APPENDIX 9; STRATEGIES FOR THE MANAGEMENT OF TREMBLING ASPEN ON TFL15

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December 7, 2001

Ed Collen, R.P.F.
Weyerhaeuser Company Limited
Box 39
Okanagan Falls, British Columbia
V0H 1R0

Dear Ed Collen:

I have reviewed your "Strategies for the Management of Trembling Aspen on TFL 15" document submitted to our office on September 4, 2001.

I am satisfied that this document proposes reasonable strategies for dealing with aspen on Tree Farm Licence (TFL) 15. I have considered that with the introduction of the *Forest Practices Code of British Columbia Act*, and its emphasis on biodiversity, the recognition of aspen and its role in the ecosystem has changed significantly. I am also aware that aspen is relatively rare on the TFL landbase, and this strategy attempts to sustain the existing levels of aspen on the landbase over time.

I herewith, approve the application of this strategy for use on TFL 15. It is my expectation that this strategy will be incorporated in the next update of the Management Plan for TFL 15. Impacts of implementing this strategy will be considered in the next TFL timber supply review.

Furthermore, the continuous improvement initiative in your Environmental Management System certification will provide feedback and appropriate adjustment to the strategy will be made.

Yours truly,

John H. Wenger
District Manager
Penticton Forest District

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Strategies for the Management of Trembling Aspen on Tree Farm Licence 15

Prepared for

Ed Collen, RPF
Weyerhaeuser Company Limited
OK Falls Division

Project: WCF-083-007

August 31, 2001

Weyerhaeuser
The future is growing™

J.S. Thrower & Associates Ltd. *Consulting Foresters*
Vancouver – Kamloops, B.C.

Acknowledgements

Thanks to the many people who have taken time to read over and comment on this document: Walt Klenner, PhD, PAg, Alan Vyse, RPF and Hadrian Merler, RPF from the Kamloops Regional Office; Ed Collen, RPF, Weyerhaeuser, OK Falls; Sean Curry, Weyerhaeuser, Kamloops; Steve Jones, RPF, Southern Interior Forest Craft Ltd; Brian Harris, Habitat Protection Officer, Ministry of Environment, Lands and Parks, Penticton, and Ted Sales, RPF, Second Growth Consulting, Kamloops. Thanks also to those who helped provide information on wildlife issues, succession and aspen management: Les Gyug, RPBio and Dick Cannings, RPBio, biologists in the Penticton area; Dennis Lloyd, RPF, and Suzanne Simard, PhD, RPF from the Kamloops Regional Office; Teresa Newsome, RPF from the Cariboo Regional Office and the forestry staff at Weyerhaeuser, OK Falls Division.

Executive Summary

Aspen is a component of less than 7% of the forested area of TFL 15. However, it is very important from a biodiversity and wildlife viewpoint, particularly for cavity nesters and small mammals. The strategy outlined in this document provides a flexible approach to managing aspen as a component of coniferous stands that considers its relative abundance on the landscape, the importance of the species, the potential impacts of root disease, and the potential impacts of aspen on conifers.

An adaptive approach to aspen management is recommended for TFL 15. Goals will be set in co-operation with Ministry of Forests and Ministry of Environment, Lands and Parks, and plans prepared to meet them. These goals must be reviewed and revised in conjunction with the Management and Working Plans for the TFL. It is also recommended that the decision diagrams developed as part of this strategy be considered for testing for use in the management of areas with aspen in Weyerhaeuser's Forest Licences in the Penticton Forest District.

Mappable subhygric or hygric site series with the equivalent of five well-distributed stems per hectare or greater of aspen, and all patches exceeding one hectare where aspen is a major species, will be retained in existing harvested stands. In areas proposed for harvesting, they may be retained or managed as separate standards units with reduced stocking standards. A mosaic of smaller patches and individual stems will be retained on some blocks; patches or stems with valuable wildlife attributes will be given preference for retention. In non-harvested stands, more effort may be required to identify aspen at the pre-harvest stage.

On non-harvested or recently harvested sites, a decision will be made as to whether or not some clumps or individual mature aspen stems will be removed before treatments are done on the block. Mechanical site preparation adjacent to residual aspen may be carried out at the licensee's discretion and these areas may be planted to higher densities of conifers than the remainder of the block. Conifer release may also be done at the licensee's discretion to meet the stated goals. More aggressive measures are recommended where initial densities of mature aspen stems or clumps of aspen exceed 10 per hectare.

No further removal of individual stems or clumps of mature aspen is recommended in areas where site preparation and planting are already completed, where more than three years have passed since harvesting or where free growing standards are currently met. Where initial densities of aspen exceed 10 clumps or mature stems per hectare, it is recommended that the minimum stocking standards of the conifers be reduced to allow a component of aspen in the regenerated stand.

Recommendations are made to refine and localize the strategy outlined in this document.

Table of Contents

List of Tables

List of Figures

1. INTRODUCTION

1.1 DOCUMENT OBJECTIVES

Several cut blocks on Tree Farm Licence (TFL) 15 age approaching their free growing assessments but may not achieve the standards set out in the silviculture Prescription (SP) because the SPs did not adequately address competition from trembling aspen (*Populus tremuloides* Michx.) Before undertaking an aggressive control program that may include the use of chemicals, Weyerhaeuser determined that it would be more efficient to develop a strategy to manage aspen both on previously harvested blocks and on blocks to be developed in the future.

This report outlines a landscape level approach to aspen management to address wildlife, biodiversity and free growing concerns while respecting the silvics of both aspen and coniferous tree species. It proposes an adaptive management approach where aspen stands will be managed within set objectives for the TFL.

1.2 BACKGROUND

A Phase I Vegetation Resource Inventory (VRI) of TFL 15 was completed in 1997 and this data was used in Management Plan (MP) 8. Phase II will be completed for use in the timber supply analysis for MP9. The following information is summarized from the approved Phase I inventory and represents the most current data available for the land base. Stands containing trembling aspen constitute less than seven percent (7%) of the timber harvesting land base[1] (THLB) of TFL 15. The map in Appendix I shows the spatial distribution of these stands. The majority of stands containing aspen occur within the IDF dm1 and the MS dm1 subzones as shown in Figure 1 and Figure 2. Over 75% of these stands have less than 10% aspen in the stand. Figure 3 breaks down the area of stands containing aspen by the percent of aspen in the stand and further breaks this down by subzone. Of these stands, there are two spikes in the age class distribution: 34% of stands are in age class 1 (<20 years) and an additional 37% are in age class 4 (61-80) (Figure 5). The low occurrence of aspen is attributed to the generally coarse textured granite soils present in the TFL (Dennis Lloyd Pers. Comm.)[2].

Details of the aspen component of the three Forest Licenses (A18674, A18970, and A49782) for OK Falls Division are included in Appendix II. The aspen component of these licenses ranges from 2.0 to 4.4%.

By comparison, it is estimated that mixed broadleaf/conifer stands may occupy 23.9% of the forested land in B.C. and that broadleaf species are the leading species on an additional 11% of

[1] Approximately 196 hectares of stands with a leading deciduous forest cover label (0.4%) have been removed from the THLB.

[2] Lloyd, Dennis, RPF, Regional Ecologist, Kamloops Forest Region. December 1999.

the productive forestland. Leading aspen stands are estimated to cover about eight percent of the forested land base of the province (Comeau 1996).

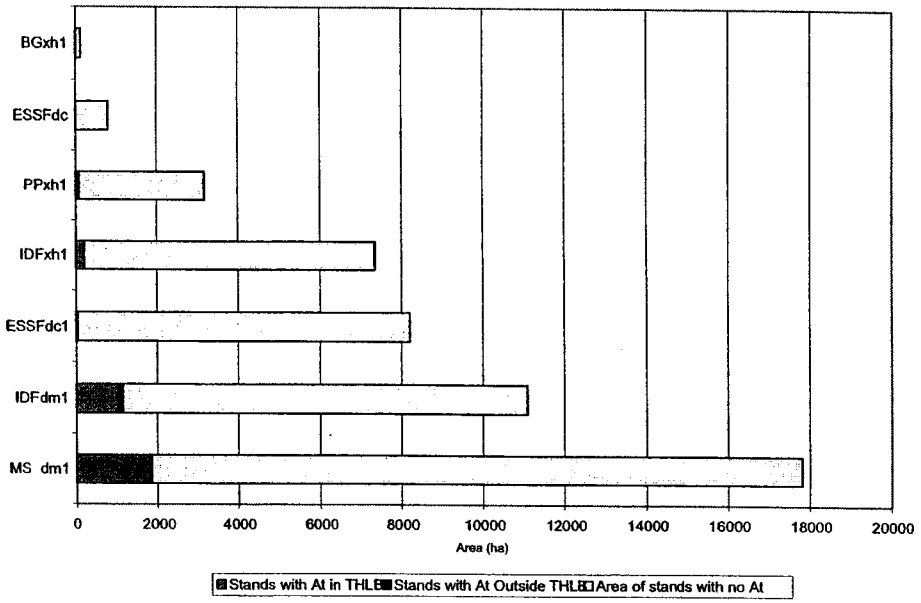

Figure 1. Aspen Component by Subzone.

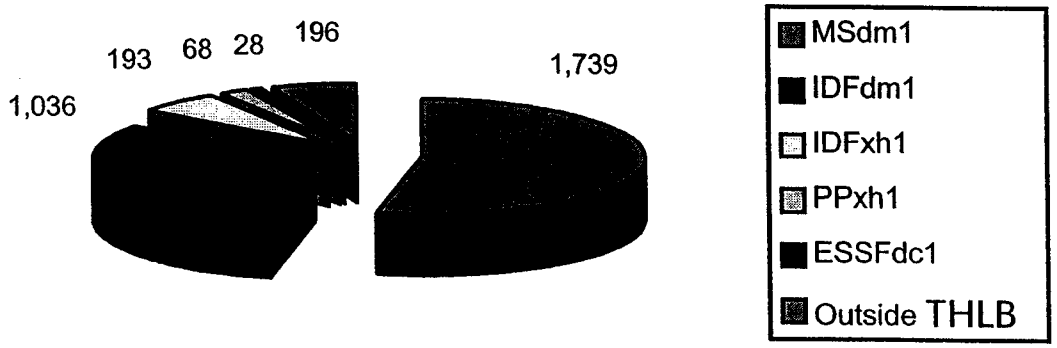

Figure 2. Breakdown of Area of Stands Containing At by Subzone.

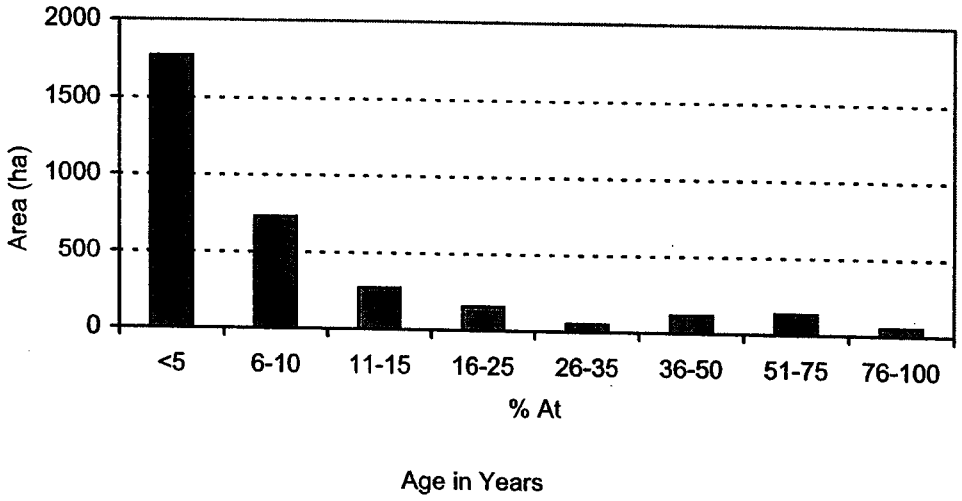

Figure 3. % At by Area, All Subzones.

