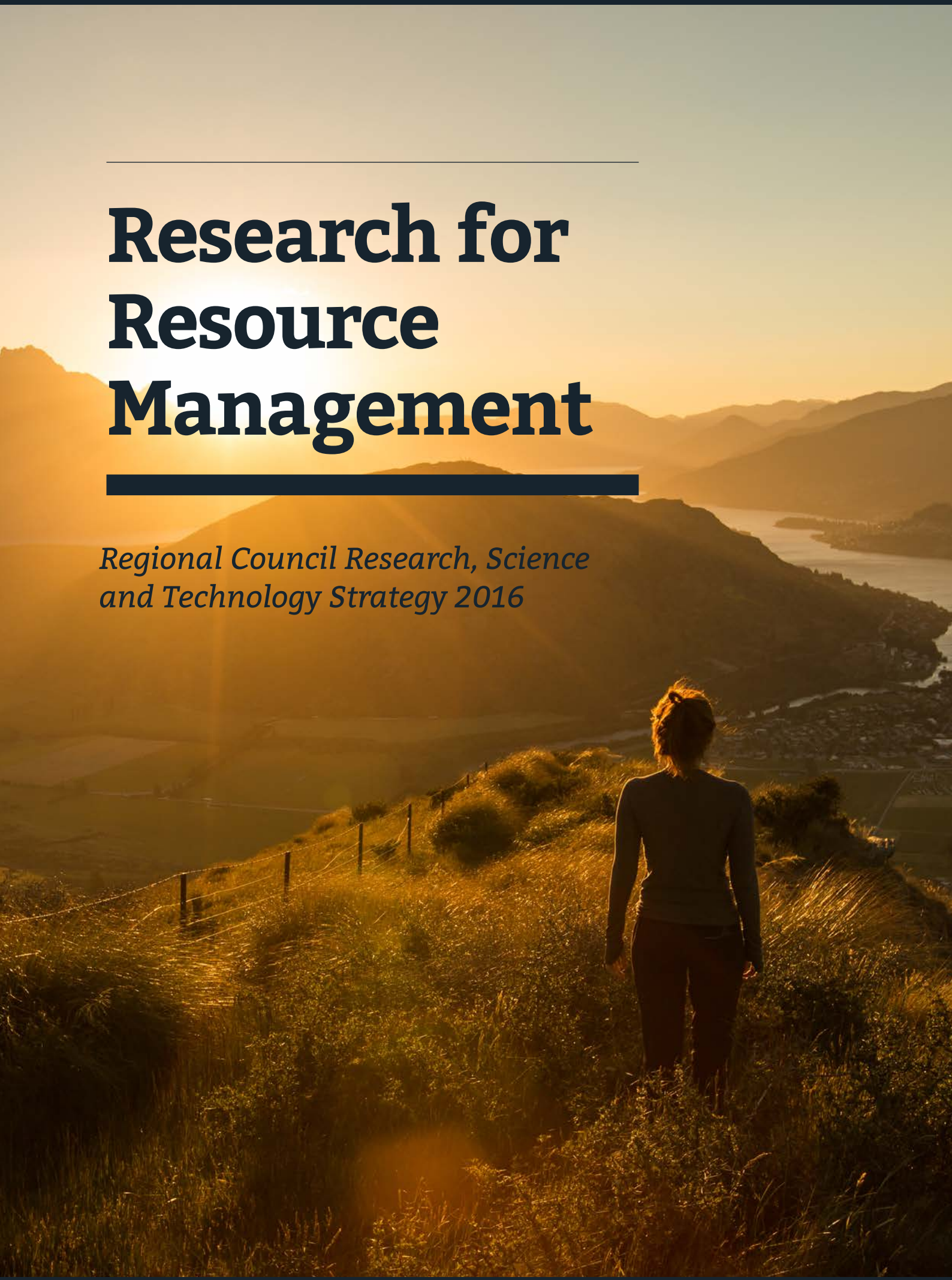
Research for Resource Management

Regional Council Research, Science and Technology Strategy 2016



Foreword

Regional and Unitary Councils throughout New Zealand are faced with increasingly complex and critical decision-making, often requiring a balance between conflicting or incompatible expectations around managing, developing, or maintaining natural resources, and utilising science that may be incomplete and with ill-defined uncertainty.

After 25 years of resource management under the RMA, by and large the 'easy' stuff has been sorted. We now are faced with what is not malleable, within a context of more informed communities with broad conflicting values and expectations and more constrained research resources. Sage decision-making requires sound science as input for reference and guidance, and experience has shown that scientific research must be anticipated and planned years if not decades in advance of key decisions being made, if timely, robust, and comprehensive science is to be best placed to inform the decision-making process and thus enhance New Zealand's enduring environmental and economic performance.

In 2007, the Regional Councils CEO Forum and the Resource Managers Group endorsed the development of a Research, Science & Technology Strategy with the objectives:

- To produce a Strategy that will provide a framework within which Regional and Unitary Councils can pursue the further development of high quality, relevant research and timely and appropriate knowledge transfer mechanisms.

- To provide an overview as to what the Regional and Unitary Councils require in research, science and technology, including a process to achieve goals and objectives contained within the Strategy or formulated from time to time through the pathways set out within the Strategy.

This is now the third edition of the Strategy. As with previous versions, it identifies key issues for research engagement and prioritisation to focus on over the next few years. The research priorities have been developed with input from regional council Special Interest Groups. The revised Strategy will continue to provide an influential voice for Regional and Unitary Councils to communicate immediate and longer-term Research, Science & Technology priorities to funding agencies and research providers.

The Science Advisory Group, established by and reporting to the CEO Forum, will keep the Strategy alive and ensure that the processes are followed to achieve the objectives of the Strategy and particularly to review the ongoing effectiveness of implementation.

Gary Bedford
Chair, Science Advisory Group (2008-present)

Executive Summary

The vision of the Strategy is that the profile of Regional and Unitary Councils continues to move from being end users to being "partners" in research with key Government Departments and research providers.

The Research, Science & Technology Strategy provides a process for the combined councils to influence and participate in NZ's environmental research direction. A key purpose is to ensure that the councils provide a united, influential, and well-regarded front to funding agencies and research providers both for identifying research priorities and also capability requirements for the present and future.

Responsibility for the Strategy rests in the first instance with the Science Advisory Group on behalf of the Regional and Unitary Councils. The Science Advisory Group is mandated by and answers to the Regional Councils' Chief Executives' Group.

Since the original strategy was finalised and approved for implementation by the Regional Councils' Chief Executive Group in March 2009, there has been considerable progress communicating the strategy to decision-makers in Wellington. The Strategy has also been influential during the Crown Research Institute (CRI) Task Force Review of Crown Research Institutes and related initiatives, and more recently in the development of the National Science Challenges.

The Strategy has also provided the catalyst to improve coordination between councils in identifying longer-term research priorities and science capability needs, and to share knowledge between councils. In the last three years, many Special Interest Groups (SIGs) have developed their own science strategies and have identified key research priorities. These have proved very useful in contributing to the formulation of National Science Challenge programmes and to the development of specific projects. The revised 2016 Strategy proposes to continue this role to identify longer-term research priorities and capability needs as well, and to enhance inter-council collaboration and knowledge sharing.

Regional and Unitary Councils have previously had very little formal input to high-level central government science strategy and agendas, but this has changed with the implementation of the Research Strategy. Council representatives have been involved in a number of high-level and influential fora, and the Strategy envisages a continuing place and push for regional council recognition and contributions within such fora. The revised Strategy provides the means to continue to influence central government decision-making (e.g. through MBIE, MfE, MPI) and to also provide direct guidance to Crown Research Institutes, universities, and other research providers involved in environmental/natural resources and related research relevant to councils.

The Strategy will continue to provide a process to ensure greater formal involvement by councils in research prioritisation and implementation, and is especially focused on providing a unified voice in Wellington. The Strategy has four main Goals: (1) Providing timely, authoritative and respected direction to science research and funding; (2) Catalysing and enhancing science delivery – capability, capacity, and targeting; (3) Science uptake opportunity and facilitation; and (4) Receiving feedback and updating the Strategy.

It is envisaged that by committing to a process of keeping the Strategy current and specifically implementing key objectives by following an Annual Operating Plan, Regional and Unitary Councils will demonstrate greater leadership in providing research direction; key tasks will be completed within a relevant and acceptable time frame; research will become more targeted at key long-term as well as short-term priorities; key science capability will be developed and maintained; and stronger partnerships will develop between councils and with other agencies. Implementation is key to the success of this Strategy and the Regional and Unitary Councils will provide a dedicated resource to ensure the Strategy is kept alive, implemented, and reviewed in an appropriate and timely manner.

The strategic priorities that have been identified as the top current priorities are set out below. There is further explanation in the "Strategic Priorities" section of this document, and users of this Strategy should also note carefully that each of the councils' Special Interest Groups have identified through their own strategies, particular requirements and important needs that go beyond those discussed herein. These are described further in Appendix 2 of this Strategy.

Strategic Priorities

This Regional Council Research Science & Technology Strategy has taken a top-down and a bottom-up approach to determine key research priorities for the next 5 to 10 years. In addition, the Regional Policy Managers Special Interest Group (SIG) has also highlighted the need for a broader perspective, beyond science, to ensure that the research strategy extends across the applied sciences that inform environmental issues, and across the design and delivery of management policy, to the delivery of effective resource management.

The broad set of policy-relevant research priorities are strategically focused on improving environmental management across a wide scope of practice; fundamentally science-based (in method); and though not directly about specific environmental sciences (as the subject); they are about the decision outputs and policy tools and processes of environmental management, as opposed to science inquiries to generally inform such management.

Details of the strategic priorities are expanded in the document.

Priority 1: Better Science Utilisation

An ongoing priority for Regional Councils is to better access science results from New Zealand and also international research providers and to incorporate the findings from relevant research projects into decision-support tools. Today's requirements are even more complex than before as we realise the importance of valuing ecosystems and broader social and cultural values and incorporating this knowledge into community value-setting processes.

In particular, in this priority research area, there are two research themes that need to be promoted: (1) Research into and in support of decision-making systems, including community values-setting and accounting, and management policy design and evaluation, as distinct from but integrated with research into understanding of environmental issues. (2) Research to develop operable approaches to assessments of resources or aspects of the environment as stocks and services, that explicitly address complexities and uncertainties including risk.

Priority 2: Policy Effectiveness

There is a need for better approaches for assessing the effectiveness and efficiencies of policy, including a tool that can model and evaluate the likely impact of a full range of policy options in terms of effectiveness. Research is needed to develop and improve the application of the range of policy development methods, tools and processes for the design and evaluation of policy or other decision responses to environmental management issues.

Priority 3: Integrated Land and Water Science for Enhanced Sustainable Production

The National Policy Statement for Freshwater Management (NPSFW) and the National Objective Framework (NOF) continue to be expanded and continued, and to a considerable extent, increased research effort into understanding the interactions between soil, land use, and water in all forms will be required into the foreseeable future. There is a need for a clear understanding of the science so as to apply any additional NOF attributes in a defensible and well-considered manner, respecting both community aspirations and the scientific context, including limitation to their application. Included in this priority is exploring the concept of "managing within limits" in depth, to ensure we identify and grasp consequence and that we have determined the right "limits" for the values and use each community desires, as well as for protecting the integrity of the water quality.

