

Chair & Chief Executive's Overview

We welcome you to this Statement of Corporate Intent (SCI) for 2012–2017, which sets out our purpose, strategic initiatives and science priorities for 2012/13. There has been a significant phase of evolution in the direction and structure of our science and interaction with our stakeholders during 2011/12. Landcare Research has adapted itself to the recommendations of the 2010 CRI taskforce and the new expectations of its shareholders. New Zealand, like many countries, faces the imperative to create jobs and growth without undermining the natural environment on which society depends. Landcare Research is well organised to respond to this challenge.

Our science is now arranged in ten Portfolios, each of which is a hub for aligning our resources with those of our stakeholders to achieve outcomes for New Zealand. Our Portfolios will be dynamic, evolving with changes in the operating environment and developments in science. A growing emphasis on technology transfer will see greater involvement of our stakeholders in the lifecycle of our scientific work. The need to bring excellent science to bear on national challenges will see us continuing to build the footprint of our scientific capability through recruitment, development and collaboration in New Zealand and overseas.

Major developments are taking place in our ability to contribute to all four national outcomes in our core purpose. Land resources underpin about 25% of our national GDP. Their importance means we are creating a national centre to make land resource information easily accessible and to facilitate land-use decisions. Many water quality and availability issues originate with land-use; so we are investing in technologies to improve freshwater quality and the efficiency of its use. The fate of carbon in the soil – a larger sink of carbon than the atmosphere – is critically important to our national greenhouse gas balance. The impact runs into billions of dollars. We have therefore invested in a new facilities and research programmes that will throw light on this challenging issue.

Our national flora and fauna are a key part of New Zealand's identity. The need for security against exotic weeds, pests and diseases threatening our indigenous biodiversity and primary production means that we are investing in a new plant pathology science facility and collaboration with partners in Australia. Where economic activity impacts biodiversity our skills in the measurement and management of biodiversity are of increasing importance. We are also engaged in international initiatives to assess and manage ecosystem services – the natural infrastructure on which all economies depend.

As we work with businesses and policy-makers our focus is increasingly on what can be done rather than what cannot be done — a focus on solutions rather than problems. In order to scale up our solutions and give them private sector, commercial support we are working increasingly with the National Network of Commercialisation Centres and look forward to collaborating with the proposed Advanced Technology Institute.

Our underlying financial position is strong and our key performance indicator of return on equity in our science business will continue to meet or exceed the Government's cost of borrowing. A tailored rate of return is achieved where the Board recognises opportunities to invest in science and/or assets to secure the long-term viability and increase the value of the CRI to New Zealand. Science revenue from all sources is not anticipated to grow significantly in the current economic climate of constraint, both in the public and private sectors. Therefore we now focus strongly on adding greater value through our science and improving the overall efficiency of our operations. We are actively engaged with the other CRIs and universities to share resources and improve efficiency across the science sector. Our overseas collaborations also contribute by enabling us to bring knowledge and technologies to New Zealand. They also help to sustain our scientists at the forefront of their fields of endeavour and maintain the reputation of New Zealand for leading science and its application.

Jo Brosnahan
Board Chair

Richard Gordon
Chief Executive

Landcare Research at a Glance

Landcare Research is one of eight Crown research institutes (CRIs) formed in 1992. CRIs function as independent companies but are owned by, and accountable to, the New Zealand Government. Our shareholders are the Minister of Finance and the Minister of Business, Innovation and Employment.

Our Core Purpose is to drive innovation in New Zealand's management of terrestrial biodiversity and land resources in order to both protect and enhance the terrestrial environment and grow New Zealand's prosperity. We have 380 staff at nine locations across New Zealand, including our subsidiary carbonZero Holdings Ltd at Lincoln and Auckland. We collaborate extensively with other research organisations in New Zealand and around the world.

Our science revenue (about \$59 million per year) is derived primarily from contracts with the Ministry of Business, Innovation and Employment (MBIE), Ministry for the Environment (MfE), Ministry for Primary Industries (MPI), Department of Conservation (DOC), Animal Health Board (AHB), local government, private sector businesses and organisations, and Māori organisations.

Our Board of Directors is appointed by the Government. The recent CRI reforms transferred significant accountability for investing in science and innovation to CRI Boards. Landcare Research receives approximately \$24 million per year of government revenue in a Core Funding Agreement from MBIE, and the Board is accountable to shareholding Ministers for the impacts and value achieved from investing this money in research Portfolios to achieve our four National Outcomes.

The Board also has the option of reinvesting operating surplus (strategic investment) in specific initiatives that are strategically aligned to our Core Purpose. High value initiatives consist mostly of science infrastructure but may include significant, cutting-edge research initiatives within our science Portfolios.

The Board is charged by the shareholding Ministers to take strategic advice both from leading scientists and key stakeholder partners (see page 28) through Advisory Panels.

Manaaki Whenua – Manaaki Tangata Care for the land – Care for the people

Our Māori name means to care for the land in all senses. Māori are tangata whenua, the indigenous people with whom we consult and collaborate. Our recognition of and respect for Māori as tangata whenua is reflected in our Vision Mātauranga strategy.

www.landcareresearch.co.nz

Statement of Corporate Intent 2012-17

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(Manaaki Whenua)

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Landcare Research's Niche

Our Vision

Science and environment for a better New Zealand.

Our Core Purpose

Landcare Research's Core Purpose is to drive innovation in New Zealand's management of terrestrial biodiversity and land resources in order to both protect and enhance the terrestrial environment and grow New Zealand's prosperity.

Stakeholder Partnerships

Landcare Research will fulfil its Core Purpose through the provision of research and transfer of technology and knowledge in partnership with key stakeholders including industry, central and local government and Māori, to achieve four National Outcomes.

Our National Outcomes

- Improve the measurement, management and protection of New Zealand's terrestrial ecosystems and biodiversity, including those in the conservation estate.
- Achieve the sustainable use of land resources and their ecosystem services across catchments and sectors.
- Improve the measurement and mitigation of greenhouse gases from the terrestrial biosphere.
- Increase the ability of New Zealand industries and organisations to develop within environmental limits and meet market and community requirements.

Our Scope of Operation

Landcare Research is recognised as the lead CRI in the following areas:

- Catchment-level ecosystems (including wetlands) and related ecosystem services
- Terrestrial vertebrate pest control
- Terrestrial carbon processes and inventory, and other greenhouse gases from soil and land
- Land cover, land use capability and effects, and spatial land information that integrates across sectors and scales
- Soil characterisation, processes and services
- Integrated social and biophysical research to support the sustainable management of terrestrial biodiversity and land resources.

Landcare Research is expected to work with other research providers and end-users to contribute to the following:

- Biosecurity, land, soil and freshwater management
- Climate change adaptation and mitigation
- Industry and business environmental performance including verification
- Indigenous forestry
- Urban environments
- Antarctica

Our Approach

We will:

- Focus on *growing the prosperity* of New Zealand across the dimensions of economy, society, culture and environment.
- Be proactive in working with stakeholder partners to develop *evidence-based solutions* to *present and projected challenges*.
- Use *collaborative research* and *integrative approaches* in creating solutions that bridge sectors, scientific disciplines, mātauranga Māori, and both landscape and temporal scales.
- Address *complex environmental problems* and the associated often-polarised views of stakeholders with appropriate techniques, and be proactive in ensuring the *role of our science* evolves to meet the expectations and needs of society.
- Achieve high standards of *science excellence* and *science capability*, which are supported by *careful stewardship* of and *strategic investment* in our knowledge assets, capability and key infrastructure, to benefit New Zealand.
- Achieve *effective and timely technology and knowledge transfer* to meet the needs of end-users, community stakeholders and research collaborators.

Operating Environment

Economic Development & Green Growth

The pressure for economic development, export growth and productivity gains is greater than ever in the aftermath of the global economic crisis and the Canterbury earthquakes. Within economic development, the importance of the natural environment and water resources are increasingly recognised because they underpin primary production, market competitiveness, national identity and New Zealand's contributions to global issues (e.g. biodiversity loss, climate change). Our soil resources alone, for example, are estimated to underpin 25% of New Zealand's GDP. Our challenge is to find solutions that enable New Zealand to develop economically but within environmental limits. Greening growth is an opportunity that applies both to how we do business as a nation but also the export opportunities for New Zealand in countries that seek greener solutions to their own challenges. The 2011 report of the Green Growth Advisory Group is important in this respect.

The Innovation Ecosystem

The innovation ecosystem is the web of inter-connecting players, processes and levers that create value from knowledge. As this concept gains traction in New Zealand, organisations will gain greater understanding of each other's roles. CRIs are skilled connectors, bringing together the creators and users of knowledge and facilitating its application. Landcare Research plays an unusual role in the innovation ecosystem because the natural environment touches so many aspects of national value — economic, social and cultural — and we make connections across all of those aspects.

Accessibility of information and knowledge is the key to an effective innovation ecosystem and is a major requirement of our work. The Government is focused on an open-access framework for the management and public provision of data and is supporting the development of ultra-fast networks and high performance computing facilities (e-science). Policy and funding agencies increasingly depend on e-science and robust integrative modelling across local, national and even global scales. The Government clearly expects the science sector to create new opportunities and benefit for New Zealand from these technologies.

Rebuilding Christchurch

A successful Christchurch is essential to both the South Island and wider New Zealand economies. Following the most devastating earthquakes, the rebuild provides the opportunity to showcase and develop technologies relevant not only to Christchurch but to all other cities. Manufacturing and ICT service sectors can contribute to growth in the surrounding rural economy by building skills, productivity and export opportunities. Our low impact urban design and development science and 'green' technology contribute solutions for these sectors and also in the social arena.

Landcare Research has a special interest in opportunities for organisations around Christchurch, where our headquarters is based. We are working with other Canterbury-based organisations to enhance the potential of sustainable land-based production in the local region. This is designed to focus the considerable local resources on a major challenge: to very significantly increase the economic value generated from the land while also increasing environmental and social capital. The intent is also to attract investment and new businesses into the science precinct formed in the triangle between Lincoln/Rolleston, Christchurch and Ashburton.

Strategies for Industry

The primary production, minerals extraction and tourism sectors need solutions for their particular environmental issues. Government is also emphasising the role of the high value manufacturing and services sectors in developing environmental solutions. For example, innovative agri-technology such as variable rate irrigators combined with real-time information on soils from our science delivers significant improvements in effective water use by intensive agriculture and reduces the risk of ground water contamination.

Natural Resources and Assets

New Zealand needs to enhance its long-term economic return from land and water resources by making use of them while sustaining the natural assets. These assets include the ecosystem services that support healthy urban environments and primary production – for example, provision of clean water, nutrients, pollination – and support society through aesthetic, cultural and spiritual benefits. This does not automatically imply limiting resource use; rather it focuses on how resources are allocated and managed. Themes of collaborative governance (e.g. for water allocation) and market mechanisms (e.g. for nutrients and biodiversity management) are increasingly important and informed by our science and tools.

Māori Business

Significant economic resources are being returned to Māori through Treaty of Waitangi settlements. These represent major opportunities for economic development. Matching land use to the land's capability and its ability to sustain ecosystem services are central to strategies for sustainable economic gain from the land. Decision-making by Māori organisations usually takes a holistic approach, linking the environment with people, history, culture and the economy. Our science increasingly embraces a similar integrated approach aligning scientific and traditional knowledge for better understanding.

Science's Evolving Role in Society

Scientific organisations must contribute to national conversations on increasingly complex environmental issues in which views may be polarised, where the risks are high, and there is no 'right' answer. In recent years climate change has been such an issue. In New Zealand, land and water issues increasingly fall in this category. Our science must provide evidence on which effective government policy can be based, support strategic green-growth thinking by industry, and be able to connect with other sources of knowledge (e.g. mātauranga Māori).

Skills Succession and Collaboration

International competition for talented environmental scientists is increasingly fierce, making it a constant challenge for New Zealand research organisations to attract and retain the best and brightest. Collaboration both within New Zealand and with overseas organisations is a necessary strategy to grow the pool of skills and innovative thinking that we can access. CRIs are moving strongly to collaborate on skills recruitment and development.

Pan-CRI Shared Services and Procurement

We participate in several pan-CRI initiatives intended to improve effectiveness of delivery on our Core Purpose and greater efficiency with consequent cost savings. Joint action, as well as benchmarking and implementation of best practice across participants, are key elements. The pan-CRI procurement forum, formed in 2009, currently delivers measurable savings of \$3 million annually across its eight members. This includes \$1 million in insurance savings (pre-earthquake baseline). The forum complements the all-of-government procurement reforms. Landcare Research also participates in the pan-CRI insurance collective. In addition, a wide-ranging review of functional services, such as information services, has begun to identify where pan-CRI sharing can add value and reduce costs. We have completed an initial pan-CRI study of human resource policies and practices, and initiated stage two of this programme to identify specific actions.

Science Framework for National Outcomes

Goal

Landcare Research's science framework is clear, effective and facilitates engagement with stakeholders who collaborate with us in achieving National Outcomes.

Achieving Outcomes for National Benefit

Our Science Framework is focused on contributing to the achievement of four National Outcomes for New Zealand (see Our Core Purpose, page 4). Outcomes represent the agreed benefit to be derived from public investment in our science. It is a reality of environmental science that some benefits are more readily quantified than others. For example, economic benefits from greater water-use efficiency in agricultural production can be more readily quantified than societal benefits from the conservation of iconic species or forests. To help us understand and measure benefit for each Outcome, we have identified two Impacts that focus on (i) status and trends — what natural assets are there, what value they have or could have and (ii) management solutions — the ways that we both use and sustain these assets. Key performance indicators on a 3–5 year timescale show how our progress towards Impacts can be assessed.

Research Portfolios

Science initiatives needed to achieve Impacts (and hence Outcomes) have been clustered into ten research Portfolios. The clustering process brings complementary areas of science together to work on a common purpose. Portfolios interact with each other and individual science projects may contribute to different Outcomes simultaneously (e.g., work on ecosystem services may contribute to both the biodiversity and land resources Outcomes). The Portfolios reflect the multi-disciplinary nature of environmental science and trans-disciplinary nature of our Outcomes.

Our ten research Portfolios are:

- Defining Land Biota
- Measuring Biodiversity Change
- Managing Biodiversity
- Managing Invasive Weeds, Pests & Diseases
- Enhancing Policy Development
- Characterising Land Resources
- Understanding Ecosystem Services & Limits
- Realising Land's Potential
- Measuring Greenhouse Gas & Carbon Storage
- Supporting Trade

Portfolios — the outward face of our research activities — achieve impacts; they are flexible, responsive to end users' needs, reasonably dynamic, and the focal point for interacting with our key partner stakeholders. Portfolios include research by collaborating organisations, and are funded by contributions from several sources, including our Core Funding Agreement with MBIE, key partners (government ministries and departments, local government, industries and iwi) and internal strategic investment. Portfolios are of significant size (approximately \$5m per year).

One of our strengths is our ability to manage, integrate and interpret huge quantities of complex information and deliver it in the form of solutions fit for stakeholders' needs. For example, more sophisticated models and user-friendly decision support systems are being developed for diverse applications such as managing possum control through to evaluating ecosystem services at regional and national scales.

Aligning Portfolios to Outcomes

Delivery of each of our National Outcomes is being met through research in specific Portfolios. Each Portfolio is a coherent body of research with a clear focus that addresses one or more Impacts. The following pages provide the rationale for the Outcomes, summarise the Impact statements agreed with our shareholders and how these are aligned to our stakeholders' key priorities. Our most significant stakeholder partners in terms of

research revenue are DOC, MPI, MfE, AHB, and local and regional government. Our work with many businesses and industry sectors is growing and strategic engagement is mostly through BusinessNZ, MED, Dairy NZ, FAR and Future Forests.

Portfolio Leaders are responsible for developing five-year rolling plans and delivering a set of agreed milestones and outputs to make strong progress towards Impacts and Outcomes. 'Success' will be reviewed by MBIE and other key partners, our Science Advisory Panel and our Board of Directors.

Key Performance Indicators

- Percentage and number of relevant funding partners and other end-users that have a high level of confidence in Landcare Research's ability to set research priorities, and the effectiveness of the collaboration or partnership (*MBIE indicator with data provided from their external survey*)
- Percentage of relevant national and international research providers that have a high level of confidence in the Landcare Research's ability to form the best teams to deliver on its Outcomes (*MBIE indicator with data provided from their external survey*)

National Outcome 1: Improve measurement, management and protection of New Zealand's terrestrial biodiversity, including in the conservation estate.

Key Performance Indicator

- The status and trend in national and regional biodiversity show an improvement in biodiversity in some environments, and a halt in the decline of representative examples of all others.

