Cortex Consultants

Haida Gwaii / Queen Charlotte Islands LUP Timber Supply Analysis

Analysis of Base Cases

November 17, 2004

prepared for: **Ministry of Sustainable Resource Management**

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Acknowledgements

The analysis team would like to thank Leah Malkinson and John Sunde of the Ministry of Sustainable Resource Management for their guidance and participation in this project. We would also like to thank Jim Brown of the Ministry of Forests, for his advice regarding this study's representation of the TSR base cases, and his review and consideration of the results presented in this report.

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1.0 Introduction

A strategic Land Use Planning process for Haida Gwaii /Queen Charlotte Islands is currently underway, with a central goal of the LUP to develop a comprehensive ecosystem-based and balanced land use plan that: (i) protects ecosystem integrity; (ii) maintains spiritual, cultural values; (iii) enhances sustainable economic opportunity; and (iv) fosters social and community well-being.

With this goal in mind, Cortex Consultants Inc. and Gowlland Technologies Ltd. were retained to provide technical support to members of the LUP (via the Process Technical Team, or PPT) by projection and analysis of the timber supply implications of proposed LUP land management scenarios using a linked suite of modeling tools.

This study has three objectives.

1. The first objective is to provide spatial timber supply base cases for Haida Gwaii/QCI. A timber supply base case illustrates the effect of current management practices on the supply of timber using the best available information, and provides a reference point for determining the impacts of different management practices.
2. The second objective is to analyse various scenarios that specify different management practices and to quantify their effects on timber supply, and to compare their results to the base case scenarios.
3. The third objective is to generate environmental indicators for selected base case and management scenarios. These environmental indicators are inputs to other analyses that support the environmental assessment requirements of the LUP.

This report describes the results of the analysis of the base cases. The modeling assumptions are described fully in a separate report (Cortex, 2004) and the application of the environmental indicators that were generated for the base cases will be described in project reports developed for the various environmental values of concern to the LUP.

2.0 Overview of Methods

2.1 Building the Landbase

Forest management on Haida Gwaii /Queen Charlotte Islands extends across four forest management units: The Queen Charlotte TSA (Ministry of Forests), TFL 25 (Western Forest Products), TFL 39 (Weyerhaeuser) and TFL 47 (Teal/Jones Group). *Gwaii Haanas National Park Reserve and Haida Heritage Site* covers the southern portion of Moresby Island and various provincial parks and reserves occupy the remainder of the islands. The Queen Charlotte TSA, TFL 39, TFL 47 and TFL 25 are spatially modeled for base case timber supply (explicitly reflecting spatial requirements such as adjacency, and providing spatially explicit information on stand conditions), reflecting TSR 2 assumptions (with some modifications). *Gwaii Haanas National Park Reserve and Haida Heritage Site*, the provincial parks and reserves, and the inoperable (non-contributing) land base are also spatially modeled for growth and natural disturbance, and their contribution to regional level biodiversity (old seral retention) and habit supply requirements.

The landbase for the QCI LUP Timber Supply Analysis was developed using source data provided by MSRM. The source data contains the most up-to-date TSR datasets for each management unit, as well as national and provincial park information. Updates and overlays were completed to produce a landbase that meets current management objectives and reflects current management assumptions. The source data also reflects current logging history up to 2003.

The riparian management areas of QCI TSA were updated with spatial representation.

Updated spatially-explicit riparian management zones were implemented on the THLB for QCI TSA, replacing the aspatial netdowns used to represent riparian management areas in the most recent TSR. This resulted in a loss of THLB for the QCI TSA. For a more detailed explanation please refer to the Timber Supply Modeling Assumptions report, Section A.2.1.1. The riparian reserve and riparian management zones were already spatially represented on the other management units.

The operable landbase was adjusted.

The operable land base has been updated to reflect current practices. For the QCI TSA, the landbase was adjusted to include additional operable area where heli-logging is occurring. For TFL 47 the operable landbase was increased by the inclusion of additional mid-volume cedar.

The THLB was converted to binary representation (contributing/non-contributing).

One of the objectives of this analysis is to convert the contributing landbase from proportional inclusion factors to a binary THLB layer, where each cell is designated as either contributing or non-contributing. This process results in a slightly different landbase, but ensures that each cell or polygon is either contributing or non-contributing. For a more detailed explanation of the spatialization process please refer to Section A.2 of the Timber Supply Modeling Assumptions report.

Datasets were generated for each modeling system.

