Forest Management Plan 2004–2013

Mid-term audit report

Supplemental advice to the Conservation Commission concerning the reasons for differences between the realised and forecast yields of jarrah sawlog during 2004-2007

Forest Management Branch
Department of Environment and Conservation
May 2009

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Summary

Data presented in Key Performance Indicator No. 11 in the mid-term audit report on the *Forest Management Plan 2004-2013* suggested an average shortfall of 15 per cent in the volume of jarrah sawlog realised from harvest operations compared to forecast yields. Unfortunately this average figure was erroneous, and revised analyses indicate that the average was 9 per cent *more* sawlog volume realised in the inventory monitoring plots than forecast. However, statistically this figure is inconclusive because the statistical confidence associated with this estimate indicates that there may be no significant difference between the realised and forecast yields for these plots.

Nevertheless, there is a clear trend of less volume being realised (relative to forecasts) in all silvicultural strata in the Swan Region. An average shortfall of 44 per cent between the volumes realised relative to forecasts in the Swan Region was offset by higher recovery (relative to forecasts) in the South West and Warren regions. Despite a range of management actions to realise more yield, the Department considers there is a moderate to high likelihood of the trend of a shortfall between realised and forecast yields persisting in the Swan Region through to 2013, due to the marginal size, quality and dispersed location of the sawlog resource in the region.

An average of 9 per cent more volume of jarrah sawlog realised than forecast suggests a revision of the sustained yield before 2013 is not warranted. Modelling of an indicative sustained yield for six yield scenarios representing the range of circumstances represented by the monitoring data suggests there would be negligible difference between the sustained yields computed from 2010 or 2014, and hence limited value and significant costs in advancing the timing of revision of the sustained yield to 2010. The current jarrah sawlog sustained yield of 131,000 cubic metres is between the scenario of a 44 per cent shortfall in the Swan Region and a 9 per cent excess yield applying across all regions for the period of the forest management plan.

While a complete revision of the FMP sawlog sustained yield may not be warranted or practical at this time, any significant shift in the sawlog specifications delivered to Forest Products Commission customers should be accompanied by a calibration of that portion of the 131,000 cubic metres sustained yield that the new grade comprises.

Introduction

The purpose of Key Performance Indicator (KPI) 11 is to monitor the level of sawlog production from State forest relative to the volumes forecast in the calculation of sustained yield. Data collated for this KPI and reported in the mid-term audit of the *Forest Management Plan 2004-2013* (FMP) suggest that the overall yield of jarrah sawlogs per hectare being realised from harvesting operations during the period 2004-2007 was less than forecast. Averaged across 96 inventory monitoring plots in the three forest regions, the mid-term audit of the FMP reported 15 per cent less jarrah sawlog volume was realised in the operations than forecast. The Conservation Commission has requested that the Department of Environment and Conservation (DEC) provide a detailed analysis of the causes for this variation. This report constitutes the supplemental advice from DEC to the Conservation Commission on

the reasons for an apparent shortfall between the realised and forecast yield of jarrah sawlog during 2004–2007.

The first section of the report provides background information on the basis of the strategic timber yields and the inventory plot monitoring. Interpretation of the trends observed in sawlog removal during 2004 to 2007 relative to forecasts is then provided, together with some corrections to the data originally reported in the mid-term audit for this KPI. The main factors giving rise to differences between the realised and forecast yields are identified. A discussion of the implications for the timing of revision of the jarrah sustained yield is included the report.

Basis of the FMP strategic timber yields and inventory plot monitoring

The FMP provided for the removal of a sustained yield of 131,000 cubic metres per annum of jarrah sawlog (first and second grade) during the period 2004–2013. This annual level of cut equates to less than one per cent of the estimated standing sawlog volume on that portion of the forest estate available for timber production. This yield is obtained by harvesting an area each year equivalent to approximately one per cent of the available forest estate (Table 1).

Table 1. Projected annual area cut over and jarrah sawlog yield relative to the total area and standing volume of the jarrah forest available for timber harvesting under the FMP.

Area (ha)		**Jarrah sawlog (cubic metres)**	
Total available for timber*	788,380	Total standing volume**	17,100,000
Projected annual area cutover	8,000	Annual sustained yield	131,000
Percentage cut over annually	1 %	Percentage of standing volume removed annually	1 %

* Area includes jarrah/wandoo forest.

