STRATEGIC INVENTORY REPORT

NSW WESTERN REGIONAL ASSESSMENTS

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Brigalow Belt South

Resource and Conservation Assessment Council

STRATEGIC INVENTORY REPORT

BRIGALOW BELT SOUTH

SFNSW

A project undertaken for
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CONTENTS

Tables

PROJECT SUMMARY

This report describes a project undertaken for the Resource and Conservation Assessment Council as part of the regional assessments of western New South Wales. The Resource and Conservation Assessment Council advises the State Government on broad-based land use planning and allocation issues. An essential process for the western regional assessments is to identify gaps in data information and the best ways in which to proceed with data gathering and evaluation.

Project objective/s

The objectives of the Timber Resources Strategic Inventory were to:

1. provide stratum-level statistics for timber volumes by product class;
2. provide data for the prediction of long-term wood flows;
3. assign volumes at the sub-compartment level; and
4. provide spatial linkages between the inventory and attribute data.

Unit total volumes and unit volume of high value wood were to be estimated with a target accuracy of ±30% of the true value, at the 95% confidence level.

Methods

The native forest population to be sampled was defined as the net State forest area within the Pilliga (PMA), Gilgandra (GMA) and Dubbo Management Area's (DMA), which occur within the Brigalow Belt South (BBS) Bioregion . The sample design for the population was a stratified design. Strata in the native forests were based on a yield association (amalgamations of forest type) by stand structure matrix. Sample points were selected with a random plot point generation tool. At each point, a range of standard mensurational parameters were measured. All inventory data were processed with the MARVL software package.

Key results and products

Results for native forests showed that the accuracy target for total volume was met with a sample of 25 plots per stratum Accuracy targets for total volume were met in 19 out of the 20 strata, which contained 97.7% of all volume estimated in the inventory. The data were considered to be sufficiently close to the confidence limits for the more important strata to effectively underpin long term yield estimates.

It is anticipated that the Strategic Inventory data will passed to the FRAMES Western Yield Simulator for calculation of the range of future yields that then underpin the sustainable yield calculations performed by the FRAMES Western Strategic Yield Scheduler. The FRAMES Western Yield Simulator will be the subject of a separate project proposal as a part of Stage 2 of the Bioregional Assessment. All plot locations and associated strata are stored in a GIS database.

1. INTRODUCTION

State Forests has traditionally collected inventory data on a management area basis, in response to prevailing market demands. A variety of inventory techniques have been used to estimate timber resources: broad area inventories using fixed area or point samples, pre-harvesting inventories and desktop assessments. The inventories described in this report used standard methods for the South Brigalow Assessment. The use of standard methods and the creation of standard inventory databases will allow monitoring and updating processes to be more easily achieved.

The purpose of this report is to document the procedures used in the strategic inventory of the State Forests in the Pilliga, Gilgandra and Dubbo Management Area's, within the Brigalow Belt South Bioregion, and to present results of the inventory in terms of the stated objectives.

This report aims to present, in a single document, an overview of the strategic inventory. Procedures and techniques are described in detail in a series of separate reports, all of which are appended to this report. The individual reports are:

- MARVL system analysis (Appendix A)
- Strategic Inventory - Field Manual (Appendix B)

2. INVENTORY PROCEDURES

2.1 OBJECTIVES OF THE INVENTORY

The objectives of the strategic inventory, as stated in the "Timber Resources Strategic Inventory CRA Project Proposal" were:

1. to provide estimates at stratum level (aggregated forest types by structure class) of total timber volume and timber quality class volume with associated confidence limits; as well as estimates of volume by log product class,
2. to provide data for the prediction of long term wood flows (with particular emphasis on the next 20-30 years)using stand structure information;
3. to assign total and available timber volume by quality class, calculated at stratum level, to stand unit (sub-compartment) level, where stand units comprise strata within a compartment. Other forest attribute data could also be assigned at this level; and
4. to provide a spatial link for forest attribute and inventory data.

The accuracy target for the strategic inventory is that the unit volume of all useable wood (that is, all products and species) in any given stratum, are to be estimated to an accuracy of ±30% of the true value, 95 times out of 100.

It is emphasised, objective 3 notwithstanding, that the strategic inventory was not designed to be accurate at compartment level or lower. Each stratum has a volume per hectare (the arithmetic mean volume of all plots in that stratum), and the stratum net area in each compartment is known, so it is possible, in a mechanical sense, to estimate total volumes at the compartment level. The sampling design devised for the strategic inventory took into account only variation which occurred within the strata; no provision was made for measuring within-compartment variation. Because there is no information available on within-compartment variation, no definitive statement can be made about the accuracy of compartment-level estimates, but experience has shown that compartments are often highly variable, so it can be reasonable inferred that the accuracy of compartment-level estimates, when calculated as described, would be low.