Outcome rationale

Demonstrating improvements in biodiversity status at local, regional and national scales will enable us to protect our New Zealand lifestyle, facilitate appropriate development, and meet international obligations to care for our unique plants and animals. Research will identify the most threatened components of biodiversity and will highlight the most immediate opportunities to improve the delivery of effective policy and conservation management.

The integrity of our iconic natural places, and the biodiversity they support, is central to our identity, lifestyle and the economy. Intergenerational responsibility for the management of indigenous ecosystems, expressed through kaitiakitanga, is also central to Māori aspirations. The effective management of biodiversity must be undertaken in the context of more complete knowledge of its composition and of changes in its state through time and in different ecosystems.

Impact 1.1: Trends in national and regional biodiversity on public and private land are known and understood, based on best available definitions and descriptions for species and indices of ecological integrity.

Key Performance Indicator

- DOC and regional councils are using comparable metrics to measure status and trend and impacts of interventions on biodiversity within their jurisdictions

Impact 1.2: Frameworks are in place to ensure the most threatened ecosystems, habitats and species are managed to reduce the risk of decline in native biodiversity.

Key Performance Indicator

- Consents related to land-use change under the RMA are informed by a scientifically-based set of criteria that take account of cumulative effects on habitat availability
- Management decisions by DOC, MPI and regional councils, aimed at reducing threats to species and habitats, are based on robust risk models that reflect best available knowledge about the efficacy, cost and acceptability of management strategies and tools.

Key Stakeholders' Priorities

DOC

- Understand and manage agents of biodiversity decline and change
- Classification systems and assessment methodologies to enhance reporting on biodiversity change
- Improved tools and practices to manage species and ecosystems

MPI

- Prevention and reduction of harm to the natural environment from pests and diseases
- Protection and sustainable use of biological resources

MfE

- State of Environment reporting
- Proposed National Policy Statement on Biodiversity

Regional Councils

- Comprehensive terrestrial biodiversity monitoring
- Indexing biodiversity value in productive landscapes

Business

- Stimulate private sector to measure and manage biodiversity
- Business tools for biodiversity and ecosystem management

Māori

- Mātauranga Māori and science to support kaitiakitanga and co-governance of terrestrial ecosystems

Key Portfolios aligned to Outcome 1

Measuring Biodiversity Change

Improving the measurement, analysis and interpretation of change in the status of biodiversity at a range of spatial and temporal scales will benefit public and private conservation initiatives, and land management decisions.

Research in this Portfolio will increase our understanding of trends in biodiversity and, very importantly, how such trends relate to natural ecosystem dynamics, diverse climate and soils, land-use and invasive species (including effects of multiple weeds and pests interacting with each other). More robust measures of ecological integrity will also demonstrate the link to ecosystem services. Research will specifically assess the effectiveness and difference made by management interventions. Other research in the Portfolio is using long-term data to evaluate how human activities affect biodiversity in Antarctica, and the impacts of climate change and fisheries on penguin populations.

An area of relevance to Māori is our work with Ngā Uri o Whakakii, a hapū of Ngāpuhi on measuring population trends in sea birds that breed on Ririwha, Northland, to support sustainable cultural harvesting.

Key Research Initiatives 2012/13

- Develop standardised, consistently applied measures of biodiversity, for use by DOC and regional councils to monitor, report, prioritise and inform policy for the management of indigenous biodiversity
- Develop the tools and predictive models of ecosystem dynamics needed to interpret trends in ecological integrity on public and private land for DOC and regional councils
- Develop the tools required to determine the difference made by management in influencing trends in indigenous biodiversity on public and private land for DOC and Regional Councils
- Maintain and develop the National Vegetation Survey databank as a world-leading repository of vegetation data. This nationally (and internationally) significant database is used by researchers, local and central government agencies as a major information source for understanding and reporting on status and trend in New Zealand's plant biodiversity
- Develop new tools to link trends in biodiversity, ecosystem services and changing land management on public and private land for DOC, Māori and Regional Councils
- Synthesise existing Adelié penguin data from past surveys over many years to determine population trends as an indicator of environmental change

Key Knowledge and Technology Transfer Activities

- Working with regional councils and DOC to progress the suite of indicators for regional-scale biodiversity monitoring, consistent with the national biodiversity monitoring and reporting system, and to ensure these indicators meet reporting needs (domestic and international); holding regular meetings with DOC and regional councils to plan research and knowledge transfer
- Working with DOC to support New Zealand participation in the recently formed Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). IPBES will be the science-policy interface to build capacity for and strengthen the use of science in policy making
- Engaging with industry (e.g. energy sector) to identify impacts on biodiversity and potential assessment and offsetting activities for major development plans
- Advising Antarctica NZ, MFAT, CCAMLR and CEP on a marine protected area network in the Ross Sea

Key research partners include the University of Queensland, the Arthur Rylah Institute for Environmental Research, the University of Cambridge, the Swedish University of Agricultural Sciences, Stanford University, the University of Canterbury Waikato University (all are partners in various aspects of terrestrial biodiversity management); and NIWA and Antarctica New Zealand (sustaining the Ross Sea ecosystem).

Managing Biodiversity

This Portfolio will lead to improvements in the targeting and efficacy of policy and management intended to protect and restore terrestrial biodiversity.

Research focuses on (i) determining the effect of losing genetic diversity and keystone species, (ii) understanding the character and significance of naturally rare ecosystems for sustaining biodiversity, and (iii) improving the resilience of major threatened biomes. Projects also cover how biodiversity in sensitive ecosystems (wetlands) and ecotones (treeline) responds to major disturbances (fire, climate and human impacts) over variable ecological time scales in order to determine the impact of global change.

Research of particular relevance to Māori includes wetland ecosystem management with the Tainui Waikato Raupatu Rover Trust; podocarp forest management with Tūhoe Tuawhenua Trust; a bicultural management framework to help increase coastal forest recovery with Hauraki, Ngāti Awa, Ngātiwai and Ngā Uri o Whakaki; and Marsden-funded palaeoecological studies on the timing of settlement on the Chatham Islands Hokotehi Moriori Trust – Chatham Islands.

Key Research Initiatives 2012/13

- Determine biodiversity loss rates and significance, and provide research results on dryland ecosystems through relevant RMA forums to enable regional and district councils to develop policies and rules to protect dryland terrestrial biodiversity from cumulative loss on private land
- Review all knowledge gained on naturally rare ecosystems since 2005 and provide information for scientists, policy analysts, planners, industry and land managers via an updated web site featuring factsheets for all of 72 ecosystems
- Support a national workshop focusing on sustaining predator control, improving biodiversity outcomes and measuring biodiversity performance for organisations involved in maintaining predator-free areas
- Develop clear management guidelines to protect the ecological integrity of threatened ephemeral native wetland systems and communicate these to DOC, regional councils and other biodiversity protection groups
- Review the fire history of New Zealand ecosystems and provide a synthesis to predict fire-vulnerability of major biomes and the consequences for managing biodiversity persistence
- Develop new services (EcoGene[®]) to improve forensic DNA detection from scat and new species ID tools to detect multiple mammalian pests and native avian species

Key Knowledge and Technology Transfer Activities

- Providing information and tools (including DNA services by EcoGene[®]) for regulatory and policy agencies, iwi and community groups responsible for species recovery, protecting dryland ecosystems and for managing eco-sanctuaries, wetlands and indigenous forests
- Supporting the government's Wildlife Enforcement Group by providing court evidence to support prosecution of importers of illegal wildlife products e.g. ivory
- Organising and hosting the annual Sanctuaries of New Zealand workshop to ensure local community groups and trusts have the most up-to-date research for their eco-restoration and conservation programmes
- Working with iwi, and providing technical training for marae-based environmental management, e.g. for wetland and forest ecosystem management
- Supporting Te Tapuae o Rehua Limited with two scholarship to increase Māori capability

Key research partners include the University of Canterbury and Massey University (bird pollination and dispersal mutualisms); and the University of Otago (conservation genetics).

Managing Invasive Weeds, Pests & Diseases

Invasive species are the major threat to native biota (and primary industries) in New Zealand, and one of the top five drivers of global change. This Portfolio produces new or improved technologies and strategies for invasive species management to better protect biodiversity, and help meet community expectations (humane, environmentally-friendly and safe tools) and market demands for green products and tourism.

Research will increase both understanding of species interactions and invasive species ecology, and the cost-effectiveness of control at local and landscape scales. This will enhance our ability to predict biodiversity impacts, prevent incursions of unwanted species, and suppress or eradicate invasive species over large areas of New Zealand through improved targeting and efficacy of weed, pest and disease management.

Of interest to Māori is our work with Tūhoe to develop strategies for managing possums for biodiversity goals while at the same time providing economic livelihood from fur and skin trapping; and our work with Kaupapa Kererū, a Ngāi Tahu-led conservation initiative on Banks Peninsula, providing research advice as needed. We also actively develop Māori capacity through postgraduate student supervision.

Key Research Initiatives 2012/13

- Progress a 50% reduction target in the cost of aerial application of 1080 baits in large-scale pest control for the livestock industry (AHB) and DOC
- Develop a user-friendly model for predicting the level of herbivore control required to increase tree survival to acceptable levels, in order to provide DOC with quantitative estimates of the benefits of current herbivore management strategies on forest health at specific sites
- Identify persistent environmental contaminants or diseases/pathogens that are known, emerging or unrecognised threats to New Zealand biota to help MfE and MPI prioritise management and monitoring actions, and facilitate processes for impact analysis
- Determine the impact of herbicides versus biocontrol on heather (a significant invasive weed) to enable DOC and the New Zealand Army to demonstrate the benefits to biodiversity from targeted biocontrol compared to non-target herbicides
- Develop new knowledge on distribution, density, and impacts of at least one invasive invertebrate species and integrate this into ecological models to enable DOC and regional councils to estimate biodiversity losses across landscapes
- Complete controlled field experiments on multi-trophic interactions among plant-herbivores-fungi-fungivores-predators to help DOC and regional councils evaluate the impacts of introduced biocontrol agents on native biodiversity, and determine negative effects of local predators on the success of introduced biocontrol agents

Key Knowledge and Technology Transfer Activities

- Providing tools for pest control businesses, farmers and agencies to improve the cost-effectiveness of weed, pest and disease control, and to measure outcome success
- Assisting DOC with accurate and reliable predictions of beech masting to plan for pest irruptions
- Upskilling industry and government in pest control strategies through the hugely popular annual 'Biosecurity Bonanza'; weed biocontrol training courses for councils and DOC; the annual National Education and Training Seminar of the NZ Biosecurity Institute; outcome-focused training workshops; and a range of print and on-line newsletters

Key research partners include the Invasive Mammals Cooperative Research Centre (pest animals); AgResearch (weeds, including prioritisation, population modelling, herbicide use and optimising biodiversity benefits from weed management); Lincoln University (invasive mammal impacts); and the University of Auckland (invasive mammal impacts and the Joint Graduate School for Biodiversity and Biosecurity).

Strategic Investment:

Participation in the Invasive Animals CRC

The Invasive Animals Cooperative Research Centre (IA CRC) is an AU\$19.7M programme of research and extension activities spanning all aspects of managing terrestrial and freshwater vertebrate pests, including pest fish, reptiles, birds and invasive mammals. The IA CRC is funded by Australia's Department of Innovation, Industry, Science & Research (DIISR), and recently received five years of extension funding for the period July 2012–June 2017. Landcare Research has an international reputation for delivering high-quality, evidence-based solutions to invasive species problems, and because of this, we were invited to participate in the IA CRC.

Our new investment and involvement in the CRC targets invasive species of concern to both New Zealand and Australia — species that pose significant threats to economic productivity, and which also have conservation impacts on native plants and animals. Our investment will support capability and capacity building through new post-doctoral positions focused on operations research, bio-economic and ecological modelling, risk assessment and decision-making.

Benefit

Benefits will accrue primarily towards addressing Outcome 1 (through managing threats to biodiversity) and Outcome 4 (through maintaining market access). As a result New Zealand will better realise the potential of its productive lands through land owners and policy-makers having better tools to reduce the impact of pest species. New Zealand lacks capacity in some critical areas of invasive species management. Landcare Research's investment will address these gaps and also MBIE's top priority in its Environment Sector Plan — 'stronger prediction and modelling systems'. Additional benefits include new strategic links to Australian institutions and agencies, with opportunities to engage collaboratively in international projects that will enhance New Zealand's scientific reputation, especially in China and other Asian countries.

Becoming a Core Participant provides for a guaranteed 2:1 return on our annual investment over the next five years through research contracted to the CRC.

Strategic Investment:

Plant Pathogen Facility at Auckland:

Landcare Research is a world-leader in weed biocontrol and the dominant provider of this research in New Zealand. Biocontrol depends on containment facilities for the safe introduction of biocontrol agents (largely insects and fungal pathogens) and subsequent testing, experimentation and breeding. To carry out this work, we require ready access to secure, world-class facilities acceptable to New Zealand statutory authorities. There is currently no glasshouse facility available in New Zealand to undertake work on plant pathogens *in-planta* requiring a high level of containment (i.e. beyond PC2).

Investment in a new facility will strengthen our research on both incursions of unwanted plant pathogens that are readily able to penetrate biosecurity defences, and host-specific plant pathogens that have significant potential as biological control agents for an escalating weed problem in New Zealand. (Completion due August 2012)

Benefit

The facility will save New Zealand the cost of contracting work overseas. The facility will also have significant potential to benefit New Zealand, and will enable research to be safely undertaken into pathogens threats to native flora (e.g. Kauri dieback PTA), and others that pose a risk to the horticultural and agricultural estates (e.g. kiwifruit PSA bacterium).

Further, genetically modified organisms could be investigated safely within this new facility enabling ground-breaking new research into interactions between plant pathogens and their hosts. The threat of pathogens to native species and commercially important crops in New Zealand could be assessed in this manner, an area of research in which Plant and Food have indicated interest.

The facility will also enable us to bid for biocontrol projects in the wider Pacific where pathogen containment facilities are lacking despite the widely acknowledged urgent need to conduct weed biocontrol research across the region.

Defining Land Biota

This Portfolio is primarily responsible for the preservation, maintenance, and development of five Nationally Significant Collections and Databases (see Appendix 1), associated data-infrastructure, and related systematics research that underpins the scientific value of these biological collections and supports end-user needs.

It implements research priorities that were agreed with key stakeholders (iwi, DOC, MPI, EPA, Museum of New Zealand Te Papa Tongarewa). New opportunities for discovery and accurate definition of our biodiversity are being realised by the combination of innovative sequencing technologies, collections management, modern electronic infrastructures, classical taxonomy, phylogenetics and biogeography.

This portfolio helps support iwi development, cultural heritage initiatives, and underpins their conservation management. Research includes our ethnobotanical information resources and nationally significant living collections of harakeke (*Phormium* spp, flax) and tī (*Cordyline* spp, cabbage trees); and our broad consultation with iwi on how to manage DNA extraction from specimens held in the Allan Herbarium.

Key Research Initiatives 2012/13

- Develop and maintain and keep scientifically current our five collections as world-class facilities to provide DOC, regional councils and MAF with agreed collection services that underpin understanding and reporting on national and regional biodiversity on public and private land and support management decisions aimed at reducing threats to species
- Develop new on-line tools that improve accessibility to, and usability of, authoritative, fit-for-purpose information associated with the Collections to support DOC, MPI, regional councils, iwi, universities and other research organisations, including other Portfolios
- Undertake systematic research (incl. DNA diagnostics) on plant pathogenic bacteria to support border protection and industry sectors in the successful protection of our biological economy and market access
- Undertake systematic research on fern groups for publication in the electronic Flora series that supports scientific research, biodiversity reporting by DOC and regional councils, and threatened species management by DOC, MPI, iwi and regional councils
- Revise the taxonomy of native Noctuidae moths for a future volume in the Fauna of New Zealand series that supports scientific research and the various needs of DOC, MPI, industry and regional councils for accurate identification of species, threatened species monitoring, and faster recognition of new potential pest species
- Reconstruct the formation (phylogeny) of New Zealand's Compositae (the largest and most significant plant family for biodiversity, weeds and primary production) using modern DNA technology to support DOC, MPI, iwi and regional councils in the management of biodiversity

Key Knowledge and Technology Transfer Activities

- Providing precision identification services that facilitate market access and to assessing biosecurity risks
- Developing the New Zealand Organisms Register (NZOR) infrastructure and engaging with potential end user partners to progress the on-line inventory of all recorded biodiversity in New Zealand to support research, conservation and biosecurity issues
- Publishing definitive flora, fauna and mycology guides, plus numerous user-friendly on-line information systems, resources and identification guides based on our systematics research
- Enabling local communities to understand and appreciate local biodiversity through our biennial BioBlitz 24-hour biodiversity event ('finding nature in the city'), with extensive participation by many other agencies, schools and general public

Key research partners include Te Papa (plant systematics); Te Papa and NIWA (New Zealand Organisms Register – NZOR; electronic Flora); the Allan Wilson Centre (evolutionary pathways); Plant & Food (Botrytis genetics) and Auckland Museum, Scion, University of Canterbury, Massey University, Lincoln University, University of Otago, University of Waikato and Australia's Virtual Herbarium partners (NZ Virtual Herbarium).