**Adjusted from 1990 inventory to account for areas cut over to 2004. Estimate includes sawlog in all trees, including those that would be retained for silvicultural and habitat purposes if areas harvested.

The sustained yield calculation was based upon estimates of the sawlog yield made available when areas of forest are harvested to the various silvicultural objectives specified in the jarrah silviculture guideline (Department of Conservation and Land Management 2004). The estimates of sawlog yield are derived from a strategic level inventory conducted during 1988–1990 in which inventory plots were located systematically across State forest (Spencer 1992). The application of silviculture to each inventory plot is simulated using computer models before aggregations of plot yields for geographic areas are combined to provide sawlog volume estimates.

When harvesting occurs in an area in which there is an inventory plot the removed and retained volumes are measured during harvest to provide a basis for comparing the realised with forecast yields. The comparisons are with yields realised at the stump, as logs are not tracked to sawmills.

The total number of plots measured each year varies depending upon the geographic overlap of the location of inventory plots with harvest areas and the resources

available for field measurement. A higher level of sampling than usual was adopted in the first four years of this FMP to accrue data for KPI 11, with an expectation of reducing the sample frequency commensurate with the resources available to implement the FMP.

Comparison of jarrah sawlog volumes realised with stand level forecasts during 2004-2007

The volume of jarrah sawlog realised as a percentage of the forecast for inventory monitoring plots within jarrah forest harvested during 2004–2007 was reported in Table 11 (page 63) of the mid-term audit report. Rechecking of all data and analyses for this report has resulted in some amendments to those figures and a major correction to the important conclusion that averaged across all regions there was a 15 per cent shortfall between realised and forecast yields (i.e. the ratio of realised:forecast volume was 0.85).

The revised results are presented in Table 2 (below) as ratios of the volume of sawlog realised:forecast, where a ratio of 1.0 indicates perfect agreement between the realised and forecast volume. The presentation of ratios assists the interpretation of the associated standard error figures for each silvicultural objective and region.

The amended figures in Table 2 are as a result of: the inclusion of a plot for thinning in eastern jarrah forest in the South West Region; correction of a typographic error that previously reported a percentage of 11 per cent in the Warren Region for the release regeneration (gap) objective – the figure should have been 89 per cent; and correction of a typographic error reporting one instead of two plots contributing to the figure of 100 per cent for the eastern shelterwood objective in the Swan Region.

Averaged across all Regions, the ratio for the volume of jarrah sawlog realised:forecast volume is 1.09, not the 0.85 previously reported in the KPI 11 information. The incorrect figure of 0.85 appears to have been erroneously transposed from an incomplete preliminary analysis of the dataset, and the error was not subsequently detected through the cross-checking procedures in place.

Consequently, Table 2 infers that averaged across all the regions, there was 9 per cent more sawlog volume realised in the inventory monitoring plots than forecast. However, the standard error of 0.14 associated with the 1.09 mean indicates that the mean ratio may not be statistically different from 1.0.

Similarly, the small number and uneven representation of plots measured within most of the silvicultural / region strata contribute to large standard errors for the mean ratios. Nevertheless, there is a clear trend of less volume being removed (relative to forecasts) in all silvicultural strata in the Swan Region. The overall ratio of 0.56 in the Swan Region indicates an average shortfall of 0.44 or 44 per cent between the volumes realised relative to forecasts. The lower recovery of jarrah sawlog in the Swan Region has been offset by higher recovery (relative to forecasts) in the South West and Warren regions.

Table 2. Ratios of the volume of jarrah sawlog realised in 98 sample plots relative to the volume forecast for combinations of silvicultural objective and region. Figures in parentheses are the standard error.

