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OFFICE OF THE DEPUTY VICE-CHANCELLOR (RESEARCH)

13 December 2013

ORS Ref: 3128

Denise Caddy
Department of Industry
GPO Box 9839
Canberra ACT 2601

Dear Denise

Re: **Progress Report – National Centre for Future Forest Industries**

Please find attached a copy of the Milestone 4 progress report for the **National Centre for Future Forest Industries**.

On behalf of the University of Tasmania and the NCFFI Director, Prof Mark Hunt, I would like to thank you for supporting this project.

Should you have any queries regarding the administration of the project, please contact Dr Alice Percy, Funding Officer, Office of Research Services on (03) 6226 7100 or by email Alice.Percy@utas.edu.au.

Yours faithfully

Professor Patrick Nixon
Deputy Vice-Chancellor (Research)

UNIVERSITY OF TASMANIA

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National Centre for Future Forest Industries (Project B) Progress Report: December 2012 – December 2013

Introduction

The NCFFI has moved into its second year and excellent progress has been made on both strategic and operational fronts. The centre now has R&D activity ongoing in Western Australia, Tasmania, Queensland, South Australia, Victoria and New South Wales; in hardwoods and softwoods; across genetics, forest management, wood quality, processing, product development and building and energy solutions. Twenty forest growers and five forest processors are contractually engaged in NCFFI projects and as well as the five major R&D providers several smaller providers of research and development services are actively involved in the program. We also have an active cohort of associated postgraduate students.

Changes in government at a federal level and continued debate about the Tasmanian Forest Agreement at a state level have resulted in an unstable political, policy and funding environment that has proven a challenge to negotiate given the short term nature of the centre's funding. Notwithstanding this, the activities and aspirations of the centre have been effectively communicated to governments and policy makers as well as industry with strong support being received from all quarters.

The Australian Forest Products Association has embarked on an attempt to create an FP Innovations-style national forest products research institute and the NCFFI has been working to ensure that efforts to develop the current centre and the proposed institute are undertaken collaboratively and towards a common goal. Continued support for NCFFI in its current modest form towards development into the AFPA institute model, headquartered in Tasmania, would be an ideal outcome from this process. Much work needs to be done at industry and government level (state and federal) to realise that ambition. In the interim, NCFFI is fortunate to have AFPA CEO, Ross Hampton, as a member of the Centre Advisory Board.

This progress report sees the completion of the initial phase of NCFFI, with grant funds committed to projects and contracts finalised with partner organisations. Outputs, in the form of publications and industry bulletins, are now beginning to flow much more quickly. The next six months will provide feedback on the appetite for industry and government to continue to fund the centre so that a decision about the future can be made and communicated in the June 2014 Annual report.

Between now and then we will continue to work hard and collaboratively to provide applied, rigourous research outcomes to industry in a way that enhances business outcomes and facilitates innovation.

Prof Mark Hunt

Director, national Centre for Future Forest Industries

Participants undertaking NCFFI funded activities – subcontractors

University of the Sunshine Coast

CSIRO

University of Melbourne

Queensland Department of Agriculture, Fisheries and Forestry

PlantPlan Genetics

Southern Tree Breeders' Association

Whitegum Forest and Natural Resource Management

ForestQuality

Milestones

Milestone1:

Reported September 2012

Milestone 2:

Reported December 2012 - outstanding item: Collaboration Agreement

The collaboration agreement that was drafted ahead of the Milestone 2 delivery date was not viewed as a suitable vehicle for taking the NCFFI collaboration forward by the partners. Due to the short term nature of the funding, it was decided that projects should be designed and contracted on an as needs basis rather than falling under a formal collaboration mechanism. Essentially the transaction cost of a formal collaboration did not make sense considering the amount of money involved and the funded life of the Centre and potential partners were not prepared to go down this path.

This has not reduced the extent or value of the collaboration and it has been straightforward to develop projects under individual multi-partner agreements under the NCFFI umbrella. A list of contracts is contained in the appendices.

A mechanism to secure ongoing funding for a period of at least five years is being sought. If successful this will meet the requirements of potential partners to warrant signing a formal umbrella collaboration agreement.

Milestone 3:

Reported June 2013 - outstanding item: Presentation of Annual report to Partners Forum

The Annual Report was subsequently presented to the collaborators in NCFFI and sent to participants in the Centre.

Milestone 4:

At least one technical report and industry bulletin per theme produced - achieved. The three themes are focussed differently with respect to both clients and outputs. Consequently the mix of bulletins and refereed publications has not been uniformly distributed. For instance Theme 2 has a significant amount of work centred on operations research where technical style outputs are useful whereas Theme 3 considers questions that are more amenable to delivery to stakeholders through model

parameterisation. When considered across the three themes, the minimum output requirements for the centre have been well exceeded. Please see appendix 4 for publications list.