National Outcome 2: Achieve the sustainable use of land resources and their ecosystem services across catchments and sectors.

Key Performance Indicator

- New Zealand land use is matched within the land resource’s environmental limits and key ecosystem services are maintained or enhanced.

Outcome rationale

Land resources include the soil’s dynamic physical, chemical and biological ‘systems’, and the land cover, topography and hydrology. Land resources sustain primary production, ecosystem services (e.g., clean water, fertile soils) and the aesthetic benefits upon which New Zealand’s economy, tourism, identity and brand are based.

Effective management of land resources requires improved knowledge of their variability and change over time and across catchments and landscapes (natural, managed and urban), their response to human impacts, and potential environmental limits. Improving knowledge assets will enhance policy development for land use and resource allocation; improve the economic and environmental performance of primary sector; and support government in meeting international reporting obligations. Our soils and land science capabilities are complemented by our informatics skills in accessing and analysing land information, and making it accessible in appropriate ways.

Impact 2.1

The status and trends of land resources and ecosystem services (including their interactions) are known and understood.

Key Performance Indicator

- LCDB (land cover), LUDB (land use), S-map (soil) and ESDB (ecosystem services) components of LRIS (Land Resource Information System) have been enriched and are being used under the New Zealand Government Open Access Licensing framework for web-services.

Impact 2.2

Opportunities and threats to land resources and ecosystem services are recognised and balanced to maintain or enhance the provision of ecosystem services.

Key Performance Indicator

- Regional councils and the irrigation, pastoral and arable sectors are using knowledge of soil variability to improve the match between land use practices and land capability.

Key Stakeholders’ Priorities

DOC

- In situ real-time monitoring
- Enhanced ecosystem resilience, understanding thresholds, and the provision of ecosystem services

MPI

- Understand sustainable use limits and resilience at farm, catchment and sector levels
- Scope and scale of ecosystem services needed and policies to protect and enhance them

Māori

- Tools and services to sustainably manage key Māori land resources and ecosystems

MfE

- More effective management frameworks to improve the quality and availability of fresh water
- Credible processes and targets for land and water monitoring and management

Regional Councils

- Determine full range of ecosystem services and underpinning processes
- Develop specific measures sensitive to change in ecosystem services

Business

- Better understand the value of land resources
- Tools to increase resource-use efficiency and reduce environmental footprints

Key Portfolios aligned to Outcome 2

Realising Land's Potential

This research enables industries and land managers to improve the alignment between land use and key environmental social, economic and cultural goals. Strategies to minimise, buffer or mitigate adverse environmental impacts from using and developing land (e.g. agriculture, tourism, energy production, mining, timber, transport) assist in maintaining a comparative advantage in competitive global markets, and improve the health of our land and water assets.

The Portfolio covers productive landscapes (including urban environments) and focuses on (i) supporting sustainable production within environmental limits, (ii) mitigating contaminants and emissions to maintain/enhance resource use and support licence to operate, and (iii) integrating land, water, biota, social, cultural and economic factors to improve resilience and adaptability of ecosystems. Future priorities will centre on system-wide approaches for resource use within multifunctional landscapes, and the tools and technologies that support this (e.g. eco-verification and fit-for-purpose certification, and off-set or mitigation practices). Research in this Portfolio also supports Outcomes 3 and 4.

Research of interest to Māori includes indigenous forestry with Tūhoe Tuawhenua Trust and Waitutu Incorporation.

Key Research Initiatives 2012/13

- Develop understanding of soil variability to inform precision agriculture and irrigation approaches, improve water and energy-use efficiency and reduce environmental contamination
- Scope an improved erosion hazard assessment approach that can be used by industry, regional and central government to improve land use management and inform policy on targeting high risk areas for mitigation
- Establish a new procedure for direct measurement of nitrous-oxide and nitrogen during denitrification as an alternative to conventional approaches to facilitate more rapid assessment of losses and improve understanding for land managers and policy agencies
- Develop new understanding of contaminant leaching (such as for cadmium) so that the efficacy of mitigation measures (such as raingardens) can be enhanced enabling environmental consultants, city and regional councils to understand and cost-effectively manage environmental contaminants
- Refine our understanding of biofilters as technologies for managing and/or mitigating methane to enable land managers and central government agencies to reduce liabilities and support productive land use
- Develop the concept of multi-functional landscapes that enhance ecosystem services alongside economic production

Key Knowledge and Technology Transfer Activities

- Working with the irrigation, fertiliser and agriculture industries to integrate our knowledge of soil properties and soil variability with precision irrigation to improve water and energy-use efficiency and reduce environmental contamination
- Supporting regional councils in the development of best practice and guidelines for land-use management to improve surface and groundwater quality
- Developing erosion modelling tools for regional councils and the primary production sector to improve management of erosion-prone hill country and to reduce sediment loads entering rivers

Key research partners include AgResearch, ESR and NIWA (clean water, productive land); ESR (biowastes); Scion (non-timber values of forests); AgResearch and Plant & Food Research (our partners in the Sustainable Land Use Initiative, SLURI); University of Waikato (soil dynamics) and the Pastoral Greenhouse Gas Research Consortium (nitrification inhibitors)

Understanding Ecosystem Services & Limits

This portfolio will enable more confident decision-making to sustain the life-supporting qualities of ecosystems. Globally, there is growing concern that the exploitation of ecosystems and land use intensification is causing widespread declines in ecosystem condition. Nationally, there is an urgent need to develop evidence-based policy that takes ecosystem services and limits into account (e.g., the scope of work by the Land & Water Forum).

The scientific goal of this portfolio is to better understand the key pressures and drivers of ecosystem change, the consequences for ecosystem properties and processes, and ultimately ecosystem services (i.e. benefits such as carbon sequestration, water availability, and contaminant removal). Research will help policy-makers understand what drives ecosystem change, and the spatial and temporal trade-offs in managing for different or multiple ecosystem services. The Portfolio will lead data integration and syntheses across disciplines, determine the consequences of ecosystem degradation or rehabilitation, and ultimately resolve to what extent ecosystems are able to provide sustainable services.

Key Research Initiatives 2012/13

- Develop a robust approach for evaluating ecosystem services using model systems for soils, biota and external drivers, and standardised measurements to enable DOC and regional councils to effectively understand and report on state and trends in ecosystem services
- Evaluate current evidence for ecosystem limits, using New Zealand information for (i) biotic effects on soil services, (ii) weed impacts in ecosystems, (iii) flow and degradation of contaminants in soils, (iv) erosion within catchments, (v) soil natural capital, and (vi) water and nutrient caps for watersheds.
- Develop a research strategy for quantifying the drivers and impacts on ecosystem services associated with land use intensification.
- Scan pathways for research uptake and develop a strategy for valuation of ecosystem services and the knowledge needed for incorporating ecosystem services into policy development and decision making for land management. This will include engaging with Māori to identify cultural values and environmental limits

Key Knowledge and Technology Transfer Activities

- Delivering seminars and workshops to regional councils, iwi and industry to increase awareness and understanding of processes that determine ecosystem services and their significance in policy and land resource management
- Most of the work in this Portfolio is transferred to our other research Portfolios across all four Outcomes.

Key research partners include AgResearch and ESR (sustaining soil services); and Stanford University, Swedish University of Agricultural Sciences, University of Aberdeen, Lancaster University, and the University of Nevada (increasing ecosystem resilience to weeds).

Characterising Land Resources

This research underpins improvements in land management, identification of new sustainable land use opportunities and enables monitoring of land use intensification trends and impacts.

The Portfolio is responsible for the stewardship of data and infrastructure associated with our nationally significant land and soil databases, including the acquisition of new data through field surveys and by using LiDAR and standard remote sensing technology. Our role is to enhance the quality, accuracy, spatial coverage and accessibility of soil and land information. Research focuses on (i) creating fit-for-purpose data and information, now and for the future, (ii) stewardship of authoritative data and information asset, and (iii) designing smarter, ready-to-use ways of communicating information. The Portfolio supports the National Land Resource Centre.

Of particular relevance to Māori is our work in developing the on-line Māori Land Visualisation Tool, with earlier support from Te Puni Kōkiri.

Key Research Initiatives 2012/13

- Enhance the quality, spatial coverage and access to soil data to enable regional councils, fertiliser companies and the agricultural industry to understand soil variability and thereby improve agricultural land management
- Develop improved mapping and data synthesis methods to assess land cover state and trend to enable central government and regional councils to easily and cost-effectively understand and report on the implications of land use change
- Quantify the errors and uncertainty associated with two land resource datasets, including identifying the key sources of uncertainty across scales, and determining how best to communicate this to end-users to improve the use of land resource science as an evidence base

Key Knowledge and Technology Transfer Activities

- Providing regional councils, primary production sector groups (e.g. Dairy NZ) and MPI with models of nitrate leaching to surface and ground water from agriculture — evidential support for policy setting and to support improve land use and irrigation efficiency
- Using remote sensing technology to map the state and trend of ecosystem services for government and local government, particularly carbon sequestration from net afforestation, and loss of high class land to urbanisation over the last 20 years
- Providing a remote sensing and LiDAR data, analyses and applications to a wide range of users
- Developing the new edition of the Land Cover Database (LCDB3) with MBIE, MfE, LINZ, MAF, DOC, NZ Fire Service and regional councils
- Providing on-line access through the National Land Resource Centre (see page 20) to digital soil maps (S-map On-line), land resource and environmental data (Our Environment) and geo-spatial data (LRIS Portal) for users in government departments and ministries, local government, industry, universities and other researchers
- Working with Antarctica NZ to develop environmental domain mapping and to make Antarctic environmental data accessible through a web portal

Key research partners include AgResearch, Scion and Plant & Food Research (the Soil and Land Use Alliance); CSIRO Land & Water (the Oceania Node of the Global Soil Map); and Antarctic New Zealand (Antarctic soils and environmental domains).

Strategic Investment:

National Land Resource Centre

New Zealand's economy is founded on its land resources. Agriculture, forestry, mining and tourism provide more than 25% of New Zealand's GDP; hence our national prosperity is highly dependent on the 'land economy'. One of the Government's priorities is 'unlocking the potential of energy and natural resources' through innovation. Stakeholders are demanding fit-for-purpose, authoritative, ready-to-use information based on high quality, credible science to guide the choices they make in protecting, enhancing and leveraging the land economy. However the science of land resources is scattered across many providers and lacks coordination and strategy. Our investment in developing the *National Land Resource Centre* (NLRC) is intended to remedy this.

The NLRC will be an online and physical gateway to authoritative land resource data and information held by Landcare Research and other CRIs and agencies, and will optimise use of information assets. The NLRC is an opportunity to better coordinate stakeholders' needs for soils and land data, and so help prioritise research in our 'Characterising Land Resources', 'Realising Land's Potential', and 'Measuring Biodiversity Change' Portfolios and that undertaken by other science providers. Knowledge derived from research will be delivered through the NLRC.

Benefit

The on-going investment in the NLRC will deliver a step change in the accessibility of data and information needed by land managers and policy-makers to enhance the productive and sustainable use of our land resources. Greater access to more comprehensive land information will enable users to better tailor land use to the land's capability. Improved understanding the implications of different land uses on ecosystems services will support protection of these services. The Centre will also aid professional development and training in public and private sector organisations interested in land management through initiatives such as practitioner training workshops, secondments, internships and hosting visiting scientists. A further aim of the NLRC is to improve national science capability. With an ageing workforce in soil and land sciences, we need to foster new capability and capacity for the on-going stewardship of authoritative data and information assets, and to ensure we have the ability to respond to future information needs.

National Outcome 3: Improved measurement and mitigation of greenhouse gases from the terrestrial biosphere.

Key Performance Indicator

- New Zealand is meeting its international reporting obligations and reducing net greenhouse gas emissions from the terrestrial biosphere.

Outcome rationale

New Zealand must meet its international greenhouse gas reporting obligations and decrease net emissions of greenhouse gases from terrestrial systems below ‘business as usual’ levels. To achieve this, it is necessary to have (i) a robust inventory of net emissions and carbon storage, and (ii) effective mitigation options for reducing net emissions. Changes in emissions and carbon storage as a consequence of management, land use and global change can then be forecasted and appraised. Present uncertainties in, for example, soil carbon stocks have very large potential implications for reporting. Research is needed to develop new methodology for measuring soil carbon storage and quantifying changes in emissions as a consequence of key land use and management change. This will allow mitigation strategies to be developed and approaches for increasing carbon storage to be identified and adopted.

This is an area in which the science challenges are substantial and we are developing new national and international collaborations to address them. We have a significant role to play and are acknowledged internationally for our expertise in carbon and nitrous oxide science.

Impact 3.1

The status of terrestrial greenhouse gas emissions and removals are known, and changes in relation to management strategies, land use policies and global change are forecasted.

Key Performance Indicator

- MPI and MfE are using verified estimates of greenhouse gas emissions and carbon storage to reduce uncertainty in national inventories

Impact 3.2

Land use options, asset management and other methods that increase carbon storage and mitigate greenhouse gas emissions are understood and balanced for environmental, economic and social benefits

Key Performance Indicator

- Agricultural land managers and DOC are where appropriate, using validated methodologies and land use practices to mitigate greenhouse gas emissions and increase carbon storage and adapt to likely climate change effects

Key Stakeholders’ Priorities

DOC

- Climate change impacts on key ecosystems and species, and potential responses of pests
- Ways in which conservation land benefits from and contributes to carbon accounting

MPI

- A reduction in NZ’s agricultural GHG emissions compared to business as usual
- An increase in the removal of carbon from the atmosphere from forestry

Business

- Stimulate business reason to measure & mitigate GHGs
- Promote practical means for GHG mitigation

MfE

- Decrease NZ’s net GHG emissions below business as usual levels in a cost effective way
- Meet NZ’s reporting commitments (Kyoto)
- NZ’s emissions are managed through the ETS

Regional Councils

- Determine if we are stabilising and decreasing net emissions
- Ensure links between carbon storage and biodiversity management

Māori

- Capturing business opportunities to mitigate GHG emissions and create carbon sinks

Key Portfolio aligned to Outcome 3

Measuring Greenhouse Gases & Carbon Storage

This Portfolio contributes to reducing New Zealand's potential liability for greenhouse gas emissions and carbon stocks by ensuring national inventories meet international best practice. It is also overcoming the challenges implicit in developing cost-effective mitigation practices and technologies without reducing agricultural productivity.

Unlike most developed countries, half of New Zealand's greenhouse gas emissions are methane and nitrous oxide resulting from agricultural practices. As these gases are emitted at landscape scales and atmospheric concentrations are very low, there are high uncertainties in measurement. This Portfolio focuses on (i) determining the processes and drivers regulating greenhouse gas emissions from grassland, shrubland and forest systems, (ii) reducing uncertainties in measuring and scaling emissions and removals, and (iii) providing the modelling and analytical tools for assessing, scaling and reporting emissions at farm to national scales.

Research of most relevance to Māori will be establishing the potential for carbon sequestration on their lands.

Key Research Initiatives 2012/13:

- Quantify emissions of carbon dioxide, methane, and nitrous oxide and soil carbon changes in pasture, to improve understanding of the consequences of intensification for national level GHG inventory calculations
- Improve GHG emission models through better understanding of soil processes, parameterisation and integration to estimate and predict GHG emissions
- Develop novel techniques to improve understanding and estimation of farm-scale soil carbon stocks, and demonstrate effect of plant functional richness on carbon sequestration, for farm-scale management of soil carbon and for more accurate national inventory
- Predict carbon accumulation during natural regeneration of multiple-species woody plant successions and provide guidelines for their establishment and minimisation of threats to improve landholder ability to increase national carbon biomass
- Develop up-scaling techniques that incorporate improved GHG emission models to understand the impact of land-use change and stocking intensification on GHG inventories, and produce trend national maps

Knowledge and Technology Transfer Activities

- Working with the dairy industry to improve pasture nutrient management based on a range of process-based models (e.g. denitrification-decomposition) specific to New Zealand soils and climate
- Providing MPI with more accurate estimates of pasture quality at national scale using remote sensing to quantify the effects of policy scenarios on reducing emissions at farm scales, and to support implementation of the ETS
- Working with DOC to provide more accurate measurements of carbon storage and the potential for increasing carbon storage on conservation land
- Developing a range of process-based models, such as a denitrification-decomposition model specific to New Zealand soils and climate to improve pasture management for the dairy industry
- Supporting university teaching programmes and young doctoral and post-doctoral researchers in New Zealand and overseas through the joint professorial role that one of our senior researchers holds with Massey University
- Contributing to the research programme of the NZAGRC (see page 23)

Key research partners include AgResearch, NIWA, Lincoln University and Massey University (measurement and verification of greenhouse gas emissions); and Scion (carbon sequestration rates). We also contribute to the New Zealand Agricultural Greenhouse Gas Research Centre.

