Appendix III

to

TREE FARM LICENSE No. 47

MANAGEMENT PLAN #3

TIMBER SUPPLY ANALYSIS

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Executive Summary

This appendix to the Management Plan for Tree Farm License No. 47 (TFL 47) examines the sensitivity of the long-term timber supply to a wide range of analytic assumptions and resource considerations. TimberWest believes that the role of a timber supply analysis is to provide reliable information on the long-term timber supply to the public, the Chief Forester of the Ministry of Forests and TimberWest employees and shareholders. This information is then used by the Chief Forester, along with other social, environmental and economic information to assign an allowable annual cut (AAC) for TFL 47 for the next five years. This process ensures that harvest levels of this long-term resource are adjusted with a periodicity that avoids the need for major disruptive changes in the AAC. Each new analysis incorporates new resource information and uses improved analytic approaches.

The Timber Supply Analysis does not test whether forest practices conform with the modelled assumptions of the analysis. Confidence that harvests proposed through simulations are achievable in practice is provided through approved 20-Year Plans. Informed decision-making requires review of both the Yield Analysis and 20-Year Plans. Together they are intended to demonstrate that a given harvest level is sustainable, approvable, and economically viable.

This analysis demonstrates that flexibility in harvest scheduling is the key to maximizing harvest opportunities. In a forest resource such as TFL 47, where harvest opportunities are constrained by non-timber resource considerations, the maximum sustainable harvest level is not determined by the availability of mature timber but by the nature of constraining factors and flexibility of harvest scheduling around these constraining factors. Use of harvest rotations based on first entry age rather than culmination of mean annual increment maximized harvest over both the near and long-terms by improving harvest scheduling flexibility. Strict adherence to harvest rotations based on culmination of mean annual increment resulted in significant reductions in both short and long-term harvest levels.

TimberWest believes that this Timber Supply Analysis demonstrates that a harvest level of 708,300 m^3 per year represents a sustainable and economically viable combined AAC for the Bonanza Lake and Johnstone Strait Management Units of TFL 47. This proposed AAC considers TimberWest's recent decision to phase out clear-cutting in favour of variable retention harvesting and also reflects the reduction in AAC resulting from TimberWest's June, 1997 change in ownership

TimberWest is confident that, within the context of appropriate government policies, it can economically harvest this volume of timber and continue to contribute to employment opportunities and wealth creation in support of both local and provincial economies.

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1. INTRODUCTION

This report summarizes the results of timber supply analyses carried out by TFL Forest Ltd. (TimberWest), for the Johnstone Strait and Bonanza Lake Management Units of Tree Farm License No. 47 (TFL 47). These analyses are part of a periodic review process that examines the short and long-term effects of forest management practices on the availability of timber for harvesting in TFL 47. The intent of this report is to provide an understanding of the timber resource — its availability and interactions with both timber and non-timber values over time. This information is then used to assist the Chief Forester of the Ministry of Forests (MoF) in his determination of an appropriate allowable annual cut for TFL 47.

This report examines the effects of different management approaches and intensities through a series of "timber supply sensitivity analyses". A description of the land base and TimberWest's approach to forest management is presented in the document, "Tree Farm License No. 47 - Management Plan No. 3". The analytic assumptions behind the analysis and supporting information is provided in the "Timber Supply Analysis Information Package for Tree Farm License no. 47" which is appended to this analysis (Appendix I). The "Base Case" for this analysis is intended to reflect current management practices as of January 1, 1998.

Timber Supply projections are made independently for the Johnstone Strait and Bonanza Lake Management Units in TFL 47 for 250 years into the future. The intent of these projections is not to identify precise harvest levels for this period but to examine the implications of different harvest levels on both timber and non-timber values over time. The timber supply projections also provide an opportunity for TimberWest to identify a rate of harvest that is approvable under current regulations, economically feasible, and is sustainable over time.

2. DESCRIPTION OF TFL 47 MANAGEMENT UNITS

The Management Units of TFL 47 are described in Section 1.1 of Management Plan No. 3. A brief summary of the total and timber harvesting land base for each Management Unit is provided below. Further details on the harvestable land base determination can be found in Table 3 of the Timber Supply Analysis Information Package for Tree Farm License No. 47 (Appendix I)

Table 1. Timber harvesting land base – Johnstone Strait and Bonanza Lake Management Units of TFL 47

Management Unit	Total Land-base	Total Long-term Harvestable Timber Base
Johnstone Straits	101,847	71,260
Bonanza Lake	38,020	21,676
Total Area	**139,867**	**92,936**

3. MODELING PHILOSOPHY

3.1 MODELED VERSUS ACTUAL HARVEST

Timber Supply Analyses are intended to provide insights into potential harvest levels and their impacts over the long-term. In response to the rapidly changing environment for harvest planning, decision-making models used in carrying out these analyses have become increasingly sophisticated and complex. While these models can simulate harvest levels under multiple constraints they are not expected to simulate actual harvest plans.

The COMPLAN model used in the current Timber Supply Analysis is described in Section 4.0 of the Timber Supply Analysis Information Package for Tree Farm License no. 47 (Appendix I). The model identifies candidate stands for harvest on the basis of species, age and site and uses harvest constraints to simulate operational planning considerations such as maintenance of forest cover, and harvest constraints associated with non-timber considerations such as viewscape, biodiversity, riparian zones, etc. Candidate stands are then placed in an "oldest first" queue for harvest. Tests are then made to determine how much of the stand can be harvested before any constraints are violated. Eligible stands, or portions of stands, are then harvested until harvest targets are met or no further eligible stands exist (failure to meet target).

While the modeling process provides an adequate picture of harvest opportunities over time it does not depict the harvest of actual cutblocks across the landscape. Due to the "oldest first" harvest order it will also tend to harvest the remaining eligible old growth more quickly than will actually occur operationally. Operational harvest plans must consider issues such as access and adjacency, which are not rigorously modelled in the timber supply analysis. Confidence that harvests proposed through simulations are achievable in practice is provided through approved 20-Year Plans. Informed decision-making requires review of both the Yield Analysis and 20-Year Plans.

3.2 TARGET HARVEST LEVELS

Proposed harvest flows targeted in the harvest simulations do not focus on achieving evenflow harvest levels. Due to significant changes in the levels of growing stock and variation in eligibility for harvest due to harvest constraints there is an almost infinite number of harvest levels that can be selected. In this analysis, harvest targets are set to approximate the maximum level that be achieved without "major" fall-down events. Occasional failures to meet target harvest levels can be desirable in terms of modeling

and analysis as they can provide meaningful insights into achievable harvest levels and harvest-limiting constraints. The overall intent of these analyses is to demonstrate, and provide insights into, the cause, timing, and magnitude of future harvest restrictions.

Harvest targets are identified by examining the relationship between harvest and growth during each period. This allows identification of periodic surpluses and deficiencies in growth and provides guidance on the appropriate target harvest levels.

4. RESULTS

Results are presented for each Management Unit individually. The harvest level simulated during the first four 5-year periods is based on average harvest levels proposed in the 20-year plan for each Management Unit. Harvest levels targeted for the remaining 230 years of each simulation attempt to approximate the maximum harvest level that can sustain relatively even harvest flows.

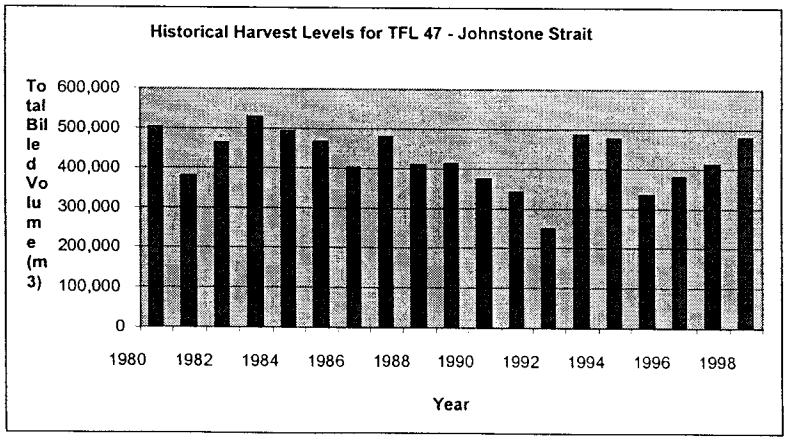
4.1 JOHNSTONE STRAIT

The Johnstone Straits Management Unit of TFL 47 is unique among the coastal Tree Farm Licences in that the majority of the volume harvested from this Management Unit over the past decade has been second growth. 10% of the harvestable land base is currently old growth (e.g., greater than 250 years of age) with over 45% of the harvestable land base between the ages of 70 and 250 years reflecting the long harvest history in this area.

The theoretical long-term harvest rate for the Johnstone Strait is 634,680 m^3 per year (628,330 m^3 per year after deducting 1% for non-recoverable losses). This theoretical long-term harvest rate assumes all stands currently in the timber harvesting land base, grow as predicted by the managed stand yield tables and are harvested at the culmination of mean annual increment (MAI).

Historical harvest rates are shown in figure1.

Figure 1. Historical harvest levels - Johnstone Strait.

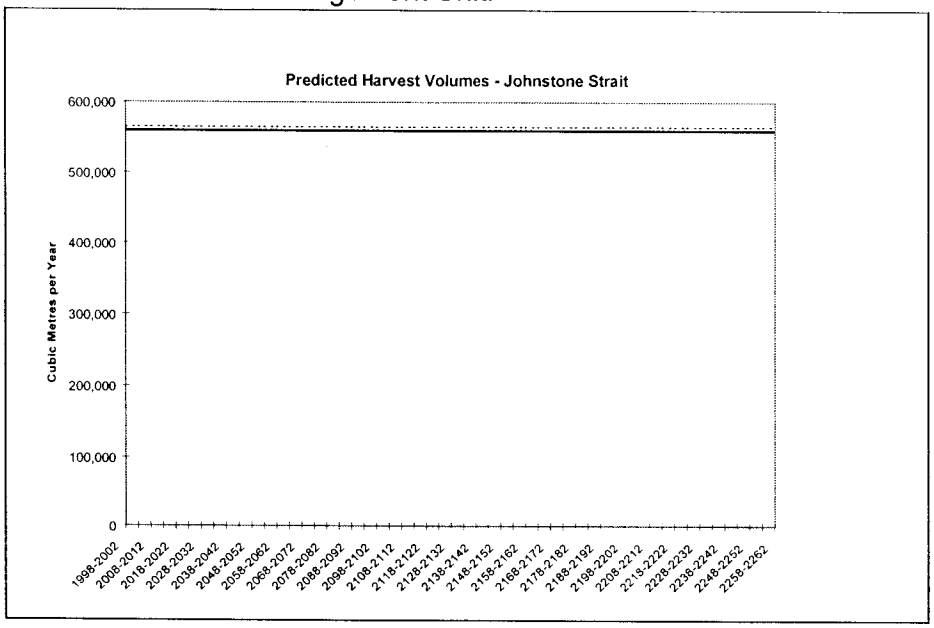


4.1.1 Option 1 - Base Case

As described in the Timber Supply Analysis Information Package for Tree Farm License No. 47, the Base Case for the Johnstone Straits Management Unit includes the impacts of meeting the Forest Practices Code of British Columbia Act (1995) (FPC). The biodiversity requirements of the FPC have not been fully implemented. Specifically for TFL 47, the Central Coast Land and Coastal Resource Management Planning (CCLCRMP) and the Vancouver Island Land Use Planning (VILUP) processes are still incomplete – zoning of biodiversity emphasis options has not been finalized. Therefore the anticipated timber supply impacts are modelled using a blended[1] target for the amount of old-growth to be reserved in each biogeoclimatic subzone/variant.

The Base Case is consistent with the proposed 20-year Plan harvest level which averages 569,000 m^3 per year. The simulated harvest rate of 565,000 m^3 per year - 559,350 m^3 per year after deductions for non-recoverable losses[2] - can be maintained over the 250+ years of the timber supply analysis (figure 2).

Figure 2. Base Case - projected harvest rate over time - Johnstone Strait Management Unit.