In response to industry and other stakeholder feedback, the mix of outputs has been adjusted to focus on 4-5 page technical bulletins and formal peer reviewed publications, omitting lengthy unrefereed technical outputs as the latter have no discernible audience.

Refereed publications in press - achieved, please see appendix 4.

Second progress report supplied to Commonwealth - this report.

Budget position

All funds in the initial NCFFI grant have now been committed to collaborative project work with industry and supporting administrative activities. A budget position is attached in the appendices. A breakdown of allocation to projects and activities is as follows:

Theme 1:

Three projects have been initiated in Theme 1.

Project 1.1 is a major study of the utilisation of plantation *Eucalyptus nitens* and *E. globulus* through consideration of peeling and subsequent product use if the resultant veneers. The project includes University of Tasmania, the CRC Forestry, Queensland Department of Agriculture Fisheries and Forestry and University of Melbourne as key partners and is working with New Forests, Australian Bluegum Plantations and Forestry Tasmania as industry partners. CSIRO has also made significant contributions to the project through commitment of salaries under the CRC Forestry extension arrangements. Plantations have been sampled in Victoria, South Australia and Tasmania and processing components of the research are being carried out in Queensland. $540,000 of NCFFI money was matched with $400,000* cash from the CRC Forestry and a further $200,000 in kind contribution from the partners. The project is due for completion in the first quarter 2014-2015.

Project 1.2 further aims to understand utilisation opportunities of plantation grown hardwoods and addresses both residues and building systems. The project is being led by the University of Tasmania Centre for Sustainable Architecture with Wood and draws on resources from the engineering and architecture disciplines. The project has commenced in Tasmania with a view to expanding to Vitoria and then further afield if warranted. The initial investment underpins applications to industry and state government for ongoing work in this area. Key industry partners are McKay Timbers, Neville-Smith Forest Products, Ta Ann, Circa Morris-Nunn, Britton Timbers, Porta Mouldings and Barry Hill Timbers. The present nominal allocation to the project is $290,000 over eighteen months (7/2013 – 12/2014), dependent on matching funding targets being met. The University of Tasmania and others have already made significant matching contributions to the project through salary commitments.

*Note that the $400,000 CRC Forestry contribution was administered through the University of Tasmania accounts.

Project 1.3 is an industrial scale veneering project that addresses questions around recovery for larger trees with particular interest in pruning effects over time. The project outcomes have relevance to the broader plantation hardwood sector across temperate and Mediterranean

Australia. The project includes University of Tasmania and QDAFF as research partners and Forestry Tasmania and Ta Ann as industry partners. $30,000 has been committed to this project from NCFFI, matched by $30,000 from Forestry Tasmania and an equivalent in kind contribution from Ta Ann. Further contributions of salaries by Forestry Tasmania have been committed. The project will commence in January 2014 and be completed by December 2014.

A total investment of $860,000 of the NCFFI grant is committed to Theme 1. Thus far, commitments of $430,000 cash revenue have been matched with a further (approx) $400,000 institutional/company salaries and in kind.

Theme 2:

Six projects have been initiated in Theme 2.

Project 2.1 is a CRC Forestry residual industry funds project. CRC Forestry residual industry funds cash of $50,000** was contributed as well as $60,000** of funding from FWPA and these funds did not need to be matched by cash from the NCFFI grant. However, salary and in kind contributions for NCFFI partners were committed. The project resulted in a report to FWPA which can be found here http://www.fwpa.com.au/The-extent-and-causes-of-decline-in-productivity-from-first-to-second-rotation-blue-gum-plantations. This project is now closed.

Project 2.2 is a supply chain solutions project undertaken by University of the Sunshine Coast closely aligned with CSIRO in Project 2.1 and engaging a range of industry partners (primarily forest growers). $160,000** cash was contributed to the project from the CRC Forestry residual industry funds. The project supported a range of industry focussed outputs in the form of technical bulletins and presentations. A full library of AFORA bulletins can be found here http://www.usc.edu.au/research/research-partnerships/australian-forest-operations-research-alliance-afora and those completed under the NCFFI arrangements thus far are listed in Appendix 4. This project is now closed and has been superseded by Project 2.5.

Project 2.3 is a modelling activity aimed at identifying the economic priorities in addressing potential productivity shortfalls across the hardwood plantation estate in southern Australia. The project is lead by CSIRO, supported by UTAS and engaged with several industrial forest growers, particularly in Western Australia where the largest hardwood estate exists. This is a CRC Forestry residual industry funds project (continuing where CRC Forestry project 1.8 left off). $155,000** of CRC residual funding as allocated to this project.

