

## **Regional Council Critical Issues and Research Needs**

**Objective** To develop an agreed list of critical issues facing Regional Councils now and looking ahead over the next 20 years, and a corresponding list of research needs to incorporate into the Research Strategy and subsequently to be the basis of research and funding prioritisation. The priority was to look beyond a pre-occupation with immediate needs, to anticipate what councils might have to deal with in the future and so bring timely research to bear; but this principle was not followed exclusively in developing the agreed list of critical issues.

**Background** The Regional Council Research Strategy requires the identification of key strategic research needs to influence Government-funded research direction, primarily in Environmental research, but also including those wider areas of relevance to Regional Council function.

**Approach**

1. Councils and BMG submitted information on their perceived critical issues and research needs in response to the question: “What are your Region’s top two critical issues/research needs over the next 20 years within each of the subject areas identified by FRST?” Responses were submitted prior to 20 June 08.
2. Council representatives participated in a “Future Research Needs” workshop on 20 June 08 and ranked research priorities by FRST portfolio.
3. Councils commented on a draft document of “Critical Issues and Research Needs”, representing the outcomes of that workshop – and returned comments by 14 July 08.
4. The current document is the edited version of Critical Issues and Research Needs and is to be finalised on approval by the Science Advisory Committee.
5. The finalised list of Critical Issues and Research Needs will be incorporated into the final draft of the Regional Council Research Strategy for signoff by SAG and ultimate approval by the CEO Forum on the 7<sup>th</sup> August 08.

**Summary of Document** This document presents the critical issues and research needs considered to be of very high strategic importance by New Zealand’s Regional Councils. Additional important critical issues and research needs are appended.

The document also indicates “Themes” or “cross-FRST portfolio” topics that the Regional Councils consider need to be addressed by FRST and other government departments.

**Critical Issues and Research Needs Considered to be of Very High Importance (★★★★)**

<b>Critical Issue: Valuing environmental services</b>	
<b>Research Need</b>	<b>Comment</b>
Research to develop and trial new methodologies and tools to enable RC's to place financial and non-financial values on environmental resource services. Valuing 'natural capital' in a robust, defensible and transparent way that is capable of wide application across all natural resources.	SRU and ECO portfolio

<b>Critical Issue: Accumulation of contaminants in soils – resulting from the application of fertilisers and other chemicals etc. - the side effects of productivity-modifying actions</b>	
<b>Research Need</b>	<b>Comment</b>
In a future world of alternative fertilisers (e.g., slags, biochar, effluent, chicken litter) and pesticides, what will be the consequences of use on the soil-water system (e.g. potential effects upon soil structure and quality, groundwater and surface water receiving environments, carbon sequestration) and the risks for productive and consumptive uses of the system (including plant and animal production and human occupation of sites).	SRU and also SPS

<b>Critical Issue: Application of planning mechanisms and social and economic research for land use changes</b>	
<b>Research Need</b>	<b>Comment</b>
Development of planning tools, including social and economic research, for investigating the implications and consequences of future land use changes. Tools may include models.	SRU

<b>Critical Issue: Understanding the impacts of nutrients and sediments on estuaries and coastal environments – both urban and rural context</b>	
<b>Research Need</b>	<b>Comment</b>
Land use effects on nutrient and sediment generation and transport and effects on estuaries and coastal environments, including sublethal, synergistic (or antagonistic) effects of multiple stressors and interactions	SRU

<b>Critical Issue: Determine the assimilative capacity of estuarine &amp; coastal receiving environments and ascribe land-based contaminant management standards and targets</b>	
<b>Research Need</b>	<b>Comment</b>
Need an empirical, evidence-based approach to policy development that integrates management of contaminants at source (land-based) aligned to contaminant fate (transport mechanisms) and environmental consequence (ecological impact).	SRU and ECO

<b>Critical Issue: Control tools for biosecurity pest management</b>	
<b>Research Need</b>	<b>Comment</b>
Development of new control tools for pest management – such as a replacement for 1080 and brodifacoum, should their use be curtailed in the future	Advocate for more central Govt effort ECO portfolio
Characterisation and control methods for aquatic pests – both freshwater and marine	ECO