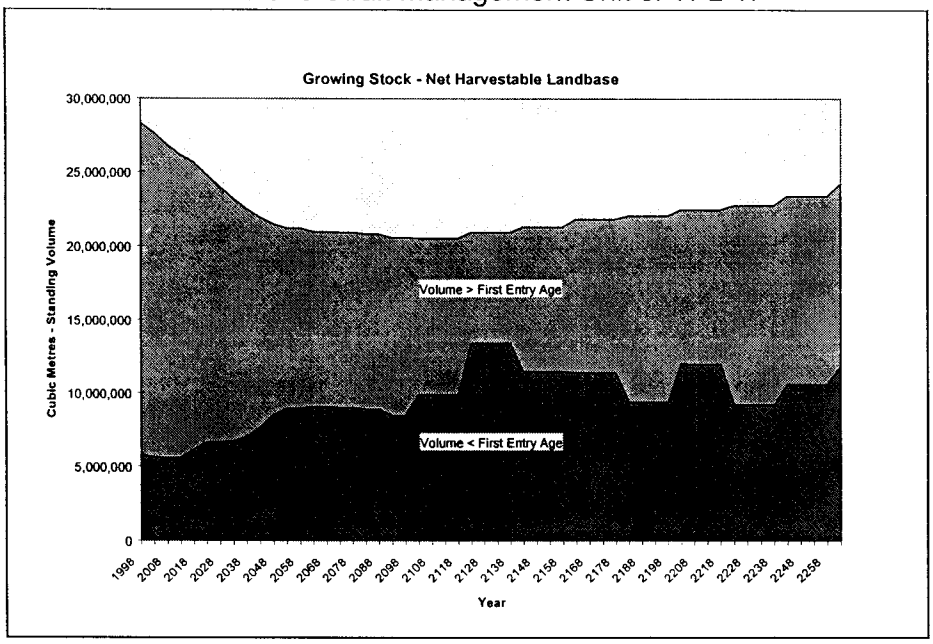


[1] Tree Farm Licence Management Plan Guide, Appendix II - Incorporating Biodiversity and Landscape Units in the Timber Supply Review, Ministry of Forests, August, 1998.
[2] Unsalvaged losses are modelled by reducing the gross harvest rate by 1%. See Timber Supply Analysis Information Package for Tree Farm License No. 47, Section 9.1 (Appendix I)

4.1.1.1 Growing Stock

In the Base Case, after an initial decline for 50 to 60 years, the growing stock from the harvestable land base gradually increases. (figure 3)

Figure 3. The predicted volume of growing stock over time on the Johnstone Strait Management Unit of TFL 47

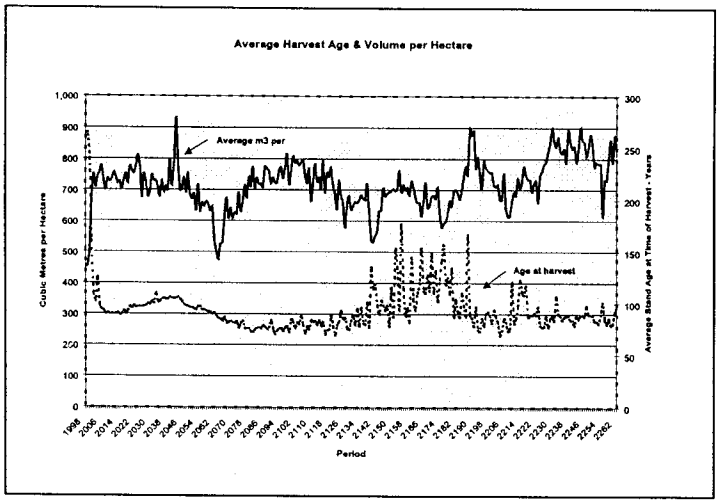


The model is unable to harvest the increasing growing stock over the long-term because of the constraints imposed for visual management (section 4.1.4 – Sensitivity to management of Visual Resources)

4.1.1.2 Projected Harvest Age, Volume per Hectare and Diameter

The average harvest volumes and harvest ages are relatively stable over time. Throughout the simulation, the average stand age at time of harvest remains above 70 years. The average volume harvested is approximately 700 cubic metres per hectare (figure 4).

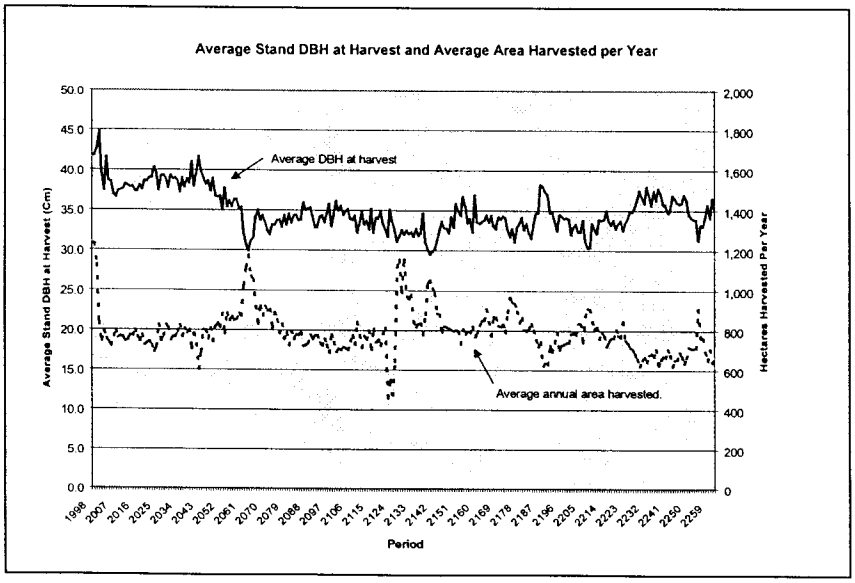
Figure 4. Average m3 per hectare and average harvest age over time - Johnstone Strait.



Initially, the average stand DBH at time of harvest is between 40 and 45 cm. This average drops over the next 60 years and stabilizes for the remainder of the simulation at 30-35 cm (figure 5).

The average area harvested remains constant at 800 ha. per year throughout the simulation. However, the model reports an initial harvest of 1,200 ha. (figure 5). As noted earlier this is an anomaly caused by the use of an "oldest-first" harvest rule that does not represent operational reality. The model is harvesting the oldest, lower volume stands when younger higher volume stands could be harvested.

Figure 5. Average stand DBH and annual area harvested (ha.) – Johnstone Strait

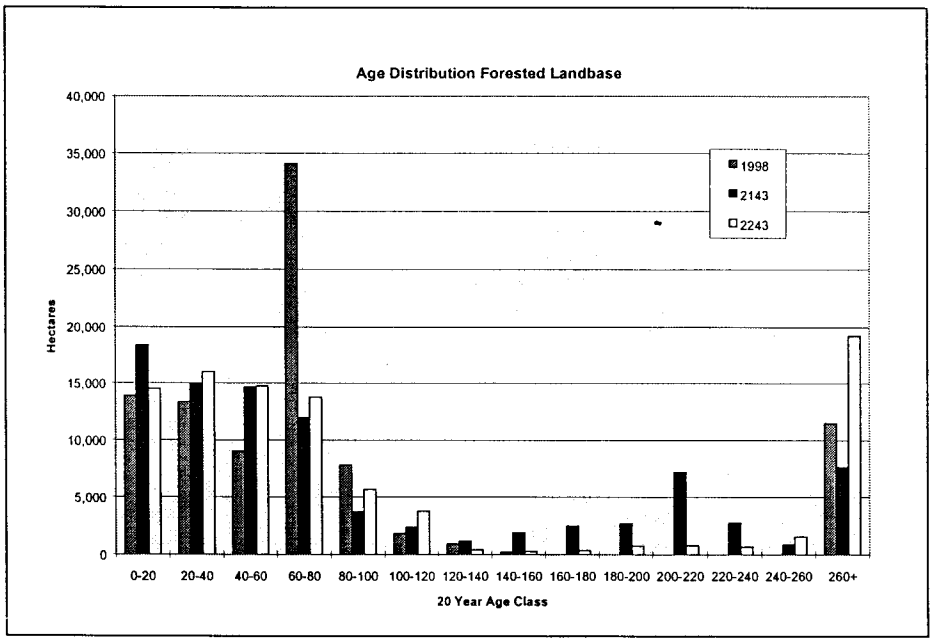


4.1.1.3 Change in Age Class Composition

The "oldest first" harvest order used in the timber supply model harvests the remaining eligible old growth more quickly than will actually occur. Operational harvest plans must consider access and adjacency – the old growth will not be depleted as quickly as predicted by the timber supply model.

A snap shot of the age class distribution taken at the beginning (1998), approximate mid-point (2143) and end (2243) of the simulation shows that while there is an initial decline in old-growth, over the long term, the area of "old-growth" timber increases. (figure 6)

Figure 6. A snap shot of the age class distribution - 1998, 2143 and 2243



The old-growth timber is recruited from the approximately 14,000 hectares of forested land that have been excluded from the timber harvesting land base to account for environmentally sensitive areas, riparian areas, recreation areas etc. required under the Forest Practices Code.

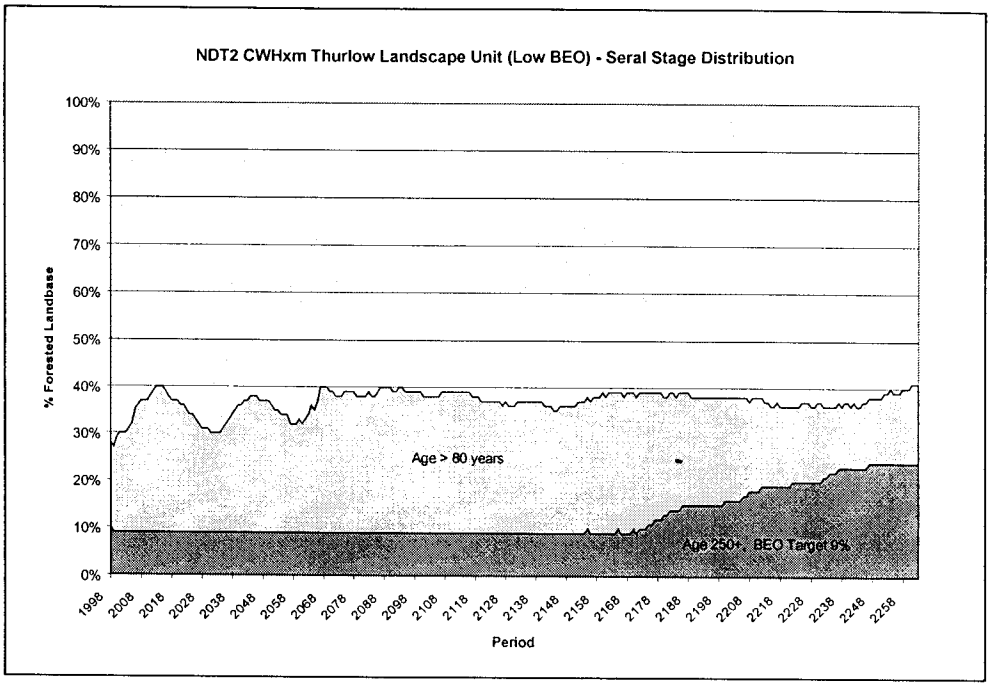
4.1.1.4 Seral Stage Targets

Requirements to meet the old seral stage targets for each variant within each landscape unit, results in some old-growth timber being excluded from harvest.

The Johnstone Strait Management Unit falls within the boundaries of six draft landscape units – the Broughton, Gilford, Fulmore, Gray, Thurlow and Quadra. These landscape units in turn contain a number of variant/sub-zone ecological units (e.g. CWHxm, CWHvm1 etc.). Harvesting is constrained within these variant/sub-zones to ensure that

the forested land base contains a specified percentage of old-seral stage. The typical pattern of recruitment of timber into the old seral stage is shown in figure 7

Figure 7. Recruitment of old growth within the NDT2, CWHxm variant - Thurlow landscape unit.(Low BEO)



In the event that the old seral stage target exceeds the area of old-growth within a landscape unit-variant/sub-zone, the model is constrained to prevent harvesting in the remaining old growth and the old-seral constraint is applied to the mature (typically timber age 80+ years) component of the forest. This ensures that the old seral stage target is met as soon as possible.

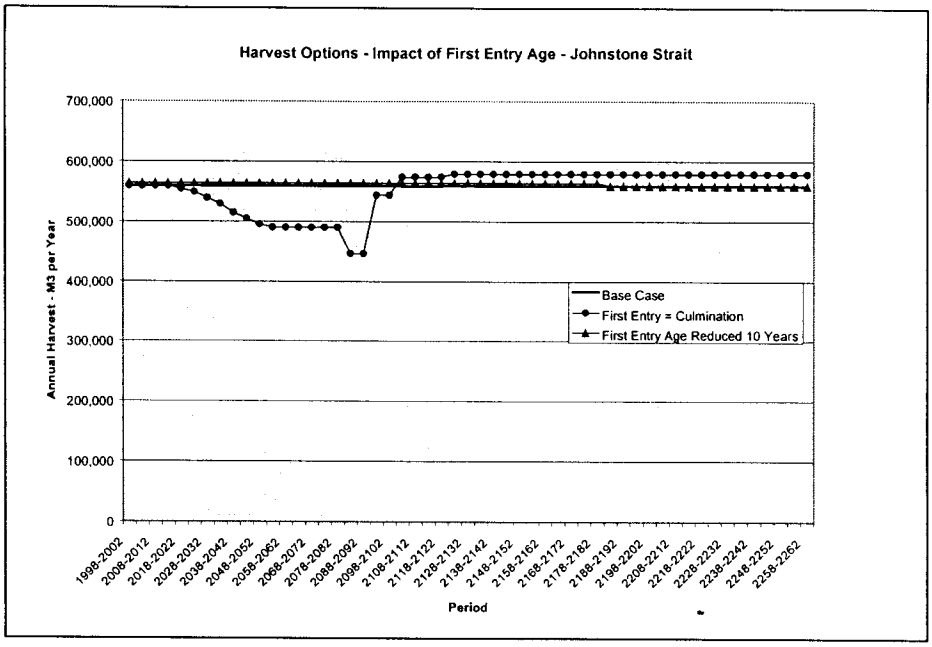
4.1.2 Sensitivity to Harvest Age Criteria

TimberWest has proposed first entry ages, which approximate financial rotations. Examination of the sensitivity of the Base case harvest levels to harvest ages based on culmination of mean annual increment rather than the shorter first entry ages (see section 10.3 Timber Supply Information Package for Tree Farm Licence 47) shows that the Base Case harvest levels cannot be maintained.

