INTRODUCTION TO SUSTAINABLE HARVESTING IN THE WESTERN FOREST PRODUCTS (WFP) DFA

INTRODUCTION:

The following paper is intended to provide a relatively simple summary of the various concepts and factors that are related to determining sustainable harvest levels in the DFA. Of note, the DFA discussed throughout is only the Western Forest Products DFA. A driver for this paper has been the question posed by the WIWAG: **What is a sustainable harvest level for the DFA?** The goal therefore is to ensure that the concepts and factors, and their relationships over time, are understood.

At the most basic level, when we look at this resource against other natural resources (like gas & oil) and ask if what we are doing is sustainable, the answer is yes. Trees will grow back and gas and oil resources won't. Sustainable harvesting must consider the biology of the forest, as well as long-term profitability.

One way to look at the sustainability of timber harvesting is to first estimate the forest growth and hence harvest rate that could be sustained in the long-term. Then it is a matter of determining the short-term and medium-term harvest levels that will provide an appropriate / acceptable transition from the current forest structure and harvest rate to the future goal. This is the approach used in this paper.

The key concepts that will be outlined include: forest, stand, timber harvesting landbase (THLB), growth rate, Mean Annual Increment (MAI), long term harvest level (LTHL), age class, and the Allowable Annual Cut (AAC). We assume in this discussion that all other ecological or biological values are recognized and preserved by net-downs, buffers, other reserves and management practices related to sensitive ecosystems, etc.

This is an update on the initial report dated March 10, 2006. The DFA has changed significantly with the removal of private land (now managed by Island Timberlands) the Sproat Lake, Cous and Nahmint landscape units (now managed by B.C. Timber Sales (BCTS)), the Maa-Nulth Designated areas in the Sarita and Henderson landscape units and the Timber Licences outside TFL 44 (now managed by BCTS). The gross DFA area has been reduced by more than 50% from 315,000 ha to 151,000 ha.

The main change within the reduced DFA has been the establishment of draft Old Growth Management Areas (OGMAs). These are included in the current analysis for all except the Henderson and Effingham landscape units.

LAND BASE DEFINITIONS:

Hectare (ha): A hectare is slightly less than two football fields. One football field is .6 ha.

Stand: A Stand is an area of the forest where the site conditions and trees are similar. Stands can be anywhere from 2 to 400 hectares in size. Our knowledge of the types of stands makes up our understanding of the forest as a whole.

Cutblock: Cutblocks describe an area where harvesting is planned. They are usually composed of more than one stand. A cutblock can be anywhere from 10 – 100 hectares in size.

Landscape Unit (LU): Landscape Units are large,10–15,000 hectare, areas whose boundaries usually fall along Watershed Boundaries.

Forest: This term refers to the Western Forest Products DFA. The concepts, related examples and data that we are thinking about in this initial paper are applied to the "forest area" known as the DFA. Existing calculations of harvest levels (the AAC and the Long Term Harvest Level) are based on this macro land base as well.

ESTIMATING THE LONG-TERM SUSTAINABLE HARVEST RATE:

The *Long Term Harvest Level (*LTHL) is essentially a best estimate of growth and hence of the potential timber harvest in the future forest. It considers productivity of the land, management methods and management constraints. In this future forest all areas have been harvested at least once and managed according to the assumed approach. This is different from our current forest, which includes a mixture of original (old-growth) forest and harvested areas (we commonly call this second-growth – although in some places it has now been harvested twice).

Another means of estimating harvest is the ***Long Run Sustained Yield (LRSY).*** LRSY, like the LTHL, is the theoretical optimum growth of a forest without the considerations of green-up, visuals and management constraints. LRSY assumes that harvesting takes place at the culmination of the Mean Annual Increment, or the optimum harvest age, while the LTHL does not assume this. The LRSY is about 5-10% higher than the LTHL.

