be removed from the forest as harvested wood products.

The net impact of timber harvesting and natural disturbance on the forest carbon balance captures the net carbon impact associated with forest dynamics and depletions. The assumption regarding harvested timber is that 97% of the merchantable timber that is cut is removed from the forest and the amount of carbon in the logs that are taken to mill is quantified. However, emissions associated with the logging, processing and transporting to mill are not tracked in CBM, nor as mentioned above, is Drax' removal of slash and otherwise unmerchantable logs.

Finally, to extend the analysis, the consulting team did some post analysis of the harvested wood products. In general, long-lived forest products such as lumber and structural board products can remain in use for a long period of time, storing the carbon within them for an extended period. In contrast, short-lived products are generally paper and cardboard, much of which gets used within a few years of production. Both long-lived and short-lived products are generally assumed to be landfilled once their period of use is over, where they gradually decay anaerobically (although a substantial percentage of paper and cardboard gets recycled). There has been a considerable amount of investigation regarding the length of time various products remain in use (modelled as a decay curve) and the fate of forest products in landfills. Note that landfills are capturing an increasing amount of the methane produced by anaerobic decay, and burning it so it does not enter the atmosphere and may replace the use of fossil fuels. International data are also needed as BC exports a substantial portion of its forest products output and there are different patterns of use and disposal in the importing countries.

All of this is to say that there are many variables associated with modelling the fate of forest products. In this analysis, forest products sales data between 2017 and 2021 (BC Ministry of Forests undated) was used to estimate that 23% of the wood products produced in BC were used domestically and 77% were exported. Of the total amount of timber harvested, 10% was estimated to be used to produce bioenergy. The bioenergy fraction includes not only wood pellet production but also the fibre used by mills to produce bioenergy. Sawmills use wood waste to generate heat, especially for drying kilns, and pulp mills use residues for generating steam and heat that is used in the pulping and drying processes. There are also 2-3 stand-alone energy production facilities that burn wood to generate power. The many other producers of bioenergy in the catchment area mean that Drax does not account for a particularly high proportion of the bioenergy generated in the CA; the absence of data on the total amount of wood fibre used to produce bioenergy limited the ability of this study to identify what proportion of the total bioenergy generation is produced by Drax.

The C storage and the GHG emissions in the forest products life cycle were estimated using the VM0034 Canadian Forest Carbon Offset Methodology, v2.0 (April 2020), developed under the voluntary Verified Carbon Standard[23]. The VM0034 methodology was developed by the BC Ministry of Environment for forest carbon projects and provides detailed assumptions regarding the decay rates of C stored in HWP and related GHG emissions for products consumed domestically and for exports. The methodology also

[23] https://verra.org/methodology/vm0034-canadian-forest-carbon-offset-methodology-v2-0-2

provides data on emissions associated with the equipment used for harvesting activities, log transport, and manufacturing.

Figure 24 and Figure 25 both show the amount of carbon stored in long-lived Harvested Wood Products (HWP) produced from the CA, as well as emissions from the forest due to wildfire and slash pile burning, and emissions from the HWP that are sent to landfill. Net C represents the total amount of forest carbon plus the amount of carbon stored in HWP less emissions from HWP in landfills.

8 Market Profile

8.1 Overview

The forest industry is a primary driver of the economy in the catchment area. The foundation of the industry is the production of solid wood products, i.e., dimension lumber manufactured in sawmills. Most of the timber harvested from the catchment area is processed by local mills and most of the finished products are exported. The US represents the largest market for BC forest products; about two-thirds of the lumber produced in BC is exported to the US.

Approximately 55-60% of the volume of wood processed in sawmills is recovered as lumber, 35% as chips, and the remainder as sawdust, shavings, and hogfuel. An abundant supply of sawdust and shavings from sawmills, as well as chips and trim blocks, are the main supply of fibre for the two Drax pellet plants and made up a large component of PacBio's fibre supply. More recently, "hogfuel" from sawmills (miscellaneous waste fibre, mostly tree bark) is being used by pellet plants and biomass powered generators.

At the junction of two major Interior highways and with large rail facilities, Prince George is a natural location for the regional industry hub. The city has the province's largest concentration of mills, including three large sawmills and three pulp mills, as well as many support industries. There are also a number of large sawmills in the smaller communities surrounding Prince George, such as Vanderhoof. Highway 97, the main north-south artery through the catchment area, connects 100 Mile House, Williams Lake and Quesnel in the south with Prince George, and links Prince George with Mackenzie in the north. This facilitates regional flows of wood and wood products, helping to integrate the industry in this region.