First entry ages offer a higher sustainable harvest level over the short and medium term. Using culmination age, the resulting reduced harvest flexibility constraints overall harvest opportunity. However the increased growing stock available under culmination age results in a slight (19,800 m^3 per year) increase in the long-term harvest rate to 579,150 m^3 per year

Increasing harvest flexibility by reducing first entry ages 10 years has no impact on harvest rates (figure 8).

Figure 8. Impact of rotation length criteria on harvest rates - Johnstone Strait Management Unit



4.1.3 Sensitivity to Estimates of Timber Yield

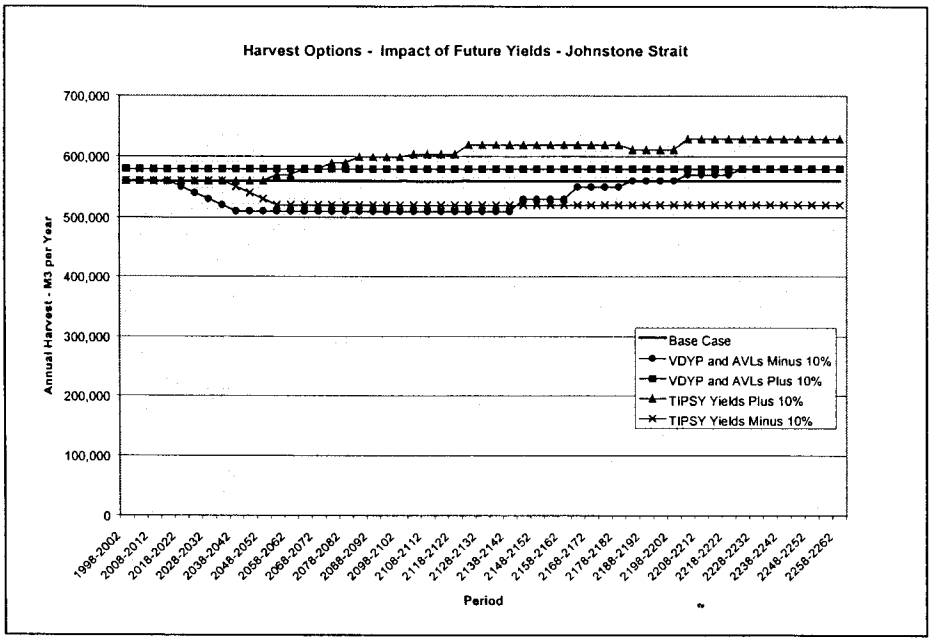
The twenty-year plan harvest levels can be maintained over the next 20 to 30 years even if estimates of volumes in existing and future stands are overestimated in the timber supply model. If the volume of stands established prior to 1974 (VDYP and AVL volumes[3]) is overestimated by 10% then by 2038 the harvest rate declines to 509,850 m^3 per year. However a recent audit of timber volumes undertaken by the Ministry of Forests on the Johnstone Strait Management Unit found no significant differences in the estimates of timber volumes. Therefore an overestimate of volumes in stands established prior to 1974 is unlikely.

If the volume estimates of stands established after 1973 are overestimated in the timber supply model then over the medium term the harvest level drops to 519,750 m^3 per year.

Not unexpectedly, if the timber supply model underestimates existing and future volumes by 10% then sustainable harvest rates could be increased (figure 9).

[3] VDYP – Ministry of Forest Variable Density Yield Prediction and AVL – Average Volume Line – estimates of m3 per hectare from field samples

Figure 9. Sensitivity of harvest levels to estimates of volume yields in existing and future stands - Johnstone Strait Management Unit.



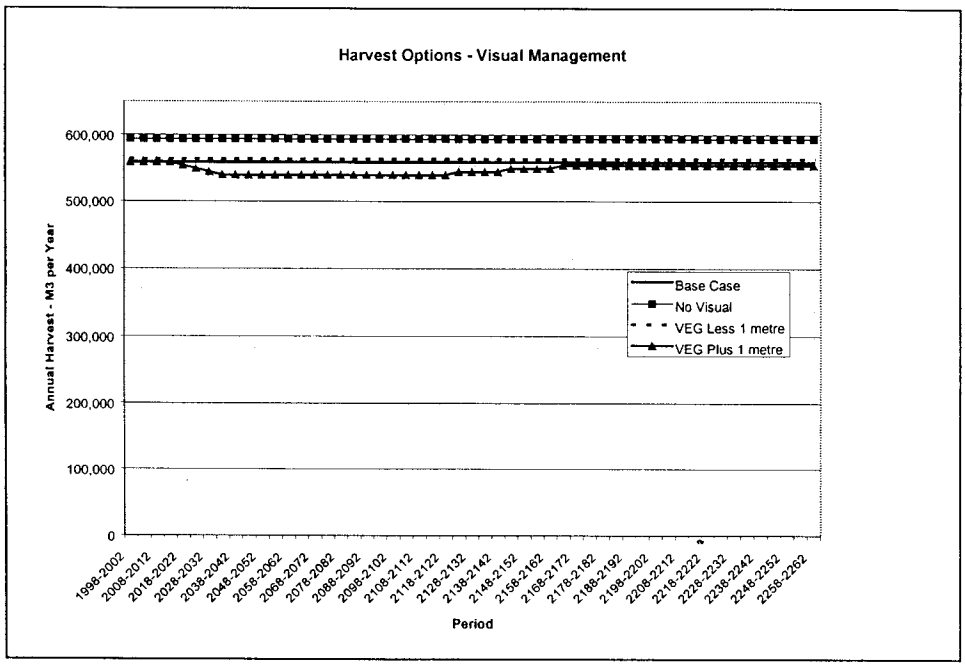
4.1.4 Sensitivity to Management of Visual Resources

The harvest rate in the Johnstone Strait Management Unit is quite sensitive to the constraints imposed for managing visual resources. Without any visual constraints the sustainable harvest rate increases to 594,000 m^3 per year. If the visual constraints are made more restrictive[4] by increasing the height required to meet Visual Effective Green-up (VEG) by 1 metre, then over the medium term the harvest rate decreases by approximately 20,000 m^3 per year to 539,550 m^3 per year. (Figure 10).

If the forest cover requirements for visual management are made less restrictive by decreasing the VEG height by 1 metre, there is no impact on timber supply.

[4] In practice visual constraints could also be made more restrictive by decreasing the maximum denudation percentages within visually sensitive areas.

Figure 10. Impact on harvest rates of managing for viewscapes - Johnstone Strait Management Unit.

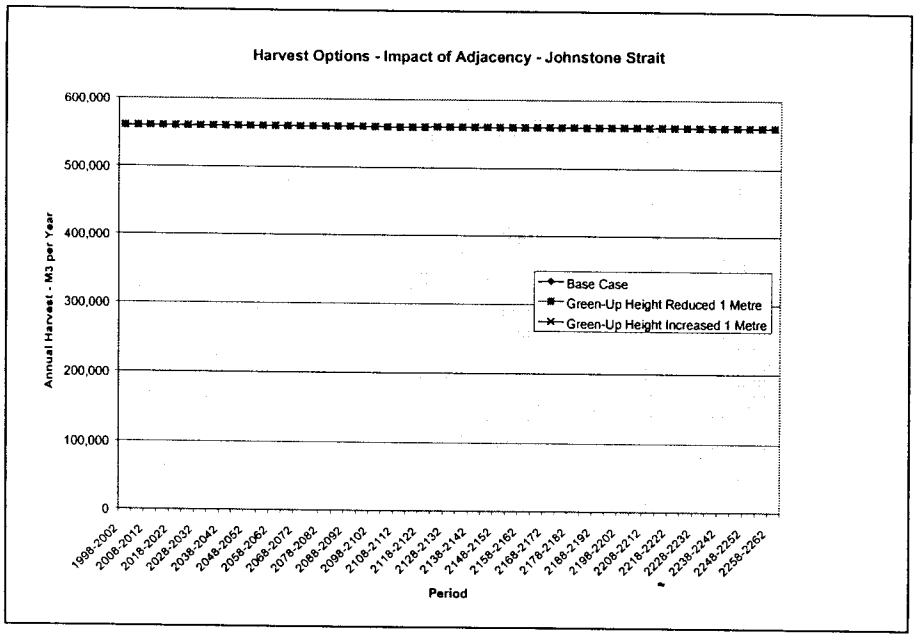


4.1.5 Sensitivity to Green-Up Requirements - Adjacency

The FPC requirement that harvesting cannot proceed on an area until the adjacent logged area has greened up is modelled by using a forest cover constraint. The constraint specifies that a maximum of 25% of the timber harvesting land base can be occupied by stands that are less than a green-up height of three metres.

Reducing the green-up height to 2.0 metres, or increasing the green-up height to 4.0 metres, has no impact on potential harvest rate (figure 11).

Figure 11. Impact of adjacency constraints on harvest rates - Johnstone Strait Management Unit.



4.1.6 Sensitivity to Meeting Seral Stage Targets

The Johnstone Strait Management Unit includes portions of six landscape units designated under the Central Coast Land and Coastal Resource Management Planning (CCLCRMP) and the Vancouver Island Land Use Planning (VILUP) processes.

It is anticipated that these two planning processes will recommend[5] the biodiversity emphasis options listed in table 2.

Table 2 . Landscape Units and anticipated BEO designations - Johnstone Strait Management Unit

Landscape Unit	Biodiversity Emphasis Option (BEO)
Broughton	Low
Fulmore	Low
Gilford	Low
Gray	Low
Quadra	Intermediate
Thurlow	Low

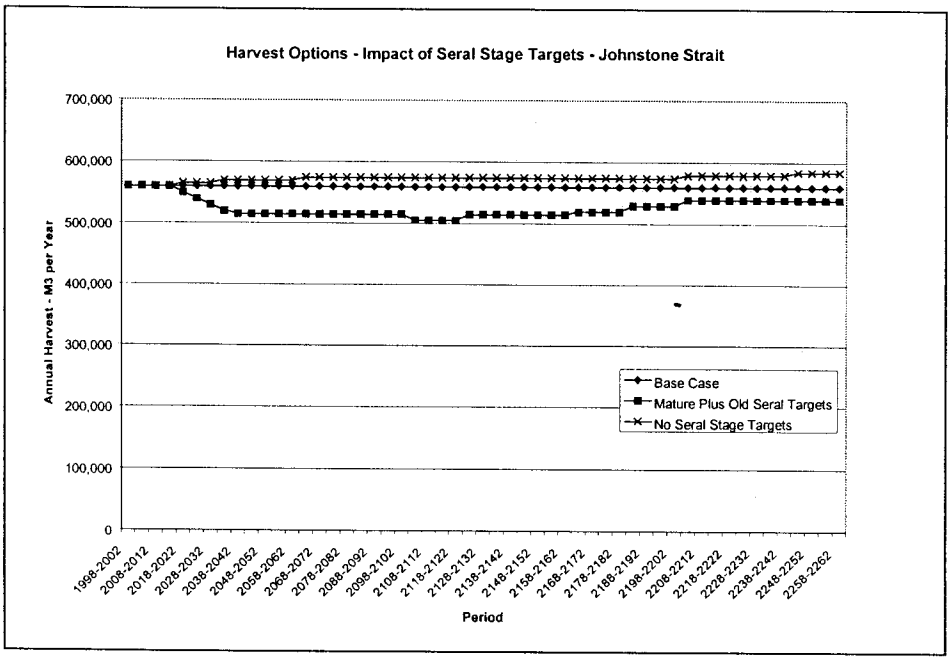
The impact of meeting seral stage targets is discussed in two sections. Section 4.1.6.1 discusses the impacts of meeting combined mature plus old targets. Section 4.1.6.2 discusses the impact of meeting the recommended BEO targets.

[5] The Biodiversity emphasis recommendations are from "Central Coast Interim, Land and Coastal Resource Management Plan, Recommendation to Government, March 15, 2001."

4.1.6.1 Mature plus "Old" Targets Seral Stage Targets

If seral stage targets are not required, then the harvest rate in Johnstone Strait can be increased over the medium to long-term by approximately 15,000 m^3 to 574,100 m^3 per year.

Figure 12. Harvest rate impacts of meeting seral stage targets - Johnstone Strait Management Unit.



