# Appendix F

# June 1, 2017 Biomass Methodology Report

# Avista Corporation

KPMG

*cutting through complexity*

# AVISTA

## Methodology for Determining Age Class of Canadian Biomass used at Kettle Falls Generating Station

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# Contents

# 1 Introduction - Purpose of the Document

The purpose of this document is to establish a conservative methodology whereby Avista's Kettle Falls Generating Station can estimate the percentage of its Canadian biomass supply that is derived from old growth sources.

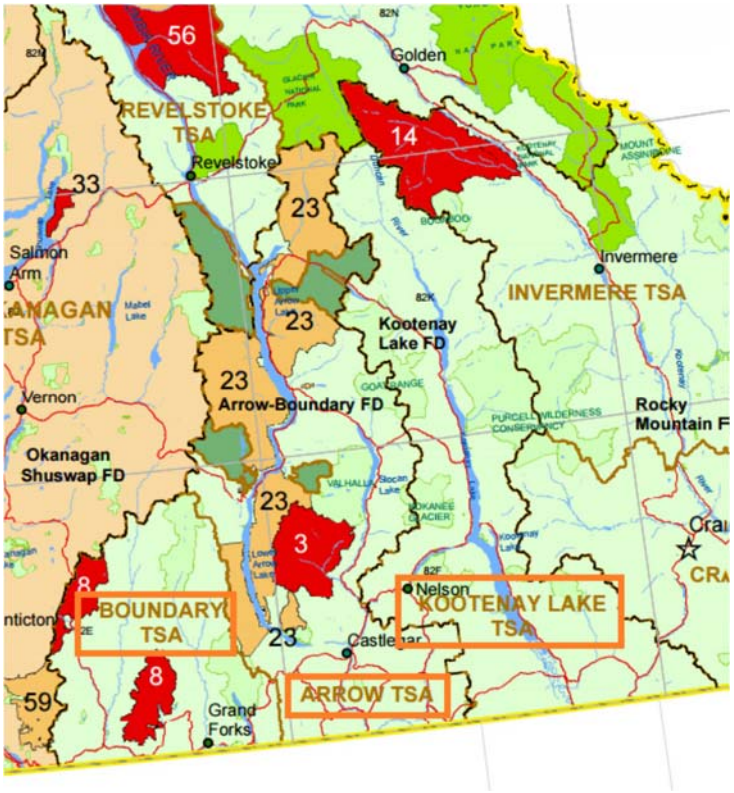
The document describes a methodology for sourcing, compiling, and analyzing forest cover loss and land ownership datasets using geographic information system (GIS) technology to determine where wood fiber is being harvested within Avista's Canadian fiber supply area and how old that wood fiber is.

# 2 Scope

This methodology is applicable to the Canadian fiber supply area of Avista's Kettle Falls Generating Station.

The fiber supply areas lies within the province of British Columbia and comprises the area within the boundaries of the Arrow, Boundary, and Kootenay Lake Timber Supply Areas (TSAs) in southern British Columbia.

*Figure 1 Timber Supply Area (TSAs) within project scope*



# 3 Analytical Tools and Source of Data

GIS is an established tool for assessing land use, and forest cover changes. As aerial imagery increases in resolution, GIS becomes more important for policy makers in determining landscape disturbance across the globe (Kumar 2011; Margono et al. 2014;. Achard et al. 2002; Alo and Pontius 2008; Troy and Wilson 2006). The Ministry of Forest, Lands and Natural Resource Operations (MFLNRO) in British Columbia has numerous monitoring and inventory programs that use GIS, while independent organizations such as the World Resource Institute track and monitor annual forest cover change across the globe. These independently gathered datasets are available for public use and report key forest inventory features, such as age class, and disturbance.

