Strategic planning and information support for the Intensive Forest Management Program

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Abstract

A series of strategic planning and information projects has been undertaken to support major components of the Intensive Forest Management Program. These have included projects to gather and collate field data to identify and describe forest stands suitable for intensive forest management operations. Other projects provide inventory systems for the storage and analysis of such data and provide planning and modelling systems. This paper describes each of these projects and outlines some of the major benefits that have resulted from the project outcomes.

Introduction

The Intensive Forest Management (IFM) Program is a major component of the implementation of the Forests and Forest Industry Strategy (FFIS). The Program has involved:

- Plantation establishment and treatment;
- Native forest thinning;
- Changing the resource base from mature timber to regrowth for eucalypt veneers;
- Increased targets for the production of special-species timbers;
- Establishment of special-species plantations; and
- Inventory of private forests.

Implementation of the above projects required significant supporting information, computer systems and biometric models to enable appropriate levels of project planning and maximum benefits from the intended investments. Major relevant databases and systems already existed within Forestry Tasmania's forest management infrastructure. However, some important elements were not available, were inadequate in scope or capacity, or would not have been completed in time for implementation of the IFM Program. In particular, more sophisticated systems and databases were needed for plantation management.

Results from the Strategic Planning and Information Support Projects were needed near the start of the IFM Program to assist in the planning and implementation of other projects in the Program. This paper outlines the scope and nature of the strategic planning and support projects. Their objectives were to:

- Gather and collate field data (including inventory, mapping, and photo-interpretation) which identify and describe forest stands suitable for intensive forest management operations;
- Provide computer-based inventory systems for the storage and analysis of such data; and
- Provide planning and modelling systems to underpin the management of intensively managed forests.

The information contained in this paper was correct at the project completion in 1995. Other data have accumulated since that time.

Field data for forest stands suitable for intensive forest management

A number of separate projects (see below) were involved in providing support information for determining those forests suitable for intensive forest management.

1. Height/density typing of regeneration

The oldest regeneration on a significant proportion (about 32 000 ha) of the most highly productive State forest in Tasmania has been classified according to height and density, based on interpretation from large-scale colour aerial photographs.

The resultant classified forest stands have been mapped and digitised onto the Geographic Information System (GIS) for strategic analysis. This will enable strategic-level review of the silvicultural options available in these stands as part of the Native Forests Resource Review which is the five-yearly yield review required under the FFIS.

The height/density mapping has provided a focus for ground-based assessment of stands which have the highest likelihood of being able to be thinned commercially.

2. Photo interpretation of forest blackwood

A total of 440 000 ha of native forest in Circular Head Forest District was surveyed by photographic interpretation to identify and delineate those stands in which blackwood forms a significant component. A number of new blackwood areas were found and, in all, 23 548 ha of forest types containing blackwood were mapped (Figure 1).

The photo-interpreted (PI) forest classes which resulted were mapped and digitised onto the GIS. These data were then used to provide area statements and analyses (e.g. Figure 2) for the Blackwood Resource Review which was recommended as part of implementation of the Special Timbers component of the FFIS.