<b>Critical Issue: Cumulative effects of activities on ecosystem structure, function and resilience</b>	
<b>Research Need</b>	<b>Comment</b>
Improved understanding of natural ecosystem complexity, diversity and resilience, and the cumulative effects of on-site and off-site activities on NZ natural ecosystems (i.e. how to avoid ‘death by a thousand cuts’ in our ecosystems; are there ‘tipping’ points and if so, when do they occur?)	ECO and SRU

<b>Critical Issue: Urban stormwater management</b>	
<b>Research Need</b>	<b>Comment</b>
Address barriers to science and technology transfer on what is known about stormwater diversion, retention, treatment, and utilisation in urban areas; both greenfield and brownfield. Development of robust indicators identifying contamination issues and ecosystem changes (by stormwater) in natural systems.	SCS. Especially a need for greater technology transfer.

<b>Critical Issue: Sustainability frameworks to evaluate community wellbeing and quality of life</b>	
<b>Research Need</b>	<b>Comment</b>
Development of innovative methods to evaluate community wellbeing and quality of life – for example, genuine progress indicators; and advice on how to achieve effective application of such methods in strategic community decision-making cycles.	SCS

<b>Critical Issue: Technologies to improve air quality</b>	
<b>Research Need</b>	<b>Comment</b>
Development, and/or technology transfer, to improve options to abate air quality emissions from existing home and industry sources in energy efficient ways (Note: the National Environmental Standard focuses on new sources, not existing ones)	SCS

<b>Critical Issue: Managing primary production systems under increasingly constrained inputs (water, soil, land)</b>	
<b>Research Need</b>	<b>Comment</b>
Techniques and tools for managing primary production systems under constrained inputs; what might 'constrained input' agriculture look like; what new environmental pressures might it bring, or existing pressures might it ease?	SPS
Optimising and integrating existing nutrient management tools e.g., SPASMO etc. Improved agricultural nutrient models e.g., OVERSEER, to manage non-point source discharges and consequent effects, not just on-site nutrient balancing; need for greater reliability under a range of specific conditions.	SPS
Mechanisms for sustainable water management and allocation efficiency and equity; including valuing of water and understanding of social distributive issues etc.	SPS

<b>Critical Issue: Aquaculture impact on benthic systems</b>	
<b>Research Need</b>	<b>Comment</b>
Understanding the positive and negative impacts of aquaculture on benthic systems (both freshwater and marine) including the associated benthic invertebrate and fish communities.	SPS

<b>Critical Issue: Environmental performance evaluation including auditing and certification</b>	
<b>Research Need</b>	<b>Comment</b>
Robust defensible protocols for identifying, measuring and evaluating environmental performance, for the benefit of producers (accountability to consumers), their market/consumers (choice); and for environmental regulators (full environmental impact assessment).	SPS, PQA

<b>Critical Issue: High class soil management</b>	
<b>Research Need</b>	<b>Comment</b>
How can we value high quality lands (i.e., soil-climate systems) that are under pressure from non-productive land use development (e.g., urban sprawl onto highly productive lands)	PQA, SPS

<b>Critical Issue: Waste management</b>	
<b>Research Need</b>	<b>Comment</b>
Reuse or recycling of solid waste and wastewater. All waste types. Productive reuse, and integration with other values e.g. wastewater for carbon sequestration irrigation	ORI

<b>Critical Issue: Technological hazards</b>	
<b>Research Need</b>	<b>Comment</b>
Technological hazard and risk analysis – e.g., power outages- likelihood, vulnerability analysis	RIC

<b>Critical Issue: Climate change</b>	
<b>Research Need</b>	<b>Comment</b>
Planning for impacts of climate change (GLO, SPS) – adaptation to risks including opportunities presented by climate change.	GLO, SPS
Impacts of climate change on indigenous biodiversity values and change including what are the biodiversity values and resources most at risk?	GLO

<b>Critical Issue: Community change</b>	
<b>Research Need</b>	<b>Comment</b>
Social science research - how to effectively promote highly targeted behaviour changes towards desired ends amongst particular populations, for particular issues. Including a mix of policy options.	Cuts across portfolios; could be a theme
Investigate impacts on, and ability for communities to adapt /respond to changes in their environment and the distribution of impacts including identification of equity issues and mechanisms to minimise negative consequences on well-beings.	Cuts across portfolios; could be a theme
Identify examples co-management models between Maori and Council and evaluate their effectiveness.	Cuts across portfolios; could be a theme
Identify links between social, economic, cultural and environmental well-beings and evaluate the effectiveness of their inclusion in council and other agencies decision making.	Cuts across portfolios; could be a theme

