



GREENWOOD

S T R A T E G Y

DEVELOPMENT OF A SPATIAL DATABASE

Report Prepared for the Central West NSW
Forestry Hub
Project reference: CWFH001
January 2022



CENTRAL WEST NSW
FORESTRY HUB

CONTENTS

Contents	2
Disclaimer.....	3
Executive summary	3
Introduction	5
About the Hub	5
Rationale for the project.....	7
Regional snapshot.....	7
Project methodology	11
Project scope.....	11
Development approach	11
Project development.....	13
Plantation Data.....	13
Step 1: Data collation.....	13
Step 2: Data verification.....	13
Step 3: Assigning age class and rotation.....	14
Haulage Analysis	15
Web-based spatial database.....	17
Utility and user interface.....	18
Use and application of the database	19
Intended use	19
Limitations.....	19
Dynamic product.....	20
Maintenance and updates	20
Potential future applications.....	20
References.....	22
Appendices	23
Appendix 1: Data sources	24
Appendix 2: Stakeholders consulted	25



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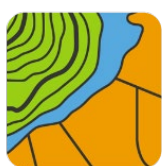
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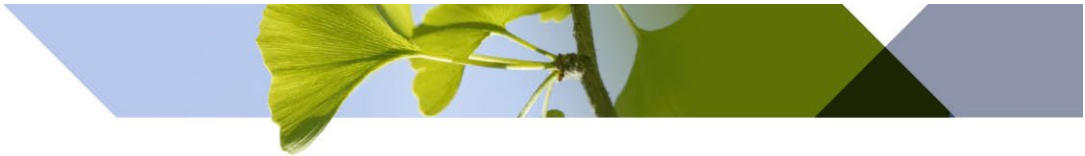
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EXECUTIVE SUMMARY

Greenwood Strategy was engaged by the Central West NSW Forestry Hub (the Hub) to develop a spatial database as part of a suite of three projects aimed at improving the understanding of current and potential future fibre production and utilisation from the region's plantation forests.

This report provides a summary of development of the spatial database, which is to be hosted on the Hub's website.

The database has been developed using information available from the forest and wood products companies operating in the region as well as a range of other publicly available data sources and our own primary research.

By incorporating all known plantations equal to or greater than 5 hectares in plantation area, this project has identified a total of 89,757 hectares of softwood plantation in the region, of which 70,871 hectares are publicly owned and managed by Forestry Corporation of NSW¹ and 18,886 hectares are privately owned by Hume Forests Limited, Plantation Pine Products Australia Pty Ltd and a large number of smaller growers.

Due to commercial sensitivities (including because the database will be available on the Hub's website), the data and analysis is necessarily coarse and strategic (rather than operational) in nature and has a number of limitations. However, it provides a comprehensive snapshot of the region's plantation estate and more detailed data may be available to Hub members.

The spatial database is designed as a dynamic product which can be easily updated with new and more detailed data and information. There are also a number of other potential applications of the database which the Hub may consider for future developments.

¹ Note that as a result of recent NSW Government land-use decisions, approximately 2,000 ha of plantation in Newnes State Forest was removed from the database as it will now not form part of the long-term productive area in the region.



INTRODUCTION

Greenwood Strategy Solutions Pty Ltd (Greenwood Strategy) has been engaged by the Central West NSW Forestry Hub (the Hub) to undertake this project (CWFH001) to develop a spatial database in the form of a web-based map tool accessible from the Hub's website and providing a suite of information regarding the location, condition, management and road transport routes of the region's privately and publicly owned softwood plantations.

This is one of three inter-related projects which the Hub has commissioned Greenwood Strategy to complete. The other projects are:

CWFH002: Potential for increased plantation productivity, utilisation and recovery of harvested products.

CWFH003: Plantation capability mapping for the Central West NSW Forestry Hub.

This report presents a summary of the methodology and approach undertaken to develop the spatial database. The database is to be hosted by the Central West Forestry Hub on its website.

About the Hub

The Hub was established in 2020 with funding under the Commonwealth Government's National Forest Industry Plan².

The Hub is located across parts of the Central Tablelands and Southern Tablelands of New South Wales (refer to Figure 1). The majority of the region's commercial plantation forests are concentrated in the Oberon Local Government Area (LGA), in the central-east, with important outliers located between Bathurst and Lithgow and around Orange in the north of the region. There are also smaller plantation areas scattered throughout the region, including south of the Abercrombie River.

The forest and wood products sector within the Hub is focused more or less exclusively on plantation grown *Pinus radiata* as the fibre source for wood products manufacturing, with most of that fibre processed at Oberon and, to a lesser extent, Raglan and Burruga.

The Hub's key objectives are to:

- Analyse the constraints that affect the productivity and efficiency of the forestry sector.
- Pinpoint opportunities for future investment in infrastructure and technology, and areas for potential expansion by forest industries.
- Identify and support business cases for the investment in new infrastructure, such as roads, bridges, ports, telecommunications and training facilities, thereby assisting forest service industries to better plan their futures.
- Determine the potential for future plantation expansion within appropriate transport distances and near other existing sources of wood and fibre.

² Commonwealth of Australia (2018) *National Forest Industries Plan: Growing a Better Australia – A Billion Trees for Jobs and Growth*