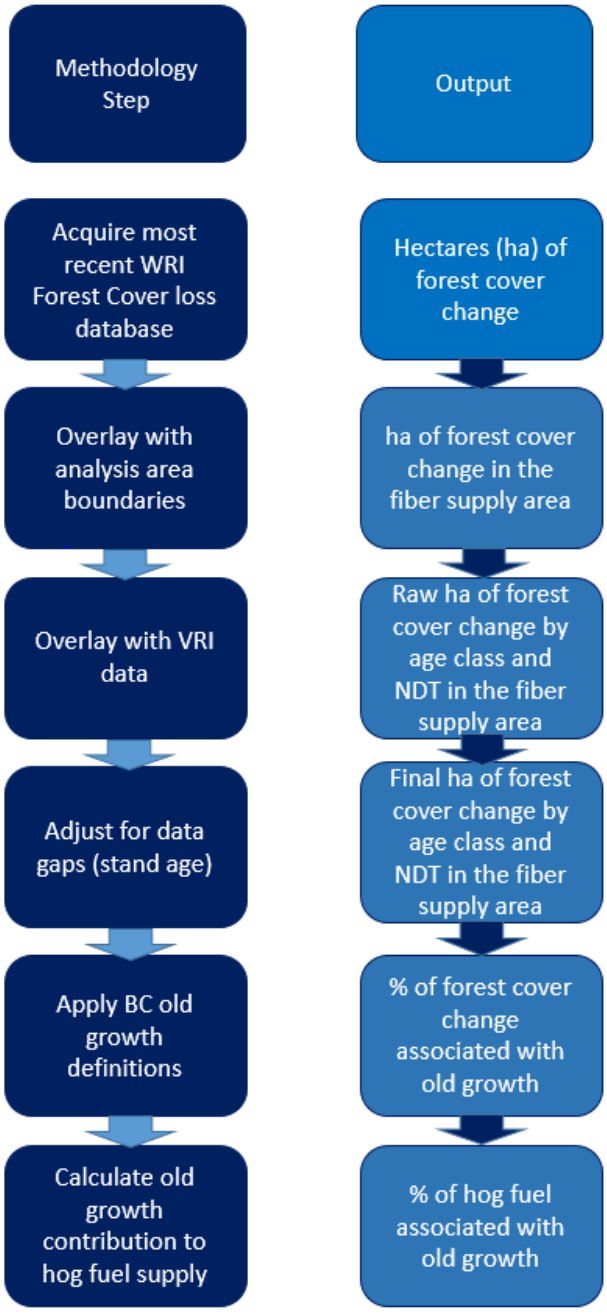
The key datasets used for the analysis were:

1. 2014 tree cover loss mapping produced by the World Resource Institute (WRI). This is derived from medium resolution satellite imagery and very well suited to the analysis performed in this project.
2. Private and crown lands – drawn from BC's Integrated Cadastral Information Society (ICIS) cadastre used to distinguish public versus private land ownership. The data sources from provincial data holdings, and was provided by ICIS (not publicly available);
3. Kootenay Lake, Arrow, and Boundary TSAs – BC government data sets to identify the area of interest https://catalogue.data.gov.bc.ca/dataset/fadm-timber-supply-area-tsa;
4. WRI 30 meter pixel data showing tree cover change with study assessment boundaries for 2014 (note – WRI's processing of the 2015 data was yet complete therefore the data was unavailable – http://earthenginepartners.appspot.com/science-2013-global-forest/download_v1.2.html);
5. Vegetation Resource Inventory (VRI) data – BC government data sets to calculate the percent 'age class' attributed to forest change within the study assessment boundaries. The Vegetation Resource Inventory (VRI) is a two-phased vegetation inventory design consisting of Phase I: Photo Interpretation and Phase II: Ground Sampling. Updating of the inventory due to changes in the forest such as harvesting, fire and other catastrophic events are done through electronic data submissions from licensees and as well through a combination of mapping from satellite imagery, aerial photography and Global Positioning System mapping. [note, the VRI data forms a time period pre-dating the WRI tree cover change data so as to identify age classes of timber that have been removed]. https://catalogue.data.gov.bc.ca/dataset/vri-forestvegetation-composite-polygons-and-rank-1-layer; and
6. Biogeoclimatic Ecosystem Classification (BEC) data – BC government data sets to identify whether the forest disturbance was due to natural or anthropogenic causes https://catalogue.data.gov.bc.ca/dataset/biogeoclimatic-ecosystem-classification-bec-map.
7. Openings – BC Government data set containing administrative boundaries for areas harvested with silviculture obligations or natural disturbances with intended forest management activities on Crown Land – (https://catalogue.data.gov.bc.ca/dataset/results-openings-svw); and
8. Fire Year – BC Government data set to identify fire-affected areas and year of occurrence – (https://catalogue.data.gov.bc.ca/dataset/fire-perimeters-historical).