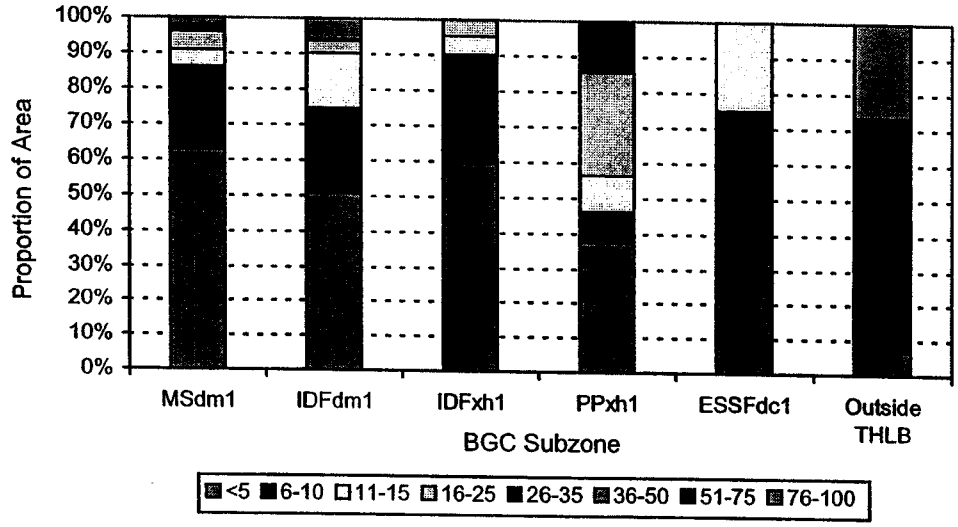

Figure 4. Distribution of At Component (species %) by Subzone

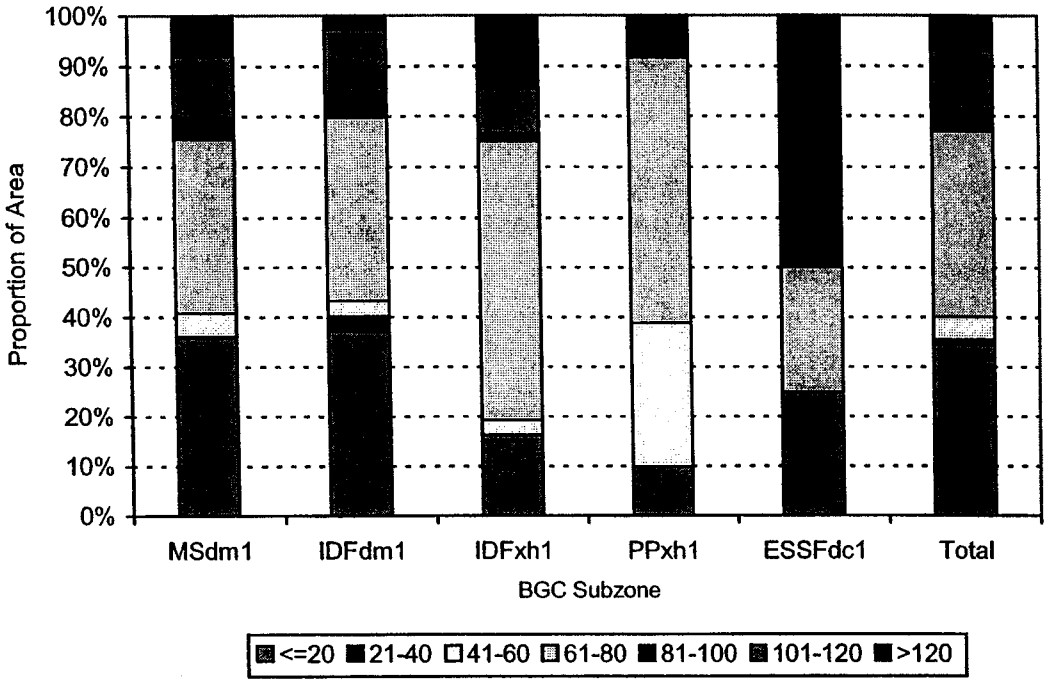

Figure 5. Age Class Distribution of Aspen by Subzone.

Over the past 12 years, approximately 10,858 ha of cutover areas have been surveyed on TFL 15. As shown in Figure 6, fourteen percent of the area surveyed, or 1,533 ha show aspen in the Rank 1 inventory label. Only 242 ha (2.2%) show greater than 1,000 stems/ha of aspen in the inventory label and 156 ha of that category are in one opening. Table 5 in Appendix III summarizes the survey findings based on information from Weyerhaeuser's Silviculture Records Management System (SRMS).

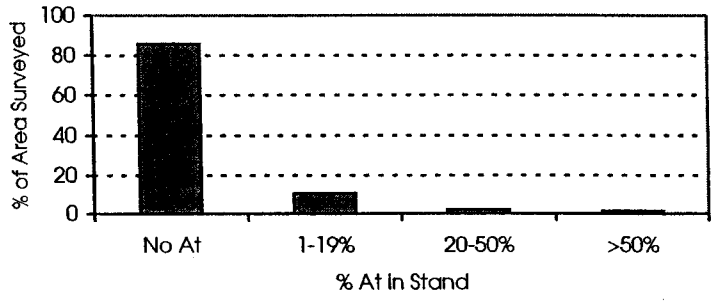

Figure 6. Summary of SRMS Survey Data (based on Rank 1 inventory labels).

1.3 THE ROLE OF ASPEN

Aspen serves many roles within TFL 15, the most important of which are summarized in Table 1 and Appendix IV. These issues must be addressed in setting management goals for the aspen resource on the TFL.

Aspen in riparian areas may be of particular importance because of its scarcity on the landscape. A GIS search showed only 243 ha of stands containing aspen within 20 m of streams or wetlands (Figure 7).

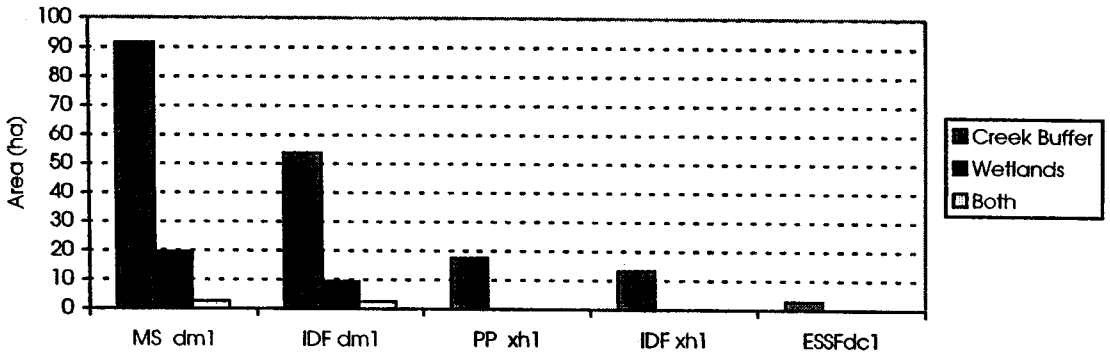

Figure 7. Distribution of area of At within 20 m of creeks or wetlands

Table 1. Summary of Attributes of Aspen Stands.

Value	Importance of Aspen	Source
Wildlife	▪ Prime habitat for cavity nesters ▪ Habitat for small mammals	Cannings[3], Gyug[4] Pers. Comm.
	▪ Food source for white-tailed deer	Peterson and Peterson 1995
Biodiversity	▪ Supply of coarse woody debris	Peterson and Peterson 1995
	▪ Snags remain standing longer than coniferous snags	
	▪ Rare ecosystems in association with grasslands	Lloyd[1] Pers. Comm
Visual quality	▪ Break up conifer-dominated landscape	
Forest health	▪ May reduce damage from *Pissodes terminalis*	Safranyik, Nevill and Morrison 1998
	▪ May reduce spread and mortality from *Phellinus weirii*	Morrison, Merler and Norris 1991

[3] Cannings, Richard, RPBio, December 1999 and February 2000.
[4] Gyug, Les, RPBio, November 1999.

Value	Importance of Aspen	Source
Nutrient Cycling	▪ More rapid nutrient turnover than under conifers ▪ Young stands take up large quantities of nutrients and reduce leaching losses ▪ Increased rate of forest floor decomposition.	Peterson and Peterson 1995
Water Relationships	▪ More snow reaches the ground than in a pure conifer stand	Debyle 1985
Grazing	▪ Cover for free ranging cattle	Simard, Mather and Heineman 1999[5]
Blowdown	▪ May help to reduce windthrow in older stands.	Newsome 1997

1.4 BIOLOGY OF ASPEN

Aspen usually occurs in three different distributions: pure or leading aspen stands, leading conifer stands with minor aspen and scattered individual stems. The successional pathways of each are outlined in Table 2 based on information provided by Dennis Lloyd[1]. It is important to understand these pathways in order to predict or influence the development of immature aspen stands following a disturbance.

Table 2. Successional Pathways of Aspen.

Stand Type	Successional Pathway
Pure aspen (>80% At)	▪ Generally follows a harvest or burn ▪ May be indication of root rot ▪ May be some interior Douglas-fir (Fdi) or spruce (Sx) regeneration under the aspen canopy ▪ Competition and leaf fall may result in patchy Fdi regeneration ▪ Conifers may replace aspen in about 100 years
Mixed conifer/aspen stands	▪ Coniferous component is usually Fdi or Sx ▪ Aspen component generally falls out in 150-170 years ▪ Often on toe slopes with seepage inputs ▪ May be the most productive aspen stands
Scattered aspen stems (<5% At by volume)	▪ Probably not significant competitors – they may be a minor component of the stand because of the site ▪ May be important for nutrient cycling ▪ Suckering may not be significant due to low root densities.

A summary of the regeneration strategies and early growth of aspen is given in Table 3 and Appendix V. It is important to understand these strategies to successfully manage the aspen component of coniferous stands.

[5] Simard, Suzanne, J. Mather and J. Heineman. 1999. Aspen Complex. Unpublished draft report.

Table 3. Summary of Biological Factors Influencing Aspen Management.

Factor	Importance to managers	Source
Regeneration is mainly from suckers	• Most suckers initiate from shallow roots of small diameter	Schier, Jones and Winokur 1985
	• 95% of suckers establish within first year following disturbance	Peterson and Peterson 1995
	• Mechanical site preparation treatments that cut deeper than 12 cm may help to reduce suckering.	Navratil 1996
Density and initial growth of suckers following disturbance is influenced by site and stand factors	The initial density of suckers following harvest may be as high as 200,000 stems/ha but is often in the range of 20-40,000 stems/ha. Factors affecting the density of suckers include:	
	• stocking of aspen prior to harvest	Schier et al 1985, Navratil 1996
	• opening size and silviculture system	Navratil 1996
	• season of cutting	Haeussler, Coates and Mather 1990; Sauder 1992
	• light availability	
	• soil type, moisture and temperature	
	• treatment of parent trees	Peterson and Peterson 1995
	• Most severe competition with conifers will be on mesic and wetter sites, particularly on toe slopes (IDF xh1-06, 07; IDF dm1-01, 05; MS dm1-01, 05, 06).	Lloyd[1] Pers. Comm.
	• Height growth of suckers from cut trees is better than from girdled trees.	Haeussler, Coates & Mather, 1990
	• Growth slows considerably after the first year.	Simard, Mather & Heineman 1999[4]
Self-thinning occurs rapidly	Up to 40% of suckers may be dead by the third year.	Peterson and Peterson 1995

2. ASPEN MANAGEMENT STRATEGIES FOR TFL 15

Strategies for managing aspen on TFL 15 should include the following components:

- The approach must be flexible and adaptive.
- It should consider:
  - the silvics of aspen and of the conifers that will be managed on the sites,
  - the range of sites on which aspen occurs,
  - the low percentage of the land base occupied by aspen,
  - the potential impacts of root diseases,
  - an assessment of the potential impact of aspen on the next crop,
  - the legal obligations of the licensee to regenerate the stand.
- The approach should allow for regeneration of aspen stems for wildlife and potential future harvesting.
- The end results should not be the same everywhere.
- The costs and benefits of recommended silviculture treatments should be considered.

2.1 An Adaptive Approach to Aspen Management

The background to this project has identified the following:

- Aspen occupies a relatively small percentage of the land base on TFL 15 (less than 7%).
- Its contribution to wildlife habitat and biodiversity far outweigh its distribution.
- Over the harvesting history of the TFL, despite little intervention to reduce the severity of aspen competition, surveys show less than 450 ha with greater than 500 stems/ha of aspen and less than 250 ha with greater than 1000 stems/ha of aspen out of a total of 10,858 ha surveyed (Appendix III).
- In order to maximize the contribution of the aspen component of the TFL to biodiversity and wildlife, the licensee should have the flexibility to look at a range of aspen densities within set limits for different results.
- The success of aspen management must be evaluated at the forest level, not at the stand level.

These points can be addressed effectively in an adaptive approach to managing aspen on TFL 15. This approach would set goals for the allowable amount of aspen over the TFL and would then allow the licensee maximum flexibility to manage aspen as a component of coniferous stands within these goals. Goals would be related to specific blocks and would be used to determine the standards for each block. Inventory information on the existing mature and immature aspen resource as well as schedules for future harvesting in aspen areas would be included in each Management Plan (MP) for the TFL.

Operating areas covered by Forest Licences held by Weyerhaeuser in the Okanagan Falls area are very similar to TFL 15, and their aspen component is also very low as shown in Appendix II. It would be appropriate to consider testing the use of the decision diagrams presented in Appendix IX for management of cutblocks with aspen within these operating areas, within the Penticton Forest District, in order to evaluate their applicability. Depending on the results, and in consultation with other District staff, the decision diagrams may be applied to other Forest Districts within the Weyerhaeuser, OK Falls operating area. This would provide consistency for Weyerhaeuser's forest managers and would provide a greater awareness of the aspen resource on these licences.

Management of aspen on TFL 15 will have two interim objectives:

1. At the landscape level, to retain a specified component of aspen over the landscape to meet biodiversity and wildlife concerns.

2. At the stand level, to develop silviculture prescriptions and stand management prescriptions to meet the landscape level objectives and to take appropriate measures to manage aspen within the parameters of these prescriptions.

During the preparation of MP9 for TFL 15, these interim objectives will be reviewed and confirmed or modified within the context of the recently approved Okanagan-Shuswap Land and Resource Management Plan. MP9 approval and the AAC determination must be completed by July, 2004.

Under Part 2, Section 4(3) of the British Columbia Forest Practices Standards Act, the District Manager has the authority to "establish objectives for a landscape unit, and may vary or cancel an objective". Part 5, Division 2 of the Operational Planning Regulation provides for regeneration of mixed species where it was present on the area before the timber was harvested (unless otherwise provided for in a higher level plan); or where a mix of species is ecologically suited to the area and is required in any higher level plan or in the forest development plan that applies to the area under the prescription.

2.1.1 Process and Responsibilities

Figure 8 shows an outline of the how the adaptive management process would be implemented for managing aspen on TFL 15. Further details on the process are included in Appendix VI.