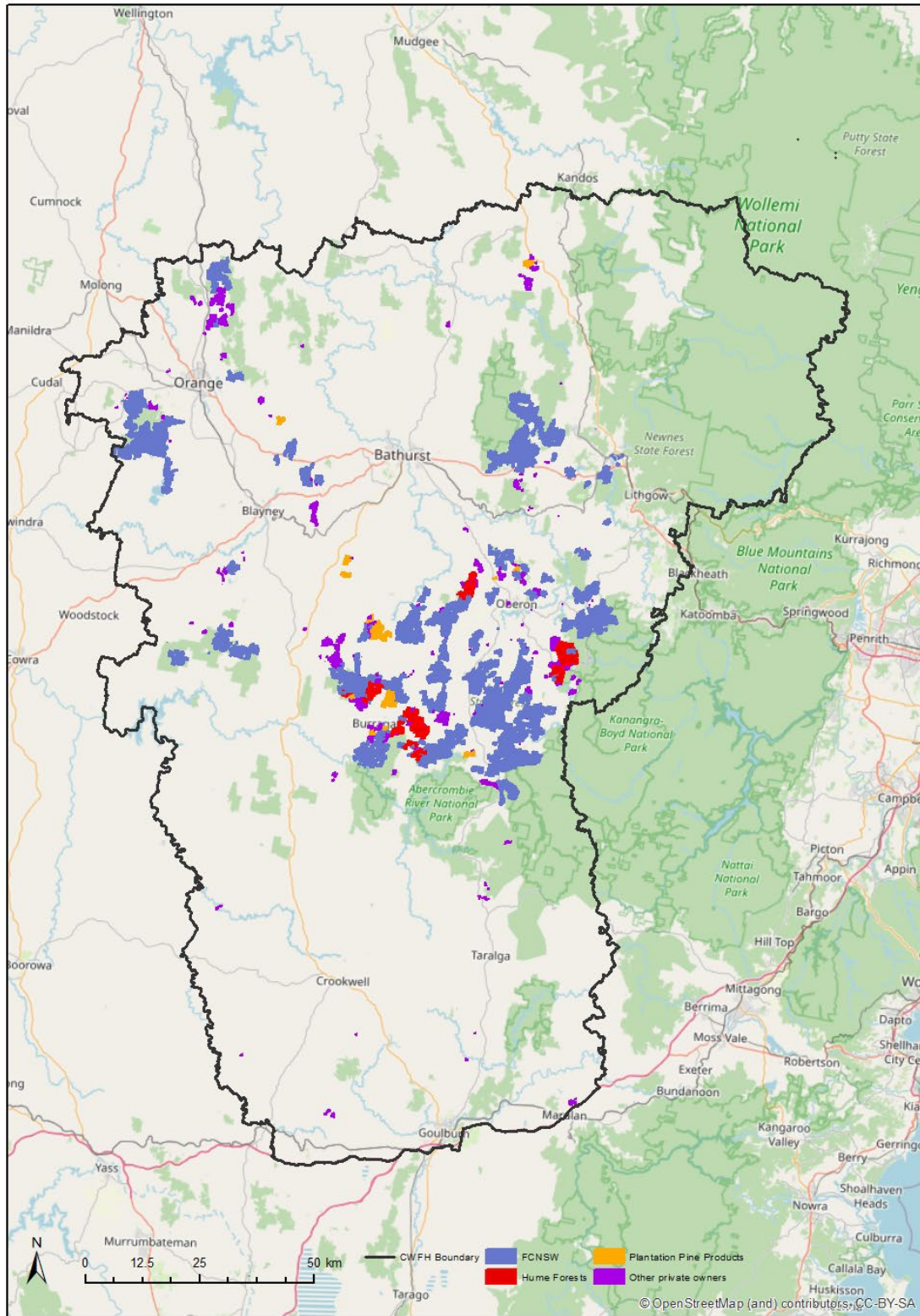


Figure 1: Central West NSW Regional Forestry Hub - plantation location and ownership



Rationale for the project

The Hub has identified a need to better understand the size, location, characteristics and owner/manager of wood fibre resources available from the region's plantation estate. In particular, there is a recognised need to better document the private plantation resource base within the boundaries of the Hub and this is a key objective of the project.

The project required development of a plantation estate spatial database to be available in web-based format for access by Hub members and other stakeholders, as appropriate, via the Hub's website. The tool has been designed in a manner which makes it is easy to use and navigate, can be readily secured and maintained as new data and information become available, and which provides core information about the plantation estate within the region, for the purpose of understanding where and when wood fibre supply might be available.

There are additional potential benefits from this project which have been considered during its development. Specifically, there is an opportunity to use the web-based platform to assist coordination of regional fire response and management activities between various land-owners and responsible agencies. There may also be potential utility for local government authorities with regional planning responsibility.

These additional benefits also raise the prospect of how data is protected, presented and made available with respect to privacy obligations.

Regional snapshot

There are three main plantation estate managers in the region - Forestry Corporation of NSW (FCNSW – a NSW State-owned enterprise), Hume Forests Limited (Hume) and Plantation Pine Products Australia Pty Ltd (PPP). There is also a large area of smaller privately owned plantations. The project has mapped 89,757 hectares³ of softwood plantations including units of five hectares or larger in the region.

For the purposes of mapping, a plantation is considered to be an area which has been deliberately planted, or allowed to re-establish, with exotic species and is over five hectares in area. The definition of plantation for this project includes areas currently planted, harvested and awaiting replant and currently fallow. While the definition adopted includes all plantation tree species, in reality it is almost exclusively *Pinus radiata* with the exception of some small historic trials of other softwood species on the public estate. A snapshot of key regional plantation estate data is presented in Table 1 to Table 4, and Figure 2 to Figure 3. These are examples of the range of information and analysis which can be extracted from the data collected for the project and are not exhaustive.

³ Note that the basis of mapped area for each of the estates in the region varies depending on what has been provided by the estate owner. We have used the term mapped area to reflect the differences in resolution of mapped data provided

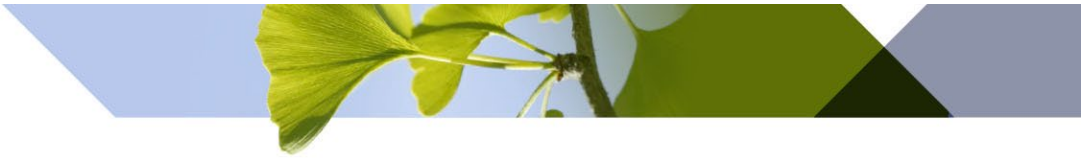


Table 1: Plantation area by ownership in the Hub region.

Ownership	Mapped area (ha)
Forestry Corporation of NSW*	70,871
Hume Forests	6,810
Plantation Pine Products	2,819
Other private owners	9,257
Total	89,757

* Includes 559 hectares of joint venture plantations

Table 2: Plantation area by age class/category in the Hub region.