More accurate estimates at the compartment level would require that the inventory process be redesigned to somehow account for, and measure, within-compartment variation. Given the large number of compartments in each Management area (MA) of the BBS bioregion, and the observed high variability of these compartments, it is clear that measurement to the compartment level would require the measurement of many, many more sample plots, a proposal that was not thought realistic, given the time and cost constraints that were in force when the inventory design was being considered.

2.2 DETERMINATION OF AREA TO BE SAMPLED

2.2.1 Native forest

The net mapped area for the inventory (the sample population) was determined by State Forests' Western Region staff. The gross area of State forest was reduced to net area by excluding the following classifications:

- physically and economically inaccessible forests areas;
- steep land;
- non-commercial forest types;
- unavailable Preferred Management Priority (PMP) zones;
- areas excluded because of conservation protocols; and
- drainage buffers (filterstrips).

Steep land was defined as contiguous blocks of land, with an area greater than 1 hectare, and with a slope greater than 30 degrees.

Forest types, as defined in Forestry Commission of NSW technical paper No.8 (1967), Forest Types of the NSW Cypress Pine Zone; commonly referred to as Lindsay types, were used to separate commercial and non-commercial forest types.

Unavailable PMP zones were:

PMP 1.3 Preserved Natural Forest
PMP 1.1.7 Flora and Fauna Protection (where timber harvesting was excluded)

Native forest stratum areas are shown in Table 4. These areas are correct as at 31/01/2000.

2.3 DATA TO BE COLLECTED

2.3.1 Native forest

The variables measured at each plot are defined in the "Strategic Inventory Field Manual" (refer Appendix B). Measured variables are listed below.

Inventory-level variables:
inventory name
Region
Forest Centre(s)
Management Area

Plot-level variables:

- plot number
- State Forest identifier
- compartment number
- measure date
- coordinates (zone, easting, northing)
- site height
- plot area
- distance to filter strip (if <=50 m)
- stratum identifier
- name of measurer(s)
- aspect
- slope
- terrain element
- forest type
- stand structure
- regeneration parameters

Tree level variables

- tree number
- species code
- DBHOB
- availability
- dominance
- crown quality
- harvest status
- hollow status
- MARVL tree description (quality codes and height)

2.4 METHODS OF MEASUREMENT

Plot measurement methods are described in the "Strategic Inventory Field Manual" (refer Appendix B).

Plots were fixed area 0.1 ha circular plots. The same size plot was used for all strata so that restratification could be easily accomplished.

A brief summary of the measurement procedure for each plot is as follows. Sample points were predetermined in the office; transect bearings and distances were calculated from identifiable take-off points to each sample point. A hip chain and compass were used to locate the points. A 0.1 ha plot (which has a horizontal radius of 17.84 m) was established at each sample point, using either a tape and clinometer (in conjunction with a conversion table to correct for variation in slope) or a Forestor "Vertex" hypsometer (which automatically corrects for variation in slope). To facilitate possible relocation, the centre point of each plot was marked with a painted peg. Individual tree numbers were sprayed on each sample tree to permit relocation for audit purposes.

All trees with an overbark diameter at breast height (DBHOB) equal to or greater than 100 mm, were measured in the inventory. The State Forest standard for breast height is 1.3 m; this point was marked on each tree.

Other variables recorded for each tree were tree availability, crown condition, dominance, harvesting status and hollow status. These variables are described in "Strategic Inventory Field

Manual" (Appendix B). A MARVL tree description was recorded for each tree. A MARVL tree description is a method for describing the morphology of each tree and the quality of the timber it contains. The method is described more fully in "MARVL system analysis" (Appendix A).

Tree heights were measured as part of the MARVL tree description. All heights were measured with the Forestor "Vertex" hypsometer. All trees sampled in the plot were measured for total height.

All field work was done by State Forests' staff.

2.5 SELECTION OF THE SAMPLE

2.5.1. Pilliga Management Area

Stratification
Strata used in the inventory were a combination of Lindsay forest type groups and structure class. A Lindsay forest type group is an amalgam of Lindsay forest types. Lindsay forest type groups are described in Table 2.1.

TABLE 2.1 LINDSAY TYPE GROUPINGS USED IN PILLIGA MANAGEMENT AREA BBS BIOREGION

Lindsay group name	Description
White cypress pine / box types	Dominated by Lindsay types PgP, PPf, and PPg. With minor associations of PCn, Pf, PfP, Pg, PgBP, PgPf, PH and PPgC types.
Eucalypt	Dominated by NT, NTBp,CT, C, N, NTBr and TNBp.
White cypress pine /ironbark	The most dominant group in the Pilliga. Types COP and PCO dominate with BCP, PCB and TBCP dominating other minor types
White cypress pine/ red gum types	This is primarily dominated by the red gum types, BAP, BNBp, BNP, BP, PB and PBA

Structure classes were derived from the Wood Resources Study. Stand structure was primarily focussed on the white cypress pine component of the stand. Classes and descriptions are shown in Table 2.2.

