NATIONAL INSTITUTE FOR
FOREST PRODUCTS INNOVATION

NIFPI Launceston Centre Project Progress Summary Reports - Summary reports as of 10 June 2020

NT001 / NS020 Solutions for the optimal use of dense, remotely acquired data by forest growers

Lead organisation
NSW DPI Forestry/ University of South Australia

Principal researcher
Dr Christine Stone, NSW DPI Forestry / Dr Jim O'Hehir, UNISA

Start date 1/11/2018
Completion date 15/6/2020

Project description
Rapidly advancing remote sensors on UAV, airborne and satellite platforms are providing high fidelity data in terms of spatial, spectral and temporal resolution. A trans-Tasman team of remote sensing specialists, data scientists and forest industry service providers will ensure the delivery of multiple task specifications and procedures for the operational implementation of these technologies by the forestry sector.

Summary of progress
Plantation resource managers are increasingly attracted to the use of remote sensing systems for obtaining tree measurements and assessments due to increasing sensor and platform capability and availability, reducing deployment costs and increasing costs and risks associated with the current manual systems. This project is developing and adapting new cutting-edge sensor and platform technology for use in forestry applications. The project is comprised of several sub-projects which are actively involved in developing solutions for applications using a range or sensors and platforms in different situations across Australia. The project is benefitting from a high level of collaboration between industry and researchers to make multiple data sets available with knowledge sharing on solutions.

Ultra high-resolution imaging from Unmanned Aerial Systems (UAS) for detection of weeds and tree health assessment represents the sub project being undertaken by the University of Tasmania. Data has been collected at three pine plantation sites in Northern Tasmania using a range of sensors: hyperspectral; multispectral, visible and thermal, with the aim of testing which sensors are best at detecting weeds. Data processing is now complete, and the results are being summarised.

A second sub project; hyperspectral detection of nutrient deficiencies in radiata pine undertaken by Scion (New Zealand) has demonstrated that generalised field predictions of photosynthetic capacity can be made using only remote sensed reflectance data. This will benefit the industry by improving the assessment of plantation nutrient status at a fraction of the cost and complexity of manually collected and analysed methods.

The University of South Australia (UniSA) is undertaking a sub project: monitoring Forest Properties at the Individual Tree Level using UAV-borne Sensors. Two approaches have been developed to undertake survival counts of young radiata pine plantations from pre-processed Hyperspectral and Phantom UAV images. Both methods work but the second approach has been found to be more accurate and cost-effective in terms of estimating tree survival counts. Most plantation companies already have the equipment to capture the necessary data and allow the companies to estimate replanting costs to make more informed decisions.

The automation of forest inventory sub-project undertaken by the University of Sydney, has progressed development of workflows and algorithms for tree-level census using point clouds, deep learning and human-machine interaction. Recent research indicates tree detection methods developed for high resolution Airborne Laser Scanning (ALS) data based on deep learning object detection could also be applied effectively to low resolution ALS data. The implication for forest companies is that using this method, cheaper data can be used to obtain more tree attribute information.

UniSA are undertaking a sub project: Growth and Yield Modelling for the Future. The sub project has incorporated ground truth data into plot imputation models and shown that potential to increase the efficiency, and lower the costs, of ALS surveys by reusing calibration plot data both spatially and temporally. The UniSA sub project: Investigation of data management and processing options for forest industry has resulted in the development of a report which draws on the literature to compare options for forestry data management with an emphasis on large data sets.

Interpine have continued working on Ultra-Dense Point Clouds for Inventory implementing forest inventory using a backpack LiDAR scanner. The resulting scans are being incorporated in a virtual reality application (VRForest) and these results are then available for use in forest resource planning software.

NT004 Optimising machinery configurations for profitable harvesting operations of small-scale plantations

Lead organisation
University of the Sunshine Coast

Principal researchers
Dr Mauricio Acuna, USC

Other participants
Private Forest Tasmania

Start date 1/11/2018
Completion date 31/12/19

Project description
This project will provide guidelines and a web-based decision support tool (DSS) to effectively select harvesting equipment configurations for smaller, more dispersed woodlots. This may improve profitability for landowners, contractors, consultants, forest companies and potential machinery co-operatives.

Background

The main goal of this project is to identify optimal machinery configurations available for efficient and profitable harvesting of small-scale plantations. Major industry partners of this project are Private Forest Tasmania (PFT) and the Australian Forest Growers Association (AFG).

Summary of progress
To date, the project has produced two significant deliveries:

1. An exhaustive review of the small-scale forest harvesting equipment available worldwide, grouped by activity (felling and processing, extraction). The review provided valuable information so that small and medium forest owners and farmers get a better understanding of the currently available small-scale harvesting technologies, including limitations, cost, and operational requirements.