As mentioned previously, 100 Mile House, Williams Lake and Quesnel also have significant industry presence. 100 Mile House has a large sawmill, Williams Lake has three large sawmills, veneer and plywood mills, and one of the Drax plants, while Quesnel has two large sawmills, three panel mills and two pulp mills. Prince George and the part of the catchment area to the south also has numerous secondary manufacturing facilities and specialty mills (e.g., telephone poles and cedar mills). This makes for a very competitive wood fibre market in this part of the catchment area.

The catchment area is highly dependent on the forest sector. British Columbia's 2010 State of the Forest report (BC Ministry Forests, Mines and Lands 2010) identifies the majority of the catchment area as "Most Vulnerable" to a forest sector downturn; most vulnerable areas had a high proportion of local income derived from the forest sector while the local economies were not very diverse. Since 2010, Prince George has become more diversified as the key economic centre in the northern Interior, with expanding education, health and service sectors. However communities such as Quesnel and Williams Lake remain very dependent on forestry.

The impact of the MPB in the BC Interior has been profound, since the majority of the mature lodgepole pine has been killed. AACs were increased by as much as 100% in the Interior, and the catchment area, to encourage the salvage of dead and dying lodgepole pine. Extensive fires during 2017, 2018, 2021 and now 2023, supported by a combination of abundant dead wood killed by the MPB and climate change, have further reduced the amount of live forest. As the salvage of the MPB killed wood came to an end during the 2019-2021 period, the Chief Forester has begun to dramatically reduce AAC's throughout the Interior, including in the catchment area. As a result, since 2019 the catchment area has seen the permanent closure of large sawmills in Quesnel, Isle Pierre (near Prince George), and Mackenzie, an OSB mill in 100 Mile House, as well as numerous closures of mills outside the catchment area . Some closures were forestalled by the unprecedented boom in lumber and board prices, stimulated in 2020 and 2021 by effects from the pandemic. However by the fall of 2022, lumber and board prices had dropped significantly and they have continued to decline and stay low to the present (November 2023), leading many sawmills to curtail production.

Now, with less timber being cut and fewer sawmill residuals to go around, available residuals have become more expensive. In a market with three pulp mills competing for the relatively low-end pulpwood, PacBio closed in 2022 as it found itself unable to afford prices that the pulpmills were willing to pay. In April 2023, the pulp line at Canfor Prince George Pulp and Paper mill ceased production however the paper mill continues to operate.

Within the catchment area, Mackenzie has experienced the most significant reduction in its forest industry. Triggered by the 2019 closure of one of the community sawmills, the pulp mill, the other local sawmill, owned by Conifex, and a finger-joint mill all closed temporarily. The pulp mill re-opened but closed again in 2020 and was permanently shut down in 2021. The Conifex mill has had operations curtailed at different times in 2020 and 2021, but continues to operate for now, and the finger-joint mill has also maintained operations.

Error! Reference source not found. shows the location of the main forest products mills in the catchment area. Chip mills, which are usually co-located with pulp mills and pellet facilities, small sawmills with a capacity of less than 94,390 m^3/yr[24] and other small specialty mills, are not shown. There is a string of large sawmills along Highway 97 from Prince George south to 100 Mile House; they are indicated by a single symbol regardless of whether there is one or more mills of the same type in a community (e.g., Quesnel and Prince George). Similarly, the pulp mill symbol on Prince George represents the three pulp and paper mills in that city. Table 8 lists the mills by type, company, location and capacity. The capacity data was obtained from FLNRORD 2020.[25]

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[24] Equivalent to 40 million fbm.

[25] FLNRORD. 2020. Major Primary Timber Processing Facilities in British Columbia 2018. Forest Policy and Indigenous Relations Division, FLNRORD, BC. April 2020.

