

# connections

## What will the new water standards mean for forestry?

Government's freshwater reforms aim to balance economic growth with sustainability, and herald a change to the way freshwater is managed. Communities are now responsible for setting the standards for freshwater management within their region, creating the opportunity for forestry growers to be actively involved in the process.

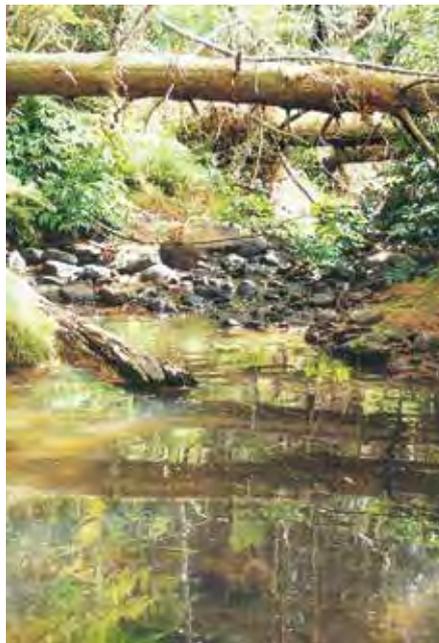
Dr Brenda Baillie's background in forestry and water quality saw her nominated to sit on the freshwater National Objectives Framework (NOF) reference group made up of representatives from iwi and public, private and academic sectors across the country, formed to advise and assist with the development of a National Objectives Framework. The framework is designed to guide regional councils in the setting of freshwater objectives and policies in their regional plans.

"It's been an interesting process and often involved healthy discussion and debate within the group," says Brenda. "Scientific information is critical, but just one of many factors that inform policy - there were also social, cultural, economic, business and political considerations."

Lakes and rivers now need to meet minimum requirements for ecosystem health and human health for recreational purposes. Some of the attributes used to measure these two values, such as nitrate toxicity in rivers, have numeric standards assigned to them including national bottom lines, which are underpinned by robust science.

"More national numeric attributes will be included in the NOF over time but until then, it is up to regional councils to include attributes they consider appropriate to manage the freshwater values in their region," explains Brenda. "Some councils have already started this process and are setting their own numeric limits for attributes such as sediment and nutrients, in consultation with their communities."

"This will be a big challenge for forestry - having enough people on the ground to



*Freshwater reforms herald a change to the way freshwater is managed.*

be able to participate in these community processes and ensure forestry is not disadvantaged going into the future," she says. "Another is the cyclic nature of forestry. Occasionally, forestry activities affect water quality - increased sedimentation as a result of harvesting for example. This needs to be balanced against the freshwater ecosystem services forestry provides for the intervening 20 or so years, but is something which is often overlooked."

Chief Executive Warren Parker is encouraging forestry land holders to be actively involved in the consultation processes.

"Wider community consultation is already underway in the Bay of Plenty on rules for the allocation of nitrogen discharge limits on land holdings exceeding two hectares. Rural land holders have been informed and should get involved because the rules that are finally confirmed will define the scope of 'sustainable' enterprises for land units in the long term."

The hard work of improving New Zealand's fresh water is only starting and it is a process that will take decades. But the future of forestry and its contribution to water quality looks promising, with hearty discussions around sediment already taking place in some regions.

**For further information:**

Contact Dr Brenda Baillie at [brenda.baillie@scionresearch.com](mailto:brenda.baillie@scionresearch.com)

### Contents

What will the new water standards mean for forestry?	1
Forestry can improve water quality	2
Greater flexibility for quarantine treatments	3
Building community awareness of fire risks	4
Giving forests a head start with good weed control	6
Packaging design with science and technology	7
Pictures explain results	7
Rapid screening for <i>Phytophthora</i> pathogens	7
Upcoming events	8
Telling our stories	8

# Forestry can improve water quality

The Government's new National Policy Statement for Fresh Water Management will have far-reaching, long-term effects on land management, land use and water quality. Although some perceive the minimum 'standards' for water quality to be lax, these are expected to tighten as confidence in applying the new framework grows.

Rural land holders face a future with tighter nutrient constraints and greater accountability to perform within specified water quality limits than in the past. Public consultation is already under way on the rules for the allocation of nitrogen (N) discharge and other limits on land holdings.