Project 2.4 aims to enhance plantation productivity and profitability of Australia's main plantation species by better matching their genotypes to sites, silviculture and products. Given limits to site productivity, improved genotype deployment is a key option to maximise the yield of harvestable biomass and maximise product value. University of Tasmania, University Sunshine Coast, QDAFF, Southern Tree Breeding Association, PlantPlan Genetics Pty Ltd, Forestry Tasmania, WAPRES and CSIRO are all participants in the project and as such are making contributions of salary and in kind. The Project has a budget of $410,000 from NCFFI and this is being matched with investment under the Cooperative Research Networks scheme, from University of Tasmania salaries and in kind in the form of extensive data sets and field experiments built over the past 25 years. In addition to industrial funding applications presently being reviewed the following application to the Australian Research Council has recently been submitted:

Prof BM Potts, Dr M Hamilton, Dr J Costa e Silva, Dr T McRae, Dr D. William. Quantitative genetic control of economic traits in *Eucalyptus globulus* (requested ARC LP14 - $387K).

Project 2.5 saw the Australian Forestry Operations Research Alliance brought under the NCFFI program starting July 2013. The AFORA is an operational R&D alliance engaging 17 of Australia's forestry companies in collaborative research undertaken with University of the Sunshine Coast and University of Tasmania. The initial contract covers two years of operation and saw $280,000 of industry cash met with $150,000 of NCFFI funding to support work undertaken primarily through USC.

Project 2.6 is a small activity responding directly to immediate needs from one of the softwood growers regarding mammalian browsing in Tasmanian and South Australian plantations. The browsing is having severe impact on productivity. An investment of $15,000 NCFFI cash has been matched with $19300 industry cash plus in kind and the project is being completed collaboratively between the University of Tasmania and Timberlands Pacific. Both collaborators are making significant additional in kind and salary commitments. The following funding application to the Australian Research Council has also been submitted:

O'Reilly-Wapstra, J.M., Davies N.W., and Potts, B.M., Aurik, D., Dungey, H., Jefferson, P. and Elms, S. ARC Linkage Grant. Linking plant genetics and chemistry to increase tree production in softwood forestry. $540,000 Submitted November 2013.

In summary an NCFFI investment in Theme 2 of $638,000 has been met with a total of $725,000 matched funding plus in kind including $365,000** CRC funding, $60,000** FWPA funding, $280,000 AFORA industry funding, $19,300 Timberlands Pacific.

**Note that these matching cash funds were paid directly from the residual CRC Forestry account (or other party) to University of the Sunshine Coast and CSIRO and were not administered through the University of Tasmania accounts.

Theme 3:

Three projects have been initiated in Theme 3.

Project 3.1 will determine for target native tree species the extent to which provenance/genotype choice impacts productivity and survival, traits associated with survival and drought tolerance and, where relevant, product quality; the genetic variability, plasticity and environmental drivers of functional trait variation; and the extent to which site adaptation and species biophysical limitations can be modelled from functional trait, genetic and environmental data. This has critical implications for forest management over the next rotation and beyond in the face of changing and variable climate. Project partners include University of Tasmania, the Western Australian Department of Parks and Wildlife, University Sunshine Coast, CSIRO Ecosystem Sciences, Edith Cowen University and Greening Australia. NCFFI has contributed $130,000 funding to the project and this was met by $100,000 from CRC Forestry and $30,000 from the Cooperative Research Network scheme. Further contributions in the form of salaries and in kind have made by all project partners. Three grant applications have been submitted during the past year to build further leverage but these have all been unsuccessful. This project will run until December 2014.

Project 3.2 is a collaboration between CSIRO, University of Tasmania and industry. NCFFI and CSIRO each committed $125,000 cash to the project and this will support a cofounded/joint appointment over two years. The project scope will be finalised based on direction and contributions from the industry partners but will build on work considering impacts of climate on forest production and risk. This project will commence early in 2014.

Project 3.3 commenced in July 2013 to provide industry with a review and summary of the plantation water use and drought research that has been undertaken over the past 25 years, primarily in Western Australia. The project is a collaboration between University of Tasmania, CSIRO and Whitegum FNRM, with contributions from a range of blue gum forest growers. The ouputs will be arrange of high impact publications and a series of industry bulletins. NCFFI has nominally committed $125,000 to this project and we are expecting this to be matched with cash, salaries and in kind between now and December 2014 when the project is expected to be completed.

NCFFI has committed $380,000 to Theme 3. At this stage $255,000 in cash has been matched.

Education:

The education theme is funded on a 50:50 basis between the NCFFI grant and the University of Tasmania at a Faculty level (Faculty of Science, Engineering and Technology). The funding supports a 0.8 fractional academic position to coordinate postgraduate research, not only at the University of Tasmania but at collaborating institutions. UTAs contributes additional funding through scholarship support and supervision and a small amount of NCFFI funding has been set aside to support PhD project operating expenditure including the communication of results. NCFFI contributes $190,000 to this theme and University of Tasmania has contributed $140,000 plus scholarship and academic supervisory salaries – approx. $50,000 to date.