TABLE 2.2 STRUCTURE CLASSES USED IN PILLIGA MANAGEMENT AREA BBS BIOREGION

Class	Description
1	Thinned 1890's stand with no regeneration or regeneration unthinned
2	Thinned 1890's stands in conjunction with stands of thinned 1950's regeneration
3	Unthinned 1890's stands
4	Thinned and unthinned 1950's stands only, no 1890's stands present
5	Stands containing little or no commercial cypress pine.

In PMA the basis of splitting regrowth polygons was the Wood Resources Study stand structure data. The stratum matrix, with stratum labels, for the PMA is shown in Table 2.3.

TABLE 2.3 STRATUM DEFINITION AND LABELS, PILLIGA MANAGEMENT AREA

	Structure class				
Lindsay Group	1	2	3	4	5
White cypress pine / Box types	1	2		3	
Eucalypt spp.		4		5	6
White cypress pine / Ironbark	7	8	9	10	11
White cypress pine / Red gum types	12	13		14	15

Stratum area statistics as at 31/1/2000 are shown in Table 2.4.

TABLE 2.4 NATIVE FOREST STRATA IN PILLIGA, GILGANDRA AND DUBBO MANAGEMENT AREAS WITHIN THE SOUTHERN BRIGALOW ASSESSEMENT AREA

Stratum	Pilliga Management Area	Gilgandra and Dubbo Management Areas
1	11296	5967.8
2	27358	5678.5
3	11348	6994.3
4	11350	24438.7
5	21656	33671.3
6	28554	
7	62924	
8	69720	
9	6023	
10	37823	
11	15284	
12	5825	
13	6673	
14	8881	
15	7840	
Total	332555	76750.6

Plot selection
Within the net mapped area, plots were allocated to the strata described above. Initially plots were allocated to strata in proportion to net area, that is, each plot represented the same number of hectares. Proportional sampling resulted in some smaller strata , which could not be further grouped, having as few as ten sample plots, in such instances a minimum sample size of 25 plots per stratum was adopted.

ARCVIEW software developed by the State Forests GIS Branch, Applications Development Unit was used to select sample points. The Random Plot Point Generation Tool was used to select all plots.

2.5.2 Gilgandra-Dubbo Management Area's

Stratification
The stratification for the G-DMA was based on amalgamated Lindsay type groups. Amalgamated forest groups are shown in Table 2.5.

TABLE 2.5 STRATUM DEFINITION AND LABELS, GILGANDRA AND DUBBO MANAGEMENT AREAS, AS AT 31/1/2000

Stratum Number	Area	Amalgamated Lindsay groups
1	Other forests	Black Pine, Black pine-Red gum, Ironbark-Black pine, Ironbark-Pine, Narrow leaved ironbark-Black-Pine
2	Other forests	Box, Box-Pine, Pine-Box, Pine-Ironbark, Pine-Narrow leaved ironbark, Pine-Red gum, Red gum-Pine
3	Other forests	Narrow leaved ironbark, Narrow leaved ironbark-Pine
4	Goonoo/Cobbora	Ironbark-Black Pine
5	Goonoo/Cobora	Narrow leaved ironbark-Black Pine

Plot selection
In the G-DMA inventory plot locations were selected within strata using the Random Plot Point Generation Tool described in section 2.5.1.

2.6 FIELD WORK

Plot measurement was conducted in accordance with the guidelines set in the "Strategic Inventory Field Manual" (Appendix B) Each native forest inventory crew had three people, including one experienced in marketing to assist with tree classification. All crews received training prior to commencement and were regularly monitored by supervisory staff.

2.7 DATA INPUT

Data collected using the methods described above were entered into the computer using the software package MARVLDE3. Data entered using this program are stored in a standard form, ready for import into the MARVL database.

A full description of MARVLDE3 can be found in NZFRI (1995a). An important point to note here is that data are validated on entry. This validation occurs at several levels; MARVL default variables, user-defined variables and tree descriptions.

Continuous MARVL default variables are checked against limits set in the MARVLDE3 configuration file. The relevant section of this file is shown in Table 2.6. Four figures are quoted for each variable. Values within the range of the inner pair (100.0 - 1500.0 for diameter, for example) are accepted without question. If a value falls in the range of either of the outer pairs (60.0 – 100.0 and 1500.0 – 4000.0 for diameter) the operator is asked to confirm the value. Values outside the extremes are not accepted.