Age class/category	Mapped area (ha)	Mapped area (%)
1-10 years	29,287	32.63%
11-20 years	23,306	25.96%
21-30 years	15,755	17.55%
30+ years	7,684	8.56%
Clearfell in progress	1,102	1.23%
Planting in progress	346	0.39%
Wilding regeneration	441	0.49%
Unplanted	11,836	13.19%
Total	89,757	100.00%

Table 3: Per cent age class/category by owner and owner type in the Hub region

Age class/category	FCNSW	Hume	PPP	Other private	Total
1-10 years	33.26%	54.68%	30.40%	12.23%	32.63%
11-20 years	29.18%	17.06%	20.07%	9.69%	25.97%
21-30 years	20.63%	1.81%	3.61%	9.82%	17.55%
30+ years	7.59%	5.33%	8.74%	18.34%	8.56%
Clearfell in progress	0.00%	0.00%	0.00%	11.91%	1.23%
Planting in progress	0.00%	0.00%	12.28%	0.00%	0.38%
Regrowth	0.00%	0.00%	0.24%	4.69%	0.49%
Unplanted	9.34%	21.12%	24.66%	33.32%	13.19%
Total	100.00%	100.00%	100.00%	100.00%	100.00%



Table 4: Forest area by ownership and distance to Oberon

Distance band (km)	FCNSW	Hume	PPP	Other private	Total
0-25	24,172	3,236	105	2,122	29,635
26-50	32,122	3,574	2,337	4,187	42,220
51-75	4,391		300	1,029	5,720
76-100	10,183		76	1,724	11,983
101-125	3			196	199
Total	70,871	6,810	2,818	9,258	89,757