# 4 Project Methodology

The project methodology is described in Summary form in Figure 4.1 overleaf.

**Figure 4.1 Overview of Methodology**



**Methodology Description**

Fiber supply area boundaries were overlaid onto World Resources Institute (WRI) pixel data showing tree cover change for the year in question. The Vegetation Resources Inventory (VRI) data from BC's Forest Analysis and Inventory Branch (FAIB) was then used to calculate the percent 'age class' attributed to forest.

All datasets for the review were integrated using a common map projections (UTM) and visualized within Esri's ArcGIS environment allowing for rapid qualitative and quantitative assessment. The analysis used geo-processing tools provided by Esri ArcGIS software, including overlay and intersection functions to determine age classes of lost forest cover on crown and private land. Age class and disturbance type values intersecting the 2014 forest cover loss data were identified within crown and private lands and summarized by area.

The resulting information characterizes each polygon where forest cover has been removed by natural disturbance type and age. This information is then used to identify which stands are considered "old growth". The definition of old growth used was the definition in the Kootenay Boundary Higher Level Plan Order which establishes legal old growth objectives for the area that includes Avista's BC fiber supply area. The definitions are shown in Table 4.2 below

**Table 4.2 Applicable British Columbia Old Growth Definitions.**

| Natural disturbance type | Biogeoclimatic Ecosystem Classification | Mature (yrs) | Old (yrs) |
|---|---|---|---|
| 1. Ecosystems with rare stand-initiating events | Interior Cedar Hemlock (ICH) | >100 | >250 |
| | Engelmann Spruce Subalpine fir (ESSF) | >120 | >250 |
| 2. Ecosystem with infrequent stand-initiating events | ICH | >100 | >250 |
| | ESSF | >120 | >250 |
| 3. Ecosystems with frequent standing-initiating events | ICH | >100 | >140 |
| | ESSF | >120 | >140 |
| | Montane Spruce (MS) | >100 | >140 |
| 4. Ecosystem with frequent stand-maintaining fires | ICH | >100 | >250 |
| | ESSF | >100 | >250 |
| | Ponderosa Pine (PP) | >100 | >250 |

Based on Provincial old growth definitions, stands in NDT1,2, and 4 were identified as old growth if over 250 years in age and stands in NDT3 were identified as old growth if over 140 years in age.

As the Provincial VRI dataset includes a significant number of polygons lacking age class data in one part of the analysis area, the BC Government's Openings data set was used to supplement this information as this data set, which applies to harvest sites, includes a PREV AGE CLASS CODE attribute. This reduces the number of sites lacking age class data to a very low level (approximately 0.3%).

Finally, to filter out the impact of natural disturbance, the BC Government fire data for the relevant year is used to identify forest loss by NDT and age class within the analysis area that was due to fire. This data was then removed from the final results.

**Treatment of missing data**

A number of records within the data do not contain information to identify whether the land is private or Crown land. For analysis purposes this is treated as Crown land. As the data for Crown and private land is subsequently amalgamated this has no impact on the analysis.

A small number of records within the data (specifically within NDT 3) do not have associated stand age information within either the VRI or Openings dataset. For projection purposes these stands are conservatively considered as old growth.

The resulting information was compiled into a summary format as shown in Table 4.3 below.