The re-allocation these rules are seeking to achieve is not trivial. For example, the current 750 tonne nitrogen load into the Rotorua Lakes each year needs to be reduced by 320 tonnes by 2032, with 270 tonnes of this coming from rural land holders. The near-term goal is to achieve 70% of this decrease by 2022, with tax and rate payers contributing \$45 million towards the cost. At Lake Taupo, nitrogen inflows are to be reduced by 20% (100 tonnes per annum) by 2021, the public cost of which is \$81.5 million. The 'Healthy Rivers' project is also underway to improve water quality in the Waikato and Waipa Rivers by reducing nitrogen, phosphorus, sediment and bacterial loads by 2030. The public cost is at least \$220 million over 30 years.

It is clear that the public cost of reversing the decline in water quality is quickly mounting. The new framework for managing freshwater will ultimately see more of the cost internalised to those responsible for the deterioration in water quality. Many land owners will need to either change their management practices, their mix of enterprises, or co-operate with others in their catchment in order to meet the new limits.

This provides a great opportunity for the positive role of forestry in sustainable land management to be highlighted and better appreciated by the public and those responsible for implementing regional and district policies. Vitally, forests provide ecosystem services that counter the effects of pastoral and other high nutrient input agricultural activities. For example, trees require little or no fertiliser, store carbon, slow water run-off and mitigate flooding, prevent erosion, enhance biodiversity and improve landscape aesthetics. However, forests can generate negative environmental effects if poor practice at harvesting allows sediments and log trash into waterways, or the spread of wildings. In some catchments, forests may compete for water.

At Scion we are therefore looking at a range of technologies to mitigate these externalities and increase the economic returns from forests - such as new biotech approaches to tree breeding to generate sterile conifers, and better harvesting practices. Achieving better returns for wood processors through product diversification and efficiency gains is essential too.

We also want to ensure forestry's negligible requirement for fertiliser does not preclude greater use of nutrients in the future as the third, fourth and fifth rotations of forests are harvested - a forest might leach 2-6 kg/ha/annum of N compared to 9-16 kg/ha/annum N for sheep and beef cattle, or 35-70 kg/ha/annum N for dairy. In principle, enterprises with a low environmental footprint such as forestry should not be strategically disadvantaged by the new rules, but rather, encouraged. In this context, profitability must be viewed from both a land owner's and New Zealand perspective and include the 'true' costs to society (or externalities).

The new National Policy Statement for Freshwater Management thus starts to get to the nub of addressing the issue of externalities - some land-use activities privatise more benefits and socialise greater costs than others. In recent times, this state of affairs has disadvantaged forestry despite it being good for both the environment and the economy.

To improve our understanding of forest ecosystem services and their contribution to sustainable land use and the economy, and encourage increased forest plantings to assure wood supply (and improve New Zealand's greenhouse gas profile) from the mid-2020s, we have significantly boosted our capabilities in resource economics and value chain optimisation. We are also increasing our focus in remote sensing, 'big data' capabilities and soil science to help the forest industry fulfil its economic, environmental and social potential for New Zealand.

In this edition of *Scion Connections* you can read about other actions we are taking to improve the forest industry's competitiveness. You are most welcome to contact me or any of the authors listed to discuss these topics.



Warren Parker, Chief Executive



**Want to know more?** Contact Dr Warren Parker at [warren.parker@scionresearch.com](mailto:warren.parker@scionresearch.com)



The golden-haired bark beetle, *Hylurgus ligniperda*.

# Greater flexibility for quarantine treatments

Some of the tight scheduling pressures around log exports for ports and log marshalling companies have been eased, thanks to Scion's forest protection scientists.

In June this year, the Ministry for Primary Industries (MPI) extended the maximum post-fumigation exposure period for export logs during winter from 72 hours to 21 days for all of New Zealand ports except Northland. This is the period logs can be held after fumigation before having to be re-treated due to the risk of re-infestation.

The decision, which was based on Scion's on-going research into phytosanitary pest behaviour, will have huge economic benefits for the export log industry.

At present New Zealand's international trading partners require log exports to have approved treatments applied year round. Research Leader Dr Steve Pawson says the extended post-fumigation exposure period is a positive step towards achieving a treatment free, low risk winter period and responding to mounting global pressure to reduce the use of methyl bromide, a widely known and accepted phytosanitary treatment.