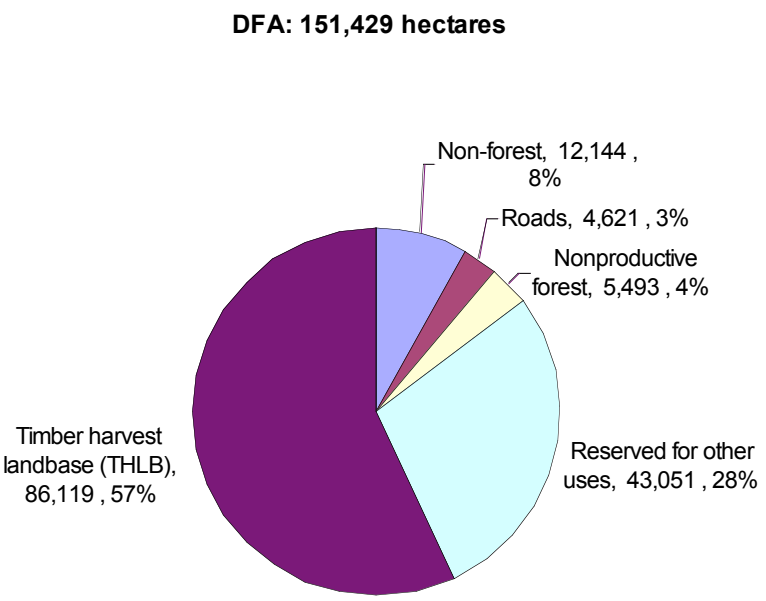
1. Let us first consider ***area***.

   The DFA productive forest area is 133,791 ha with roads and 129,170 ha. excluding existing roads. The productive forest measure includes all forest areas except those with very low productivity (often called non-productive or scrub).

   The area we need to consider for harvesting purposes however, is the ***timber harvesting landbase (THLB)***. Productive forest includes riparian buffers and other areas/reserves that are in fact not actually managed for growing and harvesting trees – they are reserved. The timber harvest landbase in the DFA is 86,119 ha. This measure reflects the area that is actually being managed for growth and timber harvest. The THLB is sometimes referred to as the operable or available (for timber management) area.

   When estimating the LTHL we reduce the THLB even further to account for the loss of future productivity on roads that will occur in yet undeveloped areas. The resulting long-term THLB is estimated at 84,285 ha.

2. The second major component in our estimation of the LTHL is ***projected growth***.



In this exercise we are visualizing the future managed forest in which all areas in the THLB have been harvested at least once and are managed according to our defined management strategy.

The growth of forest areas (stands) varies according to site productivity, species and management inputs and constraints. Plots (small areas of trees) have been measured throughout the second-growth forest for up to 50 years plus. The measurements have covered a wide range of growing site and management situations. This data has been used to develop ***yield models*** – models for predicting future volumes for stands of defined site productivity (growing capacity of the soil), species and management (e.g. number of planted seedlings).

The potential volumes predicted in yield models are adjusted to reflect operational realities. ***Operational adjustment factors*** include allowances for small non-productive areas (e.g. rock and wet areas) not recognized in the forest inventory, epidemic impacts of insects and disease and logging breakage and waste.

It is useful to now introduce a measure of the average rate of growth of a stand called ***Mean Annual Increment (MAI)***. The MAI of a stand (area of forest) is measured in cubic meters/ha/year.

For reference as you read through the paper you can think of ***cubic meters*** in this way. A logging truck you would normally see on the highway holds about 40

cubic meters of logs, while an off highway truck carries about 90 cubic meters of logs. So the volume from the 10 ha stand described below is about 100 highway truck loads.

- For example a 10 ha stand has a volume of 4,000 m^3 at age 50.
- The average volume per ha is 400 m^3 (4000 m^3 divided by the 10 ha).
- The average rate of growth (the MAI) over the 50 years is 8 m^3/ha/year (400 m^3/ha divided by 50 years).

