Kitselas First Nation Combined Heat and Power using Wood Residue, Northwest BC

Fibre Supply Assessment

Prepared for: **Kitselas First Nation**
Natural Resources Canada: Indigenous Forestry Initiative

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1 Introduction

Kitselas First Nation (Kitselas) holds several forest tenures in the Coast Mountains Natural Resource District. Like many forest tenure holders in the Pacific Northwest, Kitselas has access to an abundance of non-merchantable woody residue, as much of the timber harvested in this area is decadent and overmature. This woody residue is normally disposed of by open burning, in accordance with the BC *Wildfire Act*, resulting in carbon emissions to the atmosphere. Kitselas is investigating the possibility of using this woody residue to produce heat and power and other biomass products in a small-scale combined heat and power (CHP) facility at Gitaus, a self-contained Kitselas community.

Gitaus is approximately 19 kilometres east of Terrace BC and borders the Skeena River and Highway 16 (Figure 1). Gitaus is a residential community and is also the location of the Kitselas Administration building and the world-famous Kitselas Canyon. Kitselas is considering commercial features on or adjacent to Gitaus as part of the Nation's efforts to improve and attain social and economic prosperity.

The Gitaus community is comprised of 81 homes, administration buildings for the Kitselas Band, a fire hall, and the tourism facilities at Kitselas Canyon. Kitselas has expansion plans slated for 2021, including: the addition of 46 homes; additional infrastructure (e.g., a sewage lagoon, community centre, and school); and commercial development (e.g., a greenhouse or marijuana facility).

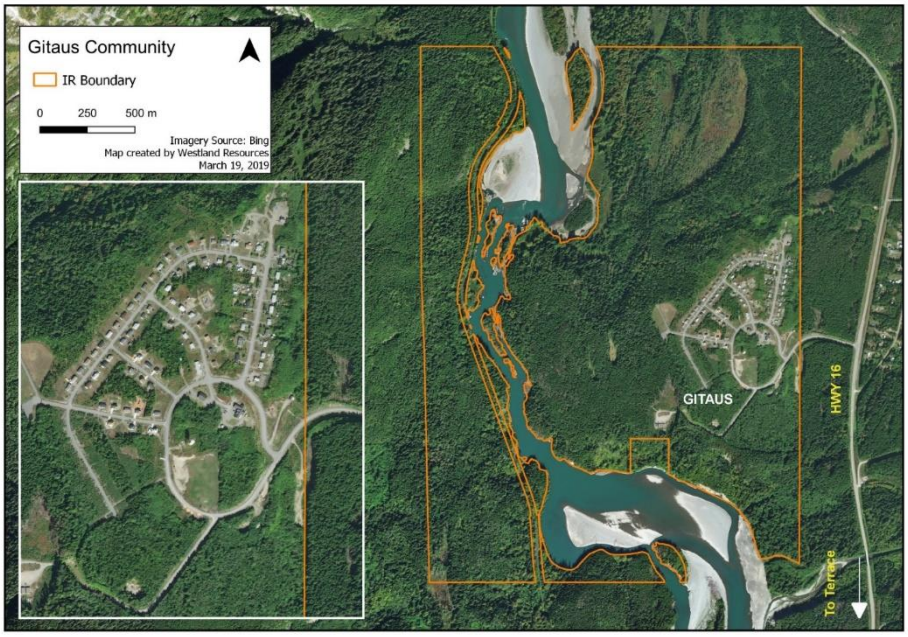

Figure 1: The Gitaus Community, located on Kitselas IR 1

On behalf of Kitselas, Westland Resources Limited (Westland) is conducting investigations into CHP for Gitaus. These investigations are the part of the second phase in a proposed three phase project for CHP. Funding for Phases 1 and 2 have been provided by the Indigenous Forestry Initiative (IFI) of Natural Resources Canada, with additional in-kind contributions from Kitselas and interested non-profit organisations, the Pacific-North Coast Development Society (PNCDS) and the Skeena-Nass Centre for Innovation in Resources Economics (SNCIRE).