Our Role in the NZAGRC

The **New Zealand Agricultural Greenhouse Gas Research Centre** (NZAGRC) is a partnership of five CRIs, Massey and Lincoln universities, DairyNZ and the Pastoral Greenhouse Gas Research Consortium (www.nzagrc.org.nz/). The NZAGRC is a "virtual" Centre and the research that it funds is carried out by researchers working in their own organisations. Ninety five percent of agricultural emissions in New Zealand arise from the pastoral sector. For this reason, the primary focus of the NZAGRC's activities is on the pastoral sector. There are four research programmes dealing with: methane; nitrous oxide; soil carbon and integrated systems research.

Landcare Research is recognised as the lead CRI for research on terrestrial carbon processes and inventory, and greenhouse gases from soil and land. We contribute to the research in the NZAGRC through collaboration with other CRIs and Universities to: (1) study denitrification processes in soil, (2) quantify the level of carbon already stored in soils in New Zealand and (3) model soil carbon dynamics at a range of scales. We also provide leadership to the soil carbon programme jointly with Ag Research. In addition, there are opportunities to orientate some of our core-funded research around the aims of the NZAGRC. A recent example has been to establish a new research platform on a commercial dairy farm in Canterbury in partnership with Synlait, to determine the impact of intensification of dairy systems on greenhouse gas emissions and soil carbon dynamics.

National Outcome 4: Increase the ability of New Zealand industries and organisations to develop within environmental limits and meet market and community requirements.

Key Performance Indicator

- Integrated solutions add value in industry, international markets; meet and demonstrate compliance with regulatory and market requirements; reduce costs of production; and provide measurable benefits to local communities.

Outcome rationale

To achieve sustainable economic development, New Zealand must work within environmental limits and be responsive to local communities (licence to operate), the cultural context of Māori world view, and commercial markets and opportunities (licence to sell and being competitive).

Such development is becoming increasingly complex with no ‘right answer’ for resolving high risk and polarised viewpoints. The challenge is to bring together the community, the public sector as regulators and policy-makers, business as the economic engine, and scientists as providers of trusted evidence. This Portfolio is producing a better understanding of and resolving complex environmental issues, such as adapting to global change and reducing vulnerability to resource scarcity. Solutions that integrate economic, social, cultural and environmental dimensions may be applied within communities, market-places, governance structures or individual organisations.

Impact 4.1

Factors (including the form of institutions) required to resolve complex environmental issues adapt to global change and reduce vulnerability to resource scarcity are understood and recognised.

Key Performance Indicator

- Industry sectors, central and local government are making strategic use of research findings, associated indicators of performance, and new economic instruments to respond to complex environmental issues, global change processes and resource scarcity.

Impact 4.2

Best solutions that integrate economic, social, cultural and environmental initiatives maintain or enhance international competitiveness, market access and social license for business and industry to operate.

Key Performance Indicator (project-based to meet AHB’s priorities)

- Bovine TB is eradicated by AHB from vector populations in the two extensive and difficult forest areas

Alignment to Stakeholders’ Priorities

DOC

- Adaptive management ahead of climate change; pursuit of alternative economic instruments
- Linkages between biodiversity, ecosystems and prosperity; and community, Māori and business expectations and opportunities

MPI

- Primary sectors use natural resources and systems in an increasingly sustainable manner
- Adaptation to a changing climate (farmers, forestry and pest management)
- Prevention and reduction of harm to economic and cultural resources from pests and diseases

Māori

- Mātauranga Māori and science integrated to balance environmental, cultural, economic and social aspirations and achieve competitive advantage in the global market

MfE

- Frameworks to manage environmental effects and allocate resources within environmental limits
- Better solutions to environmental problems through community action, and international cooperation

Regional Councils

- Increase production and consumption while their environmental footprint is decreased
- Management tools that incorporate community, regulation and market tools

Business

- Promote understanding of environmental limits
- Integrating environmental performance to core business management strategy
- Eradication of TB from wild animal populations

Key Portfolios aligned to Outcome 4

Enhancing Policy Development

Effective policy, whether public or organisational, is an important component of resource management and planning as it provides the framework for sound decision-making. This Portfolio complements Landcare Research's biophysical science by focusing on the social, cultural and economic processes and information needed to improve policy performance.

Development of effective policy entails designing, undertaking and evaluating engagement processes and strategies; understanding preferences, values and governance processes for natural asset management; assessing information to underpin choices and decisions; designing policy instruments and their implementation; and tracking policy performance to enable adaptive management.

Our research spans urban, rural and conservation landscapes and catchments, the full-range of ecosystem services and natural resources, and a wide array of stakeholders – central and local government, industry, NGOs, community and Māori organisations. The Portfolio draws on research in a number of other Portfolios.

Areas of particular interest to Māori includes our work on environmental management and governance models for Tūhoe; and the incorporation of Māori cultural values in urban development, policy, planning and reporting with a number of iwi and city councils.

Key Research Initiatives 2012/13

- Refine catchment based agro-environmental economic models for regional councils and central government (NZ-FARM) to assess the economic and environmental impacts of their policy and planning decisions.
- Develop a framework for regional councils to track their performance against their stated outcomes in plans

Key Knowledge and Technology Transfer Activities

- Providing expert advice and knowledge to the Land and Water Forum to help develop governance structures for managing and allocating freshwater resources more effectively
- Assisting industry end users and policy makers by providing models that integrate environmental, social and economic impacts of different greenhouse gas mitigations at regional and national scale, their social acceptability and economic feasibility
- Regularly participating in the Regional Council Forum to explore and test alternative approaches to the decision-making cycle; and developing LU-CLASS, the land use classification and analysis support system for the Regional Council Land Monitoring Forum
- Contributing to on-going discussions with Christchurch City Council, CERA, ECan, industry, business and community groups around rebuilding Canterbury and how low impact urban design techniques could be incorporated

Key research collaborators include Aqualinc, Motu Economic and Public Policy Research and NIWA (Land & Water Forum issues, framework for interoperable freshwater models, nutrient trading and water quality); the World Resources Institute (policy instruments to address multiple ecosystems services); the Cawthron Institute, NIWA and AgResearch (water governance).

Supporting Trade

This Portfolio supports trade by enabling business, production and tourism industries to understand and meet community expectations and market demands for environmental responsibility and sustainable practices. Our approach links the economic, social, cultural and environmental aspects of business performance. The ability of businesses to understand their own performance, manage and where appropriate to report it publicly, is becoming increasingly important for market access and community licence to operate. The integrity of responses to such challenges is widely seen as critical to the New Zealand brand.

The portfolio includes our important research on bovine TB control, which is a trade compliance issue for New Zealand's animal industry. (AHB's mission is to eradicate TB from wild vector species across 2.5 million hectares or one quarter of TB risk areas by 2026, and eventually eradicate the disease entirely, to increase New Zealand's competitive in overseas food markets.) Also included is work on trade policy impacts, market developments in respect of sustainability and green growth, and our support to businesses implementing environmental management and reporting systems.

Key Research Initiatives 2012/13

- Ensure continuous incremental improvement in the cost-effectiveness and social acceptability of the disease control and surveillance strategies used to manage TB in wildlife, and assist AHB in further reducing the number of infected herds in New Zealand and in progressing their freedom from TB goal by more than 200,000 hectares per annum
- Improve existing rabbit control tools to increase both cost-effectiveness and social acceptability (e.g. animal welfare), and decrease environmental impacts (e.g. residues) to enable primary industries maintain or enhance productivity while meeting community and market needs
- Design new pest and weed management frameworks delivering measurable environmental or carbon benefits, which will enable primary and extractive industries to quantitatively off-set their environmental impacts and improve their environmental credentials
- Enhance the range of tools and systems available to New Zealand businesses to meet market and regulatory requirements through environmental management systems, e.g. water footprinting, biodiversity assessment and offsetting and public reporting

Key Knowledge and Technology Transfer Activities

- Working with AHB, DOC and regional councils to develop publicly-acceptable, environmentally-safe, and economically-efficient possum and rabbit control strategies and to evaluate and deploy them
- Working with BusinessNZ to implement a standard set of sustainability indicators and methodologies to support firms in public reporting and to enable benchmarking across sectors and businesses
- Working with New Zealand businesses wanting to enhance and demonstrate their environmental performance through green growth and certification activities

This Portfolio partners with Agribusiness and Economics Research Unit at Lincoln University, whose track record and expertise in global trade developments, environmental footprinting and economics strongly complements our own. Other key research partners include the University of Chicago and the Argonne National Laboratory's Computation Institute (global change and trade); Lincoln University (agribusiness); AHB and University of Otago (sustaining TB freedom); and Massey University (the Life Cycle Management Centre).

Strategic Investment:

Global Change and Trade

This on-going strategic investment focuses on the impact of global climate change on land-based primary production and international trade. More detailed and robust economic assessments of such impacts could play a key role in increasing the ability of New Zealand industries and organisations to develop within environmental limits and meet market and community requirements (Outcome 4).

This cutting edge project is enhancing Landcare Research's capability in integrated economic-environmental modelling, which is demanded increasingly by government policy groups. It is ambitious in that it requires comprehensive understanding of agricultural and forestry economics, and how primary productivity might be affected by climate change. Vast datasets are required to cover all the permutations of such complex biophysical processes and market forces. Developing integrated models and manipulating the data in meaningful ways are only possible using high-performance super-computing resources. To this end, we are collaborating with the internationally renowned Argonne National Laboratory's Computation Institute (CI) and University of Chicago, which was ranked first in the world in the Thomson Reuters global survey that assessed the impact of environmental research organisations over the period 2001-11. At the same time, we are looking to develop our internal capabilities to utilise the high performance/grid computing opportunities becoming available through NeSI (page 37).

The next stages are to work with our overseas collaborators to test a prototype of a spatially-detailed, dynamic economic model of land-based production in New Zealand. We have remote access to the CI's Petascale Active Data Store (PADS) that, with the help of CI technical and research staff, will be used to store and process very large spatial datasets (peta meaning quadrillion). These datasets will be used as inputs to very large-scale simulation campaigns on CI's supercomputers (5– 200 times more powerful than University of Canterbury's Blue Fern machine).

Benefit

This programme will increasingly enable New Zealand government and private sector organisations to develop climate change adaptation strategies. We will be able to investigate climatic uncertainty and management responses in much more detail than was previously feasible. The work is already attracting interest from CSIRO in Australia and US federal government agencies such as the US Department of Agriculture (USDA) and US Environmental Protection Agency.

strengthen relationships with industry and government for sustainable economic development. Key messages from this Panel were that Landcare Research needs to be bold in its mandate to lead; focus on a smaller number of important relationships; invest in supporting quality conversations and understanding values; improve communication; and reframe the way science is shared including the form, timing and language of delivery.

Outcome Scoping Groups

One or two *Outcome Scoping Groups*, consisting of senior managers from stakeholder organisations and our Portfolio Leaders will focus on the delivery of our National Outcomes. The role of the Groups is to help identify emerging issues and opportunities within a 10–20 year strategic horizon, and to scope new science Portfolios that would fit our Core Purpose and benefit New Zealand.

Steering Groups

Steering Groups will be formed when a product or service requires specific scientific advice on development, uptake, maintenance or implementation.

Key Performance Indicators

- Percentage and number of relevant funding partners and other stakeholders that have a high level of confidence in Landcare Research’s ability to set research priorities and the effectiveness of the collaborative partnership (*MBIE indicator with data provided from their external survey*)
- Total value of subcontracts to industry, government and Māori organisations per annum (*MBIE indicator*)

Technology & Knowledge Transfer

Goal

Landcare Research is at the leading edge of technology and knowledge delivery to users.

Context

Technology and knowledge transfer are core activities that support development of effective government policy, improve the environmental and economic performance of business and industry, and benefit the community. Transfer ensures research finding is put to work quickly to create value for New Zealand. Effective transfer and uptake require comprehensive engagement across many levels of stakeholder organisations— from CEOs to the people ‘on the ground’, and throughout all stages of projects — from identification of research priorities, project definition and initiation through to project completion and the implementation of new policies or processes. From time-to-time, we second our staff to regional councils, the Animal Health Board and government agencies specifically to assist with the uptake and implementation of research. Our biological control of weeds programme and integrated catchment management programmes work directly with NGO end users and farmers to prioritise work and speed uptake of research; and the success of these models has been recognised internationally. Print and e-newsletters tailored to the interests of stakeholder groups are well-received. Our Wellington lunchtime briefings on topical research issues attract good audiences and constructive debate among our stakeholders.

We also undertake a wide variety of initiatives with the community to raise awareness of particular issues and opportunities where our science can inform, benefit and aid the community initiatives. These initiatives and activities often involve a significant amount of voluntary personal time from our staff because of their commitment to making a difference.

Strategic Focus 2012/13

- We will increase our development of user-friendly ‘*web portals*’ that can simultaneously access and integrate multiple data layers from different sources across Landcare Research and other providers. Web portals appear deceptively simple but are highly efficient and powerful tools enabling more sophisticated environmental and economic modelling. We will work closely regional councils, ministries and other CRIs in developing the National Land Resources Centre (NLRC) (page 20).
- *Knowledge stewardship* refers to our responsibilities in relation to the use of information from our research and databases. We have a vested interest in the continued integrity and value of our data, what happens to it and how it is used by others. We will work with partners to enhance knowledge stewardship, agree on the appropriate form and timing for transfer of new knowledge assets, and the incorporation of tacit stakeholder knowledge into these assets. The latter will be highly relevant to Māori. Knowledge stewardship also includes helping our stakeholders to use our information effectively. (see page 37)

Strategic Investment

- The *National Land Resource Centre* (NLRC): The investment will enable us to further develop activities to lead the delivery of authoritative land resource information from Landcare Research and other providers, and the coordination of national research and capability development. (See page 20)

Key Performance Indicator

- Percentage of relevant end-users who have adopted knowledge and /or technology from Landcare Research (*MBIE indicator with data provided from their external survey*)

Vision Mātauranga

Goal

Landcare Research is a key part of strategic, science-related partnerships with iwi and Māori organisations in addressing Māori needs, issues and aspirations.

Context

Vision Mātauranga is a Government policy framework intended to unlock the innovation potential of Māori knowledge, resources and people to assist New Zealanders to create a better future. Landcare Research has a 20-year history of research projects with iwi. Initially our focus was on specific projects with Māori organisations and included developing geographic information systems (GIS) to represent cultural values and interests, and protecting taonga species. Landcare Research is now moving to a more strategic position with specific iwi, providing the science and technology needed to support them in the particular stage they have reached in the Treaty of Waitangi claim settlement process. Māori are looking to science and innovation to enable them to meet their aspirations, realise business opportunities, and achieve sustainable management of natural assets.

The Māori economy comprises \$40bn in assets, and in 2010 contributed 7.9% of GDP to the national economy, primarily through farming, forestry and fishing. Entities with established settlements, such as Ngāi Tahu and Waikato-Tainui, are seeking to grow their asset base by taking advantage of new land use opportunities identified by our research, and by expanding global business, export interests, markets and networks to accelerate sustainable Māori economic development.

The science and innovation sector must recognise and reflect Māori goals, principles and traditional knowledge systems (mātauranga). It is important that mātauranga is incorporated in the governance and management arrangements for entities being developed in the early stages of the settlement process so traditional values and approaches are thoroughly embedded as the entity matures.

Strategic Focus 2012/13

Our Māori Responsiveness Strategy crosses and links all four of our National Outcomes; there are three key areas within the strategy:

- Maintain and develop *responsive, long-term strategic relationships* with iwi and Māori organisations and use our science to help identify opportunities arising from the Treaty claims settlement process.
- *Grow our core Māori capacity* and *develop a strong bicultural ethos* to ensure our staff have the confidence to develop and maintain long term strategic partnerships with iwi and Māori organisations.
- *Integrate mātauranga Māori and science* to enable Māori to use our research, technology and information in developing the management and governance of natural assets.