2. An interactive, Excel-based Decision Support Tool (DSS) called WATAS, which has been developed to assist woodlot owners in making better decisions regarding the most cos-effective harvesting equipment that best suits their woodlot conditions. The tool allows the comparison of different combinations of equipment and determines the ones that maximise the net returns for woodlot owners. As inputs, WATAS uses the woodlot area, terrain mix (% of slope), equipment size class (small, medium, large), log process by grade, merchantable volume and grade %, harvesting costs, cartage costs, and distances to customers, among others.

Potential savings of at least $10M are expected if landowners in Tasmania adopt and implement optimised machine configurations more suited to the harvest of small-scale plantations. This, assuming that at least 800 landowners owning on average, 10 ha of forest (yield = 250 m^3/ha) save $5 per m^3 by replacing conventional harvesting equipment (large size machinery) by machinery that is more cost-effective for small woodlots and agroforestry.

Also, the adoption and introduction of small-scale harvesting equipment in Tasmania have the potential to create new jobs and businesses (manufacturers, contractors, drivers, mechanics, etc.) around small-scale machinery and services, which will contribute to reinvigorating the economy of many rural communities.

NT010 Conceptualise and develop a functioning Model for Collaborative integrated Pest Management within the Tasmanian Forest Industry

Lead organisation
Technical Forest Services Pty Ltd

Principal researcher
Justin Bailey, TFS

Start date 1/11/2018
Completion date 13/3/2020 – Project completed
– Final report will be publically available soon

Project description
The project will develop an innovative integrate pest management model to provide prompt information to stakeholders on pest and disease status across all land tenure. Enabling timely and co-operative management activities

Background
The forest management sector in Tasmania has implemented forest health surveillance processes as a management tool for decades. These monitoring and reporting processes are almost exclusively undertaken at an operational level and the details not usually shared outside of an organisation. Any inter-agency pest management strategies have largely been informal and information spread heavily reliant on established personal relationships. The traditional limitations to spread of pest monitoring and management communication has meant that a high proportion of ongoing management activities by organisations have been reactive in nature.

Summary of progress
In late 2018 members within Tasmania's forest growing sector sought the establishment of an integrated pest management project. A new collaborative concept for the forest industry within Tasmania. Its establishment was viewed as a means to build upon meetings held some years prior centred around the value an integrated pest management concept could provide.

The main project outcome to develop an innovative model which would provide prompt information to stakeholders on pest and disease status enabling timely and effective management activities.

To galvanise relationships within all levels of the Tasmanian Forest Industry.

- Provide a structured process means for communication amongst all interested stakeholders.
- Develop a process to document and share reportable evidence of pest management activities.
- Drive an increase in industry directed research initiatives and provide a format to both fund and advocate such initiatives.

This project set-out to establish an understanding of forest industries needs in terms of pest monitoring and management at a strategic level. Firstly, to establish a steering committee of interested stakeholders to provide a forum for pest management developments and issues. Culminating in the development of an IPMG guiding policy for the Tasmanian forest growing sector.

NT011 Unlocking financial innovation in forest products with natural capital

Lead organisation
CSIRO

Principal researcher
Dr Libby Pinkard, CSIRO

Start date 1/11/2018
Completion date 30/9/2021

Project description
The objective of the project is to unlock investment in the non-timber natural capital value of Australian forest resources, by developing methods and tools for forest owners and investors to cost-effectively assess, monitor and manage natural capital risks and opportunities.

Summary of progress
In its first 12 months, the project delivered two reports:

1. Opportunities for natural capital financing in the forestry sector. This report assesses opportunities for natural capital financing as a source of funding for managing non-timber natural capital and the goods and services that flow from forests to the economy and society. It describes the options for natural capital to influence balance sheets, cash flows or risk management through different financial mechanisms: equity, bonds, loans public sector finance, philanthropy, environmental markets and insurance. The report formed the basis of a workshop on natural capital financing opportunities that brought together members of the forest industry, government, environmental NGOs, environmental markets and universities, to start the process of identifying specific opportunities for financing the non-timber ecosystem goods and services that the forest industry currently delivers.

2. Forest natural capital risk assessment, that provides the first materiality assessment for forestry-based natural capital risks. Twenty key natural capital risk areas were identified. The materiality of these risks varied with sub-sector (softwood plantation, hardwood plantation and native forest). Indicators are now being identified to enable reporting against these risks and tracking of change in risk over time.

The report is being used to develop approaches for enterprise-specific natural capital risk assessment that will facilitate engagement with investors, shareholders, government and the community.