Across most SIGS, encapsulating Mātauranga Māori alongside traditional science advice for community discussions is a high priority.

Priority 4: Biosecurity/ Biodiversity

The regional council "Strategic roadmap for biosecurity and biodiversity research" identified five common and overarching research goals:

1. Halt and reverse the decline of native biodiversity and protect natural habitats
2. Reduce land-use and invasive species impacts in freshwater and marine ecosystems
3. Ensure integrity of ecosystem services and natural capital
4. Improve environmental outcomes through increased community awareness
5. Anticipate and plan for future risks

The value of biodiversity and the value in improving biosecurity need to be measured and explained to the community and to other key stakeholders. Councils require cost-effective tools, including new toxins and methods, and also proof of performance. Biosecurity is an area where it is extremely important that we can communicate the benefits, as well as the costs, of pest-control methods, particularly to communities. This is very much about maintaining a "licence to operate" at both regional and also national levels.

Priority 5: Hazard Risk Management

If Regional Councils are to provide and promote meaningful and comprehensive engagement in risk analysis and reduction, there is an overall need for better tools to address hazards and reduce consequent societal risks. Research and guidance is needed to provide robust and defensible positions for addressing risk, to give decision-makers confidence, and to give communities clarity around risk levels and abatement alternatives. Land-use planning applied as a risk reduction tool needs to be integrated with other planning drivers. A key issue is well-informed risk management - how to deal with risk, identifying effectiveness risk reduction measures, balancing risk reduction with acceptable cost, and providing acceptable levels of residual risk.

Priority 6: Coastal

Research is needed on ways in which customary knowledge can be captured, in accordance with tikanga Māori, and incorporated into coastal and marine monitoring and management frameworks. In addition, important Māori environmental values will need to be captured that relate to kaitiakitanga, whakapapa, tino-rangatiratanga and mānaakitanga. There is a need for consistency amongst councils for national state of the environment (SoE) monitoring and reporting. In addition, high quality, 'fit for purpose' data is needed in many regions to establish regional monitoring programs.

In order to manage ecosystems and resources, we need to quantify change, and understand how the Coastal Marine Area (CMA) and associated organisms and habitats respond to various stressors (both natural and anthropogenic). A particular challenge highlighted in the New Zealand Coastal Policy Statement (NZCPS) is acknowledgement of the synergistic effects of multiple stressors, tipping points, and cumulative environmental change.

Priority 7: Retaining and Building Science Capability and Capacity

Councils rely, to a large extent, on long-term science and long-term data sets to provide the necessary information to be able to make well-informed decisions for the future. This is critical to State of the Environment (SOE) monitoring. Incentives need to ensure good quality science that is relevant to council needs. The requirement in environmental science is not only for excellent, ground-breaking research that leads to new science frontiers, but also for well-designed and implemented research programmes that are enduring and open-ended; taken together, these will provide credible answers and advances to the New Zealand situation. Therefore, a priority for this Strategy is to ensure that Central Government decision-makers understand what is required in science capability and capacity now and in the future, and that all forms of excellence in science are supported, i.e., incremental gain, refinement and review of fundamentals, and break-through advances.

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Introduction

New Zealand requires effective policy to be underpinned by excellent and relevant environmental research and this requires strategic thinking to identify needs well in advance of the emergence of big problems and policy response requirements.

This is the third version of the Regional Councils' Research, Science & Technology strategy since the first one was compiled in 2009. Over the six-year period, since the first strategy was launched, science has become even more important to Regional Councils. Solutions are demanded as soon as issues are hypothesized. Objectives, policies, and methods of implementation and action are expected to be evidence-based. Environmental issues are now more politically charged as the various components of New Zealand society jostle for their say in how finite resources should be allocated and treated. Resource management as espoused by councils must be credible and defensible more than ever. Questions are being asked about what parameters are required to better define and what measures are needed to ensure 'sustainability', providing for the enduring value and utilisation of the natural resources with which New Zealand is endowed. This is most evident in the water space as, for example, irrigated dairy farming rapidly expands in many regions, highlighting issues of the efficient and effective use of soil resources and land management inputs, and of water allocation, but also water quality and downstream impacts. The National Policy Statement for Freshwater Management establishes such questions as nationally and regionally crucial for resolution. It is also now more clearly recognised by central and regional government that we need to have a strategy to explicitly manage our soil resource to ensure productive and protective functions for all of New Zealand society now and in the future. The coastal environment is also in greater focus than it was a few years ago with the introduction of the National Coastal Policy Statement (2010) and corresponding implementation plan (2011), which require councils to identify coastal processes, resources or values that are under threat from adverse cumulative effects and include provisions to manage these. Resource use needs to be optimised for both economic gain and also for environmental quality, exploring all the implications of what it means to 'manage within limits'.

The understanding and encapsulation of aspects of Mātauranga Māori into Council science, policy formulation and review, including monitoring and reporting of activities, is an evolving need for Councils. This encapsulation is required to recognise and give effect to the relationship iwi have with the environment and their role as kaitiaki. In many regions this need for encapsulation of Mātauranga Māori is being advanced through treaty settlement legislation and/or other negotiated agreements and understandings, which is creating co-management arrangements and/or increased participation for mana whenua in environmental management. Mātauranga Māori needs to be embedded in all research planning.

Government science has also evolved over the last few years. The recent (October 2015) National Statement on Science Investment and the earlier introduction of the National Science Challenges (May 2013) have significant implications for how science is directed, funded, and conducted, and knowledge delivered to end-users. Both these initiatives provide significant opportunities for Regional Council involvement but also require resourcing and an adaptive and meaningful engagement, that recognises that Regional Councils are able to make a significant and credible contribution if opportunities are recognised in a timely manner.

"Science is not an end in its own right; effective and meaningful communication of its findings and outcomes and integration into a wider context of contribution to social, cultural and economic wellbeing remains an enduring challenge."

Effective knowledge transfer, and translation of science into policy and decision-making, will always be a high priority for councils but there is a broader perspective required, beyond science, to ensure that community values as well as the physical sciences are understood as a package that can produce solutions to guide decision-making. Science is not an end in its own right; effective and meaningful communication of its findings and outcomes and integration into a wider context of contribution to social, cultural and economic wellbeing remains an enduring challenge.

It is timely to develop and implement a new Regional Council RS&T Strategy as there are several new drivers for science and most of the Special Interest Groups (SIGS) have developed strategies and research priorities of their own that need to be communicated and implemented in a coordinated fashion.

Purpose of the Strategy

The purpose of the Strategy continues to be to provide a process that will catalyse and assist in the further development of high quality relevant research and timely and appropriate knowledge transfer mechanisms for the benefit of Regional and Unitary Councils. However, while the underlying purpose for a strategy has not changed, the imperative for a contemporary strategy has increased in 2016 as the importance of good science for council decision making increases and the funding allocated to environmental and related sciences becomes increasingly uncertain and constrained. Converting scientific research results into useful information through to applied knowledge continues to be a major challenge as few funding mechanisms outside of councils' internal funding and Envirolink are available to ensure this happens.

This document serves as the guide to achieve the goals and objectives set out below.

The Strategy is prepared by the Science Advisory Group, which acts collectively and collegially on behalf of Regional and Unitary Councils. This Strategy is owned by these Councils. It provides a process, through the Special Interest Groups (SIGS) to get input from all Regional and Unitary Councils on Research, Science & Technology (RS&T) priorities, promote greater collaboration, and enhance communication within the Local Government framework to ensure that good science supports the roles and functions of Councils. The Strategy Process also provides a unified and influential voice for Regional and Unitary Councils to communicate immediate and longer-term RS&T priorities to funding agencies and research providers. This will enable Regional and Unitary Councils to be acknowledged as a partner in setting research agendas and to have greater influence on RS&T investment and capability retention and development.

Scope

The scope of the strategy, as before, includes:

a. Research, science and technology that is necessary to support and inform the sustainable management of natural resources
b. Environmental research and relevant hazard research, and also social, cultural, and economic aspects where they relate to the roles and functions of Regional and Unitary Councils
c. The recognition and promotion of sciences that go beyond just the physical to incorporate values and societal effects and values and perspectives
d. Science to enable policy issues to be addressed.

[1] *Based on the definition in RMA Section 2*

For the purpose of this strategy, 'environment' includes: [1]

- Ecosystems and their constituent parts, including people and communities
- Natural and physical resources and processes, including influences and consequences, and uses of those resources
- Amenity values
- Social, economic, aesthetic, and cultural conditions relevant to the above points.

Vision

The Regional Council vision is to be effectively involved in the identification, development, communication and implementation of research, science and technology that will undergird Regional and Unitary Councils' actions for the wider benefit of New Zealanders.

'Effective involvement' covers collaboration and coordination between councils and with research providers and funders; credible and timely engagement; clarity around current and future research priorities; meaningful partnerships; transfer and uptake of research and knowledge; and promoting the availability of RS&T capability and capacity.

Current State

New Zealand has 16 Regional and Unitary Councils (including the unitary councils of Auckland, Gisborne, Tasman, Nelson and Marlborough). The country also has eight Crown Research Institutes (CRIs), eight universities and additional quasi-private research providers such as Cawthron and Lincoln Agritech that conduct Government-funded research relevant to Regional and Unitary Councils. In addition, there are a number of private environmental consulting companies that are also involved in research and provide a contract service to Regional and Unitary Councils.

Government Research Funding

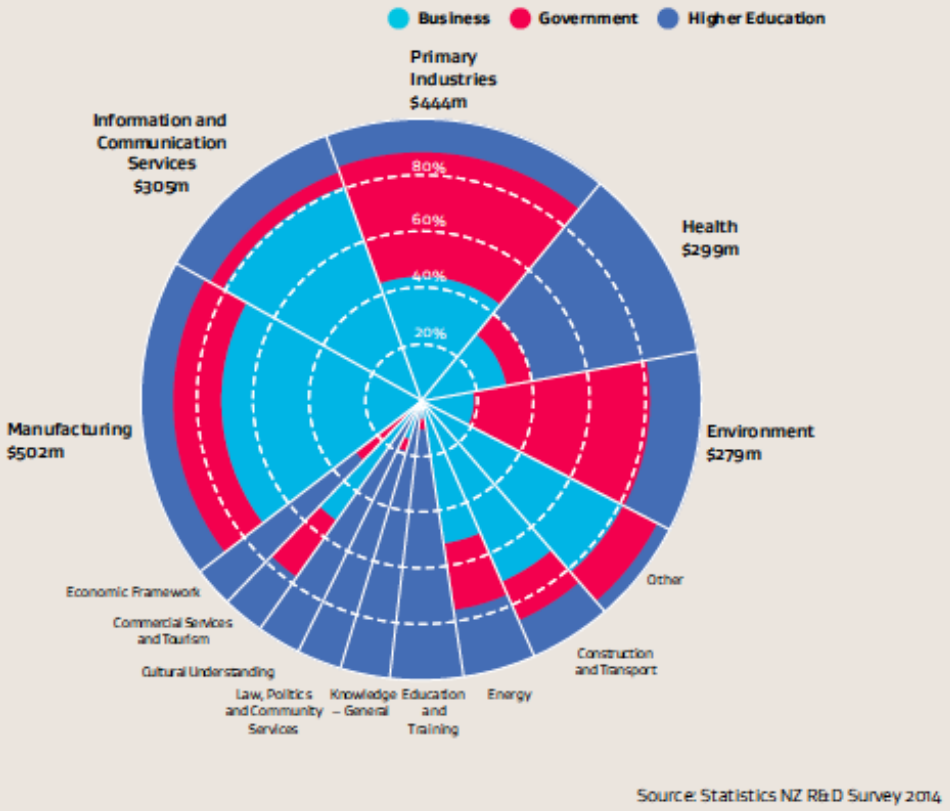
The Government science landscape has changed considerably in the last few years. Ten National Science Challenges (NSCs) were announced in May 2013 and of these, four are very relevant to Regional Councils: New Zealand's Biological Heritage, Sustainable Seas, Our Land and Water, and Resilience to Nature's Challenges. An eleventh challenge was announced in September 2014: Building Better Homes, Town, and Cities, which is also relevant to some councils. As identified in the "Key Drivers" section, the NSCs are changing the way science is being conducted in New Zealand and this provides both challenges and opportunities to councils.