Company	Location	Capacity
Sawmills		
Sinclair Group (Apollo Forest Products Ltd.)	Fort St James	125 Million fbm3
C & C Wood Products Ltd.	Quesnel	43
Canadian Forest Products Ltd.	Bear Lake	263
Canadian Forest Products Ltd.	Prince George	344
Canadian Forest Products Ltd.	Isle Pierre	200 (Closed in 2020)
Canadian Forest Products Ltd.	Vanderhoof (Engen)	450
Canadian Forest Products Ltd.	Mackenzie	293 (Closed in 2019)
Carrier Lumber Ltd.	Prince George	294
Conifex	Fort St. James	263
Conifex	Mackenzie	216
Dunkley Lumber	Strathnaver	528
Sinclair Group (Lakeland Mills Ltd)	Prince George	230
Sinclair Group (Nechako Lumber Co)	Vanderhoof	240
Tolko Industries Ltd.	Williams Lake	140
Tolko Industries Ltd.	Quesnel	119 (Closed in 2019)
Tolko Industries Ltd.	Williams Lake	170
West Fraser Mills Ltd.	Williams Lake	145
West Fraser Mills Ltd.	100 Mile House	230
West Fraser Mills Ltd.	Lejac	262
West Fraser Mills Ltd.	Clinton	214
West Fraser Mills Ltd.	Quesnel	420
Veneer & Plywood etc		
West Fraser Mills Ltd. (Veneer)	Williams Lake	137
West Fraser Mills Ltd. (Veneer)	Quesnel	113
West Fraser Mills Ltd. (Panel)	Quesnel	207
West Fraser Mills Ltd. (Plywood)	Williams Lake	219
West Fraser Mills Ltd. (Plywood)	Quesnel	235
Norbord (OSB)	100 Mile House	440 (Closed in 2020)
Pulp Mills		
Canadian Forest Products (Intercontinental Pulp)	Prince George	324 Mt
Canadian Forest Products (PG Pulp and Paper)	Prince George	316
Canadian Forest Products (Northwood)	Prince George	524
West Fraser (Quesnel)	Quesnel	344
West Fraser and Mercer (Cariboo Pulp and Paper)	Quesnel	349

Pellet Mills		
Drax Group	Williams Lake	300 M ODTs
Drax Group	Meadowbank	240
Pacific Bioenergy	Prince George	500 (Closed in 2022)

TABLE 8. MAJOR FOREST PRODUCTS MILLS IN THE CATCHMENT AREA.

8.2 Employment

Provincial forest employment data show a significant downward trend. Provincial employment in Forestry and Logging, including support activities, declined from 26,900 in 2003 to 17,700 positions in 2022 (BC Statistics 2023). The period saw considerable variation – a low of 13,300 jobs occurred in 2009 in the depth of the Great Recession, which was followed by a partial rebound to 21,500 in 2015. From there, there has been a steady decline to the current level of employment.

Employment in the mills (Wood Product Manufacturing) experienced a more pronounced decline. From 51,400 positions in 2003 to a low of 30,300 in 2009, there was a very muted increase to 35,300 positions in 2015. Since then, the amount of employment has dwindled to 23,400 in 2022, reflecting closures and increasing automation. Current Wood Product Manufacturing employment data includes 44 employees at Meadowbank and 31 at the Williams Lake facility. The annual data are shown in Figure 26.

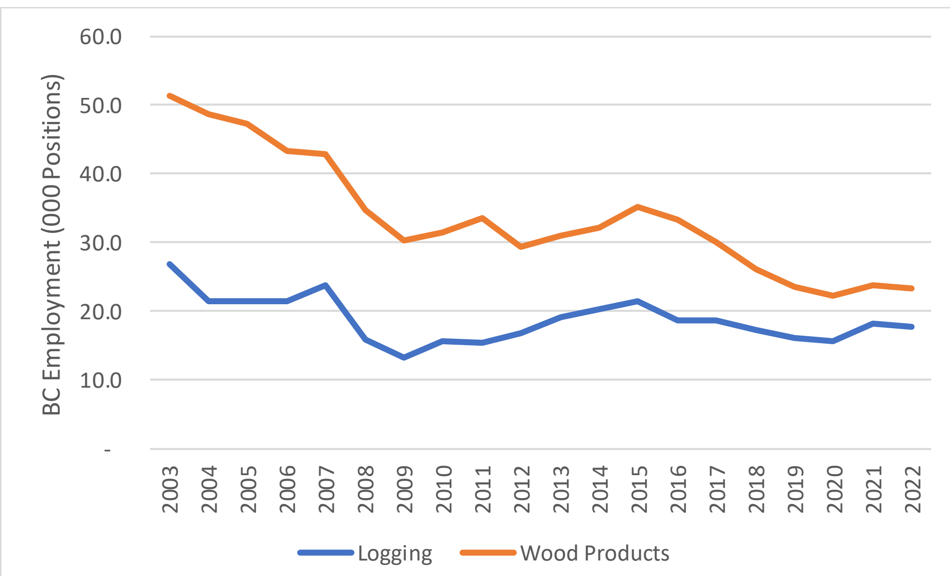

FIGURE 26. BC EMPLOYMENT IN FORESTRY AND LOGGING AND WOOD PRODUCTS MANUFACTURING (2003-2022).