The three phases of this project are as follows:

1. Investigate and identify CHP processes
2. Determine economic and engineering feasibility of selected CHP process(es)

3. Install selected CHP process and infrastructure

Phase 1 of the project resulted in a decision by Kitselas Band Council to continue the project.

Phase 2 will span two years and includes the following works:

- Investigate value added partnerships (specifically with the company: BC Biocarbon), including a review of paired products streams of BC Biocarbon and a CHP
- Confirm fibre supply,
- Confirm energy demands in detail, and
- Work on the design of a potential facility.

2 Scope

This report is related to the confirmation and description of fibre supply and will:

- Describe the type(s) and amounts of wood fibre required for biomass-based energy.
- Evaluate the availability of the fibre types from Kitselas First Nation businesses, and from other sources if necessary.
- Estimate the cost of delivery for the fibre.

3 Wood fibre required for biomass-based energy

The Gitaus CHP project is currently expected to utilise any form of woody material. This can include residue from logging or sawmilling, or logs delivered from the field.

Gitaus is located within the Kalum Timber Supply Area (TSA), part of the Interior of BC as defined by the province's Ministry of Forests Lands Natural Resource Operations and Rural Development (MFLNRORD). MFLNRORD defines and determines how logs are measured and graded. Interior log grade information, as referenced in the following paragraphs, can be found in the BC Timber Scaling Manual[1].

Woody residue

Logging and sawmilling produce woody residues. Small stems, tree tops and branches are usually left behind in a block after logging, as there currently is no market for this residual material. When logs are milled, slabs, sawdust, and shavings are produced. Generally, these woody residues are disposed of by burning, landfilling, or letting them rot on site.

A focus of this fibre supply assessment is to consider accessing these woody residues for the Gitaus CHP project. From the perspective of MFLNRORD, any woody material used or moved needs to be recorded and measured; very small logs are assigned a Grade of "6". The rest of this woody material is not made of logs *per se*, but is still assigned a Grade of "Z".

Fibre-quality Logs

When logging the forests of northwest BC, the timber products include logs of different qualities. Some logs can be used for clear, tight-grained lumber, furniture, and veneers and can be sold for a higher value. These logs are generally identified by MFLNROD as Grade 1. Other logs have more knots or wider grain and can be turned into products with less value. These would be Grade 2. There are also logs that have rot or defects that do not allow them to be turned into lumber-style products, but instead are valued primarily as source material for pulp and paper products; these logs generally have the lowest

[1] BC Timber Pricing Branch. 2021. Scaling Manual, Amendment No. 4. Province of British Columbia. Accessible from: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/timber-pricing/harvest-billing/timber-scaling/scaling_2011_amend_4_master_b.pdf

value and are identified as Grade 4. There is also a component of logs that have so many defects that they cannot be sold, even as a pulp log, but are still comprised of woody fibre. These are identified as Grade Z.

Utilising these Grade Z "fibre logs" is a goal of the Gitaus CHP project, as they will normally be left behind after logging. In addition, there has often been times when there is no market for pulp logs: these may be an additional source of woody material for CHP. Ideally, however, these pulp logs should preferentially be used for real-world products as opposed to being burned for bioenergy.

Sawlogs

As noted in the previous paragraphs, northwest forests include logs that can be milled for lumber and furniture. These logs are quantified by the Province of BC as Grade 1 or 2. These are not considered as a source of material for the Gitaus CHP project.

4 Wood fibre availability

The Gitaus CHP project is currently planned to consume 5 oven-dry tonnes (ODT) of woody material per hour. Assuming the facility is run on a 24 hour-per-day basis, the annual demand of the plant would be 43,800 ODT.

Woody fibre from the forest is often expressed in terms of cubic metres (m^3), and this material is green, i.e., it has not been dried yet. In northwest BC, a green log is estimated to have at least 55% moisture content, so this means that on average, 1 ODT requires 2.52 green m^3 of wood. Therefore, the annual fibre demand is approximately 110,400 m^3.