If the timber supply model is constrained to meet the mature plus old seral stage targets for each biogeoclimatic unit in the six landscape units, then, over the medium-term, the harvest rate decreases by approximately 45,000 m^3 to 514,800 m^3 per year. The long-term harvest rate under this scenario is 539,550 m^3 per year – approximately 20,000 m^3 per year less than the Base Case long-term harvest rate. (Figure 12).

4.1.6.2 Meeting "Old" Biodiversity Emphasis Option (BEO) Targets

Meeting the "old" seral stage target for the recommended Biodiversity Emphasis Objectives (BEO) from the Vancouver Island Land Use Planning (VILUP) and Central Coast Land and Coastal Resource Management Planning (CCLCRMP) planning process, when compared to the blended target used in the Base Case simulation, had no impact on Johnstone Strait timber supply. The Base Case harvest level of 565,000 m^3 per year – 559,350 m^3 per year after deductions for non-recoverable losses – is maintained throughout the simulation. This is not unexpected since the blended targets used in the Base Case simulation are within 1% of the draft BEO targets (see table 3)

Table 3. Draft versus blended BEO targets for the Johnstone Strait Management Unit.

Landscape Unit	NDT	BCG unit	BEO	Seral Stage	Land Use Planning Guidebook Targets	Blended Target Applied in Base Case	Difference
Broughton	NDT1	CWHvm1	Low	Old	13%	14%	(1%)
Fulmore	NDT1	CWHvm1	Low	Old	13%	14%	(1%)
Fulmore	NDT1	CWHvm2	Low	Old	13%	14%	(1%)
Fulmore	NDT1	MHmm1	Low	Old	19%	20%	(1%)
Fulmore	NDT2	CWHdm	Low	Old	9%	9%	-
Gilford	NDT1	CWHvm1	Low	Old	13%	14%	(1%)
Gray	NDT1	CWHvm1	Low	Old	13%	14%	(1%)
Gray	NDT1	CWHvm2	Low	Old	13%	14%	(1%)
Gray	NDT2	CWHdm	Low	Old	9%	9%	-
Quadra	NDT2	CWHmm1	Intermediate	Old	9%	9%	-
Quadra	NDT2	CWHxm	Intermediate	Old	9%	9%	-
Thurlow	NDT1	CWHvm1	Low	Old	13%	14%	(1%)
Thurlow	NDT1	CWHvm2	Low	Old	13%	14%	(1%)
Thurlow	NDT2	CWHdm	Low	Old	9%	9%	-
Thurlow	NDT2	CWHmm1	Low	Old	9%	9%	-
Thurlow	NDT2	CWHmm2	Low	Old	9%	9%	-
Thurlow	NDT2	CWHxm	Low	Old	9%	9%	-

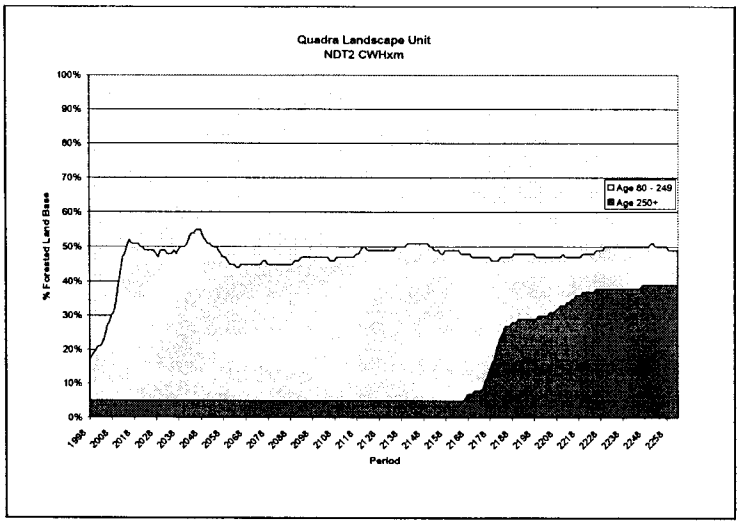
The Johnstone Strait was initially created as an immature management unit within TFL 47. Consequently there is minimal old growth within the TFL. Because of the lack of old growth, for the majority of the biogeoclimatic variants within the landscape units, it is not possible to meet old growth targets immediately. Instead BEO targets are met over time by recruiting mature timber. The approach is consistent with the recruitment strategies outlined in the Landscape Unit Planning Guide[6] to meet the "low BEO" targets within three rotations (240 years).

Quadra is the only landscape unit within the Johnstone Strait Management Unit, designated as an "intermediate BEO". While the intent of an intermediate BEO is to meet the old targets immediately, this is not possible given the age class distribution in the Quadra Landscape Unit. The Quadra SMZ is further restricted to maintaining 25% of the forested land base as mature or old timber.

For CWHxm, it takes until 2006 before the target of maintaining 25% of the forested land base as mature or old can be met. (figure 13)

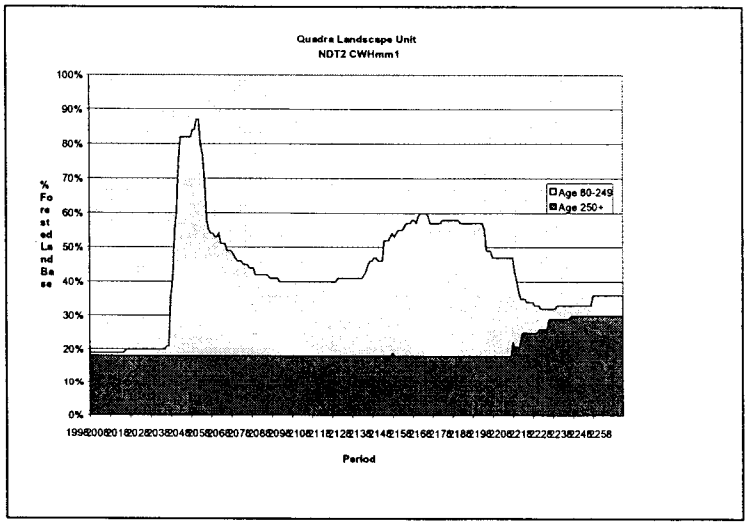
[6] Landscape Unit Planning Guide, Ministry of Forests, Ministry of Environment Lands and Parks, March, 1999.

Figure 13. Seral Stage Distribution – Quadra Landscape Unit - CWHxm



For CWHmm1, it takes approximately 40 years, until 2040, before the requirement that 25% of the forest land base be older than age 80 can be met (figure 14).

Figure 14. Seral Stage Distribution – Quadra Landscape Unit – CWHmm1



4.1.7 Quadra – Special Management Zone

The Vancouver Island land Use Planning process (VILUP) has recommended that all Crown lands on Quadra Island outside protected areas should be designated Special Management Zone 19 (SMZ-19).

While this designation will have a significant impact on the management of TFL lands within the SMZ, it is unclear what the long term timber supply impacts of this designation

will be. It is expected that this will become clearer once the designation has become official, operating guidelines and regulations are established by government agencies and TimberWest gains some experience in operating under the new guidelines and regulations.

In the interim, the government has suggested[7] that the SMZ designation will on average not impact timber supply more than 10%. Quadra Island represents 9.1% of the schedule B portion of the timber harvesting land base in Johnstone Strait Management. This would indicate that the impact of SMZ-19 on harvest rates would be approximately 5,500 m^3 per year[8].

4.1.8 Timber Supply Implications of Variable Retention

TimberWest has announced a policy to phase out clear-cut harvesting and implement variable retention (VR) harvesting on all lands under its management. Two broad categories of VR are envisioned – aggregate retention where a minimum of 10% of the gross harvest area would be left and dispersed retention where individual trees or small clumps of trees representing 5% of the basal area would be left standing.

It is expected that two-thirds of the harvest will be aggregate retention, one-third dispersed. Within aggregate retention, the requirement to retain 10% of the gross harvest area will be met from the existing netdowns required by the Forest Practices Code (FPC). For dispersed retention, the short-term impact (leaving 5% of the basal area in the stand) is expected to be 5%. While the longer-term impact on yield is expected to be 5.6% (section 10.3.6.2 - Management Plan No. 3, TFL No. 47 Johnstone Strait and Bonanza Lake Management Units Timber Supply Analysis Information Package). A 5.6% yield reduction on one-third of the harvest is expected to reduce future yields 1.9%, or 10,500 m^3 per year[9] in the Johnstone Strait Management Unit.

The expect 1.9% impact on yield is well within the yield sensitivity analysis discussed in section 4.1.3

4.1.9 Impact of Depleting Johnstone Strait Old-Growth Over an Extended Period

It was anticipated that the "oldest first" harvest rule used in the timber supply model would harvest the remaining eligible old growth more quickly than will actually occur. Consequently, it was expected that a sensitivity analysis would be required to quantify this potential bias on harvest rate.

However, as shown in figure 15, a substantial amount of the existing old-growth is retained in the Base Case. During the first five-year period, the model harvests approximately 3,600 ha. of old-growth leaving 7,800 ha - either because it is excluded from the timber harvesting land base, or because harvesting it would violate the

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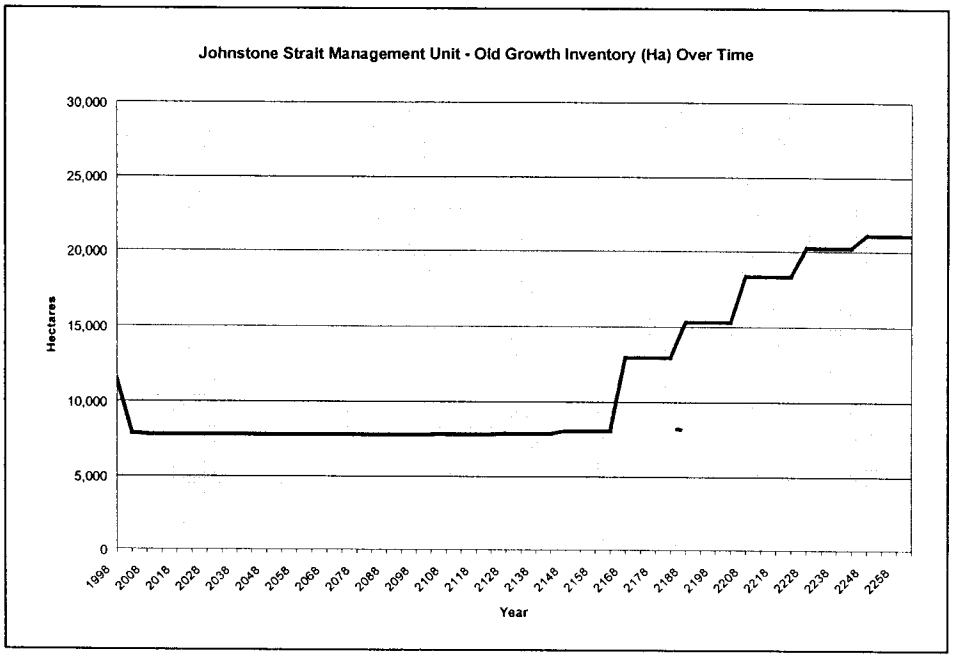
[7] Special Management Zone Project, Information Report, June, 1998, Land Use Co-ordination Office, B.C. Government, (www.luco.gov.bc.ca/smz/info.htm)

[8] 10% reduction in yield x 9.9% of the THLB x 559,350 m^3 per year = 5,537 m^3

[9] 33.3% of the harvest x 5.6% long-term yield reduction x 559,350 m^3 per year = 10,430 m^3

requirements to meet old seral stage targets. Eventually younger stands excluded from the timber harvesting land base are recruited into old-growth at age 250 years.

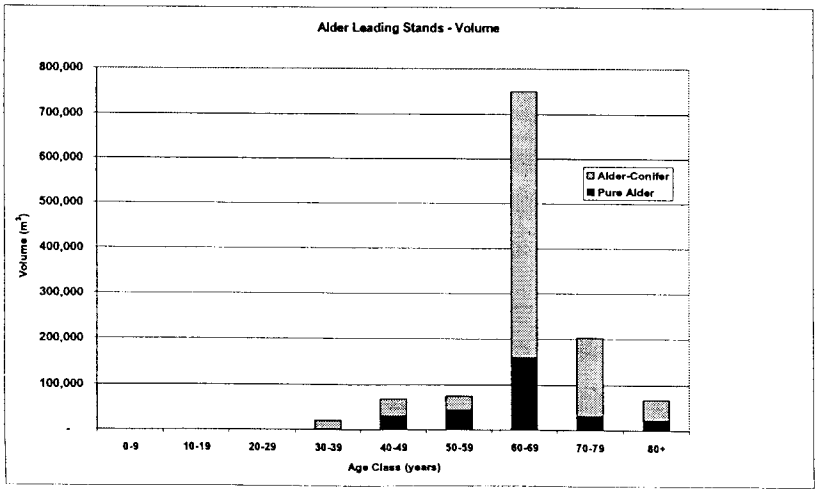
Figure 15. Hectares of "old-growth" standing inventory over time – Base Case Johnstone Strait Management Unit.