The decline in employment is all the more striking when compared with broader provincial statistics. In 2003, wood product manufacturing represented 25% of provincial manufacturing employment; in 2022, it accounted for just 12.7% of manufacturing employment in BC. During the same 20-year time period, the share of provincial employment in logging and wood product manufacturing fell from 3.9 to 1.5%.

While these broad provincial trends are reflected in regional data for the catchment area, employment in logging in the southern part of the catchment area (the Cariboo[26]) fared better than the province did. Between 2011 and 2021 (the time period for which regional data are available), employment rose from 3,000 to 3,700 positions. While the increase partially reflected recovery from the Great Recession, logging employment has been quite steady between 2017 and 2021, fluctuating between 2,700 and 3,900 positions. Regional employment in wood product manufacturing also remained strong until 2018, averaging 5,300 positions, before taking a step down to average 4.1 between 2019 and 2021.

Figure 27 shows that wood products manufacturing declined from 64% of regional manufacturing in 2011 to 44% in 2021, however the proportion of overall regional employment in the logging and wood product manufacturing sectors slipped only slightly during this period, from 10.5 to 9.2%.

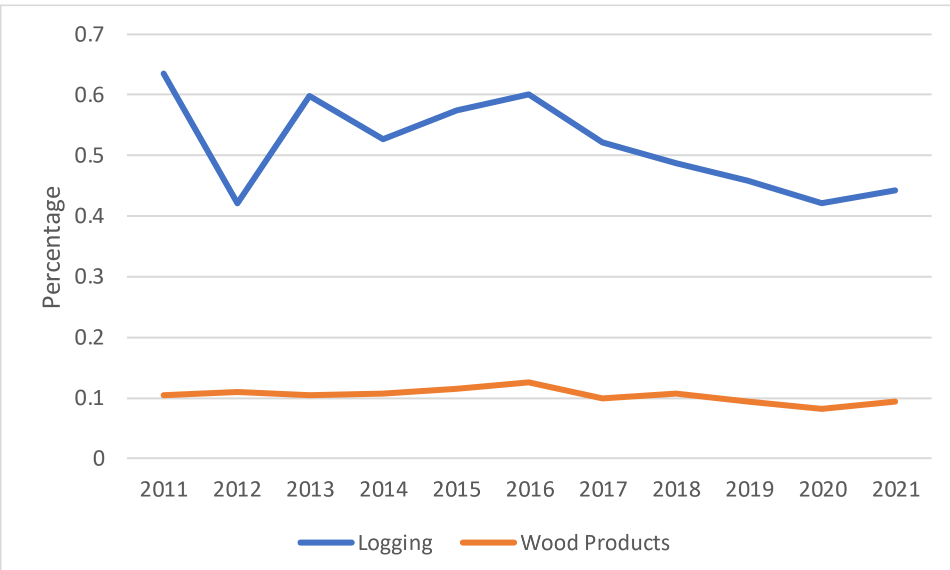

FIGURE 27. PROPORTIONAL EMPLOYMENT IN FORESTRY AND LOGGING AND WOOD PRODUCTS MANUFACTURING IN THE CARIBOO REGION (2011-2021).

The data above describe trends in direct employment in the forest industry. The sector also stimulates a considerable amount of indirect and induced employment. Indirect employment consists of jobs at companies that supply the forest sector while induced employment is that generated as a result of the expenditures by employees in the direct and indirect industries. The Ministry of Forests reported that in the northern Interior, the direct employment per 1000 m3 of timber harvested is 0.51 positions, and the indirect and induced employment is 0.30 and 0.25 positions, respectively. These multipliers are relatively low compared with those in the forest sector in other regions of BC, mainly because the Interior sector is very efficient at converting timber to product.