The National Statement on Science Investment (October 2015) indicates that $279 million a year is invested into environmental science (See Figure 1). This includes tertiary education as well as the more applied science of a smaller amount of business investment. The Government has confirmed it is justifiably the main investor in environmental research as the public is the main beneficiary for research that improves understanding of the environment, processes, threats and mitigations. Research on the environment is seen as important to New Zealand because of the importance to trade in both primary products and tourism (environmental credentials). Government science is described as having two main pillars or areas of focus: impact and excellence. Science excellence is about involving the best people, both from research providers and stakeholders; about scientific rigour and ability to deliver results. From an environmental science perspective, impact encompasses the ways in which scientific research benefits New Zealand. The explicit focus on impact now encourages scientists to think about the broader implications of their research from the outset and during the research process including the delivery of results and potential for uptake by end-users, including translation into policy. A goal of Government expressed within the NSSI is to improve our understanding of the potential and measured impacts of research, including impacts resulting from the encapsulation of Mãtauranga policy. Measurement and demonstration of impacts will be a requirement of the National Science Challenges and also the MBIE Contestable Science Fund. As potential recipients of new knowledge, this measure of value in research investment is to be welcomed by councils. The Regional Council RS&T Strategy needs to ensure that both excellence and impact are factored into future thinking. Traditionally, universities have tended to be stronger on the excellence and weaker on considering dissemination; councils may need to intentionally advocate for a higher degree of knowledge transfer as a key component of publicly-funded research. There is a clear opportunity for the councils to give voice to what excellence and impact look like from a resource management and regional community perspective.

"Science excellence is about involving the best people, both from research providers and stakeholders; about scientific rigour and ability to deliver results. From an environmental science perspective, impact encompasses the ways in which scientific research benefits New Zealand."

Conversely, it appears that the Government may be expecting more from the private sector within incremental and applied science research e.g., within the primary sector. This RST Strategy envisages that Regional Councils should seek to further enhance partnerships with sector research organisations, noting that while in the first instance they will always exist to serve their own interests, there will be any number of situations where shared concerns and opportunities could be explored in a collaborative and mutually beneficial manner. It

EXPENDITURE ON R&D BY PURPOSE OF RESEARCH AND SECTOR OF EXPENDITURE 2014



Source: Statistics NZ R&D Survey 2014

Figure 1. NZ expenditure on R&D by purpose (NSSI 2015)

A HORIZONS-BASED MODEL FOR THINKING ABOUT PUBLIC SCIENCE INVESTMENT

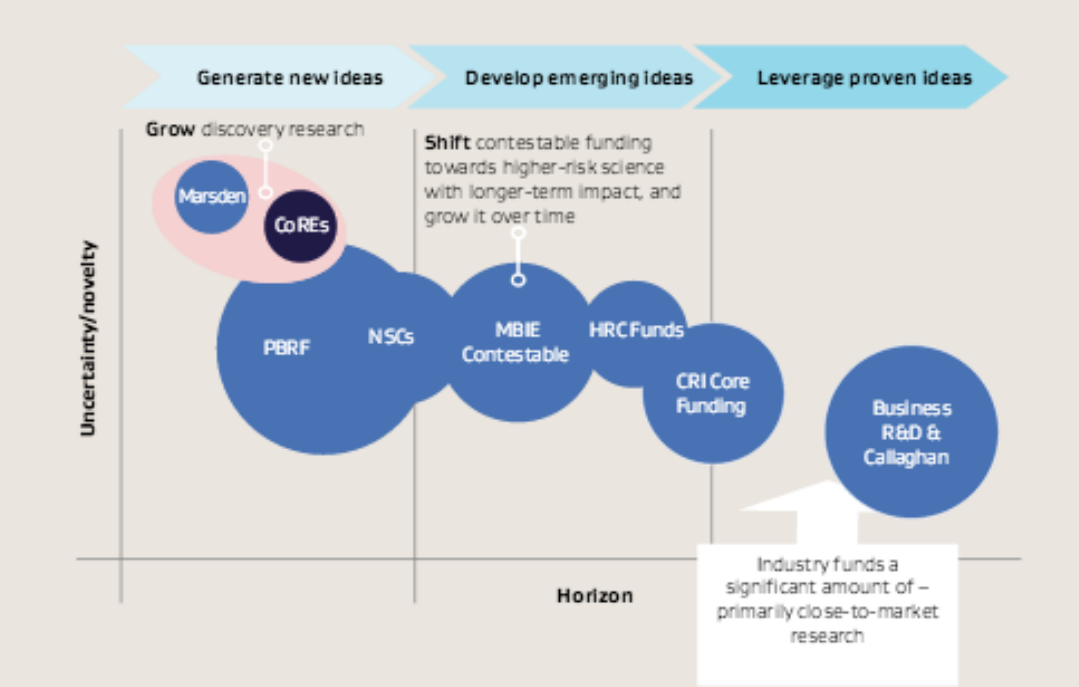


Figure 2. Government thinking on public science investment (NSSI 2015)

behoves councils to maintain at the least as wide a 'watching brief' as is practicable and achievable within constraints such as commercial sensitivity etc.

In addition, MBIE staff have flagged that there may well be opportunities for Regional Councils to take proactive and even leading roles in proposing and pursuing research projects e.g., by drawing together consortia of their own choosing to lodge an application for Government funding on topics of their own choosing, instead of relying on CRIs or universities to pursue applications that co-incidentally have relevance for council functions and interests.

Implications of the National Science Challenges (NSC)

In May 2013 the National Science Challenges were announced as a new way to fund research. As of May 2016 most of the challenges are just starting to make traction; Directors are in place, and initial projects are being funded. The challenges represent a new way to fund and conduct research with a focus on mission-led science and step-change innovation. The Government's thinking on how the various science funding streams are currently being allocated is shown in Figure 2 (from NSSI 2015).

The Government's main mission-led science investments relevant to Regional Councils are the MBIE contestable funds ($190M/year); the NSCs ($68M plus up to $64M aligned CRI core funding); and CRI core funding ($201M), which enables CRIs to meet their core purpose. While there is relatively little new money in the NSC's, they do offer an opportunity to better coordinate research effort in New Zealand to deal with large complex issues.

Regional Councils interests strongly align with "mission-led" science. While councils generally do not provide very much in the way of direct funding to national science programmes, they do conduct their own mission-led research and are also able to influence how MBIE contestable, CRI core, and the National Science Challenge funds are allocated. A key focus for this strategy is to ensure that research funded by these three streams is designed, conducted, and knowledge is transferred in such a way that it has a positive impact on the environment. To be successful councils will have to work closely with the relevant research providers and other stakeholders.

Of the now 11 NSCs, six have some degree of relevance to Regional Councils, while four are particularly so. These are listed in the table along with comments. The 2011 RST Strategy, along with the relevant SIG strategies were used to help formulate the NSCs from the start of the process. The intention is to embed RC staff into the most relevant challenges and the most relevant projects in order to enhance the value of these challenges to councils and to the country. Additionally, RC staff involved in the various projects will be encouraged to formally report back through SAG using a project reporting template that will be used to keep other interested RC staff informed of developments. A diagram in Appendix 4 indicates the various RC staff that are involved in the challenges at the time of writing. This

National Science Challenge	Mission	Relevance and RC Role (as of May 2016)
Our Land and Water	Improved primary production while improving land and water quality	Understanding and managing within catchment limits RC staff involved in governance, science direction, and end-user advisory
New Zealand's Biological Heritage	Protecting and managing biodiversity; improving biosecurity; enhancing resilience to harmful organisms	Reducing risk and enhancing and restoring ecosystems RC staff involved in governance and end-user advisory
Sustainable Seas	Enhanced utilisation of marine resources within environmental constraints	Societies, values and seas; ecosystem-based management RC staff involved in governance and end-user advisory
Resilience to Nature's Challenges	Enhancing resilience to natural disasters	Resilience of the rural sectors and expanding urban areas RC staff expected to be involved in the near future
The Deep South	Understanding the role of the Southern Ocean in determining NZ climate	Impacts and implications of changing climate RC staff involved in governance
Building Better Homes, Towns and Cities	Developing better housing and urban environments	Collaboration and knowledge transfer Mainly Auckland involvement in advisory

diagram is on the Envirolink website and will be maintained to document changes in involvement.

Implications of the National Statement on Science Investment (NSSI)

The National Statement on Science Investment (October 2015) signals changes to the way contestable funds will be allocated. For example, instead of funds being ring-fenced for environmental research, there will be just one contestable pool to cover all research areas and it will be open to all providers. The NSSI also signals a shift to greater investment in higher risk/higher return "discovery" science and a shift away from investing in more applied science.

The NSSI states that Government investment in environmental research is justified, where the public is the primary beneficiary, however considerable environmental research is directly related to the primary production sectors. CRIS, and Cawthron, have mainly been focused on the more applied end of research and in areas of considerable relevance to councils, often involving long-term environmental data sets. The Government is signalling that it expects industry to step up with greater investment in research at the applied end of the spectrum. This shift could have significant implications to Regional Council interests, as long-term research programmes and datasets are required to fully understand and demonstrate or test the effectiveness of council policies such as the implications of land-use impacts on environmental factors, or air shed interventions.

Incremental applied research is also critical to biosecurity needs where existing tools often need constant improvements to deal with pests to reduce impacts on indigenous biodiversity. Higher-risk discovery research can potentially lead to significant breakthroughs, but the timeframe to introduce validated new pest control tools, following on from successful research, can be very lengthy.

The Government has signalled very clearly in the NSSI that it wants to get more from its science investment. Not only does it want to build national innovation capacity and knowledge-based capital, but more specifically for Regional Councils, it wants to improve the availability of knowledge to address environmental, economic, and social priorities. It feels that today, too much investment is focused on low-risk projects with more certain short-term impacts. This new thinking creates opportunities, as well as threats for Councils as we can help direct future research funding into higher risk/ higher reward projects, but possibly at the expense of continued funding for existing more incremental research. This is an issue that the Strategy covers later in the document.

A key signal in the NSSI is that new research investment will be guided by an investment plan, end-user relationships will be important, and a major focus will be on science excellence to benefit New Zealand. The opportunity is to provide clear signals to MBIE as to what Regional Councils believe to be important and to ensure effective two-way knowledge transfer in all stages of relevant research projects.