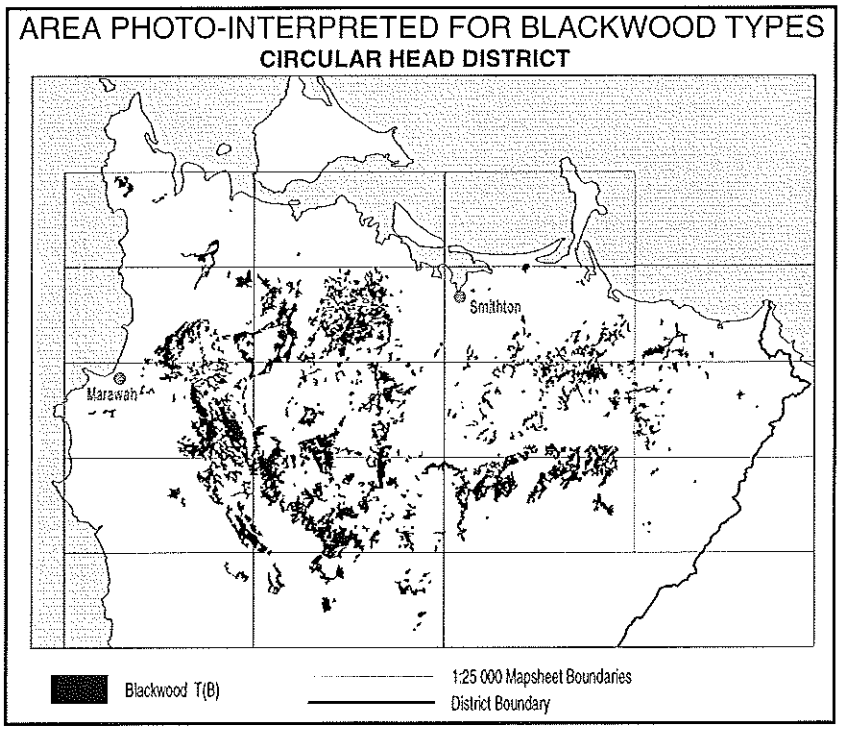

Figure 1. The area that was photo-interpreted for blackwood in the Circular Head District.

3. Completion of regrowth mapping

Approximately 110 000 ha of forest in the Florentine Valley area was photo interpreted and mapped for inclusion in resource statements required for the IFM Program. The mapping enabled inventory stratification, area estimates, and the identification of tall regrowth for veneer-log samples for the IFM Veneer Project. It also provided the base typing and photography needed for operational implementation of the IFM Thinning Project and for the Native Forest Resource Review.

4. Mapping of private plantations

Most of the private plantation patches recorded on the private forestry database (called the Private PAS database) were mapped from aerial photographs onto 1:25 000 base maps to ensure that the data could be incorporated into the Private Forest Resource Inventory Project.

Methods were developed and tested to map private plantation stands to a spatial accuracy required for strategic resource review. The method was subsequently implemented as the basis for the Private Forests Resource Inventory project.

Development of field assessment methods and geographic information systems

The IFM Program has necessitated the development of a number of new procedures for field assessments and for incorporation of the results into the existing GIS and associated databases. These projects are outlined in the following sections.

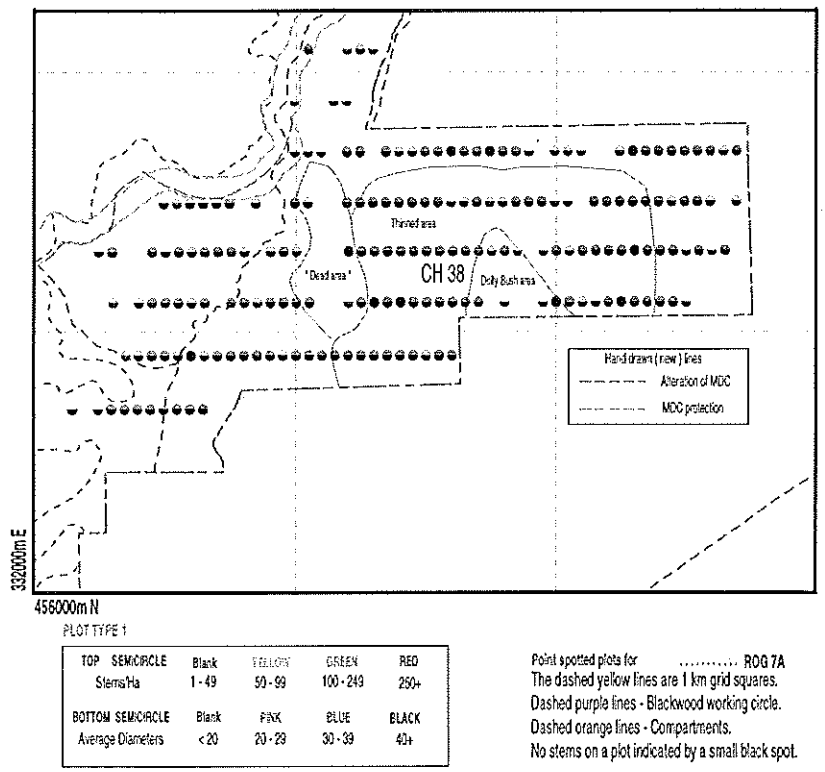

Figure 2. An example of the detailed assessments that have been undertaken in the blackwood swamp area of north-western Tasmania. These assessments have provided stocking and diameter data for management analysis using the SWAMPS Model (see page 10).