Administration:

The NCFFI grant supports a Centre Director for a three year term at level E. In addition to salary expenses, administrative support, and operating expenses for the directorate are allocated to this account. $640,000 of the NCFFI grant has been allocated to this activity.

In summary, NCFFI has made a nominal commitment of $2.7 million over the life of the current grant, a nominal over commitment of $200,000 against the initial $2.5 million grant. At present the commitment of matching cash (including cash for salaries within University of Tasmania) is in excess of $1.4 million, though some of these funds have been receipted to collaborating institutions where the work is being undertaken rather than to University of Tasmania. Collaborator salary and in kind commitments to NCFFI projects and other activities is presently in excess of $2 million.

It is anticipated that leverage ratios will improve over the coming year as the results of funding and grant applications become known.

Progress towards outcomes

Project 1.1

***EUCALYPTUS NITENS* AND *EUCALYPTUS GLOBULUS* PEELING STUDIES (QDAFF, UTAS, UMELB)**

In kind support for this project was also provided by Australian Bluegum Plantations, New Forests and Forestry Tasmania, in the form of the logs, harvesting and handling.

Data sorting, filtering, analysing etc is well advanced on tree through to veneer data sets. Preparations for paper 1 (see below), are expected to be well advanced by mid January 2014. Adhesives have been sourced internationally after much consultation with industry and adhesive suppliers and adhesive testing is well advanced. Protocols, sample selection and preparation for pressing into plywood and laminated veneer lumber (LVL) products are being finalised for both species. Products are expected to be manufactured and performance evaluated in Q1 2014. Consultation between QDAFF, the University of Melbourne and others has commenced on market acceptance factors.

UTAS (Mario Vega) has commenced processing discs taken from the top of peeled logs (growth rings, basic density, heartwood/sapwood boundary and the extraction of radial samples for NIR/silviscan).

HOOP PINE PEELING STUDY (QDAFF)

Methodology and protocols have been defined, adhesives have been sourced, industry partners have been engaged, specific equipment has been procured/modified for trial and sample laminar products have been manufactured. Preliminary/model scale testing is scheduled for mid December 2013 (dependant on last stage of equipment modification).

***EUCALYPTUS NITENS* RESOURCE CHARACTERISATION AND NEAR INFRARED MODEL DEVELOPMENT (UTAS, FOREST QUALITY, FORESTRY TASMANIA, CSIRO, CIS-MADERA)**

Currently, 42 *E. nitens* Forestry Tasmania *E. nitens* plantation sites have been sampled for the purposes of resource characterisation (generally 1 disc from 3 trees per site, supplied by Forestry Tasmania). Approximately half of these discs have been processed, had growth rings measured, been assessed for basic density and heartwood/sapwood boundary and had radial samples for NIR analysis extracted. The remaining discs are in cold storage. Additional sites will be sampled in the first half of 2013-14. This work will form part of Mario Vega's PhD thesis.

Forest Quality is undertaking the analysis and reporting of the application of a tension wood (non-recoverable collapse) detection method based on the radial scanning of wood samples using NIR. They are collaborating with CIS-Madera (Manuel Touza), and have been able to show that high levels of NIR-detected tension wood were strongly associated with non-recoverable collapse in sawn boards of *E. globulus* grown in Spain. Manuel Touza is developing opportunities in Europe for its further application.

In addition to the work outlined above, Forest Quality are combining increment core data that has been subjected to NIR radial-scanning from over 7 WA sites and 2 Victorian sites (over 500 cores) to assess the extent and severity of tension wood occurrence, including site and spacing effects. This work will be prepared for journal publication and should give some indication of the extent of its prevalence in sites typically used for pulp production. Forest Quality has also provided routine kraft pulp yield and cellulose content analyses in several projects for Australian companies, and CSIRO.

Preliminary near Infrared models for wood density and MOE in *Eucalyptus nitens* have been developed and presented at the 18th International Nondestructive Testing and Evaluation of Wood Symposium.

***EUCALYPTUS NITENS* AND *EUCALYPTUS GLOBULUS* RESOURCE CHARACTERISATION - GENETIC EFFECTS (UTAS, AFORA, FORESTRY TASMANIA, CSIRO, FOREST QUALITY, WAPRES)**

Silviscan estimated density (0.025 mm resolution from pith to bark) and MFA/MOE (1 mm resolution) for 1000 trees from Forestry Tasmania's Southport and Tarraleah *E. nitens* progeny trials have been obtained from Rob Evans. These cores were initially extracted by Forestry Tasmania and

the CSIRO (Simon Southerton) to provide estimates of tree-level means for these traits. Initially these data will be analysed as part of Mario Vega's PhD but it is anticipated that an additional paper will be produced with a focus on genetic variation in radial trends in wood properties. In addition, radial NIR scans of samples from a *E. globulus* progeny trial near Manjimup (WAPRES property), in WA, have been completed by Forest Quality.