## **Themes or Cross-Portfolio Topics that need to be Addressed**

<b>Topic</b>	<b>Comment</b>
Mechanisms to identify, access and harness economic drivers that lead (knowingly or unknowingly) to desirable environmental change. Need to be able to counter short-run pricing positions by government or resource user sectors with sound science-based environmental policy; i.e. how to make environmental science more effective in policy formulation as a driver of societal change. Institutional ways of operating. How do you slow down what's going on – with science? Influence. Developing our own economic drivers.	Links in with more than just FRST – should also be MED, MAF, MfE.
Social science research - how to effectively promote highly targeted behaviour change towards desired ends amongst particular populations, for particular issues. Including a mix of policy options.	Another theme to communicate to FRST and others
Future proofing of science capability in NZ.	Communicate to FRST – high level– big message.
Integrating Water quality and land-use – but also in relation to community change.	
Maintaining environmental (green image) integrity. Proof of environmental 'acceptability'- robust, comprehensive, and practical certification of environmental quality of production, for consumer approval (e.g. an answer to the debate over 'food miles'), and as a regulatory tool describing environmental performance	Broad policy issue
Better methodologies for balancing economic and societal/cultural values e.g. <i>balancing economic pressures from aquaculture, tourism and forestry industries, while taking regard of community aspirations to maintain tranquillity, attractive landscapes, clean air and water, heritage features and terrestrial marine flora and fauna.</i>	
Need to incorporate system complexity in the identification and understanding of links between land-use activities and receiving environments.	Ties in with SRU

<b>Topic</b>	<b>Comment</b>
Biodiversity and pest management prioritisation setting technologies need to be developed to assist RC's Includes tools to assist RC's to make a stock take of biodiversity values and pests. Tools that could provide an inventory of values at sites with an overlay of pest impact, including the relationship between pests. A	This primarily concerns integrated tool development – and part of a theme that RC's need to communicate to FRST) (high importance for RC's but it's something

National biodiversity inventory, information and management system (including a database) is required; (LENZ would be a subset of this); lends itself to a Platform approach; Framework for thinking: what have we got, how does it work, how do we keep it?	RC's need to do with research provider assistance)- Could recommend this as a Platform to FRST.
National water monitoring methodologies.	(needs to be done but not research)
A water platform might be from surface to estuary. Integration key. Something to discuss. SWIM.	(not a research issue – philosophical approach to communicate to FRST)
Databases of national significance (water, climate etc) – need to connect databases – also National Hydrometric Network. National data bases for pests and risk modelling tools.	Encourage FRST; another philosophical point to make
Biodiversity - how can we better measure what difference we are making?	Should be another theme that goes across portfolios
The generic challenge is integrated assessment & dynamic modelling of systems (resource and ecosystems) for running and evaluating scenarios including the analysis of risk and uncertainty with each scenario	

Topic	Comment
Appropriate standards for contaminated land – e.g for residential use in the context of high rises and apartments, instead of in context of '1/4 acres section' growing vegetables etc. Also, for ecologically-based environmental acceptance criteria for contaminated sites – as opposed to merely human health issues Bioaccumulation risk profiling and comparative risk assessment from older agricultural and horticultural sites still in production or under residential development scenarios: this work to underpin or support NES for contaminated sites.	High for MfE – but research not needed

Topic	Comment
Robust methods for improving our ability to predict consequences of different policy options and evaluate the effectiveness of management actions on the environment.	Links with SCS, SPS

Topic	Comment
Impacts of intensive agricultural practices on soil quality and water systems (surface and groundwater).	Theme to discuss with MAF.

<b>Topic</b>	<b>Comment</b>
Options for enhancing soil quality/integration with other co-benefits such as carbon sequestration.	A theme to discuss with MAF and MfE

<b>Topic</b>	<b>Comment</b>
Biosecurity - how can we better measure what difference we are making at reducing risk and managing pests? How can we best target limited resources?	A theme to discuss with MAF

<b>Topic</b>	<b>Comment</b>
Continued investigation of hazards and risks to the NZ community. It's difficult to formulate research programmes on topics below.	
Work on NZ standard for Flood Risk Management	

<b>Topic</b>	<b>Comment</b>
Accepting there is a need to do something to prepare for climate change in a social context.	