Using the updated landbase, raster and polygon datasets were generated for modeling each scenario described in section 2.2, using the systems described in section 2.3. The Woodstock modeling system is aspatial but uses polygon information to produce the model's inventory input file. The polygon information is represented as themes in the model. The Haida Gwaii

Landscape Model (HGLM) modeling system is spatial and uses raster grids as the inventory input files. Each theme in the model must have a corresponding raster grid. The Woodstock polygon coverage was used to produce the HGLM raster grids ensuring both models used the same landbase themes and source data.

2.2 Development of Scenarios

Three base case (BC) scenarios were evaluated, each of which reflects different landbase and management assumptions.

Base Case 1 (BC1) – Recreating TSR 2

The objective of BC1 is to recreate the TSR 2 forecast for each management unit using TSR2 modeling assumptions and to demonstrate that the modeling systems used in this study can produce similar results to those documented in the TSR timber supply analysis reports. The results are unlikely to be identical due to changes in the inventory and different yield assumptions.

Base Case 2 (BC2) – Spatial 2004 Base Case Forecast

The objective of BC2 is to create an updated '2004' base case forecast for each management unit, consistent with current TSR methodology, that

- includes updated assumptions to reflect 'current management'
- is spatially explicit, i.e., inputs are spatially explicit (riparian zones, roads and retention blocks), and the resulting harvest schedule is spatially defined.

The changes affected the THLB in two units. In the QCI TSA a spatial representation of the riparian areas was implemented and 2588 ha of low-site cedar stands that are currently deemed economically operable by helicopter logging were included in the THLB. In TFL 47, low volume (<200 m^3/ha) old (>250 years) cedar-dominated stands were included in the THLB to reflect current harvesting practices.

Comparing BC2 and BC1 isolates the impact on the timber supply of these changes in management assumptions and the spatial inputs and outputs.

Base Case 3 (BC3) – Current Reality Scenarios

The objective of the BC3 scenarios is to create alternative Base Case scenarios that reflect three additional current management practices believed to be occurring, but not modeled in Base Case 2 because they are not legislated management requirements.

Base Case 3a (BC3a) removes Haida Protected Areas from the landbase contributing to the cut in QCI TSA, TFL 39, and TFL 47. These areas have been largely deferred from harvesting, e.g., a temporary Part 13 Order established over Duu Guusd has prohibited harvesting in this 148,880 ha area (15,900 ha operable).

Base Case 3b (BC3b) applies an additional assumption of 20% retention within cutblocks to the BC3a landbase (Haida Protected Areas removed), to reflect recent survey information and local feedback indicating significant levels of cutblock retention.

Base Case 3c (BC3c) applies BC3b management assumptions (additional retention and Haida Protected Areas removed), but constrains the cut in TFL 39 to not exceed 600,000 m^3 per year, reflecting a current agreement between Weyerhaeuser and the Council of the Haida Nation.

Table 1 lists the area of THLB determined for each scenario.

Table 1. Area (ha) of the timber harvesting land base (THLB) determined for each scenario

Scenario	QCI TSA	TFL 25	TFL 39	TFL 47	HG/QCI
TSR	82,373	25,166	119,030	17,564	244,133
BC1	81,918	25,080	119,136	17,574	243,708
BC2	74,993	25,091	116,435	19,466	235,985
BC3a	50,789	25,081	108,970	18,694	203,534
BC3b	40,804	20,094	92,645	15,007	168,497
BC3c	40,804	20,094	61,951	15,007	137,803

2.3 Modeling Systems

The analysis of the base case scenarios is required to produce two types of information:

- timber supply forecasts that are technically acceptable
- spatially explicit indicators of environmental state that can be used to drive critical habitat models and ecological risk assessments

Furthermore, the analytical system must simultaneously schedule the four management units on Haida Gwaii (TFL 25, TFL39, TFL47 and the QCI TSA) and, subsequent to the base case analysis, efficiently process many scenarios and sensitivity analyses.

Two models are being utilized in the QCI LUP timber supply analysis, and a third model has been developed to report on environmental indicators.

The first model, the Haida Gwaii Target Model (HGTM), uses the spatial modeling system Woodstock/Spatial Woodstock/Stanley. Woodstock is a strategic forest estate model that uses linear programming to solve models with complex management themes, objectives, and forest cover constraints. Woodstock generates an "optimum" schedule for timber harvesting, given certain management assumptions, objectives, and forest cover constraints. Although the inputs to Woodstock and some of its functionality are spatial, the outputs are not spatially explicit—they do not place cutblocks or roads on the landscape. This means that the optimized harvest solution does not account for spatial constraints such as the construction of road networks needed to meet a harvest schedule, or report out on spatial impacts of harvesting to habitat for species at risk.