Kitselas has forest tenures with a total allowable annual harvest of 43,445 m^3. Historically, most of this volume would be in the form of sawlogs and pulplogs (Grades 1, 2, and 4). Currently, if woody material is to be removed from the forest for the purposes of the CHP project, the amount moved would be deducted[2] from the allowable harvest level. Therefore, Kitselas' forest tenures do not have enough room to accommodate the total fibre demand for the Gitaus CHP project.

Woody residue can come from multiple sources: sawmills; land clearing; renovations and demolitions; silviculture and arboriculture treatments; and logging.

Sawmill residues are generally the cleanest supply, and are likely quite cheap; however, the only large sawmill in the area (Skeena Sawmills) also operates a pellet plant, so its residues are already committed. An alternate source could be small-scale sawmills: in 2005, there were over 50 small sawmills in northwest BC, producing over 17.8 million board feet (bdft) of wood products[3]. Assuming a lumber recovery factor of 300[4] bdft/m^3, this will generate approximately 17,400 m^3 of waste, or about 6,900 ODT per year (t/yr). The number of active small sawmills in the region has decreased since then: in 2018 there were only 8 small sawmills cutting for profit, with an annual capacity of just under 4.0 million bdft/yr[5], or approximately 1,550 ODT/yr. While this volume would be welcome for a CHP facility, it will not act as the primary supply.

[2] There may be ways to gain an exemption from this deduction; this may be a future follow-up action.
[3] Brouwer, R. and T. Jobb. 2005. *The Small-Scale Wood Processing Sector in the Kalum-Kispiox Region of British Columbia: Challenges and Opportunities*. Unpublished study by Northwest Timberlands Ltd for the North West Loggers Association,
[4] Jobb, T. April 23, 2021. Personal communication.
[5] Jobb, T. 2018.*Cutting for Profit – Small Sawmill Contact List*. Unpublished study by the Skeena-Nass Centre for Innovation in Resources Economics for the Regional District of Kitimat-Stikine.

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Note that the number of active small sawmills in the region has decreased significantly in recent years. By comparison, in 2005, there were over 50 small sawmills in northwest BC, producing over 17.8 million board feet (bdft) of wood products[8] per year, or about 6,900 tonnes per year (ODT/yr). This shows that the region is likely capable of supporting increased sawmilling activity.

Arboriculture treatments can provide a clean supply of fibre. Arboriculture treatments are a ready-made - albeit small - source of woody residue.

Land clearing can be a good source of woody residue if the clearing projects are done properly, and dirt is kept out of the woody residue. Land clearing only happens when land development is occurring, and this has been a sporadic process in northwest BC. Reliance on land clearing is not suggested as a prudent business strategy.

Renovations and demolitions have potential to be a small but cheap source of fibre, but there is likely to be challenges with keeping the material from these activities clean and free from contamination.

Silviculture treatments, such as precommercial thinning and brushing, can provide a clean supply of fibre. Recovery of woody waste from silviculture treatments is likely to be costly, and there has to be careful consideration of how much can be removed from the forest, versus how much needs to remain to provide on-site nutrition. Since there has not been a lot of logging in the area over the past 20 years, the amount of silviculture activity has also been reduced and is therefore limited. If logging increases, the potential supply of material from silviculture will increase, but it is not considered to be a significant volume at this point.

Logging can create significant amounts of woody fibre. However, logging is currently market-dependent, where the local price for logs from the main sawmill in the area is often at odds with the costs of logging. As a result, the total amount of logging in the area has varied from year to year, from as low as about 400,000 m^3 in 2012 to over 1,000,000 m^3 in 2014, with an average since 2005 of around 55% of the potential harvest level, or approximately 675,000 m^3. This means there certainly is volume available to support additional fibre consumption, although the cost of that fibre may present a challenge.

5 Wood fibre costs

In this section we consider the cost of delivering fibre from logging operations, as this will be the primary supply of woody materials.