<b>Topic</b>	<b>Comment</b>
The role of science to stimulate discussion on sustainable development. How can science play this role?	

## Appendix - Summarised Notes from Workshop and Council Submissions

### ***SRU - Maintaining environmental integrity for sustainable resource use***

#### **Purpose**

Investments in Maintaining Environmental Integrity for Sustainable Resource Use will support and develop options for sustainable development of productive and manufacturing environments, including rural landscapes and the biotic and physical resources on which primary production and manufacturing enterprises depend. The primary benefits should be environmental but there needs to be strong integration of economic, social and cultural considerations.

#### **Scope**

Targeted-basic and applied research including strong components of technology transfer within research programmes. Covers land- and sea-based productive and manufacturing environments and enterprises with an emphasis on resource use and degradation, (for example water quality and allocation, soil and air services), and the long term environmental integrity of these environments.

#### **Critical research needs – ranked very high in importance (★★★★)**

<b>Topic</b>	<b>Comment</b>
Valuing environmental services – placing an economic value on the (significance) service of the resource, e.g. water - should we consider only its cost of supply, or its value as used?	Also SPS
Accumulation of trace elements associated with fertiliser use – now and future ones – drenches and other chemicals too; Alternative fertilisers – e.g., slags, biochar, effluent, chicken litter – consequences, including means of altering availability, e.g., phosphorus in allophonic soils.	Also SPS and PQA
Planning mechanisms and social research – planning land use changes – e.g., impact on Rotorua lakes (how to change society)	Also SPS
Impacts of nutrients and sediments on estuaries and coastal environments; use and effects; nutrient requirements, sublethal etc. Both urban and rural context.	Also SPS, PQA

☆☆☆ **Research needs**

Topic	Comment
Methods for managing agricultural emissions – nutrients, gases, (not including diffuse) – air emissions and water discharges	Also SPS
Scenario modelling for land use change. Predictive tools. Develop integrative modelling architecture.	Also SPS
Managing optimal nutrient use	
Identifying environmental constraints and bottom lines. Determine assimilative capacity and ascribing environmental standards (i.e. TMDL's for SS). e.g., soil nitrogen.	Tipping point research
Evaluating environmental performance of best management practices – current and future – e.g., nitrification inhibitors, biochar, etc – and indirect effects, emerging issues, -avoiding future 2,4,5 – T example, unforeseen effects. eg who is looking at effects of nitrification inhibitors on soil biota and in-stream photosynthetic bacteria?	Also SPS
Investigation of potential methods for lake maintenance, enhancement and restoration water quality, e.g., chemical treatments for nutrient stripping etc	
Soil loss processes, especially carbon. Related to future more intensive market gardening as 'food miles' argument kicks in and local production becomes more important. Soil management practices to mitigate against. Method to evaluate soils. Tie in with ecosystem services perhaps? Cost of production vs. loss.	Also SPS, PQA
More development of NZ-relevant guidelines and trigger values for sustainable management of the environment. MfE – water and soil. Soil quality indicators. Including improving monitoring tools to include socio-economic aspects.	Also PQA
Indexing of Biodiversity value within productive landscapes (eg urban, agricultural pastoral), not just in 'natural' landscapes.	Also SPS
Social and economic costs of losing Class 1 soil to urban sprawl.	Also SPS
Protecting and enhancing indigenous biodiversity in urban environments, and not just in 'quarantined' segregated landscapes.	High importance for urban areas.
The opportunities for genetic modification to enhance biosecurity effectiveness.	Might also fit in ECO or SPS

☆☆ **Research needs**

<b>Topic</b>	<b>Comment</b>
Underlying resource datasets – soil maps; models, tools – for making decisions on a regional basis – to do with the land. Some areas lack scale and information; ground-truthing needed. Underlying soil maps. S-maps. Fundamental lack of information on land use change around the country. Lack of methodology for land use change mapping.	High for S-maps
Need for greater lake water quality monitoring – research case studies perhaps? Are we research/monitoring as many lakes as we should? Are there more effective ways to monitor? Is the National lakes monitor protocol (MfE) comprehensive enough, or too selective? Nationally significant lake monitoring programme. We need to avoid surprises everywhere.	Need to influence FRST to fund long-term monitoring – building the datasets – research follows.
Water issues? Tool or method for ungauged catchments.	NIWA has something
Sub-lethal, and synergistic (or antagonistic) effects of multiple stressors and interactions.	