4.1.10 Sensitivity to Alder Harvest

The alder volume in alder leading stands in the Johnstone Strait Management Unit is estimated to be 1.2 million m^3. The majority of this alder is in mixed alder-coniferous stands aged 60+ years. (figure 16)

Figure 16. Deciduous volume - alder leading stands.

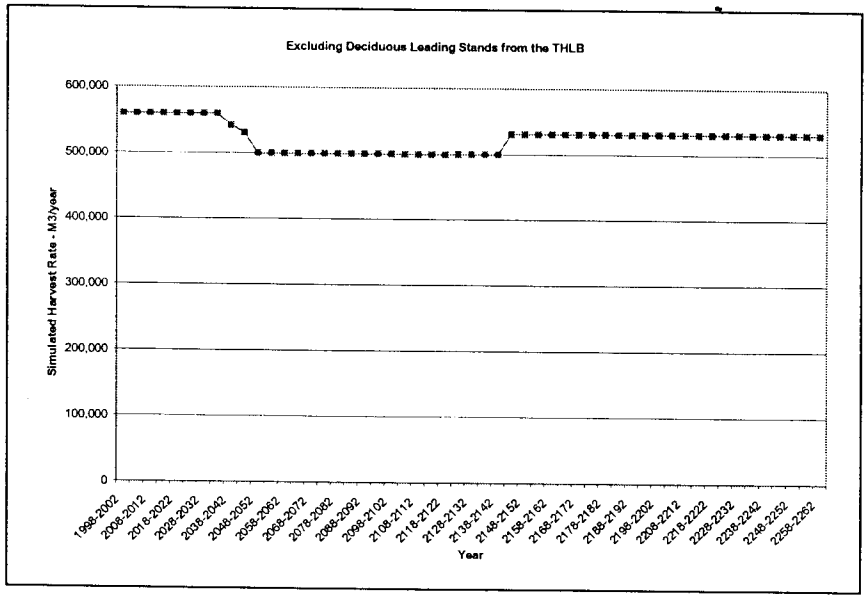


The economic opportunity to harvest alder is limited. It is only within the last year or two that a stable market has existed for alder sawlogs. TimberWest has entered into a long-term commitment to provide alder sawlogs to Northwest Hardwoods[10].

Alder sawlog specifications require "*Reasonably straight logs where 50% of the gross scale will cut out lumber and at least 50% of the lumber will be Merch or better. Minimum sawlog length of 5.2 meters, 20 cm top DIB. Logs must have at least 2.5 meters straight sections between crooks*[11]". There are very limited market opportunities for low quality alder. In Johnstone Straits, high quality alder stands tend to be on the higher site classes on BEC zone CWH site series 05 and 07.

Unless alder stands contain a significant percentage of sawlog material, harvesting is not economically viable. In addition to the market economics, access and the logistics of operating on the Johnstone Strait islands limit the logging chance. TimberWest expects to harvest 40,000 cubic meters of alder per year over the next ten years (400,000 m^3 total)[12].

Figure 17. Projected harvest flow. Base Case with alder leading stands excluded from the timber harvesting land base.



If 5,048 ha. of alder-leading stands (alder - 1,132 ha. and alder-coniferous - 3,916 ha.) are excluded from the timber harvesting land base then the base case harvest of 565,000 m^3 per year can be maintained for 40 years after which the harvest rate drops to 505,100 m^3 per year until 2143 when it rises to a long-term harvest rate of 536,750 m^3 per year.

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[10] Weyerhaeuser acquired Coast Mountain Hardwood in Oct. 2000. It has since changed its name to Northwest Hardwoods-Delta Division

[11] TimberWest Alder-Merch sawlog specifications.

[12] TimberWest has committed to supply 30,000 m3 per year. Experience shows there is a 25% "fall down" between cruise and scaled alder volumes.

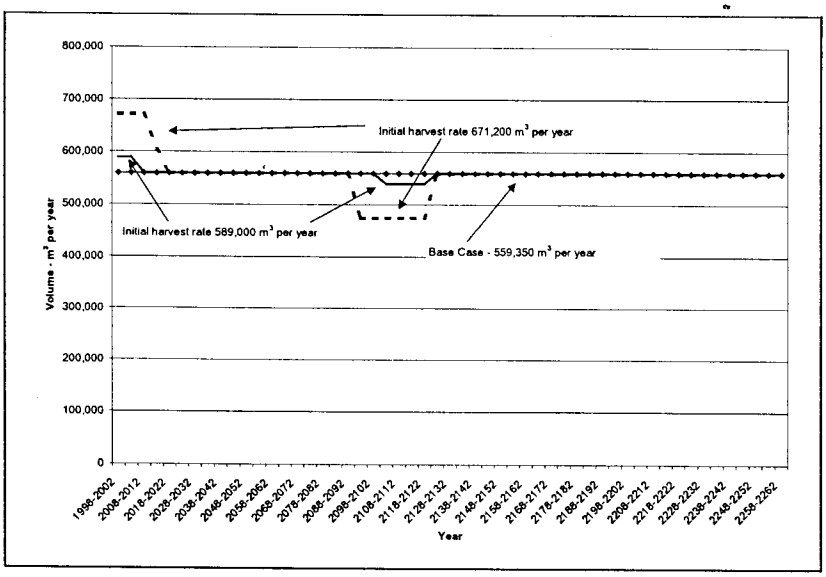
However, in practice the simulated decline in harvest between 2037 and 2143 is unlikely to occur. Over the next 40 plus years, natural succession will convert most of the older alder-coniferous stands into coniferous-leading stands. These coniferous-leading stands will be economically harvestable between 2037 and 2143 (figure 17)

4.1.11 Alternate Harvest Rates

Two alternate harvest rates were tested for the Johnstone Strait Management Unit. Since any harvesting strategy which contemplated a lower initial harvest rate than the base case will result in essentially the same long-term harvest rate, both scenarios considered higher initial harvests.

Scenario 1 considered an initial harvest rate of 589,000 m^3 per year for 10 years, afterwards decreasing to the base case rate of 559,350 m^3 per year. The resulting harvest flow was non-declining except for the twenty year period 2103 – 2122, one

Figure 18. Alternate harvest rates.



hundred years hence, when the harvest decrease 20,000 m^3 per year. (figure 18) Scenario 2, considered a 20% increase in the initial Base Case harvest rate to 671,220 m^3 per year. After 10 years, the harvest rate was decreased to the base case rate of 559,350 m^3 per year. This harvest rate was sustainable except for the 30-year period 2093-2122, when the harvest decreased to 474,200 m^3 per year.

In both scenarios, the long-term harvest rate is the same as that predicted for the Base Case.

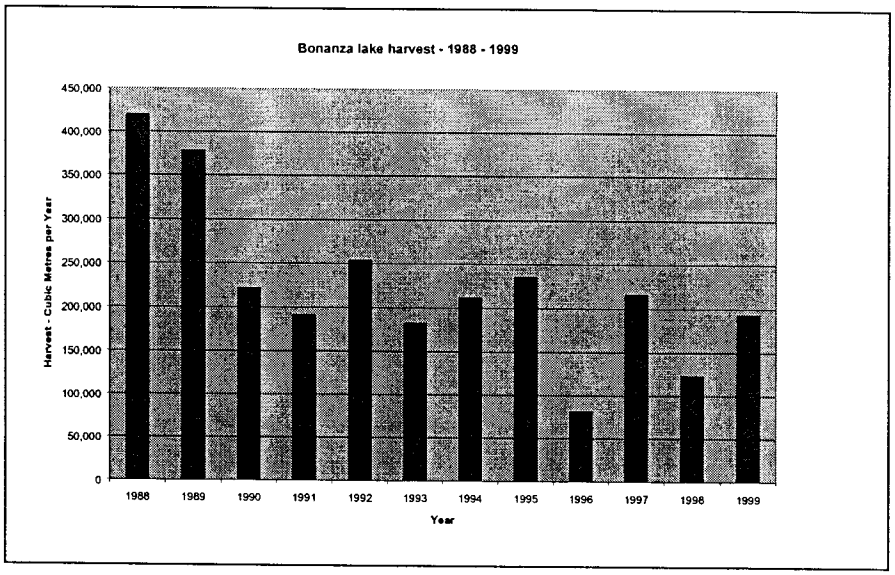
4.2 BONANZA LAKE

This Management Unit is characterized by significant volumes of remaining old growth western hemlock, amabilis fir, western redcedar, cypress and, to a lesser degree, Douglas-fir. In 1994 operable old growth accounted for over 37% of the harvestable land base. Valley bottoms and lower slopes are fully stocked with immature stands with current harvest activities focused almost exclusively in old growth.

Historic harvest levels in the Bonanza Management Unit reached a peak of 460,000 m^3 in 1987 and have been relatively stable in the low 200,000 m^3 range since 1990. (Figure 19).

Harvest levels proposed in the 20-year Plan are intended to take the annual harvest from the present level to the sustainable harvest level over the next 20 years. This stepped progression to the sustainable harvest level results in a lesser impact on TimberWest employees and the local community in this timber-dependent area of northern Vancouver Island and does not result in a significant fall-down in the sustainable harvest level.

Figure 19. Historical harvest rates - TFL 47 Bonanza Lake



The theoretical long-term harvest rate for Bonanza Lake portion of TFL 47 is 169,400 m^3 per year (167,700 m^3 per year after deduction 1% for non-recoverable losses). This theoretical long-term harvest rate assumes all stands currently in the timber harvesting land base, grow as predicted by the managed stand yield tables and are harvested at the culmination of mean annual increment (MAI).

TimberWest is of the opinion that the productivity of the land base may be underestimated. In particular, it is felt that the immature stands exceed the site index of the original old growth stands on which these immature stands have been sited. Terrestrial Ecosystem Mapping (TEM) was recently completed for Bonanza Lake. We are anticipating FRBC funding to undertake a comprehensive study to accurately

determine ecologically based site indices. This study will provide a better estimate of this management unit's growth potential.

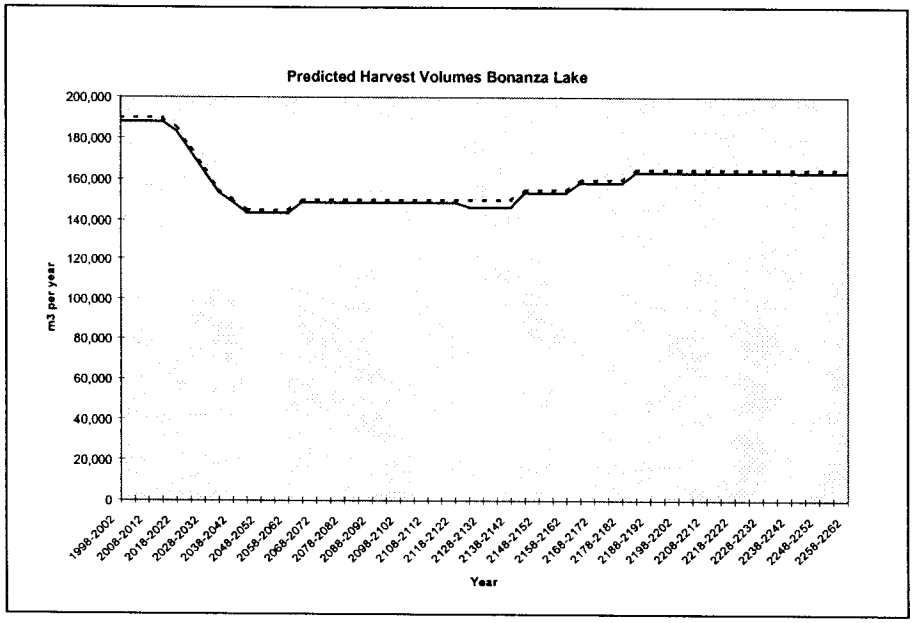
Additional considerations in the Bonanza Lake Management Unit include:

1. Future land-use designations. The Vancouver Island Land Use Planning process has recommended that a large percentage of this Management Unit be designated for Enhanced Forestry. This will have a positive impact on timber supply if government approves this designation along with appropriate regulations to reduce forest cover constraints and biodiversity impacts.
2. Harvesting in Low site and Inoperable areas. Operability mapping was carried out in 1993. Additional fieldwork since then has shown that the areas currently mapped as inoperable contain significant opportunities for harvesting — especially of high value cypress.
3. ESA mapping, particularly ESA-soils, is quite conservative[13].

4.2.1 Option 1 - Base Case

As described in the Timber Supply Analysis Information Package for Tree Farm License No. 47, the Base Case for the Bonanza Lake Management Unit includes the impacts of meeting the Forest Practices Code of British Columbia Act (1995) (FPC).

Figure 20. Projected harvest flows over time for the Bonanza Lake Management Unit.