Project 1.2

SCOPE AND PROJECT DEVELOPMENT

The project scope has been determined and methodology developed with industry partners and participants. This methodology includes the determination of the types, characteristics and quantities of wood processing residues generated in the state followed by the assessment of current and potential medium-term markets, demand and other relevant factors for different types of wood processing residues. The performance requirements for these markets will also be determined. A literature review has also been completed alongside a briefing paper for participants and key issues identified through industry consultation discussed in the briefing paper. The paper has been circulated to key Tasmanian industry stakeholders and proposed project participants.

The methodology involves collecting data directly from wood processing facilities and also existing and potential wood residue end-users.

An interim report will be available by the end of March 2014 and final report by December 2014.

PROJECT PARTICIPANTS/COLLABORATORS

Proposed project participants and collaborators include:

Tasmanian Wood Processors

The project will aim to obtain information from all wood processors in Tasmania, some only by written questionnaires and phone interviews however key participants will be visited directly for interviews and onsite measurements.

Key processor participants currently are:

Neville Smith Forest Products
Britton Timbers
McKay Timbers
Ta Ann
Porta Mouldings
Torenius Timbers (to be confirmed)

Secondary processors including joinery, furniture, truss manufacturers, laminated beam plants etc will also be engaged and these businesses are being contacted over the next month.

Residues End-Users and Market Contacts

Specific contacts have not been confirmed yet, however will include the following categories:

Pellets (eg Pellet Fires Tasmania)
Industrial Heating for brick manufacturing, greenhouses, food processing etc
Firewood
Other bioenergy contacts
Engineered Wood Products
Mulches, compost, potting mixes
Landscaping
Animal Bedding
Chemicals, additives

Export Wood Chip, pulp and paper

Other Project Participants

Forestry Tasmania

Residues Equipment Manufacturers (to be determined)

Project 1.3

Methodology has been agreed. Contract has been prepared. Staff have been allocated. Project work is yet to commence.

Project 2.1

Complete. Peer reviewed project report will be available on FWPA website once review process is finished - http://www.fwpa.com.au/The-extent-and-causes-of-decline-in-productivity-from-first-to-second-rotation-blue-gum-plantations.

Project 2.2

Complete. Industry bulletins available on AFORA website - http://www.usc.edu.au/research/research-partnerships/australian-forest-operations-research-alliance-afora

Project 2.3

Project scope, participants and design has been completed. Commencement for project work *per se* will be early in 2014 with an anticipated delivery of September 2014.

Project 2.4

Project partners - University of Tasmania, University Sunshine Coast, QDAFF, Southern Tree Breeding Association, PlantPlan Genetics Pty Ltd, Forestry Tasmania, WAPRES, CSIRO

QUANTIFYING AND PREDICTING GENOTYPE BY ENVIRONMENT INTERACTIONS (GXE)

The analysis of GxE for 6 year growth and survival in national network of *E. globulus* diallel trials established by STBA/UTAS with support from FWPA.

- Six year data has been collected from all 5 trials planted in 2007.

The analysis of GxE in the network of *E. globulus* breeding trials established by the STBA across Australia for growth, survival and wood properties (many of these trials are close to harvest age)

- A subcontract is currently being organised with PlantPlan Genetics Pty Ltd. This will involve analysis of 46 2nd generation *E. globulus* breeding trials from across southern Australia, identification of environmental factors causing variation in GxE (assessed using type B genetic correlations), and defining appropriate deployment zones.

OPTIMISING GENETICS FOR MULTI-ROTATION COPPICE MANAGEMENT OF E. GLOBULUS

Determine genetic factors affecting coppice success and vigour,

Determine the stability of first and multi-rotation performance for growth and wood properties, and develop multi-rotation genetic evaluation strategies.

- Two trials have been harvested and a study of genetic effects on harvesting productivity and traits is being written up. Initial coppice vigour has been assessed and WAPRES will thin surviving coppice to two stems per tree before the end of the year.
- Pre-harvest measures of growth, wood properties, form and harvesting traits have been obtained from a family and mapping trial in Western Australia, have been analysed and are

currently being prepared for publication. This data will form the foundation for comparing across-rotation performance.

- Further sampling of the harvested *E. globulus* mapping trial (supported by a REGS grant) for DNA has allowed expansion of the size of the three mapping populations to better determine the genetics of coppice vigour and subsequent traits.

GENETIC OPPORTUNITIES AND TRADEOFFS FOR MANAGING ABIOTIC AND BIOTIC RISK

Identification of traits associated with genetic variation in *E. globulus* drought susceptibility for prediction of correlated responses to selection.

- The quantitative genetic correlation between all relevant traits in the available for the same genetic material as has been assessed for drought damage has been completed in collaboration with Greg Dutkowski (PlantPlan Genetics Pty Ltd) and will be prepared for publication in 2014.