☆ **Research needs**

<b>Topic</b>	<b>Comment</b>
Carbon farming – wider aspects of maximising biodiversity- co-benefits identified and enhanced	Also SPS

## ***ECO - Resilient functioning and restored ecosystems***

### **Purpose**

Investments in Resilient, Functioning and Restored Natural Ecosystems will enhance and support the resilience, functioning and recovery of land, freshwater and marine ecosystems and their components at a range of scales and levels of complexity. The research investment should primarily benefit the natural and indigenous environments.

### **Scope**

Targeted-basic and applied research. Includes research conducted at a range of spatial scales and localities (in terms of the way the research is conducted and the research focus), and different levels of biological organisation (including individual and interacting taxa, habitats, populations, communities, ecosystems and environments). This portfolio will include research on biodiversity and on biosecurity. The portfolio is not limited to specific types of research or methodological approach. (Note: Research on land-use effects and sustainable resource use on the functioning of ecosystems may also address

influences and responses of estuaries, dunes or coasts in this portfolio, e.g. where it is sensible to take a whole-catchment land-based approach).

**Critical research needs – ranked very high in importance (★★★★)**

Topic	Comment
New control tools for biosecurity/pest management – high priority for BMG (includes desire for a future alternative for 1080) including characterisation control methods for aquatic pests – freshwater; but also marine;	While this is a central Govt issue we can still advocate for a research need
Understanding natural system complexity. <b>Cumulative/multiple effects</b> of activities on ecosystem structure, function and resilience.	Also SRU
Evaluation of ecosystem services using market and non-market valuation techniques.	Also SPS, SRU

**★★★ Research needs**

Topic	Comment
Options for control of multi species (BMG priority) rather than single-species approach generally adopted to date—are we investing in the right areas?	
Border biosecurity – improved detection technologies – especially for the little things – bacteria, fungi etc; early detection of pests that are here – finding those things that are in low numbers;- we can support MAF priorities.	Message is for MAF to keep this as a high priority
Valuing ecosystem services. How do we do this?	Also covered elsewhere
Methods for enhancing ecosystems: How do we best manage what we have left within the threatened ecosystems? What needs help, what is beyond help, what sort of help is best? Fragile, remnant, threatened ecosystems. Connectivity- what does it offer? How much is enough- how can we prioritise our efforts to best effect? Including knowing how much there is on a national, and not just a regional, basis.	Maybe link with valuing ecosystem services?
Eco-connect? – ecosystem integrity, what’s the tipping point?	High priority for DOC
Bioaccumulation risk profiling and comparative risk assessment from HAILs, hazardous facilities and contaminated sites’ contamination of lowland urban waterbodies and coastal marine sinks – also river systems	
Understanding the structural and functional components of ecosystems along varying disturbance gradients. – how well systems are doing (dealing with tradeoffs – “just a little bit more is okay”	

**★★ Research needs**

Topic	Comment
Understanding the nature of risk – social aspects – public perceptions; managing perceptions and risk; e.g.,	

1080. The risks to current management tools – arising from changing public perceptions. How might these perceptions change in the future- how can we stay ahead of public mood	
Biodiversity – enhancing biodiversity in urban settings	Links to SCS
Understanding the role of groundwater dependent ecosystems.	
Evaluation of ecosystem services in unique environments – e.g., geothermal, alpine, high sediment content ecosystems etc.	
Non-wadeable streams – standard monitoring protocols needed- and do we know (quantifiably) their ecological value? Is it a case of ‘we haven’t looked, so we don’t know?’	
National criteria for protection of “protected areas” – standard reporting terminology. Levels of protection. Minimum standards of care concept. Thresholds, transitions, Biological control of insect pests – also linked to climate change- the changes in pest distribution and virulence that might occur	
Rapid screening techniques for ecosystem health/significance. Determine ecosystem significance, risk and consequence in a rapid manner. Need to incorporate sensitivity and risk analysis.	
Restoration and rehabilitation tools to redress the loss of lowland indigenous biodiversity	
Impacts of weeds and pests and new organisms on indigenous biodiversity (e.g. phytosphthora impact on kauri)	

★ **Research needs**

<b>Topic</b>	<b>Comment</b>
Emerging risks from climate change – risk analysis in light of CC. and what we have already that may change due to CC. more of an impact. Changes in risk profile.	Also under GLO

## ***SCS - Building sustainable cities and settlements***

### **Purpose**

This portfolio supports research for New Zealand related to the management, development and governance of cities and settlements that are conducive to positive environmental, social, cultural and economic outcomes. Investments in this area aim to support New Zealand’s efforts to ensure the sustainable development of our cities. This is achieved by supporting research that improves the quality of the urban environment, and creates an urban information base.