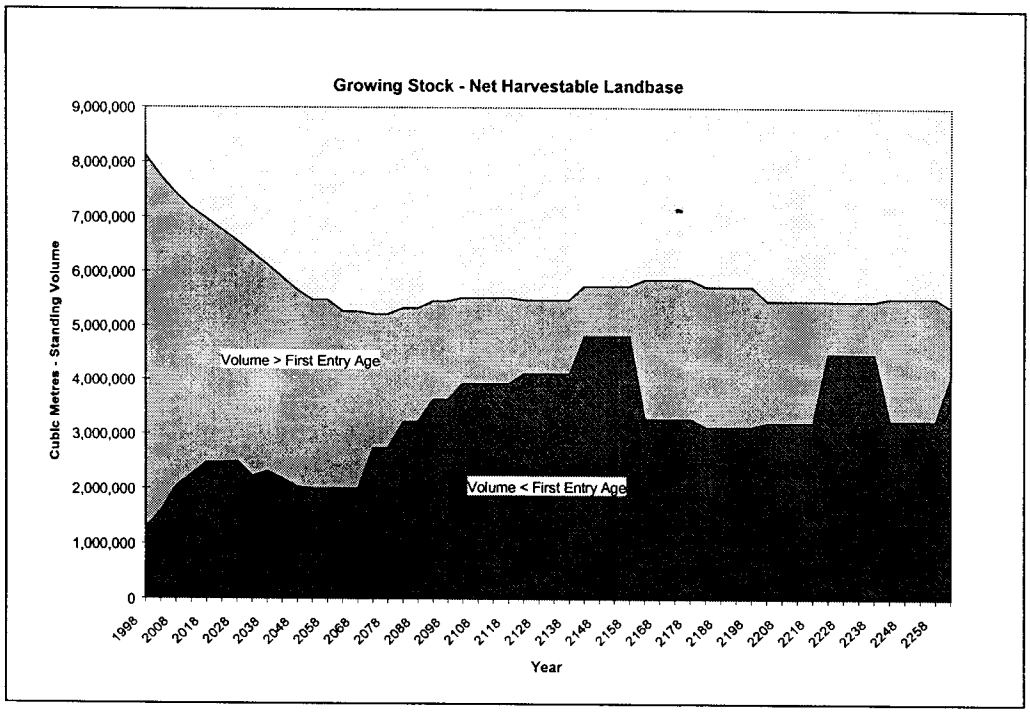
[13] Field work for a terrain Inventory was completed for Bonanza Lake in 1999. A comparison between of the 1992 and 1999 inventories on approx. 10,000 ha. indicates that the new inventory shows 20% less area in terrain class IV and V.

A harvest rate of 188,100 m^3 per year[14] is maintained for the first 20 years of the simulation period. Over the next 120 years, the harvest rate gradually decreases to 146,400 m^3 per year before rising to the long-term sustainable harvest rate of 163,350 m^3 per year. (Figure 20)

4.2.1.1 Growing Stock

As can be seen from figure 21, after an initial decline in the growing stock, growth approximates harvest.

Figure 21. Base Case growing stock - Bonanza Lake Management Unit of TFL 47.

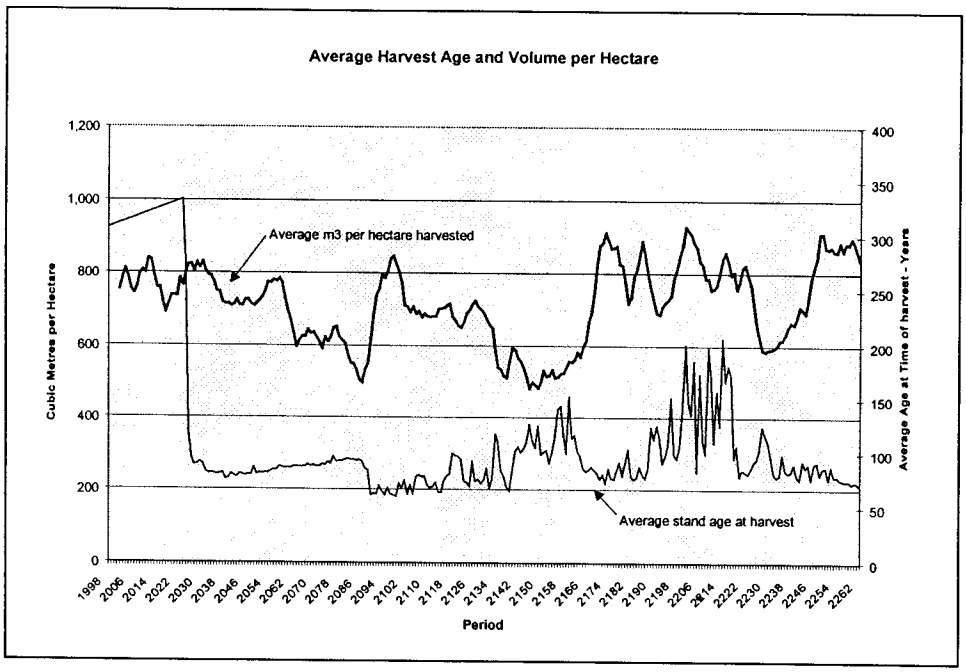


4.2.1.2 Projected Harvest Age, Volume per Hectare, Area Harvested and Average Diameter

Over the first 30 years of the simulation, the timber supply model harvests all the old growth that is within the harvestable land base and not required to meet the seral stage forest cover constraints. After 30 years, the average harvest age decreases. Average volume per hectare harvested gradually decreases from 800 m^3 per hectare to 500 m^3 per hectare over 80 years, and then increases again to 800 m^3 per year. This pattern results from the model periodically having timber surplus to the requirements to meet seral stage forest cover requirements (figure 22).

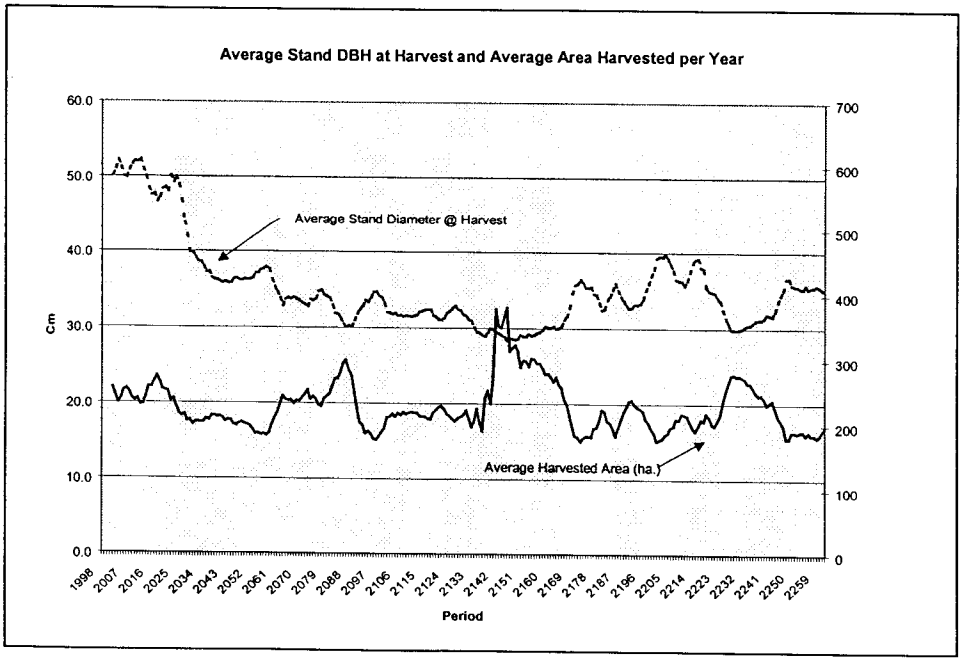
[14] After the 1% deduction for non-recoverable losses

Figure 22. Average m^3 per hectare harvested and average harvest age over time – Bonanza Lake Management Unit.



The average stand diameter at harvest decreases from 50 cm to 30 cm over the first 80 years. Average area harvested remains fairly constant between 180 to 200 hectares per year.(figure 23).

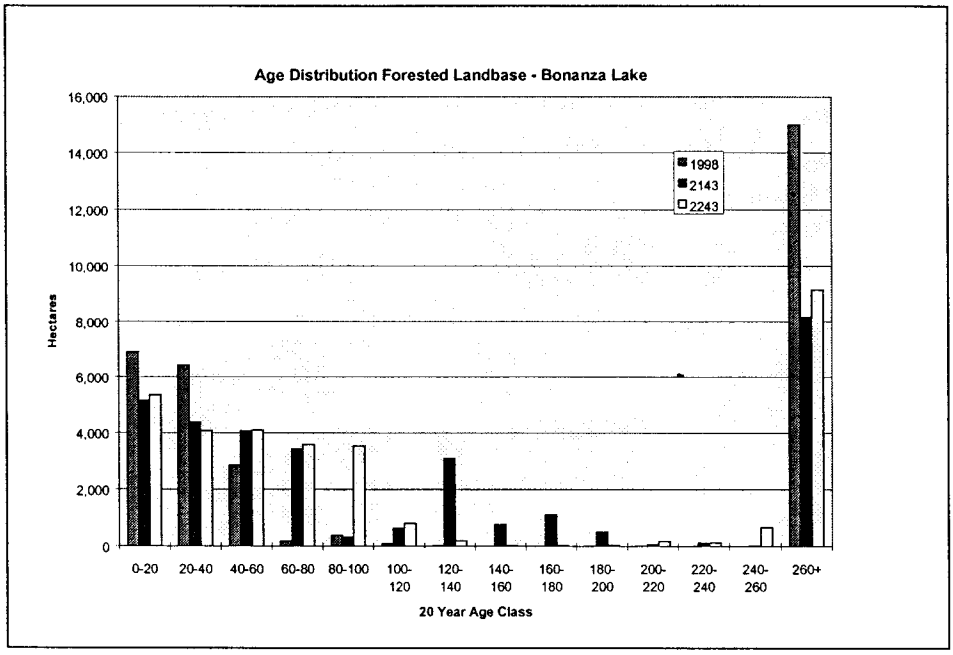
Figure 23. Average stand DBH and annual area harvested (ha.)



4.2.1.3 Change in Age Class Composition

A snap shot of the age class distribution taken at the beginning, approximate mid-

Figure 24. A snap shot of the age class distribution - 1998, 2143 and 2243 - Bonanza Lake.



point (2143) and end (2243) of the simulation shows that the amount of old-growth never declines below 8,000 hectares. By 2243 the immature stands are relatively evenly distributed across the range of pre-harvest ages (e.g., 0 - 100 years). (figure 24).

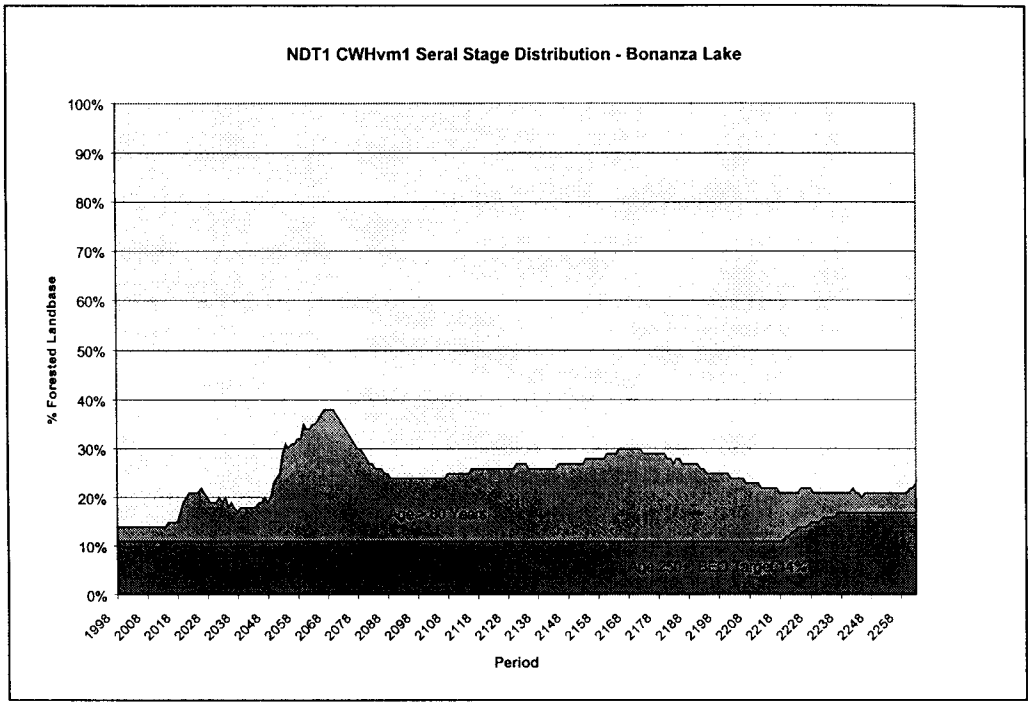
4.2.1.4 Seral Stage Targets

The Bonanza Lake Management Unit of TFL 47 is wholly contained within the Bonanza Landscape Unit. The TFL area includes three biogeoclimatic variants - CHWvm1, CWHvm2 and MHmm1. Both the CWHvm2 and the MHmm1 have sufficient old-growth outside the timber harvesting land base to meet the "blended" seral stage old target. However, the lower elevation CWHvm1 has insufficient old timber to meet the target.