Westland has developed a proprietary model that analyzes and estimates the cost of delivery for fibre from multiple landscapes in northwest BC. This model was originally developed to estimate the delivered cost of sawlogs and pulp logs, but has been expanded to consider biomass materials and its

[6] Jobb, T. 2018.*Cutting for Profit – Small Sawmill Contact List*. Unpublished study by the Skeena-Nass Centre for Innovation in Resources Economics for the Regional District of Kitimat-Stikine.
[7] Jobb, T. April 23, 2021. Personal communication.
[8] Brouwer, R. and T. Jobb. 2005. *The Small-Scale Wood Processing Sector in the Kalum-Kispiox Region of British Columbia: Challenges and Opportunities*. Unpublished study by Northwest Timberlands Ltd for the North West Loggers Association.

influence on delivered log costs. This delivered log cost model has been used to estimate and quantify the location (and costing) for the woody material necessary to supply the Gitaus CHP project and estimates costs current to 2019.

Four factors that have a significant influence on delivered log costs include: timber volume per hectare, access requirements (i.e. road and bridge construction), harvesting system, and haul distance. We do not discuss those factors in this report, but awareness of them is important, as these factors influence why some landscapes are selected over others in the model[9].

On average, non-merchantable material from typical logging operations in the area results in an additional 27% over and above the merchantable volume[10]. Based on an annual demand of 43,800 ODT, and a desire to only utilise non-merchantable wood, i.e. limbs, tops, bark and cull logs, Westland's proprietary delivered log cost model shows that a combined total harvest (i.e fibre, pulplogs and sawlogs) of 510,500 m^3 will have to occur each year. This is consistent with the current status quo harvest levels of the past 15 years as noted in the previous section of this report. The lowest cost of this harvesting was estimated to average \$68.91/m^3 in 2019[11] (or \$173.75/ODT), and the volume to generate this would come from the 11 landscapes with circles in them on the map below.

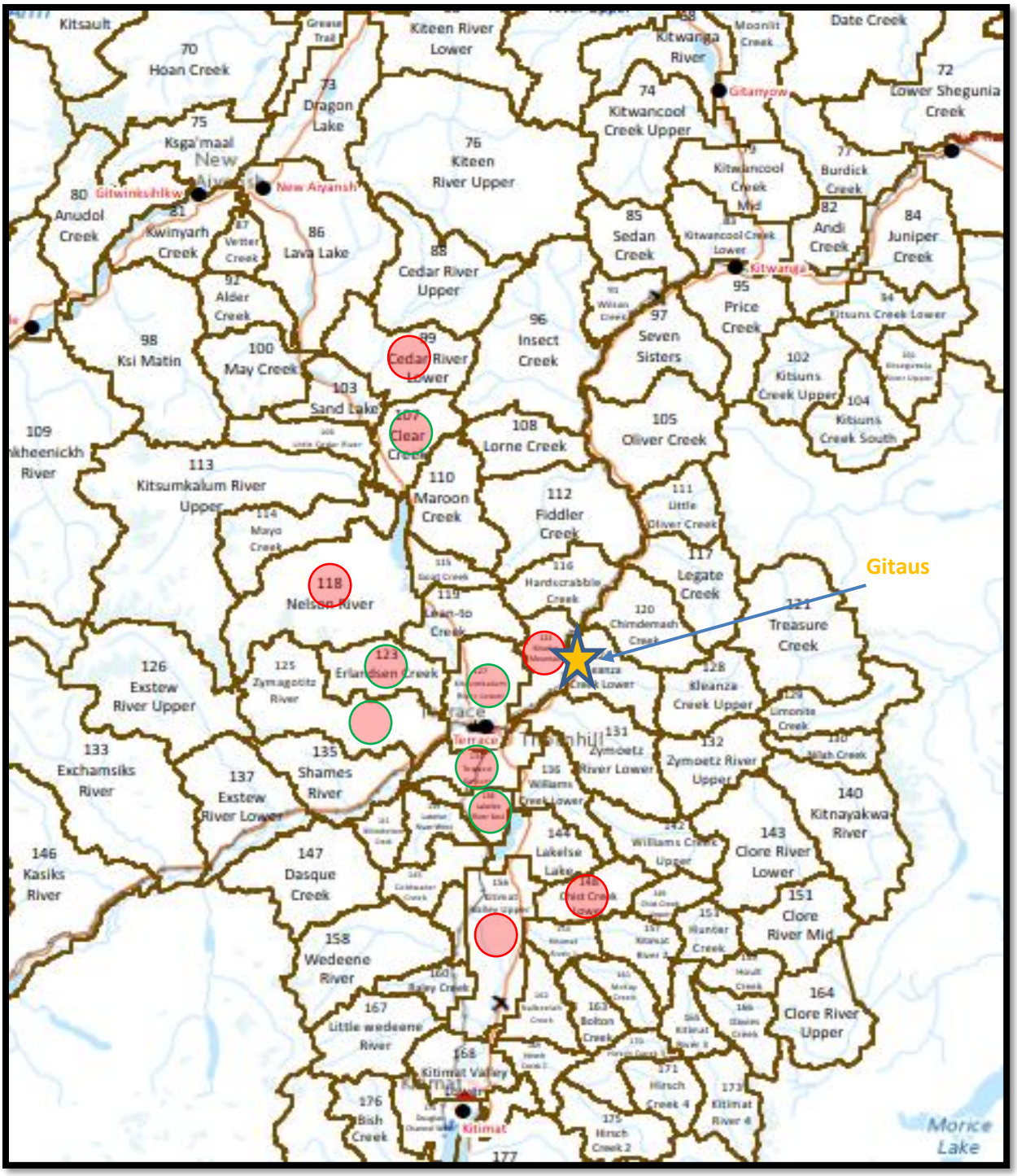
If there were an acceptance of pulp logs as an additional source of woody material for the CHP facility, the average cost would lower to \$66.15/m^3 - or \$166.79/ODT - coming from the six landscapes whose circles are outlined in green.