Silvicultural objective of harvest operation	Swan Region		South-west Region		Warren Region		Total	
	Mean ratio	No. of plots	Mean ratio	No. of plots	Mean ratio	No. of plots	Mean ratio	No. of plots
Promote growth on retained trees (thinning)	0.81	5	1.14	5	-	-	0.98 (0.27)	10
Promote growth on retained trees (thinning) – eastern forest	3.81	1	-	-	-	-	3.81 (-)	1
Release regeneration (gap)	0.81	1	0.55	1	0.89	3	0.81 (0.21)	5
Establish regeneration – eastern (shelterwood)	1.00	2	0.78	10	-	-	0.82 (0.24)	12
Establish regeneration – western (shelterwood)	0.27	6	1.07	24	3.61	3	1.15 (0.21)	33
Single tree selection (*Phytophthora* dieback areas)	0.53	6	1.55	14	3.55	2	1.45 (0.41)	22
Selective*	0.48	6	0.42	5	-	-	0.45 (0.15)	11
Jarrah sourced from mixed karri stands	-	-	0	1	1.48	3	1.11 (1.11)	4
Combined average	**0.56 (0.12)**	**26**	**1.10 (0.16)**	**61**	**2.28 (0.63)**	**11**	**1.09 (0.14)**	**98**

* Stands that have been cutover and retained a high proportion of cull (unmerchantable) trees, and in which limited silvicultural treatments have been applied.

Factors giving rise to differences between realised and forecast yields during 2004-2007

A range of factors can give rise to differences between the realised and forecast yields in the monitoring plots.

Each individual plot is a single sample unit (i.e. realised yield) relative to a population mean (i.e. yield forecast) for the strata. Consequently, normal sampling variation can be expected to give rise to some plots having higher and some lower realised yields within the strata. Also, reliable inferences about absolute volume differences cannot be drawn for strata / region groupings with few plots, but examination of the plot characteristics can identify the factors that have contributed to differences in the realised and forecast yields.

Aside from normal sampling variation, consistent trends of higher realised yields relative to forecasts reflect some or a combination of the following:

- Conservative assessment of sawlog volumes within trees at the first inventory measurement, leading to higher sawlog volumes being recorded at the second measurement when the trees were felled;
- Growth in sawlog volume between the first inventory measurement and the second measurement when the trees were felled. This can comprise both 'ingrowth' of new smaller trees into sawlog size classes between the first and second measurements, and routine growth on trees over time. The first measurement in many plots was around 1990 and significant ingrowth and sawlog growth has been recorded over the ensuing decade;
- Variation between modelled and actual treemarking. Stand structure and composition in some stands can provide an opportunity to retain habitat and crop trees without reducing sawlog yield (e.g. if a high proportion of marri habitat trees are present). This can give rise to differences between the modelled and actual treemarking, but remain consistent with the jarrah silviculture guideline (Department of Conservation and Land Management 2004); and
- Variation between the modelled and applied sawlog specifications. A minor contribution to higher realised sawlog volumes can arise when stump heights, or defect characteristics are lower than modelled.

The current dataset does not contain a sufficient number of plots (degrees of freedom) to ascertain the relative statistical significance of each factor. However, a clear cause of the substantially higher realised yields in the Warren Region was some of the plots being located in stands yielding substantially greater sawlog than the stratum averages. Similarly, a major factor contributing to the higher realised yields than forecast in many silvicultural strata was variation between the modelled and applied sawlog specifications. In those instances the forecasts were based on a conservative modelling of the height of crown break (i.e. bole length), resulting in the sawlog volume being under-estimated because longer bole lengths (and hence more sawlog) where realised when the trees were felled.

In contrast, factors described in the mid-term audit report as contributing to realised yields being lower than forecast yields include:

- *"Variation between modelled and actual treemarking. The yield forecasts assume stands are treemarked to the precise thresholds in silvicultural guidelines. While field variation is expected, in some instances, more sawlog was retained in the forest because more trees than required by the guidelines were retained as crop or habitat trees within the stands. These trees remain available to potentially contribute to future yield;*
- *Trees forecast to be available for harvest were not taken. In areas containing a significant proportion of sawlogs of minimum size or marginal quality, trees included in the yield forecast were not removed due to a variety of market, operational safety and other reasons. These trees also remain available to contribute to future yield;*
- *Variation between modelled and applied sawlog specifications. Within a harvested tree bole, variations arose between the proportion of a log that was actually cut as sawlog in the field relative to the proportion of the log forecast (modelled) as a sawlog. Examples include where a higher sawlog standard was applied in the field and hence not all sawlogs that met the minimum specification as modelled were removed; and*
- *The silvicultural objective that was implemented was not always consistent with the silvicultural objective assumed in the modelling. An overall reduction in the area cut to release regeneration (refer KPI 6) and higher than forecast area cut to establish regeneration (shelterwood) meant that more areas were marked to objectives that retain more trees per hectare than forecast."*