TABLE 2.6 MARVLDE3 CONFIGURATION FILE

DiamRange=	60.0000	100.0000	1500.0000	4000.0000
HeightRange=	0.0000	0.0000	50.0000	70.0000
AgeRange=	2.0000	10.0000	50.0000	100.0000
PlotAreaRange=	0.0100	0.0200	0.1000	1.0000
BAFRange=	1.0000	2.0000	4.0000	25.0000
SlopeRange=	-40.0000	-30.0000	30.0000	40.0000
TallyRange=	0.0000	2.0000	25.0000	50.0000
LengthRange=	1.0000	5.0000	60.0000	200.0000
StratumAreaRange=	0.0100	0.0200	10000.0000	99999.0000

User-defined variables, which may be either continuous or categorical, are checked against ranges stored in the input file. Values for dominance code, for example, can only be 1, 2, 3, or 4. No other values are accepted.

Tree descriptions are checked for internal logic by MARVLDE3. Such things as minimum/maximum heights and diameters, heights decreasing up the stem, or diameters increasing up the stem are trapped at this stage.

The end result of the data entry process is a file called a MARVL Data Interchange file, an MDI file, which is the method by which data are imported into the MARVL database.

All data collected were first recorded on paper plot sheets and then entered into the computer later.

2.8 DATA PROCESSING

2.8.1 The MARVL system

All data were processed using the MARVL software package. This method is described in detail in "MARVL system analysis" (Appendix A); a brief overview of the method is given below.

MARVL differs from other inventory systems in that it separates the field assessment of size and quality of stems from the actual cross-cutting. When the stand is cruised, no attempt is made to divide the stem into logs or estimate merchantable limits at any point on the tree. (Lawrence, 1986).

Use of MARVL involves three basic steps (NZFRI, 1995b):
1. inventory design;
2. sampling of stand(s) to assess tree size, structure and quality; and
3. analysis of the sample data to determine potential product yield.

At step 1, MARVL supports the use of fixed area plots ("bounded" plots in MARVL literature), horizontal point and horizontal line samples, which may be used in simple or stratified designs.

Step 2 is referred to in MARVL literature as "cruising". Standard tree size indices (such as DBHOB, height) are measured in this step. There is the facility for the inclusion of user-defined variables. In addition, each tree is described by structural and quality codes.

Step 3 is accomplished with the Analyse module of MARVL. This module enables the user to produce one or more reports, using one or more views as input, with one or more cutting strategies, to one or more projection dates.

Cutting strategy
The cutting strategy used for the conversion of quality codes to products is summarised in Table 2.7. This strategy will need to be refined after a study of the size mix of logs sold as a part of stage 2 of the BBS bioregional assessment.

TABLE 2.7 CUTTING STRATEGY USED FOR STRATEGIC INVENTORY

Product Type	Allowable qualities	Price ($/m^3)	Min SED (mm)	Max SED (mm)	Max LED (mm)	Min length (m)	Max length (m)
High quality hardwood sawlog	A	53.57	340	550	700	2.4	14.0
High quality hardwood small sawlog	A	58.90	200	370	440	2.4	14.0
Low quality hardwood sawlog	A, B	22.32	240	900	1000	2.4	14.0
White cypress pine high quality sawlog	A,B	38.98	120	800	800	2.6	14.0
White cypress pine low quality small log	A,B	24.00	80	120	180	2.0	2.8
Fuelwood	A, B, P	7.50	100	800	1000	2.4	14.0

NB: Minimum length of product is an operational constraint.
High quality small sawlogs have a greater monetary value than high quality large sawlogs.
Stems with > 55cm diameter not included in merchantable volume estimates.
Product length assessed from top of stump and not breast height (1.3m).

Taper and volume functions
Two forms of volume and taper functions were used; the Gordon (Gordon, 1983) form was used for Ironbark (*E. crebra and E. fibrosa)* and White Cypress pine (*C. glaucaphylla*) estimates and the Muhairwe (Muhairwe, 1999) form was used as the default function.

Height/diameter functions
The MARVL processing method requires that all trees have a total height, either measured or estimated, which is used as an independent variable in taper and/or volume functions (see "MARVL system analysis" (Appendix A) for more details). Heights may be estimated with either a height/age or height/DBHOB function. As individual tree age is not known in native forests a decision was made to measure the height of each in tree. This was done using an electronic measuring device called a Forester Vertex. Instructions for use of the Forester Vertex are contained I the "Strategic inventory field manual" in Appendix B.

The MARVL database
All strategic inventory data are stored in the MARVL database. The database is described in "MARVL system analysis" (Appendix B). The main point to emphasise about this database is that it stores only raw data; derived results, such as plot statistics, are not stored.

3. INVENTORY RESULTS

The results of the inventory will be discussed in four sections, which relate to the objectives of the inventory, as stated earlier in this report.