At the time of writing there are significant implications from the NSSI and the new MBIE contestable funding process to freshwater science investment as the amount of funding available in the 2016 contestable round is less than the amount of funding coming off contract. The Regional Councils' Science Advisory Group has raised this issue internally and externally and MBIE is well aware of the situation.

Key Drivers for Research Science and Technology (RS&T)

Summary

- Focus on evidence-based policy development and decision making
- Councils required to manage complex, multi-dimensional systems with diverse communities with variable levels of science and outcomes uncertainty.
- Strong focus on management of Freshwater (NPS) and increasing expectations of councils to acquire and provide extensive knowledge of water systems and flows on a comprehensive basis.
- Implementation of National Science Challenges, particularly Our Land and Water, Biological Heritage, Sustainable Seas, Resilience to Nature's Challenges, and The Deep South.
- Additional national policy statements that will require environmental standards and application of scientifically robust and effective interventions at a regional level.
- Implementation of recommendations from the MPI report "Future requirements for soil management in New Zealand".
- Revision of New Zealand science and potential reallocation of limited science funding and threats to key science capability.
- Biosecurity 2025, Government Industry Agreements, and the drive to improve national and regional biosecurity systems.
- Increasing recognition of the social, cultural and economic implications and consequences of our scientific research and increasing encapsulation of Mātauranga Māori in science.

Science-based input into decision-making that shapes a long-term sustainable future for New Zealand's natural resources on a region-by-region basis is a critical component of regional council functions. It is fundamental that New Zealand's science and research efforts are maintained at a level that reflects the size of the task and the importance of the purpose, and are targeted at areas that are priorities for councils (not only immediately but with an eye on nascent and emerging issues) and that research results are not only highly credible but that they are also accessible, disseminated, and implemented in a timely manner.

Since the last Strategy was launched in August 2011, there has been considerable change in the political, policy, science funding, and science delivery landscapes that have in turn re-shaped the influences and pressures Regional Councils expect and how they engage in science. These in turn have sharpened the imperative for sound, targeted, and comprehensive science that previously existed. At the heart of these pressures is a recognition that the problems that now confront Regional Councils are complex and wide-ranging and multi-dimensional across space, time, and environmental domains. The range of issues that councils are expected to tackle is expanding into new fields, while at the same time councils are under ever-increasing pressure to deliver effective and efficient interventions that can be justified to a critical and diverse community and that meet ever-increasing public expectations yet must be delivered at minimum cost. Second-order and unintended consequences are not always recognised in the first instance. We are increasingly recognising that science itself may not be and may never be exact and complete; we need to have a stronger sense of the confidence limits inherent in the 'answers' we give, being explicit around the limitations and applicability of what we offer. Yet the science machinery that is required to generate the knowledge needed for good quality interventions is itself undergoing transformation, the outcomes of which are still uncertain.

In terms of **national resource management policy**, the NPS on Freshwater with its associated National Objectives Framework was intended to create national consistency across a selected few criteria for water quality, thus obviating the need for individual councils to set and defend regional standards. However, the reality is that the NPS framework of water management units and flexibility for councils to set additional criteria according to community expectations around uses and values, together with water quality and quantity accounting requirements, has overall significantly increased the expectation that councils will hold and provide extensive knowledge of water systems and flows, on a comprehensive basis. The sheer diversity of New Zealand's hydrological cycles on a catchment-by-catchment basis makes this a herculean task.

As well as being actively involved in providing direction to the Our Land and Water NSC, councils and in particular SWIM, GWF, and SAG have had direct discussions with MBIE, MfE, NIWA and Cawthron about strategic needs in the freshwater science space, most recently through the MBIE/MFE Water Information Strategy. As mentioned elsewhere in this strategy, councils are particularly concerned about continued funding for key programmes of freshwater science and the maintenance of long-term datasets.

The Government has further flagged a work programme of additional national policy statements and environmental standards, in addition to existing and recently released documents such as the national Coastal Policy Statement and the National Environmental Standards on air quality. The development of regional objectives, policies, and means of attainment to give effect to the national instruments will require access to well-informed and robustly defensible science for Regional Councils and their communities.

In line with the Government's **Business Growth Agenda**, MPI has adopted a goal to double primary industry exports in real terms between 2012 and 2025. A key to increasing primary production (not only within existing sectors but in innovative uses of soil and land) is a better understanding of the soil resource and the opportunities our soils and landscape offer to enhance and optimise the value of this resource. In this regard, regional council representatives have been closely engaged in initiating and subsequently supporting the work that has since been led by MPI as a three-phase project to inform future policy and good practice principles to protect and realise the full potential of NZ's soil resource. 'Future requirements for soil management in New Zealand: Phase 3-Looking forward' was released by NLRC in December 2015. It sets out a wide-ranging list of matters to be addressed- policy, practice, science, and institutional shifts that must be gained, if we are to get all we want as a country from our soils. The implementation of the pathway for change still wait as a challenge to be taken up.

The 2011 RST Strategy signalled that research capability in both soils and also resource evaluation needed review and strengthening. MPI has the soils area well in hand and will potentially identify new skills and research needs through the process previously mentioned. Resource valuation is about the need to better identify trade-offs and weigh up multiple values of natural resources; taking a whole-systems approach. This need is being picked up by the science challenges and should provide new knowledge to enhance decision-making taking into account multiple values important to communities.

The **Government science funding and procurement** landscape has also changed considerably in the last few years. The **National Science Challenges**, announced in 2013, are a

key driver for Regional Council RS&T. What became obvious very quickly was that councils could not simply sit back and wait for these Challenges to deliver the goods they require. To do so would be a disservice to their own communities and to New Zealand as a whole. Rather, recognising the scientific competence that resides within councils, their intimate acquaintance with their regional 'backyards', and the absolute need to identify and articulate research needs from their own awareness of issues, councils have needed to and have already engaged with Challenge leaders and participants at a variety of levels, from governance boards and advisory panels to technical working groups. For several science challenges, council staff were well prepared with SIG science strategies developed in the last few years, which they referred to in workshops developing the challenge programmes.

The real work of Challenge investigation and research is still only beginning, and opportunities for councils to make wide-ranging contributions and to reap multiple benefits through meaningful and well-considered participation within the Challenges still wait for those prepared to be proactive.

As mentioned previously, the Government has issued its **National Statement on Science Investment** (NSSI), to which councils contributed significantly in submissions and workshops on the draft NSSI document. Importantly, this document highlights changes to the basis upon which contestable funds will be allocated and the purpose for which they will be targeted; and instead of funds being ring-fenced for environmental research, there will be just one contestable pool to cover all research and open to all providers. There may well end up a smaller allocation to environmentally focused research; there may well be a greater focus on break-through type research rather than pursuit of incremental gains, refinement and clarification; there may well be an emphasis upon short-term research rather than investment in research that requires long-term, data-rich, wide-ranging gathering and harvesting of information. This creates both issues and opportunities for Regional Councils. Councils will need to be aware that the monitoring and database management fundamental to maintaining long-term databases may lose some of its national funding in favour of novel, 'break-though' type research investment; adaptation may be required. The key opportunity is to be strategically positioned to continually review, engage in, and help direct the allocation of limited science funding.

The challenge for Councils is to get the most out of the re-worked research funding and targeting initiatives, and in order to do that a process is proposed within this Strategy.

The Regional Councils' **Special Interest Groups** (SIGs), collectives of staff across councils who have a common task or responsibility or skill, have recognised the need to think strategically around research and issues, including recognising where issues are faced in common and hence opportunities exist for collaborative action. This Strategy pursues that process (while also noting that the RCEOs forum has implemented a programme of plenary workshops and enhanced reporting of SIGs to RMG/RCEOs, across a wider range of topics and matters, to make the SIGs a more powerful and effective mechanism for regional council performance). SIGs need to ensure their research strategies are kept current. SIGs have also noted the need for greater cost-effective research, monitoring and investigations ('do it smarter and cheaper'), continually asking the questions: 'are we getting value for our research dollar? Is research delivering on its promise? How can we derive greatest value for a limited research investment?'

On the **biosecurity front**, MPI launched Biosecurity 2025 in September 2015 and this will result in a new vision statement to drive biosecurity efforts. Also, the Government Industry Agreement (GIA) process, which basically establishes a partnership between government (MPI) and primary sectors, is highlighting the need for greater science to prepare the country for pest and pathogen incursions, and to respond accordingly. Regional Councils are involved in and closely linked to biosecurity generally and to initiatives such as GIA specifically, e.g., providing direction in research to reduce the threat of the Brown Marmorated Stink Bug (BMSB) currently knocking at NZ's door. The need, and the opportunity, is to work closely with MPI on terrestrial and aquatic biosecurity issues and seek opportunities to enhance knowledge and improve national and regional biosecurity systems.

'**Citizen science'** is an emerging concept of some significance that is becoming a new influence on RS&T, especially when aided by low-cost widely available technology such as mobile phone apps. A strategic use of science has to now incorporate concepts around the socialisation of science, expertise, and interpretation (while guarding against the dumbing-down of research outcomes and its applications). This Strategy, even more than its predecessors, seeks to recognise the social, cultural and economic implications and dimensions and consequences of our scientific research.

The understanding and encapsulation of aspects of Mātauranga Māori in science and other areas is an evolving need for Councils. Mātauranga Māori should not be seen as a separate work area as it is relevant to all the environmental domains managed by Councils. The need is to develop agreed frameworks and processes for the integration that embeds and devolves the required activities through the organisations, and then continues to provide specific support for Mātauranga Māori needs corporately to ensure the legislative and partnership requirements are achieved.

Strategic Goals and Objectives

Goals

The goals for the RS&T Strategy remain as before:

Goal 1: To Provide Timely, Authoritative and Respected Direction to Science Research and Funding

This is mainly about having input to Government science direction, strategic priorities, and funding allocation. It is also about partnering with research providers in RS&T. A new opportunity that has arisen from changes in Government policy, expressed in the NSSI, is the ability to identify and lead research programmes and attract external funding. This Goal recognises the key role that Regional and Unitary Councils play in delivering environmental outcomes.

Goal 2: To Catalyse and Enhance Science Delivery

This Goal focuses on ensuring that Regional and Unitary Councils have the capability and capacity to deliver good science, and also that there is communication with research providers and especially universities as to future skill requirements and with Government on maintaining and enhancing key capability within the science sector generally.

Goal 3: To Facilitate Science Uptake

This Goal focuses on ensuring that science outputs are useful to Regional and Unitary Councils and that research results are applied in a timely manner. Ideally the process starts with the initiation of a research project and extends throughout the life of the project.

Goal 4: To Ensure an Ongoing RS&T Strategy Process

This Goal is about providing processes for governance and keeping the strategy alive and regularly updated.

Key objectives, relevant to each goal, are appended.

Roles and Responsibilities

The Science Advisory Group (SAG) has been established and endorsed by the CEO Forum to provide a governance function to the development and ongoing implementation of the Research Strategy. A Research Coordinator is contracted on a part-time basis to coordinate the implementation of the Research Strategy and reports to the Science Advisory Group. The RCEOs, the Resource Managers Group (RMG), and the Biosecurity Managers' Group (BMG) oversee the Special Interest Groups (SIGs), who in turn are responsible for developing science strategies and identifying research priorities for their areas of expertise. These are covered in a later section.