In the Swan Region, detailed examination of the 26 plots indicate that harvest operations in these plots had the highest proportion of sawlog retained as 'surplus' crop or habitat trees, the highest proportion of sawlogs made available but left standing (not taken), and the lowest proportion of logs not forecast to be sawlogs that were realised as sawlog. These factors combined to result in the lowest proportion of sawlog recovered relative to forecasts.

The timber harvesting operations in the Swan Region have a number of characteristics that contribute to this result. Firstly, a high proportion of the sawlogs made available in the Swan Region are of marginal size and quality (refer to Figures A1 and A2 in Appendix 1) relative to other regions. Secondly, the forest available has generally been cut over several times, and within the regrowth landscape the trees having larger sawlogs are dispersed at a low frequency. Accessing all available areas within a coupe can be dependent on the availability of sufficient non-sawlog markets to contribute to the total commercial yield. This means that the larger sawlogs are more likely not to be harvested in the Swan Region relative to other regions. Thirdly, a high component of the sawlog volume is available in trees of candidate size for retention as habitat or crop trees, such that any conservative 'over-marking' of such trees will retain a high percentage of jarrah sawlog.

Implications for the timing of a revision of the sustained yield for jarrah sawlogs

A revision of the sustained yield is a necessary step in the preparation of each forest management plan, which is required at least every ten years. The next revision of the sustained yield is scheduled to be undertaken during 2012 and 2013 to inform the next forest management plan.

The overall average ratio of 1.09 for the volume of jarrah sawlog realised:forecast suggests a revision of the sustained yield before 2013 is not warranted. However, given the context for this supplemental advice requested by the Conservation Commission, further work involving a risk-based assessment was undertaken to explore the implications of advancing the timing of recalculation of the sustained yield. This approach considers the extent to which management actions can address yield shortfalls, particularly in the Swan Region; the likelihood that the trends identified in realised versus forecast yields will continue to 2013; and the consequence on future sustained yields of not revising the yield before the completion of the FMP.

Capacity for management actions to address lower realised yields in the Swan Region

A portion of the sawlog volume not realised in areas harvested to 2007 remains standing in the forest and will contribute to future yield. The current expectation is that this factor will be taken into account when the sustained yield is revised in 2012-13 for the next plan. In those instances where a reduction in the realised yield has arisen from the retention of sawlogs in trees made available but not taken, or conservatively treemarked for retention, that component of any yield shortfall remains standing and is largely deferred until the next cutting cycle. However, where marginal size and quality sawlog has been retained in a selective silvicultural outcome rather than release regeneration, there will be future growth forgone that may impact beyond the next 50 years.

A number of management actions during 2009–2013 could address the inconsistent retention of sawlog arising from these silvicultural issues. Table 3 summarises actions necessary in all regions to maximise the realised yields and improve the quality of information needed to revise the sustained yield.

Table 3. Measures to maximise the realised jarrah sawlog yields.

Factor	**Addressed by**	**Responsibility**
Consistency in area cut over at the coupe and regional scale relative to forecasts	• Increased attention to net area requirement and avoidance of local adjustments • Full access to areas above minimum economic threshold within coupe	Forest Products Commission Forest Products Commission
Consistency between modelled and implemented silvicultural objective	• Increased attention to silvicultural condition of stands in selecting silvicultural objective • Increased capacity to commercially remove non-sawlog material within stands so as to more closely achieve desired silvicultural outcomes • Continuation of silvicultural monitoring and reporting including silvicultural outcomes	Forest Products Commission Forest Products Commission Department of Environment and Conservation
Consistency between modelled and actual treemarking at the patch scale	• Application of treemarking to avoid retaining sawlog in crop or habitat trees beyond limits specified in silviculture guidelines	Forest Products Commission
Consistency between modelled and actual removal of trees containing sawlogs	• Enforcement or quantification of minimum size and quality standards for in-forest treatment • Improved quantification of minimum size and quality specifications acceptable to sawmilling sector	Forest Products Commission Department of Environment and Conservation and the Forest Products Commission
Consistency between modelled and applied sawlog specifications	• Consistent and rigorous application of log grading standards • Improved quantification of variation between FMP and industry-preferred sawlog specifications	Forest Products Commission Department of Environment and Conservation