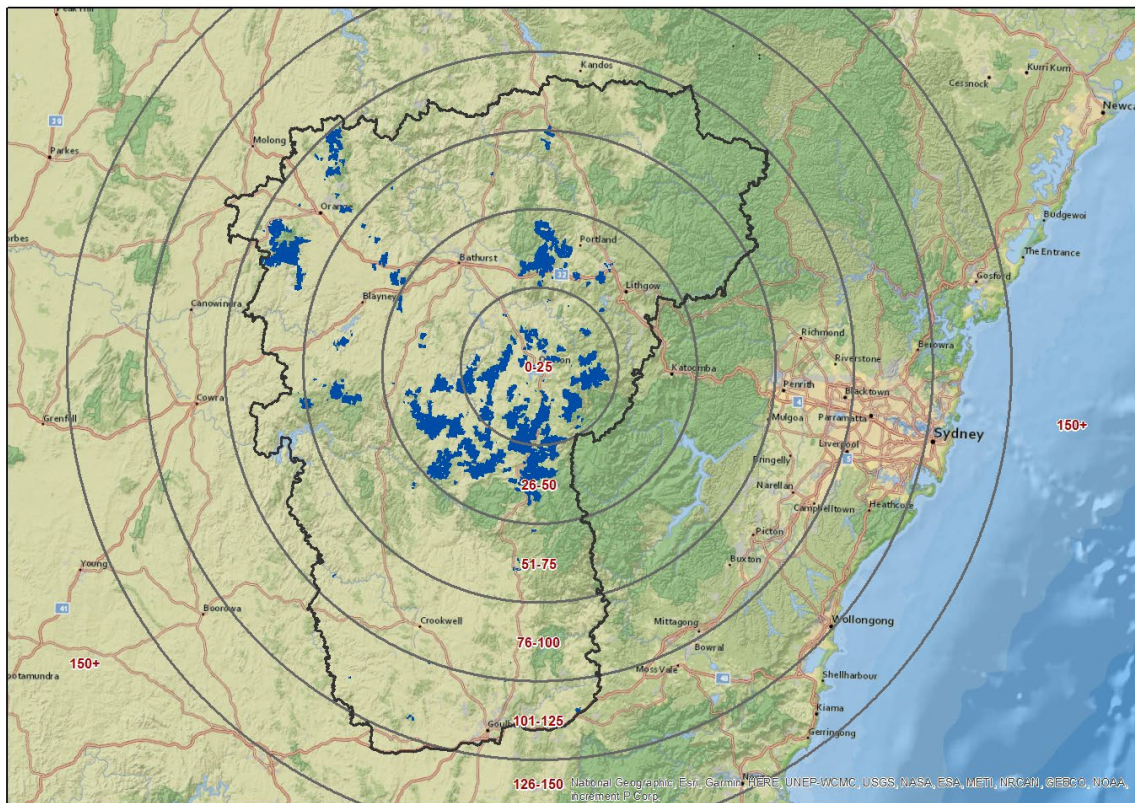


Figure 2: Haulage distance bands to Oberon

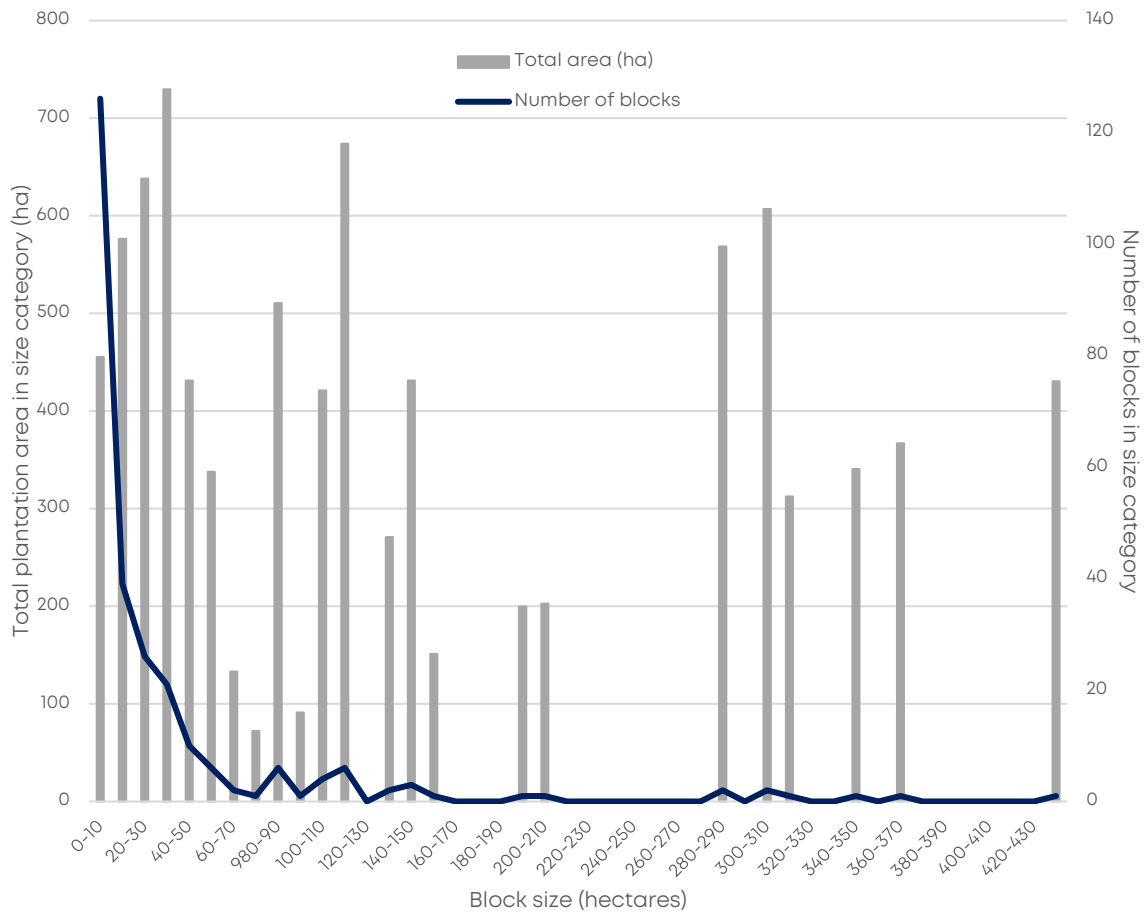
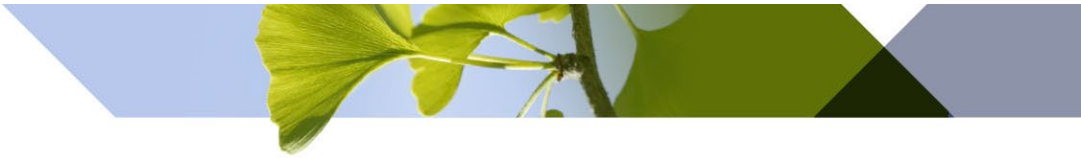


Figure 3: Private property block size and number of blocks by 10 hectare size category



PROJECT METHODOLOGY

Project scope

The project scope was developed by the Hub with the intent to develop a Hub-wide representation of current assets and future aggregate supply to the region’s processing facilities. This specifically excluded production of a dataset which could be used to calculate detailed wood flow from any individual forest grower.

Spatial database requirements were specified by the Hub as:

1. All forestry plantation areas equal to or greater than five (5) hectares within the Hub boundary including cutover or burnt and not yet replanted areas
2. Planted area (hectares)⁴
3. Land tenure
4. Species
5. Rotation (first or subsequent)
6. Silvicultural condition (e.g. un-thinned, first thinned - T1, multi-thinned, pruned)
7. Road transport route to processors (Raglan, Oberon and Burruga)
8. Year of planting (if not specific, an estimation)
9. To the extent that this information can be obtained, the database was to include:
 - a. Owner
 - b. Manager
 - c. Qualitative information on:
 - i. Management history
 - ii. Silviculture
 - iii. Overall plantation quality
 - iv. Access

Development approach

The development logic for the spatial database is presented in Figure 4. This process has been applied to create the two key spatial layers which form the strategic data at the core of the Hub’s spatial database:

1. Resource (area) layer
2. Haulage network (line) layer

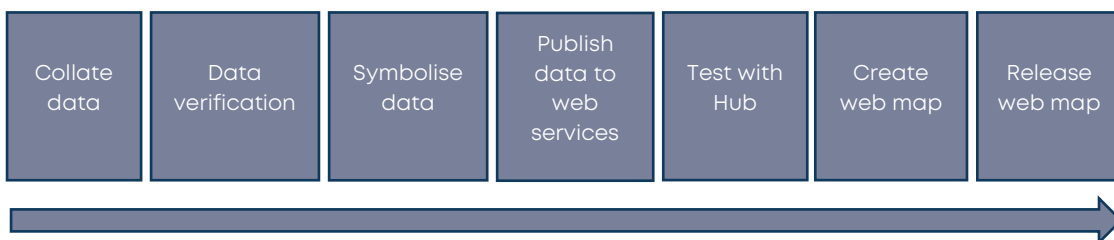
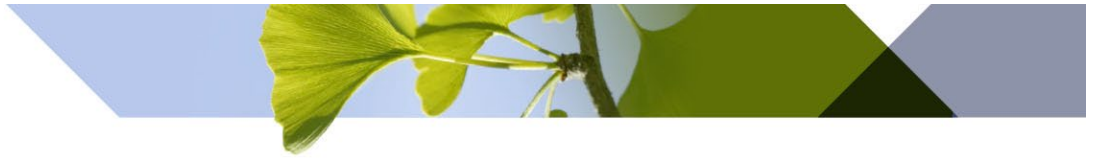


Figure 4: Development logic for the Hub spatial database

⁴ As noted earlier in this report, mapped area was utilised in order to address the varying level of detail available from different data sources.



The spatial resource schema were created to account for attribution as specified in the project scope.

Potential initial data sources were identified, including:

- Forest growers (FCNSW, Hume, PPP)
- Australian Bureau of Agricultural and Resource Economics Sciences (ABARES).
- Remote sensing imagery and data.
- Consultation with local service providers.
- Consultation with log processors and purchasers.
- Consultation with owners and/or managers.
- Consultation with the Central West NSW Forestry Hub (CWFH).
- State/Federal government base data - roads, contours, hydrology, local government boundaries and crown land, for example.