- Looking 20 years into the future at the same stand (now 70 years old), we estimate the stand volume to be 7,000 m^3 or an average of 700 m^3/ha.
- At this time the MAI (average growth rate) will be 10 m^3/ha/year (700 m^3/ha divided by 70 years).

As we see from our example, the MAI (growth) of a forest area (stand) varies with the age of the trees. It also varies with soil productivity, tree species and management. It is expected that in the DFA, harvest ages will likely vary from 35 years to more than 120 years, harvest volumes from less than 300 m^3/ha to 1,000 m^3/ha plus and average growth rates from around 1 m^3/ha/year to more than 15 m^3/ha/year. The current timber supply analysis of the DFA, indicates an average long-term MAI of approximately 10.1 m^3/ha/year. Associated with this MAI are:

- An average rotation (harvest age) of approximately 80 years
- And consequently an average volume at harvest of 808 m^3/ha (80 years X 10.1 m^3/ha/yr)

Again, the projected MAI of 10.1 m^3/ha/year and the volume of 808 m^3/ha at age 80 are the average of wide ranges of soil productivities, management situations and rotation ages throughout the DFA.

Recent experience in harvesting second-growth has resulted in lower volumes and harvest ages on average than the projected average of 808 m^3/ha at 80 years[(1)] . The differences are largely explained by the following:

- The current second-growth harvest is mainly from naturally established stands. These current harvest areas have a more irregular stocking, including more unstocked gaps than our expectations for today's managed stands. In the analysis, volume estimates for the older second-growth areas (currently older than 40 years) averaged approximately 15% lower because of this stocking effect.

- The analysis applies a yield increase to account for gains expected from using seedlings from parent trees selected for superior growth performance (tree improvement). These gains are not present in trees harvested today.

- Most of the current harvest is from higher than average sites and hence with shorter rotations (younger harvest ages) than the average.

- The model schedules harvest from different areas to maximize the harvest (subject to constraints) over the analysis period. Operationally the order (schedule) of harvest may vary for practical reasons.

3. The next step is to combine the long-term timber harvesting land base and the forest average MAI to estimate the ***long-term harvest level***.

   The long-term THLB X forest average MAI = LTHL
   84,285 X 10.1 m^3/ha/year = 851,000 m^3/year (the LTHL)

   This is an estimate of the sustainable timber harvest in the long-term given the landbase and assumptions on management and forest growth.

   Note that the current forest growth for the DFA THLB is estimated at 545,000 m^3/year, considerably less than the LTHL of 851,000 m^3/year. This is largely because 32% of the current THLB (refer to the age class distribution on page 6) is old-growth. In our projections, we assume that overall, old-growth is not growing. This assumption is supported by plot measurements in old-growth that show on average decay and mortality in some areas is balanced by new growth in other locations in old-growth stands. Forest growth in the THLB will increase as harvesting of the old-growth and re-establishment with actively growing new forest proceeds.

   The LTHL changes as changes occur in our forest management practices and as information on forest growth improves.

- Examples of recent changes in management practices:

  Establishment of additional parks and protected areas during the 1990s in the McBride (top end of Great Central Lake) and Carmanah/Walbran areas. The result is a reduction in the THLB and hence in LTHL.

  Weyerhaeuser introduced its BC Coastal Forest Strategy in 1998. The variable retention and old-growth stewardship zones reduce the THLB and also reduce the growth of regenerated stands (through increased crown competition from retention areas). Allowances for these effects were made in the TFL 44 Management Plan (MP) #4 analysis, resulting in a 10% reduction in the LTHL. The same allowances have been made in this DFA analysis. A Management Plan is developed by the company and submitted to the MoF in order to facilitate the Chief Forester's determination of the AAC.

  This analysis includes allowances for draft OGMAs in most landscape units. This further reduces the THLB relative to that assumed in the TFL 44 MP #4 analysis.

  Planted trees are increasingly grown from genetically selected seed. The resulting increased growth rates will translate into an increase in the LTHL.