This approach would:

1. Allow Weyerhaeuser to manage stands with a component of aspen for a wide range of objectives. Aspen will be tracked as part of the inventory process to classify the stands and their contribution to the aspen goals.
2. Encourage higher level planning to meet broad objectives rather than dealing with issues on a block-by-block basis.
3. Encourage the licensee to become more aware of aspen at the pre-harvest stage and, if necessary, to carry out treatments prior to harvest in order to minimize future liabilities for treatments.
4. Encourage the licensee to try different treatments.
5. Give the licensee the flexibility to allow some areas to develop as immature aspen stands according to specific objectives set out in the Management Plan.

2.1.2 Setting Goals

An interim goal may be as follows: *Weyerhaeuser will manage immature stands on TFL 15 so that the aspen component is retained but does not occupy more than 7% of the total land base of TFL 15 in either pure patches or mixed conifer/broadleaf stands with more than 500 stems/ha of aspen.*

These goals will be refined for inclusion in MP9 as knowledge of the aspen resource on TFL 15 is expanded. Goals in the future may include numbers of trees over a specified diameter, distribution by age class or population goals for specific wildlife species. Appendix VIII includes some recommendations for further work to better understand the aspen resource of TFL 15.

The objectives outlined in this report will be included in the next MP for TFL 15 and the details will be incorporated into all new SPs being prepared.

2.2 Impacts on Timber Supply

In the current Timber Supply Analysis, all deciduous leading stands have been removed from the THLB. All deciduous volume in non-deciduous leading stands has been removed from the VDYP tables prior to modeling. Weyerhaeuser realizes that any changes resulting from the implementation of the Aspen Management Strategy will have to be reflected in the next Timber Supply Analysis. By managing for aspen in cutblocks, Weyerhaeuser recognizes that there might be a negative effect on coniferous harvest levels. Impacts relative to MP8 will be difficult to determine, as there are several significant data collection initiatives that will be included in MP9. However, VRI updates and new silviculture surveys will provide current forest cover information that will be used during the next timber supply analysis. Yield curve development for MP9 and any recommendations from this strategy will be modeled to show potential impacts.

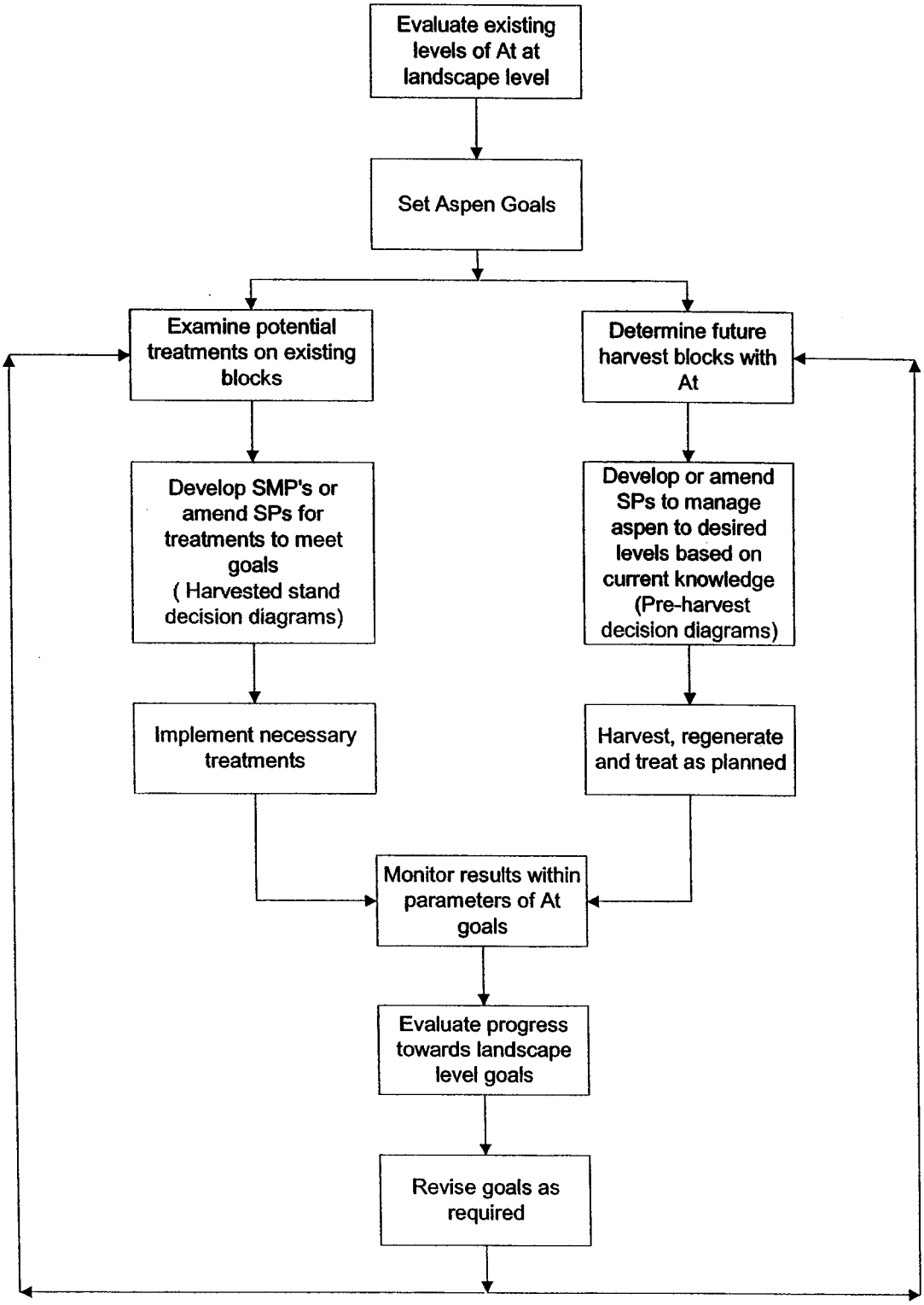

Figure 8. Adaptive Management Process for Aspen Management.

3. SPECIFIC RECOMMENDATIONS FOR ASPEN MANAGEMENT

Recommendations are given for specific types of aspen stands:

- deciduous stands with identified root disease,
- aspen on subhygric or hygric sites,
- patches exceeding one hectare where aspen is a major species,
- areas greater than one hectare with more than 10 residual clumps or mature aspen stems per hectare and
- dispersed residual aspen patches or scattered individual mature stems.

Suggestions are given for stands that have already been harvested as well as areas proposed for harvesting. It is recommended that more effort be put into controlling aspen at the pre-harvest stage than in stands where it is already established following harvesting, unless the sites are drier than mesic.

In determining an appropriate silviculture regime for a stand, the prescription must consider the overall goals for aspen, the probable successional pathway of each stand (Table 2), and the anticipated levels of control required to meet the objectives for that stand. The most difficult areas to manage for conifers will be toe slopes with seepage inputs where aspen is present prior to harvest. The drier the site and the lower the initial density of aspen, the more effective will be the control efforts. On wetter sites, the prescription may either accept a higher component of aspen or more aggressive measures will have to be taken to limit its density in the regenerated stand.

Measures to control aspen are going to occur mainly in the IDFdm1 and the MSdm1 (as shown in the breakdown in Figure 1 and Figure 2). However, it is anticipated that aggressive measures will have to be taken on stands with >10% aspen in the original stand on mesic and wetter sites (IDFdm1/01 and 05; MSdm1/01, 05 and 06), which is less than 500 ha in total. Information from the new TEM mapping can further define these areas for the forest manager.

Within the PPxh1, IDFxh1 and ESSFdc1 subzones, stands containing greater than 15% aspen fall into the category of a rare forested ecosystem[6] that should be given priority for contribution to old seral stage targets, old growth management areas, connectivity and wildlife tree patches (WTPs) for each Landscape Unit. Control of aspen within these subzones should be severely limited.

[6] Glossary, Okanagan-Shuswap LRMP – MELP: a forested ecosystem that comprises less than 2% of a landscape unit and is not common in adjacent landscape units.

3.1 AREAS WITH ROOT DISEASE

The presence of root disease in stands will influence the outcome of silvicultural treatments to a large degree. TFL 15 has developed a Forest Health Management Plan that includes recommendations made in the Forest Practices Code Root Disease Management Guidebook. Areas with root disease identified prior to harvest may be considered a separate standards unit (standards unit) or may be removed from the Net Area to Reforest (NAR). On these areas, aspen may be managed as a short-rotation interim crop. If they are kept within the NAR, these standards units will follow the same stratification as the remainder of the block based on the aspen component and the sites on which they occur. Stumping should be carried out and coniferous stocking standards should be reduced to allow a component of aspen in the regenerated stand.

The presence of aspen may be an indication of root disease in some stands. Polygons of age class 3 and older having significant broadleaf components should be suspect for root disease. Stands that show a mosaic of conifer and broadleaf types on aerial photos may represent root disease affected areas.

Aspen patches recognized as root disease centres may be retained as wildlife tree patches. In harvested areas with root disease, aspen should be considered an essential component of the stand and, in some cases, aspen may be managed on these sites as a short-rotation interim crop. Maintaining a component of broadleaf trees may help to reduce the impact of *Phellinus weirii* on the gross stand volume. Where lodgepole pine (Pl) and aspen are ecologically suited, a mixture of these species that are less susceptible to *P. weirii* is recommended for regenerating diseased sites.

3.2 AREAS NOT YET HARVESTED, NO APPROVED SP

At the pre-harvest stage, all aspen components and root disease centres must be identified. Root disease centers will be maintained as a separate standards unit as described in Section 3.1. The objectives for aspen for each block must be clearly stated prior to harvest and some or all of the steps below may be necessary to achieve these objectives. A map of the proposed cut block showing polygons with aspen, site series, streams and wetlands is required.

3.2.1 Subhygric or Hygric sites

1. Where aspen occurs at a density of five well-distributed mature stems/ha or higher on mappable subhygric or hygric sites, (A) the aspen may be retained and the area removed from the NAR or, (B) that area may be defined as a separate standards unit. Consideration should be given to removing areas from the NAR where:
   - the association is rare in the adjacent landscape,
   - there are significant non-timber values to preserve,
   - there is a low probability of successfully establishing a free growing coniferous crop,

- the use of chemicals is not possible or desirable and the success of other treatments to control At may be limited,
- the unit is too small to be managed efficiently.

2. Areas removed from the NAR may become Wildlife Tree Patches (WTPs). Outside WTPs, conifers may be harvested for forest health reasons or to remove blowdown.
3. Where these sites fall within Riparian Management Areas (RMAs) as defined in the FPC, conifers will be retained as outlined in the "Riparian Management" section of the Forest Development Plan 2000-2005 for TFL 15, which is included in Appendix VII. Widths of RMAs for streams and wetlands are also included in that appendix.
4. The openings created by harvesting may be fill-planted at the licensee's discretion, preferably with Sx or Pl. A low (0.5 m) inter-tree spacing is recommended and cluster planting of high or open ground is preferred.
5. Where separate standards units are defined, the stocking standards may be reduced to account for At in the regenerated stand. Consideration should also be given to accepting vigorous, good quality spruce overtopped by At as acceptable free growing stems.
6. Where the cut block is to be planted, the recommendations given in Section 3.2.4 for reforestation adjacent to residual aspen should be followed within 20 m of these sites. The component of Sx in these areas may be increased.
7. A new inventory label will be established for areas removed from the NAR. Two silviculture survey plots per hectare will be established in all areas within the NAR.

3.2.2 Patches Larger Than One Hectare with Aspen as a Major Species

1. All patches exceeding one hectare in size where aspen is a major species should be excluded from the NAR in the Silviculture Prescription (SP). If no harvesting is to take place, these may become WTPs. Patches with mature Fdi, western larch (Lw), ponderosa pine or Sx should be given preference as WTPs. This does not preclude retention of coniferous WTPs within cut blocks with an aspen component.
2. If conifers are to be removed from WTPs for forest health reasons, this should be discussed with the district manager and designated MELP officials prior to removal.
3. Openings created within the patches by the harvest of conifers may be direct planted at the licensee's discretion with Sx or Pl, immediately following harvesting. A component of Lw or Fdi may be included where they are suitable to the site and size of opening. A minimum inter-tree spacing of 0.5 m may be used to take advantage of good microsites but conifers should not be planted within three meters of mature aspen stems.
4. Where the cut block is to be planted, the recommendations given in Section 3.2.4 for reforestation adjacent to residual aspen should be followed within the 20 m of these patches.
5. A new inventory label will be established for the patches at the time of the next survey.

3.2.3 *Aspen Patches Greater Than One Hectare, More Than 10 Mature Stems or Clumps/ha*

Where areas greater than one hectare with more than 10 clumps or individual stems of mature aspen per hectare (but aspen is not a major species) can be stratified, these should become separate standards units.

1. Within the standards unit, some patches or individual stems may be removed prior to or immediately following harvest. Patches on rocky ground should be retained regardless of their distribution. Stems with existing cavities, large snags, large mature trees or patches of aspen with high volumes of coarse woody debris, natural gaps or high vertical stratification should be given preference for retention.
2. In determining the number or area of patches to retain, their extent over the standards unit and their potential impact on survey results at free growing must be considered.
3. Patches or individual stems that will not be retained will be girdled, treated with herbicides or cut during harvest. Preference will be given to treatment before harvest.
4. Depending on its initial density, coniferous stocking standards may be reduced to allow a component of aspen in the standards unit.