NT013 Sensing technology and digital tools to support decision-making in hardwood timber drying

Lead organisation
Sustainable Timber Tasmania

Principal researcher
Professor Gregory Nolan, University of Tasmania

Other participants
Britton Timbers; McKay Investments Pty Ltd; Neville Smith Forest Products (NSFP); Porta Timber, Tasmanian Timber Promotion Board.

Start date 1/11/2018
Completion date 15/6/2020

Project description
A Tasmanian based project aiming to develop and validate a timber drying technology suite with an accompanying decision support tool ‘app’, for higher value product recovery across the wider timber industry in Australia and overseas.

Background
Air drying is a common and low-energy method used in the initial stages of drying high-quality sawn hardwood in Australia and internationally. However, in addition to factors that can be controlled, the efficiency of air drying depends on prevailing weather conditions. This complicates process management. Producers can only broadly estimate optimal drying conditions and the timber’s likely moisture content at any given time. This project aims to refine and test an integrated suite of onsite sensors and accompanying data assessment and decision-making support tools or

'apps' that can resolve much of this uncertainty, and improve the connection between hardwood air drying and product value recovery from processed logs.

Summary of progress
The project has found that an affordable suite of sensors can be deployed that reliably collect data about the key climatic factors that influence air-drying on industry sites, and that this information can be incorporated into workable statistical models that closely predict board drying down to individual rack level. The type, number and spread of sensors required on sites with different climatic and physical conditions are now being confirmed.

Resolving management uncertainty about the timber's condition during air drying allows timber producers to exercise much more effective process control during this important stage of production. With this control, they can: reduce product and quality loss through drying degrade; increase recovery through adopting less conservative milling tolerances; and improve scheduling. Taken together, these steps can increase overall product value significantly. Preliminary findings in this research have already changed industry practice and increased its investment in improved drying equipment and infrastructure.

NT014 Increasing the durability, and other material characteristics of Tasmanian hardwoods

Lead organisation
Britton Timbers

Principal researcher
Professor Gregory Nolan, University of Tasmania

Other participants
Koppers; Neville Smith Forest Products; Sustainable Timber Tasmania; Ta Ann Tasmania; Tasmanian Timber Promotion Board; University of Melbourne; with Queensland Department of Agriculture and Fisheries.

Start date 1/11/2018
Completion date 15/6/2020

Project description
This project focuses on increasing the desirable material characteristics of Tasmanian hardwood species: Tasmanian oak and plantation hardwoods, for use in several product groups: sawn appearance board, cladding, veneer-based products and glue assembled products: glulam and cross laminated timber (CLT).

Background
Tasmania's native and plantation hardwoods generally have low natural durability, low (but useful) resistance to bushfire attack, and moderate hardness. These characteristics limit the material's use in key interior and exterior appearance-grade markets. This project focuses on increasing the desirable material characteristics of Tasmanian hardwood species: Tasmanian Oak and plantation hardwoods, for use in several product groups: sawn appearance board, cladding, veneer-based products, and glue assembled products such as glulam.

Summary of progress
Project activity has shown that key constraints to successfully treating the material persist while indicating that other modification processes may be successfully

pursued. Unlike pine and other softwoods, initial results show that densification of Tasmanian native forest and plantation hardwoods can occur without unacceptable spring back in the material.

Successful modification of Tasmanian native and plantation hardwoods can open significant markets for producers in external and more demanding internal building application, including cladding in bushfire prone areas and flooring in high-traffic commercial premises. These increased market options improve producers' product opportunities and can allow them to optimise returns from the existing log supply and support milling of lower grade eucalyptus logs from either the native forest or plantation estates. This can produce flow-on effects for both millers and forest growers.

NT015 Developing a New Generation of Tasmanian Appearance Hardwood Products for In-State Design and Manufacturing

Lead organisation
Neville Smith Forest Products

Principal researcher
Dr Louise Wallis and Dr Mark Sawyer, University of Tasmania

Other participants
Britton Timbers; Forico; McKay Investments; Porta Timber; SFM Environmental Solutions; Sustainable Timber Tasmania; Ta Ann Tasmania; Tasmanian Timber Promotion Board; University of Melbourne

Start date 1/11/2018
Completion date 15/6/2020

Project description
This project will develop a new generation of hardwood appearance products for manufacture in-state using current and new technologies from the available native, reclaimed, and plantation resources.

Background
Most high value applications for Australian hardwoods are for appearance products. This project's objective is to develop a new generation of hardwood appearance products that can be economically manufactured in-state and that can extend existing and emerging timber resources into high-value architectural applications. This involves exploring and developing these products, determining product feasibility and innovation adoption by industry, and identifying in-state product development opportunities that can be achieved through industry collaboration.