"Our forest protection scientists have been gathering information on distribution

and population levels of forest pests throughout the country for the past two years," says Steve. "We have installed traps at forest sites and ports around the country, and the data we collect on insect flight activities are matched with meteorological conditions. This pest activity data supports MPI's decision-making on post-fumigation exposure periods."

At present New Zealand's international trading partners require log exports to have approved treatments applied year round.

The new regulation provides log marshallars with far greater flexibility to schedule fumigation treatments between periods of bad or cold winter weather. It will also largely eliminate the need to fumigate a buffer volume of logs, traditionally up to 5% of the cargo.

"Extending the time between having to re-treat logs means we will reduce costs

in the supply chain and have more flexibility around getting our goods to market," says Don Hammond, Chairman of Stakeholders in Methyl Bromide Reduction (STIMBR). "Importantly, we can also improve our environmental performance. These are all of great significance to the forestry industry. The sector can build on this achievement and apply it across other export products.

"Vitaly, this once again confirms the credibility of New Zealand's science in the eyes of off-shore markets and government agencies. We can't underestimate the value of that."

The new regulation provides log marshallars with far greater flexibility to schedule fumigation treatments between periods of bad or cold winter weather.

For Steve though, the next step is a real-time assessment of risk. "This was a very warm winter and a serious test to the concept of a winter fumigant-free period.

"Pest trapping will continue to expand our data bank. Long term, we want to use these data, information on landscape composition and forest harvesting activity to develop a model that can predict the risk of pest infestation at any location and at any time. This will allow decisions on treatment to be based on an assessment of the actual risk. We also want to see how we can apply these data to Northland, which currently handles about 15% of the country's log exports.

"Further work will involve expanding this pest-free period out of the port and into forests where we can in the future, confidently dispatch logs straight onto the ship without having to fumigate. Forest management activities will play a key role in this."

Having a three month fumigant-free period has the potential to save industry millions in averted fumigation costs and will protect New Zealand's access to overseas markets for forest products.

Scion would like to acknowledge the support of MBIE, STIMBR, and the Primary Growth Partnership fund for supporting this programme.

For further information visit our website: [www.quarantinetreatment.wordpress.com](http://www.quarantinetreatment.wordpress.com)

#### For further information:

Contact Dr Steve Pawson at [steve.pawson@scionresearch.com](mailto:steve.pawson@scionresearch.com) or Don Hammond at [don@hrml.co.nz](mailto:don@hrml.co.nz)



Scion has developed a range of fire behaviour models and prediction tools.

# Building community awareness of fire risks

Scion's Rural Fire Research Team has been running hot this past year with the fire research programme again receiving Gold status in the Ministry of Business, Innovation and Employment's (MBIE) annual reporting round, one of only 18 awards over 250 contracts.

This is a huge achievement for the team. The success is due in part to the development of new technologies, particularly fire behaviour tools such as smart phone 'apps', and a range of tools and recommendations for end-users based on sound science. It's also reflective of the extensive collaboration undertaken by team members with researchers, industry groups and communities, both nationally and internationally.

## Photo guide makes it easier to identify fuel type

Over the years Scion has developed a range of fire behaviour models and prediction tools to help fire managers calculate how fast a fire is likely to spread and how best to control it. In the heat of the moment, choosing the wrong fuel type could prove a costly decision.

Scion's recently published *Guide to New Zealand Fuels* contains 110 pages of images and technical descriptions of the different fire fuel types in New Zealand, making it easier for fire managers to choose the most appropriate behaviour model to use in prediction tools such as the Fire Behaviour Field Manual or smart apps.



"There are currently 18 individual fuel types recognised in New Zealand, with 18 fuel load and nine rate-of-spread models available to predict fire behaviour," explains fire researcher Veronica Clifford. "Selecting the proper fuel model that represents the fuel types present is one of the most important decisions to make

when choosing which fire prediction model to use. For example, a fire in a forest or sparse scrubland with a grass understory may be supported entirely by the grass rather than the trees themselves and their behaviours are very different.

"Fire managers have to assess the physical characteristics of the fuels present too - like quantity, moisture content, condition and arrangement. Environmental aspects and site conditions also play a major role in fire behaviour."