Aggressive measures will have to be taken on these standards units if management goals are to restrict the stocking of aspen. It is anticipated that heavy suckering of aspen will occur within the first year following harvest for a radius of approximately 20 metres around any felled or residual aspen stems. This distance is only an estimate and it is unlikely that suckering will occur in a regularly shaped area surrounding existing aspen. The density and vigour of suckers should be lower on drier, nutrient-poor sites and higher on moister and richer sites. In order to limit aspen competition, the following steps should be taken:

1. Natural regeneration of conifers should not be relied upon unless aspen is planned to be the dominant species over the next rotation. However, if the licensee feels that free growing standards can be met without planting, these areas may be left unplanted.
2. MSP should be carried out.
3. The areas adjacent to all residual aspen should be planted to 2000 stems/ha with a 1.0 m tolerance. Depending on the contribution of aspen to the MSS, the planting density may be reduced accordingly.
4. Do not plant within three meters of mature aspen stems.
5. Pl should contribute to the stocking up to the MSS for the standards unit and spruce should make up the remainder, consistent with the site series.
6. One or more conifer release treatments may be required.

3.2.4 Dispersed patches and scattered mature stems (<10/ha)

1. Where aspen is dispersed and cannot be stratified as a separate standards unit or where units are less than one hectare, the MSS for coniferous species should be reduced for the standards unit.
2. Patches on rocky ground should be retained regardless of their distribution.
3. Stems with existing cavities, large snags, large mature trees or patches of aspen with high volumes of coarse woody debris, natural gaps or high vertical stratification should be given preference for retention.
4. Patches or individual stems that will not be retained will be girdled, treated with herbicides or cut during harvest. Preference will be given to treatment before harvest.

On these areas, if the cut block is to be planted, the following steps may be taken to limit aspen competition adjacent to residual stems and patches:

1. Mechanical site preparation to break up aspen roots may be carried out at the licensee's discretion.
2. Planting may be done at a density of 2,000 stems/ha with a minimum inter-tree distance of 1.0 m within 20 m of residual aspen. If appropriate to the site, a mix of Pl (up to the MSS for the site series) and Sx may be used.

Conifer release will be carried out to selectively release potential crop trees if aspen regeneration will prevent the achievement of free growing standards or to prevent mechanical damage to conifers.

At the time of the silviculture survey:

1. In standards units with a component of aspen, silviculture surveys will be carried out at an intensity of two plots per hectare.
2. The goals set in the adaptive management process must be measured in the silviculture survey procedure.

3.3 Recently Harvested Areas – Site Preparation and Planting Not Completed or Areas with an Approved SP That Are Not Yet Harvested

Where scattered residual patches or scattered individual mature stems are present, a decision must be made either to retain all of these stems or patches or to reduce their numbers. This decision should be based on the status of aspen regeneration in relation to the goals set out in Section 2.1, the site series, whether or not harvesting has taken place and, if harvested, the number of years since harvest. The drier the site, the less aggressive aspen will be as a competitor and the less need there should be to remove stems. The longer the interval since harvest, the less intervention there should be to remove individual stems or small patches because suckering will have taken place already and there will be little advantage removing mature stems. As a guideline, stems should not be removed if more than three growing seasons have passed since harvest. Where a decision is made to remove aspen patches or

individual stems on cut blocks where harvesting is already complete, herbicides are recommended over girdling, which may take longer to kill the tree.

3.3.1 Subhygric or Hygric Sites

1. If mappable subhygric or hygric areas with an equivalent of five or more mature well-distributed aspen stems/ha have not been removed from the NAR, they will be assessed and either removed from the NAR or established as a separate standards unit. SPs will be amended accordingly. Consideration should be given to removing areas from the NAR where:
   - the association is rare in the adjacent landscape,
   - there are significant non-timber values to preserve,
   - there is a low probability of successfully establishing a free growing coniferous crop,
   - the use of chemicals is not possible or desirable and the success of other treatments to control At may be limited,
   - the unit is too small to be managed efficiently.
2. Areas removed from the NAR may become Wildlife Tree Patches (WTPs). On blocks not yet harvested, conifers may be harvested outside of WTPs for forest health reasons or to remove blowdown.
3. On blocks that have not yet been harvested, where these sites fall within Riparian Management Areas (RMAs) as defined in the FPC, conifers will be retained as outlined in the "Riparian Management" section of the Forest Development Plan 2000-2005 for TFL 15 (Appendix VII). Widths of RMAs for streams and wetlands are also included in that appendix.
4. The openings created by harvesting may be fill-planted at the licensee's discretion, preferably with Sx or lodgepole pine (Pl). A low (0.5 m) inter-tree spacing is recommended and cluster planting of high or open ground is preferred. The guidelines for reforestation adjacent to residual aspen stems in Section 3.3.4 should be followed for the area within 20 m of these sites, if the block is to be planted. A new inventory label will be established for these sites at the time of the next survey.
5. Where new standards units are defined, stocking standards must be determined that account for some aspen in the regenerated stand. Appropriate treatment options to achieve these standards must also be included in the SP.

3.3.2 Leading Aspen Patches Larger Than One Hectare

The SP will be amended, if necessary, to stratify and remove from the NAR any areas exceeding one hectare in size where aspen was a major species prior to the harvest of conifers. These areas may be classified as WTP's. The guidelines in Section 3.3.4 should also be followed adjacent to these patches. A new inventory label will be established for these sites at the time of the next survey.

3.3.3 Areas Greater Than One Hectare, Greater Than 10 Mature Stems or Residual Clumps per Hectare

Where the initial density of individual mature stems or residual clumps exceeds 10 per hectare on an area larger than one hectare, this area should be stratified as a separate standards unit and the SP amended accordingly.

1. Where harvesting has not yet occurred, excess mature aspen stems may be removed.
2. Within that standards unit, conifer stocking standards may be reduced to allow for a component of aspen within the regenerated stand.
3. Natural regeneration should not be used unless At is to be the dominant species in the next rotation or if free growing standards can be met without planting.
4. MSP should be done.
5. Guidelines in the following section for reforestation and stand tending adjacent to residual aspen stems should be followed.
6. More than one conifer release treatment may be required depending on the standards set for the unit.
7. In standards units with a component of aspen, silviculture surveys will be carried out at an intensity of two plots per hectare.

3.3.4 Dispersed Patches and Scattered Mature Stems (<10/ha) or Less Than One Hectare

Where the initial density of individual mature stems is less than 10 per hectare or residual clumps are dispersed and less than one hectare in size, this area should become a separate standards unit where the objective is to minimize the impact of aspen on the crop trees. Consideration should be given to some reduction in the MSS of conifer species within these standards units. If the block is to be planted, the following guidelines for reforestation and stand tending adjacent to residual aspen stems should be followed.

1. Mechanical site preparation to break up aspen roots may be carried out at the licensee's discretion.
2. Planting may be done at a density of 2,000 stems/ha with a minimum inter-tree distance of 1.0 m within 20 m of residual aspen.
3. If appropriate to the site, a mix of Pl (up to the MSS for the site series) and Sx may be used.

Conifer release adjacent to residual aspen may be necessary to achieve the free growing standards or to prevent mechanical damage to conifers.

At the time of the silviculture survey:

1. In standards units with a component of aspen, silviculture surveys will be carried out at an intensity of two plots per hectare.
2. The goals set in the adaptive management process must be measured in the silviculture survey procedure.

3.4 HARVESTED AREAS, SITE PREPARATION AND PLANTING COMPLETED

If the stand meets the current free growing standards for the cut block, no further action is required. However, where harvesting is more than two or three years old, aspen suckers will probably be well established, and site preparation and planting of conifers may also be complete. It is not practical at this point to remove any existing residual patches or individual mature stems; the damage to the existing conifers would outweigh the perceived benefits of reducing the aspen component. The percentage of these cut blocks occupied by mature aspen may be higher than in future blocks where some patches and individual stems may be removed prior to harvest.

It is unlikely that the current SP standards for height increment or for height above competing vegetation will be met on areas adjacent to residual aspen where planting at higher densities was not carried out. In some cases, the MSS may not be met either. Following conifer release however, SP standards should be achieved on the remainder of most blocks where there were no delays between harvesting and planting. Aspen is going to be a more severe competitor on wetter and richer sites with fine-textured soils and these may be the best sites for mixed aspen/conifer stands within the aspen goals set for the TFL.

1. If mappable subhygric or hygric areas with an equivalent of five or more well-distributed mature aspen stems/ha have not been removed from the NAR, they will be mapped and the SP amended to remove them or to establish them as a separate standards unit. Consideration should be given to removing areas from the NAR where:
   - the association is rare in the adjacent landscape,
   - there are significant non-timber values to preserve,
   - there is a low probability of successfully establishing a free growing coniferous crop
   - the use of chemicals if not possible or desirable and the success of other treatments to control At may be limited,
   - the unit is too small to be managed efficiently.

   New inventory labels will be established at the time of the next silviculture survey for any areas removed from the NAR. Within new standards units, the MSS must account for At in the regenerated stand and consideration should be given to accepting vigorous, good quality spruce overtopped by aspen as acceptable free growing stems.
2. The SP will be amended if necessary to stratify out any areas exceeding one hectare in size where aspen was a major species prior to the harvest of conifers. These areas may be classified as WTPs. New inventory labels will be established at the time of the next silviculture survey.
3. Where the initial density of individual mature stems or residual clumps exceeds 10 per hectare on an area larger than one hectare, this area should be stratified as a separate standards unit and the SP amended accordingly. Within that standards unit, the MSS for conifers should allow for some aspen in the regenerating stand and appropriate treatment

options to achieve these standards must be added. More than one conifer release treatment may be required depending on the standards set for the unit.

4. Where mature aspen stems at an initial density of less than 10 per hectare or residual clumps less than one hectare in size are dispersed over the block or a portion of the block, the MSS for conifers may be reduced to consider the impact of aspen regeneration over the standards unit.
5. Conifer release will be done over all areas of the cutblock, which do not meet free growing standards. Aerial photography will be very useful in mapping areas where the conifer release is required.
6. Conifer release should be concentrated on releasing crop trees of good form and reasonable vigour. Aspen that may cause mechanical damage to crop trees in the future should also be removed. Where it is not competing with conifers or where the conifers are already severely etiolated, aspen should be retained. Crews will have to be trained to determine acceptable stems around which they are expected to brush.

Within standards units with a component of aspen, the following survey standards should be applied and SP standards amended to reflect these changes:

1. Plots will be established at an intensity of two plots per hectare.
2. The goals set in the adaptive management process must be measured in the silviculture survey procedure.

3.5 SURVEYS

It is anticipated that considerable effort in the next few years will be focused provincially on changes to survey methodology. These changes will be incorporated into the Aspen Management Strategy and subsequent MPs where appropriate.

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APPENDIX I. MAP SHOWING DISTRIBUTION OF ASPEN ON TFL 15

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APPENDIX II. FOREST LICENCE BACKGROUND

Table 4. Summary of Forest Licences.

Forest Licence	Area (ha)	At in Rank 1 Label	At Leading	% of Area with At in Rank 1 label
A18674	170,667	7,483.5	566.3	4.4
A49782	3,862	113.4	35.2	2.9
A18970	27,744	558.4	47.0	2.0

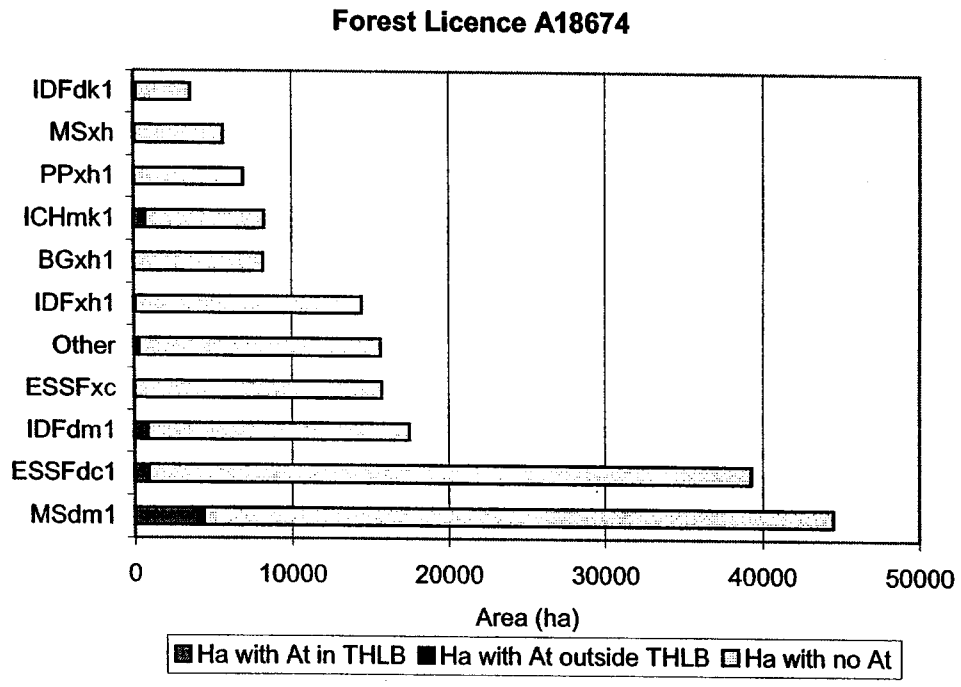

Figure 9. Aspen Component by Subzone, FL 18674.

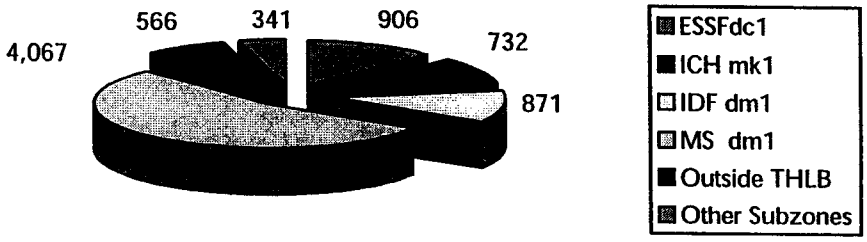

Figure 10. Breakdown of stands containing At by subzone for FL A18674.