Summary of progress
Stage 1 of this project generated an opportunity analysis for new products based on four criteria— Disruption, Extension, Collaboration, and Investment. Along with an industry partner survey, this analysis identified target products areas for further investigation. In Stage 2, the project team is investigating these new product development opportunities through prototyping and proof of concept exercises. Subtractive machining is one of the target areas identified.

This project can generate new opportunities for industry to expand market and production horizons. The continuing reduction in high-quality native forest logs for

sawn board and veneer products presents numerous challenges to the future of Tasmanian hardwood processing. At the same time, the current and impending supply of sawlog and fibre-managed plantation hardwood resources will provide additional product possibilities. The potential to recover additional value from blended or complementary sawn and veneer appearance products from this plantation material is high. One outcome of this process has been a series of high-value acoustic panels, produced as a proof-of-concept demonstration product that indicates the potential of subtractive machining with current 'low-value' plantation resources.

NT016 Developing laminated structural elements from fibre-managed plantation hardwood

Lead organisation
CLTP Panel Products Pty Ltd

Principal researcher
Dr Hui Jiao, University of Tasmania

Other participants
Britton Timbers; Neville Smith Forest Products

Start date 1/11/2018
Completion date 15/6/2020

Project description
This project will develop the grading, jointing and gluing expertise and results necessary for the production of structurally reliable glue laminated elements from boards from a fibre-managed plantation hardwood resource.

Background
In recent years, manufacturing engineering wood product such as glulam, cross-laminated timber, and laminated veneer lumber from plantation hardwood has gained increasing attention. While glulam is an everyday product, manufacturing structurally reliable glulam economically from Tasmanian fibre- managed plantation hardwoods is novel. Effective grading processes for this material and the potential to configure laminates for structural efficiency are still being developed. This project focuses on predicting the strength and stiffness of the glulam element based on the individual lamination of plantation *E. nitens* together with the gluing practice in manufacturing necessary for the production of structurally reliable glue laminated elements.

Summary of progress
The result of initial visual characterisation reveals that visual stress grading plantation *E. nitens* boards recovered from fibre-managed logs to the Australian standard (AS2082) is not viable. The prevalence of features in most boards leads to them being marked as out-of-grade. A specific grading trial is in progress. Samples were cut into the desired size for the bending test to evaluate bending capacity, density and moisture content. The acoustic wave velocity across the *E. nitens* sample length is also being examined.

Tasmania currently produces and mainly exports approximately 3 million m3 of plantation hardwood, usually as chips. Simply milling a portion of this resource into scantling products is likely to be unprofitable due to competition with more economically efficient pine production. However, the resource's conversion into

larger structurally reliable glulam products offer the potential for economically viable manufacturing.

NT018 A forest resource characterisation of Tasmania – Stage 1 of 2. Feasibility

Lead organisation
Tasmanian Timber Promotion Board

Principal researcher
Associate Professor Julianne O'Reilly Wapstra, University of Tasmania

Other participants
Britton Timbers; Forico; Neville Smith Forest Products; Porta Timber; Private Forests Tasmania; Reliance Forest Fibre; SFM Environmental Solutions; Sustainable Timber Tasmania; Ta Ann Tasmania

Start date 1/11/2018
Completion date 15/6/2020

Project description
This project is Stage 1. Feasibility of a two part project on developing more accurate and reliable models that can provide estimates of hardwood log outputs alignment to primary product outcomes, from both private and publically owned native forest and plantation hardwood estates, by region and location. This stage shall collect, collate and compile available existing data and information on the Tasmanian estates.

Summary of progress
This project has assessed the feasibility of developing models to characterise the wood volume and wood quality of the Tasmanian hardwood estate. The ability to model the characteristics of the Tasmanian hardwood estate would provide valuable information to the forestry sector for forest growers, timber producers, and end users.

The project has reviewed the available data and methods used for collecting information on wood properties and volume and assessed the availability of information on key drivers of variation in wood characteristics. Key gaps in the capacity to create a complete forest characterisation of the Tasmanian hardwood estate and potential projects to address these gaps were determined. There is large body of evidence indicating the major environmental drivers of both wood properties and volume. The major gap in the capacity to characterise the Tasmanian hardwood estate is a lack of available data on variation in wood property information across the estate. The only current detailed information exists for plantation *E. nitens* across a specific and limited environmental range. However, there are numerous techniques and tools available for the assessment of wood properties and, therefore, there is capacity to increase data collection of wood property information across the estate.