Likelihood of trends observed to 2007 continuing to 2013

The trend of substantially higher realised yields than forecast in the Warren Region is likely to reduce over the period 2008-2013 as harvesting samples an expanded range of stand conditions and plots accrue from areas with closer to average stratum yields. In all regions, the contribution of sawlog growth and ingrowth to higher yields will persist through to 2013 and continue while the inventory estimates are based on the 1990 inventory.

The overall average ratio of 1.09 is therefore expected to trend toward the value of 1.0 in the longer term.

The Department considers there is a moderate to high likelihood of the trend of a shortfall between realised and forecast yields persisting in the Swan Region through to 2013. This is because direct management interventions aimed at improving the consistency between the realised and forecast yields (Table 3) can only address some of the causes. An increased focus on the application of silviculture, the choice of trees to retain while treemarking, and the consistent application of log grading specifications will recover more sawlog to the FMP size and quality specification. However, the size and quality of the available log resource (Appendix 1) will not alter markedly during this plan. Consequently, where lesser yield has been realised because there has been a shift in the size and quality of sawlogs acceptable to some parts of the sawmilling sector, that yield will not be recovered by management actions during the period of the FMP unless there is improvement in the underlying economic viability of accessing and processing those logs.

Impact of a revised timing on the magnitude of the sustained yield for jarrah sawlog

Given the moderate to high likelihood of a shortfall in the realised jarrah sawlog yield persisting in at least some harvesting operations, the impact on the jarrah sustained yield for a number of scenarios was modelled. Six scenarios were examined to indicate the range of circumstances represented by the KPI data in Table 2. These are:

- A shortfall of 44 per cent on the yields realised in the Swan Region, persisting for the period of the FMP only;
- A shortfall of 44 per cent on the yields realised in the Swan Region, persisting for this FMP and into the future for the next 100 years;
- A shortfall of 44 per cent on the yields realised in the Swan Region, an excess yield of 10 per cent realised in the South West Region, and an excess yield of 128 per cent in the Warren Region, all persisting for the period of this FMP only;
- A shortfall of 44 per cent on the yields realised in the Swan Region, an excess yield of 10 per cent realised in the South West Region, and an excess yield of 128 per cent in the Warren Region, all persisting for the period of this FMP and into the future for the next 100 years;
- An excess yield of 9 per cent on the yields realised in all Regions, persisting for the period of the FMP only; and
- An excess yield of 9 per cent on the yields realised in all Regions, persisting for the period of the FMP and into the future for the next 100 years.

For each scenario the impact of revising the sustained yield with effect from 2010 and from the commencement of the next forest management plan in 2014 was computed to compare the impact of timing on the magnitude of the sustained yield.

The scenarios assumed all other settings of the Forest Management Plan were maintained. Given the time constraints the calculation of the revised sustained yields did not involve detailed woodflow scheduling, as would normally be done for the development of a forest management plan, but rather gross adjustment of the strategic woodflows developed for the FMP. This approach provides for illustrative comparisons, but the sustained yield volumes should only be considered indicative, as full scheduling and evaluation of the operational feasibility of the strategic woodflows has not been undertaken. Moreover, the yield adjustments for these scenarios have been applied at the broad regional scale (e.g. 44 percent shortfall on all yields in the Swan Region) rather than being varied for silvicultural strata within the region.

Table 4 summarises the indicative sustained yield for each scenario and timing, in ascending order of volume. Under each scenario there was negligible difference between the sustained yields computed from 2010 or 2014, suggesting limited value in advancing the timing of revision of the sustained yield to 2010. In contrast, there was a major impact for each scenario of varying the period for which the yield shortfall or excess applied, with markedly reduced sustained yields when the yield shortfall or excess was maintained into the future (beyond the current FMP). In practice, the extent to which the trends recorded to 2007 would persist in future management plans will depend upon the various silvicultural, timber industry, and other settings adopted in those plans. The process of inventory update, adjustments and (if necessary) corrective actions being undertaken at least every 10 years with the revision of the sustained yield means that the persistence of the same figures over multiple management planning periods is highly unlikely. Such scenarios would not be considered realistic in future sustained yield calculations.