"There are currently 18 individual fuel types recognised in New Zealand, with 18 fuel load and nine rate-of-spread models available to predict fire behaviour."

For added versatility, a condensed version of the photo guide for field use is available along with an electronic version that has been added to Scion's Fire Behaviour Toolkit calculator software. The photo guide and prediction tools are already being widely used by fire managers.

## Mapping the high-risk zones

At a more strategic level, the research team has developed a way of mapping the risk of wildfire in rural-urban areas. Areas that are particularly vulnerable are where flammable vegetation borders

people and property, jeopardising people's lives should fire break out. The methodology will have enormous benefits for rural fire managers.

"Knowing areas that have a high fire risk means fire authorities can prioritise their activities - like fire prevention measures, or creating fire breaks, reducing vegetation and promoting FireSmart communities," says fire researcher Grant Pearce. "Councils and fire agencies can also use this information to strengthen planning and building regulations in high fire risk zones."

### Areas that are particularly vulnerable are where flammable vegetation borders people and property, jeopardising people's lives should fire break out.

This information will be collated with similar studies on other natural hazards as part of Scion's work with the 'Resilience to Nature's Challenges' science challenge to help communities build resilience to the forces of nature.



### Keeping our firefighters fit and well

Following a thorough review of the National Rural Fire Authority (NRFA) health and fitness guidelines for volunteer firefighters, our Fire Research Team has proposed a new 'fit for purpose' approach to fitness standards.

Fighting forest and rural fires is physically demanding and a high level of fitness is required to minimise fatigue and to work competently and safely. The study provides recommendations for minimum fitness standards for different firefighting tasks, based on discussion with firefighters and fire agencies, and a review of international approaches.

### Building community resilience to wildfires

Around 3,000 wildfires occurred each year between 1992 and 2007, and research suggests that many rural communities

are unaware of the risk of causing rural fires and ill prepared to protect themselves should one occur.

"Communicating with communities in wildfire areas is not a simple one size fits all approach," says social scientist Lisa Langer, who has recently completed a study aimed at increasing community awareness, careful use of fire and preparedness for wildfire. "Communication needs to be targeted, with messages tailored to suit the audience. Fire users and non-users within rural communities need different messages, and various methods of communication are appropriate in particular situations. For example, rural or semi-rural fire users need to be kept aware of fire risks, restrictions (such as permits and fire seasons), and prevention and preparedness should a wildfire occur.

"Similarly, recreational fire users, such as those lighting campfires and fireworks, need tailored communications on awareness, fire restrictions and fire prevention, whereas non-users just need messages on awareness and how to be prepared for wildfires to ensure everyone in the community is safe."

The 'Effective Communication' study is part of a wider Australasian Bushfire CRC programme, 'Communicating Risk', led by RMIT University in Melbourne and Lisa hopes to combine her research with studies undertaken in Australia. She is currently providing rural fire communication recommendations for New Zealand agencies based on her findings.

### "Communicating with communities in wildfire areas is not a simple one size fits all approach," says social scientist Lisa Langer.

Lisa has also been working with the Technical University of Lisbon to adapt the study for use with rural Portuguese communities and provide a wider international perspective. Information gathered as part of all these studies will be used to explore the nature of community networks and help communities be better prepared for natural disasters in the future.



#### For further information:

Contact Dr Richard Parker at [richard.parker@scionresearch.com](mailto:richard.parker@scionresearch.com)





Scion is looking at ways to overcome some of the common weed problems faced by the forestry sector.

# Giving forests a head start with good weed control

Good weed control during a forest's early years is necessary for tree survival and growth, and ensures timber yield throughout the life of the stand.

Scion's Weed Management Team is looking at ways to overcome some of the common weed problems faced by the forestry sector and its 'licence to operate' as certified by the Forest Stewardship Council is maintained.

## FSC-compliant alternatives for weed control

The two most widely used herbicides in forestry are terbuthylazine and hexazinone, providing excellent control of major weeds. Both herbicides, however, are classified as hazardous by the Forest Stewardship Council (FSC) and forest growers are granted permission to use them under certain restrictions while further research is underway to find alternatives. Over the past two years, our research team has been trialling herbicide mixes that could potentially replace these herbicides.