A large sampling project is required. Variation in wood properties is highly dependent on silvicultural management, age and species and therefore, we recommend initial projects designed to model wood properties across the whole estate focus on a single silvicultural method (plantation or native) and a single species at a set age. Matched with this, there is a wide range of environmental and climatic data available that could be used to inform wood property models. While a Tasmanian estate wide model of wood volume is not currently available, the data and modelling available within forestry companies provides the information to produce volume characterisation models and predictions, although estate wide modelling would rely

on combining this data. With publicly available environmental and estate distribution maps, expanding models beyond individual companies is feasible. New remote sensing technologies may also provide techniques for estate level assessments of productivity, however, current limitations on the automation of collection and data processing means that this technology is not yet applicable over large forest areas.

NT042 Eagle Eye – Applying the Internet of Things to landscape scale Wedge-tailed eagle management

Lead organisation
Sustainable Timber Tasmania

Principal researcher
Dean Williams, Sustainable Timber Tasmania

Other participants
DPIPWE Tas; Forico; Forest Practices Authority; Indicium; Midway Tasmania; Newood; Norske; Private Forests Tasmania; TasNetwoks; Timberland pacific; Reliance Forest Fibre; Resource Management Service.

Start date 30/4/2019
Completion date 31/5/2021

Project description
Utilising wireless Industrial Internet of Things (IIoT) remote sensing technologies to improve Wedge-tailed eagle (WTE) management options for forestry and electricity network industries, by detecting and reporting WTE nesting activity.

Summary of progress
From the first season of work, the project has yielded some encouraging initial results, and also revealed challenges to the technology in the field deployment.

Within the first few weeks of deploying the first seven sensors, signals were relayed by the network to the live web browser-based data dashboard, that a nest has been visited by a pair of Wedge- tailed eagles. This activity was supported by video from the accompanying camera.

However, as time went by over the winter months, contact was lost with the sensors. Diagnostic tests in the lab revealed a weakness in the firmware of the sensors which made them permanently loose connection with the satellite gateways that relay their data to the internet. This weakness has been addressed and sensors have received the upgraded firmware for deployment in the 2020 season. We have now deployed 12 of the upgraded sensors, with the deployment of a further four planned in the next few weeks. We are also testing a second type of gateway using 3G wireless for its effectiveness in relaying sensor data to the internet.

We have developed an appreciation of how the landscape topography and vegetation can impact the transmission of signals from the sensors to the gateways, with ranges of transmission varying from a few Km to nearly 30 Km. This indicates that careful planning of sensor and gateway installation is critical to reliable operation of the network.

The COVID-19 pandemic has further highlighted the need for a technological solution to nest activity checks, a solution that replaces the reliance on people working in close proximity for extended periods onboard small aircraft.

NT043 Short Log Supply Chain Impacts in Hardwood Plantations

Lead organisation
University of the Sunshine Coast

Principal researchers
Dr Mauricio Acuna, USC and Dr Glen Murphy, USC

Other participants
Forico and Sustainable Timbers Tasmania

Start date 1/7/2019
Completion date 31/8/20

Project Description
Project will answer the question “will the additional value and volume recovery generated from an increased mix of short logs from hardwood plantation forests outweigh any additional supply chain costs?”

Background
The main goal of this project is to determine if adding short saw logs to the current basket of log grades would have a positive or negative impact on net revenues in hardwood plantations. Major industry partners of this project are Forico Pty Ltd and Sustainable Timber Tasmania (STT).

Summary of progress
To date, fieldwork for the first two unpruned sites has been completed in Tasmania, and a technical report presenting the main results of the study has been delivered to industry partners. This technical report is a major milestone to get a better understanding of the impact of short logs in the supply chain and represents a substantial progress against the objectives established in this project.

Based on the results from both the high quality and low-quality unpruned sites adding short saw logs to the current basket of logs would be expected to reduce net revenues by 5% to 12%. Adding short saw logs to the basket generally decreased productivity and increased costs for all activities – harvesting, forwarding, loading, and trucking – by 5 to 10%. The relative cost increases found for harvesting and transport were not dissimilar to those reported elsewhere in the literature. They are also similar to those found for mill yard (5 to 8%) and mill processing (6%) activities. There was little to no improvement obtained in gross revenue by adding short logs to the basket. This was largely due to there being only a 4% difference in assumed log prices for sawlogs compared with pulp logs.

It can be concluded that, in unpruned hardwood plantation stands, harvesting and transport cost increases would not be expected to be covered by the additional revenue obtained from adding short saw logs to the current mix, particularly if there is little difference between short saw logs and pulp logs in log prices.