1. *Regrowth assessment system*

An efficient, purpose-designed inventory measurement and processing system was developed to assess stands of native forest regeneration for which thinning operations are being considered. The system, known as REGASS, includes the following components:

- A systematic strip line plot layout, with field measurements concentrating on stand and operational site parameters and a minimum only of tree/log measurements.
- A user-friendly, menu-driven computer system, fully operated by field staff, which accepts and processes field measurement data.
- A range of standard reports designed to meet the needs of operational planners (e.g. see Figures 3, 4).

Following its development, REGASS has been used by IFM Thinning Program officers for pre-operational assessment of over 2500 ha of regeneration, using 1555 plots. A separate version, called SWAMPS, incorporates the blackwood growth model which was developed as part of the IFM Strategic Planning Project (see Figure 2). SWAMPS was successfully used on 6911 plots to calculate swamp sub-compartment yields for the Blackwood Resource Review.

2. *Plantation Area System*

The establishment of a GIS coverage describing plantations was a necessary part of the IFM Program. Its completion has resulted in a fully attributed digital stand-mapping coverage of Tasmania's State forest plantations, both soft-wood and hardwood. The data set is known as the Plantation Area System (PAS). Currently, about 60 600 ha of plantation are recorded, mostly at a resolution equivalent to 1:10 000-scale mapping. Altogether, 11 260 separate stands are identified and coded according to 25 separate items. These items include, for example, species, year of planting and regime.

All plantations established on State forest under the IFM Plantation Program have been mapped and recorded on the PAS database, which is updated annually. The PAS stand information is now routinely used for all levels of plantation management planning; it is a vital component of the Plantation Integrated Management System (PIMS) which was developed under the IFM Strategic Planning Project.

3. *GIS development*

The following computer system elements were purchased to support GIS functions required by IFM and FFIS projects:

- Two SUN Sparc Station 1 workstations, with UNIX operating software, each with 16" colour graphics display, 8 Mb memory, 150 Mb tape cartridge, and 3 x 327 Mb hard disks.
- One Zeta A1 pen plotter.
- Two Tektronix 4207 colour graphics terminals and two digitising tablets.
- Two single-operator, floating-point licences for use of the ESRI Arc/Info geographic information system on the SUN workstations.

In addition to the purchase of hardware and software for the GIS, system installation and support services were provided to ensure a smooth operational working environment.

4. *GIS data sets and support*

A total of 1555 regeneration inventory plot locations on REGASS were digitised onto the Forestry Tasmania GIS. This data set was subsequently overlain with other regeneration data layers to map and analyse the interaction between inventory volumes and regeneration PI-types as part of the IFM Thinning Project. The data have also been used to provide representative plot samples to describe regeneration strata in a review of sustainable yields (e.g. see Figure 3).

A further 6911 blackwood REGASS inventory plot locations were digitised. This data set was subsequently overlain with other blackwood thematic layers, including PI-types, sub-

compartments and tenure, as part of the Blackwood Resource Review needed to implement the FFIS special timbers annual production target of 10 000 m^3 of blackwood sawlogs.

All 8670 Plantation Inventory System plot locations were digitised. This data set enabled operational implementation of the Plantation Integrated Management System for hardwood and softwood plantations.