"The use of terbuthylazine remains in question," says Research Leader Carol Rolando. "But we are researching potential alternative herbicide options for the forest industry that will minimise off-site impacts of herbicides while maintaining productivity."

## The effects herbicides have on our environment

Forest harvest residues may play an important role in managing the risks

associated with aerially applied herbicides, according to soil scientist Loretta Garrett.

The research team recently completed a two-year study on the environmental outcome of terbuthylazine and hexazinone on planted forests in Pumice soils, to investigate their behaviour in the soil and water and to ensure their continued use in FSC-certified forests. Results indicated the environment was most at risk on the actual day of spraying and the month following. After then, low amounts of the herbicide were found on site due to rapid degradation, posing little risk to the environment.



"These results highlight the importance of forest litter and the retention of harvest residue organic matter on site in retaining terbuthylazine and to some extent hexazinone, limiting its movement down the soil profile," says Loretta.

Other soil types likely to be vulnerable to leaching include Recent and Raw soils.

"These results highlight the importance of forest litter and the retention of harvest residue organic matter on site in retaining terbuthylazine and to some extent hexazinone, limiting its movement down the soil profile."

"The lack of information we have at this stage about how herbicides behave on other forest soils, or underlying site geology that may accelerate leaching, means there is still uncertainty about the risks these herbicides pose to the environment without further research."

## Controlling the spread of wildings

Scion is actively seeking ways to control the spread of wilding conifers. Wildings are a major threat to biological conservation within New Zealand, currently covering about 500,000 hectares from the central North Island to the South Island high-country. Many of these species were actively planted for erosion control. Those considered wildings are *Pinus contorta*, *P. nigra*, *P. sylvestris*, *P. mugo*, *P. pinaster*, *P. radiata*, *Larix decidua* and *Pseudotsuga menziesii*.

"Wildings grow in dense stands that have no economic value and reduce productivity of managed pasture, displace native biodiversity and alter the character of the landscape," says Carol Rolando. "Their impacts on productive land and on conservation values are well documented but control programmes present a number of challenges. As well as the sheer scale of the problem, some affected areas are remote and difficult to access, making it dangerous and costly to control. We are working to find effective, alternative herbicide treatments to control wilding infestations, as well as developing application techniques to minimise spray drift onto surrounding vegetation.

"We're also progressing a treatment and delivery system to kill isolated, scattered individual trees in remote and difficult to reach locations. Future research will probably focus on locating isolated wildings using remote sensing which will greatly reduce the costs of the current search and destroy method."

### For further information:

Contact Dr Carol Rolando at [carol.rolando@scionresearch.com](mailto:carol.rolando@scionresearch.com)  
Loretta Garrett at [loretta.garrett@scionresearch.com](mailto:loretta.garrett@scionresearch.com)



Dr Elspeth MacRae

## Packaging design with science and technology

Scion's General Manager Manufacturing and Bioproducts, Dr Elspeth MacRae, was recently appointed to the Executive Committee of the Packaging Council of New Zealand (PAC.NZ).

"It's exciting for Scion to be part of the packaging industry and helping implement the Council's strategy for the future," says Elspeth. "In return, our involvement will help position the industry in other areas of benefit such as the National Science Challenges, the Virtual Centre for Food Safety and our global research networks."

The Packaging Council plays an active role in supporting New Zealand's packaging industry from raw material suppliers to manufacturers and service providers. It also promotes the sustainable management of packaging to ensure minimal waste and the 'reduction, reuse, recycling and recovery' of all packaging products.

As Elspeth says, "Creative packaging is as much about product appeal as it is about functionality and ensuring a product reaches the consumer in the best possible condition. A lot of design, research, science and technology goes into developing packaging that both looks good and protects the product inside, as well as having good end-of-life options.

"The research we do here at Scion on product development and performance testing on paperboard and plastic packaging, and other biopolymer and wood composite materials will underpin the Council's advocacy of the packaging industry."