## Scope

The types of research targeted for investment from this portfolio cover a range of focus areas including: urban/peri-urban and rural dynamics across different types of settlements. This portfolio supports basic-targeted and applied research (including natural, physical and social science).

### **Critical research needs – ranked very high in importance (☆☆☆☆)**

<b>Topic</b>	<b>Comment</b>
Stormwater diversion, retention, treatment, and utilisation in urban areas – the whole package including costs; both greenfield and brownfield. Quite a bit of this is technology transfer; need to address barriers to tech transfer.	
Sustainability frameworks. Development of innovative methods to evaluate community wellbeing and quality of life, for example genuine progress indicators.	or Social
Technologies to improve air quality from existing sources, not just new ones – emissions – home and industry. Retrofitting domestic and industrial systems.	

### **☆☆☆ Research needs**

<b>Topic</b>	<b>Comment</b>
Life cycle analysis for building materials Low impact design – including on-site and off-site effects; materials and energy- towards the best (lowest impact) building materials and designs of the future	SCS
LCA for production systems - mfg; waste management – waste generation.	
Urban transformation. Developing alternatives to peripheral growth: (1) where else could growth go? (2) viable economic alternatives for periphery other than land speculation. Implications of compact urban form for varying community needs.	
Understand more thoroughly issues surrounding affordable housing. (SCS) – link of affordable housing to air quality	
Research on the relationship between public health and air quality regarding PM2.5 and other contaminants.	Very high priority for urban areas

### **☆☆ Research needs**

<b>Topic</b>	<b>Comment</b>
Effects on surrounding environment from urbanisation – sprawl on landscapes – amenity values	
Urban stream restoration. Methodologies for rehabilitation. Valuation of streams – more than methodologies.	High for urban areas

★ **Research needs (four star???)**

Topic	Comment
Implications of demographic change on regional economy and society – scenarios to take into account increasing diversity, widening social disparities, changing service requirements of aging portion of population, etc.	

***SPS - Sustainable production systems***

**Purpose**

Investments in *Sustainable Production Systems* will lead to land, freshwater, estuarine and marine based production systems with improved environmental indices, reduced resource use and greater social acceptance of production practices resulting in the maintenance of the cost competitive position of New Zealand's primary produce.

**Scope**

Basic and applied research into all aspects and types of land and sea based biological production systems, (including biophysical, socio-economic and environmental aspects and also inclusive of research relating to mitigation of the environmental impacts of production systems and obligations

**Critical research needs – ranked very high in importance (★★★★)**

Topic	Comment
Proof of environmental acceptability (SPS, PQA) – links to best management practices.	Also PQA
Techniques and tools for managing primary production systems under constrained inputs – water, soil, land.	
Optimising existing nutrient management tools – SPASMO etc. – (links to a current Envirolink tool project) – both optimising and enhancing uptake. Improved agricultural nutrient models e.g., OVERSEER to manage non-point source discharges; make it more reliable under specific conditions i.e. not just a nutrient budgeting tool, but able to reliably predict environmental effects in real world scenarios.	
Mechanisms - Water management and allocation efficiency – valuing water according to different uses, not just costing it according to cost of supply etc	
Aquaculture impacts or benefits to benthic systems including the associated benthic invertebrate and fish communities, given the likelihood of expanding aquaculture for food supply in a land-constrained world	

☆☆☆ **Research needs**

Topic	Comment
Rabbits as a re-emerging issue – new control methods; understanding behaviour of RHD.	
More research on viruses, bacteria, cyanobacteria, from algae etc in water systems, and their health effects under varying conditions, concentrations etc.	Links to coastal
What is acceptable health criterion for viruses in surface water, stock water, drinking water.	High for MoH
Cost-effective and appropriate virus detection methods.	High for MoH
Source identification for viruses.	
Effective and cost-effective methods of measuring land use change on a regional and catchment scale – consistent methodology required for national inventory, regional comparisons and benchmarking.	Also SRU
Understanding the linkages. Systems approach. Primary production. Research into biological, hydrological and geophysical cycles to promote sustainable resource use.	