3.1 STRATUM STATISTICS, NATIVE FORESTS

Objective number 1. is met by the presentation of stratum statistics.

Stratum statistics for the Pilliga Management Area (PMA) are shown in Tables 4.1 (total standing volume), 4.2 (total standing merchantable volume), 4.3 (total standing merchantable high quality White Cypress pine volume), 4.4 (total standing merchantable high quality small White Cypress pine volume), 4.5 (total standing merchantable high quality hardwood volume) 4.6 (total standing merchantable high quality small hardwood volume), 4.7 (total standing merchantable low quality hardwood volume) and 4.8 (total standing merchantable fuelwood quality volume).

The project proposal for the strategic inventory specified an accuracy target of ±30% for total standing volume and total standing merchantable volume. Table 4.1 shows that, for estimates of total volume, accuracy targets have been met in 14 strata, that is, 14 out of the 15 strata have PLEs of 30% or less. These strata contain 97.7% of the total volume estimated by the inventory, so it can be said that accuracy targets have been met for 97.7% of the total volume in the PMA.

Stratum statistics for the Gilgandra and Dubbo Management Areas (G-DMA) area shown in Tables 4.9 (total standing volume), 4.10 (total standing merchantable volume), 4.11 (total standing merchantable high quality White Cypress pine volume), 4.12 (total standing merchantable high quality small White Cypress pine volume), 4.13 (total standing merchantable high quality hardwood volume), 4.14 (total standing merchantable small high quality hardwood volume), 4.15 (total standing merchantable low quality hardwood volume) and 4.16 (total standing merchantable fuelwood quality volume).

Table 4.9 shows that target PLE's has been met in 5 out of the 5 strata; these strata contain 100% of the total volume estimated by the inventory, so it can be seen that accuracy targets have been met for 100% of the total volume in the Gilgandra and Dubbo MA's.

Accuracy targets for total volume have been met for the total volume in both PMA and G/DMA of the BBS bioregion. Lower accuracy for sub-sets of the total volume (the product volumes) are a commonly seen result in forest inventory. The individual products found in a stand occur as varying proportions - depending on initial stand condition, treatment history, and uncontrolled events such as fire - of a quantity that is itself highly variable. This result, and its consequences, are analogous to the problem of compartment-level estimates, described earlier in

this report. An inventory designed to sample variation within the merchantable fraction of the forest would require a prohibitive number of plots.

3.2 DATA FOR WOOD FLOW

These results are relevant to objective 2 of the strategic inventory. Fundamental to the projection of growth is the idea of a yield table. A yield table presents anticipated yields from a stand over time (Vanclay, 1994).

Yield tables for western forests require the development of a Western yield simulator, which will be the subject of a separate project proposal, as a part of Stage 2 of the Bioregional Assessment. Inputs into the yield simulator may take the form of a "tree list", which is simply a list of raw tree data, as measured in the inventory. Models to estimate future growth, which will also be the subject of a separate project proposal under stage 2 of the South Brigalow Assessment, may be run against this data to produce yield tables.

Tables 4.17 and 4.18 show the total stocking and basal area for each stratum in the Pilliga, Gilgandra and Dubbo Management Area's. Stocking and standing basal area are important factors in determining the timing and the intensity of harvesting events. The project proposal for the strategic inventory specified an accuracy target of ±30% for total standing volume and merchantable volume. Basal area is correlated with volume and as such it is expected that the accuracy target for BA will be $\pm$ 30%. This target accuracy has been met in all strata, that is, 20 out of the 20 strata have PLEs of 30% or less.

3.5 ASSIGNMENT OF VOLUME

The results of the strategic inventory have been used to assign volumes at the compartment level, using the process described earlier in this report. However, for reasons which were also explained earlier in this report, compartment-level accuracy cannot be achieved without a significant redesign of the inventory and a much larger sample. The results of this inventory are not accurate at the compartment level, and are therefore of little use and may even be misleading when applied to small areas.

3.6 SPATIAL LINKS

The spatial link objective has been met by the creation and maintenance of an ARCVIEW point coverage, which records the location of all inventory plots. The coverage can be intersected with other ARCVIEW coverage's, as required.

4. TABLES

4.1 KEY TO TABLE HEADINGS

The tables which follow have identical column headings, which are described below.