The "blended" seral stage target for "old growth" requires that 14% of the timber greater than age 250 be retained in the CWHvm1 variant. At the beginning of the simulation period, only 11% of the forested land base was old-growth and 14% greater than age 80 years. Two forest cover constraints were applied, the first ensured that the amount of protected old-growth was never less than 11%; the second specified that 14% of the forested land base must be older than 80 years.

The projected seral stage distribution over time for CWHvm1 is shown in figure 25.

Figure 25. Recruitment of old growth within NDT1, CHWvm1 variant - Bonanza Lake Landscape Unit.

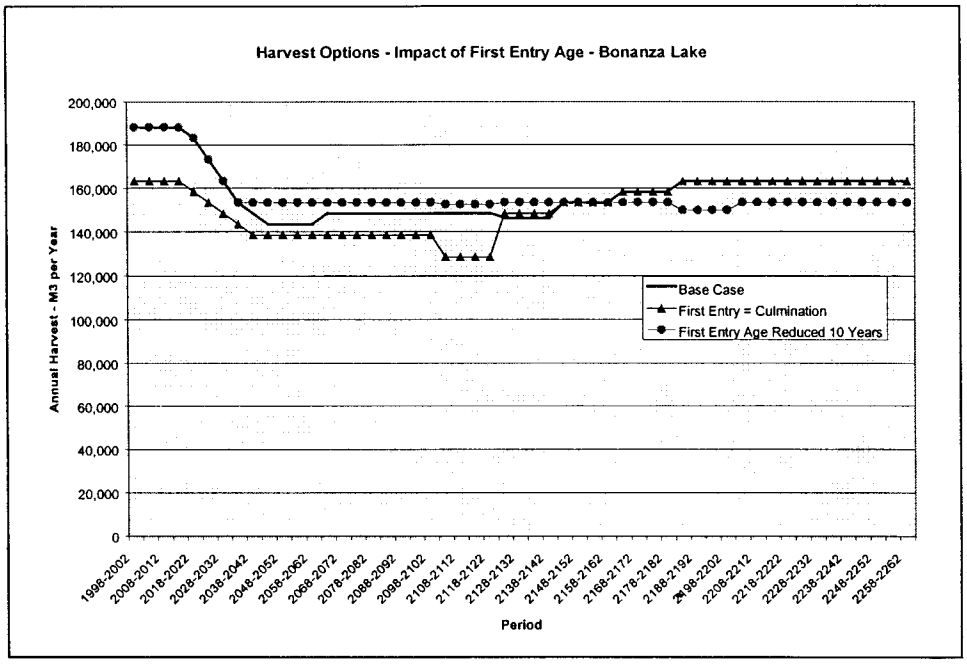


4.2.2 Sensitivity to Harvest Age Criteria

The choice of first entry age has a significant impact on timber supply within the Bonanza Lake Management Unit. If first entry age is based on culmination of mean annual increment, then the short and medium term harvest rates are significantly reduced when compared to the first entry ages used in the Base Case. Base Case first entry ages approximate a financial rotation but more importantly provide harvest flexibility. Without this harvest flexibility, initial harvest rates decrease almost 25,000 m^3 per year, from 188,100 m^3 per year to 163,350 m^3 per year. Using culmination age, the harvest rate continues to be less than the Base Case harvest for the next 125 years until 2123 (figure 24). The culmination age long-term harvest rate eventually stabilizes at the same harvest rate as the Base Case - 163,350 m^3 per year.

If additional harvest flexibility is provided by reducing the first entry ages by 10 years, then the short term harvest rate can be maintained and additional volume can be harvested over the medium term. However, the younger first entry ages end up at a long-term harvest rate of 153,450 m^3 per year – 9,900 m^3 per year less than the Base Case. (figure 26)

Figure 26. Sensitivity of the Base Case harvest levels to harvest age criteria for the Bonanza Lake Management Unit.



4.2.3 Sensitivity to Estimates of Timber Yield

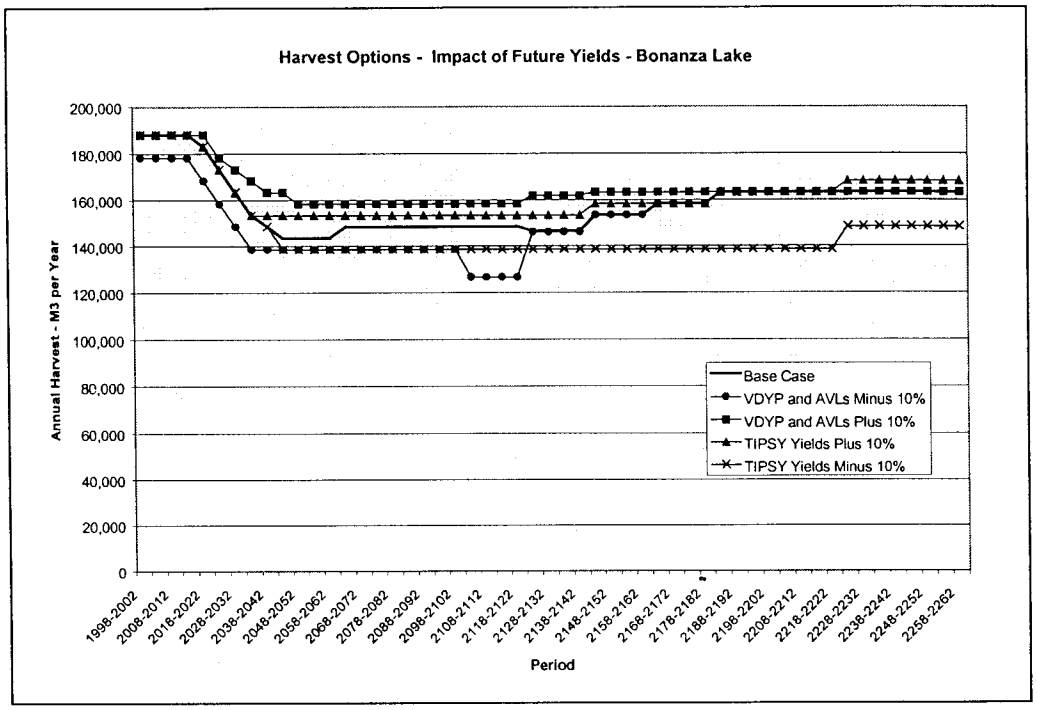
If the timber supply model has overestimated the timber yields in existing stands established prior to 1974 (VDYP and AVL volumes[15]), then the short term base case harvest rates are reduced 10,000 m^3 per year from 188,100 m3 per year to 178,200 m3 per year.

If the volume estimates of stands established after 1973 are overestimated in the timber supply model then the short term Base case harvest rates can be maintained, but the medium and long term harvest rates are reduced.

Not unexpectedly, if the timber supply model underestimates existing and future volumes by 10% then sustainable harvest rates could be increased (figure 27)

[15] VDYP – Ministry of Forest Variable Density Yield Prediction and AVL – Average Volume Line – estimates of m^3 per hectare from field samples

Figure 27. Sensitivity of Base Case harvest rates to estimates of stand yields – Bonanza Lake Management Unit.



4.2.4 Sensitivity to Management of Visual Resources

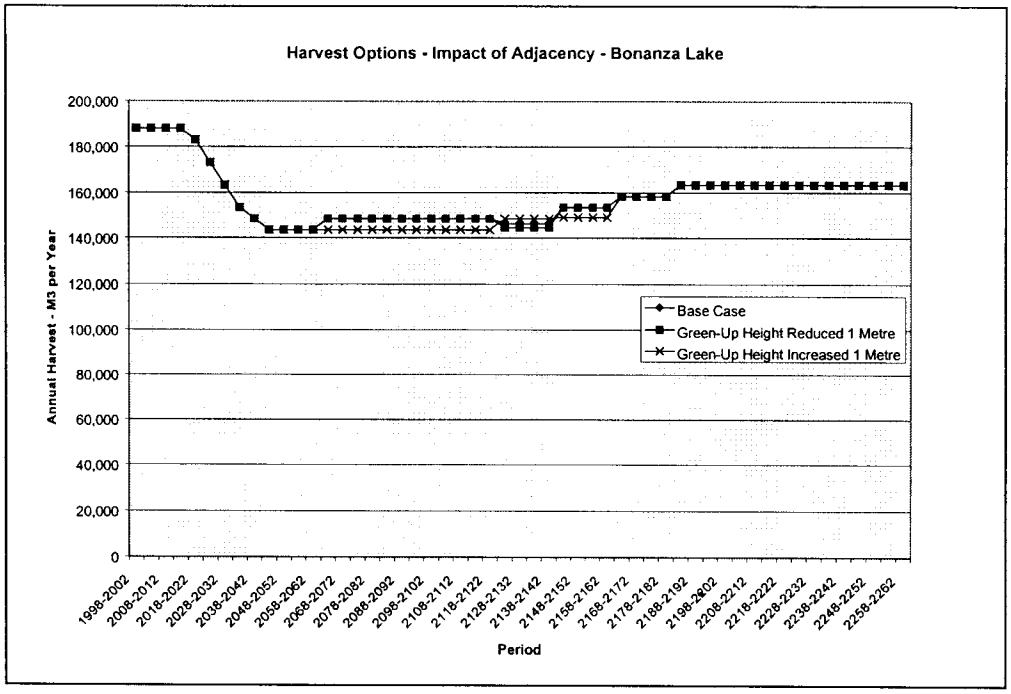
The Bonanza Lake Management Unit has approximately 900 ha. in the visual landscape inventory. Tightening the visual constraints by increasing by 1 metre the height required to meet Visual Effective Green-up (VEG) or relaxing the constraint by decreasing VEG height by 1 metre has no impact on the projected harvest rates.

4.2.5 Sensitivity to Green-Up Requirements

The FPC requirement that harvesting cannot proceed on an area until the adjacent logged area has greened up is modelled by using a forest cover constraint. The constraint specifies that a maximum of 25% of the timber harvesting land base can be occupied by stands that are less than a green-up height of three metres.

Reducing the required green-up height to 2.0 metres has no impact in potential harvest rate. If green-up heights become more restrict and the green-up height is increased to 4.0 metres, then the medium term harvest rate is reduced slightly (figure 28)

Figure 28. Impact of adjacency constraints on harvest rates - Bonanza Lake Management Unit.



4.2.6 Sensitivity to Meeting Seral Stage Targets

The majority of the TFL 47 portion of the Bonanza landscape unit is within the CWHvm1, CWHvm2 and MHmm1 biogeoclimatic units. The CWHvm1 is the valley bottom, CWHvm2 the mid-slopes and the MHmm1 the higher elevations.

Table 4. Existing seral stage distribution of the forested land base - TFL 47 portion of the Bonanza landscape unit.

			Percentage – Forested Area			
		Forested Area	Early[16]	Early-Mature	Mature	Old
NDT5	**AT**	29	0%	0%	0%	100%
NDT1	**CWHvm1**	13,804	64%	22%	3%	11%
NDT1	**CWHvm2**	9,981	41%	0%	1%	58%
NDT1	**MHmm1**	7,476	5%	0%	0%	94%
NDT5	**MHmmp**	619	0%	0%	0%	100%

The Bonanza landscape unit has been given an intermediate biodiversity emphasis option (BEO) in the VILUP process.

[16] Seral stage is based on stand age. "Early" is < 40 years, "Early-Mature" is >39 years and for CWH < 81 years, for MH < 121 years, "Mature" is > 80 years for CWH and > 120 years for MH, "old" > 250 years.

The timber supply impacts of meeting seral stage targets are discussed in two sections. Section 4.2.6.1 discusses the impact of meeting combined mature plus old targets. Section 4.2.6.2 discusses the impact of meeting the old target.