The second model, the Haida Gwaii Landscape Model (HGLM), was developed using the Spatially Explicit Landscape Event Simulator (SELES; Fall and Fall 2001). SELES provides a structured modeling framework for performing spatially explicit operations, and for developing and executing spatial landscape simulation models. The HGLM was designed to be capable of spatializing a Woodstock harvest schedule or to make spatial timber supply assessments independently using a simulation approach that effectively spatializes the FSSIM (Forest Service Simulator) model used by the BC Ministry of Forests for timber supply analysis. This latter functionality was based on a spatial timber supply model developed in collaboration with Forest Analysis Branch and implemented in SELES (Fall 2003).

HGLM implements an optimized Woodstock harvest schedule by scheduling and building roads and locating and placing harvest blocks according to spatial constraints not represented in the Woodstock model. The result is an optimized harvest schedule that is realistically modeled across the landbase given real-world spatial constraints like road networks, riparian reserves, and variable retention.

As a stand-alone spatial timber supply tool, experiments can be designed in which multiple simulations of the HGLM are used to converge on maximal sustainable harvest flows. Comparing the results of the two approaches showed that the simulation approach identifies similar harvest flows to the optimized Woodstock schedules, and results presented in this report were derived using the simulation approach.

The outputs of the Haida Gwaii Landscape Model include harvest flow indicators, and maps and time series of analysis units (types of forest based on species and productivity), stand age, and road networks. These outputs are the basic information needed to predict impacts of timber harvesting on environmental indicators.

The third modeling system is the Environmental Indicators Models. This group of models, also implemented using SELES, uses the spatial outputs of the Haida Gwaii Landscape Model to provide information on the impacts of the proposed harvest schedule(s) on several indicators of ecological integrity. These include summaries of habitat for species at risk (marbled murrelet and northern goshawk), hydroriparian impacts, old-growth representation, and road impacts.

Among the interesting innovations of the Environmental Indicators Model are its ability to estimate the number of stream crossings required to harvest a given volume of wood, which provides information on impacts to hydroriparian values, and to estimate the wood volume transported on roads, which can be translated into measures of traffic volume, a useful indicator of impact to species such as black bear.

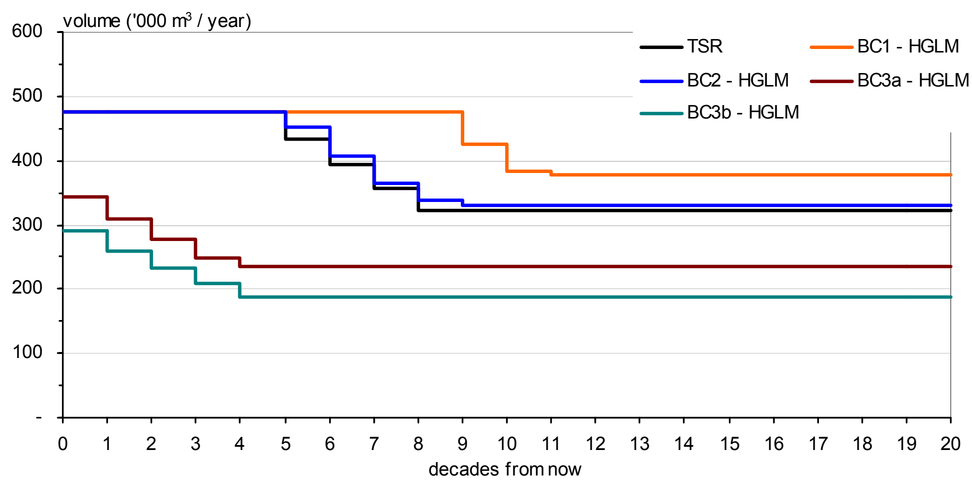
3.0 Analysis Results

This section reports for each scenario, including the most recent TSR base case, the main indicator of timber supply—the schedule of annual harvest volume—and an indicator of the state of the residual forest—the total and merchantable inventory volumes on the THLB by decade. These indicators are reported for each management unit and for Haida Gwaii in its entirety. The scenarios are simulated for 40 decades but only the first 20 are plotted.

3.1 QCI TSA

For the QCI TSA, BC1 and TSR show a significant difference in harvest levels beyond decade 5 (Figure 1), with BC1 sustaining the initial harvest level until decade 9, before dropping to a long term harvest level (LTHL) that exceeds the TSR level by 15%.