A set of GIS-derived 1:25 000-scale map transparencies was generated for each Forest District, delineating areas which met the plantation site-selection criteria prescribed by

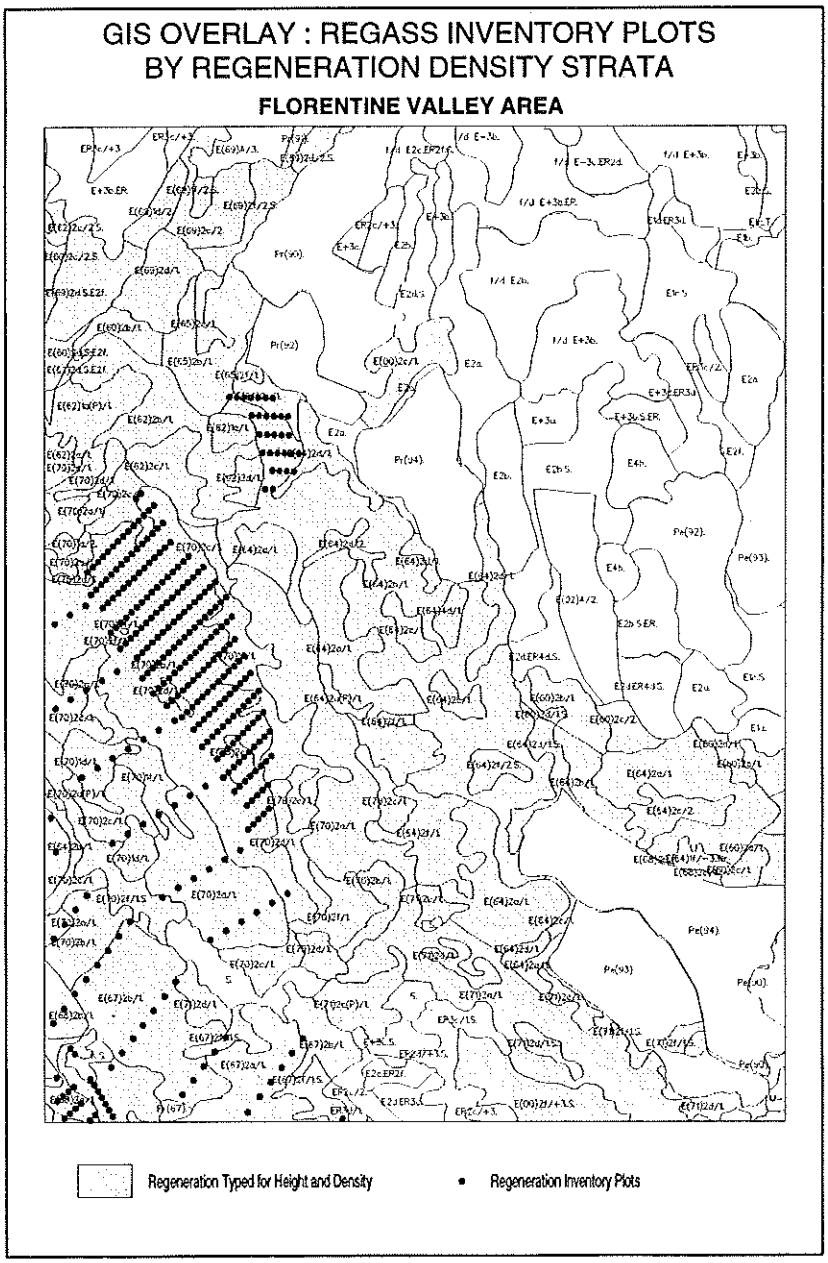

Figure 3. An example of the maps used in conjunction with the REGASS inventory plot data.

managers of the IFM Plantation Program. The transparencies were used by District planning staff to compile priority planting areas for further evaluation. They have also provided a focus for more detailed programmes of soil sampling and site-potential mapping.

Map layers comprising about 48 700 ha of regrowth age-classes, and 7600 ha of regeneration height and density typing have been converted to digital format to allow integration with other data layers and thus to support the IFM Thinning Project and the IFM Veneer Project. The regrowth age-class data were successfully used as a basis for inventory stratification in the Greater Southern Forests Assessment.