PROJECT DEVELOPMENT

Plantation Data

Step 1: Data collation

Data provided

Plantation data was provided in shapefile format by FCNSW, Hume and PPP. Data from FCNSW were mapped to compartment boundaries. Data provided by Hume and PPP were mapped to property extent, with no internal boundaries. FCNSW provided data with 10 year grouped aged classes and rotation. Hume and PPP did not provide this information.

Field Discovery

After fieldwork and consultation in the region, Google Earth® pin locations were used to locate private plantations. Using a variety of available imagery services (Google Earth®, ESRI base maps®, Bing maps®, Landviewer®) and plantation areas equal to or greater than 5 hectares were mapped.

Desktop Discovery

Using a variety of imagery services (Google Earth®, ESRI® base maps, Bing maps®, Landviewer®) and an ABARES plantation dataset from 2016, plantation areas equal to or greater than 5 hectares were mapped. In addition, a private property hard copy report (Rose, 1999) was utilised to provide historical context for the private plantation estate.

Collation

The data was then collated and consolidated into a file geodatabase and the following fields assigned;

- Species (assumed that plantations were *P. radiata*; FCNSW have other softwood species trials which were identified).
- Rotation.
- Age group (10 year age class).
- Mapped area (hectares).
- Source (how the data was obtained).
- Plantation name (supplied).
- Owner/Manager/Primary contact.

Step 2: Data verification

Once the data was consolidated, it was verified using online imagery services to confirm that plantation existed and that there was no duplicate data. For Hume plantation areas, non-plantation areas were removed from the data to better estimate net rather than gross planted area (for example native forests, dams, agricultural areas were excluded) – see Figure 5. A check was also made of FCNSW and PPP data.

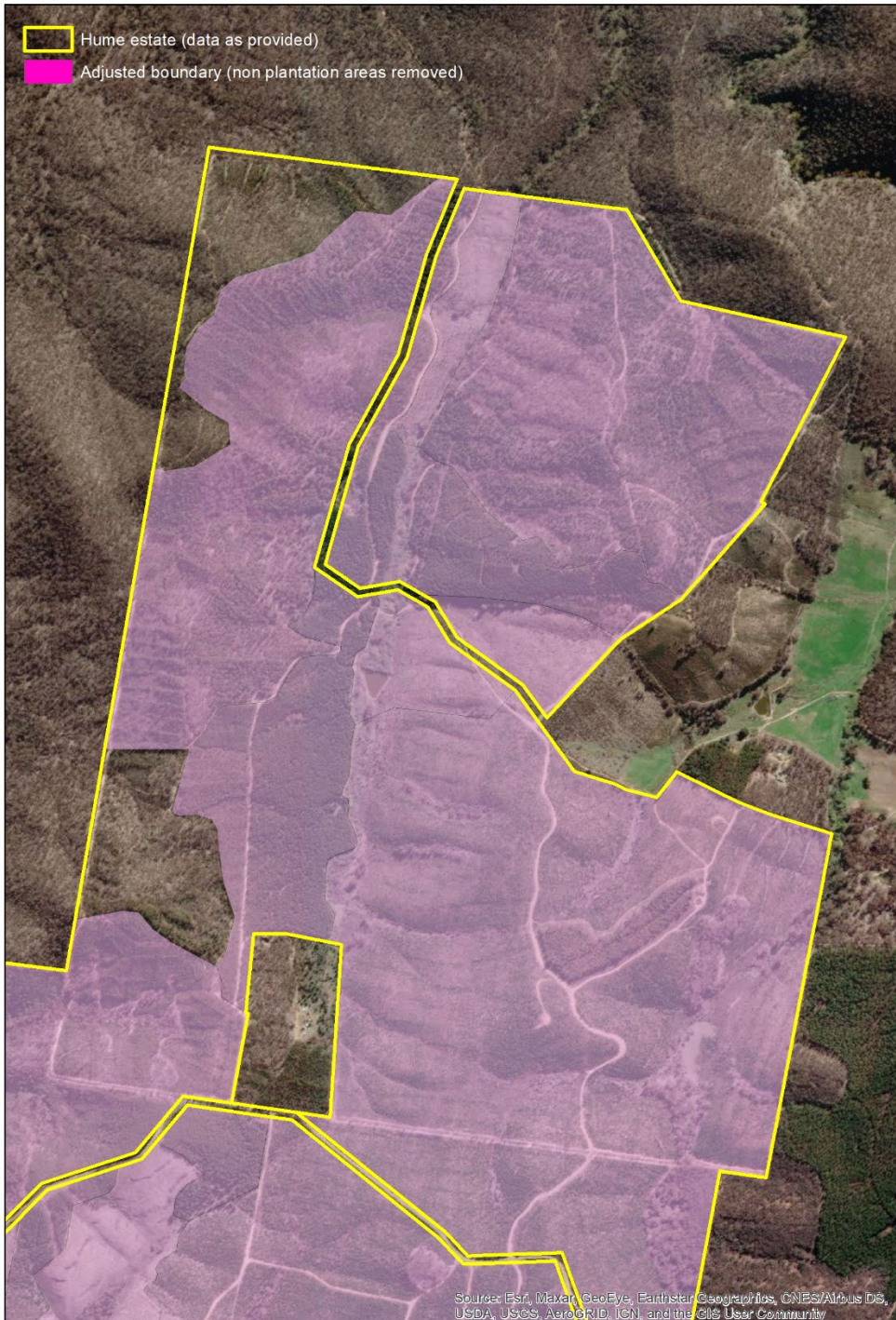


Figure 5: Example of Hume estate area with non-plantation areas removed

Step 3: Assigning age class and rotation

Using historical imagery available through Google Earth®, age classes and rotation were assigned to plantation areas that did not have age classes provided (remote



sensing identified, Hume and PPP). Once assigned, these areas were delineated by age class, not compartment boundary.