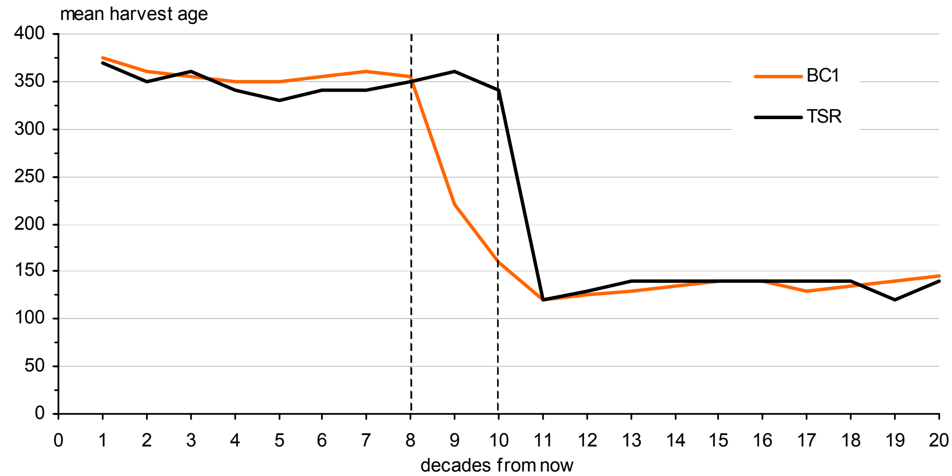
Figure 1. Harvest forecast, QCI TSA.



At the time of the preparation of this document, we were still investigating the cause of this deviation.

One line of investigation concerns the sensitivity of the model to the age at which older stands are harvested. Figure 2 shows the average age of harvest for BC1 and the TSR. In the BC1 analysis, the transition to second growth stands occurs 2 periods before it occurs in the TSR harvest schedule. Other BC1 analyses (not shown) where the model is constrained to follow the TSR harvest ages closely track the TSR harvest schedule through decades 5-8, but still reach a LTHL about 12% higher than that of the TSR.

Figure 2. Mean age of harvest for BC1 and the TSR, QCI TSA.

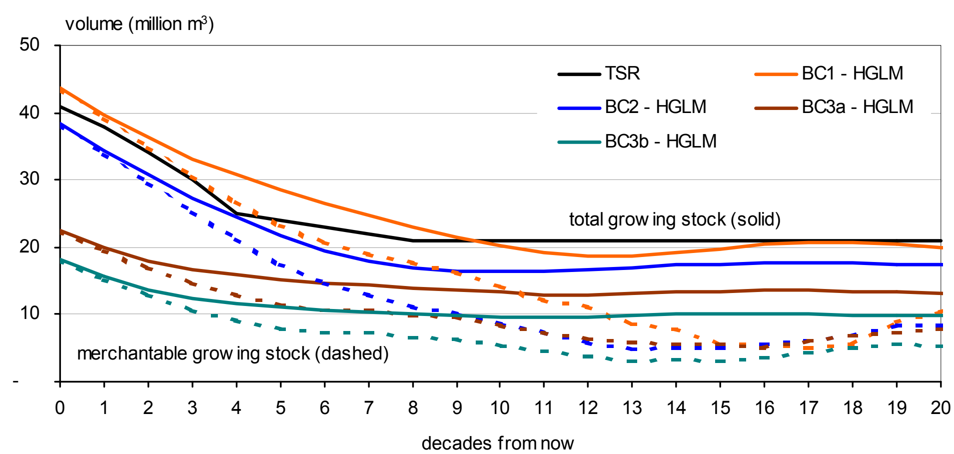


For all other scenarios (BC2, BC3a and BC3b) the harvest forecasts can be rationalized by the decreases in the THLB and increase in stand-level retention.

Figure 3 plots the growing stock (total and merchantable) for QCI TSA. While total growing stock for all scenarios stabilizes at decade 10, the merchantable growing stock drops to about 25% of the total growing stock at decade 16. This is likely a pinch-point in the supply, and in combination with the even-flow constraints that are operating in the long term, this situation is likely suppressing the LTHL. This pinch-point likely plays a role in the difference between BC1 and TSR results.

The initial growing stock in BC1 is at the TSR levels (for both total and merchantable) and the BC1 growing stock forecast is similar to the TSR forecast. As THLB is removed in subsequent scenarios there is a decrease in total and merchantable growing stock in the THLB.

Figure 3. Forecast of growing stock volume on the THLB, QCI TSA.



3.2 TFL 25

The harvest forecast (Figure 4) for TSR and BC1 are coincident until decade 5. Between decade 5 and 14, the HGLM BC1 harvests more volume, but the forecasts are very close from decades 15 to 20. The harvest flow policy implemented in the TSR analysis was to harvest 256 ha per year, even flow. The small deviation noted over decades 5-14 may be attributed to the HGLM model's harvesting of more hectares annually (315 ha, on average).

For all other scenarios the harvest forecasts can be rationalized by the decreases in the THLB and increase in retention.

Figure 4. Harvest forecast, TFL 25.