4.2.6.1 Mature plus "Old" Targets Seral Stage Targets

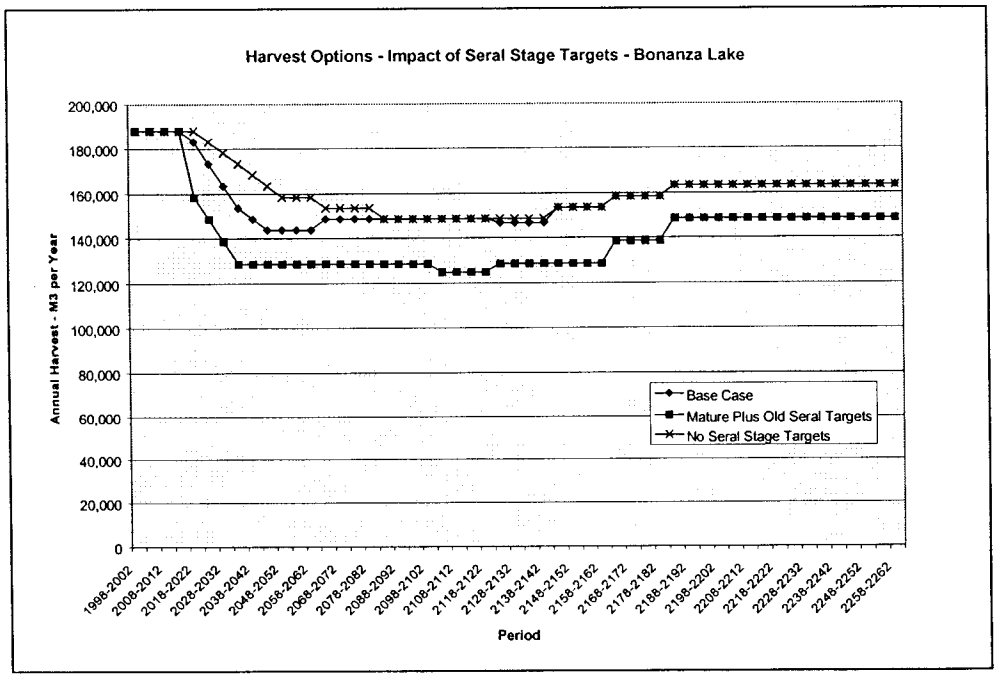
The recommended[17] seral stage distribution for the CWHvm1 and CWHvm2 is that 13% of the forested area be retained in the old and 36% in the mature plus old seral stage.

Historical harvesting patterns have resulted in nearly two-thirds of the CWHvm1 being in the early seral stage (less than age 40), only 14% of the forested land is in the mature plus old seral stage – see table 4.

If no seral stage constraints are applied, the harvest rate in the mid-term does not decline as rapidly as the Base Case. Over the longer term the harvest rate without seral stage constraints matches the Base case.

If the timber supply model is constrained to meet mature plus old seral stage targets, then the harvest rate decreases approximately 20,000 m^3 per year (figure 29).

Figure 29. Harvest rate impacts of meeting seral stage targets - Bonanza Lake Management Unit.

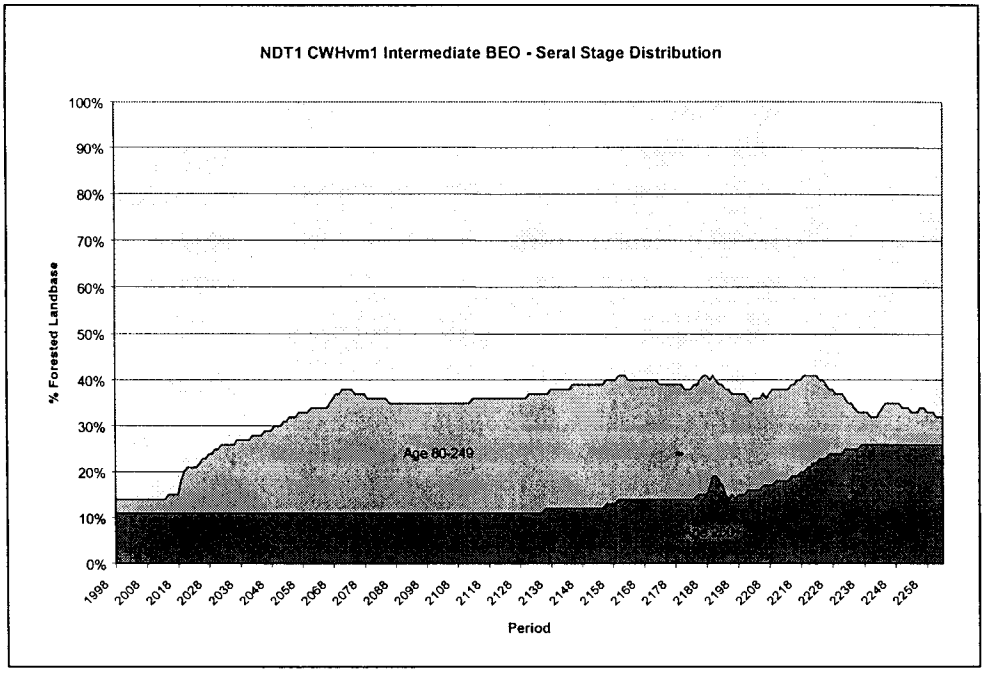


Applying the seral stage constraint does not mean the targets are met immediately. Because of the shortage of timber in the mature and old seral stages of the CWHvm1, the mature plus old target is not met until 2032 and the old target of 13% is not met for approximately 160 years in 2156 (figure 30). In the Base Case, 13% of CWHvm1 is in

[17] Forest Practices Code of British Columbia, Biodiversity Guidebook, September, 1995.

the old seral stage in 2220, approximately 60 years later than can be achieved by applying the seral stage with its concomitant reduction in harvest rate.

Figure 30. Mature plus old seral stage distribution CWHvm1 - Bonanza Lake Management Unit.



4.2.6.2 Meeting "Old" Biodiversity Emphasis Option (BEO) Targets

Meeting the "old" seral stage target for the recommended[18] Biodiversity Emphasis Objectives (BEO) from the Vancouver Island Land Use Planning (VILUP) planning process, when compared to the blended target used in the Base Case simulation, has no impact on timber supply. This is not unexpected since the blended targets used in the Base Case simulation are within 1% of the draft BEO targets (table 5)

Table 5. Draft versus blended BEO targets for the Bonanza Lake Management Unit.

Landscape Unit	NDT	BCG unit	BEO	Seral Stage	Land Use Planning Guidebook Targets	Blended Target Applied in Base Case	Difference
Bonanza	NDT1	CWHvm1	Intermediate	Old	13%	14%	(1%)
Bonanza	NDT1	CWHvm2	Intermediate	Old	13%	14%	(1%)
Bonanza	NDT1	MHmm1	Intermediate	Old	19%	20%	(1%)
Bonanza	NDT5	AT	Intermediate	Old	n/a	n/a	

[18] In the Vancouver Island Summary Land Use Plan, February 2000, the Bonanza landscape unit is assigned a General Biodiversity Conservation Management objective as well as an "Enhanced Silviculture" (ES) and "Enhanced Timber Harvesting' (ETH) objective.

The simulated harvest rate using the recommended "old" BEO target follows the base case harvest pattern. Only the CWHvm1 constraint is binding and relaxing the constraint by 1% does not have a discernible impact on simulated timber supply.

4.2.7 Timber Supply Implications of Variable Retention

As described in Section 4.1.6, it is assumed that aggregate retention will be met through the existing netdowns and constraints currently required under the FPC. For the one-third of the harvest expected to come from dispersed retention, the timber supply impacts are 5 to 5.6%. The timber supply impact on the Bonanza Lake Management Unit of TFL 47 is expected to be 1.9% or approximately 3,500 m^3 per year[19].

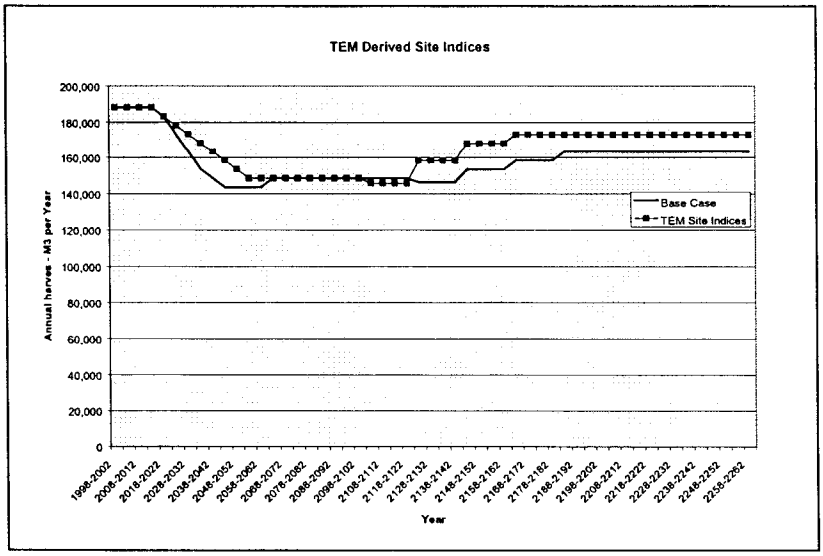
4.2.8 Timber Supply Implications of TEM Derived Site Indices

Terrestrial Ecosystem Mapping (TEM) was completed on the Bonanza lake Management Unit of TFL 47 in 1999. The TEM mapping identified ecological site units to the site series level. A preliminary comparison of the site indices carried on TimberWest's forest inventory to the average site indices by ecological unit, indicated that the potential site indices for Bonanza Lake may be underestimated by 10%.

In order to estimate the timber supply implications of this under estimate of the site potential, revised yield curves were generated using average site indices published in "*Site Index Estimates by Site Series for Coniferous Tree Species in British Columbia, 1997, Province of British Columbia*"

With the revised site indices, there is greater flexibility in managing the harvest falldown from 2025 to 2065. The long-term harvest rate increases to 173,250 m^3 per year (figure 31)

Figure 31. Harvest rate using TEM derived average site indices - Bonanza Lake.

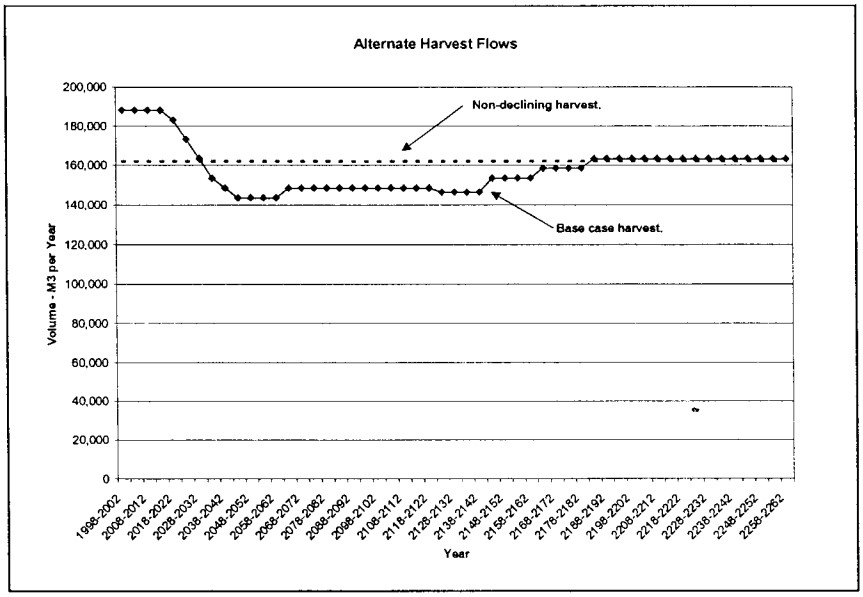


[19] A 5.6% yield reduction x 33.3% of THLB x 188,100 m^3 per year = 188,100 = 3,508 m^3

4.2.9 Alternate Harvest Levels

A policy of non-declining yield would result in a harvest level of 162,162 m^3 per year. The long-term sustainable harvest rate is the same in both cases (figure 32).

Figure 32. Alternate harvest levels.



5. SUMMARY AND CONCLUSIONS

TimberWest believes that the role of the timber supply analysis is to provide reliable information on the long-term timber supply to the public, the Chief Forester of the Ministry of Forests and TimberWest employees and shareholders. This information is then used along with other social, environmental and economic information to assign an allowable cut for TFL 47 for the next five years. This process ensures that harvest levels of this long-term resource are adjusted every five years, thus avoiding the need for radical changes in harvest rates. Each new analysis incorporates new resource information and uses improved analytical approaches.

This timber supply analysis incorporates the requirements of the Forest Practices Code of British Columbia Act.

The timber supply outlook for the Johnstone Strait and Bonanza Lake Management Units appears very favourable.

Table 6. Derivation of the proposed AAC

	Johnstone Strait	**Bonanza Lake**	***Total***
Base Case – 1998- 2003	559,350	188,100	*747,450*
Less Reduction for Variable Retention	(10,500)	(3,500)	*(14,000)*
Less Reduction for Quadra SMZ	(5,500)		*(5,500)*
Sub-Total	**543,350**	**184,600**	***727,950***
Less reduction for SBFEP[20]	(20,524)	(4,630)	*(25,154)*
Proposed AAC	**522,826**	**179,970**	***702,796***

As noted in table 6, TimberWest proposes an AAC of 702,800 m^3 per year after accounting for TimberWest's commitment to replace clear-cutting with variable retention harvesting and for the 1997 5% AAC reduction resulting from TimberWest's change of ownership.

[20] The transfer of ownership of TimberWest Forest Ltd. on June 23, 1997 resulted in a 5% reduction in AAC. A total of 28,242 m3 of AAC was transferred to the SBFEP (MoF letter October 24, 1997). The numbers in this table represent an allocation of this reduction between the Johnstone Strait, Bonanza Lake and Moresby Management Unit.