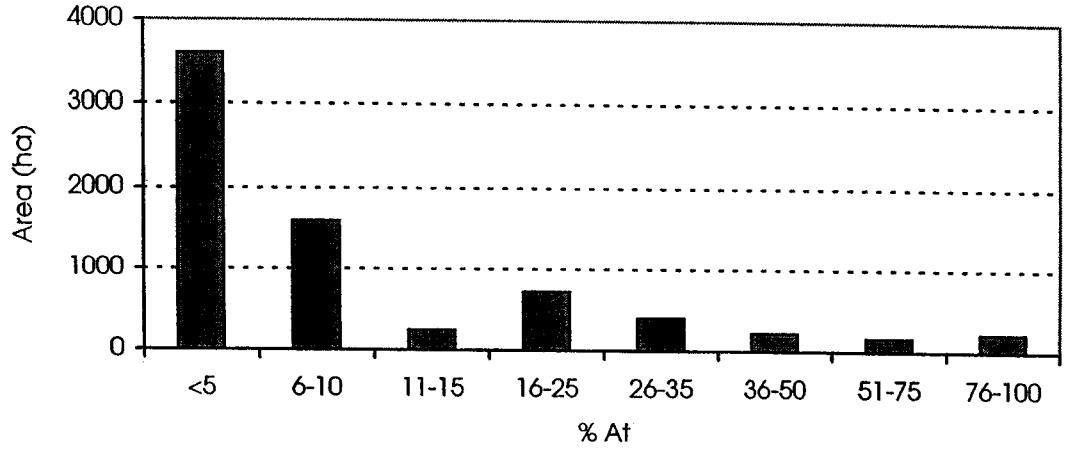

Figure 11. % At by area, all subzones, for FL A18674.

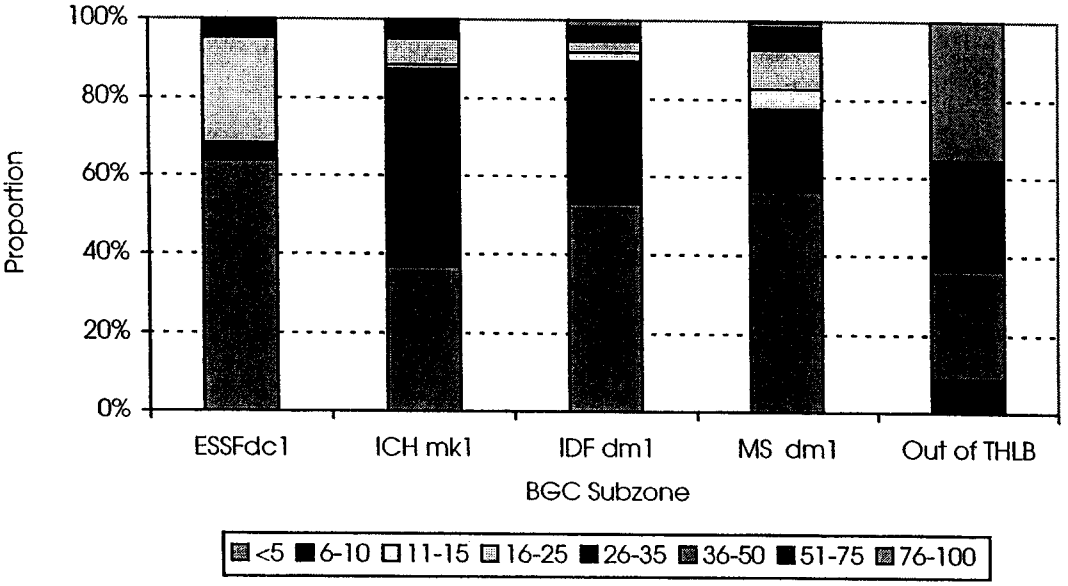

Figure 12. Distribution of At component by subzone for FL A18674.

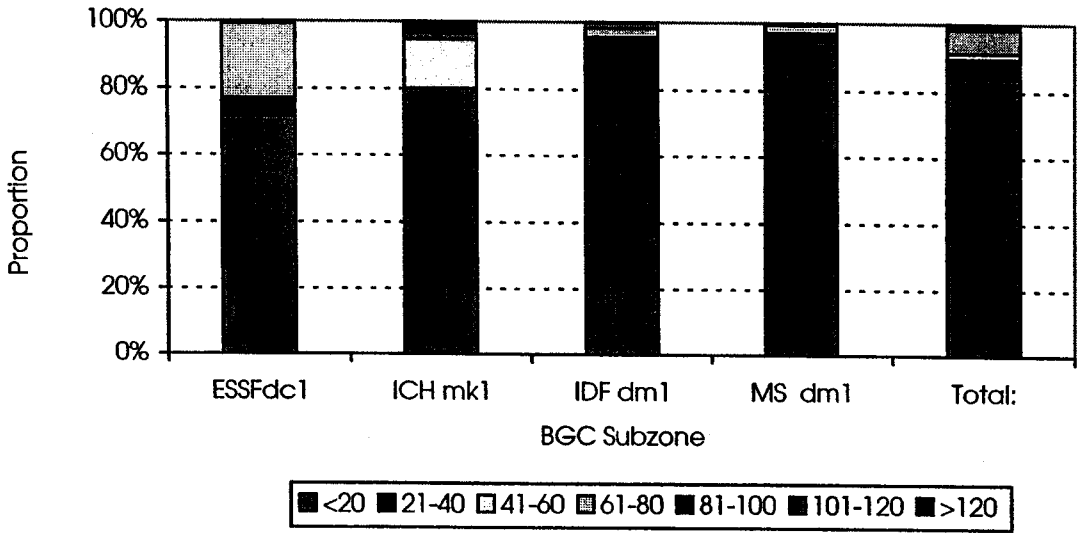

Figure 13. Age class distribution by subzone for FL A18674.

Forest Licence A49782

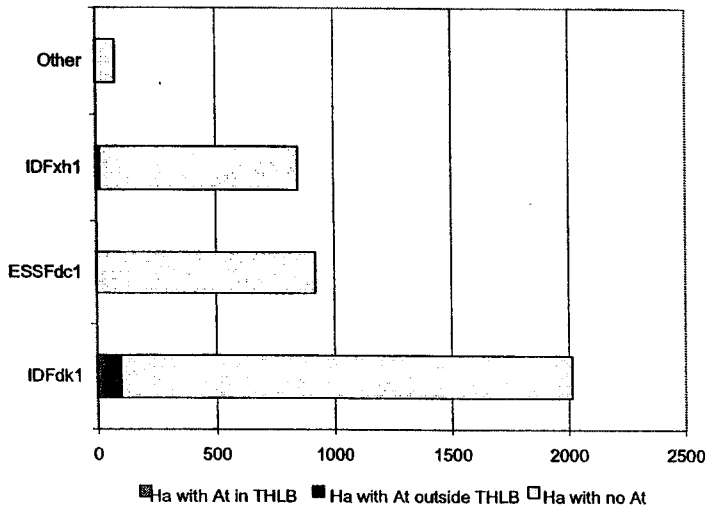

Figure 14. Aspen Component by Subzone, FL 49782.

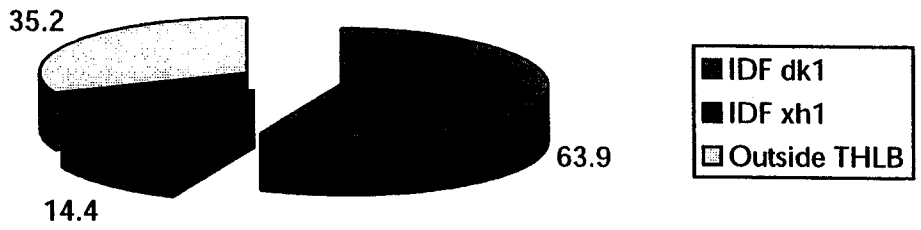

Figure 15. Breakdown of stands containing At by subzone in FL A49782.

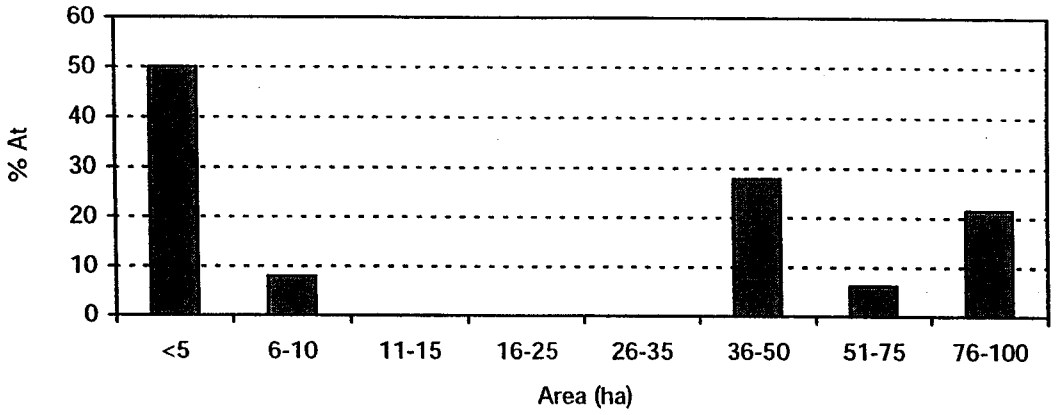

Figure 16. % At by area, all subzones for FL A49782.

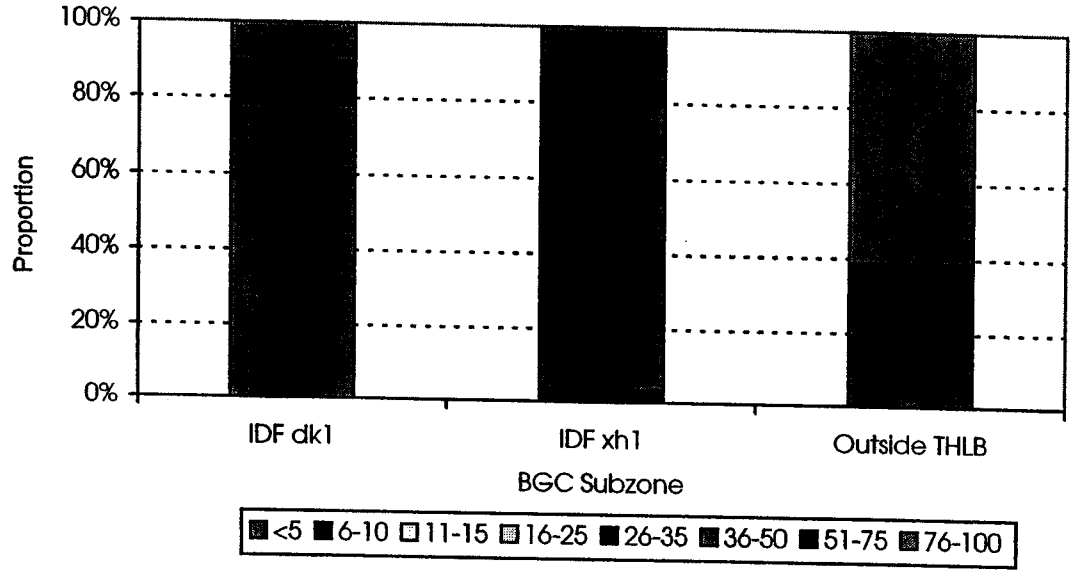

Figure 17. Distribution of At component by subzone for FL A49782.

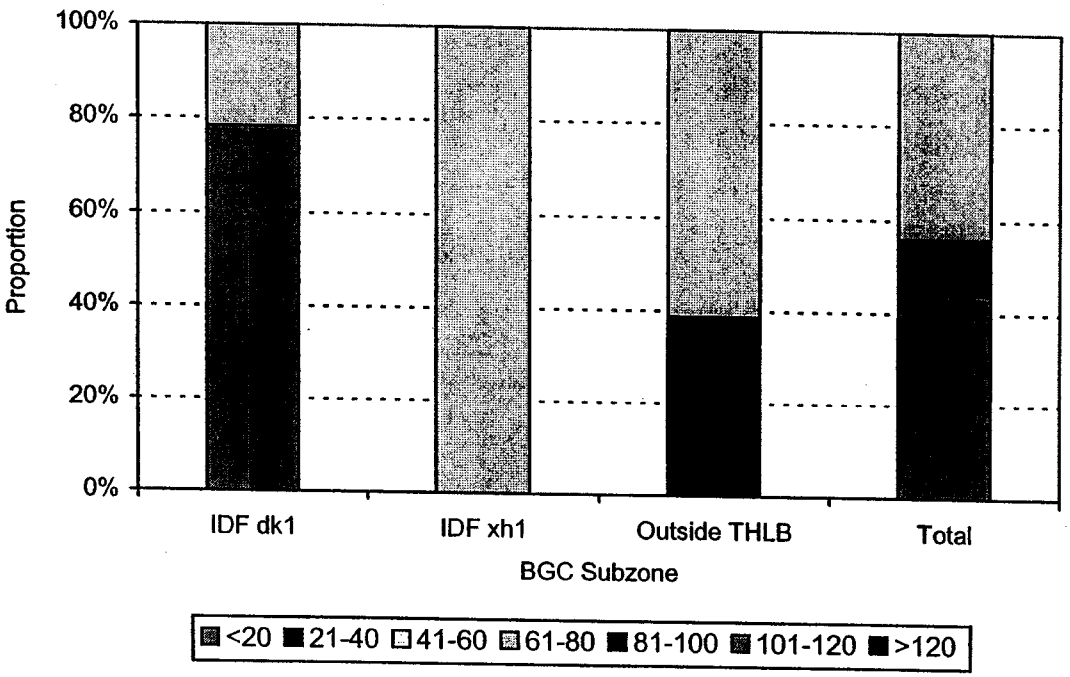

Figure 18. Age class distribution by subzone for FL A49782.