- An example of changes in information:

  Improved estimates of soil productivity (often called site index) have resulted in an increase in growth projections and hence the LTHL by more than 25% in the DFA. This increase in growth was first applied in the TFL 44, MP #3 timber supply analysis in July 1997. The resulting increase in the LTHL has been offset by the reductions to the THLB that occurred during the 1990s (protected areas, increased net-downs for riparian areas, unstable terrain and non-timber values and variable retention).

- Further changes will occur in the next few years – including:

  Changes to the draft OGMAs and establishment of OGMAs in the Henderson and Effingham landscape units.

  Definition of tenures (areas) for Bill 28 AAC allocations remaining within the DFA

  Refinements in volume projections and management (including harvest) strategies.

In summary – we have estimated the forest growth and hence the timber harvest that is sustainable in the long-term. The long-term timber harvesting landbase of 84,285 ha combined with an average growth rate of 10.1 m^3/ha/year gives us a long-term forest growth rate or harvest level of 851,000 m^3/year.

This future forest includes a wide range of growing sites and management conditions – but in a simple sense is further characterized by an average rotation (harvest age) of 80 years with an average harvest volume of 808 m^3/ha.

SHORT-TERM HARVEST LEVELS THAT ARE CONSISTENT WITH THE LONG-TERM SUSTAINABLE HARVEST RATE:

Now we move to a short-term focus. What harvest levels in the short-term (the next 5 years) and in the medium-term (say years 6 to 50) are consistent with our objectives and are sufficiently in-line with the long-term harvest level? A reminder again that the LTHL is based on projections of a largely second growth forest, while in reality our forest is composed of about 32% old growth still. This is one of the factors that will impact actual shorter term harvesting.

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1. The current THLB ***age-class distribution*** is a good indicator of timber volumes that are currently available for harvest. Let us look at two examples before describing the age class structure in the DFA.

Example #1

Consider first a forest that is managed on a 30-year rotation (harvest age) and has much of its area in younger age classes. In this example there is a shortage of mature stands to support the harvest as projected by the LTHL.

Forest A		
Age Classes	**Area (ha)**	**Average ha/year**
1-10	10,000	1,000
11-20	5,000	500
21-30	3,000	300
Overall (1-30)	**18,000**	**600**

The older age-class (20 to 30) supports a harvest of only 300 ha/year. In the longer-term the 18,000 forest provides an average harvest of 600 ha/year (18,000 ha divided by the 30-year rotation). The harvest will increase over time. New Zealand is an example of this situation. In 2001 the harvest of exotic conifer amounted to 18 million m^3. With the current area planted (significantly more in young age classes compared to in older age classes), the annual harvest is expected to increase to approximately 34 million m^3 in 20 to 25 years time.

Example #2

In this example, there is more than ample mature trees to cut the LTHL and in fact, it would be to your advantage to cut more than the LTHL, if your goal is to move in that direction over time.

In our second example consider an untouched natural forest of area 600 ha with an average volume of 800 m^3/ha. In developing a plan for managing the area, we project a 60 year rotation with a yield of 600 m^3/ha at age 60 (a mai of 10 m^3/ha/year) for the future managed forest. If we harvest the forest over 60 years then the current harvest rate is 10 ha (600 ha divided by 60 years) at a volume of 800 m^3/ha or a total of 8,000 m^3/year. The LTHL however, is lower at 6,000 m^3/year (10 ha times 600 m^3/ha). In this situation the current age class distribution and standing timber volumes support a short-term harvest level that is higher than the LTHL.

Now let us look at the current age class distribution in the DFA.

DFA		
Age Class	**THLB ha – end of 2005**	**% of Total THLB**
0-20	21,766	25.3%
21-40	15,371	17.8%
41-60	11,817	13.7%
61-125	9,614	11.2%
125 plus	27,551	32.0%
Total	86,119	100%

The current forest structure is a mixture of old-growth and regenerated stands. The LTHL of 851,000 m^3/year is based on management with an average harvest age (rotation length) of approximately 80 years. In this future forest one would expect a regular distribution of age classes, with approximately 25% of the THLB older than 60 years. The current age class distribution has 43% (11.2% plus 32.0%) of the THLB older than 60 years. This suggests that there is sufficient inventory available for harvest, for us to cut more than the LTHL in the short-term.