For the period of the FMP, the FMP jarrah sawlog sustained yield of 131,000 cubic metres is between the scenario of a 44 per cent shortfall in the Swan Region and a 9 per cent excess yield applying across all regions.

Table 4. Indicative sustained yield of jarrah sawlogs for six scenarios of varying realised yields and duration, comparing the impact of revising the sustained yield with effect from 2010 or the commencement of the next forest management plan in 2014.

Scenario	Year of revision	Indicative sustained yield of jarrah sawlogs (cubic metres per annum)			
		Total	Swan Region	South West Region	Warren Region
44 per cent shortfall Swan only – ongoing	2010	112,700	20,700	73,000	19,000
	2014	111,900	19,900	73,000	19,000
44 per cent shortfall Swan only – 10 years only	2010	129,200	37,200	73,000	19,000
	2014	129,100	37,100	73,000	19,000
Forest Management Plan 2004-2013	***2004***	***131,000***	***39,000***	***73,000***	***19,000***
9 per cent yield excess All regions – 10 years only	2010	132,200	39,400	73,600	19,200
	2014	132,300	39,400	73,700	19,200
Table 2 (KPI) regional factors – 10 years only	2010	132,600	37,200	73,800	21,600
	2014	132,600	37,100	73,800	21,700
9 per cent yield excess All regions – ongoing	2010	143,500	42,700	80,000	20,800
	2014	144,100	42,900	80,300	20,900
Table 2 (KPI) regional factors – ongoing	2010	146,400	20,700	80,800	44,900
	2014	147,100	19,900	81,200	46,000

Status of information to inform a revision of the sustained yield

A key assumption in the calculation of the sustained yield scenarios in Table 4 is that all the current FMP settings and datasets remain the same in future forest management plans. In practice, variations may arise to such factors as the forest area available for timber production, the silvicultural practices adopted, sawlog product specifications, structure and location of timber processing facilities and the provision for risks associated with the impacts of disease and climate change on future timber yields. A number of these settings have been highlighted in the mid-term audit for further refinement during the period 2009–2012 to inform the next revision of the sustained yield. Consequently an important consideration in the timing of a revision of the sustained yield is the status of information and data necessary to comprehensively update the sustained yield. The refinement and update of forest inventory, stratification and growth datasets has been scheduled (subject to available resources) to coincide with the processes for the preparation of the next forest management plan. Advancing the timing of a revision of the sustained yield would preclude the application of data being collected or scheduled for collection through projects underway.

Calibration of sustained yield for variations to sawlog product specifications

A fundamental setting in the calculation of sustained yield is the minimum sawlog specification to be available to industry. The KPI data indicate that a significant factor in lesser yield being realised than forecast in some areas is the rejection (as being of marginal size or quality) of some logs that meet the FMP jarrah sawlog specification. The native timber sawmilling sector has recently proposed a change in the number of sawlog grades, including variations to the current size dimensions and acceptable quality parameters. These changes broadly seek to separate out the worst 20 per cent (lowest quality) of the current FMP sawlog specification into a lower grade product.

While a complete revision of the FMP sawlog sustained yield may not be warranted or practical at this time, any significant shift in the sawlog specifications delivered to Forest Products Commission customers should be accompanied by a calibration of that portion of the 131,000 cubic metres sustained yield that the new grade comprises. In other words, an increase in the minimum size or quality of sawlog accepted by some customers would require a downward adjustment to the allowable volume of sawlog to be removed to maintain equivalence to the 131,000 cubic metres of first and second grade sawlog in the FMP. This is necessary because the annual production rate of the highest quality logs needs to be integrated with all other sawlogs to ensure the combined total does not exceed the sustained yield.