Key Performance Indicators

- Number of positive strategic partnerships in which we are linking science and mātauranga Māori in projects with iwi and Māori organisations and which address Māori goals and aspirations.

Science Excellence & Collaboration

Goal

Landcare Research is recognised nationally and internationally for excellent science collaborative research with CRIs, universities and other organisations, including those overseas.

Context

Our science reputation is integral to our ability to attract and retain talented staff; and with such staff we can win research contracts and partner with the world's best research organisations to benefit New Zealand. We collaborate with other research organisations to assemble the best scientific capability for tackling environmental issues. This approach enables us to be at the forefront of science and technology developments relevant to our Core Purpose and National Outcomes, and it engenders trust among end-user partners and the wider community in research findings.

'Best Teams'

In recent years, New Zealand science has progressed from a highly competitive to a more collaborative culture. This trend has made it easier to assemble "best teams" – those that bring together the most appropriate capability and skills to address national challenges. We manage our capability within seven science teams that report to the Chief Scientist. These science teams are the long-term collegial 'home' for staff where they are able to develop skills and experience, plan career paths, and develop new ideas. The Chief Scientist and Science Team Leaders service the changing capability and capacity needs of the Portfolios. Where potential gaps are identified, we address these through partnering with other research providers in New Zealand and offshore; recruiting new staff with the required expertise; and enabling our staff to develop new capabilities.

In order to develop talent and new research ideas, we invest a subset of our Core funding in capability-building science projects of 1–2-year duration, inward and outward fellowships (see page 41), and post-graduate and post-doctoral training. We have made a strategic investment (see page 27) in partnering with the University of Chicago, which is the top ranked research organisation in the world.

Strategic Focus 2012/13

- We will track the quality of our science our performance against relevant national and international benchmarking sources. This will complement evaluation of our research impact and support on-going monitoring of our science performance by MBIE, stakeholder partners and peer review.
- We will use national and international experts to evaluate our research Portfolios, primarily in regard to science excellence and strategy, and to recommend areas for improvement.

Collaboration to Extend our Research Capability

Our wide-ranging focus on complex environmental issues *across* sectors and spatial scales complements the capabilities of the primary sector CRIs (AgResearch, Scion and Plant & Food Research), which are principally focused on economic performance *within* their sectors. Similarly, we complement other CRIs with an interest in the natural environment (NIWA and GNS especially). Landcare Research is a partner in several collaborative research centres, networks and consortia (Appendix 1) that pool capability in science areas relevant to the scope of our operations as outlined in our Statement of Core Purpose.

In areas of our core capability, Landcare Research partners with New Zealand government agencies (MFAT, MBIE) and international funders (private sector, philanthropists, NGOs, national governments and donors) on science projects across many countries in South America, SE Asia, the Pacific, China and Korea. Such

collaboration helps realise opportunities for New Zealand through support for trade and diplomacy, and also through the knowledge and experience that we bring back to New Zealand. Our highly successful biocontrol of weeds programmes depend on international collaboration — initially to locate and safety-test potential biocontrol agents overseas, then to collect and send likely candidates to us in New Zealand for further testing.

Strategic Focus on Collaboration for 2012/13:

- We will work with the primary production CRIs and sector organisation on environmental issues of relevance to their sectors (e.g. greenhouse gases in the dairy sector, and plant diseases in the kiwifruit sector).
- We will continue to collaborate with Plant & Food Research and AgResearch in the Sustainable Land Use Initiative (SLURI) www.sluri.org.net
- We will work with NIWA, production sectors, iwi and local government on issues linking land use to water quality and quantity. We will work with GNS, MPI and local government on long-term land erosion issues.
- We will continue to play a key role in leading bio-informatics research with DOC, Te Papa and other New Zealand and overseas agencies, geo-informatics research across the CRIs and universities, and through the government's National e-Science Infrastructure (NeSI - www.nesi.org.nz) high-performance supercomputer programme (see page 37).
- We will support government agencies working overseas by providing expert scientific input on global issues such as climate change, biosecurity and biodiversity. Similarly, we will have a foresight role interpreting overseas trends in environmental reporting, policies, standards and market expectations, and developing solutions for New Zealand's exporters.

Joint Graduate Schools and co-appointments with universities

We are committed to increasing our formal links with universities in order to grow sector capabilities and the involvement of staff and graduates in each other's research and technology transfer.

Strategic Focus 2012/13:

- We will co-supervise (and support) post-graduate students in research relevant to our national Outcomes through our Joint Graduate School in Biodiversity and Biosecurity with the University of Auckland. This will be enabled by several of our senior staff holding Professorial or Associate Professorial roles (each at 0.2FTE).
- We will identify opportunities for collaborative projects with Agri-business and Economic Research Unit at Lincoln University, facilitated by our recent appointment of our 'Supporting Trade' Portfolio Leader who holds a professorial role at the University.
- We will continue to foster links with research organisations and universities in Chile and India to support capability building in agricultural greenhouse gases and to attract promising PhD and post-doctoral researchers to work with us. This is underpinned by one of our senior greenhouse gas researchers at Palmerston North holding a Professorial Chair in Environmental Science, a joint appointment with Massey University that also comprises a tripartite agreement with the Punjab Agricultural University, India.
- Our staff will teach several university courses and co-supervise post graduate students across a wide range of projects, thus helping build national capability for New Zealand.

Strategic Investments

- *Global Change and Trade*: Investment in this collaborative initiative with the University of Chicago and Argonne National Laboratory’s Computation Institute supports development of a new dynamic, spatially-detailed economic model of how primary production and international trade should respond to climate change (page 27)
- The *Invasive Animals Cooperative Research Centre (CRC)*: Investment on this CRC, Australia’s largest integrated invasive animal research programme, enables us to collaborate on pest management issues and provides access to capability in the partner organisations — the 36 Australian government agencies, industry bodies, and seven international organisations from New Zealand, Britain and the USA (page 14)
- To enhance opportunities for international collaboration and developing new capability, we will support four Fellowships (page 41)

Key Performance Indicators

- Number and percentage of joint scientific peer-reviewed publications and IP outputs with other New Zealand or international research institutions per annum (*MBIE indicator*)
- Total number of international awards, significant New Zealand awards, invitations to participate on international committees, and editorial boards for the CRI’s published papers, per annum (*MBIE indicator*)
- Proportion of published papers in the top 25 international journals relevant to the scope of Landcare Research (as outlined in the SCP) per annum (*MBIE indicator*)
- Total number of citations per CRI published paper (*MBIE indicator*)
- Percentage of relevant national and international research providers that have a high level of confidence in Landcare Research’s ability to form the best teams to deliver on the its Outcomes (*MBIE indicator with data provided from their external survey*)
- Total dollar value of revenue (in cash), and dollar value subcontracted out to other organisations from each ‘source category’ per annum from rolling three years (*MBIE indicator*).

Informatics & Systematics

Goal

Landcare Research's science knowledge, databases and collections, analyses and modelling are readily available and can be used efficiently and effectively.

Context

The New Zealand Government has designated a number of databases and collections in various organisations as being 'Nationally Significant'. Landcare Research is custodian of and curates seven of these – the largest holding for any of the CRIs, and larger than equivalent collections held by museums in New Zealand. We hold significant knowledge assets and biological collections on behalf of Pacific Island Countries. We receive Government funding to manage the collections and databases because they underpin science, primary production, biosecurity, conservation and environmental management. Data from these collections are increasingly available on-line to our stakeholders, along with interpretive services as required.

Informatics is the science of designing information systems that can manage and process huge quantities of complex data and deliver the right information to the right person in the right place, at the right time and in the right way. Such developments are being enabled by high network speeds, such as the ultra-fast KAREN (Kiwi Advanced Research & Education Network) and the High Performance Computing facilities, such as those being built and managed by National e-Science Infrastructure (NeSI) investment.

Systematics is the science of discovery and universally systematic description of biodiversity, and of its ecological and evolutionary relationships; it is the science associated with biological collections.

Strategic Focus 2012/13

The Informatics Strategy underpins all four of our National Outcome investment strategies and supports all ten of our research Portfolios. It seeks to improve the effectiveness and ease-of-use of terrestrial environmental data, analyses, computer models and decision support systems across all sectors in New Zealand by:

- Facilitating access to data and providing fit-for-purpose applications, covering status and trends in environmental parameters, under open-access licence
- Developing new, creative, syntheses to enable understanding and insights from large quantities of data

The Systematics Strategy also underpins our National Outcomes and research Portfolios, particularly 'Defining Land Biota', but also 'Measuring Biodiversity Change' and 'Managing Invasive Weeds, Pests and Diseases'. Systematics provides essential services to the 'Supporting Trade' Portfolio in relation to border biosecurity initiatives and market access. The focus is:

- Adopting new technological developments, enhancing information delivery and expanding the scope of services. We will continue working with the other partners in the New Zealand National Herbarium Network and Council of Heads of Australasian Herbaria to increase access to information held in collections throughout the country (e.g., through the New Zealand Virtual Herbarium)
- Enhancing engagement with the international science community, and contributing to global databases, metadatabases and initiatives such as the Global Biodiversity Information Facility (GBIF) so that information can be shared more readily
- We lead the New Zealand Organisms Register (NZOR). NZOR is the key to New Zealand being a regional hub in Species2000, which is funded through the multi-million dollar EU projects (4D4Life & i4Life) that are attempting to complete the global Catalogue of Life. We are a partner in those projects and the associated Global Names Architecture (GNA) project. The international bodies (ICZN, ICBN) that regulate the creation of new names are moving to electronic registration and e-publication, and new technology/standards are required to support this

Strategic Investments

- *National e-Science Infrastructure (NeSI)*: Landcare Research is a junior partner contributing high performance computing capacity to the programme that is led by Universities of Auckland, Otago and Canterbury, and NIWA. This is an investment in a future of inter-operability of systems between science providers both in New Zealand and overseas to enhance both effectiveness and efficiency
- *Informatics Data Management and an Informatics Data Warehouse for Environmental Modelling*: The investment will facilitate a step change in data accessibility and functionality for end users, and establish Landcare Research as an international leader in shared geospatial data and modelling systems (see page 37)
- *National Vegetation Survey (NVS)*: NVS is the Nationally Significant repository for 77,000 vegetation survey plots including over 19,000 permanent plots throughout New Zealand, with data spanning more than 50 years. The investment will enable us to initiate a systematic process of scanning of all paper records in NVS to improve security and reduce risk to highly valuable NVS data (see below)

Key Performance Indicators

- Client surveys show satisfaction with our informatics initiatives and the value of our Nationally Significant Databases and Collections (*Landcare Research — user on-line survey*)
- Percentage change in the number of requests, enquiries and transactions for Landcare Research’s publicly available databases and collections (*MBIE indicator*)

Strategic Investment:

The National Vegetation Survey Databank (NVS)

NVS is a physical archive and computer databank containing records from approximately 77,000 vegetation survey plots--including data from over 19,000 permanent plots. NVS provides a unique record, spanning more than 50 years, of indigenous and exotic plants in New Zealand's terrestrial ecosystems, from Northland to Stewart Island and the Kermadec and Chatham islands. A broad range of habitats are covered, with special emphasis on indigenous forests and grasslands.

The physical archive includes plot sheets, maps, and photographs from many years of vegetation surveys. The original surveys were conducted by the New Zealand Forest Service, Department of Lands & Survey, and the DSIR Botany Division. On-going surveys and research by the DOC, regional councils, universities, private consultants and Landcare Research are constantly providing new data to NVS. Such widely sourced information collated in one databank is part of the value of NVS to New Zealand. At the same time, the interests of data providers are protected through written agreements that determine access rights to specific datasets within NVS.

Benefit

NVS data underpins research, ecological restoration, and evidence-based knowledge decision and policy making. It supports reporting requirements for the Convention on Biological Diversity, Framework Convention on Climate Change, Resource Management Act, State of Environment, and the Montreal Process. Historical information in NVS has significance in enabling New Zealand to address issues of current concern that were unforeseen at the time of data collection, including the impacts of climate change on indigenous ecosystems, the storage of carbon in indigenous ecosystems, and setting restoration goals in areas since degraded.

The investment in beginning a systematic process of scanning of all vulnerable paper records in NVS will improve security and reduce risk to highly valuable NVS data. Digital versions of the data will better enable their use in future research, monitoring and modelling.

Strategic Investment:

National e-Science Infrastructure (NeSI)

Landcare Research (LCR) is a partner in the \$48M National e-Science Infrastructure (NeSI) investment by Government, the Universities of Auckland, Canterbury and Otago, and NIWA to build and operate inter-linked High Performance Computing Facilities. NeSI will enable us to carry out advanced modelling across all of our Outcome area, including their application to land and ecosystem resources, historic ecosystem structural development, physical and economic climate change impacts, and invasive species modelling. It will also facilitate collaborations with researchers overseas.

On-going strategic investment over the period 2011–2014 includes purchase of High Performance Computing (HPC) hardware (jointly with the University of Auckland), and contributions to operating expenditure and support of staff. The collaborative HPC facility is hosted by University of Auckland and has support from MBIE. The first stage of the facility went live in early February 2012. The first Landcare Research project was processing genomics sequences.

Benefit

NeSI keeps New Zealand abreast of major computing infrastructure developments in the rest of the world and therefore able to connect with all the key players. Within New Zealand, it enables greatly enhanced effectiveness and efficiency in scientific computing by linking users to the massive capacity of the major partners. Landcare Research has been at the forefront in the NeSI development and, as a CRI whose value to New Zealand depends on information processing and accessibility, we will benefit greatly from NeSI.

Strategic Investment:

Informatics & Science Data Management

This on-going investment will fast-track creation of new key technologies for managing and modelling environmental science data, and improving accessibility for the benefit of end users; developing collaborative, shared geospatial data and systems; and establishing a new NeSI-based environmental modelling platform that will be used to address a wide range of environmental issues confronting New Zealand and the Oceania region. Such technologies are vital to supporting government policy and 'greener' business practice.

The *Data Management* project supports and is consistent with evolving standards in data management and contractual data obligations for our major databases and also for the myriad of smaller everyday datasets that support all of our research.

The *Data Warehouse for Environmental Modelling* project, *SCENZ-Grid*, will enable many of Landcare Research's environmental modelling research efforts to move to the new NeSI high performance computing facilities. The investment is also aligned to and supports the Global Change and Trade modelling work with the Computation Institute (CI) in Chicago, and the Global Soil Map's Cyber-Infrastructure Working Group, led by Columbia University.

Over the coming year, the intent is to populate the data warehouse, test and refine the warehouse's performance, and build initial spatial models based on existing modelling endeavours that could benefit from NeSI (e.g., ecosystem service modelling, national possum population modelling, Environmental Domains of Antarctic).

Benefit

Data management is a common challenge for scientific organisations the world over. Our effectiveness in delivering environmental solutions depends upon our ability to access, process and store data and make information available in user-friendly fit-for-purpose ways. This project links us to best practice in different countries and enables us to adapt it for New Zealand conditions. In this endeavour we are linking closely to the informatics groups of the other CRIs to share learning.

Commercialisation

Goal

Landcare Research adds value to the New Zealand economy through commercially viable products and services and their transfer to partners in the private sector.

Context

CRIs are expected to transfer commercially-viable technology and knowledge to the private sector at an early stage instead of committing capital to start-up businesses. CRIs are expected to draw on existing commercialisation capacity in New Zealand, including using the National Network of Commercialisation Centres (NNCCs) e.g., Auckland UniServices and KiwiNet.

We provide new pest control products to the New Zealand market through licensing arrangements with commercial partners. We have a number of branded business units that have been developed from our research and now provide commercial services to clients in New Zealand and overseas. These business units are EcoGene[®], Invasive Species International (ISI), Manaaki Whenua Press, and Enviro-Mark[®]. We regularly review commercial business ownership, value and related risk issues.

There is major global investment in ‘green technologies’, with the OECD pushing strongly for implementation of Green Growth policies. The New Zealand Government’s Green Growth Advisory Group have made a number of recommendations that are relevant to our fourth National Outcome, to support industries growing within environmental limits and responding to market and community requirements.

Strategic Focus 2012/13

Landcare Research will enhance its approach to creating environmental solutions and up-scaling their availability through commercial channels.