**Table 4.3 Old growth forest change by NDT**

| Natural disturbance type | Forest Cover Change associated with mature and younger forest (ha) | Old growth forest cover change (ha ) | Total Forest Cover Change (ha) |
|---|---|---|---|
| 1. Ecosystems with rare stand-initiating events | | | |
| 2. Ecosystem with infrequent stand-initiating events | | | |
| 3. Ecosystems with frequent standing-initiating events | | | |
| 4. Ecosystem with frequent stand-maintaining fires | | | |
| All NDTs | | | |

# 5 Rationale for Approach Taken

Table 5.1 below describes the key decision points in the development of the methodology and the rationale for each decision

**Table 5.1 Rationale for individual methodology elements**

| Methodology Element | Rationale |
|---|---|
| Selection of WRI tool for assessing forest cover change. | While detailed Provincial Crown Land disturbance data are available, the WRI tool is independent of tenure type and therefore captures forest cover changes across all land tenure types in a single data set. As the fiber supply areas includes both Crown and private land a tool that forest cover change of private land was essential. |
| Use of stand age data based on Provincial VRI datasets | Provincial Vegetation Resource Inventory (VRI) includes stand age by polygon for both Crown and private land. |
| Selection of old growth definition | Different types of forest stands are expected to develop old growth characteristics at different rates. These rates vary with the stand type and the prevailing natural disturbance regime.<br><br>British Columbia has established definitions for old growth and has implemented regional specific old growth definitions within the Kootenay-Boundary Higher Level Plan Order that are based on a combination of the prevailing natural disturbance regime and the biogoeclimatic ecosystem classification of the stand.<br><br>These definitions are recognized through legislation and used to define regulatory targets for old growth retention in British Columbia.<br><br>As such the legally established definition of old growth was applied as it constitutes the best available information. |
| Use of regional average data rather than supplier specific data | Avista's plant uses hog fuel which is generally not a primary forest product. The vast majority of this fuel is derived as a by-product from yards and sawmills that are processing logs from multiple locations. There is no methodology available that can trace hog fuel back through sawmills to the specific location from which the tree it was derived from was harvested.<br><br>It is generally possible on Crown land to trace back to the sum total of the cutblocks that supplied each given sawmill during a year as the timbermarks are specific to a unique location.<br><br>However, sawmills also source logs from private land and sort yards and the timbermarks for these sources do not lead back to a unique location. |

| Methodology Element | Rationale |
|---|---|
| | Options to gather all the private land and sort yard data were investigated but found to be impractical and heavily reliant on gathering multiple levels of supplier data that ultimately it would be difficult to quality check.<br><br>A more defensible approach is to assume that the percentage of hog fuel that is derived from old growth stands is similar to the percentage of stands harvested in the region that are defined as old growth. This allows the calculation to rely entirely on independently sourced data. |
| Approach to treatment of stands that lack age data | A subset of the VRI and Openings data was found to have missing stand age data. There are 4 possible approaches to addressing this:<br><br>1) Apply the average stand age for the remainder of the area;<br>2) Exclude this data from the analysis and focus only on data that includes stand age; or,<br>3) Assume all stands with missing age data are old growth (which is conservative but likely to be less accurate than the alternatives).<br>4) Identify the location(s) where the VRI data lacks stand age information and gather supplementary information (e.g. from site level plans) for the cutblocks in that location [Note: this is possible because the missing information relates to Provincial Crown land for which alternate data can be gathered].<br><br>Given the number of stands missing this data is very small (<1% of the analysis area) Option 3 was applied as the most conservative option. |
| Approach to treatment of stands that lack tenure type data | A number of records within the data did not contain information to identify whether the land owner was private or a federal/provincial crown. The end result is that these missing data attributes create gaps in the data sets. In these cases, the attributes designated as 'null' were assigned to the "crown ownership" category. The logic for designating null values as crown land is based on the fact that the private legal fabric is very well maintained therefore has a lower probability of being incorrect or missing a record. |

# 6 Analytical Purposes

The analysis will be run for two purposes:

- Planning - in which case the most recent WRI dataset will be used to establish an expected percentage old growth in the fiber supply for a given period. For planning purposes, stands with missing age data will be treated as old growth.
- Final Reporting - in which case the final WRI dataset for the year in question will be used to establish the percentage old growth in the fiber supply for a given period. For reporting purposes, Avista will maintain the option of treating stands with missing age data as old growth or gathering site specific information to more accurately assign these stands based on ages identified in site level plans.

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