Determine the genetic variation in resistance of plantation eucalypts to the introduced myrtle rust and its association with resistance to native pathogens, initially focusing on *E. globulus* and *Corymbia* sp. (with USC & QDAFF)

- Screening for susceptibility to myrtle rust, in collaboration USC and QDAFF, is nearly complete including. *Corymbia citriodora variegata* (CCV) has been completed (20 plants/families from 128 OP families). Preliminary analyses demonstrate broad variation, and strong genetic control of susceptibility (H^2 ~ 0.6) in each species, suggesting there are good prospects to select resistant germplasm. There was no significant correlation with resistance to native fungal pathogens (*Mycosphaerella* in *E. globulus* and *Ramularia* in CCV).
- On 27th Nov 2013 representatives from CSIRO, UMELB, SCUni, USC, QDAFF and UTAS met in Brisbane to discuss their research plans and develop further collaborations under this project.

Project 2.5

Project contract and subcontracts signed. Prioritisation of research activities agreed to by industry partners and activities selected. Project planning advanced with work to commence in earnest in the new year.

Project 2.6

Project specified with Industry partner. Contract developed. Field work commenced for the Tasmanian component.

Project 3.1

***Partners* - University of Tasmania, CSIRO, Greening Australia, University Sunshine Coast**

Literature review of the tree and leaf traits related to climate and water availability and development of appropriate statistical models;

- A data base of leaf water traits for over three hundred species has been complied and we are currently exploring inter and intraspecific variation in these traits in relation to existing range species observations and climate. In particular we are looking for relationships between water relations traits and climates at the extremes of the population distributions

Targeted field studies that will assess trait variation across environmental gradients to link performance and survival with key functional traits. This work will use *E. globulus* as a model species and *E. pauciflora* as a species targeted for environmental plantings. Studies of the functional trait variation underlying genetic variation in drought damage of *E. globulus*. Studies of genetic variation

and genotype interactions for growth and survival in plantings of dry land species currently being used in carbon trials in Tasmania, and the relationship of this variation with tree-level traits and environmental/climatic factors. This will use recently planted (Greening Australia) and historic (UTAS) progeny trials;

- Environmental planting research is ongoing with Greening Australia (GA –partner ARC Linkage grant). Assessments of *E. pauciflora* genetic trials affected by drought have been completed and are revealing genetic signals. The impact of habitat factors on genetic quality of seed has been assessed and a publication submitted. Three-year growth and survival assessment of Greening Australia *E. pauciflora* trials have been completed. Range-wide sampling of *E. ovata*, a key revegetation species for Tasmanian midlands, has been completed and seedlings are growing in a commercial nursery for planting in 2014. Modelling of current and future climate envelopes for Tasmanian species has commenced.
- Sampling of variance of water relations traits among provenances of *Eucalyptus pauciflora* and *E. globulus* using the midlands trials and the Geeveston seed orchards is ongoing.

Genomic studies of adaptation to aridity in populations of widespread keystone *Eucalyptus* and *Corymbia* species that grow across rainfall/temperature gradients in Western Australia, Victoria, Queensland and Tasmania. Genomic scans will be used to assess the potential of eucalypt populations to adapt to changing environments, to monitor population genetic change, and to inform seed selection/transfer guidelines.

- Ongoing collaborations between UTAS/NCFFI and the Western Australian Department of Parks and Wildlife, CSIRO Ecosystem Sciences and Edith Cowen University have resulted this year in the production of one manuscript on *E. tricarpa* physiology across an aridity gradient and a second on using genomic techniques to bypass reciprocal transplant experiments (in *E. tricarpa*) that will be submitted shortly. A collaborative project between UTAS and USC, focussing on *Corymbia citriodora* adaptation to aridity will commence in December 2013.

Project 3.2

Project agreement and contract is being finalised between University of Tasmania and CSIRO.

Project 3.3

Meta analysis of relevant data sets has been completed. Draft manuscripts have been prepared for the first three publications with submission expected before Christmas.

Education Theme

The Education Manager in conjunction with PhD supervisors from University of Tasmania and University of the Sunshine Coast developed and advertised 11 PhD projects. These projects were advertised on relevant email servers around Australia, to forestry colleagues in Finland (by J. O'Reilly-Wapstra and M. Brown) and were also advertised on the Education Managers Website (The BITE Research Group).

In total there were 16 enquiries from students and these were predominantly international students affiliated with Finnish institutions. Two of the international students submitted application forms for UTAS scholarships and admission to undertake projects with Dr Luke Mirowski and Prof Paul Turner (both UTAS) and Dr Mauricio Acuna (USC).

The Education Program received two applications from NCFFI PhD students for grant support from the new student grants developed by the Director and Education Manager. Both grants were funded.

Mario Vega - $4486. Mario applied for travel funds to present his poster *Near infrared calibrations for wood density and modulus of elasticity for Eucalyptus nitens from Tasmania* at the 18th International Non-destructive Testing and Evaluation of Wood Symposium, Madison, USA.