Note that there are other factors that may limit the availability of these older age classes for harvest (e.g. constraints such as reduced harvest rates in visual landscape areas, the requirement for harvested areas to green-up before adjacent areas are logged and minimum requirements for old forest). The timber supply analysis attempts to recognize these additional complexities.

2. The ***harvest flow strategy*** can have a significant effect on harvest levels in the short-term.

Harvest flow strategy refers to variations in harvest that are permitted relative to the current harvest level and the LTHL. Of interest are the harvest levels that occur between now (current harvest levels) and the longer-term goal (the LTHL).

Overall objectives determine harvest flow strategy. Let us look at some examples:

- The Ministry of Forests (MoF) is required to consider both short and long-term implications and the economic and social objectives of government. It is necessary that their approach allow for some flexibility. It appears that their strategy allows for:

  A change in harvest level by up to 10% to 12% per decade.

  Harvest to drop below the LTHL for a period in the medium-term as long as it stays at or above the estimated LTHL of the natural (not managed) forest.

- Company harvest flow objectives for TFL 44 have been to:

  Gradually adjust harvest levels towards the best estimate of the LTHL for the forest:

  In 2002 the recommended AAC contribution for TFL 44 excluding Clayoquot Sound for MP #4 was reduced to 1,675,000 m^3/year from the 1,724,000 m^3/year in MP #3. Note that the estimate of the LTHL for this area was 1,555,000 m^3/year.

TFL 44 (excluding Clayoquot)	
Period	**Harvest Level (m^3/year)**
MP #3 (1998-mid 2003) AAC Contribution	1,724,000
MP #4 (2003 -mid 2007) AAC Contribution	1,675,000
Projected for 2008-2012	1,625,000
Projected for 2013-2017	1,575,000
Projected LTHL	1,555,000

Limit harvest reductions per decade to no more than 10% unless greater reductions are necessitated by timberland reallocation to higher land use:

> The MP #4 analysis base option for TFL#44 projected harvest levels decreasing by 50,000 in five years, another 50,000 in 10 years (a reduction of 6% over the 10 years) and then to the LTHL of 1,555,000 m^3 in 15 years (note that this projection will change at the next analysis depending upon land-base, management practices in place and information available at that time).

The analysis for the current DFA also shows a gradual decline in harvest from the current AAC allocation of 1,011,637 m^3 to the estimated LTHL of 851,000 m^3/year:

DFA (December 2006)	
Period	**Harvest Level (m^3)**
First 5 years (2006-2010)	1,012,000
2011-2015	961,000
2016-2020	913,000
2021 plus	851,000

- Some groups, usually not directly dependent on economic output from the forest industry, recommend a policy of non-declining even flow. This means that the harvest in any given period (e.g. over 5 years) is no greater than the harvest in any future period.

  In the MP #4 analysis, the non-declining even flow harvest for TFL#44 was estimated as 1,558,200 m^3/year. Relative to the "transition approach" described for the MP #4 base option, the non-declining even flow method results in a more abrupt change in current harvest levels (1,724,000 to 1,558,200 rather than to 1,675,000) and hence a significant decrease in harvest opportunities for the next 15 years. These changes are offset somewhat by a small (3,200 m^3/year) increase in the LTHL. In other BC Coastal forests the difference between the two approaches is more dramatic.

DETERMINATION OF THE ALLOWABLE ANNUAL CUT (AAC):

What we have described in the above sections, are many of the factors that are incorporated into a timber supply analysis, and considered by the Chief Forester in an AAC determination. Refer to the attachment "Considerations for the BC Chief Forester in establishing an Allowable Annual Cut ".