NT044 Assessing the economic impact of damage to *Eucalyptus nitens* logs during mechanised harvesting operations

Lead organisation
University of the Sunshine Coast

Principal researcher
Dr Mauricio Acuna, USC

Other participants
Sustainable Timber Tasmania

Start date 1/5/2019
Completion date 31/3/21

Project Description
The project will deliver improvements to practices and equipment to reduce log damage to *Eucalyptus nitens* logs during mechanised harvesting, improving profitability for landowners, forest growers, contractors and machine manufacturers.

Background
The main goal of this project is to report and guide to effectively select equipment and work methods for reduced log damage in Eucalyptus nitens harvesting operations. Major industry partners of this project are Sustainable Timber Tasmania (STT), Forico Pty Ltd, and several machine manufacturers and processors.

Summary of progress
To date, two rounds of trials (one in Spring 2019 and one in Autumn 2020) have been conducted in Tasmania, including the log damage assessment of about 500 stems, and four harvesting machines, including harvesters and feller bunchers. Data from these trials are being processed and analysed at the moment, and the first technical report will be published by the end of June.

Also, a literature review has been conducted as part of this project. The review provided valuable information regarding log value losses and the major types of log damage that can occur during harvesting, processing, and handling, including tree breakage, end splits, fractures, slabbing, and surface damage. The document also provided a summary of the main approaches that can be employed to reduce the incidence and severity of log damage arising from felling, cross-cutting, and handling logs.

It can be concluded that log value loss can occur at any point along the supply chain, however, the greatest potential for value loss occurs during felling, cross-cutting, and, to a lesser extent, handling. It is believed that the effective selection of harvesting equipment and work methods to reduce log damage to *Eucalyptus nitens* logs during mechanised harvesting operations will increase revenue by up to 10-20% (up to $5-10 per m3 on average) for forest growers who specify such technology and best practices.

Some approaches to reduce log damage during harvesting operations include among others:

1. Adjustment of harvester feed roller and delimbing knife pressures to minimise log damage while maintaining harvester productivity,
2. Use of experienced operators and/or specific operator training in how to reduce log damage,
3. Use of directional felling machines to reduce falling speed and avoid obstacles.

NT045 Managing timber's moisture content in the supply chain, construction and in service

Lead organisation
SFM Environmental Solutions

Principal researcher
Professor Gregory Nolan, University of Tasmania

Other participants
Britton Timbers; McKay Investments; Neville Smith Forest Products; Porta Timber; Sustainable Timber Tasmania; University of Queensland; Weathertex; Wesbeam;

Start date 1/11/2018
Completion date 15/6/2020

Project description
The project aims to understand the moisture content (MC) of wood products and timber in the Australian timber supply chain and develop guidance that allows industry to limit unacceptable MC variation and improve customer confidence.

Background
Wood's moisture content (MC) variation and consequent MC-induced movement are vital considerations in timber-rich design and construction. Unacceptable product MC and MC variation in the timber supply chain and in service generate direct and indirect losses to producers, fabricators and building owners and managers. This project's objective is to generate and distribute informed industry guidance on best practice for the economic and effective MC control of timber and wood products in the Australian timber supply chain. This involves identifying regular problems and key influencing factors; building an initial knowledge base of equilibrium moisture content (EMC) conditions and timber's MC performance in the timber supply chain; and generating initial industry best practice guidance.

Summary of progress
Through producer and supplier interviews and site inspections, project activity has identified several persistent issues with inexplicable boards splitting during or after element fabrication, board damage during storage, and unacceptable movement in service.

Reducing MC-based product loss and customer claims minimises rectification costs and increases customer confidence in the product and timber solutions generally. Currently, losses to individual companies are known anecdotally. Sudden climatic changes and resultant MC-induced movement have causes significant product loss in very short periods. Similarly, loss in product value while transporting material and incorrect storage of timber product nationally and internationally can be as high as 50%. An improved understanding of the EMC and ventilation rates of the environments in which timber and wood products are transported, stored, installed or serve will enable companies to take effective preventative action when the potential for damage or loss is high.

NT046 Minimising market-limiting discolouration in appearance Tasmanian hardwood

Lead organisation
Britton Timbers

Principal researcher
Professor Gregory Nolan, University of Tasmania

Other participants
Neville Smith Forest Products; Porta Timber; Sustainable Timber Tasmania

Start date 1/11/2018
Completion date 15/6/2020

Project description
Project will investigate the cause of market-limiting, grey discolouration and 'tyre track' of Tasmanian Plantation Oak (*E.nitens*), a future resource, as well as process-induced discolouration of appearance Tasmanian hardwood boards, particularly 'sticker mark' in Tasmanian Blackwood and Oak.