Critical RS&T Issues and Opportunities for Councils

Summary

- Councils have an excellent opportunity in the National Science Challenges to help formulate research, get involved in specific projects, and ensure that knowledge is effectively transferred to contribute to decision-making and policies.
- With MPI, implement the recommendations from the MPI report "Future requirements for soil management in New Zealand" and ensuring that the importance of soils research is recognised in the Our Land and Water challenge and other initiatives.
- Inclusion of community values with physical science in research planning, priorities and outputs.
- Ensuring council priorities are recognised in the Government's science investment plan.
- Councils need to (1) convincingly demonstrate the value of long-term research and datasets, and (2) work with research providers to determine ways to conduct research more cost-effectively.
- Ensuring effective RS&T knowledge transfer to councils.
- Identifying, coordinating, and leading new research programmes funded from external as well as council resources.

Involvement in National Science Challenges

Traditionally New Zealand science has been conducted in silos based on sectors and/or science disciplines, reinforced by the competition between CRIs and the structure of the MBIE contestable funding system. To deal with the increasing complexity of the problems that now face councils there is a need to provide a broader perspective, beyond science, to ensure that community values as well as the physical sciences are understood as a package that can produce solutions to guide decision-making. The advent of the National Science Challenges provides the opportunity to facilitate this process and to ensure that coherent strategies drive science and useful delivery of science results to end-users.

Councils have an excellent opportunity in the National Science Challenges to help formulate research, get involved in specific projects, and ensure that knowledge is effectively transferred to contribute to decision-making and policies. This will be particularly important for the Our Land and Water (OLW) challenge as it deals with issues raised by the NPS on Freshwater and the National Objective Framework as councils go about setting objectives, policies and rules about freshwater in their regional plans. Soils are also a very important component of the OLW challenge, while MPI's recent report "Future requirements for soil management in New Zealand" calls for a national prioritisation of soil research to support the national science challenges, sectors, and government agencies and guide investment in R&D. There are similar opportunities in the Biological Heritage, which aims to reverse the decline of New Zealand's biological heritage through a national partnership to deliver a step-change in research innovation, globally leading technologies and sector action by developing and implementing new knowledge, tools and technologies. Sustainable Seas NSC has a very wide scope and the opportunity to provide influence is more limited. However, given the requirements for Regional Councils in the National Coastal Policy Statement and Implementation Plan (2011), there are very good reasons to try to become more involved. The NSCs also provide an opportunity to ensure that council science is even more recognised than it has been. While the opportunity for council involvement is attractive, the most critical issue is likely to be resourcing as council staff are already fully engaged in their own council's work programmes.

Accounting for all Resource Values

There are great challenges in integrating different frameworks and associated methods for understanding and accounting for the dynamics of social values held for resources and the environment. There is a wide spectrum of uses of environmental services and resources stocks having ecosystem, economic, social and cultural dimensions of value. Fitting all such values into any single framework for understanding across these dimensions is problematic; as each of such dimensions has a different scope of relevance, and the time-spatial dynamics of natural and utilised systems is complex and is subject to a range of uncertainties, as to systemic behaviours, information and social risks. There are different methods of valuing and accounting in a range of inquiry settings, with variable integration and tool development is limited at the most needed time-spatial scales. Research priorities are identified to deal with this issue in the "Strategic Priorities" section.

Influencing Government Science Funding/Research Providers

Government is signalling, primarily through the NSSI, that science funding will become more competitive and constrained, and any investment will be guided by an investment plan, and it will need to demonstrate significant benefit to New Zealand. A critical issue is ensuring council priorities are recognised in the investment plan. Long-term research providing long-term datasets has proved invaluable to councils and to government departments in providing information for tool development and for setting policies. A push towards discovery science may lead to reductions in funding for longer-term applied research. Councils need to do two things (1) convincingly demonstrate the value of long-term research and datasets, and (2) work with research providers to determine ways to conduct research more cost-effectively.

Of immediate concern to councils is the funding threat to freshwater science programmes that have unfortunately been caught up in a timing issue as contracts end and government policy changes.

Ensuring Effective Knowledge Transfer and Uptake

Knowledge transfer remains a critical issue for Regional Councils, both from research providers to councils, and between councils. There is a particular challenge extracting knowledge from university academics, generally more interested in achieving PBRF ratings than in seeing their research implemented. This issue has previously been mentioned to MBIE and others but remains an issue.

Leading New Research Programmes

Changes in Government science policy, as reflected in the NSSI and other references, has opened the way for Regional Councils to take a more active role in identifying, coordinating and leading new research initiatives. In some cases, this may be to initiate high priority research projects where councils are the most logical organisation to take the lead; in others it may be to identify and initiative new research funding sources to maintain science and technology capability where Government has signalled it will be reducing investment.

Research Prioritisation

Following the release of the 2011 RS&T Strategy a process was started to work with the relevant Special Interest Groups to develop their own science strategies. This provided value to the SIGS in different ways. For some SIGS it provided a good opportunity to work more closely with key research providers to understand their science priorities relative to what Regional Councils were interested in, realising that Councils are not the only end-users for much of the research conducted. As the process evolved strategies became more encompassing and linked land and water and coastal issues to provide a more coherent picture as to what was needed.

The Science Advisory Group ran a SIG Workshop in June 2013 with the purpose to consider the new significant changes that the environmental management practice community in local government will be facing into the future and to develop a plan to respond to these challenges. A key recommendation from this workshop was a review of the regional sector's arrangements for strategic and operational knowledge-building and responsiveness by all tiers of practitioners, across and beyond environmental management. The objective of this review was "to improve the sector's capabilities and successes in its statutory responsibilities and strategic effectiveness, not only for environmental management, but across all its business and in time, across the local government sector at large". This became known as the "SIG Review" and the recommendations from this review are currently being implemented, led by the RCEOs.

A further step in the research prioritisation process was another SIG workshop in March 2015. This provided a fresh chance to prepare for the future together by bringing together the various SIG research strategies and re-examining them collectively and identifying opportunities for actions in the research space that to provide the greatest mutual benefit and a basis for engagement with the wider research sector.

The following Special Interest Group science strategies were presented and discussed at the SIG Workshop in March 2015 and are available online **(www.envirolink.govt.nz/Research-Strategy/).**

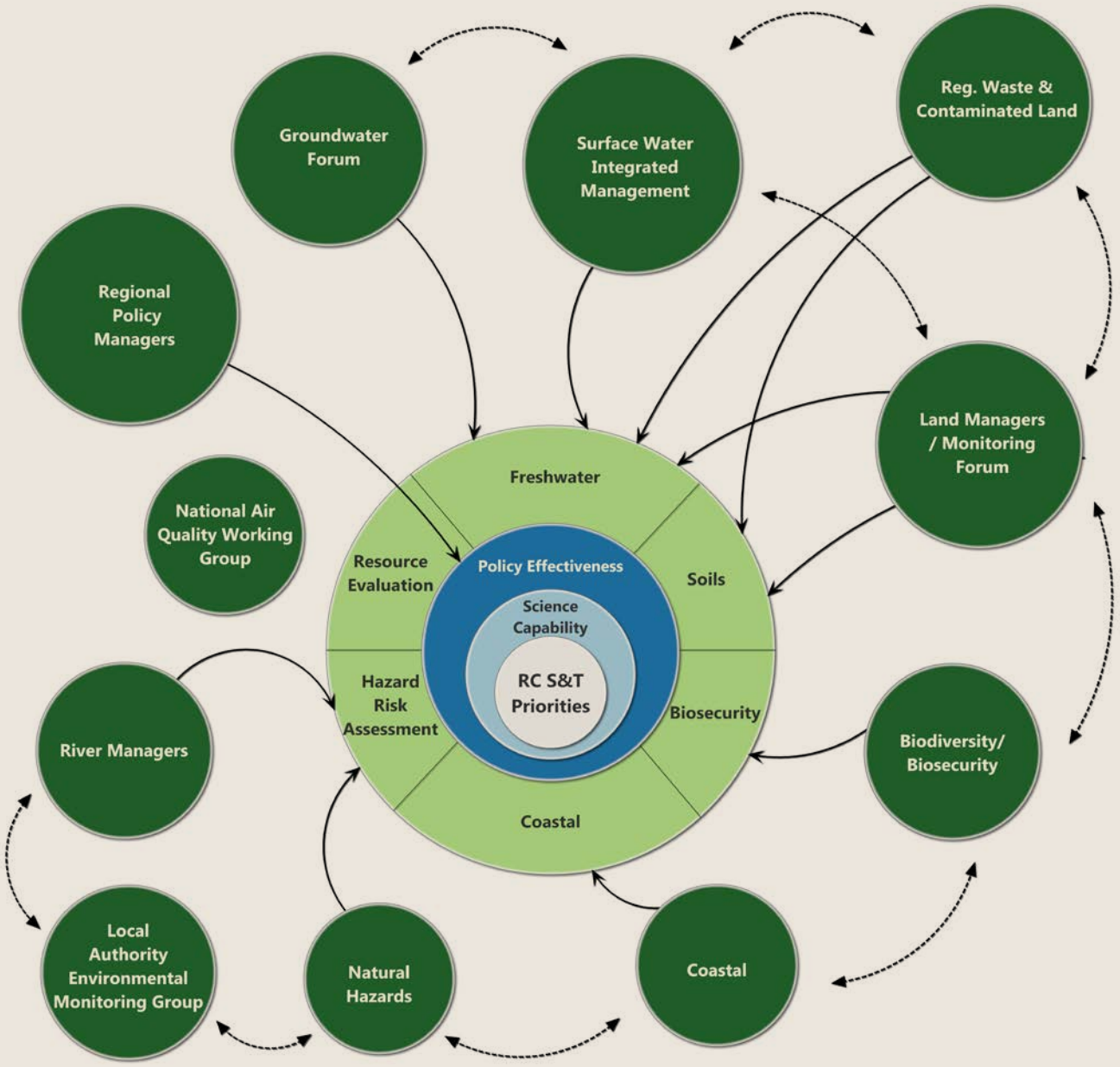
- National Air Quality
- Groundwater Forum
- Surface Water Integrated Management
- Land Managers Group
- Land Monitoring Forum
- Biosecurity
- Biodiversity
- Coastal Management
- Policy Managers

In addition to the SIG strategies, all SIGs, including those yet to develop a strategy, were asked to prioritise their research needs to indicate both internally and externally where the greatest RS&T effort is required for the next 5 to 10 years. These have been made available to MBIE and research providers and are available online at the same URL as the strategies.

The process for linking SIG strategies and research priorities to the umbrella Regional Council RS&T Strategy is shown in the diagram below (Figure 3). Readers are directed to the URL **(http://www.envirolink.govt.nz/Research-Strategy/)** to drill down into specific detail for each SIG.

One key theme in both the 2013 and 2015 SIG workshops was a recognition of their value for promoting and providing an opportunity for mutual interaction and integration of research. It is noted that the February 2016 Plenary workshop for SIGs, hosted by the RCEOs, built on this recognition, and the RCEOs have identified the provision of ongoing opportunities for interaction and collaboration as a priority.