Adam McKiernan - $11,400. Adam applied for project funds to enhance his PhD experimental work to examine *The effects of drought on Eucalyptus leaf* chemistry and better communicate the results to industry and other stakeholders.

The Education Manager made contact with Dr Julia Ferrari from the University of York to investigate the University of York's industry placement program for undergraduate students. This is an excellent initiative that places students in Industry for a year. A report on this program is being prepared.

Issues arising

It should be noted that Milestone 5 due in July 2014, 'A business plan for sustainability of the Centre prepared with evidence of ongoing third party investment' will need to be planned and prepared in consultation with the Australian Forest Products Association (AFPA) and Forest and Wood Products Australia (FWPA) with reference to the National R,D&E Strategy (carriage of which is through the National Forestry R,D&E Forum) as to the appropriate way for NCFFI to move forward within the context of industry aspirations, other R&D Centres operating in this industry space, and the present concept development of an Australian Institute for Forest Products Innovation by AFPA.

It should also be noted that given the very tight industry funding environment and the contracted requirement to operate the Centre on a national, collaborative and distributed basis it has not been useful or possible to administer all matching industry and other funding through the University of Tasmania. It will be useful to discuss with the Commonwealth how this may be approached and accounted for well ahead of the need for audited financial statements being prepared in the second half of next calendar year.

Proposed changes

It is proposed that the Commonwealth formally recognise that an appropriate combination of industry bulletins (2-5 pages) and peer reviewed journal articles form the published output from the NCFFI and that technical reports not be considered necessary if these other two vehicles are used in line with and in response to industry feedback. These written outputs will be provided alongside in-person presentations and other forms of media (webinars for instance).

It is also proposed that the requirement for three industry roadshows in the contract be adjusted to permit a single national industry workshop that addresses the three themes. This request is in deference to the industry's current difficult financial situation and the increased difficulty associated with companies trying to fund their staff to three separate events.

Appendices

Appendix 1: Statement of funds

Of the $2.5 million dollars initial grant, the entire amount remains in the revenue account, to be brought down against expenditure at the end of the University year (December).

At present, $1,527,918.82 has been expended (including contracted forward salary commitments) against the account across the Centre projects. This includes payments to third parties and subcontractors.

With unspent external revenue, the project remains in surplus to the amount of $948,280.47. With contracts being finalised over the next few weeks the revenue position will improve markedly, the remainder of the NCFFI grant will be committed, and the project revenue will be brought down to

the expenditure accounts in line with the contracted 13 December 2013 earliest date for final drawdown of funds against project activities. A further detailed statement of funds on an activity (research project) basis will be forwarded to the Commonwealth immediately these actions occur.

Appendix 2: Recipient contributions

Not applicable – Schedule 6 – Funds - paragraph 3.

Appendix 3: Other contributions

Not applicable – Schedule 6 – Funds - paragraph 4.

Appendix 4: Outputs (publications and presentations)

Refereed publications

Blackburn D, Hamilton M, Harwood CH, Baker T and Potts BM (2013) Assessing genetic variation in *Eucalyptus globulus* stem straightness. *Annals of Forest Science* 70, 461-470.

Byrne M, Prober S, McLean L, Steane D, Stock W, Potts B and Vaillancourt R (2013) Adaptation to climate in widespread eucalypt species: Climate-resilient revegetation of multi-use landscapes: exploiting genetic variability in widespread species. pp. 86 Report Published by the National Climate Change Adaptation Research Facility. (Theme 3)

Costa e Silva JC, Potts BM and Tilyard P (2013) Stability of genetic effects across clonal and seedling populations of *Eucalyptus globulus* with common parentage. *Forest Ecology and Management* 291, 427 - 435. (IF 2.9) (Theme 2)

Costa e Silva J, Potts BM, Bijma P, Kerr RJ and Pilbeam DJ (2013) Genetic control of interactions amongst individuals: Contrasting outcomes of indirect genetic effects arising from neighbour disease infection and competition in a forest tree. *New Phytologist* 197: 631–641. (IF 6.9) (Theme 2)

Downes GM, Touza M, Wentzel-Vietheer M, Harwood CE (2013) NIR detection of tension wood in *Eucalyptus globulus*. In 'Workshop on commercial application of IR spectroscopies to solid wood'. (Eds PJ Harris and CM Altaner) pp. 37-48. (Theme 1)

Freeman JS, Potts BM, Downes GM, Pilbeam D, Thavamanikumar S, Vaillancourt RE (2013) Stability of QTL for growth and wood properties across multiple pedigrees and environments in *Eucalyptus globulus*. *New Phytologist* 198, 1121–1134. (IF 6.9) (Theme 2)

Hamilton MG,Williams DR, Tilyard PA, Pinkard EA,Wardlaw TJ, Glen M, Vaillancourt, RE, Potts, BM (2013) A latitudinal cline in disease resistance of a host tree. *Heredity* 110**,** 372-379**.** (Theme 2)