The delivered log cost values above would allow a facility operator to independently harvest and bring wood to their facility. In other words, if they can pay those values for logs and woody material, they will be able to ensure a secure, long-term supply. However, it is likely that the costs above are high for a bioenergy facility; in fact, one source[12] has indicated that pricing for chipped woody material delivered to a facility would ideally be less than \$70.00/ODT, or \$27.75/m^3. On that premise, the considerations need to change.

If the direct cost to acquire woody fibre is too high, then consideration needs to be given to acquiring the fibre through an indirect process, i.e. by recovering woody residues and waste wood from areas that will be harvested regardless of whether there is a CHP facility. For example, if logging is occurring to support a sawmill or other such solid wood facility, current practices result in residual woody material left on harvest areas, which could then be a source of supply for a CHP facility.

If logging is already occurring to meet an existing demand - such as a sawmill - then the costs related to that logging are already committed and accounted for; costs such as licensing and permitting, road building, yarding (bringing the logs to the roadside), and silviculture are already "sunk" into the area. After logging, an amount of woody fibre remains on site. In many cases, this "woody waste" has to be disposed of by controlled burning to reduce fire hazard. If a person were to instead want to remove that woody fibre, the only incremental costs related to that material would be setting it up for loading, loading it into transport vehicles, and hauling it away.

[9] For more detail on a delivered log cost model similar to Westland's proprietary model, refer to the information in the 2019 document *Future Forest Products and Supply Streams for Northwest BC*, available on the Westland Resources website at: https://www.westlandresources.ca/recentpublications .
[10] Brouwer, R, T. Jobb. August 16 2019. Personal communication.
[11] All costs are provided as of 2019.
[12] Marsh, P. January 27, 2021. Personal Communication.



The cost for grinding or chipping of woody waste is estimated at $11.90/m3. This is based on Westland's personal knowledge from supervising several large scale land clearing operations.

Hauling of the material from the woods has been calculated in Westland's delivered log cost model, and will vary with each landscape area.