- We will seek external investment to grow the global business of the carbonZero^{Cert™} programme, which was corporatised in 2011 and is currently our wholly-owned subsidiary.
- We will continue to support and grow science-based services retained within our organisation for the mutual advantage of external users and our science capability. Examples include services from EcoGene[®] and Invasive Species International.
- We will continue to develop the Enviro-Mark[®] environmental management and certification programme specifically to meet the needs of the New Zealand businesses. (Over 170 New Zealand businesses are already part of the programme.) We will seek to extend the programme to enable its members to access green growth opportunities through our science.
- We will transfer commercially-viable products and services to the private sector via licensing, IP sale and use of start-up business. In doing so we will seek investor capital and financial risk-sharing for the establishment years, making use of the services of the National Network of Commercialisation Centres.

Key Performance Indicator

- Total number and percentage of licensing deals of Landcare Research-derived IP (including technologies, products and services) with New Zealand and international partners per annum (*MBIE indicator*)

Science Investment:**Genetic Analyser for the Ecological Genetics Laboratory**

Landcare Research has had a sequencing and genotyping facility since 1999, and our researchers have been extremely successful in utilising the advantages of genetic technology across a number of areas. Since the initial focus on DNA analysis for biosystematics and evolutionary biology, genetics tools have broadened to include pest monitoring, selecting biocontrol agents and monitoring their impact, microbial ecology, DNA diagnostics for biosecurity identifications and risk assessment, wildlife forensics, and emerging diseases. EcoGene® has been developed as a commercial service providing ecological and identification genetics, and wildlife forensic services to a range of clients outside Landcare Research.

This new investment in a new state-of-the art 3500 Series Genetic Analyser (rapidly becoming the industry standard) will streamline a wide range of applications used routinely in the Ecological Genetics Laboratory in Auckland, and also the Molecular Lab in Lincoln. These laboratories provide key support for genetics-based research across five of our Portfolios (Defining Land Biota, Managing Biodiversity, Measuring Biodiversity Change, Managing Invasive Weeds Pests & Diseases, and Supporting Trade).

Benefit

EcoGene® provides valuable support to agencies such as the Wildlife Enforcement Group (incorporating New Zealand Customs) and BiosecurityNZ — for example, in helping break an ivory smuggling ring and identifying the causal agent in the outbreak of the PSA disease on kiwifruit. The new analyser will enhance EcoGene®'s capacity to meet the growing demand for existing services, and enable them to deliver new DNA services for clients, including fully-accredited ISO applications.

The new technology also has a number of 'green' benefits, such as being significantly more energy-efficient than older models, contains considerably fewer hazardous and carcinogenic compounds and features an advanced long-life solid-state laser that increases capacity but reduces consumables and waste.

People, Learning & Culture

Goal

Landcare Research has an organisational culture that is adaptive in the face of change, attracts high quality talent, produces great leaders and which is supported by effective systems and processes.

Context

The external market for talented researchers is changing very rapidly, with top talent globally mobile and highly sought after, particularly in the environmental sciences. The situation is exacerbated by the trans-Tasman remuneration gap, with Australian research institutions attracting many talented young New Zealand researchers. Our science facilities, culture and our philosophy of *manaaki tangata – manaaki whenua* play vital roles in attracting and retaining staff. We have developed internal development programmes to build resilience in managerial expertise and leadership, and to further develop our bicultural capabilities

In regard to technology transfer and business engagement activities, Government expects “a significant culture change within CRIs.” Landcare Research recognises the need to enhance our stakeholder focus and knowledge-brokering capabilities, making them part of everyday business. We undertake significant engagement with key stakeholder partners at both strategic and operational levels, and believe that the new Portfolio roles will further embed the required culture change into our science framework.

Strategic Focus 2012/13

In our People & Performance Strategy, our senior managers, directors and stakeholder partners have consistently identified four key priorities that affect both individual and organisational capability. Initiatives relating to workplace culture and leadership development will have the greatest impact on growing organisational capability; initiatives relating to talent management and aligned systems, efficient administration and effective advice have the greatest impact on growing individual capability.

We will work closely with the other CRIs to seek greater effectiveness and efficiency from sharing approaches, systems and – where appropriate – physical resources. Areas such as science and technical staff recruitment and training are likely to yield mutual benefits when done in an integrated way.

- *Workplace culture:* We will create a stronger alignment between our values, our behaviours and our organisation’s strategies, and embed this culture in the organisation. We will continue our annual staff survey to assess the development of our organisational culture, employee engagement and leadership capability.
- *Leadership:* We will shift leadership from a transactional to a transformational approach. This applies to internal processes for coaching and mentoring staff, and to external brokering of knowledge by the Science General Managers, Chief Scientist and Portfolio Leaders.
- *Talent:* We will ‘build, borrow or buy’ resource to effectively manage talent for growth, innovation, collaboration, relationship management between Portfolios, and for knowledge and technology transfer activities with stakeholders. We will invest part of our Capability Funding to support training, development of new skills and succession planning in our Science Teams.
- *Compliance, Systems and Service:* We will continually improve our systems, policies, processes and workplace in order to ensure delivery of a seamless service to our clients, and compliance with all relevant legislation. We will continue to maintain tertiary (the highest) accreditation in ACC’s Workplace Safety Management Practices (WSMP) programme.

Key Performance Indicators

Culture and Leadership

- Staff survey evaluations of leadership, engagement and organisational culture.
- The number and percentage of staff in leadership positions completing the stage two leadership development programme and demonstrating improved leadership evaluations.
- Bicultural Learning & Development Strategy in place and implemented.

Talent Management

- Turnover of key staff.
- Capability management plans in place for all teams.
- Individual performance and development plans in place of all staff.

Good Employer

- ‘Good employer’ performance will be covered in transparent and comprehensive sustainability reporting on our website (www.landcareresearch.co.nz/sustainability).

Strategic Investment

Fellowships to help develop our Capability

To enhance opportunities for international collaboration and developing new capability, we will support four Fellowships

- *The Hayward Post-Doctoral Fellowship* to attract international researchers to work with us for up to two years. This Fellowship was awarded in 2012 and is continuing into its second year in 2013 with a research programme positioning Landcare Research as the leader in expertise to extract DNA from mycorrhizal fungi to underpin future ecological surveys in grasslands and forests, and vital to understanding ecosystem dynamics.
- *The Ross Beaver Fellowship* to support international researchers to work at Landcare Research for up to two years in the area of fungal taxonomy, fungal genetics, plant pathology or botany. The inaugural Fellowship starting in 2013 has been awarded to honour the achievements of Ross Beaver by completing aspects of his taxonomic study of New Zealand truffle-like fungi.
- *The Landcare Research Senior Fellowship* to provide established researchers with opportunities to work with us for up to one year, bringing new skills to share with our staff. We have awarded this Fellowship for 2013 to two candidates in different areas of research. One programme for four months will analyse and interpret existing data in a project about suspended sediment dynamics in the Manawatu catchment; and the other programme, for eight months, will improve decision-making for conservation investment using a case study of multi-stakeholder community based conservation on Banks Peninsula.
- *The Manaaki Tangata Fellowship* to provide opportunities for our staff to undertake research and develop on-going collaborative links with prestigious international organisations for up to one year. The Fellowship for 2013 has not yet been awarded.

Investment in Science

Goal

Landcare Research’s processes for investing in science and innovation are informed by key partner stakeholders and enable us to discharge our accountability to shareholding Ministers, partners and the New Zealand public.

Context

The CRI reforms transferred significant accountability for investing in science and innovation to CRI Boards. As part of this accountability, the Board is charged by the shareholding Ministers to take strategic advice from both leading scientists and key stakeholder partners (see page 28).

Landcare Research has approximately \$24million per year of revenue from government in a Core Funding Agreement (which now includes capability funding) with MBIE. The Board is responsible to shareholding Ministers for the impacts and value achieved from investing this fund in our research Portfolios.

Portfolios have five-year plans with clearly defined objectives, milestones and outputs to encourage strong progress towards achieving Impacts and Outcomes. The Board works with the Science Advisory Panel to review progress, achievements and opportunities for further investment.

Investment Types

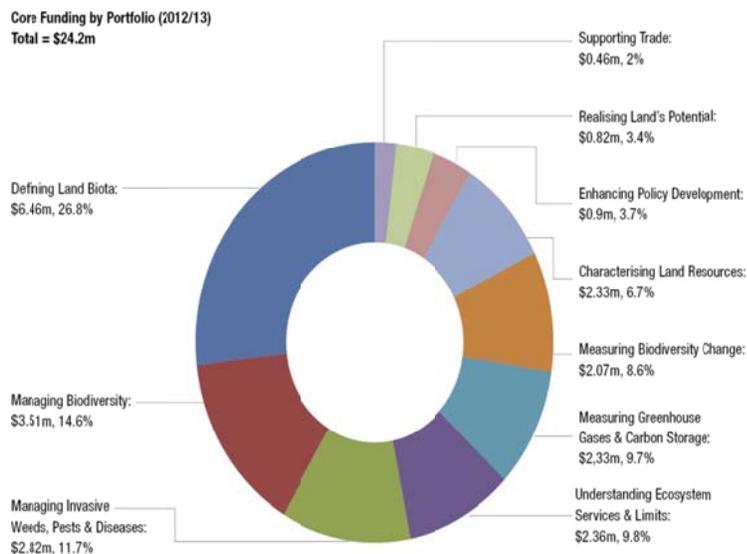
The Board is accountable for investment decisions and will exercise that accountability at specific times within the usual 5-year lifespan of research Portfolios. Directors and the Senior Leadership Team can invest from a range of revenue sources:

Core funding is approximately 80% of our total MBIE funding and subject to annual agreement with MBIE. Core funding transferred to Landcare Research is due in a large part to programmes previously funded by the Foundation for Research, Science and Technology. For example, the ‘Defining Biota’ Portfolio has responsibility for stewardship of a number of our nationally significant collections and databases previously funded under an Outcome-Based Investment programme. We have begun to signal core funding adjustments on a 5-year timeframe that prioritise our investment across Outcomes, Impacts and Portfolios. These allocations reflect a range of drivers including government priorities, stakeholder needs and willingness to co-invest, science scope and opportunities to collaborate across science providers. The allocation of core funding to Portfolios in 2012/13 is shown in the graph below. The relatively large allocation to ‘Defining Land Biota’ reflects the fact that several major national collections and databases (see Appendix 2) are maintained in this Portfolio.

Strategic investment (of retained earnings) is applied typically to larger projects (>\$200k/year) that have a transformative nature (step-change in capability and/or science direction).

Product and service development funding is applied to early-stage development of intellectual property with commercial potential.

Capital expenditure (Capex) is applied to physical assets buildings, equipment, vehicles, etc.).



Additional sources of revenue from MBIE, stakeholders and partners (approximately 60% of total science revenue) are typically won by science teams through contestable processes.

This includes revenue from central and local government entities, industry sectors (e.g. DairyNZ, AHB) and businesses (e.g. State-Owned Enterprises), Māori organisations, and also from other CRIs, universities and agencies as subcontracts. Where appropriate, we seek a change from transactional to relational research funding in order to enhance the effectiveness of co-funding science and reduce transaction costs for both parties.

Investment Cycle

Scanning uses a range of tools to identify emerging issues and direct innovation pathways. Technological and social foresight conversations with partners and other stakeholders help provide a 10–20-year horizon to our science strategy.

Scoping is used to analyse investment opportunities and inform investment decisions using criteria such as the scope for new science, fit with our core purpose, likely benefit to New Zealand, our capacity to make a significant contribution to the area, and the appetite of our stakeholders to invest.

Portfolio investment decisions are made annually, using all the investment types described above. A 5-year target is set for investment across our National Outcomes and Impacts. That target is translated into allocations across Portfolios and subsequently across projects within Portfolios. The 5-year target gives reasonable stability in revenue levels across Portfolios, but annual levels are subject to performance and changing needs.

Monitoring of Portfolio performance is against contribution to Outcome and Impact KPIs, contracted deliverables, and other metrics set by Landcare Research and MBIE. Stakeholder surveys, international benchmarking and review by our Science Advisory Panel are used. Landcare Research and the other CRIs will be subject to a 5-yearly review by MBIE.

Development is a managed pathway for products and knowledge services deemed to have commercial potential. We will engage with the proposed National Network of Commercialisation Centres (NNCCs) and other market partners. Intellectual property protection, user-facilitated design labs, market needs analysis and stage-gating development are tools used in this phase.

Exit /Partner are managed processes towards the end of a Portfolio or major project within a Portfolio. Licensing arrangements, business start-ups, third party investment and services from science teams are some of the approaches to be used in this phase. It also includes a ‘harvest’ period to sustain knowledge assets for future use.

Stakeholder engagement is not a single step in the cycle. Principal stakeholder partners are closely engaged throughout the investment cycle; and they will help us make our investment decisions and also decide where they wish to co-invest in Portfolios.



Key Performance Indicator

- Our shareholding Ministers indicate satisfaction with the transparency and relevance of our investment priorities by approving our SCI.

Strategic Asset & Infrastructure Investments

Goal

Landcare Research's proposed investments in science infrastructure are recognised by Government and other stakeholders as benefitting New Zealand.

Context

Strategic investments in infrastructure and other assets are aligned to our National Outcomes and hence have national benefit. Initiatives must bring about a step change over and above 'business as usual', maintaining national assets and capability and/or leveraging collaboration initiatives. Investment monies are derived from Capital Expenditure and Reinvestment of Surpluses.

There is a continuing need to invest in significant science infrastructure to support excellent research and to attract new graduates and internationally-regarded visiting researchers. Staff who will work in these facilities make significant contribution to the design ensuring they are fit for purpose and future needs. Where possible (within the constraints of containment requirements) facilities comply with our sustainability principles, e.g. energy- and water-efficiency and environmentally-friendly fit out.

Following the devastating Canterbury earthquakes, we commissioned a survey of the structural integrity of our Lincoln buildings. While this showed the buildings are quite safe to use and well above the old building standards, the survey identified work that needs to be undertaken on the Godley Building to ensure it complies with the new building standard. In our move to new offices in Wellington we have taken account of compliance with the new building standard.

Strategic Investments

Completed in early 2012/13:

- We will complete the upgrade of the *Allan Herbarium* to protect the irreplaceable and nationally significant plant collection (see Appendix 1) housed within the Herbarium vaults. The Herbarium facility has expanded as the collection has grown over the years, and consists of a series of vaults of mixed design and shape. This has made 'climate control' difficult. The investment project, initiated in 2011/12, removed the Herbarium's connection to an old, inappropriate heating system, and developed and installed a new temperature and humidity control system. The new system has also separated the first floor offices from the vault system, so the new systems can deliver the conditions appropriate to the two different environments.

Major science investments continuing from 2011/12 are:

- *Plant Pathogen Facility at Auckland*: Investment in a new facility will enable research on both incursions of unwanted plant pathogens that are readily able to penetrate biosecurity defences, and host-specific plant pathogens that have significant potential as biological control agents for an escalating weed problem in New Zealand. Currently there are no existing facilities for plant pathogen research work under appropriate containment so this work is currently contracted overseas. The new facility has significant potential to benefit New Zealand. (See page 14.) (Completion due August 2012.)
- *National e-Science Infrastructure (NeSI)*: We are partners in the \$48M investment by Government, three universities and one other CRI to develop shared High Performance Computing facilities. NeSI will enable us to deliver to stakeholders the results of advanced modelling of land and ecosystem resources, physical and economic climate change impacts, whole genomes, and invasive species. It will also facilitate collaborations with researchers overseas (e.g. the Computation Institute, USA, see page 27). (Contract period 2011–2014.)

Major Capital Investments

New science investments beginning 2012/13 are:

- *National Vegetation Survey (NVS)*: The investment will enable us to initiate a systematic process to digitally scanning all paper records included in NVS to improve security and reduce risk to the NVS archive. (See page 36)
- *Genetic Analyzer* replacement for our EcoGene® laboratory: This will enable EcoGene to continue providing innovative genetic-based research, increase its throughput for existing services and enable new DNA services including fully accredited ISO applications. (See page 39)
- *LECO Analyser*: This equipment is needed for daily carbon and nitrogen analyses by our Palmerston North Environmental Chemistry Laboratory. The previous machine, shared with Massey University is obsolete. Massey University has invested in a new machine but for their sole use. (See page 46)
- *Ancient DNA Laboratory*: A small room will be refitted as a secure, sterile environment. Currently, our staff use the specialised laboratory facilities at the Australian Centre for Ancient DNA in Adelaide, incurring considerable personal and financial costs (bench fees and overheads). (See page 46)

New building investments beginning 2012/13 are:

- *Reverse Osmosis water system*: Install a system to supply ultra-pure water to all laboratories in the Fleming Building at Lincoln to address current risks around water quality and availability, efficiency and cost.
- *Palmerston North Level 3 refurbishment*: Enhance the working environment for the new National Land Resource Centre and Spatial Information research groups.
- *Emergency generator for Lincoln*: Purchase a new generator for emergency power supplies to the Fleming Building (including the Greenhouse Gas Research and Invertebrate Containment Facilities) and the Godley Building computer server to significantly reduce business continuity risk, and enable improved capacity to meet/offset expensive winter peak demand electricity pricing at our largest site.
- *Auckland building*: Complete the redesign and upgrade of mechanical Heating, Ventilation and Air Conditioning (HVAC) systems.
- *Godley Building upgrade at Lincoln*: Upgrade and strengthen the building to meet the new building code requirements for earthquake risk and enhance the working environment.