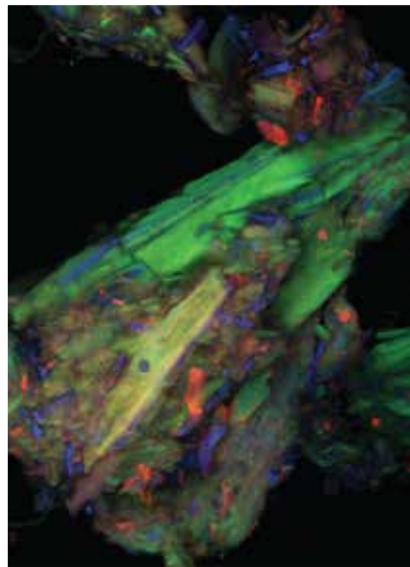
### For further information

Contact Dr Elspeth MacRae at [elspeth.macrae@scionresearch.com](mailto:elspeth.macrae@scionresearch.com)

## Pictures explain results

Fluorescence imaging and spectroscopy have provided our scientists with new insights into the molecular interaction that takes place during the conversion of softwood biomass into simple sugars and lignin. This is a vital step in the production of biofuels and biochemicals.

Softwoods, such as radiata pine, are technically challenging to convert into sugars. To overcome this, Scion's biofuels researchers developed an enzyme-based process that breaks down the cellulose and hemicellulose components in pre-treated wood, into simple sugars. These sugars can then be fermented into biofuels such as ethanol or converted into biochemicals.



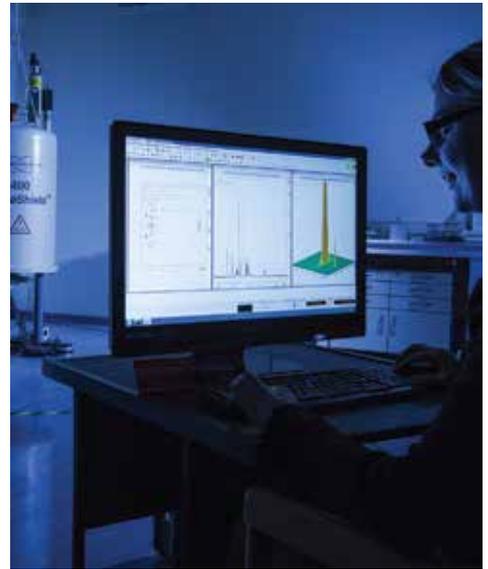
Steam exploded wood showing fluorescence of lignin (blue), cellulose (green) and cellulase enzyme (red).

Until recently, the effectiveness of this process was limited by the enzymes binding unproductively with lignin instead of the cellulose and hemicellulose, but experiments by our researchers have found this can be improved by adding small amounts of additives, such as polyethylene glycol (PEG).

The results can now be explained visually at a molecular level. By using fluorescence imaging, researchers have been able to show that PEG binds more strongly with lignin than the enzymes do, freeing up the enzymes to work their magic on the sugars.

### For further information

Contact Dr Ian Suckling at [ian.suckling@scionresearch.com](mailto:ian.suckling@scionresearch.com)



## Rapid screening for *Phytophthora* pathogens

Work is underway to develop rapid screening methods for *Phytophthora* pathogens in radiata pine, apple species and kauri as part of Scion's 'Healthy trees, healthy future' programme. Metabolomics is one such method, which screens for changes in a plant's metabolites that may indicate infection. This approach combines nuclear magnetic resonance (NMR) and mass spectroscopy to identify indicator chemicals in plant extracts, and changes to these chemicals, for rapid and cost-effective diagnosis.

NMR data provides a characteristic chemical fingerprint that can detect if a plant is in a healthy state or is being challenged by, for example, a pathogen or an environmental factor. NMR data is used to detect the class of compounds that are changing; this is then explored further using mass spectroscopy to identify the individual compounds.

Scion has recently expanded NMR sampling capacity with the purchase of two new cryogenic grinders. The grinders can pulverise leaves, needles, roots and wood tissue rapidly making it possible to analyse around 50 samples a day.

Using these methods to screen metabolites in both healthy and infected plant tissue will help identify genetic markers, or indicators, of infection. Ultimately, when combined with genetic studies, this new knowledge will help tree breeders select for greater *Phytophthora* resistance.

### For further information

Contact Dr Stefan Hill at [stefan.hill@scionresearch.com](mailto:stefan.hill@scionresearch.com)



## Telling our stories

Scion's involvement in a growing number of collaborative, multi-disciplinary research projects brings with it the need to communicate with a broad spectrum of collaborators, researchers from within Scion and from other institutions (often internationally), industry partners and end-users.