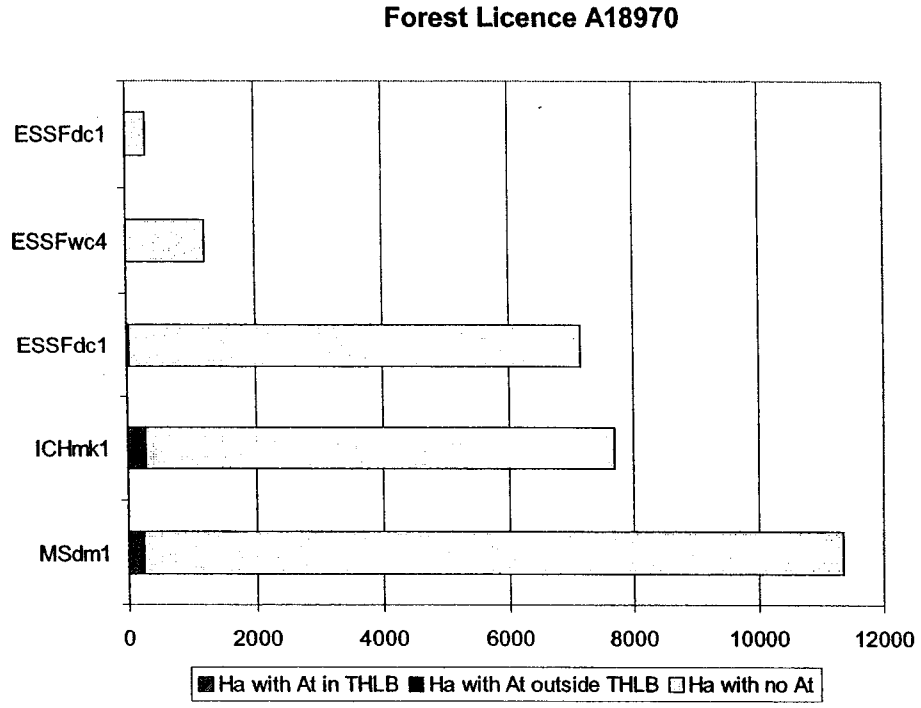

Figure 19. Aspen Component by Subzone, FL 18970.

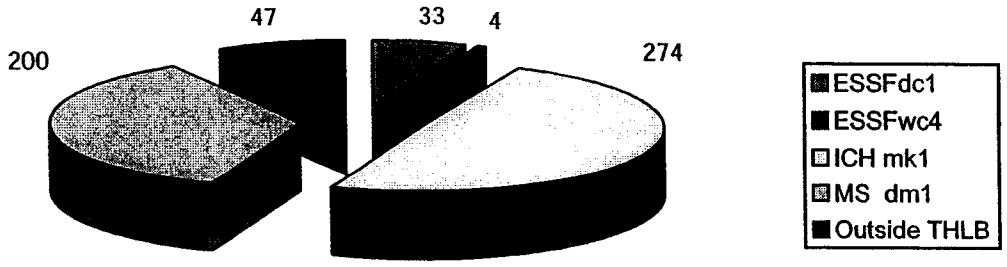

Figure 20. Breakdown of stands containing At by subzone for FL A18970.

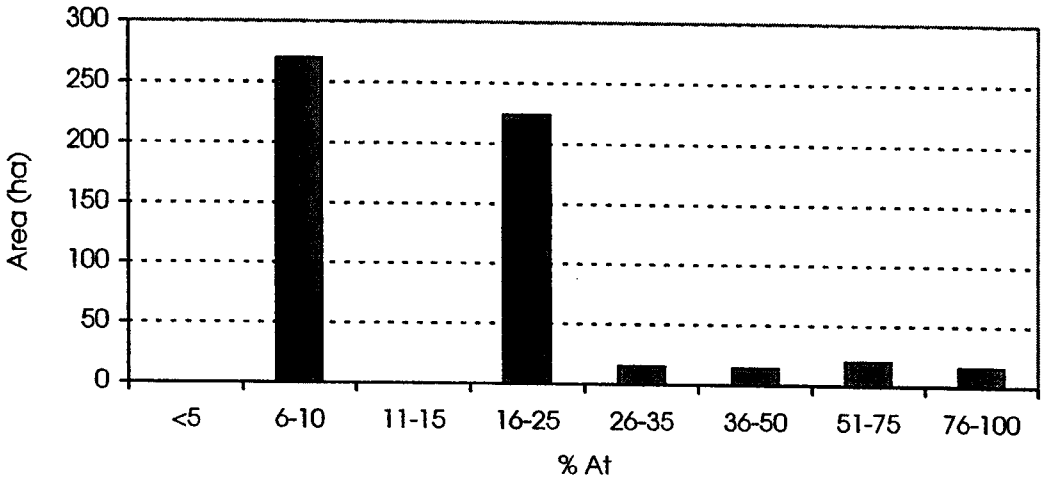

Figure 21. % At by area, all subzones, for FL A18970.

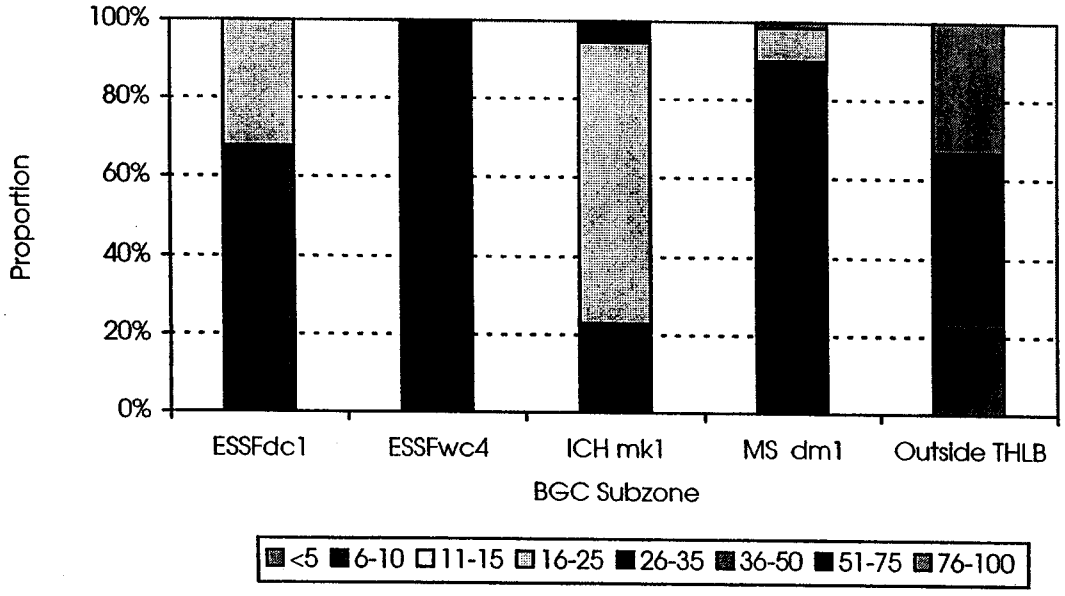

Figure 22. Distribution of At component by subzone for FL A18970.

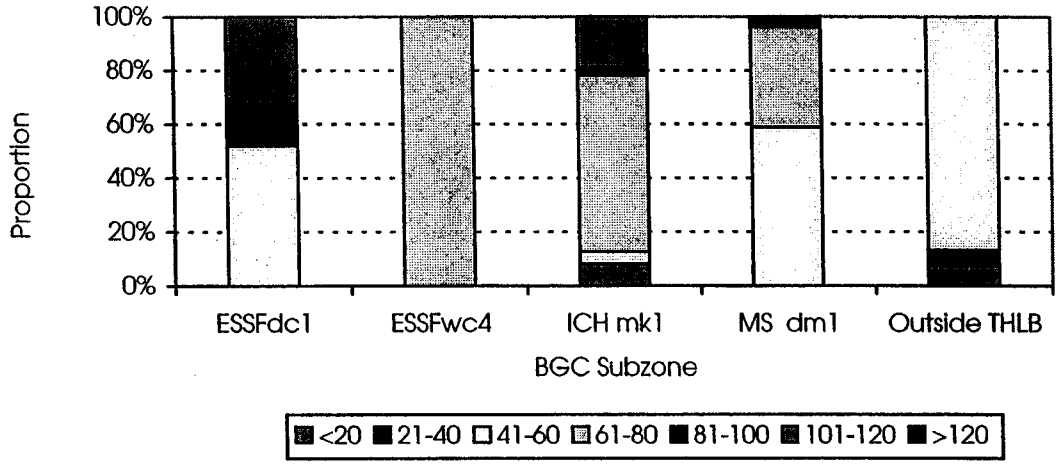

Figure 23. Age class distribution by subzone for FL A18970.

APPENDIX III. SRMS SURVEY DATA

Table 5. Summary of SRMS Survey Data (based on Rank 1 inventory label).

	Ha. Out of Total Area Surveyed	Ha. Out of At Strata[7]	% of At Strata (1532.9 ha)	% of Total Area Surveyed (10,858 ha)
Area with no At in Rank 1 inventory label	9,325			85.9
At in Rank 1 inventory label	1,533	1,533	100	14.1
▪ <10% At in inventory label	10,512	1,186	77.4	96.8
▪ <20% At in inventory label	10,618	1,293	84.3	97.8
▪ <50% At in inventory label	10,723	1,398	91.2	98.8
▪ >50% At in inventory label	135	135	8.8	1.2
▪ <100 stems At/ha in inventory label	9,753	428	27.9	89.8
▪ <200 stems At/ha in inventory label	10,088	763	49.8	92.9
▪ <500 stems At/ha in inventory label	10,415	1,090	71.1	95.9
▪ >1000 stems At/ha in inventory label	2,412	242	15.8	2.2

[7] At strata = all strata surveyed where there is any aspen in the rank 1 inventory label.

APPENDIX IV. THE ROLE OF ASPEN

Aspen serves many important roles within TFL 15 but its greatest importance is for wildlife and biodiversity. Many of the stands are associated with riparian areas and the large diameter aspen that are most important for cavity nesters are often found in these areas. Mature aspen are prime habitat for woodpeckers; half of the red-naped sapsucker nests in the southern interior are found in 20-30 cm aspen (Cannings[8], Gyug[9] Pers. Comm.). Many other species depend on the larger primary cavity nesters to excavate holes that they use for nesting and roosting. Loss of cavity sites is perceived as the most common threat to forest-dwelling vertebrates in the Pacific Northwest (Bunnell, 1999). Species that are strongly associated with aspen in TFL 15 include Western Screech-owl at lower elevations, red-naped sapsucker, downy woodpecker, northern flicker, pileated woodpecker, tree swallow and mountain bluebird (individual mature stems in clearcuts), black-capped chickadee, western bluebird and warbling vireo[3].

Mice, voles, chipmunks and shrews are the most abundant group of mammals inhabiting aspen forests and are important as the basis of the food web of many carnivorous birds and mammals (Peterson and Peterson, 1996). Locally, white-tail deer use the mixed aspen/conifer stands more than adjacent coniferous stands. Aspen-conifer mixes have the highest diversity of species but it takes only a small portion of broadleaf stems in a conifer stand to increase vertebrate richness (Cannings, Gyug Pers. Comm).

Because aspen is present on less than 8% of the area of the TFL, it is an important visual resource, breaking up a conifer-dominated landscape. Aspen patches occurring in association with grasslands may be rare ecosystems due to grazing pressures (Lloyd, Pers. Comm).

Aspen is also of importance with respect to insect damage, root diseases, nutrient cycling, coarse woody debris and water balances. Aspen may help to reduce the incidence of *Pissodes terminalis* in lodgepole pine by increasing shade, lowering stand temperatures and making it more difficult for adult weevils to locate terminal leaders (Safranyik, Nevill and Morrison 1998). The distribution of aspen may be associated with root disease but its presence may also help to reduce the spread and mortality from *Phellinus weirii* in regenerating stands (Morrison, Merler and Norris 1991). Aspen may also play an important role in nutrient cycling and in the control of runoff on some sites, particularly on the coarse soils of the TFL. More snow reaches the ground in a stand with a component of aspen than in a pure conifer stand; that will have implications for the water balance over the growing season (DeByle 1985). A component of aspen may help to reduce windthrow in older stands (Newsome 1997). At the same time, because aspen is

[8] Cannings, Richard, RPBio, December 1999 and February 2000.
[9] Gyug, Les, RPBio, November 1999.

shorter lived than conifers, its breakup may be an important addition to the coarse woody debris in a mixed aspen/conifer stand.

APPENDIX V. THE BIOLOGY OF ASPEN

Aspen regenerates almost exclusively from root suckers. Most suckers initiate from shallow roots (70% within 8 cm and 90% within 12 cm of the soil surface), of small diameter (60% less than 1 cm and 88% less than 2 cm in diameter) (Schier, Jones and Winokur 1985). Therefore, mechanical site preparation, particularly treatments that cut more than 12 cm, can help to reduce suckering following harvesting. Light scarification such as drag scarification with chains or shark-fin barrels, or broadcast burning are not appropriate treatments to limit suckering (Navratil 1996).