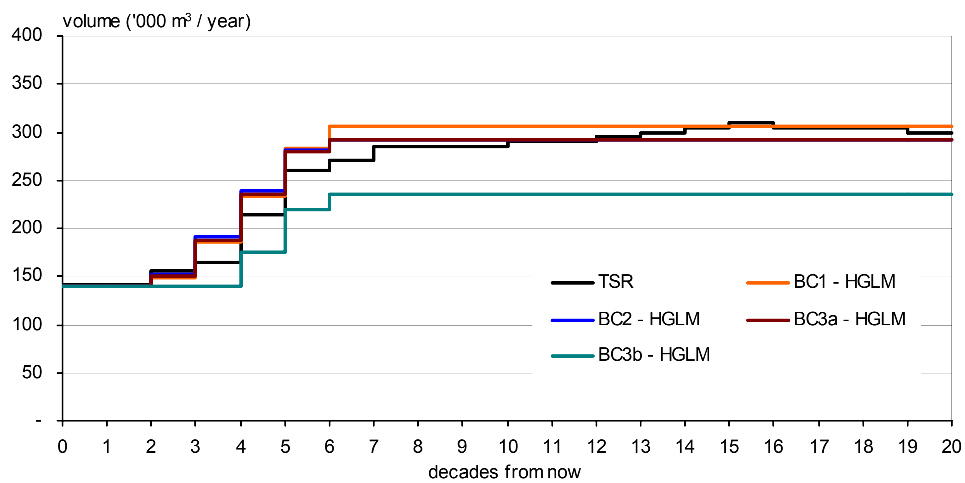
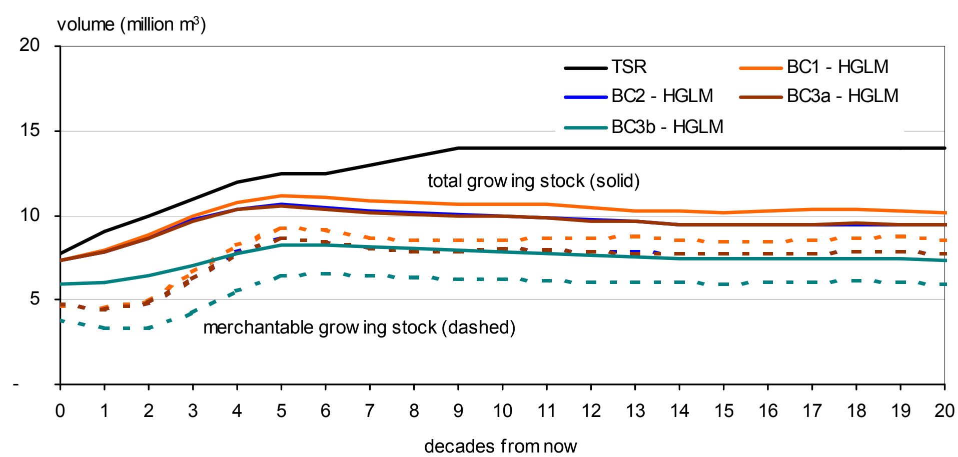


Figure 5. Forecast of growing stock volume on the THLB, TFL 25.

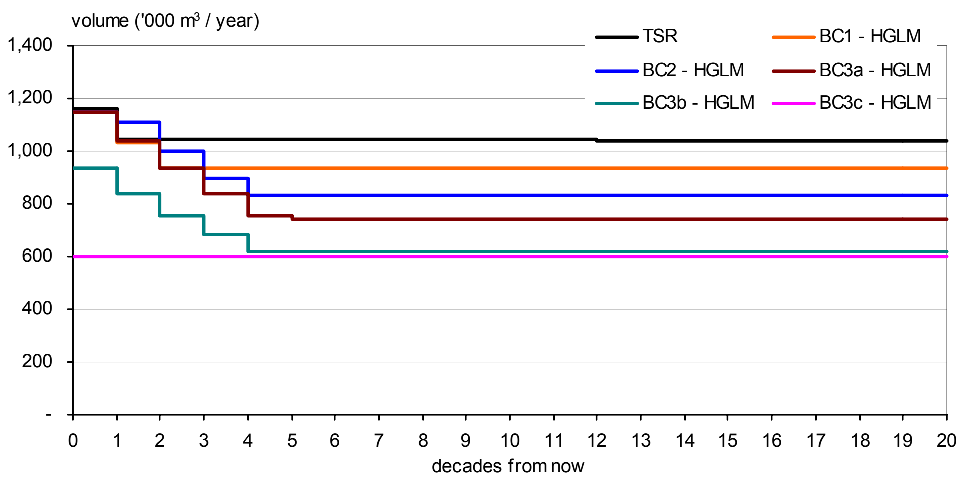


The growing stock (total and merchantable) increases over decade 1-5, before leveling out (Figure 5). The initial growing stock for BC1 is at the total TSR level—the merchantable growing stock was not described in the analysis report. The remainder of the BC1 growing stock forecast shows less stock than is forecast in the TSR. As THLB is removed in subsequent scenarios there is a decrease in total and merchantable growing stock in the THLB.