Modelling and statistical analyses

A number of modelling projects and statistical analyses were undertaken as part of the IFM

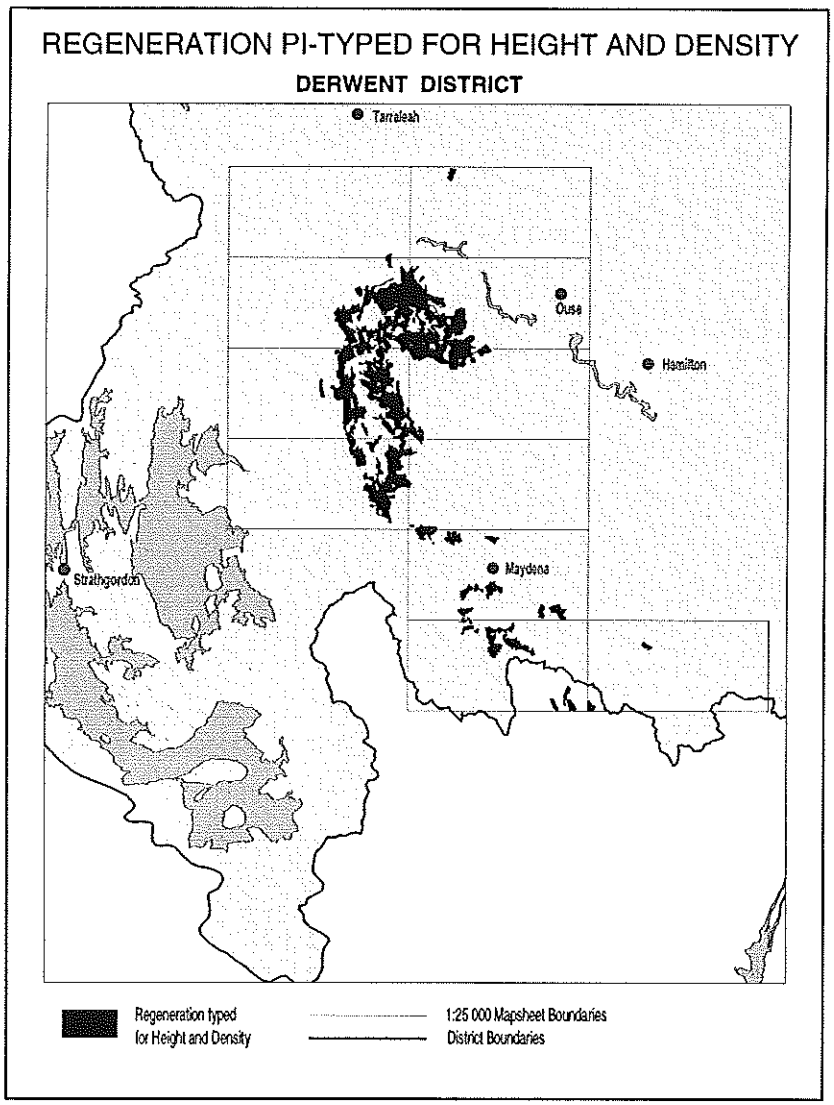

Figure 4. The extent of regeneration PI-typed for height and density in the Derwent District.

Program for incorporation of models and appropriate scientific designs and experimental applications into larger projects. Some of these projects were very specific, whilst others were more general in their application, as outlined below.

1. Statistical and biometric analyses

Statistical and biometric services have been provided to support design and analysis components of key IFM projects. These services have included:

- The investigation of stem-form responses to thinning in eucalypt regrowth.
- The derivation of upper stem diameter/ bark relationships for eucalypts, and investigation of the use of efficient centroid-sampling techniques for plantation inventory.
- Analysis of regrowth yield data to determine optimal rotation ages.
- Assistance with experimental design of plantation trials.
- Modification, programming, and running of various stand-volume, site-index, and growth simulation models to generate data for evaluation of plantation and thinning proposals.
- Analysis of veneer inventory results.

2. Regrowth inventory design

An efficient inventory design was developed to sample veneer volumes in the Greater Southern Forests Assessment. The design comprised optimal allocation of 130 field measurement plots across 22 forest classes, reflecting a stratification based on regrowth age, height and density, and mature forest height potential. The inventory design was implemented in 1992 and 1993, providing estimates of available veneer volume to the FFIC Veneer Project to underpin planning of the transition strategy from oldgrowth to regrowth. The principal elements of the design have also been adopted by Forestry Tasmania for subsequent statewide inventories to provide better veneer and sawlog estimates for the Native Forest Resource Review.