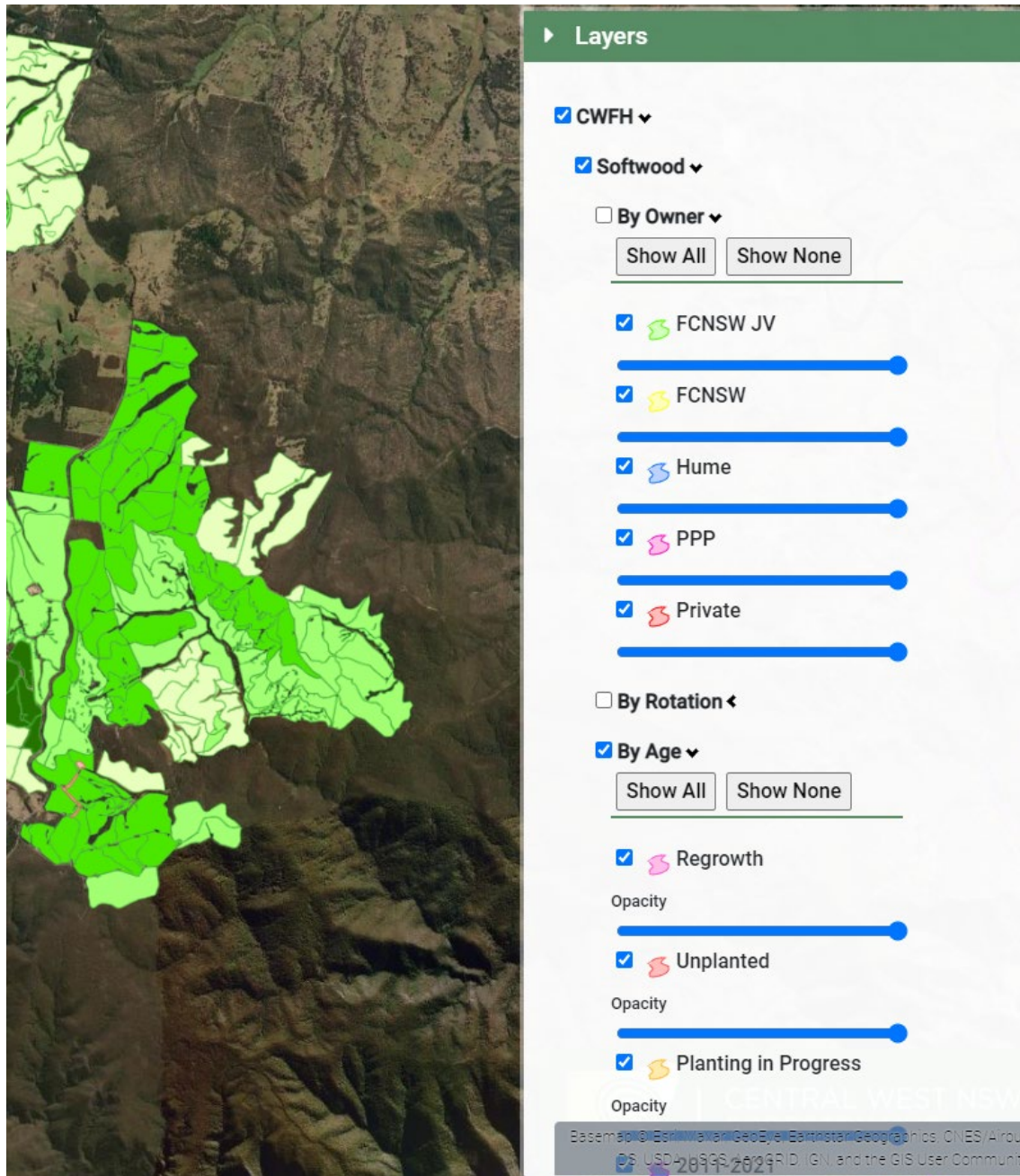


Figure 6: Example of age class mapping

Haulage Analysis

The harvest production and haulage modelling undertaken for the Hub was at a very high level.

As presented in Table 5, harvesting regimes for the haulage analysis were derived from generic yield tables for the Central Tablelands, published by ABARES (2016). Yield tables for either unthinned stands or stands subject to one thinning (first thinning –



T1) event were applied to the entire softwood estate in the Hub area. The model applied 10-year age classes, and assumed that all plantations within the 10-20 year age class could receive the thinning event nominated at 18 years. Final clearfall (CF) harvest was assumed at age 30 years. Yield is estimated in cubic metres.

Table 5: *P. radiata* generic yield tables for the Central Tablelands of NSW⁵

Silviculture regime	Thinning age (y)	T1 pulp volume (m ³ /ha)	T1 sawlog volume (m ³ /ha)	CF age (y)	CF pulp volume (m ³ /ha)	CF sawlog volume (m ³ /ha)	Total yield (m ³ /ha)	Mean annual increment (m ³ /ha/y)
Thinned	18	70	40	30	70	300	480	16.0
Unthinned				30	168	137	305	10.2

Haulage was modelled to Highland Pine Products (HPP) and Borg at Oberon, AAM Investment Group (AAM) at Raglan and AUT at Burruga (refer to Table 6). For the purposes of the analysis, a 1:1 relationship between tonnes and cubic metres was assumed.

Table 6: Destination and product for haulage analysis

Customer	Location	Product	Capacity (t/annum)
HPP	Oberon	Sawlog	Unlimited
AAM	Raglan	Sawlog	95,000
Borg	Oberon	Pulp log	Unlimited
AUT	Burruga	Sawlog and preservation	35,000

Mill production limits were considered before running the network analysis model to build the cartage distance GIS layer. To model the 95,000t/y capacity of the AAM facility at Raglan, a random selection of source plantations in each 10-year supply period was repeatedly chosen to supply the mill until the total sum of harvested sawlog volume achieved 950,000t for the full 10 years. The same approach was applied for AUT at Burruga for 35,000t/y.

All sawlog volume for all other plantations in the respective 10-year supply period was allocated to HPP. Highland Pine Products and Borg were assumed to have unlimited capacity for the purposes of this analysis.

Using the SIX Maps Roads layers⁶, a network model was built for the region’s wood supply catchment. Based on advice from FCNSW, barrier points were incorporated into the model to ensure that the volume carted from plantations in the north-east of the region to Oberon were all transported through Bathurst along the Great

⁵ ABARES (2016)

⁶ Spatial Information Exchange – NSW Government



Western Highway, before diverting south. Further localised adjustments were made in consultation with the Hub.