3.3 TFL 39

The harvest forecast (Figure 6) for TSR and BC1 deviate after decade 2, with BC1 harvesting about 10% less volume. We attribute this to the land base aggregation and yield curves used in HGLM model. TFL 39 aggregated their landbase based on species, density, and site class. Density information was not available to this project and hence the exact yield curve could not be assigned to current inventory. To remove the density factor from the TFL 39 yield curves, we calculated the area-weighted density distribution of each analysis unit from the TFL 39 TSR inventory, and used that distribution to combine the density-based yield curves into a single curve for each analysis unit (based on species and site class). This method was vetted and approved by the licensee, Weyerhauser Corp. (Peter Koefed, pers. comm.). However, the LTHL of BC1 is only 90% of the TSR.

Figure 6. Harvest forecast, TFL 39.

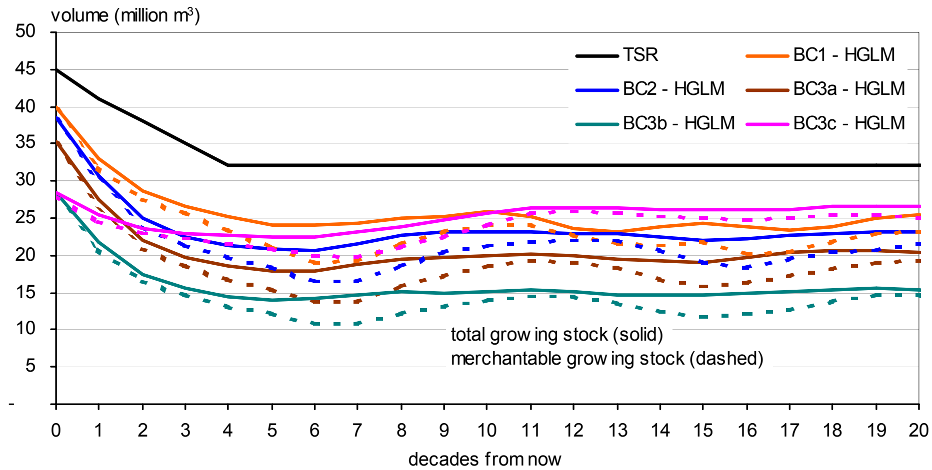


For all other scenarios the harvest forecasts can be rationalized by the decreases in the THLB and increase in retention, or in the case of BC3c, the constraint on the maximum harvest level.

The growing stock (total and merchantable, Figure 7) declines over decade 1-5, before leveling out for the remainder of the 20-decade planning period. Merchantable growing stock rarely drops below 85% of the total inventory volume. There is a 5,000,000 m^3 difference between the initial BC1 and the reported total TSR level. Merchantable growing stock was not shown in the analysis report. At decade 5, the TSR forecast level is 32,000,000 m^3 while BC1 shows 25,000,000 m3.

The growing stock forecasts in subsequent scenarios seem correct (relative to BC1) given the decrease in THLB.

Figure 7. Forecast of growing stock volume on the THLB, TFL 39.

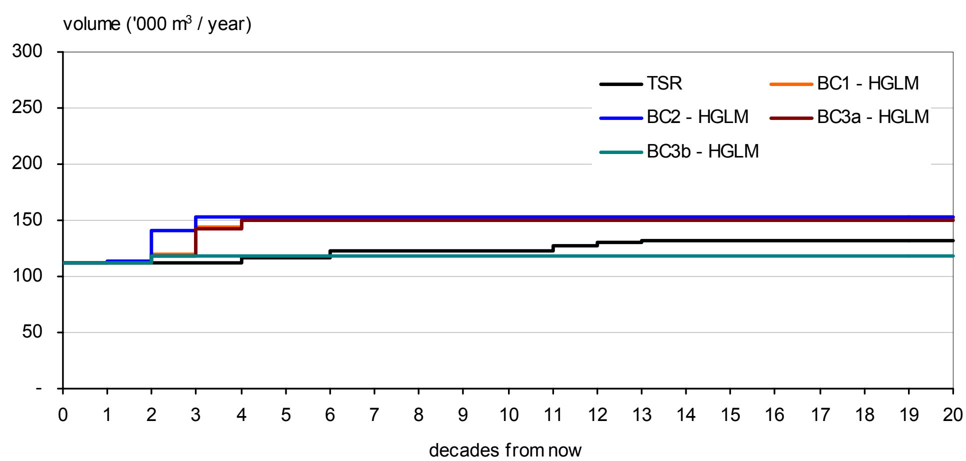


3.4 TFL 47

The harvest forecast (Figure 8) for TSR and BC1 deviate significantly after decade 3. We attribute this to differences in the TSR and QCI LUP inventory and harvest rate decisions implemented in the TSR analysis.