Figure 3. Linkages between SIG research priorities and the Regional Council RS&T Strategy (http://www.envirolink.govt.nz/Research-Strategy/)



Commonality in SIG Research Priorities

The key SIG research priorities are listed in Appendix 3. The table also shows commonality of research priorities across SIGs. While many SIGs have specific issues for which they need greater knowledge, there are a number of priorities common to most SIGS, and greater in-depth analysis and questioning would likely reveal these priorities are indeed common to all SIGS and to all Councils. The main research priorities in common are:

1. Methods for valuing and accounting for research and environmental values/services – including quantifying the value of ecosystem services to water quality, production, biodiversity etc.
2. Improving policy evaluation for complex and uncertain decision needs with many dimensions; - dealing with uncertainty – Including Policy frameworks that adequately account for dynamic interaction and different timescales of physical response; increasing accessibility of critical information to the public and commercial sectors; and providing guidance on how to determine acceptable levels of risk.
3. Improving community planning and decision processes – including science to ensure cost-effective/ collaborative implementation of the freshwater reforms; and ensuring that the social and economic implications of hazards events and specific scenarios can be applied practically.

Strategic Priorities

This Regional Council Research Science & Technology Strategy has taken a top-down and a bottom-up approach to determine key research priorities for the next 5 to 10 years. Special Interest Groups (SIGS) with a science focus have developed their own research strategies and have identified critical issues and research needs[2]. Several of the SIGS have gone beyond their own scope (e.g., the land and water SIGS) and have identified over-arching issues and priorities that need addressing. The Regional Policy Managers SIG strategy in particular highlighted the need for a broader perspective, beyond science, to ensure that the research strategy extends across the applied sciences that inform environmental issues, and across the design and delivery of management policy, through regulatory and operational services.

While most of the SIGS are focused on specific areas of interest, the Policy Managers SIG sees the need for more end-to-end thinking to ensure research is effective in helping to deliver appropriate regional environmental management. The broad set of policy-relevant research priorities are:

- strategic in being for improving environmental management across a wide scope of practice.
- fundamentally science-based (in method); and though not directly about specific environmental sciences (as the subject); they are
- about the decision outputs and policy tools and processes of environmental management, as opposed to science inquiries to generally inform such management.

These two features of policy-relevant research are closely linked. The Regional Policy Managers SIG readily supports and relies on the research effort into management implications of areas of science content, but wants to also see more sense made by research that applies across the environment, of the socio-economic and policy decision perspectives as well as the biophysical, of management issues and solutions.

[2] *See www.envirolink.govt.nz/research-strategy/*

Summary

- Better access to NZ and overseas research results to incorporate into decision support tools/processes
- New mechanism to engage university academics in relevant research
- Research into and in support of decision-making systems, including community values-setting and accounting, and management policy design and evaluation, as distinct from but integrated with research into understanding of environmental issues.
- Frameworks, methods and tools for identifying, sizing, and integrating community values for uses of environmental services and resources stocks across ecosystem, economic, social and cultural dimensions of value, including time-spatial dynamics.

Better Science Utilisation

It is commonly said that it is not always more science that is needed but in many cases better utilisation of existing science. An ongoing priority for Regional Councils is to better access science results from New Zealand and also international research providers and to incorporate the findings from relevant research projects into decision-support tools. Today's requirements are even more complex than previously as we realise the importance of valuing ecosystems and broader social and cultural values and incorporating this knowledge into community value-setting processes.

It is relatively easy to access new knowledge from CRIs, Cawthron, and other applied research organisations, while accessing knowledge from universities is much more difficult, except in the case where councils support university science chairs. New mechanisms are required that provide incentives to university academics to engage in research of relevance to councils and to transfer knowledge gained in a useable format, not simply a peer-reviewed publication that require further interpretation.

In particular, in this priority research area, there are two research themes that need to be promoted:

Theme 1

Research into and in support of decision-making systems, including community values-setting and accounting, and management policy design and evaluation, as distinct from but integrated with research into understanding of environmental issues.

Theme 2

Research to develop operable approaches to assessments of resources or aspects of the environment as stocks and services, that explicitly address complexities and uncertainties including risks, and including:

- frameworks, methods and tools for identifying, sizing, and integrating community values for uses of environmental services and resources stocks across ecosystem, economic, social and cultural dimensions of value, including time-spatial dynamics
- methods and tools for accounting for community values held for services, stocks and flows that may not be reducible to a monetary denominator, alongside monetary cost and benefit effects of marginal changes in such values, to use in evaluating policy or other decision options

PRIORITY 2

Summary

- Better approaches for assessing the effectiveness and efficiencies of policy, including a tool that can model and evaluate the likely impact of a full range of policy options in terms of effectiveness

Policy Effectiveness

There is a need for better approaches for assessing the effectiveness and efficiencies of policy, including a tool that can model the likely impact of policy options in terms of effectiveness. The opportunity is to undertake research into the challenging area of assessing the efficacy of different policy approaches. Such research would need to be integrated with State of the Environment Monitoring and Long-term Plan monitoring.

Research to develop and improve the application of the range of policy development methods, tools and processes for the design and evaluation of policy or other decision responses to environmental management issues, including:

- Design and evaluation of allocation policy or other decision options by reference to the suite of marginal changes in all relevant dimensions of value within widely varying environmental situations, iterated with-
- Design and evaluation of policy instruments informed by research into forms of legal instruments that can be crafted into workable and acceptable policy responses, drawing on practice efforts to date in RMA plan and policy design and evaluation to improve tuning of currently available or applied methods and instruments to the range of different policy issues
- Social processes for iterating problems and solutions development and delivery (e.g., collaborative planning) including relationships within and between social collectives and institutions to help improve practice success in environmental policy development
- Legal systems to improve the sustainable management bases for current resource law and policy, and the scope for improved instruments in or under the law for resource allocation and use.

PRIORITY 3

Summary

- A clear understanding of the science so as to apply any additional NOF attributes in a defensible and well-considered manner, respecting both community aspirations and the scientific context, including limitation to their application.

Integrated Land and Water Science for Enhanced Sustainable Production

The NPSFW and NOF continue to be expanded and to a considerable extent, increased research effort into understanding the interactions between soil, land use, and water will be required into the foreseeable future. MPI's recent initiative to take a non-regulatory approach to drive for a better understanding in order to realise the full potential of the country's soil resource also highlights the relative importance of this research priority to New Zealand. The scope of the research extends from rainfall through groundwater, surface water to estuaries and the coast. There is a need for a clear understanding of the science so as to apply any additional NOF attributes in a defensible and well-considered manner, respecting both community aspirations and the scientific context, including limitation to their application. Included in this priority is exploring the concept of "managing within limits" in depth, to ensure we identify and grasp consequence and that we have determined the right "limits" for the values and use each community desires, as well as for protecting the integrity of the water quality.

A strategic scan by a number of SIGs of government initiatives and strategies revealed the need for a more collaborative and consistent approach for research priority-setting and a greater

- Exploring the concept of "managing within limits" in depth, to ensure we identify and grasp consequence and that we have determined the right "limits" for the values and use each community desires, as well as for protecting the integrity of the water quality.
- A particular need to provide tools for determining land-use effects on groundwater and surface water quality.
- An urgent need for more detailed data assessment to inform the science and policy setting and field verification of a sustainable water quantity allocation, using an adaptive, precautionary approach.
- Encapsulating Mātauranga Māori alongside traditional science advice for community discussions is a high priority.

focus on uptake and adoption within the innovation system in the land and water science arena. It identified research priorities focused on identifying, implementing and ensuring uptake of best management practices (such as whole farm planning) as critical to the better land use and it also identified key data gaps, resource information and indicators for land-use reporting.

The range of research suggestions in the relevant SIG science strategies indicates that there is a particular need to provide tools for determining land-use effects on groundwater and surface water quality. The bulk of these suggestions involve research, at a national scale, generally relating to the application, optimal management, transformation, transport, and fate of nutrients, which is often driven by receiving surface water quality concerns. We anticipate that this type of water quality research will inform and support allocation limit setting and revision with well-understood uncertainty. Despite ongoing research there is currently only limited knowledge confirmed by monitoring of whether nutrient and quantity allocation limits are sustainable. It is an ongoing national need to develop better knowledge to inform refinement of allocations prior to setting effective sustainable allocation policies for groundwater quality and quantity at the regional level.

The RGWF suggestions also indicate that there is still an urgent need for more detailed data assessment to inform the science and policy setting and field verification of a sustainable water quantity allocation, using an adaptive, precautionary approach. A sustainable allocation is highly dependent upon recharge, net groundwater abstraction and surface flow data, none of which are precisely known; this uncertainty needs to be incorporated into the decision-making. In an era of competing requirements for a limited water budget, uncertainties in that budget mean that some allocations may be too stringent or too lax, and so there is a high risk that protection of users and environmental values is suboptimal.

Across most SIGS, encapsulating Mātauranga Māori alongside traditional science advice for community discussions is a high priority.

PRIORITY 4

Summary

- Improved surveillance and detection – terrestrial, marine, and freshwater
- Pathway analysis - terrestrial, marine, and freshwater.
- Novel tools, tactics and strategies for pest and weed control.
- Risk analysis and prioritization - terrestrial, marine, and freshwater.
- Development of novel tools for scaling up: landscapes and seascapes – for biosecurity management

Biosecurity/Biodiversity

The regional council "Strategic roadmap for biosecurity and biodiversity research" identified five common and overarching research goals:

1. Halt and reverse the decline of native biodiversity and protect natural habitats
2. Reduce land-use and invasive species impacts in freshwater and marine ecosystems
3. Ensure integrity of ecosystem services and natural capital
4. Improve environmental outcomes through increased community awareness
5. Anticipate and plan for future risks

These regional council goals have also influenced the direction of the Biological Heritage science challenge, which seeks to protect and manage biodiversity and to improve biosecurity. The value of biodiversity and the value in improving biosecurity need to be measured and explained to the community and to other key stakeholders. Councils require cost-effective tools, including new toxins and methods, and also proof of performance. Biosecurity is an area where it is extremely important that we can communicate the benefits, as well as the costs, of pest-control methods, particularly to communities. This is very much about maintaining a "licence to operate" at both regional and also national levels. The consequence of new pests and pathogens establishing in New Zealand, and the cost to society as well as to industry in having to live with these pests are generally not well understood or communicated and the arguments are generally about negative aspects of pest control.

Immediate priority research areas for the Biosecurity and the Biodiversity SIGS are:

- Improved surveillance and detection – terrestrial, marine, and freshwater
- Pathway analysis - terrestrial, marine, and freshwater. To implement the "pathways management" approach. Quantification of movement mechanisms for priority pests
- Novel tools, tactics and strategies for pest and weed control, and improvement of existing tools, tactics and strategies
- Risk analysis and prioritization - terrestrial, marine, and freshwater. Improved risk assessment tools to target effort
- Development of novel tools for scaling up: landscapes and seascapes – for biosecurity management
- Data management – dealing with large volumes of data

PRIORITY 5

Summary

- Overall need for better tools to address hazards, interpret 'risk', and reduce consequent societal risks.
- Ascertain the recommended resolution of topographic data for hazards identification and evaluation
- Development of a single hazards information portal
- Improve ecological outcomes of flood mitigation works.
- Understanding future geomorphological change to improve the long-term outcomes of flood management decisions.