To make information about some of our larger research programmes readily accessible, we have developed a number of websites to keep all those involved up-to-date on progress and developments. Regular newsletters are also published for many of these programmes, which are available in both electronic and hard copy.

### Growing Confidence in Forestry's Future

A joint initiative between Scion, the forest growing industry through the Forest Research Committee and the Ministry of Business Innovation and Employment (MBIE) to raise the profitability of commercial forestry.

[www.scionresearch.com/gcff](http://www.scionresearch.com/gcff)

### Healthy Trees, Healthy Future

A multi-disciplinary, inter-agency programme led by Scion to address the biosecurity threat of *Phytophthora* species to New Zealand's agri-forestry, horticulture and natural ecosystems.

[www.healthytrees.co.nz](http://www.healthytrees.co.nz) (coming soon)

### Bioresource Processing Alliance (BPA)

An alliance between four national research providers: AgResearch, Callaghan Innovation, Plant & Food Research and Scion aimed at expanding the country's export market opportunities through the creation of high value products from low value biological resources.

[www.bioresourceprocessing.co.nz](http://www.bioresourceprocessing.co.nz)



### TERAX™

An organic waste management technology jointly developed by Scion and Rotorua District Council that eliminates the volumes of organic waste going to landfill.

[www.terax.co.nz](http://www.terax.co.nz)

### Alternative Quarantine Treatments for Logs

A Scion-led research programme in collaboration with Plant & Food Research, the University of Canterbury and Bayesian Intelligence aimed at finding sustainable alternative quarantine treatments for New Zealand's log exports.

[www.quarantinetreatment.wordpress.com](http://www.quarantinetreatment.wordpress.com)

## Upcoming events

### ABRN Science Symposium - Next Generation Liquid Biofuels and Co-Products

**Distinction Rotorua Hotel, Rotorua.  
16 October 2014, 9am - 9pm**

The Advanced Biofuels Research Network Science Symposium is being co-located with the Appita Fibre Value Chain Conference and Expo on 15 October and the Bioenergy Association of New Zealand Conference on 17 October.

Internationally the pulp and paper sector is leading the way into the production of biofuels, biochemicals and the emerging bio-based materials. This suite of conferences will include a wide selection of speakers and has been structured so that you can attend all or a selection of conferences (discounts apply to multiple event registrations).

Further details can be found at [www.appita.com](http://www.appita.com)

### Bayesian Network Modelling Society Conference and Tutorials

**Pre-conference tutorials: Waiariki Polytechnic, Rotorua.  
24-24 November**

**Conference: Holiday Inn, Rotorua.  
26-27 November**

Scion is hosting the Australasian Bayesian Network Modelling Society Conference and tutorials in Rotorua. The tutorials provide a great introduction to the basics of Bayesian Network Modelling for assessing risk and making decisions in the face of uncertainty.

Check our website for details [www.scionresearch.com](http://www.scionresearch.com)

## Subscribe to Scion Connections ...

... and receive our latest news every three months in the post or direct to your inbox. Visit [www.scionresearch.com/scion-connections](http://www.scionresearch.com/scion-connections) to subscribe for the electronic version or email [publications@scionresearch.com](mailto:publications@scionresearch.com) to order your hard copy - please put "Scion Connections" in the subject line.

We'd love to receive your feedback on *Scion Connections*. Tell us what you think by emailing [publications@scionresearch.com](mailto:publications@scionresearch.com)

ISSN 2230 - 6137 (print) ISSN 2230 - 6145 (online)

© 2014 NZ Forest Research Institute Limited, trading as Scion.

*Scion Connections* is published quarterly, and is also available online at [www.scionresearch.com/scion-connections](http://www.scionresearch.com/scion-connections)

If you'd rather receive this newsletter via email, or wish to change your address details please email [publications@scionresearch.com](mailto:publications@scionresearch.com)



**SCION**   
forests · products · innovation

49 Sala Street,  
Private Bag 3020,  
Rotorua 3046, New Zealand  
Telephone: +64 7 343 5899  
Facsimile: +64 7 348 0952  
[www.scionresearch.com](http://www.scionresearch.com)