BC2 shows an increase in harvest over BC1 in decades 2-4, due to an increase (11%) in the THLB. The THLB is reduced by over 750 ha in BC3a due to the Haida protected areas, and BC3a is very similar to BC1., The decrease in the harvest for BC3b is attributable to increased retention.

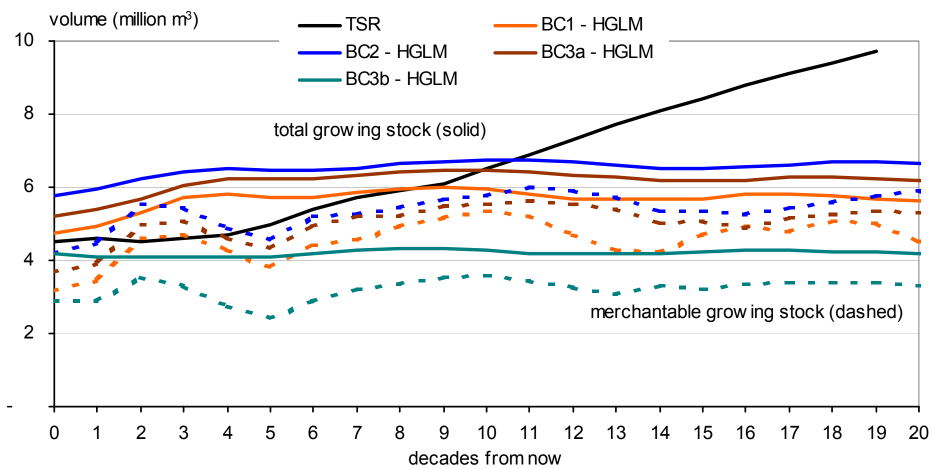
Figure 8. Harvest forecast, TFL 47.



The growing stock forecast (both total and merchantable) for TFL 47 (Figure 9) is stable out to the planning horizon.

The initial growing stock in BC1 is at the TSR level for both total and merchantable. However, the BC1 growing stock forecast is not similar to the TSR forecast. The merchantable growing stock forecast reported in the TSR analysis report shows a significant increase over time, while BC1 shows a relative even-flow. This difference could explain the difference in harvest forecasts, with the lower TSR harvest rate allowing growing stock to accumulate.

Figure 9. Forecast of growing stock volume on the THLB, TFL 47.



3.5 Haida Gwaii / QCI

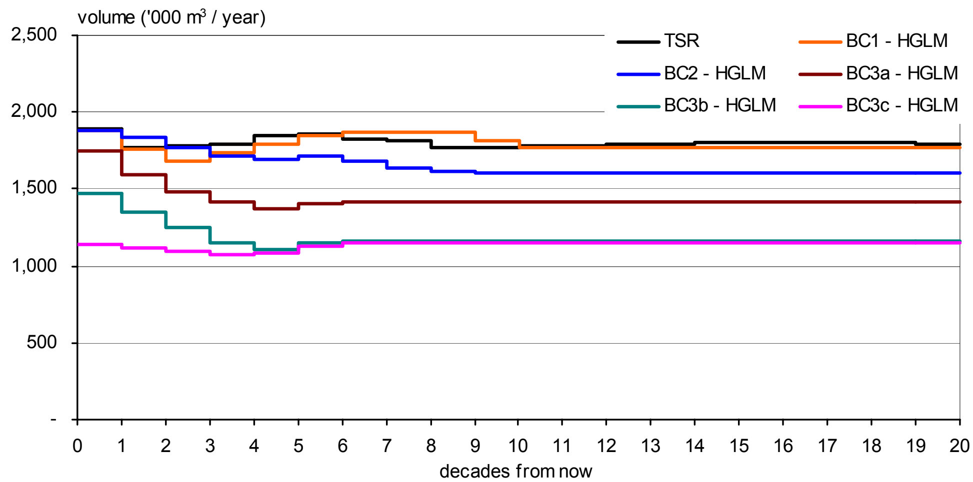
The harvest forecasts for each scenario are summarized for the entire Haida Gwaii/QCI LUP area in Figure 10.