Preparing woody waste for hauling can occur in two ways: loading it in its raw form onto or into trucks, as limbs, tops, and logs, or grinding or chipping it into transport vehicles. Both of these approaches have challenges.

The tops and logs can generally be loaded with reasonable efficiency onto logging trucks with “hay rack” configurations.

Example of a truck with a hay rack configuration. More racks may be required depending on the size of the woody material being hauled. (Photo credit:https://forestnet.com/LSJissues/July_10/alberta1.jpg)

Loading of limbs will likely require dump trucks, and the hauling will be less efficient and more costly due to a large amount of air between the limbs.

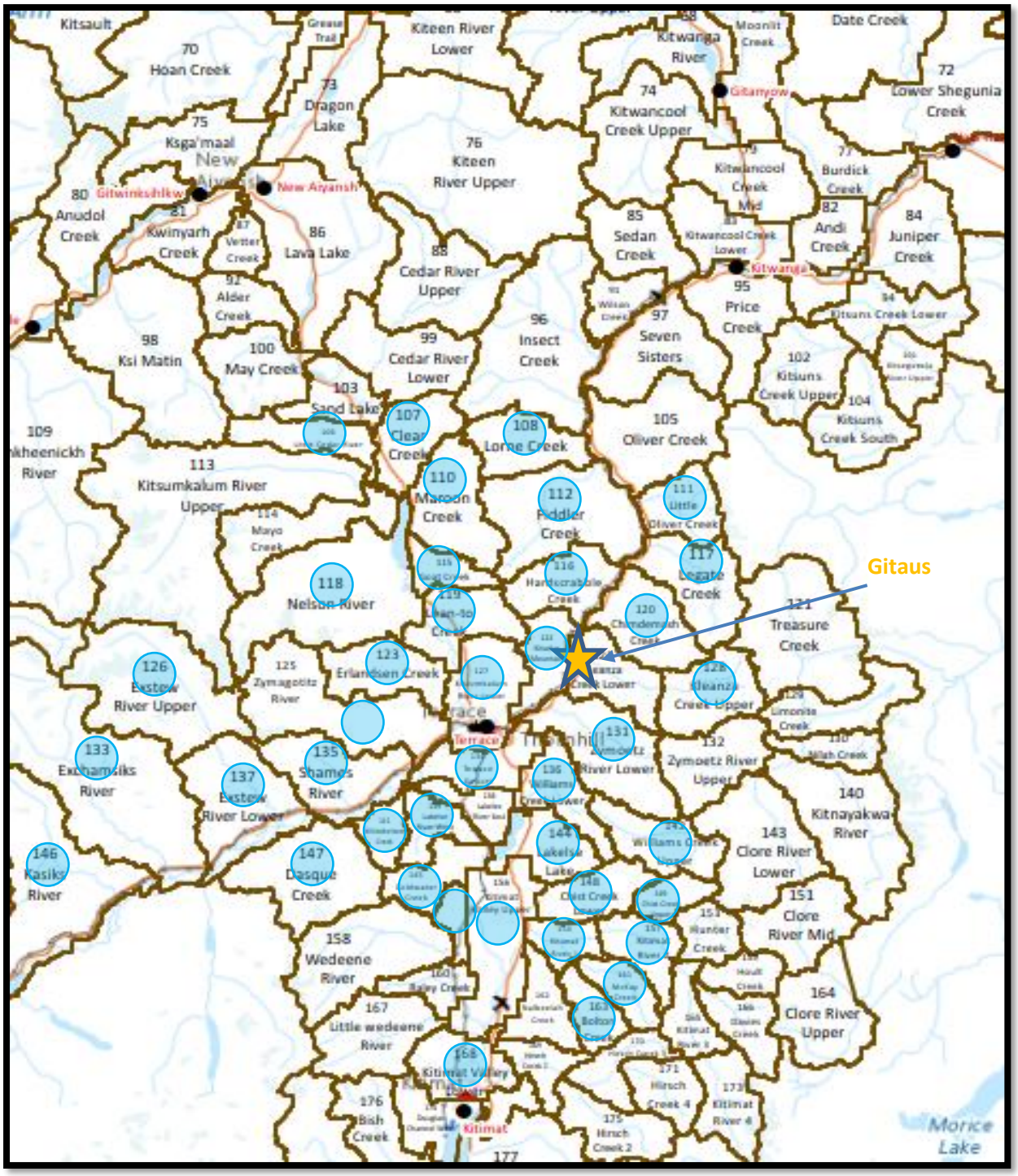
Example of a truck with a hauling branches and limbs. (Photo credit: https://www.trbimg.com/img-59c52208/turbine/os-hurricane-irma-storm-debris-contractor-problems-20170921