[26] The Cariboo region includes 100 Mile House, Williams Lake, Quesnel and Prince George. Mackenzie is in the Northeast region, for which are not shown.

Using the direct employment data from the Cariboo region above suggests that the indirect and induced employment is roughly 4,700 and 3,900 positions, respectively, on average between 2017 and 2021. This is probably a fairly good approximation of indirect and induced employment in the catchment area.

8.3 Log Market

The range of mills in the catchment area, and the range of products that they produce, ensures that there is an active wood fibre market in the part of the catchment area around Prince George and to the south. There are incentives within the system to have each log go to its highest valued use, starting with the role that BC Timber Sales plays. Roughly 25% of the harvest is overseen by BC Timber Sales, an agency of the provincial government that has forest tenure. BCTS puts timber on the market via public auction, and the auction prices are used to set stumpage prices by log grade, size, and species on the remaining Crown timber. Most of the harvesting in the catchment area is done by contractors, and their business relies in part on maximizing their revenue from their harvest blocks.

BC's log grading system has five tiers, with grade 1 the highest and grade Z lowest. The grade categories are summarized in Table 9.

grade 1: premium sawlog (large good logs).
grade 2: sawlog (the log has 50-100% firmwood, little defect, generally good condition).
grade 4: lumber reject (the log has <50% firmwood and defects such as checks, spiral grain, etc.).
grade 6: undersize (less than 10 cm diam)
grade Z: firmwood reject (lots of rot, very poor form, etc.).

TABLE 9. BC GOVERNMENT LOG QUALITY CLASSES.

There are few grade 1 logs in the catchment area – grade 1 usually applies to logs from the coast which are larger than those from the catchment area. The majority of quality sawlogs in the catchment area fall into grade 2; these logs have little defect and at least 50% of the log is firmwood. (Firmwood excludes all rot, char, holes and missing wood; detailed grade specifications can be found in the BC Interior Scaling Manual.) Any defects that are present are minor.

Grade 4 timber has less than 50% firmwood and more significant defects, such as checks and spiral grain. Grade 6 timber is small-sized wood and Grade Z is the lowest quality of log. One of the limitations of this grading system is that it does not distinguish dry and green logs. Grades 4, 6 and Z are known collectively as low-grade wood; sawmills will sometimes use Grade 4 sawlogs while Grades 6 and Z are either used for hog fuel or left in the bush.

The widespread mortality caused by the MPB, and to a lesser extent by the wildfires, created a large supply of sawlogs from dead and dying trees. The dead mature pine stayed standing for as long as 15 years, drying and remaining usable as lumber, although steadily deteriorating in quality. The sawmills ran at levels close to full capacity during this period, and some increased their capacity, creating an abundant amount of residual fibre for the pellet mills.

Until the end of 2018, dry dead sawlogs were in high demand and fetched a decent price at the sawmills. The consultants estimate that as much as 75% of the MPB deadwood was grade 2; the remainder either went to specialty mills, got burned on the landing, or was left in the block. The low-grade logs are sorted and used by local specialty mills. The remaining, even lower grade logs or residuals such as broken pieces and dead wood, are processed through a grinder for pelletizing.

During the 2010 – 2021 period, the price of lumber rose relatively steadily, as the industry recovered from the 2008-09 recession and US housing market crash (See Figure 28). As interest rates remained low, housing prices rose and demand for building materials was strong. Prices fell in 2019 as a flood of low-priced European timber entered the market as a result of a widespread spruce bark beetle outbreak.