The determination of a short-term harvest level, the AAC (for the next 5 years), Is in a simple sense, based on the current age class distribution of the timber harvesting landbase and the harvest flow objectives for adjusting harvest levels from the current rate to the estimated long term harvest level.

The re-determination of the AAC every 5 to 10 years allows for a regular adjustment of harvest levels according to changes in management and information.

NOTES:

1. During the three years from 2000 – 2003 the average age of harvest for 2nd growth has been 64 years and the average MAI for these harvested stands is estimated at 9.2 cubic meters/ha/year.

Attachment:

Considerations for the BC Chief Forester in establishing an Allowable Annual Cut (excerpted from the BC Forest Act)

In determining an allowable annual cut under subsection (1) the chief forester, despite anything to the contrary in an agreement listed in section 12, must consider

(a) the rate of timber production that may be sustained on the area, taking into account

(i) the composition of the forest and its expected rate of growth on the area,

(ii) the expected time that it will take the forest to become re-established on the area following denudation,

(iii) silviculture treatments to be applied to the area,

(iv) the stand of timber utilization and the allowance for decay, waste and breakage expected to be applied with respect to timber harvesting on the area,

(v) the constraints on the amount of timber produced from the area that reasonably can be expected by use of the area for purposes other than timber production, and

(vi) any other information that, in the chief forester's opinion, relates to the capability of the area to produce timber,

(b) the short and long term implications to British Columbia of alternative rates of timber harvesting from the area,

(c) the nature, production capabilities and timber requirements of established and proposed timber processing facilities,

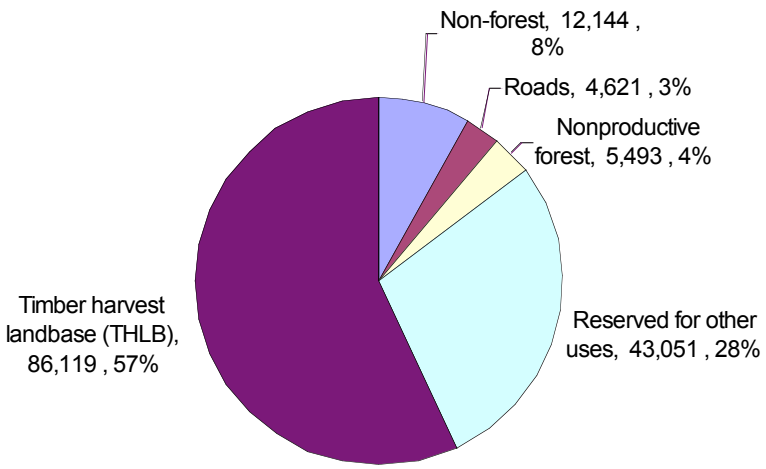
(d) the economic and social objectives of the government, as expressed by the minister, for the area, for the general region and for British Columbia, and

(e) abnormal infestations in and devastations of, and major salvage programs planned for, timber on the area.

SUSTAINABLE HARVEST SUMMARY

The Timber Harvest Land Base (THLB) is 57% of the current DFA area of 151,429 ha

DFA: 151,429 hectares



Long Term Harvest Level

- Assumes a future forest (THLB) that is completely second growth.
- Assumes a mean annual increment (growth rate) at 10.1 cubic meters/year.
- Assumes that the average age of harvest will be 80 years.
- Assumes that this will yield an average volume of 808 cubic meters/ha.

The LTHL is: 851,000 cubic meters/year

Shorter Term Harvest Levels

- The current AAC is 1,011,637 cubic meters/year
- The overall harvest flow strategy is a gradual ramping down to a harvest level that will be sustainable (LTHL) into the foreseeable future with no more than a 10% reduction/decade.

Age Class Inventory Implications

In the future second growth forest we would expect a regular distribution of age classes with approximately 25% of the THLB older than 60 years. Currently, 43% of the THLB is older than 60 years. This suggests that there is sufficient inventory to harvest more than the LTHL in the short-term.