Grinding or chipping woody material requires bringing an industrial mobile chipper to the site and dedicating a machine to load the material into the grinder or chipper. It also requires that the roads to the site be driveable for chip transport trucks, which generally cannot travel on roads that are challenging – but navigable – for logging trucks.

Example of loading ground/ chipped material in the bush, on easy, accessible ground. Photo credit: https://api.army.mil/e2/c/images/2012/02/02/233923/original.jpg

Since there are challenges with both approaches for getting material ready for loading, an incremental cost of $3.00/m3 will be applied for preparing woody waste for hauling. This estimate is admittedly an educated guess.

The three factors (setting wood up for grinding/ chipping/ loading; grinding or chipping the wood; and hauling the wood to a CHP facility) were applied to the Westland's delivered log cost model: the blue circles on the map below identify all the landscapes from which the combined incremental costs for those three factors are less than the targeted cost of $27.75/m3 or $70.00/ODT.



All of the above "blue circle" landscapes provide over 3.4 times the required biomass volume needed for a 43,800 ODT per year facility with a lifetime of 25 years. The estimated average incremental cost for the woody residuals from these areas is $25.55/m^3 or $64.42/ODT.

6 Conclusion

A facility that uses five tonnes per hour of woody material will require a total annual supply of the 43,800 ODT, or 110,400 m^3 per year. Kitselas First Nation does not control enough forest tenure to ensure this supply.

The most likely woody material sources, in ascending order of cost, are

- Sawmill residues
- Arboriculture treatments
- Land clearing
- Renovations and demolition
- Silviculture treatments
- Logging residues

The above list also reflects the relative availability for these same sources, listed from less available to readily available. In effect, the material most available to meet the supply requirements of a CHP facility at Gitaus - logging residues - is also the most expensive.

If a proponent wants to guarantee a supply of woody material from the forest, then they would have to cover all the associated costs with logging this material, which is estimated to be between \$66.15/m^3 to \$68.91/m^3 or \$166.79/ODT to \$173.75/ODT. The lower number reflects the consumption of pulp logs in the facility, and the higher number reflects consumption of waste logs and woody residues only. There are more than enough areas to provide this woody waste. This approach does not require a proponent to have their own tenue: they could buy the logs on the open market for this price. Alternatively, if a proponent had tenure for this volume, they could sell or trade the sawlogs that would be generated as a by-product to the fibre harvesting or trade them for additional fibre.

If a proponent is willing to be dependent on accessing woody material only from areas being logged to supply others (e.g. for market loggers or to supply a sawmill), then they would only have to cover the incremental costs related to accessing the woody fibre. This is estimated to be \$25.55/m^3 or \$64.42/ODT. Logging history over the past 15 years indicates that there is likely enough logging activity each year to supply a facility requiring 43,800 ODT per year.

In conclusion:

- There is enough woody residue from operations on all forest tenures relatively near to the Kitselas community of Gitaus to supply a CHP facility requiring 43,800 ODT per year.
- Forest tenures owned by Kitselas First Nation do not, on their own, produce enough woody residue volume to supply such a facility.
- On the assumption that there is no other demand for this woody residue, the cost in 2019 dollars to deliver this residue to Gitaus is estimated at \$64.42 per ODT.

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