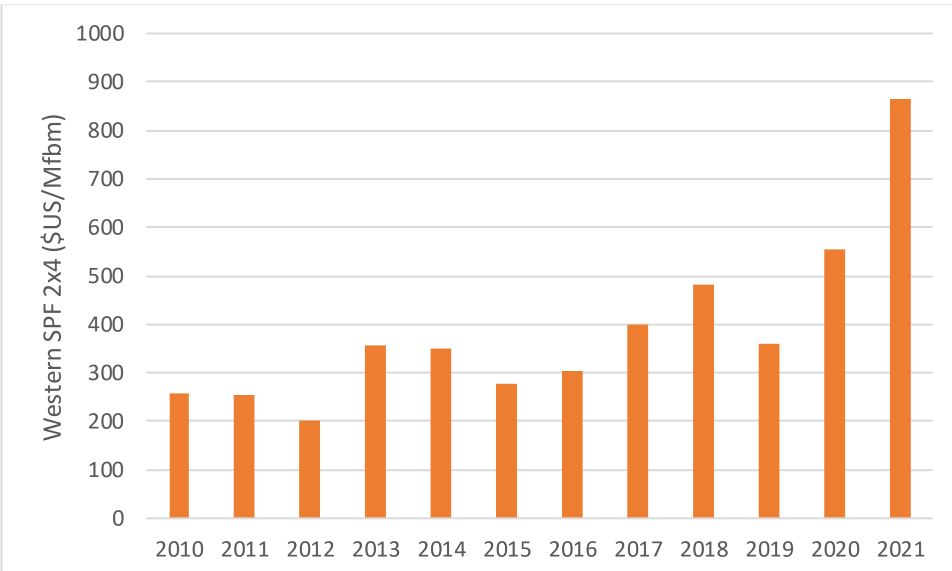

FIGURE 28. ANNUAL PRICE OF WESTERN SPF 2X4 #2 OR BETTER (US$/MFBM).[27]

By 2019, sawmills had largely stopped using deadwood as it had deteriorated beyond the point where they could use it. This phenomenon occurred throughout the BC Interior; the substantial reduction in supply has caused three large sawmills in the catchment area to close since 2019, as well as a fourth sawmill located in Chasm, to the south of the catchment area. Many other sawmills have reduced the number of shifts or taken downtime.

Girvan and Taylor (2020) [28] also point to longer hauls, steeper and more rugged logging blocks, and the tight wood supply leading to “overbidding” in the BCTS sales as contributing to price pressures on the lumber industry. Stumpage prices in the interior rose at a proportionately higher rate than product prices, so that stumpage accounted for 6% of the SPF price in 2019, compared to less than 1% in 2010.

Product prices fell again between March – June 2020, when the initial wave of the Covid-19 pandemic caused a global slump in construction activity and some mills closed temporarily due to avoid

[27] BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development. 2022. 2021 Economic State of British Columbia’s Forest Sector. Economics and Trade Branch.
[28] https://issuu.com/truckloggers/docs/truckloggerbc_fall_2020_final_lowres/s/11119030

transmission of Covid-19. During this period, Canfor announced the permanent closure of its Isle Pierre sawmill near Vanderhoof (capacity 472,000 m^3).

However, starting in June, lumber prices unexpectedly began to rise, and they have reached record prices since then. The first peak in prices occurred in September 2020, when western kiln-dried #2 or better SPF 2x4s reached $US 960/mfbm, more than double the price in mid-June ($US 378/mfbm). By the second half of 2020, stumpage prices reached $70/m3 in the BC Interior.[29]

A second and more dramatic peak was reached in May 2021, when western kiln-dried #2 or better SPF 2x4s soared to $US 1640/mfbm, a price which was reached again in March 2022. With these booming markets, the surviving sawmills are at full production – however it is notable that previously closed mills did not re-open.

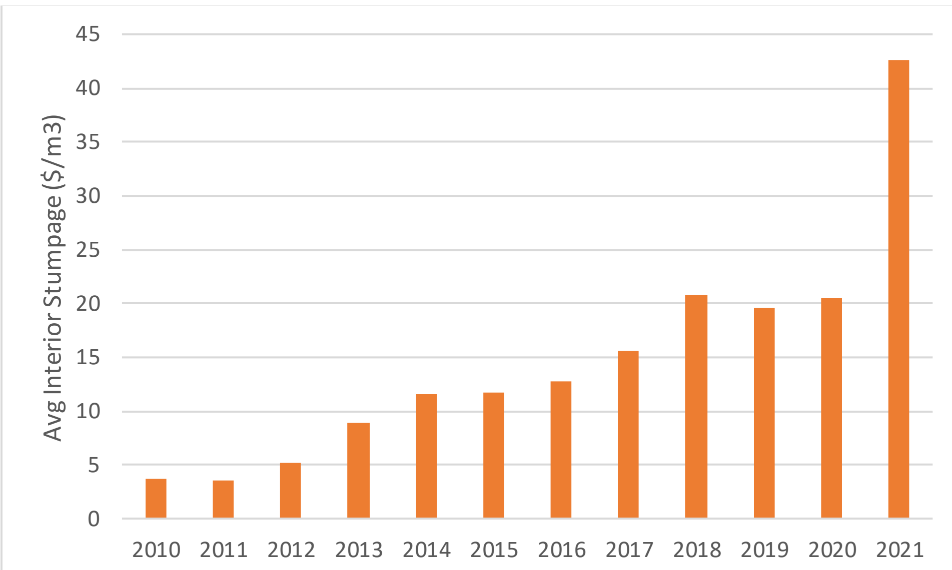

FIGURE 29. ANNUAL INTERIOR STUMPAGE PRICE ($/M3).[30]