Stratum	Stratum label
n	Number of sample points in the stratum
Max	Maximum observed value for the parameter (m^3/ha)
Min	Minimum observed value for the parameter (m^3/ha)
Average	Arithmetic mean value for the parameter (m^3/ha)
PLE	Probable limit of error, the confidence interval expressed as a percentage of the mean. Confidence limit is calculated with the standard formula, t * se
BA	Basal area (m^2/ha)

TABLE 4.1 TOTAL STANDING VOLUME, PILLIGA MANAGEMENT AREA, SOUTHERN BRIGALOW ASSESSEMENT AREA

Stratum	N	Max	Min	Average	PLE
1	24	91.9	63.2	77.5	18.5
2	25	99.7	69.8	84.8	17.6
3	24	80.9	58.7	69.8	15.9
4	25	53.8	31.3	42.6	26.4
5	25	47.1	31.1	39.1	20.5
6	25	43.6	25.4	34.5	26.4
7	60	80.9	63.3	72.1	12.2
8	69	77.0	61.1	69.0	11.5
9	25	83.3	53.7	68.5	21.6
10	25	62.6	33.9	48.3	29.7
11	25	64.4	35.0	49.7	29.6
12	22	71.0	52.3	61.6	15.1
13	21	80.9	58.8	69.9	15.9
14	20	77.7	46.1	61.9	25.5
15	16	80.8	37.9	59.3	36.1

TABLE 4.2 TOTAL STANDING MERCHANTABLE VOLUME, PILLIGA MANAGEMENT AREA, SOUTHERN BRIGALOW ASSESSEMENT AREA

Stratum	N	Max	Min	Average	PLE
1	24	61.2	43.5	52.4	16.9
2	25	60.6	44.2	52.4	15.6
3	24	53.5	31.8	42.7	25.4
4	25	34.6	18.5	26.5	30.3
5	25	37.5	21.4	29.5	27.3
6	25	28.9	12.4	20.7	40.1
7	60	55.5	43.7	49.6	11.9
8	69	53.3	41.8	47.6	12.1
9	25	66.1	44.3	55.2	19.8
10	25	53.3	26.9	40.1	32.9
11	25	45.6	21.4	33.5	36.2
12	22	55.0	36.9	45.9	19.8
13	21	59.4	38.4	48.9	21.4
14	20	46.3	27.6	37.0	25.3
15	16	56.7	18.6	37.7	50.7

TABLE 4.3 TOTAL STANDING MERCHANTABLE HIGH QUALITY WHITE CYPRESS PINE VOLUME, PILLIGA MANAGEMENT AREA, SOUTHERN BRIGALOW ASSESSEMENT AREA

Stratum	n	Max	Min	Average	PLE
1	24	16.6	6.0	11.3	46.7
2	25	7.3	2.5	4.9	49.1
3	24	7.1	2.3	4.7	51.6
4	25	1.7	0	0.7	132.0
5	25	0.2	0	0.1	206.4
6	25	24.0	9.3	0.3	206.4
7	60	13.3	7.3	10.3	28.7
8	69	9.2	4.3	6.8	36.5
9	25	14.8	7.6	11.2	32.4
10	25	5.3	0.6	2.9	80.0
11	25	2.2	0	1.0	111.4
12	22	19.8	6.7	13.3	49.4
13	21	18.6	6.0	12.3	51.2
14	20	10.2	3.0	6.6	54.4
15	16	0.3	0	0.1	213.1

TABLE 4.4 TOTAL STANDING MECHANTABLE HIGH QUALITY SMALL WHITE CYPRESS PINE VOLUME, PILLIGA MANAGEMENT AREA, SOUTHERN BRIGALOW ASSESSEMENT AREA

Stratum	n	Max	Min	Average	PLE
1	24	2.4	1.2	1.8	32.2
2	25	2.8	1.0	1.9	47.8
3	24	2.7	1.1	1.9	43.2
4	25	0.2	0.0	0.1	102.6
5	25	0.2	0.0	0.1	159.1
6	25	0.5	0.0	0.2	206.4
7	60	1.7	1.1	1.4	22.7
8	69	2.4	1.3	1.8	29.4
9	25	2.4	1.3	1.9	31.0
10	25	1.6	0.4	1.0	61.2
11	25	1.3	0.0	0.5	175.1
12	22	3.4	1.4	2.4	40.9
13	21	2.8	0.6	1.7	64.6
14	20	2.0	0.8	1.4	40.5
15	16	0.4	0.0	0.2	164.2

TABLE 4.5 TOTAL STANDING MERCHANTABLE HIGH QUALITY HARDWOOD VOLUME, PILLIGA MANAGEMENT AREA, SOUTHERN BRIGALOW ASSESSEMENT AREA

Stratum	n	Max	Min	Average	PLE
1	24	0	0	0	0
2	25	0	0	0	0
3	24	0.3	0.0	0.1	206.9
4	25	0	0	0	0
5	25	0	0	0	0
6	25	0	0	0	0
7	60	0.1	0.0	0	200.1
8	69	0.2	0.0	0.1	199.5
9	25	0	0	0	0
10	25	0.5	0.0	0.2	142.9
11	25	0	0	0	0
12	22	0	0	0	0
13	21	0	0	0	0
14	20	0	0	0	0
15	16	0	0	0	0