Background
Production-induced board discolouration such as stain and 'sticker mark' is market-limiting and reduces product value and recovery in appearance hardwood production. Effective management techniques are available for some causes of discolouration, but others, such as sticker mark, are more complex and have not been clearly defined, and management options are less clear. This project's objective is to reduce the economic impacts of market-limiting discolouration in dry appearance grade boards of key Tasmanian species, particularly Blackwood and plantation Shining gum (*E. nitens).* This involves: identifying the causes of market-limiting discolouration in this material; demonstrating best-practice production procedures to avoid or control market-limiting discolouration; and establishing benchmark chemical compositions of key Tasmanian species.

Summary of progress
The cause of 'tyre track' found in plantation *E. nitens* boards at Britton's Smithton mill was identified as a form of blue stain. The material was then subject to various comparative preservative treatments to determine their efficacy. Boards from subsequent *E.nitens* milling at Smithton and in other parts of Tasmania were assessed and found to be 'tyre track' free.

This project directly benefits companies milling and supplying Tasmanian Blackwood, Tasmanian Oak and those that may potentially mill and supplying plantation Eucalyptus *(E. nitens)* for appearance applications.
Stain evident in plantation hardwood has the potential to reduce the value of Tasmanian public managed plantation estate significantly, to the point where it may not be viable as an appearance grade product. Avoidance of market-limiting strain and sticker mark ensures the value of Tasmania's future solid wood resource *(E. nitens)* for the state-owned forest grower.

NT047 New methods of reliably demonstrating species durability in commercially relevant timeframes

Lead organisation
Britton Timbers

Principal researcher
Dr Kyra Wood, University of Tasmania

Other participants

Neville Smith Forest Products, Sustainable Timber Tasmania, Porta Timber, McKay Investments Pty Ltd, Private Forests Tasmania, Koppers Performance Chemicals, University of the Sunshine Coast

Start date 1/11/2018
Completion date 15/6/2020

Project description
The project will explore ways in which to demonstrate acceptable durability of natural and modified Tasmanian hardwood species in commercially relevant timeframes. The project will test material not covered by current durability standards, and establish longer duration comparative trials of testing processes and material performance.

Background
Long timeframes are generally required to demonstrate the effectiveness of novel durability treatment strategies. This can be a major constraint on the market acceptance of new generations of modified timber products manufactured from low durability hardwood like plantation Eucalyptus nitens. This project's objective is to establish and benchmark short duration (commercially viable) durability assessment techniques suitable for use with collapse-prone, refractory hardwoods used in Australian conditions for external cladding, decking and composite products such as glulam.

Summary of progress
A literature and material review have identified relevant durability treatment options for accelerated testing, and potential accelerated testing strategies. A long-term field site in Tasmania (temperate) has been established and will allow us to generate results for comparison with those at a field site in north Queensland (tropical). A suite of initial pilot tests to treat varying thicknesses of timber using conventional methods, such as vacuum pressure impregnation, and less conventional methods, such as supercritical fluid treatment, are underway and will generate the specimens required for accelerated testing in Stage 3 of the research.

Acceptable durability is a key market requirement for hardwoods used in building construction. While methods exist within the Australian standards for determining durability, they require long duration comparative exposure tests or specific chemical penetration percentages and retention rates, and don't readily accommodate product innovation. These limitations have direct commercial impacts, especially for low durability, refractory hardwoods found in Tasmania. If the latest treatments and technology could be applied and demonstrated to be fit for purpose in a timely manner, then large markets would become accessible for timber products made from hardwoods with low natural durability.

NT048 Implementation of single-step genomic selection in eucalypts

Lead organisation
Southern Tree Breeding Association

Principal researcher
Dr Tony McRae, STBA and Dr Richard Kerr, University of Tasmania

Other participants

Tree Breeding Australia Limited is being established as a national body and will absorb the businesses of STBA and its subsidiary and PlantPlan Genetics.

Start date 1/4/2019
Completion date 30/6/2021

Project description
Application of single-step genomic selection has the potential to double the rate of genetic gain in tree improvement programs for hardwood eucalypts by substantially reducing the generation interval and increasing the accuracy of breeding value prediction. This project will enable the technology and test its application on an industrial scale in *E. globulus* and *E. nitens*.

Summary of progress
Tree Breeding Australia (TBA), based in Mount Gambier, manages cooperative tree improvement programs for the Australian hardwood and softwood sectors. The current NIFPI project aims to expand use of single-step genomic prediction in the national breeding program for Eucalyptus globulus as well as operationalise the technology in collaborator run breeding programs for Eucalyptus nitens.

Modelling indicates that single-step genomic prediction will at least double the annual rate of genetic gain in the programs, primarily by shortening the generation interval and increasing the accuracy of prediction. This will deliver substantial long term economic and competitive benefits to the Australia forest growing sector, particularly in northern Tasmania where there is a heavy concentration of eucalypts grown.