Factors that influence the density and growth rates of suckers include stocking of aspen prior to harvest (Schier et al 1985), season of cutting, light availability, temperature, soil type, soil moisture, and whether or not the parent trees are left, cut or girdled (Haeussler, Coates and Mather 1990). The more stems left uncut, the lower the resulting stocking of suckers. Cutting during the active growing season may limit suckers and these suckers may also be susceptible to frost damage in the fall (Sauder 1992). Aspen is very effective at self-thinning; studies show that 95% of suckers establish within the first year following harvest but up to 40% of the original suckers may be dead by the third year (Peterson and Peterson 1995).

Aspen is probably only a serious competitor to conifers on the following site series found in TFL 15: IDFxh1/06 and 07; IDFdm1/01 and 05; MSdm1/01, 05 and 06 (Lloyd Pers. Comm.). The most serious competition from aspen will occur on toe slopes with fine-textured soils and sub-surface seepage. It is unlikely that conifers will outgrow aspen suckers following conifer release on subhygric sites. On drier sites, where aspen may be more of a nurse crop than a competitor (Newsome Pers. Comm)[10], the success of a single brushing treatment may be higher (Peterson and Peterson 1996).

Preliminary results from PROBE studies in the Southern Interior (Simard 1999)[11], show that brushing is not required to increase survival, to meet Minimum Stocking Standards, or the meet minimum seedling heights. Although removing aspen may moderately improve growth, potential negative impacts include reduced site productivity, less complex stand structure, loss of wildlife habitat and increased losses to root disease (Simard, Mather and Heineman 1999)[12]. Under some circumstances, a component of aspen should be accepted in regenerating stands. These may include where it was present prior to harvest, where it contributes to landscape-level or stand-level biodiversity and wildlife habitat, where its presence will provide recruitment to the aspen resource, or where its presence is not adversely affecting the growth of conifers. Where

[10] Newsome, Teresa, RPF, Research Silviculturist, Ministry of Forests, Cariboo Forest Region, December 1999.

[11] Simard, Suzanne. 1999. Brushing Effects on Conifers and Plant Communities in the Southern Interior: 1-5 year results from PROBE. Unpublished report.

[12] Simard, Suzanne, J. Mather and J. Heineman. 1999. Aspen Complex. Unpublished draft report.

densities of conifers are low, aspen may serve the same purpose as higher densities of conifers in maintaining high wood quality in crop trees.

APPENDIX VI. THE ADAPTIVE MANAGEMENT PROCESS

1. **Setting Initial Goals:** In consultation with the Ministry of Forests (MoF) and the Ministry of Environment, Lands and Parks (MoELP), acceptable goals for the aspen component would be negotiated for the TFL.
2. **Planning to meet the goals.** Development plans for TFL 15 would consider possible management actions to achieve these goals. A forecast must be stated explicitly for each block to be harvested and for each post-harvest block with an aspen component. Trade-offs can then be made in order to achieve the goals. These may include sequence of harvesting, amount of aspen to be removed at the pre-harvest stage, density of planting around aspen residuals or ranking of areas to be brushed.
3. **Implementation.** The plan must then be implemented.
4. **Monitoring.** The progress of the aspen component of the TFL towards the set goals can be measured at specific intervals to coincide with MWP deadlines.
5. **Evaluation of progress towards goals.** The actions carried out and their results must be compared to the forecasts made and the causes of deviations determined. The licensee should not be penalized if the original plan was agreed upon by all parties, the plan was implemented as stated but results differed from predictions and the stated goals were not met.
6. **Revision of goals.** Goals and measures of progress towards the goal must be evaluated and changed if necessary. Where forecasts were in error, the responses of stands and populations must be used to determine new forecasts and actions as required.

The feedback loop will continue from Step 2 as the new plan is implemented and the progress towards the goals is monitored over the next interval. Management plans are adapted based on a comparison of the measured results with the original forecasts.

Goals for the aspen component within TFL 15 may be set for each subzone-variant and should be based on historical aspen data. It must consider the proportion of pure and mixed stands as well as scattered aspen stems to maintain a diversity of aspen types. An estimate of aspen stands associated with riparian areas must also be made and steps must be taken to ensure recruitment of immature stems in riparian areas over the TFL.

APPENDIX VII. RIPARIAN MANAGEMENT AREAS FOR STREAMS AND WETLANDS

Table 6. Riparian Management Areas for Streams[13]

Riparian Class	Average Channel width (m)	Reserve Zone width (m)	Management Zone width (m)	Total RMA width (m)
S5	>3	0	30	30
S6	<3	0	20	20

Fish stream or community watershed

Not fish stream and not in community watershed

Table 7. Specified minimum slope distances for wetland riparian management areas.

Riparian Class	Reserve Zone width (m)	Management Zone width (m)	Total RMA width (m)
W1*	10	40	50
W2	10	20	30
W3	0	30	30
W4	0	30	30
W5*	10	40	50

Riparian Management

Issues

The known location of Protected Areas, Community Watersheds and community water supply infrastructures, streams, wetlands, and lakes, private property, range improvements and other interests in the planning area have been identified on the Forest Development Plan maps in Section 9.

General Objectives

Riparian areas tend to contain a concentration of both timber and non-timber values within the forest environment. The general objectives for Riparian Management Areas (RMA) are to:

[13] Riparian Management Area Guidebook. 1995. Forest Practices Code of British Columbia.

* No riparian reserve or riparian management zone is required for upland terrain within a bog dominated or muskeg dominated wetland larger than 1000 ha in boreal, sub-boreal, or hypermaritime climates. However, where a reserve or management zone is established by the district manager, the RMA should reflect the landscape level management strategy as outlined in the *Biodiversity Guidebook.*

- minimize the impact of forest use on streams and lake water quality by providing a vegetated buffer and filter between those activities and the water body.
- to maintain stream channel stability by protecting streambanks and stream bank vegetation, and by ensuring that a long term supply of large wood is available for stream channel processes.
- to have land base contribute to long term harvest yields within riparian management zones consistent with the above.

Measures to Protect

Riparian management is to be conducted in accordance with the Forest Practices Code Act and regulations.

To achieve RMA objectives, forest practices within the management zone should, where a RMA has both a reserve zone and management zone: reduce the risk of windthrow to the reserve zone; retain habitat attributes including wildlife trees, large trees, and wildlife tree patches, with consideration to on site forest health influences.

Where a RMA has only a management zone, in areas of high and moderate windthrow risk:

- manage for a buffer of deciduous, immature conifer, with retention of windfirm stems or stems meeting the post harvest habitat attributes identified below and forest health considerations in section 3.1. Machine related site disturbance will be minimized.

Where a RMA has only a management zone, and in areas with low risk of windfall, typical of a deeply incised gully:

- retain the standing timber, and adjust the management boundary to coincide with the edge of the gully;
- remove high risk windthrow prone trees along the edge of the gully.

Our silviculture prescriptions will contain site level plans that specify the restricted operation of machinery and/or the retention of trees and riparian vegetation to help minimize the effects of forest management activities on riparian attributes.

Directional falling will be used where worker safety is not compromised. If a tree is felled across a stream, it will be removed concurrent with operations. Liming and or topping may be required to ensure that removal will not damage the integrity of the stream bank. Tops and limbs, having the potential to result in debris blockages, or alteration of fish habitat, will be removed from the stream channel prior to spring freshet. In the event that a tree is felled across a fish bearing stream, the portion spanning the creek may be left in place as recruitment for woody debris.

The following variables will be used to select preferred post harvest attributes within RMZ's:

- Worker safety
    - Forest health. In our operating area, the edge effect of mistletoe ingress on regenerating stands and host material for bark beetle infestation are key considerations

- When managing for basal area retention in the RMZ, reduce the risk of non recoverable windthrow by removing species and individuals, in high risk windthrow situations, that would lead to stream bank instability and/or insect epidemic.

- Retention of conifer under story, brush and riparian vegetation
- Retention of veteran component
- Deciduous
- Co-dominant (larger diameter preferred)
- Intermediate
- Stubs

The following basal area ranges will serve to provide general guidance for stand level planning adjacent to water bodies. Variance above and below these ranges is expected on a site specific basis. On the following table, risk of windthrow potential has been selected as the one variable that is most subjective, and has the potential to cause catastrophic change to post harvest conditions.

Riparian class	**Windthrow risk**	**Range of RMZ basal area (%) retention (decid & conifer trees > 1.3 m. in ht.)**	**Discussion and Management techniques.**
S1,S2,S3,L2	high	50-80	Manage to reduce the risk of windthrow to the reserve zone. L1 lakes < 1000 ha. require a DM directed LMZ. Ref. classified lakes sec.3.6.
	medium	30-70	
	low	0-50	
S4,S5	high	0-30	Retain in order of preference: veteran class; deciduous trees; co dominant /intermediate with understory conifer .
	medium	10-40	
	low	20-50	
S6	High to low	0-10	Retain in order of preference: veteran class; deciduous trees; co dominant/intermediate with understory conifer.
W1,W2,W5	high	20-80	Manage for stability of the reserve zone.
	medium	20-50	
	low	0-30	
W3,W4	High to low	0-40	Retain in order of preference: veteran class; deciduous trees; co dominant/intermediate and understory conifer.
L3,L4	High to low	0-25	Retain in order of preference: veteran class; deciduous trees; co dominant/intermediate and understory conifer.

Lakeshore management zones for Class A, B, C, and D lakes (Okanagan T.S.A. Lake Classification Project 1997) have been determined to be 210 meters outward from the high water mark of the lake or from the outer edge of contiguous wetland vegetation.

APPENDIX VIII. FURTHER WORK

Development of an aspen management strategy has raised many questions about how this species is best managed in an area where it is relatively scarce. Some of these questions are being addressed in projects such as PROBE and research being carried out in the Cariboo Forest Region. However, in order to apply the adaptive management strategy outlined above, work will be required to determine acceptable goals for aspen, measures of those goals and methodology to track blocks to provide information on the current status of aspen in relation to the objectives set. In addition, work to localize standards and to determine how competitive aspen is to coniferous species on different subzone-variants within TFL 15 should also be done.

1.1 Development of Aspen Complexes

1. There is a need to determine the developmental patterns of mixed aspen/conifer stands on TFL 15. Current inventories and surveys do not give an accurate picture of aspen on the landscape and we have a poor understanding of how aspen may develop in the absence of management or as a component of a coniferous stand following harvesting. Where available, historical information on aspen on TFL 15 and existing data from other areas should be incorporated or adapted.
2. Use the TEM to provide summaries of the sites on which different aspen complexes occur, and set aspen goals for the TFL.
3. Summarize regenerated areas with a component of aspen by site series. This can then be compared to unlogged sites on similar site series to determine the extent of the aspen component of those stands. This may help to estimate the extent of suckering following harvesting on different sites.
4. Develop methodology to identify aspen at low densities in timber cruises. This may involve additional count plots or visual assessments.
5. Make accurate estimates of aspen suckering by subzone, variant and site series based on existing harvested areas with a component of aspen.
6. Investigate the use of site index to help determine management regimes for stands with a component of aspen.

1.2 Forest Health

1. Examine aspen patches not associated with riparian areas to determine and record the extent of root disease associated with them.

1.3 Post-Harvest Treatments

1. Design an experiment over different site series to compare mechanically site prepared areas with heavy aspen suckers to controls, to determine whether this is an effective treatment to reduce the quantity or vigour of aspen suckers.

2. Complete studies to determine the level of aspen competition that results in detrimental growth impacts to coniferous species in mixed aspen/conifer stands on TFL 15.
3. Determine if one manual release treatment when the conifers are approximately two metres in height is adequate for control of aspen competition. Timing of the treatment, type of treatment (for example, cut and bend), and site attributes should also be considered.

1.4 FREE GROWING STANDARDS

1. Develop localized standards for determining whether coniferous crop trees are "overtopped" by aspen stems in free growing assessments.

1.5 TIMBER SUPPLY ANALYSIS

1. Develop scenarios for modeling to reflect stand development after harvesting in stands with an aspen component.

APPENDIX IX. ASPEN STRATEGY MANAGEMENT FLOW DIAGRAMS

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[illegible] Harvested stand with At component [illegible] and planting [illegible]

NOTES:

- What is the successional pathway of the mature stand?
- What level of suckering do you anticipate? The higher the density of residual At or the more aspen that has been cut, the greater the # of suckers. The moister the site, the more aggressive At will be; toe slopes with seepage will be the most difficult sites on which to control At.
- What level of At is acceptable in the regenerating stand?
- Choose a combination of recommendations to meet your objectives.