Hazard Risk Management

The Resource Legislation Amendment Bill proposes to add to section 6 (as a matter of national importance, to be given effect to by all persons exercising functions under the RMA), 'the management of significant risks from natural hazards'. Further, MCDEM has acknowledged that at Government level, risk reduction as an element of civil defence is to be given greater emphasis. If Regional Councils are to provide and promote meaningful and comprehensive engagement in risk analysis and reduction, there is an overall need for better tools to address hazards and reduce consequent societal risks. Research and guidance is needed to provide robust and defensible positions for addressing risk, to give decision-makers confidence, and to give communities clarity around risk levels and abatement alternatives. Land-use planning applied as a risk reduction tool needs to be integrated with other planning drivers. A key issue is well-informed risk management- how to deal with risk, identifying effectiveness risk reduction measures, balancing risk reduction with acceptable cost, and providing acceptable levels of residual risk.

In the first instance, as identified by the Hazard Risk Management and the River Managers SIGs, priority research is required to:

- Investigate LiDAR and other technologies to ascertain what is the recommended resolution of topographic data for hazards including flooding, coastal inundation, tsunami and sea level rise.
- Research legislative policy gaps to facilitate implementation of the natural hazards policy platform; a risk-based approach that is difficult to implement by planners due to a lack of supporting research and methodology.
- Development of a single hazards information portal; a toolbox that would be supported by legal research into information disclosure and responsibilities of regional, territorial and unitary authorities.
- Improve ecological outcomes and reduce the environmental impact of flood mitigation works.
- Forecasting rainfall events to improve community response to floods. Mapping weather events just before and as they occur. Prediction modelling to forecast rainfall depths 24-48 hours in advance of weather events, including orographic distribution of rainfall across catchments.
- Understanding future geomorphological change to improve the long-term outcomes of flood management decisions

PRIORITY 6

Summary

- Capturing customary knowledge in accordance with tikanga Māori into coastal and marine monitoring and management frameworks
- Nationally consistent state of the environment (SoE) monitoring and reporting and incorporating cost-effective technologies.
- Baseline data and meaningful indicators to characterise the existing CMAs.
- Appropriate and relevant limits /standards for stressors impacting on the CMA, including those derived from land-based activities.
- Identifying the effects of stressors in the CMA - spatial and temporal context.
- Understanding synergistic and cumulative effects of multiple stressors and developing tools to manage.

Coastal

As for freshwater science, councils are required under section (s) 8 of the RMA to take into account the principles of the Treaty of Waitangi. Objective 3 Policy 2 of the NZCPS requires councils to incorporate Mātauranga Māori in regional policy statements and plans and to consider Mātauranga Māori in decision making on applications for resource consent etc. Research is needed on ways in which customary knowledge can be captured, in accordance with tikanga Māori, and incorporated into coastal and marine monitoring and management frameworks. In addition, important Māori environmental values will need to be captured that relate to kaitiakitanga, whakapapa, tino-rangatiratanga and mānaakitanga.

There is a need for consistency amongst councils for national state of the environment (SoE) monitoring and reporting. In addition, high quality, 'fit for purpose' data is needed in many regions to establish regional monitoring programs.

In order to manage ecosystems and resources, we need to quantify change, and understand how the Coastal Marine Area (CMA) and associated organisms and habitats respond to various stressors (both natural and anthropogenic). A particular challenge highlighted in the NZCPS is acknowledgement of the synergistic effects of multiple stressors, tipping points, and cumulative environmental change.

Priorities for coastal/marine research include:

- Develop nationally consistent frameworks (including determining core parameters and quality assurance) for both regional and spatially targeted coastal monitoring (e.g. estuaries) that incorporates cost-effective technologies
- Characterising the existing CMA by collecting appropriate data for establishing baselines.
- Identify relevant and meaningful indicators to describe the state and condition and assess change over time of the CMA
- Environmental thresholds and establishing appropriate and relevant limits /standards for stressors impacting on the CMA, including those derived from land-based activities
- Identifying the effects of stressors in the CMA - spatial and temporal context. Understanding synergistic and cumulative effects of multiple stressors and developing tools to manage.

PRIORITY 7

Summary

- Ensure that Central Government decision-makers understand what is required in science capability and capacity now and in the future.

Retaining and Building Science Capability and Capacity

Councils rely, to a large extent, on long-term science and long-term data sets to provide the necessary information to be able to make well-informed decisions. This is critical to State of the Environment (SOE) monitoring. Incentives need to ensure good quality science that is relevant to council needs. The requirement in environmental science is not so much for excellent, ground-breaking research that leads to new science frontiers, but rather for well-designed and implemented research programmes that evolve and endure; this combination will provide credible answers to the New Zealand situation. Therefore, a priority for this Strategy is to ensure that Central Government decision-makers understand what is required in science capability and capacity now and in the future.

Implementation

The Strategy will be communicated to key Government departments particularly MBIE, MPI, MfE and DOC. The key messages in the Strategy will also be delivered to the relevant National Science Challenges, research providers and other key players, as well as to Regional Council SIGS and individual councils. The intention will be to influence science direction, strategic priorities and funding allocation and to ensure councils have a say in NSC direction where appropriate. The Strategy will also be used to influence science capability, both for maintaining key skills but also for identifying future capability that New Zealand will need.

The National Science Challenges provide an excellent mechanism for council staff (and SIGS) to get involved in the development and execution of key research projects that can address important issues. A network of Regional Council contacts has been established to work with the NSC's, particularly Our Land & Water and Biological Heritage. This network will be enhanced and formalised to ensure two-way knowledge transfer; both for ideas into the challenge and outputs that may be useful to councils.

Specific actions to address critical issues and opportunities our detailed in the Annual Operating Plan (AOP) in Appendix 1.

Key to the success of the Research Strategy is ensuring that the strategic planning process is maintained. A three-year rolling planning cycle is followed in line with the three-year cyclic review process for Long-term Plans (formerly Long-term Council Community Plans), including a process for developing an Annual Operating Plan (AOP) (Figure 4).

The AOP will be followed to drive the implementation of the Strategy. The Strategy Coordinator (SC), under the direction of the Science Advisory Group, will be responsible for the development of the AOP and its implementation. The SC will report to the Science Advisory Group (and RMG and BMG) on a regular basis. The AOP will include milestones (updated annually), which will be monitored as a measure of implementation success. The Science Advisory Group in turn reports to the Regional Councils' Chief Executives' Group.

As part of a three-year cycle, each SIG reviews current knowledge, identifies gaps, and holds a workshop to identify future research needs for their area of interest. This information will be communicated to both external parties, including MBIE, CRI's, universities, and appropriate Government departments, and will also be fed into the SAG/RMG/BMG process for determining higher-level strategic research needs.

As shown in the planning cycle (Figure 4) a "Critical Issues and Research Needs" workshop will be held every three years to review the current situation and look ahead to future needs. The SIG Research Strategy Workshop held in March 2015 provided this perspective and an update of critical issues and research needs.

It is also intended that SIGs will work closely with key research providers through topical workshops or conferences held on a three-year rolling cycle. What this means is that NIWA, for example, might partner with the Regional and Unitary Councils once every three years to hold a workshop or conference on a particularly relevant topic.

Ensuring an Ongoing RS&T Strategy Process

The planning cycle is shown in Figure 4 below:

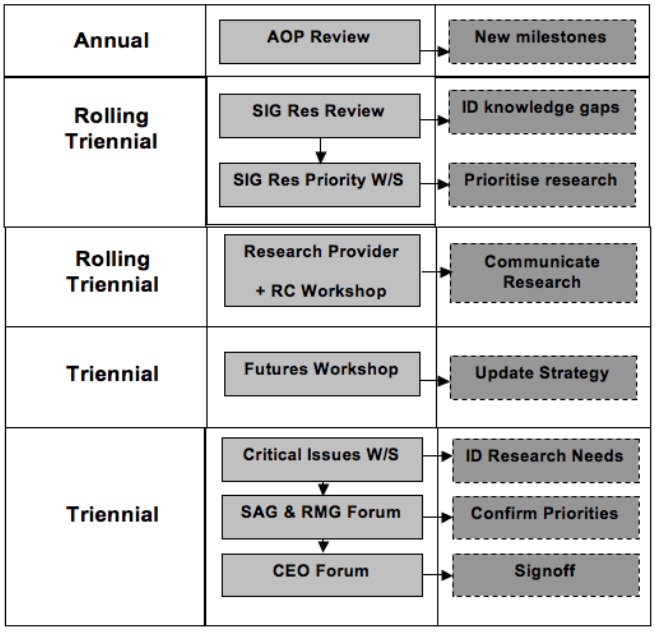


Figure 4. Regional Council RS&T Strategy Planning Cycle

Appendix 1 – AOP

Regional Council RS&T Strategy
Operating Plan 2016-2017

Goal 1: To Provide Timely, Authoritative and Respected Direction to Science Research and Funding

OBJECTIVE	ACTION
Objectives for Goal 1: 1. To be recognised as a single, representative voice with a long-term focus, that produces robust scientific knowledge and actively drives policy development and implementation 2. To be recognised as a trusted partner, not just an end user, and a unified voice as to how research funding should be allocated 3. To be viewed as real partners by research providers and funders 4. To be integrally involved in MBIE negotiated investments 5. To be recognised as an integral component of the science planning and implementation system 6. To secure and direct appropriate funding towards science goals to: i. Understand current issues and cultural values (socio-economic) of the resources and implications to the future ii. Develop tools to manage the environment and broader roles and responsibilities of Regional and Unitary Councils iii. Develop new monitoring technologies iv. Develop pragmatic solutions for problems v. Provide for more effective delivery of science vi. Provide more certainty with uncertain information vii. Provide for scenario testing 7. To maximise leverage on existing and new RC research funding to provide greater science direction 8. To influence research providers and funding agencies on the culture required to meet Regional and Unitary Councils needs 9. To advocate for multiple-provider team approach for effective use of science capability 10. To meet tomorrow's problems as well as today's 11. To foster the optimal use of science between councils 12. To develop a system for ongoing prioritisation of research for RC's needs 13. To be a voice to deal with outside agencies - such as MfE, DOC, MPI 14. To establish clear intellectual property guidelines 15. In a collegial manner, to systematically and regularly identify knowledge gaps in: i. Characterising NZ's natural resources; ii. Identifying inventories and trends; iii. Improving knowledge of processes and systems that shape the resources; iv. Continually evaluating and updating that knowledge; v. Achieving and sharing consensus on practices that lead to sustainable resource management (while identifying and incorporating regional differences and distinctiveness). 16. To lead and coordinate new research efforts where and when appropriate.	***(To be completed by 30 June 2017)*** 1. Launch the new strategy to key staff in MBIE, MPI, MfE, and DOC by 31 July 2016 and promote key messages in order to drive science and funding direction. 2. Promote RC involvement in key NZ science initiatives, such as the NSCs. 3. Promote RC involvement on key Research Provider advisory panels and maintain register on the EL website. 4. Promote RC involvement in key MBIE negotiated investment schemes at any opportunity. 5. Plan meetings with MBIE at key budget times – and other opportune times to influence budget allocation 6. Continue to work with MBIE, RPs, and RCs to direct funding to cross-sector SIG priorities including, in 2016: • Methods for valuing and accounting for research and environmental values/services • Improving policy evaluation for complex and uncertain decision needs with many dimensions • Improving community planning and decision processes – including science to ensure cost-effective/collaborative implementation of the freshwater reforms; and ensuring that the social/economic implications of hazards events can be practically applied. 8. Work with SIGS and all Councils to avoid duplication – and seek additional funding opportunities, such as NSCs, to leverage RC funds. 9. Continue to promote a clear message on culture to RPs - in particular a message on partnership and effective research delivery. 10. Continue to promote appropriate team approach through NSCs and other mechanisms. 11. Promote the SIG research strategies to ensure new research is implemented to deal with tomorrow's expected problems. Plan a Future's workshop for 2016. 12. Work with RMG and the relevant SIGS to identify opportunities to ensure resource and knowledge sharing between councils where appropriate. 13. Continue to work with SIGs on research prioritisation – plan SIG workshop for early 2017. 14. Meet with MfE, DOC, MPI on key RS&T issues as appropriate; leverage NSC opportunities. 15. Continue to communicate RC's IP policy to RPs – 16. Continue to work with SIGS and RMG to identify knowledge gaps in environmental and resource management science; work with RPs and MBIE to encourage greater knowledge dissemination of MBIE-funded research on CRI websites, conferences, workshops etc – 17. Identify opportunities and submit at least one proposal to lead a national research programme.