3. Modelling of leaf beetle impact

Specialist statistical services were provided to assist in the design and analysis of a series of experiments and investigations carried out under the IFM Biological Control Project. This work resulted in the production of a number of published and unpublished papers. Significant elements of the task included:

- Analysis of the response of plantation trees to defoliation and disbudding.
- Analysis of the impact of leaf-beetle browsing on tree-shoot growth.
- The application of phenology models to predict beetle life-stage populations.
- Analysis of the impact of insecticides on predators of leaf beetles.
- Analysis of the effectiveness of insecticide treatments in reducing defoliation levels.

4. Blackwood growth model

A growth model for swamp blackwood stands was developed. It contained a diameter projection function, a mortality function, and an ingrowth function. Evaluation of the model showed that it was more statistically valid than previous models, produced less biased estimates of growth, and provided significantly greater utility for yield calculations. The model was incorporated into the SWAMPS inventory processing system, and was successfully used to project growth on 6911 blackwood inventory plots to provide the yield estimates for the Blackwood Resource Review.

Plantation planning

Many of the above elements of the Strategic Planning and Information Projects have been incorporated into existing Forestry Tasmania

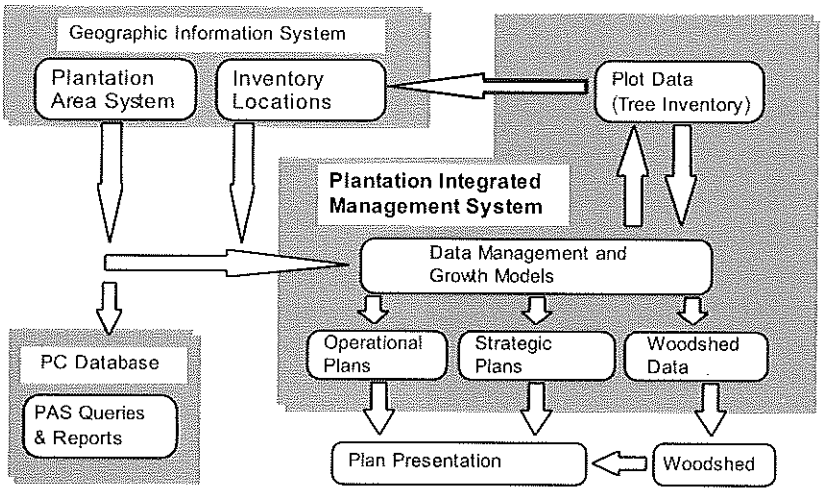

Figure 5. A flow chart summarising the Plantation Integrated Management System (PIMS), which was developed for the IFM Program to allow operational and strategic planning of Tasmanian plantations.

management planning systems, but have contributed as well to the development of a fully integrated plantation planning and decision support system. This major new system has been developed to allow operational and strategic planning and regime evaluation for hardwood and softwood plantations in Tasmania. The system is known as the Plantation Integrated Management System (PIMS, see Figure 5) and includes the following components:

- Integration of stand area data with inventory plot data using GIS technology.
- Dynamic access to the most up-to-date inventory and area data sets.
- Incorporation of the full range of Tasmanian volume equations and growth models.
- Links to the WOODSHED linear-programming optimisation package.
- Full wood-flow, log-assortment, and financial reporting.
- Menu-assisted user-interface to facilitate direct usage by planners.

Conclusions

A major outcome from the IFM Program for forestry planning and management in Tasmania has been the upgrading of existing support systems and processes and the development of new systems which allow for efficient delivery of knowledge about plantation and other intensive forest management systems. It is only through the maintenance and further development of such systems that intensification can proceed with assurance into the future.

Acknowledgements

The maps used in Figures 1–4 were derived from data held on the corporate ARCINFO GIS and produced for publication by the Special Mapping Section.