Key Performance Indicator

- Level of capital investment in science infrastructure and capability

Science Investment:

Environmental Chemistry supports several Portfolios and Outcomes

A significant amount of research across most of the Portfolios requires precise measurements of total carbon and nitrogen in soil and plant samples. Such analyses are carried out on specialised laboratory equipment, and this year, with a suitable replacement model finally on the market, we will purchase a new LECO analyser for our ISO/IEC 17025 accredited Environmental Chemistry Laboratory in Palmerston North. The existing machine is old with out-of-date computer interfaces, and undergoes considerable costly down time for repairs.

Benefit

The LECO analyser in our laboratory is a key factor in our delivering Carbon Monitoring System (CMS) work for government. Other critical research supported by the LECO includes:

- Assessing the health of ecosystem services and determining how they relate to land use and land management.
- Determining how soils and underlying layers vary in their ability to filter and buffer environmental contaminants and reduce environmental impacts of land use and land use intensification (e.g. nutrient addition, irrigation) on soil health (productivity, structural integrity and microbial diversity).
- Identifying drivers of soil C, N and P loss and retention in relation to soil type, including interactions between soil structure and microbial processes to reduce nutrient loss from soils and enhance soil and water quality.
- Measuring and modelling net greenhouse gas emissions and changes in soil carbon storage under different land use, land use change and climate change scenarios
- Quantifying the above- and below-ground processes regulating carbon storage and emissions of all greenhouse gases from soil.

The LECO will run all day every day servicing research projects that support Outcomes 2 and 4. Laboratory staff expect to be able to run in excess of 200 samples a day plus another 50 samples overnight, which equates to 10,000 – 12,000 samples per year.

Science Investment:

Ancient DNA Laboratory

Landcare Research staff are engaged in the rapidly expanding field of ancient DNA research. New techniques complement the traditional methods (e.g. examination of pollen preserved in peat, charcoal and plant macrofossil analyses) being used to study past environments, human settlement history, extinction events and to understand pre-human vegetation states for restoration plans.

Within the past decade, the development of standard techniques for the extraction and amplification of DNA from ancient bones, leaves, seeds, and soil, has provided a new and exciting tool for palaeoecological research. 'Ancient' samples can include anything from 100 year old herbarium specimens through to sediments and soils that are thousands of years old. The applications of ancient DNA research are enormous.

The strategic investment will be used to refit a small room as a sterile, ultra-clean environment that is free from DNA contamination. While we have good facilities for modern DNA work at Lincoln, it is not possible to work on ancient samples in the same as facilities (or even within the same building) that amplify DNA. This is because of the serious contamination risk to the ancient samples, which typically contain only tiny amounts of degraded DNA.

Benefit

Ancient DNA facilities have been integral to winning two prestigious Marsden projects, each lasting three years. There is significant scope for future Marsden proposals and contracts within the 'Managing Biodiversity' Portfolio. Significant economic value derived from this investment will be the savings from not taking this work to Australia, assessed at \$50,000 pa. Up until now, we have had to use the specialised laboratory facilities at the Australian Centre for Ancient DNA, in Adelaide. The new in-house facility will save costs, allow us to do more work in this area, and open up opportunities for other staff — for example, to extract DNA from samples sensitive to contamination (e.g., forensic specimens); or DNA from degraded organic specimens that MAF wants identifying (a facility at University of Auckland used for this will cease to be available later this year); and using DNA sequences from fossil soils to determine what plants were present on an island in the pre-human era, and to inform restoration planting. These are important new areas of research that will meet multiple users' needs and allow training of new researchers in an area that has a limited number of practitioners in New Zealand.

Financial Strategy & Metrics

Goals

Financial viability and flexibility

Landcare Research continues to maintain financial viability and flexibility (including meeting our Shareholders' expectations on return on equity), operates within our banking covenants, and invests for the future in both infrastructure and strategic initiatives.

Return on equity

Achieve and maintain 7.5% return on equity in our core science business. Surpluses may be used to support our commercialisation businesses and strategic initiatives to enhance our science. A tailored rate of return will be agreed during the annual planning process with our shareholding Ministers.

Context

Financial flexibility is important to enable Landcare Research to respond to changes in the external environment and pursue strategic opportunities.

In determining an acceptable *tailored rate of return* we have adopted the following underlying principles:

- In the long term the rate of return on equity should equal the weighted average cost of capital.
- In the short term the Board is prepared to accept a lower tailored return on equity to support strategic investment that will enhance science, provide benefit to New Zealand and underpin future returns, including the development of our commercial businesses.
- The targeted return on equity will be reviewed by the Board over the planning period as other strategic investment opportunities with long term benefits are presented.

In the *current fiscal situation* we are conscious that it is unlikely there will be increases in Government funding for science research. The recent Core Funding Agreement provides a degree of certainty, but no recovery of inflation; and we expect strong competition in the science sector for other sources of government and private sector revenue. Critical to the on-going success of Landcare Research will be our ability to ensure *financial viability* through a period of fiscal pressure as a consequence of the Canterbury earthquakes and global economic downturn.

Financial Operating Plan 2013-17

The Operating Plan shows the continuous improvement in financial performance.

Financial Performance and Position

<i>For year ending 30 June:</i>	2012		2013	2014	2015	2016	2017
	Target	Forecast	Target	Target	Target	Target	Target
Revenue - Consolidated	61.1 ¹	57.6 ¹	59.0	60.5	62.0	63.5	65.1
EBIT before Investment - Consolidated	3.6	2.0	3.3	3.7	3.9	4.0	4.2
EBIT - Consolidated	2.1	0.5	1.6	1.9	2.8	3.1	3.5
Assets, \$m	49.2	43.4	43.6	45.3	47.2	48.9	50.7
Investment	1.5	1.5	1.8	1.8	1.1	0.9	0.7
Dividend \$m	1.1	1.1	0.0	0.0	0.5	1.1	1.3
Equity ratio	55.4%	61.8%	64.1%	64.9%	65.6%	65.8%	66.2%
Gearing	12.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

¹ 2012 Target and Forecast revenue excludes Sirtrack, which was sold in November 2011. Including Sirtrack 2012 Target is 65.9 with 2012 forecast of 59.4. 2012 Forecast revenue is lower than target due to slower than anticipated growth in international markets for carboNZero and lower Non-MBIE science research revenues for the parent.

Explanatory notes to table:

Revenue is projected to remain stable during the 2013 financial year. Over the planning period, minor or modest increases are expected in science research revenues, and higher growth is anticipated in our commercial business revenues.

EBIT is projected to increase in 2013 due to a decrease in losses from our carboNZero^{Cert™} subsidiary.

(*EBIT*: Earnings before interest, financial lease charges and tax, and after committed business development expenditure and technology service expenditure)

Assets are projected to increase over the planning period as deferred building infrastructure issues are addressed. Major earthquake strengthening is budgeted for some buildings at our Lincoln site.

Investments are projected to increase significantly over the planning period. These strategic investments will underpin future financial viability. (Strategic investments are listed on page 44–46).

The Board proposes to withhold payment of a dividend to enable funding of strategic investment projects, contingent upon shareholder assent.

Equity ratio: Average shareholders' funds ÷ Average total assets.

The debt *gearing* ratio over the planning period remains within the acceptable range.

(*Gearing* is Interest bearing debt ÷ Interest bearing debt + Shareholders' funds, expressed as a percentage.)

Re-investment of Surplus

Landcare Research has identified strategic investment opportunities that will create future value. In determining the amount available for strategic investment we have adopted the following principle:

- We are prepared to reinvest surpluses in strategic investment opportunities that will create long term benefits provided we have both capacity to invest and Landcare Research's long term rate of return at least equals our weighted average cost of capital.

During the planning period, we intend to reinvest surpluses with an EBIT impact of \$1-1.4 M p.a. into strategic investments. This will be financed from both science research surplus and the performance of prior investments.

Strategic investment opportunities planned for 2012/13 include both:

- Initiatives committed to in previous years:
 - The Pathogen Facility in Auckland (see page 14)
 - Economic modelling capability for global change and trade (see page 27)
 - NeSI (see page 37)
 - Informatics and science data management (see page 37)
 - The Allan Herbarium upgrade at Lincoln (see page 47)
- New initiatives for 2012/13:
 - Invasive Animals CRC (see page 14)
 - National Land Resources Centre (see page 20)
 - NVS Archive Risk Avoidance and Security (see page 36)

Key Performance Indicators

Financial Indicators for the Landcare Research Group (as specified by MBIE)

Financial indicators show continuous improvement in efficiency, while maintaining growth, investment and appropriate levels of risk.

<i>For year ending 30 June:</i>	Actual	Forecast	Business Plan				
	2011	2012	2013	2014	2015	2016	2017
<i>Efficiency:</i>							
Operating Margin	11.0%	8.6%	9.5%	9.8%	11.2%	11.6%	12.1%
Operating Margin per FTE	\$16,669	\$12,245	\$13,418	\$14,286	\$16,681	\$17,737	\$18,903
<i>Risk:</i>							
Quick Ratio	1.54	0.90	0.65	0.69	0.80	0.95	1.14
Interest coverage	31.3	2.5	28.3	NA	NA	NA	NA
Operating margin volatility	14.8%	14.2%	12.0%	10.3%	12.1%	15.3%	14.2%
Forecasting risk	-2.3%	-2.3%	-4.4%	-4.1%	-4.1%	-3.1%	0.0%
<i>Tailored Rate of Return:</i>							
RoE before Investment	11.3%	7.2%	8.9%	9.6%	9.5%	9.5%	9.6%
Return on equity (RoE)*	8.6%	3.4%	4.2%	5.1%	6.8%	7.4%	8.1%
<i>Growth/Investment:</i>							
Revenue growth	3.0%	-3.6%	-0.7%	2.6%	2.5%	2.4%	2.5%
Capital renewal	0.9	2.1	1.7	1.3	1.3	1.2	1.2

NA = not applicable

*Return on equity excludes impact of legislative change regarding depreciation on buildings and fair value gains/ (losses)

Explanatory notes to table:

Operating Margin: EBITDAF ÷ Revenue, expressed as a percentage and per FTE.
(EBITDAF is EBIT before depreciation, amortisation and fair value adjustments.)

Quick ratio: (Current assets – Inventory - Prepayments) ÷ (Current liabilities – Revenue in advance).

Interest cover: EBITDAF ÷ Interest paid

Forecasting Risk: 5-year average of return on equity less forecast return on equity.

Return on equity: NPAT ÷ Average shareholders' funds, expressed as a percentage.
(NPAT: net profit after tax.)

Shareholders' funds: Includes share capital and retained earnings.

Capital Renewal: Capital expenditure / Depreciation expense plus amortisation expense.

Financial viability and flexibility

Landcare Research's projected financial performance improves over the planning period, and a strong balance sheet provides flexibility. Our modelling of potential revenue shortfall has identified actions to minimise and mitigate the potential impacts. We are fully compliant with banking covenants.

Return on equity

Landcare Research's tailored return on equity for 2012/13 is 4.2%, which has enabled strategic investment in areas approved by the Board of Directors. (To be negotiated with shareholding Ministers)

Statutory Reporting

Goal

Landcare Research's reporting of its corporate performance is timely, transparent, consistent with our Vision and Core Purpose, and meets the expectations of shareholding Ministers and other key stakeholders.

Context

Landcare Research has a responsibility to provide information that meets the requirements of the Crown Research Institutes Act 1992, the Companies Act 1993, the Financial Reporting Act 1993, the Crown Entities Act 2004, and the New Zealand Institute of Chartered Accountants (NZICA) with regards to New Zealand Generally Accepted Accounting Practice (NZ GAAP).

The following documents will be provided to our shareholding Ministers and MBIE prior to being made publicly available:

- *Statement of Corporate Intent (SCI)* containing information such as the strategic goals and key performance indicators for the next five years, and summary of the financial performance targets.
- *Annual report* covering progress against the SCI and the delivery of our National Outcomes. The annual report must be provided within three months of the financial year ended 30 June.
- *Half-year report* containing unaudited financial statements, major highlights during the period and indicating progress towards the SCI goals and targets. The half-year report is due by the end of February.

Additional information that is not publicly available:

- *Quarterly reports* containing unaudited financial statements (including current quarter and year-to-date budgets and full-year forecasts), and significant highlights during the period. The quarterly reports are due by the end of October, January, April and July.

Key Performance Indicator

- Our quarterly, half-yearly and annual reports are delivered on time and meet the expectations of MBIE and the shareholding Ministers

Corporate Sustainability

Goal

Landcare Research continues to be recognised as a leader in corporate sustainability in New Zealand

Context

Landcare Research has a decade-long reputation for corporate sustainability performance and transparent public reporting. We are committed to minimising and mitigating the adverse effects of our activities on the environment, and reporting openly via our sustainability web pages. Our most material issues are resource use, greenhouse gas emissions, staff development and good employer issues, animal welfare, by-catch of non-target native species, community licence to operate, cultural inclusiveness, economic efficiency and financial viability. These are areas in which we seek continuous improvement through targeted activities.

We are members of

- Business NZ and the Sustainable Business Council (SBC), including CEO membership of the Executive Committee of SBC and Landcare Research acting as GRI data partners with Business NZ.
- The Sustainable Business Network
- The New Zealand Green Building Council
- The EEO Trust.

Strategic Initiatives

- We will work with the *Sustainable Business Council* group of companies to benchmark our performance, and to encourage uptake of the core set of indicators by companies across New Zealand. The government's Green Growth Advisory Group's report is anticipated to increase industry and government interest in greener products, services, technologies, practices and markets.
- We will continue to *improve our procurement practices* and *collaborate with the other CRIs* to leverage our combined purchasing power. This will help to broker excellent service and supply that deliver cost savings, greater benefits and more sustainable options for procurement and other contracts such as waste management.
- We will also collaborate with other CRIs to consider opportunities for improved efficiencies and enhanced performance through a *pan CRI approach to workforce planning*. This will primarily encompass recruitment, learning and development, talent management, retention initiatives, and change management.

Key Performance Indicators

- Retain ISO14001 certification for our environmental management system and practices.
- Retain tertiary accreditation (the highest level) in the Accident Compensation Commission (ACC)'s programme for Workplace Safety Management Practices.
- External verification that our carbon management meets the requirements of the carboNZero^{Cert™} programme across all our sites.
- Cost-savings achieved through collaboration with other CRIs to gain operational efficiencies.