Each plantation was assigned a thinning or CF yield as relevant for each 10-year period and a single processing destination was assigned for each relevant product generated in that period. The centre point of each plantation was then imported into the network model and network analysis was run for each destination for each period using the ESRI® *Closest Facility* functionality. The resulting yields and haulage routes for each plantation/processing facility combination for each 10-year period were then aggregated and the sum of volume traversing each road segment was assigned to a final roads layer for display in the web-based spatial database.

It is important to note that because of the strategic nature of the road haulage analysis, there are likely to be inconsistencies at more local resolution, particularly for smaller blocks. It is envisaged that as these inconsistencies are identified, the model can be updated to reflect locally important route selection considerations.

Web-based spatial database

Once the plantation and haulage data and analysis were finalised, the database was set up as an ESRI project and symbolised. The plantation data was symbolised in different ways:

- By ownership category.
- By rotation.
- By age class.
- By age and rotation.

Other external data comprising NSW government administrative boundaries, cadastre, topography and imagery were added as WMS (web map services).

The web map was created by converting the data files into geojson files, consuming the WMS and using a combination of OpenLayers®, HTML®, javascript® and CSS®.

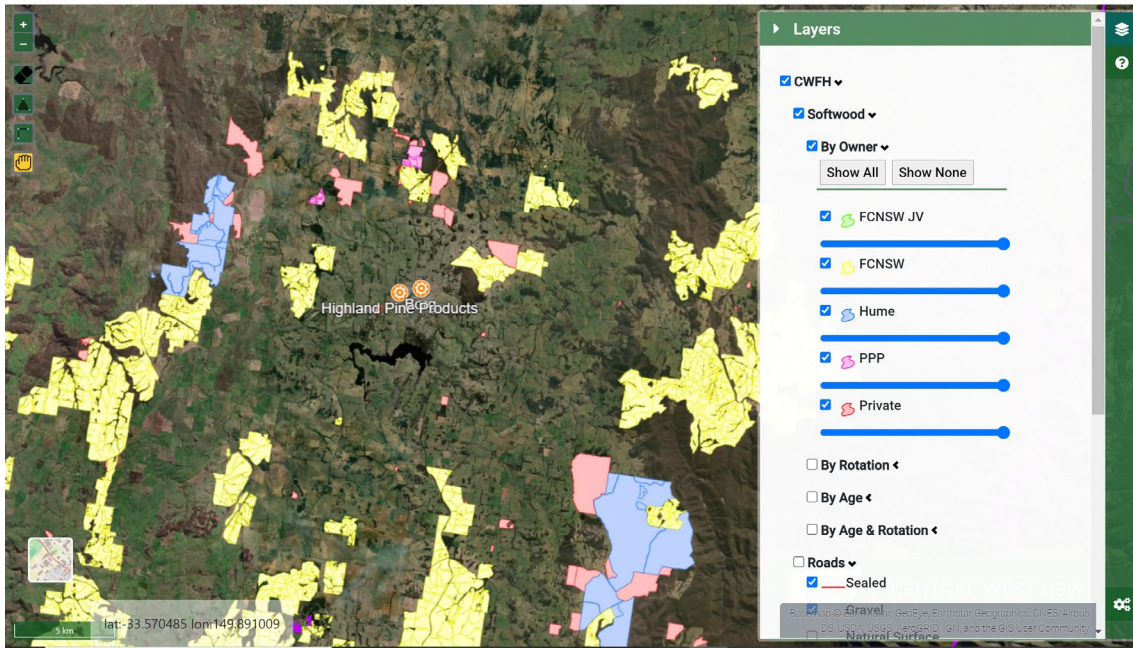


Figure 7: Screenshot of the web-map produced for the Hub

Utility and user interface

The web-based spatial database for the Hub is designed to perform intuitively and is intended to be an easy-to-use tool which is widely available to the industry and the general public. Nevertheless, it is important that users have available resources which support learning how to use the full functionality of the product.

With this in mind, the spatial database incorporates learning tools which are embedded in the product and which users can turn on or off depending on their need.



USE AND APPLICATION OF THE DATABASE

Intended use

The specific intent of the spatial database is to provide information to aid in better understanding the current plantation area, location, characteristics and wood fibre resources within the Hub boundary.

This includes providing high-level information to the Hub's forest and wood products sectors about the quantity of wood available, particularly from smaller private forest growers and to improve an understanding about that resource.

There are commercial sensitivities, particularly among the Hub's forest growers, which mean that the resolution of the data and analysis is necessarily coarse and strategic.

It is intended that the database is available to the region's forest and wood products industry, as well as other stakeholders and the general public, as a free to access, easy to use web platform hosted on the Hub's website.

Limitations

Bearing in mind the project intent and sensitivities around data detail, there are limitations. In particular, it is important that users are aware of the following:

- Spatial data regarding plantation location and areas is limited by what has been provided by plantation owners. This varies from detailed net area and compartment level information, through to simple extent of estate boundaries. The project therefore refers to mapped area.
- Information collected regarding the smaller privately owned plantations is generally qualitative and inconsistent. However, information has been gathered for 194 (70 per cent) of 277 discrete plantation blocks which represent 8,788 hectares, or about 95 per cent of the area of small private forest holdings.
- Information regarding age class, rotation, silvicultural status and other plantation characteristics is limited by what has been provided by plantation owners, augmented where possible by remote sensing interpretation. That means that age class is presented in 10 year bands. It also means that where age class and rotation have been interpreted from available imagery, the accuracy of the information will be limited but still sufficient for the intended uses of the data.
- Where growth rates have been used in the analysis (for example, haulage analysis) they have been based on generic regional yield tables available from the Australian Bureau of Agricultural Resources and Statistics (ABARES). Again, this provides strategic rather than operational level information.
- Haulage routes to processing facilities are nominal based on information provided and may not necessarily be the actual route selected at the time of harvest.



Dynamic product

The database is designed to perform as a dynamic information source, which can be readily updated with new and improved data and information so that it continues to provide a contemporary snapshot of the Hub's plantation forests and fibre supply.