As mentioned, BC Timber Sales pricing is used as a basis to set stumpage rates, and the BCTS prices closely track the prices of lumber. Figure 29 shows the average stumpage price in the Interior between 2010 and 2021. The recovery from the Great Recession can be seen in the very low average stumpage prices of 2010 and 2011, however as the economy and housing in particular began to recover, lumber prices rose as did stumpare rates. The windfall that the government received from stumpage in 2021 is clearly visible, and 2022 stumpage rates will be comparable.

[29] Taylor, Russ. 2021. A Perplexing Puzzle – Provincial Stumpage Rates in Canada.

[30] BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development. 2022. 2021 Economic State of British Columbia's Forest Sector. Economics and Trade Branch.

8.4 Drax' Fibre Intake by Source

The changes in the fibre markets during the past several years have reduced the amount of mill residual fibre available to the two Drax facilities in the catchment area. Fibre source data for the two Drax pellet plants was obtained from the government's Harvest and Billing System data. Table 10 for Williams Lake and Table 11 for Meadowbank show that both pellet mills responded to the reduced amount of sawmill residuals by increasing their use of forest-derived feedstocks, which include both low-grade solid wood and bush-grind (ground up logging slash left at the landing after the sawlogs have been processed).

Source	2017	2018	2019	2020	2021	SUM
Residual	63,926	182,863	131,390	145,519	123,862	647,560
Forest Derived	0	231	9,647	32,151	59,558	101,586
SUM	63,926	183,094	141,037	177,670	183,420	749,146

TABLE 10. FEEDSTOCK VOLUMES BY SOURCE TYPE, WILLIAMS LAKE PELLET FACILITY (ODT).

Source	2017	2018	2019	2020	2021	SUM
Residual	78,966	208,819	169,996	142,509	136,513	736,804
Forest Derived	9,709	33,030	80,120	73,070	71,841	267,769
SUM	88,675	241,849	250,116	215,579	208,354	1,004,573

TABLE 11. FEEDSTOCK VOLUMES BY SOURCE TYPE, MEADOWBANK PELLET FACILITY (ODT).

Williams Lake gets all of its forest -derived material as bush grind, which has grown from a negligible amount in 2018 and earlier to 32% of the feedstock consumed in 2021. Most of the feedstock labelled as residual comes from sawmills, with as much as 10% coming from waste produced by panel mills, pulp mills and remanufacturing facilities, yard and chipper waste and other miscellaneous sources.

Meadowbank has experienced a similar pattern in the shift in feedstock sourcing that it has experienced. From a level of 11% in 2017, the proportion of forest-based feedstock reached 34% in 2021. Unlike Williams Lake, the Meadowbank facility gets 1/3 of its forest-derived feedstock as bush-grind and the remaining two-thirds from low-grade solid wood that is trucked to the pellet facility and ground. Almost all of the residual feedstock used by Williams Lake comes from sawmills, with a minor amount from pulpmill waste.

Table 10 and Table 11 indicate that fibre procurement has become much more complicated for both facilities in recent years. The needs of the pellet mills basically created the bush grind operations. Bush grind is derived from logging slash, which consists of the tops, branches, dead wood, and other non-merchantable material. Slash is the woody debris left after harvested trees are processed into logs at landings along forest access roads; once the logs have been removed, the slash is ground into fibre and trucked to the pellet mill. Haul distances generally range from 10 to 100 km. The relatively low price for the bush grind material cannot support haul distances much beyond that. This material has no other commercial use and if it is not ground, it is either burned or left to rot.

The low-grade solid wood used by Meadowbank consists primarily of low-grade wood that has high levels of defect, poor form, or is broken. This wood is often too short to go through a sawmill but long enough to stay on the bunks of the truck taking it to the pellet mill where it is ground. Another component of the low-grade wood is tops; sawlogs are taken to a 4” top and what remains can be delimbed and brought to the mill. None of the material has an alternate use in the catchment area.