- Areas may be removed from the NAR and SP amended where:
- [illegible] association is rare in the adjacent areas
- there are significant non-timber values to protect
- there is a low probability of successfully establishing trees [illegible]
- the use of chemicals is not possible or desirable and the success of other treatments to control At is [illegible]

Mappable subhygric or hygric sites with [illegible] or more well distributed mature [illegible]

A) Remove from NAR or B) Separate Standards Unit

A

- Amend SP to remove area from NAR or to include as a WTP
- If not yet harvested, retain all At & remove conifers for blowdown or forest health reasons or follow FDP Guidelines for Riparian Management
- No silviculture survey plots will be established in dispersed non-mappable hygric or subhygric sites

B

- Amend SP to establish a separate standards unit
- Reduce stocking standards to account for At in the regenerated stand
- Consider accepting Sx of good form and vigour but overtopped by At as FG
- Manage At aggressively (as per ">1ha with >10 mature stems or clumps/ha")

- Use guidelines for **Reforestation and stand tending adjacent to residual At stems** within 20 m of these areas if block is to be planted - consider increasing component of Sx
- Establish two silviculture survey plots per ha for areas within NAR

Patches [illegible] major spp prior to harvest

Remove from NAR

- Amend SP to remove area from NAR
- **At licensee's discretion, openings may be planted using these guidelines:**
- Direct plant with Sx, Pl
- Plant some Fd or Lw in centre of openings using a 0.5 m inter-tree distance
- Do not plant within 3 m of mature At
- Conifer release to prevent mechanical damage to conifers

Establish new inventory labels at time of next survey

[illegible]

Separate Standards Unit

- Amend SP to **establish new SU**
- Stump if root rot is identified
- Natural regeneration should not be used unless At is to be dominant spp in next rotation or FG standards can be met without planting
- Aggressive control measures must be taken if management goals are to restrict At regeneration - MSP should be carried out, one or more conifer release treatments may be required
- Follow guidelines for **Reforestation and Stand Tending adjacent to residual At stems**
- MSS of conifers may be reduced to include a component of At in the regenerated stand

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- Treat excess mature At stems or patches if block is not yet harvested or if suckering has not occurred
- Preference for retention of patches with large snags or mature trees, existing cavities, natural gaps, high vertical stratification
- Retain patches on rocky ground

[illegible]

Cannot be typed as a Standards Unit

- Evaluate At component within adaptive management goals and amend SP as required
- Stump if root rot is identified
- **Reforestation and stand tending adjacent to residual At stems:**
- If block is to be planted:
- MSP at licensee's discretion
- Plant at 2000 stems/ha with 1 m tolerance within 20 m of residual At to within 3 m of residual stems
- Use Pl up to MSS, Sx for remainder, consistent with site series
- Conifer release if presence of At will prevent the achievement of FG standards or to prevent mechanical damage to conifers
- Under special circumstances, consideration may be given to amending the SP to reduce the MSS to include some At in the regenerated stand

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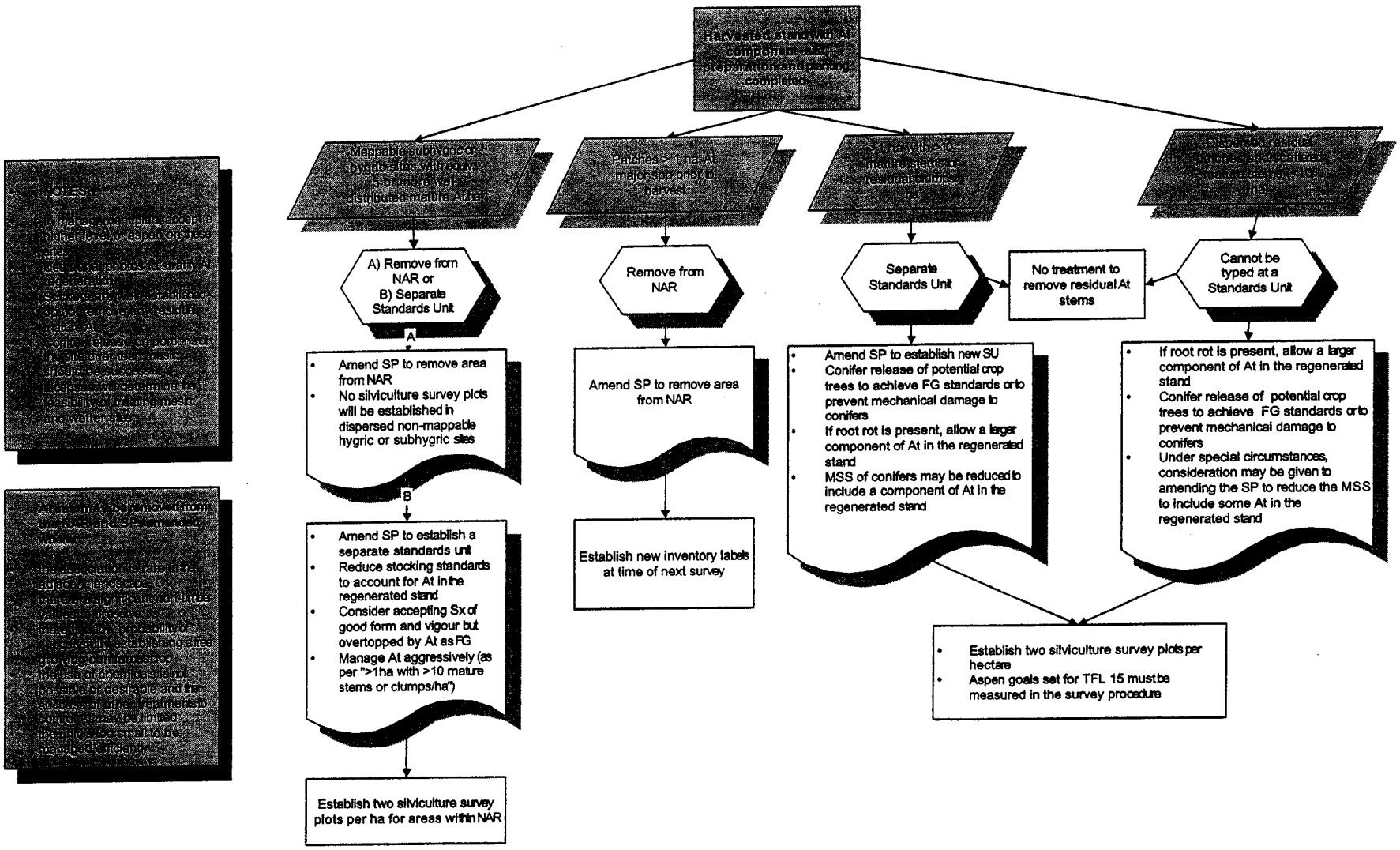
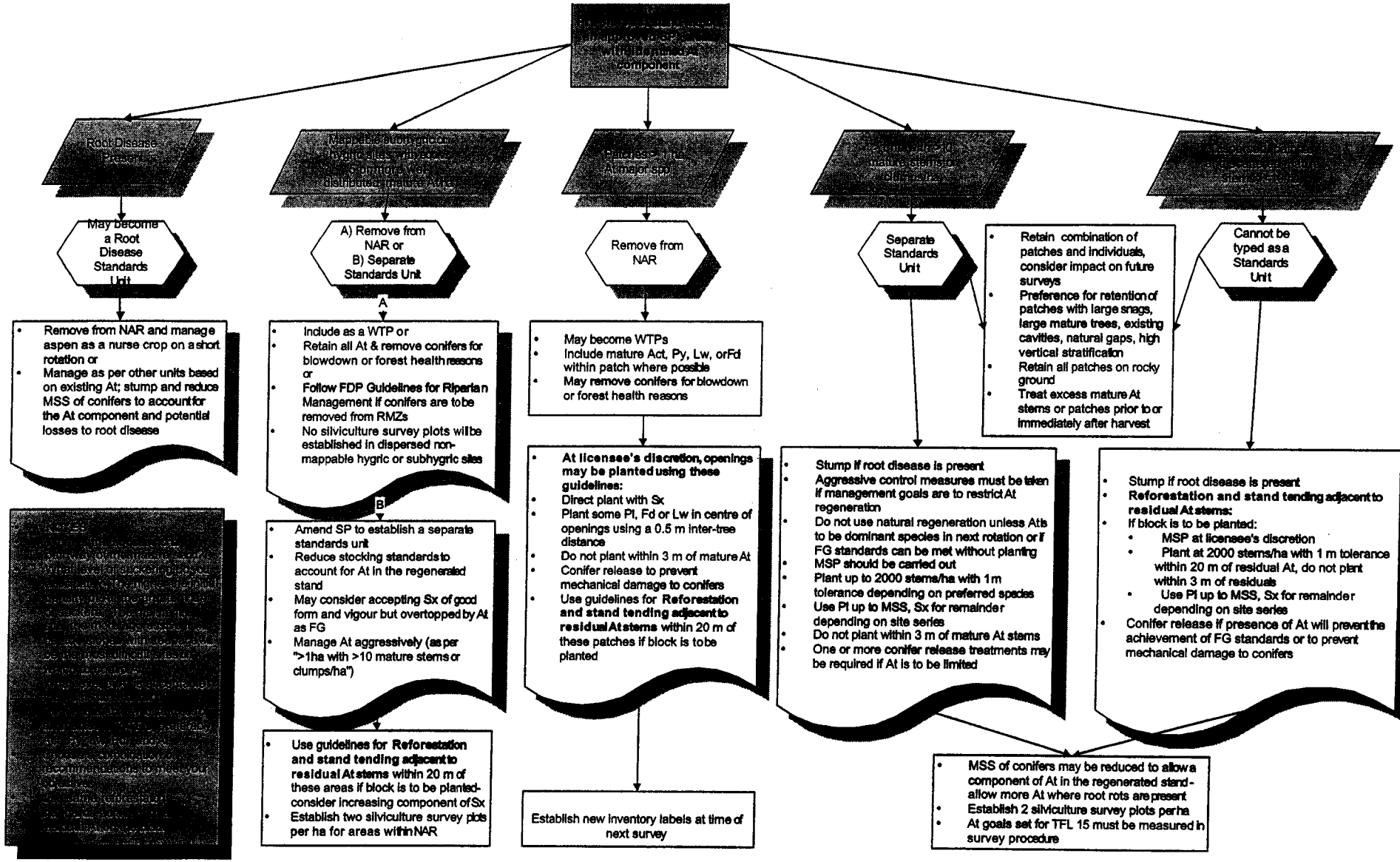
- Establish two silviculture survey plots per hectare
- Aspen goals for TFL 15 must be measured in the survey procedure


Harvested stand with At components after preparation and planting completed
Mappable subhygric or hygric sites with equal to 5 or more well distributed mature At/ha
Patches > 1 ha At major spp prior to harvest
Separate Standards Unit
No treatment to remove residual At stems
Cannot be typed at a Standards Unit
A) Remove from NAR or B) Separate Standards Unit
A
Amend SP to remove area from NAR
No silviculture survey plots will be established in dispersed non-mappable hygric or subhygric sites
B
Amend SP to establish a separate standards unit
Reduce stocking standards to account for At in the regenerated stand
Consider accepting Sx of good form and vigour but overtopped by At as FG
Manage At aggressively (as per ">1ha with >10 mature stems or clumps/ha")
Establish two silviculture survey plots per ha for areas within NAR
Remove from NAR
Amend SP to remove area from NAR
Establish new inventory labels at time of next survey
Amend SP to establish new SU
Conifer release of potential crop trees to achieve FG standards or to prevent mechanical damage to conifers
If root rot is present, allow a larger component of At in the regenerated stand
MSS of conifers may be reduced to include a component of At in the regenerated stand
If root rot is present, allow a larger component of At in the regenerated stand
Conifer release of potential crop trees to achieve FG standards or to prevent mechanical damage to conifers
Under special circumstances, consideration may be given to amending the SP to reduce the MSS to include some At in the regenerated stand
Establish two silviculture survey plots per hectare
Aspen goals set for TFL 15 must be measured in the survey procedure


Root Disease Present
May become a Root Disease Standards Unit
Remove from NAR and manage aspen as a nurse crop on a short rotation or
Manage as per other units based on existing At; stump and reduce MSS of conifers to account for the At component and potential losses to root disease
Mappable Subhygric or Hygric sites with poplar Stumpage Value distributed mature At trees
A) Remove from NAR or B) Separate Standards Unit
A
Include as a WTP or
Retain all At & remove conifers for blowdown or forest health reasons or
Follow FDP Guidelines for Riparian Management if conifers are to be removed from RMZs
No silviculture survey plots will be established in dispersed non-mappable hygric or subhygric sites
B
Amend SP to establish a separate standards unit
Reduce stocking standards to account for At in the regenerated stand
May consider accepting Sx of good form and vigour but overtopped by At as FG
Manage At aggressively (as per ">1ha with >10 mature stems or clumps/ha")
Use guidelines for Reforestation and stand tending adjacent to residual At stems within 20 m of these areas if block is to be planted- consider increasing component of Sx
Establish two silviculture survey plots per ha for areas within NAR
At major spp
Remove from NAR
May become WTPs
Include mature Act, Py, Lw, or Fd within patch where possible
May remove conifers for blowdown or forest health reasons
At licensee's discretion, openings may be planted using these guidelines:
Direct plant with Sx
Plant some Pl, Fd or Lw in centre of openings using a 0.5 m inter-tree distance
Do not plant within 3 m of mature At
Conifer release to prevent mechanical damage to conifers
Use guidelines for Reforestation and stand tending adjacent to residual At stems within 20 m of these patches if block is to be planted
Establish new inventory labels at time of next survey
Separate Standards Unit
Stump if root disease is present
Aggressive control measures must be taken if management goals are to restrict At regeneration
Do not use natural regeneration unless At is to be dominant species in next rotation or if FG standards can be met without planting
MSP should be carried out
Plant up to 2000 stems/ha with 1 m tolerance depending on preferred species
Use Pl up to MSS, Sx for remainder depending on site series
Do not plant within 3 m of mature At stems
One or more conifer release treatments may be required if At is to be limited
Retain combination of patches and individuals, consider impact on future surveys
Preference for retention of patches with large snags, large mature trees, existing cavities, natural gaps, high vertical stratification
Retain all patches on rocky ground
Treat excess mature At stems or patches prior to or immediately after harvest
Cannot be typed as a Standards Unit
Stump if root disease is present
Reforestation and stand tending adjacent to residual At stems:
If block is to be planted:
MSP at licensee's discretion
Plant at 2000 stems/ha with 1 m tolerance within 20 m of residual At, do not plant within 3 m of residuals
Use Pl up to MSS, Sx for remainder depending on site series
Conifer release if presence of At will prevent the achievement of FG standards or to prevent mechanical damage to conifers
MSS of conifers may be reduced to allow a component of At in the regenerated stand - allow more At where root rots are present
Establish 2 silviculture survey plots per ha
At goals set for TFL 15 must be measured in survey procedure