Conclusions

Whilst 9 per cent more jarrah sawlog volume was realised than forecast the statistical confidence associated with this figure indicates there may be no significant difference between the realised and forecast yields. Consequently, data from the inventory monitoring plots indicate that at the whole-of-forest scale the sustained yield of jarrah sawlogs realised during the period 2004-2007 was consistent with the forecast yields. An average shortfall of 44 per cent between the volumes realised relative to forecasts in the Swan Region was offset by higher recovery (relative to forecasts) in the South West and Warren regions.

Variation between the realised and forecast yields arise from a range of sampling, silvicultural, measurement and operational factors, the extent of which vary between regions and over time.

Modelling indicates there would be limited value and significant costs in advancing the timing of revision of the sustained yield to 2010.

Recommendations

The Department recommends that:

1. The timing of the revision of the sustained yield for the next forest management plan should remain in accordance with the timing envisaged in the FMP, and not be brought forward, given the insensitivity of the sustained yield to the level of variation in the realised yields recorded to 2007; and
2. Appropriate management actions to address operational factors that vary the realised yields, continuation of data refinement projects, and progressive development of the settings for the next forest management plan should be undertaken.

References

Department of Conservation and Land Management 2004. *Silvicultural practice in the jarrah forest.* Department of Conservation and Land Management, Sustainable Forest Management Series, SFM Guideline No. 1

Spencer R.D. (Editor), 1992. *Application of modern inventory techniques in the forests of Western Australia*. Department of Conservation and Land Management, Occasional Paper No. 1/92.

Appendix 1

The shortfall between realised and forecast sawlog yield in the Swan Region correlates with a shift in the size class distribution of logs made available under this FMP relative to the resource available prior to the introduction of the *Protecting Our Old-growth Forest Policy* in 2001. Figures A1 and A2 depict the size class distribution of sawlogs, by small end and large end diameters respectively, of the sawlogs recorded within the inventory monitoring plots in the Swan Region during the periods before and after 2001. Since 2001 the highest proportion of sawlogs made available in operations has been in the smallest size classes, where marginal defects become critical in rejecting a log as sawlog.

Figure A1. Distribution of the small end diameter under bark (SEDUB) of jarrah sawlogs measured within inventory monitoring plots in the Swan Region during 1995 to 2006.

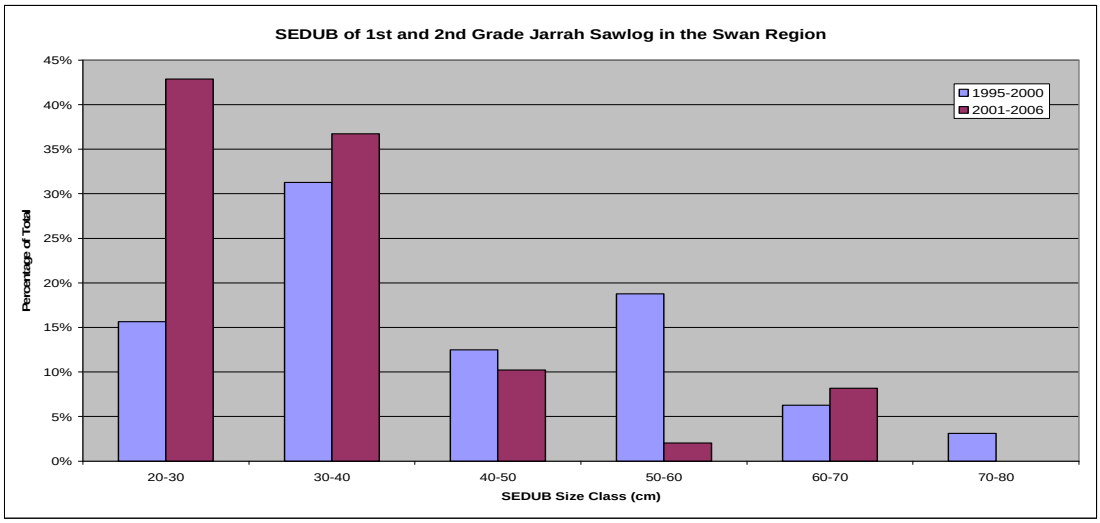

Figure A2. Distribution of the large end diameter under bark (LEDUB) of jarrah sawlogs measured within inventory monitoring plots in the Swan Region during 1995 to 2006.