APPENDIX 1

Nationally Significant Databases and Collections

<p><i>Held in Auckland:</i></p> <p>New Zealand Arthropod Collection (NZAC)</p> <ul style="list-style-type: none"> • Largest collection of New Zealand land invertebrates, with many specimens also from the South Pacific; earliest collections date from 1880s • Contains over 1 million pinned specimens, and approximately 6 million stored in ethanol; over 2,500 primary type specimens • Includes the National Nematode Collection of New Zealand (NNCNZ) <p>http://nzac.LandcareResearch.co.nz http://fnz.LandcareResearch.co.nz www.bugz.org.nz/</p>	<p><i>Held in Auckland:</i></p> <p>New Zealand Fungal & Plant Disease Herbarium (PDD)</p> <ul style="list-style-type: none"> • Primary source of information on the fungi of New Zealand and of Pacific island countries. • Contains 100,000 dried fungal specimens, including 2,000 type collections • Contains voucher specimens documenting most plant diseases recorded in New Zealand <p>http://nzfungi.LandcareResearch.co.nz http://virtualmycota.LandcareResearch.co.nz http://fungalguide.LandcareResearch.co.nz</p> <p>International Collection of Micro-Organisms from Plants (ICMP)</p> <ul style="list-style-type: none"> • Living cultures of more than 16,000 strains of bacteria and fungi from plants and soil • Mostly stored in liquid nitrogen; others in freeze-dried ampoules <p>www.LandcareResearch.co.nz/databases/icmp</p>
<p><i>Held in Lincoln:</i></p> <p>Allan Herbarium (CHR)</p> <ul style="list-style-type: none"> • The largest herbarium in New Zealand is housed at Lincoln; all plant groups are represented, plus lichens • Specialises in plants (native and introduced) of the New Zealand region, and also South Pacific • Specialist collections of seed, fruit, wood, plant leaf cuticle, liquid-preserved specimens, and microscope slides • Over 600,000 specimens with the oldest samples collected during Captain Cook's first voyage to New Zealand, 1769–1770 <p>www.LandcareResearch.co.nz/allanherbarium http://nzflora.LandcareResearch.co.nz/ www.LandcareResearch.co.nz/floras_guides www.nzherbaria.org.nz</p>	<p><i>Held in Lincoln:</i></p> <p>National Vegetation Survey (NVS)</p> <ul style="list-style-type: none"> • A national repository at Lincoln for plot-based vegetation survey data collected throughout New Zealand • A physical archive and computer databank containing records from approx. 77,000 vegetation survey plots including over 19,000 permanent plots, with data spanning more than 50 years. • Broad geographic coverage, with national coverage of data from Northland to Stewart Island, plus the Kermadec and Chatham Islands • Survey data can be deposited with NVS for management and is also available by request <p>http://nvs.LandcareResearch.co.nz/</p>
<p><i>Held in Lincoln:</i></p> <p>National New Zealand Flax Collection Living collection at Lincoln of over 160 provenances of <i>Phormium</i> species of cultural, economic and historical interest. It supports research on both traditional and new uses of <i>Phormium</i></p> <p>www.LandcareResearch.co.nz/harakeke</p> <p>Ngā Tipu Whakaoranga Ethnobotany database A fully referenced web resource of detailed information on the traditional use by Māori of native plants and fungi, including Māori names for species</p> <p>http://maoriplantuse.LandcareResearch.co.nz/</p>	<p><i>Managed through Palmerston North and Lincoln:</i></p> <p>Land Resource Information System (LRIS), including New Zealand Land Resource Inventory (NZLRI) National database depicts general land characteristics (rock, soil, slope, erosion, and vegetation), a derivative general purpose land evaluation (land use capability), and a range of management and production</p> <p>http://scinfo.org.nz</p> <p>National Soils Database (NSD) 1,500 soil profiles from 1,700 different locations throughout New Zealand, with site descriptions and chemical, physical, and mineralogical characterisations.</p>

APPENDIX 2

Formal collaborative research centres, consortia & networks

We are part of several national and international initiatives to pool research capability, in areas of our core capability as outlined in the Scope of our Core Purpose.

Ecosystems and ecosystem services, terrestrial vertebrate pest control, biosecurity, integrated social and biophysical research:

- The **Centre for Biodiversity and Biosecurity (CBB)** with the University of Auckland, including the Joint Graduate School www.cbb.org.nz/
- The **Regional Councils' Biodiversity Forum** that decides their priorities for biodiversity research
- The **Invasive Animals Cooperative Research Centre (CRC)**, which is Australia's largest integrated invasive animal research programme www.invasiveanimals.com/
- The new **Southern Temperate Ecosystems Research Network (STERN)**, with the Institute of Ecology and Biodiversity in Chile, which is initially focused on invasive species
- The **Global Biodiversity Information Facility (GBIF)**, which collates records from biological collections around the world, and **Species2000 Catalogue of Life**, which is creating a valid checklist of the world's species www.gbif.org/www.sp2000.org/

Carbon storage and greenhouse gas emissions, climate change adaptation and mitigation:

- The **New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC)** – a partnership of five CRIs, Massey and Lincoln universities, DairyNZ and the Pastoral Greenhouse Gas Research Consortium (PGgRC) www.nzagrc.org.nz/
- The **New Zealand Climate Change Centre (NZCCC)** with Victoria University of Wellington, University of Canterbury, Massey University, and many of the CRIs www.nzclimatechangecentre.org/
- The **Global Research Alliance** on agricultural greenhouse gases brings more than 30 countries together with a focus on research, development and extension of technologies and practices that will help deliver ways to grow more food (and more climate-resilient food systems) without increasing greenhouse gas emissions www.globalresearchalliance.org/

Land cover, land use, and spatial land information; land, soil and fresh water management; integrated social and biophysical research:

- The **KiwiImage consortium** is a multi-agency programme to acquire and use new higher resolution, multi-purpose satellite imagery for all of New Zealand and its sub Antarctic islands.
- The **Sustainable Land Use Research Initiative (SLURI)** pools soil science expertise across three CRIs in a programme that develops new tools for regulators and land managers

Soil characterisation, processes and services; integrated social and biophysical research:

- The **Sustainable Land Use Alliance (SLUA)** between four CRIs for a more collaborative and integrated approach to research and capability development.
- The **National Land Resource Centre (NLRC)** that will provide a gateway to soil and land data, and which will have responsibility for coordinating capability development across SLUA (see NLRC page 20).
- The **Global Soil Map** that is a global consortium to make a new digital soil map of the world using state-of-the-art and emerging technologies for soil mapping and predicting soil properties at fine resolution to assist better decisions in a range of global issues like food production and hunger eradication, climate change, and environmental degradation. We are the Scientific Coordinator of the Oceania Node and lead the Cyber-informatics working group. www.globalsoilmap.net

Industry and business environmental performance, including verification:

- The **New Zealand Life Cycle Management Centre** (NZLCMC) with Massey University and three other CRIs
<http://lcm.org.nz/>

Urban environments:

- The **New Zealand Centre for Sustainable Cities** with University of Otago and five other partners
<http://sustainablecities.org.nz/>

Antarctica:

- The proposed **New Zealand Centre for Antarctic Research**, an initiative led by Antarctic New Zealand to leverage overseas and philanthropic funding

Appendix 3

Financial Policies

Dividend Policy

Principles adopted for determining annual dividend

In determining the amount of surplus funds, consideration will be given to:

- Shareholder policies on dividends and capital structure
- Providing for strategic and capital investment requirements (including equity investments) without recourse to the Crown for equity injections to the Company
- The Company's working capital requirements (including subsidiaries and businesses in which equity is held)
- Ongoing financial viability of the Company, including its ability to repay debt
- Extent of debt financing in relation to the prudent borrowing capacity of the Company
- Obligations of the Directors under the Companies Act 1993 and other statutory requirements

The Board will detail in a submission to shareholding Ministers, within four months of the end of each financial year, the:

- Amount of dividend (if any) recommended to be distributed to the shareholders
- Percentage of tax paid profits that the dividend represents
- Rationale and analysis used to determine the amount of dividend

Estimate of the amount or proportion of annual tax-paid earnings

An estimate of the amount or proportion of annual tax-paid earnings (from both capital and revenue sources) that is recommended to be distributed to the Crown is provided below, taking into account the statutory requirement to remain financially viable and a going concern, and the following considerations:

- Shareholder policies on dividends and target levels of debt as expressed in the Operating Framework for CRIs
- The Company's peak debt level being within the acceptable range estimated in the Capital Structure Plan (this was independently assessed in May 2006 and reassessed internally in November 2010)
- The Company's three times interest cover covenant, which could be breached with increased borrowing required to fund a dividend
- The duration and magnitude of the global financial crisis on research, science and technology expenditure
- The range of investment and technology service opportunities available to the Company as set out in its business plan and agreed with shareholding Ministers and the likely requirement to maintain borrowings to fund such projects
- The increased level of capital expenditure required to maintain the Company's science capability and achieve productivity gains through support services
- The Company's projected need for capital to enhance building and IT systems infrastructure
- The Company's projected need for strategic investment to accelerate the creation of national benefit by increasing Landcare Research's science competitiveness and shortening lead times of new knowledge and technologies to market

Shareholder Consent for Significant Transactions

The Board will obtain prior written consent from the shareholding Ministers for any transaction or series of transactions involving full or partial acquisition, disposal or modification of property (buildings, land and capital equipment) and other assets with a value equivalent to or greater than \$10m or 20% of the Company's total assets (prior to the transaction), whichever is the lesser.

The Board will obtain the prior written consent of Shareholding Ministers for any transaction or series of transactions with a value equivalent to or greater than \$5m or 30% of the Company's total assets (prior to the transaction) involving:

- Acquisition, disposal or modification of an interest in a joint venture, partnership, or similar association
- Acquisition or disposal, in full or in part, of shares or interests in a subsidiary, external company or business unit
- Transactions that affect the Company's ownership of a subsidiary or a subsidiary's ownership of another entity
- Other transactions that fall outside the scope of the definition of the Company's core business or that may have a material effect on the Company's science capabilities

Intellectual property transactions, wherever possible in advance, will be notified in the quarterly reports to Shareholding Ministers.

Accounting Policies

Financial statements are prepared in accordance with New Zealand generally accepted accounting practice (NZ GAAP) and comply with NZ IFRS and other applicable financial reporting standards, as appropriate for profit-oriented entities.

General accounting policies

The measurement and reporting of profit and financial position is based on historical cost.

Particular accounting policies

The following particular accounting policies, which materially affect the measurement of profit and financial position, have been consistently applied.

Accounting period

The consolidated financial statements are those of Landcare Research New Zealand Ltd, including its fully owned subsidiaries Sirtrack Ltd and Landcare Research International Ltd, for each financial year ended 30 June.

Statement of cash flows

The terms used in the statement of cash flows are defined as follows:

- (i) Cash means coins and notes, demand deposits and other highly liquid investments in which the Company has invested as part of its day-to-day cash management. Cash includes liabilities which are the negative form of the above, such as the bank overdraft. Cash does not include accounts receivable or payable, or any borrowing subject to a term facility.
- (ii) Investing activities are those activities relating to the acquisition, holding and disposal of fixed assets and of investments. Investments can include securities not falling within the definition of cash.
- (iii) Financing activities are those activities which result in changes in the size and composition of the capital structure of the Company and include the cost of servicing the equity capital.
- (iv) Operating activities include all transactions and other events that are not investing or financing activities. Interest and dividends received and interest paid are included in operating activities.

Revenue

Revenue shown in the Statement of Financial Performance comprises amounts earned by the Company for goods and services supplied to customers in the ordinary course of business.

Income received for goods and services which have not been supplied to customers is recognised as revenue in advance.

Current assets

- (i) Accounts receivable: Accounts receivable are valued at expected net realisable value.
- (ii) Stock: Stocks are valued at the lower of cost on a weighted average price of stock on hand, or net realisable values. In the case of manufactured goods, cost includes direct materials, labour and production overheads.
- (iii) Work in progress: Costs incurred for the supply of goods and services but not billed against customers is recognised as work in progress.

Fixed assets

Completed buildings, plant, motor vehicles, furniture and tools are recorded at cost, less accumulated depreciation. Land and buildings under construction are recorded at cost.

National databases and reference collections

National databases are not valued. Reference collections are valued in accordance with FRS-3, and form part of the 'restricted equity' against which performance targets will not be measured.

Distinction between capital and revenue expenditure

Capital expenditure is defined as all expenditure on the creation of a fixed asset, and any expenditure which results in a significant improvement of the original function of a total asset. Revenue expenditure is defined as expenditure which restores an asset to its original condition and all expenditure incurred on maintaining and operating the Company.

Depreciation

After taking into account likely residual values, all depreciable assets are depreciated on a straight-line basis over their estimated economic lives.

Depreciation rates:

Buildings	1.67–10%
Plant and equipment	5–20%
IT equipment	25%
Motor vehicles	25%
Furniture and fittings	10%
Office equipment	20%
Library books & periodicals	20–50%
Rare Books collection	1%

Leased assets

The Company leases certain plant & equipment and land & buildings. Finance leases, which effectively transfer to the entity all of the risks and benefits incidental to ownership of the leased item, are capitalised at the present value of the minimum lease payments. The leased assets and corresponding liabilities are disclosed and the leased assets are depreciated over the period the entity is expected to benefit from their use. Operating lease payments, where the lessors effectively retain substantially all the risks and benefits of ownership of the leased item, are included in the determination of the operating profit in equal installments over the lease term.

Research and development costs

Research and development costs are expensed in the period incurred. Development costs are deferred where future benefits are expected to exceed those costs. Deferred development costs are amortised over future periods in relation to expected future revenue.

Intellectual property

No value is ascribed in the Statement of Financial Position to intellectual property assets. Revenue received from the use of intellectual property assets is recognised when earned, and the costs incurred in the maintenance of intellectual property assets are expensed when incurred. Costs incurred in respect of

protecting the value of intellectual property (by way of patents) will be capitalised and amortised over future periods in relation to expected future revenue.

Taxation

Taxation is provided in the financial statements on the basis of the estimated taxation payable on the taxable income by each member company of the Group, after taking advantage of all available deductions and concessions. Deferred taxation resulting from timing differences is recognised using the liability method on a comprehensive basis. A deferred tax benefit arising from timing differences is only recognised if there is a virtual certainty of realisation.

Foreign currency translation

Transactions denominated in a foreign currency will be recorded using the exchange rate at the settlement date, except for transactions subject to forward cover contracts, where the forward rates specified in those contracts will be used. Realised and unrealised gains or losses on foreign currency transactions are dealt with in the Statement of Financial Performance. Foreign currency balances are converted at the mid-TT rate applying at balance date.

Financial instruments

Revenue and expenses in relation to all financial instruments are recognised in the Statement of Financial Performance. Financial instruments carried on the Statement of Financial Position include cash and bank balances, investments, receivables, trade creditors and borrowings. These instruments are, generally, carried at their estimated fair value.

Principle of consolidation

The consolidated financial statements include those of the holding company and its subsidiaries accounted for using the line-by-line consolidation method. All intercompany transactions, balances and unrealised profits and losses on transactions between group members have been eliminated.

Changes in accounting policies

Any changes in accounting policies and the effect on retained earnings will be disclosed.

Directory

Directors

Jo A Brosnahan *QSO* (Chair)
Gavan Herlihy
Hon. M John F Luxton *QSO*
Dr Emily Parker
Peter M Schuyt
Tania J Simpson
Victoria A Taylor

Senior Managers

Dr Richard Gordon	Chief Executive
Dr Rob Allen	Acting General Manager, Science & Policy
Carol Bellette	Chief Financial Officer and Company Secretary
Katrina Direen	General Manager, People & Culture
Dr Libby Harrison	General Manager, Development
Dr Phil Hart	General Manager, Science Investment & Evaluation
Rau Kirikiri	Kaihautū (<i>part time</i>)
Dr Peter Millard	General Manager, Science & Industry
Dr David Whitehead	Chief Scientist

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Graham Carter Chief Executive

Glossary & Jargon Buster

AHB	Animal Health Board
BusinessNZ	New Zealand's largest advocacy group for enterprise, and champions policies
Capex	Capital Expenditure
CCAMLR	Commission for Conservation of Antarctic Marine and Living Resources
CBD	Convention on Biological Diversity
CEMARS	Certified Emissions Management and Reduction Scheme
CEP	Commission on Environmental Protection
CRI	Crown Research Institute
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
DairyNZ	DairyNZ is the 'industry good' organisation, representing New Zealand's dairy farmers
DOC	Department of Conservation
Ecosystem services	The 'free' services that healthy ecosystems provide e.g. Clean water, fertile soil, storm water retention, erosion prevention
Environmental limits	The point at which ecosystem services collapse, e.g. the soil's biological community is depleted to the extent that they can no longer replenish nutrients
End user	Organisations, entities and people who apply the information and recommendations arising out of our research
EPA	Environmental Protection Authority (previously the Environmental Risk Management Authority, ERMA)
ETS	Emissions Trading Scheme
ESDB	Ecosystem Services Database
FAR	Foundation for Arable Research
GHG	greenhouse gases
ICBN	International Code of Botanical Nomenclature
ICZN	International Code of Zoological Nomenclature
Kaitiakitanga	Traditional guardianship of natural resources
KAREN	Kiwi Advanced Research and Education Network
KPI	Key Performance Indicator
LCDB	Land Cover Database
LiDAR	Light Detection And Ranging (an optical remote sensing technology)
LINZ	Land Information New Zealand
LRIS	Land Resource Information System
LUDB	Land Use Database
Mātauranga	Traditional cultural knowledge
MBIE	Ministry of Business, Innovation and Employment (formed from a merger of the Ministry of Science and Innovation with other government departments)
MED	Ministry of Economic Development
MfE	Ministry for the Environment
MPI	Ministry for Primary Industries (previously Ministry of Agriculture and Forestry, and Ministry of Fisheries)
NeSI	National e-Science Infrastructure
NGO	Non-governmental organisation
MNZCCM	New Zealand Centre for Conservation Management
NZOR	New Zealand Organism Register
OECD	Organisation for Economic Cooperation and Development
RMA	Resource Management Act
SLURI	Sustainable Land Use Research Initiative
S-map	Digital soil map for New Zealand
Stakeholders	The wider community indirectly affected or impacted by our work.