TABLE 4.6 TOTAL STANDING MERCHANTABLE HIGH QUALITY SMALL HARDWOOD VOLUME, PILLIGA MANAGEMENT AREA, SOUTHERN BRIGALOW ASSESSEMENT AREA

Stratum	n	Max	Min	Average	PLE
1	24	0.3	0.0	0.1	206.9
2	25	0.3	0.0	0.1	206.4
3	24	0.5	0.0	0.2	206.9
4	25	0.6	0.0	0.2	206.4
5	25	1.2	0.0	0.4	206.4
6	25	0	0	0	0
7	60	1.3	0.3	0.8	59.5
8	69	2.6	0.7	1.6	59.0
9	25	3.1	0.5	1.8	72.9
10	25	4.1	0.6	2.4	73.3
11	25	1.4	0.0	0.7	111.5
12	22	1.9	0.0	0.8	136.6
13	21	2.2	0.0	0.7	208.6
14	20	1.3	0.0	0.6	135.6
15	16	0	0	0	0

TABLE 4.7 TOTAL STANDING MERCHANTABLE LOW QUALITY HARDWOOD VOLUME, PILLIGA MANAGEMENT AREA, SOUTHERN BRIGALOW ASSESSEMENT AREA

Stratum	n	Max	Min	Average	PLE
1	24	1.3	0.0	0.5	161.9
2	25	0.6	0.0	0.2	161.8
3	24	0.3	0.0	0.1	206.9
4	25	0.5	0.0	0.2	142.9
5	25	0.2	0.0	0.1	206.4
6	25	0.5	0.0	0.2	206.4
7	60	1.8	0.6	1.2	51.5
8	69	0.9	0.1	0.5	80.4
9	25	4.1	0.6	2.3	76.3
10	25	2.1	0.2	1.1	83.1
11	25	1.8	0.0	0.9	104.2
12	22	0.7	0.0	0.3	160.9
13	21	0.9	0.0	0.4	131.2
14	20	1.3	0.0	0.5	147.1
15	16	3.2	0.0	1.0	213.1

TABLE 4.8 TOTAL STANDING MERCHANTABLE FUELWOOD QUALITY VOLUME, PILLIGA MANAGEMENT AREA, SOUTHERN BRIGALOW ASSESSEMENT AREA

Stratum	n	Max	Min	Average	PLE
1	24	38.7	24.3	31.5	22.9
2	25	46.0	32.3	39.2	17.4
3	24	38.9	20.6	29.8	30.8
4	25	27.4	14.2	20.8	31.7
5	25	31.8	17.9	24.9	27.9
6	25	23.1	8.8	16.0	44.8
7	60	32.8	24.9	28.9	13.7
8	69	34.5	26.4	30.4	13.4
9	25	42.1	21.6	31.9	32.1
10	25	37.2	16.5	26.8	38.7
11	25	35.6	15.3	25.5	39.9
12	22	30.4	17.6	24.0	26.7
13	21	35.0	21.3	28.1	24.3
14	20	28.8	16.0	22.4	28.7
15	16	38.4	13.5	26.0	47.9

TABLE 4.9 TOTAL STANDING VOLUME, GILGANDRA AND DUBBO MANAGEMENT AREAS, SOUTHERN BRIGALOW ASSESSEMENT AREA

Stratum	n	Max	Min	Average	PLE
1	25	114.0	76.6	95.3	19.6
2	25	72.1	48.8	60.5	19.3
3	25	87.5	57.9	72.7	20.4
4	25	92.2	58.2	75.2	22.6
5	35	106.7	83.4	95.1	12.3

TABLE 4.10 TOTAL STANDING MERCHANTABLE VOLUME, GILGANDRA AND DUBBO MANAGEMENT AREAS, SOUTHERN BRIGALOW ASSESSEMENT AREA

Stratum	n	Max	Min	Average	PLE
1	25	87.2	55.6	71.4	22.2
2	25	57.6	33.7	45.7	26.1
3	25	61.7	38.1	49.9	23.7
4	25	62..3	36.0	49.1	26.8
5	35	70.8	52.1	61.5	15.2

TABLE 4.11 TOTAL STANDING MERCHANTABLE WCP. HIGH QUALITY VOLUME, GILGANDRA AND DUBBO MANAGEMENT AREAS, SOUTHERN BRIGALOW ASSESSEMENT AREA

Stratum	n	Max	Min	Average	PLE
1	25	3.5	0.0	1.6	126.4
2	25	18.7	4.3	11.5	62.5
3	25	8.8	1.1	4.9	77.7
4	25	0.0	0.0	0.0	0.0
5	35	0.5	0.0	0.2	151.7