While recognising the commercial sensitivities referenced earlier, it may also be the case that growers and processors in the region become more comfortable incorporating a greater level of detail about the Hub's plantation estate in the future. This may serve to reduce or remove some of the limitations identified above.

Maintenance and updates

In recognising the dynamic nature of the platform, it is anticipated that once it is publicly available and being used more broadly, improved information will become available which will allow the database to be refined. In addition, as plantation operations progress, there will be changes and updates required to ensure that the data is up to date and reflects the current state of the regional plantations. Finally, if the Hub identifies and wishes to progress development of additional applications for the database, these will need to be scoped and planned.

Maintenance and updating of the platform is best delivered in a structured and planned approach. A maintenance and management policy is recommended to define periodic update timing. In practical terms, this would entail the Hub identifying and documenting required changes on an annual basis, or as required and scoped for development of new applications.

Potential future applications

There are a number of potential applications of the spatial database which the Hub and broader industry may be willing to consider for development.

Additional private property detail

The development of the spatial database has resulted in a considerable improvement in the knowledge base regarding the smaller private plantation estate in the region. The spatial database is the most extensive small private grower resource database that has been developed for the region. There is further opportunity to refine the mapping for this ownership category through a stand-alone project which would combine more intensive remote sensing with field investigations to provide greater detail about net planted area, internal boundaries, plantation age and condition and plantation infrastructure. This information is likely to have broader application as well. This proposed project has been further specified as a recommendation for CWF002.

Fire management

There is considerable scope to develop the database to support regional plantation forest fire management. The plantation sector in the Green Triangle and south-west Western Australia have in place similar applications to support plantation fire



management requirements and interface with other firefighting authorities in those regions.

The Hub is currently undertaking a fire related project which is expected to produce outputs which will assist in developing a scope for this potential application.

Pest and disease management

The database has potential application in landscape scale management of pests and diseases, including collaborative monitoring and reporting.

Infrastructure management

The application currently incorporates infrastructure information at a strategic level. There is considerable potential to refine the level of detail and application of the database to supporting regional infrastructure management and decision-making. This could provide a useful and practical interface with which the forest and wood products sectors can work with local, regional and state authorities responsible for infrastructure.

Strategic resource development

The platform has potential application, particularly when considered and integrated with the outputs from Project CWFH003, to support strategic development of the region's plantation resource. This could include:

- Identification of gaps and improvements for short, medium and long term estate development.
- Identification of areas and locations for focus of effort on plantation estate development.
- Identification and analysis of infrastructure implications and requirements related to future development of the estate.
- A practical and accessible interface for engaging with potential green field plantation developers, including in relation to agroforestry and supporting future extension services.

Stakeholder engagement and collaboration support

As a publicly accessible tool which can be applied to a range of uses, the database has the potential to underpin the forest and wood products sector's stakeholder engagement and collaboration efforts at every level within the Hub region. This includes working with individual neighbours, other sectors, natural resources agencies, local government and state government agencies, particularly in relation to collaborative land management issues. Development and maintenance of the tool should link with and create a mutually beneficial exchange with ABARES' National Plantation Inventory reporting.



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- ABARES (2016) *Australia's plantation log supply 2015–2059*, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra
- Commonwealth of Australia (2018) *National Forest Industries Plan: Growing a Better Australia – A Billion Trees for Jobs and Growth*.
- Rose, D. (1999) *Private Pine Plantations in the Central Tablelands of NSW*, Report prepared by Rose Forestry Consultants Pty Ltd for the Central Tablelands Farm Forestry Project



APPENDICES



Appendix 1: Data sources

Plantation Resource

Forestry Corporation of NSW, Russell Riepsamen

Hume Forests Limited (Hume), Jake Lazarus

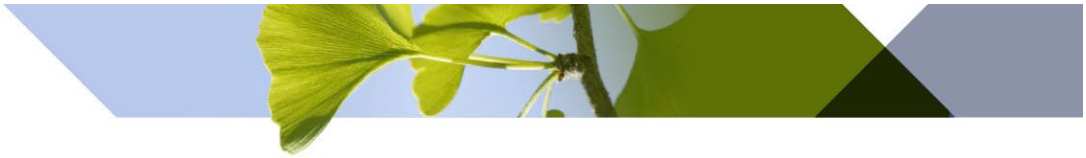
Plantation Pine Products Australia Pty Ltd (PPP), Chris Berry

Base Data & Administrative boundaries

Forestry Corporation of NSW, Russell Riepsamen

NSW Government <https://six.nsw.gov.au/>

ESRI base maps <https://www.esri.com>



Appendix 2: Stakeholders consulted

Organisation	Representative	Position
Forestry Corporation of NSW	Jason Molkenntin	Regional Manager
	Russell Riepsamen	Planning Manager
	Euan Scott	Harvesting Forester
Australian United Timbers	Phil Burke	Owner
Hume Forests	Jake Lazarus	General Manager
Highland Pine Products	Mike Bitzer	General Manager
	Peter Seve	Commercial Manager
Plantation Pine Products/Borg	Chris Berry	Wood Resources Manager
AAM	Craig Neale	Operations Manager
Oberon Shire Council	Kathy Sajowitz	Mayor
	Gary Wallace	General Manager
Mangan Logging	Chris Mangan	Director
	Michelle Mangan	Director
Pine Harvesters	Grant Phillips	Owner
	Harrison Phillips	Director
Rosin Forestry	Peter Rosin	Owner
Byrne Rural Contracting	John Byrne	Advisor
Consultant	Frank Hanrahan	Advisor
Rose Forestry	David Rose	Advisor
Penrose Pine Products	Peter Cush	Owner
PF Olsen Australia	Ray Krippner	Senior Forester
AgriWealth	Hugh Dunchue	Head Forester
Visy	Kenneth Epp	Principal Advisor - Forestry
	Dean Hawkins	General Manager – Fibre Resources
Blayney Shire Council	Rebecca Ryan	General Manager
Central West NSW Forestry Hub	Craig Taylor	Hub Manager
	Heath Molden	