☆☆ **Research needs**

Topic	Comment
Pest control tools for productive systems.	
Research on what triggers the toxins from viruses, bacteria, cyanobacteria, from algae etc.	
Causes of campylobacter outbreaks;	
Technologies and management systems to mitigate biosecurity risk – especially for viticulture and aquaculture.	Also PQA
Biomass/biofuel crop potentials	
Effluent application for biofuel crop production. Land-based crops. Integrated waste management/treatment and beneficial end-use options and opportunities.	
Innovative land management systems. For instance, developing cost effective riparian management systems using geo-spatial technology (virtual fencing).	

☆ **Research needs**

Topic	Comment
Organic farming – is it a biosecurity risk? A potential contaminated land issue?	Also PQA
Cost efficient alternatives to the use of conventional herbicide and pesticides.	(link with other chemicals)

## ***PQA - Production, quality, and assurance***

### **Purpose**

Investments in *Primary Production, Quality and Assurance* will lead to efficient and effective production, harvesting and/or processing technologies that maintain superior product quality attributes, (including public safety), and assure ongoing global market access for New Zealand's primary industry-based commodity export products.

### **Scope**

Basic and applied research and experimental development into all aspects of the production, harvesting, processing and distribution of New Zealand's primary commodity products.

### **Critical research needs – ranked very high in importance (★★★★)**

<b>Topic</b>	<b>Comment</b>
Environmental certification of productive systems High class soil management might be part of this for protecting market access? Ties with Certification.	Also SPS

### **★★★ Research needs**

<b>Topic</b>	<b>Comment</b>
Protection from marine pests with the potential to damage NZ's aquaculture industry.	
The importance of biosecurity threats and opportunities in building and sustaining export market environmental certification.	
The importance of biodiversity monitoring and reporting in export market environmental certification processes.	

### **★★ Research needs**

<b>Topic</b>	<b>Comment</b>
Biocontrol for biosecurity	

## ***ORI - Optimising physical resource use and infrastructure services***

### **Purpose**

Investments in Optimising Physical Resource Use and Infrastructure Services will lead to enhanced security of supply of physical resources within New Zealand's broader Economic Exclusion Zone, sustainable and socially acceptable extraction processes for physical resources and the identification of alternative supply of essential physical resources including renewable options within a framework of supporting New Zealand's economic development.

## **Scope**

Basic and applied research and experimental development in any aspect of the identification, extraction and primary processing of physical resources including but not limited to energy resources, mineral resources, (mineral resource evaluation, improving availability of supply, extraction and initial processing), water, air and materials for essential infrastructure and the development of alternative technologies for the exploitation of renewable resources and including assessments of environmental and socio-economic impacts of these processes and technologies.

### **Critical research needs – ranked very high in importance (★★★★)**

<b>Topic</b>	<b>Comment</b>
Reuse or recycling of solid waste and wastewater. All waste types. Productive reuse	

### **★★★ Research needs**

<b>Topic</b>	<b>Comment</b>
The use of the coastal marine area. Need to know more and need decision tools. Need more research for planning and policy.	
Use of geothermal resource – methods to achieve sustainable allocation. Characterisation.	High priority in some regions
Improved water management including wastewater management – improved and affordable innovative technologies for community supplies, especially in remote or impoverished areas etc.	

### **★★ Research needs**

<b>Topic</b>	<b>Comment</b>
Need to know more about offshore resources (and biodiversity). Ocean 2020 – seamounts for minerals-how big are they? How likely are they to be mined? How would this happen? How should it be managed?	
Medium and micro-scale hydro power generation – and other renewable energies	
Access to (identification of) resources – aquaculture, forestry (ORI) – identifying area; use capability mapping	M (for forestry) H (for aquaculture)
Electric vehicles, electricity demand, electricity supply options, RMA matters of national importance - What are the source and supply implications for powering a large electric vehicle fleet? And other issues.	
Small boiler emission reduction technology – e.g., glasshouses	

## ***RIC - Resilient infrastructure and communities***

### **Purpose**

Investments in *Resilient Infrastructure and Communities* will lead to the sustainable continuation of New Zealand's economic and social well-being in an all hazards environment - through the effective management of economic, infrastructural, social, political and other public risks.