TABLE 4.12 TOTAL STANDING MERCHANTABLE WCP. SMALL HIGH VALUE VOLUME, GILGANDRA AND DUBBO MANAGEMENT AREAS, SOUTHERN BRIGALOW ASSESSEMENT AREA

Stratum	n	Max	Min	Average	PLE
1	25	0.6	0.0	0.3	123.4
2	25	1.8	0.7	1.3	41.2
3	25	2.6	0.4	1.5	70.8
4	25	0.0	0.0	0.0	0.0
5	35	0.3	0.0	0.1	119.5

TABLE 4.13 TOTAL STANDING MERCHANTABLE LARGE HIGH QUALITY HARDWOOD VOLUME, GILGANDRA AND DUBBO MANAGEMENT AREAS, SOUTHERN BRIGALOW ASSESSEMENT AREA'S

Stratum	n	Max	Min	Average	PLE
1	25	0	0	0	0
2	25	1.1	0	0.4	206.4
3	25	0	0	0	0
4	25	0	0	0	0
5	35	0	0	0	0

TABLE 4.14 TOTAL STANDING MERCHANTABLE SMALL HIGH VALUE HARDWOOD VOLUME, GILGANDRA AND DUBBO MANAGEMENT AREAS, SOUTHERN BRIGALOW ASSESSEMENT AREA

Stratum	n	Max	Min	Average	PLE
1	25	2.1	0.2	1.2	81.6
2	25	3.1	0.3	1.7	80.3
3	25	4.1	0.9	2.5	63.5
4	25	0.0	0.0	0.0	0.0
5	35	2.0	0.4	1.2	69.7

TABLE 4.15 TOTAL STANDING MERCHANTABLE LOW QUALITY HARDWOOD VOLUME, GILGANDRA AND DUBBO MANAGEMENT AREAS, SOUTHER BRIGALOW ASSESSEMENT

Stratum	n	Max	Min	Average	PLE
1	25	2.7	0.1	1.4	89.7
2	25	2.9	0.0	1.5	99.8
3	25	3.6	0.2	1.9	89.0
4	25	0.0	0.0	0.0	0.0
5	35	2.0	0.2	1.1	77.6

TABLE 4.16 TOTAL STANDING MERCHANTABLE FUELWOOD QUALITY VOLUME, GILGANDRA AND DUBBO MANAGEMENT AREAS, SOUTHERN BRIGALOW ASSESSEMENT AREA

Stratum	n	Max	Min	Average	PLE
1	25	70.2	41.3	55.8	25.9
2	25	28.9	15.6	22.3	29.8
3	25	41.2	21.0	31.1	32.5
4	25	55.6	31.1	43.4	28.2
5	35	57.8	41.6	49.7	16.3

TABLE 4.17 TOTAL STOCKING (STEMS/HA) AND BASAL AREA (M^2/HA), PILLIGA MANAGEMENT AREA, SOUTHERN BRIGALOW ASSESSEMENT AREA

Stratum	No. trees / ha	Average BA (m2/ha)	Max BA (m2/ha)	Min BA (m2/ha)	PLE %
1	350.8	14.8	16.8	12.9	13.2
2	423.2	16.8	19.3	14.3	14.6
3	361.3	14.7	17.2	12.2	16.9
4	289.2	11.6	14.2	9.0	22.4
5	276.8	11.0	13.1	8.9	19.3
6	286.8	9.8	11.8	7.8	20.3
7	395.3	14.3	15.8	12.8	10.4
8	415.5	14.3	15.7	12.9	9.6
9	370.0	13.7	16.1	11.4	17.2
10	298.4	10.9	13.5	8.3	24.0
11	314.4	11.6	14.4	8.9	23.6
12	389.1	13.3	15.0	11.7	12.5
13	388.1	15.3	17.6	13.0	15.1
14	300.5	12.9	15.7	10.1	21.7
15	363.8	15.4	20.1	10.8	30.3

TABLE 4.18 TOTAL STOCKING (STEMS/HA) AND BASAL AREA (M^2/HA), GILGANDRA AND DUBBO MANAGEMENT AREA, SOUTHERN BRIGALOW ASSESSEMENT AREA

Stratum	No. trees / ha	Average BA (m2/ha)	Max BA (m2/ha)	Min BA (m2/ha)	PLE %
1	511.6	21.2	24.7	17.6	17.0
2	348.0	13.0	15.4	10.5	18.9
3	426.8	15.9	18.9	13.0	18.3
4	445.0	18.0	21.2	14.7	18.1
5	538.2	21.1	23.3	18.8	10.8

5. APPENDIX A - MARVL SYSTEM ANALYSIS

6. APPENDIX B - STRATEGIC INVENTORY – FIELD MANUAL

7. REFERENCES

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