Single-step genomic prediction has already been successfully piloted by TBA in both species. For *E. globulus* this project is extending the DNA based data collection which will enable early selection of juvenile progeny (progeny not yet assessed for phenotypic traits). Once phenotypic data are collected on these trials the DNA data sets will be used again and again in future prediction thus setting a foundation for early selection to become a routine breeding activity.

The project is also trialling a low-cost, low density DNA assay (tens of thousands of positions read on the genome), which has the potential to enable imputation of the equivalent information that would be obtained if a higher density, and more costly, assay was used. The low-cost assay has been developed by the Eucalyptus SNP Array Initiative (ESAI). ESAI is an international consortium of Eucalypt researchers with a mission to provide an all-purpose, multi-species, DNA chip to the eucalypt breeding community. About 1500 *E. globulus* samples have been dispatched so far and a further 2000 are being collected from field trials for processing by AgriBio. The high- density assay (based on whole genome sequencing), which has been providing the genomic information up to now, is not currently viable operationally because of its cost, but the information from it is being used to develop a new tailored low-cost assay which will be better suited and cheaper for use in the Australian breeding programs. Imputation is a key process in operationalising single-step genomic prediction in both species. The project will be testing various imputation methods and building pipelines to implement imputation as a routine step in selection.

In *E. nitens* the single-step approach has so far only been used with a relatively small-scale DNA assay. This project will further develop the genomic resources in this species so that the information obtained from this assay, and from other small assays like it, does not become a wasted investment as newer technologies emerge. Under the guidance of AgrioBio, a high-density assay in *E. nitens* is being developed that will be on par with what we have developed in *E. globulus.* The approach is based on identification and collection of tissues from key founder trees with the aim

of sampling all the genetic diversity currently found in the Australian breeding programs.

A feature of *E. nitens* breeding is the prevalent use of open-pollinated crosses. This crossing system limits knowledge of the identity of the male parent. There is scope for genomics to recover unknown male parentage, and this is perhaps more important in *E. nitens* than in other species. The project is therefore also developing a pedigree recovery pipeline to routinely check pedigree recording and to recover parentage where it is not known. The pipeline will also identify and report on realised familial relationships estimated from the genomics data and this is used in the single-step prediction.

The project will also continue to develop the single-step algorithms and processes within DATAPLAN and TREEPLAN enabling seamless combining of field-test and pedigree data with the genomic data. These methodologies are similar to what is being developed and implemented in the livestock industries and we are capitalising on lessons learned in these fields.

The rapid operationalisation of single-step genomic prediction in the Australian breeding programs has, in part, been made possible because of the adoption of a rolling front breeding system and the investment in the DATAPLAN and TREEPLAN systems. This project represents a next step on that journey, and we anticipate low-cost, low-density assay designs in both species to be completed this year as well as demonstrating successful imputation from low- density to high-density marker systems. The operationalising of single-step genomic prediction with a low-cost assay for both eucalypt species will represent a major breakthrough and will help cement the Australian breeding programs reputation as world leading.

NT049 Improve returns to forest owners by exploring the feasibility of a pellet-based industry in Tasmania

Lead organisation
Biofuels Tasmania

Principal researcher
Lachlan Esplin, Shepherds Lead

Other participants
Whetstone Pty Ltd, FutureMetrics, Synectic Accountants and Advisors, Recycling Technologies Group and Shepherds Lead Group

Start date 1/5/2019
Completion date 1/10/2019

Project description
Project aims to determine the feasibility of establishing an efficient and profitable wood pelletising industry in Southern Tasmania that converts existing underutilised wood residues and establishes an improved value chain for the Tasmanian forest industry and provide sustainable returns for forest owners.

Summary of progress
Currently six out of seven of the NIFPI research grant milestones have been completed. An in-depth comparison document between potential Southwood and Brighton sites for the proposed pellet mill reflected the risks and benefits of

construction, operation, freight and employment. Results showed Southwood as the preferred site subject to access and cost of in feed fibre.

Determining CapEx, OpEx, financial model, equipment cost, design and layout
A front end engineering study is being undertaken to help a more accurate CAPEX and OPEX for the project. Detailed layouts and designs for all aspects of the project are being developed to firm input figures for the financial modelling.

A pellet growth strategy (a part of the an overall pellet, gas, electricity comparison document) has been developed to ensure supply and demand in the domestic Tasmanian market is gradual and not counterintuitive to the overarching goal of establishing a sustainable pellet industry. The growth strategy outlines the importance of large-scale off take agreements with nursing homes, universities, municipalities and industrial applications. These end users are categorised based on their required pellet consuming device and purpose.