### **Scope**

Basic and applied research and experimental development in any aspect of the natural and man made hazard-scape in New Zealand focusing on issues of hazard characterisation, risk identification, and improved planning and preparedness prior to, during and after a hazard event encompassing both science and engineering, and socioeconomic aspects of risk reduction.

### **Critical research needs – ranked very high in importance (★★★★)**

<b>Topic</b>	<b>Comment</b>
Technological hazard analysis and risks – e.g., prolonged power outages; major 'industrial' fires explosions- what consequences need to be recognised? How can they be provided for?	

### **★★★ Research needs**

<b>Topic</b>	<b>Comment</b>
Managing (monitoring and influencing) public perception before and during an emergency - how to 'read', anticipate, and manage what the urban myths, gossip, and rumours are saying	

### **★★ Research needs**

<b>Topic</b>	<b>Comment</b>
National "standard" on identification of risk from drought and water shortage. Can we/ should we develop a nationally consistent approach to declaring and managing droughts?	

### **★ Research needs of lower importance**

<b>Topic</b>	<b>Comment</b>
Biosecurity incursion response systems; managing consequences – e.g., animal disposal etc.	

## ***GLO – Understanding/adapting to global processes and change***

### **Purpose**

New Zealand specific and internationally linked RS&T, which will help New Zealand:

- Reduce its vulnerability to global and regional variation and change
- Develop more effective adaptation and risk management strategies
- Be confident of its position when negotiating international agreements and implementing policies in New Zealand that stand scrutiny internationally
- Be a positive influence internationally and support sustainable resource development.

### **Scope**

In fulfilling this purpose the GLO portfolio will need to:

- Provide baseline data, models and knowledge for use by a wide range of users.
- Provide capability that will support greater integration of information and knowledge across other research programmes and portfolios
- Provide baseline data and models to improve predictive capability
- Improve our understanding and ability to address economic, social and environmental issues associated with tectonic processes
- Identify the sensitivity and vulnerability of economic activity (macro) and environmental processes (spatial and temporal) to global and regional variability and change.

### **Critical research needs – ranked very high in importance (☆☆☆☆)**

<b>Topic</b>	<b>Comment</b>
Planning for impacts of climate change – adaptation including opportunities presented by climate change.	Also SPS
Impacts of climate change on indigenous biodiversity values and change including what are the biodiversity values and resources most at risk.	Also ECO

### **☆☆☆ Research needs**

<b>Topic</b>	<b>Comment</b>
Coastal erosion and climate change – identification and better understanding of reasons for erosion; links to sea level change and storm surge- magnitude and likelihood.	Maybe move it to hazards.
Need for systems based research to Coordinate climate change research for regional predictions on water and hazards.	Also RIC
Modelling Storm surge potentials in coastal communities.	
Estuaries and sea level rise - As the water surface rises, will the estuary beds rise too? Lag time etc.	Also ECO

Cost of local adaptation vs. non-adaptation to climate change, for a range of current and future land uses. Economic analysis of the timing of adaptation measures, e.g., coastal subdivision.	MAF has done some of this for agricultural systems.
Evaluating the impact of new pest threats, particularly insects, in the face of regional climatic change.	Also SPS
What does biodiversity contribute to carbon sequestration (wetlands as well as forests)?	

☆☆ **Research needs**

Topic	Comment
Addressing “stationarity” on hydrological modelling.	
Options for the management and control of marine pests	

***Social (where it isn't covered elsewhere)***

**Critical research needs – ranked very high in importance (☆☆☆☆)**

Topic	Comment
Social science research - how to effectively promote highly targeted behaviour changes towards desired ends amongst particular populations, for particular issues. Including a mix of policy options.	
Identifying links between social, economic, cultural and environmental well beings and evaluate the effectiveness of their inclusion in council and other agencies decision making.	

☆☆☆ **Research needs**

Topic	Comment
Managing risk and decision making. Better risk assessment tools.	Lincoln did some of this years ago.
Managing constrained resources. Who gets what when? How much should you pay to get there?	

END