The harvest forecast for scenario BC1 and TSR are generally very close. BC1 shows a slight increase (maximum 6.7%) in harvest level during decades 6-10. The BC1 reflects inventory updates since the last TSR and will have increased amounts of recently harvested managed stands due to updated logging information.

The BC2 results show a decrease in harvest level compared to BC1. This is due to the THLB spatialization process, offset partially by positive adjustments to the THLB in the TSA and TFL 47. Significant amounts of THLB have been lost in TSA 25 (~ 9%), as well as a shift in the land base to low-site cedar in TSA 25.

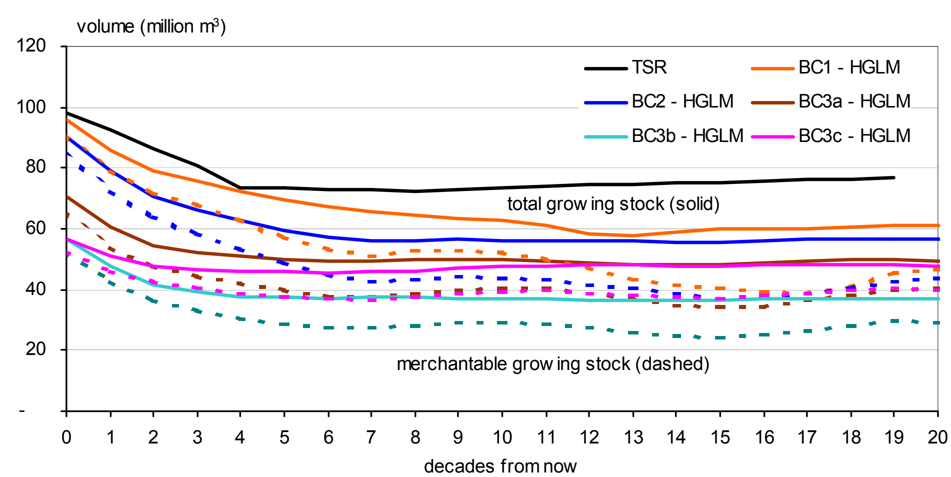
All other scenario results appear logical when compared to BC1 given the decreases in THLB due to Haida protected areas (BC3a), and increasing stand level retention (BC3b).

Figure 10. Harvest forecast, Haida Gwaii /QCI.



At the plan area level (Haida Gwaii), the plot of total and merchantable growing stock is unremarkable, except to note that the total growing stock is forecast to drop to about 60% of its current level by decade 12, while merchantable volume will drop to about 40%.

Figure 11. Forecast of growing stock volume on the THLB, Haida Gwaii /QCI.



3.6 Summary of Impacts

Table 2. Timber supply impacts (first decade and long term) relative to the TSR (2) base case, for each management unit and the HG/QCI LUP area.

	QCI TSA			TFL 25			TFL 39			TFL 47			HG/QCI Plan Area		
Base Case	Harvest '000 m3	Change '000 m3	Change %	Harvest '000 m3	Change '000 m3	Change %	Harvest '000 m3	Change '000 m3	Change %	Harvest '000 m3	Change '000 m3	Change %	Harvest '000 m3	Change '000 m3	Change %
1st decade															
TSR	475	0	0%	142	0	0%	1,160	0	0%	112	0	0%	1,889	0	0%
BC1	475	0	0%	140	-2	-1%	1,150	-10	-1%	112	0	0%	1,877	-12	-1%
BC2	475	0	0%	140	-2	-1%	1,150	-10	-1%	112	0	0%	1,877	-12	-1%
BC3a	343	-132	-28%	140	-2	-1%	1,150	-10	-1%	112	0	0%	1,745	-144	-8%
BC3b	290	-185	-39%	140	-2	-1%	935	-226	-19%	112	0	0%	1,477	-413	-22%
BC3c	290	-185	-39%	140	-2	-1%	600	-560	-48%	112	0	0%	1,142	-747	-40%
Long term harvest level (LTHL)															
TSR	323	0	0%	300	0	0%	1,040	0	0%	134	0	0%	1,797	0	0%
BC1	378	55	17%	306	6	2%	934	-106	-10%	152	18	14%	1,770	-27	-2%
BC2	330	7	2%	293	-7	-2%	832	-208	-20%	153	19	14%	1,607	-190	-11%
BC3a	236	-87	-27%	293	-7	-2%	743	-297	-29%	150	16	12%	1,421	-376	-21%
BC3b	188	-135	-42%	236	-64	-21%	619	-421	-40%	119	-15	-11%	1,162	-635	-35%
BC3c	188	-135	-42%	236	-64	-21%	600	-440	-42%	119	-15	-11%	1,143	-654	-36%

4.0 Literature Cited

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