Kremer A, Potts BM, Delzon S (2013) Genetic divergence in forest trees: understanding the consequences of climate change. *Functional Ecology*, doi: 10.1111/1365-2435.12169 (IF 5.4) (invited review). (Theme 3)

Larcombe M**J**, Barbour RC, Vaillancourt RE, Potts BM (2014) Assessing the risk of exotic gene flow from *Eucalyptus globulus* plantations to native *E. ovata* forests. *Forest Ecology and Management* 312(0), 193-202. (Education theme)

Larcombe MJ, Vaillancourt RE, Jones RC, Potts BM. (Accepted) Assessing a Bayesian approach for detecting exotic hybrids between plantation and native eucalypts. *International Journal of Forestry Research*. (Education theme)

McGavin RL, Bailleres H, Lane F, Blackburn D, Vega M, Ozarska B (In press) Veneer recovery analysis of plantation eucalypt species using spindleless lathe technology. *Bioresources* (Theme 1)

Vega M, Hamilton M, Downes G, Harwood C, Adams P, Potts B (2013) Near-infrared calibrations for wood density and modulus of elasticity for *Eucalyptus nitens* from Tasmania (Australia). Poster presentation. In: 18th International Nondestructive Testing and Evaluation of Wood Symposium, Madison, USA, p No. 121. (Theme 1)

Wentzel-Vietheer M, Washusen R, Downes GM, Harwood C, Ebdon N, Ozarska B, Baker T (2013) Prediction of non-recoverable collapse in *Eucalyptus globulus* from near infrared scanning of radial wood samples. European Journal of Wood and Wood Products 71, 755-768. (Theme 1)

Industry bulletins

AFORA Industry Bulletin 1. Brown, M, Mitchell, R & Wiedemann, J (2013) Productivity and utilisation of an in-field chipping harvest system in an unmanaged blue gum coppice stand in Western Australia. (Theme 2)

AFORA Industry Bulletin 2. Ghaffariyan, MR (2013) The natural drying process of logs and harvesting residues - preliminary results. (Theme 2)

AFORA Industry Bulletin 3. Mitchell, R (2013) Comparison of different flail chains operating in *Eucalyptus globulus* plantations in Western Australia. (Theme 2)

AFORA Industry Bulletin 4. Ghaffariyan, MR, Spinelli, R, Brown, M, Mirowski, L (2013) Chipping model: a tool to predict the productivity and cost of chipping operations. (Theme 2)

AFORA Industry Bulletin 5. Strandgard, M, Mitchell, R and Walsh, D (2013) Productivity and cost of two *Eucalyptus nitens* harvesting systems when bark is retained on logs. (Theme 2)

AFORA Industry Bulletin 6. Strandgard, M, Mitchell, R and Walsh, D (2013) Quantity of *Eucalyptus nitens* bark retained on logs at roadside following harvest, infield drying, processing and infield transport by two harvesting systems. (Theme 2)

Conference presentations

Harrison, PA, Worth, JRP, Vaillancourt, RE, Potts, BM (2013). Predicting the distribution of *Eucalyptus ovata* under past, current, and future climates. Presented at the Graduate Research – Sharing Excellence in Research (SEiR) Conference, Hobart, Tasmania, 6th September. (Theme 3)

Larcombe MJ, Steane D, Jones RC, Nicolle D, Holland B, Vaillancourt RE, Potts BM. Phylogenetic patterns of reproductive isolation in *Eucalyptus*. Presentation to *Phylomania 2013*, University of Tasmania, School of Maths and Physics, 6-8 November 2013. (Education Theme)

McKiernan AB, Hovenden MJ, Brodribb TJ, Potts BM, Davies NW & O'Reilly-Wapstra JM (2013). Effects of water limitation on plant secondary metabolite concentrations in *Eucalyptus* leaves: inter- and intra-specific plant responses. INTECOL, 8th – 23rd August, London. (Theme 2)

O'Reilly-Wapstra, J.M. Forest systems in Tasmania: addressing ecological and management questions in production forests. METLA (Finnish Forest Research Institute), Suonenjoki, Finland. August 27th 2013. (Theme 2)

O'Reilly-Wapstra, J.M., Gosney, B., Whiteley, C., Hamilton, M., Bailey, J.K., Forster, L and Potts, B.M. (2013). Tree genetics shapes community trajectories in planted forests. INTECOL, August 18th-23rd, London. (Theme 3)

Vega, M**.**, Hamilton, M., Downes, G., Harwood, C., Adams, P. and Potts, B.M. (2013) Near-infrared calibrations to predict modulus of elasticity for plantation-grown *Eucalyptus nitens.* The 18th International Non-destructive Testing and Evaluation of Wood Symposium. Forest Products Laboratory of USDA, Madison, Wisconsin, USA, Sept 24-27. (Theme 1)