Goal 2: To Catalyse and Enhance Science Delivery

OBJECTIVE	ACTION
Objectives for Goal 2: 1. To maintain and build capability and ensure resources are targeted to most effectively deliver environmental outcomes 2. To identify a process of identifying key Regional and Unitary Councils that are doing things well in some areas and use these councils as a conduit 3. To encourage partnerships and collaborative research effort 4. To empower SIGs to develop and implement research strategies 5. To assess and manage risk associated with the provision of science 6. To set up a system of advocating over public good science for maintaining capability 7. To collectively advocate to MBIE, relevant ministries, and Chief Executive Environmental Forum (action - to identify the vehicle to advocate) 8. To establish mechanisms for greater council interaction 9. To establish processes for validation of research results (e.g., peer review vs. contract report) 10. To prioritise and target science that reflects and has regard to: • Strategic importance for all RC's collectively but also specific problems of wide significance • Existing research capacity • The likely benefits • The ability of users to capture the benefits.	**(To be completed by 30 June 2017)** 1. Continue to communicate to MBIE, MPI, CRIS and universities capability needs as identified in RC RST strategy and SIG strategies, Freshwater science in 2016 in particular. 2. Progress the concept of RCs as key knowledge hubs for areas of expertise; continue to work with ESRC in this regard; extend to others. 3. Work with NSCs to establish appropriate collaborative research models and specific projects. Focus on OLW in 2016. 4. Encourage SIGS to update research strategies and to continue to communicate priorities to RPs and Government departments. 5. Work with MBIE, NSC's and others to develop a mechanism to address risk associated with science – 6. SAG to use the Strategy to advocate for key areas of science capability need – e.g., freshwater science in 2016. 7. SAG to continue in its key advocacy role with key government departments and forums. In 2016 emphasis should be on maintaining freshwater science capability.Continue to promote greater interaction in NSC's in particular and develop a mechanism for greater knowledge sharing from NSC's 8. Continue to work with research providers and SIGS to establish and implement a process for validation of research results that is relevant to RC needs. 9. Promote the research priorities from the current and revised Strategy, and the relevant SIG strategies, to MBIE and RPs, as well as to Regional and Unitary Councils. Make presentations to at least 8 councils during the year.

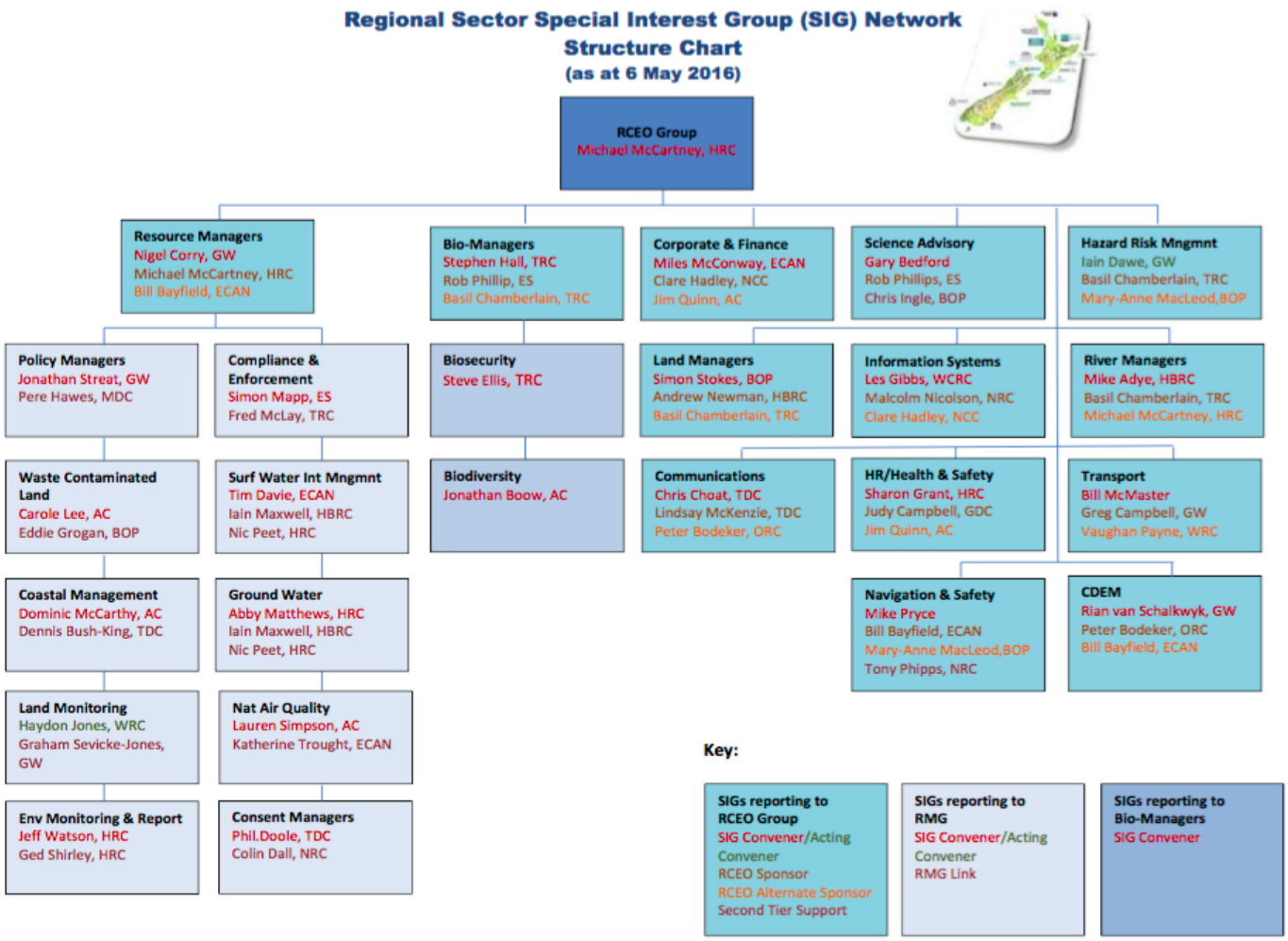
Goal 3: To Facilitate Science Uptake

OBJECTIVE	ACTION
Goal 3 Objectives: 1. To encourage the implementation of schemes such as Envirolink 2. To promote the development and utilisation of knowledge management systems 3. To promote effective two-way communication including between science and policy within Regional and Unitary Councils, so that science and research provision remain orientated towards policy and uptake priorities 4. To use the Strategy to advise Regional and Unitary Councils to think about end use before defining product in the contract. Need to consider what the underlying purpose and value of any research really means 5. To influence central government funding on appropriate output, particularly in regard to NSSI (Oct 2015) push for greater emphasis on science quality 6. To ensure effective RS&T output 7. To develop and implement a continuum model to work with scientists on key research projects 8. To advocate to councils that science knowledge is valuable and necessary for sound evidence-based decision making 9. To develop new mechanisms to attract central government funding for knowledge transfer and implementation 10. To ensure greater transparency and exchange as to who is doing what – e.g., between research providers and councils etc.	**(To be completed by 30 June 2017)** 1. Continue to encourage MBIE to develop Envirolink Plus, HazardLink etc and lobby for greater funding for knowledge transfer 2. Continue to promote the Envirolink Search Engine to RC Staff RPs and others; seek out and implement additional opportunities 3. Encourage greater interaction between the Policy SIG and other SIGS. Encourage Policy SIG to present messages in clear language to ensure the message is understood by all. 4. Continue to promote this message to RC staff and provide examples of best practice. 5. Continue to make the case to MBIE and TEC that output needs to be appropriate in order to be implemented. "Excellence" should mean much more than a good publication track record. 6. Continue to communicate to NIWA, Landcare, and others as to what effective RS&T is and provide examples of best practice. 7. Continue to promote this concept through the NSCs ensuring RC staff involvement from design through to implementation on key projects 8. Promote this message to councils and identify where the greatest needs are. By council and by knowledge area. 9. Publicise the benefits of Envirolink as a knowledge transfer mechanism by presenting at a NZ conference if possible 10. Maintain an updated register of key RC staff science contacts on the EL website. Utilise NSC's to enhance transparency

Goal 4: To Ensure an Ongoing RS&T Strategy Process

OBJECTIVE	ACTION
Goal 4 Objectives: 1. To follow a process to review, refine, and update the strategy 2. To provide the necessary resource to ensure the strategy process is successful 3. To provide a governance mechanism to oversee the strategy process	**(To be completed by 30 June 2017)** 1. SAG to review Operating Plan before 30 June 2016. Update RC RS&T Strategy before end of 2017 as necessary. 2. Research Coordinator on board – 3. SAG to provide governance and report to CEO Forum -

Appendix 2. Special Interest Group Structure (as of 6 May 2016)



Any changes to the Network Structure Chart will be made and updated on the following link:
http://www.envirolink.govt.nz/PageFiles/29/SIG%20Structure%20and%20key%20people%20as%20of%20May%202016.png

Appendix 3. Commonality in SIG Priority Research Topics (see Legend at bottom)

Topic	RP	LM	LF	WC	GW	SW	CM	RM	EM	HR	BS	BD	AQ
Valuing and accounting for research and environmental values/services – (LF - Quantify the value of ecosystem services to water quality, production, biodiversity etc)	1		4								8	1, 3	
Improving policy evaluation for complex and uncertain decision needs with many dimensions; - dealing with uncertainty – (SW - Policy frameworks that account for dynamic interaction and different timescales of response; RM – Optimise accessibility of flood hazard information; HR - Guidance on including natural hazard risk into land-use plans and determine acceptable level of risk. BS/BD – Risk analysis and prioritization.)	2			3		1		2, 5		4	4	1	
Improving community planning and decision processes – (LM - including science to ensure cost-effective/collaborative implementation of the Freshwater reforms; RM – Improve economic and social assessment tools; HR - To ensure that the social and economic implications of hazards events and specific scenarios can be applied practically.)	3	4						2		5			
Costs and benefits of BMPS to increase uptake of BP tools and technologies		1	7										
Understand land manager motivation/ behaviour to uptake BP tools		2	8										
Improve NZLRI and LUC to better account for land-use options and allow use in nutrient loss regulating; (LF - Improve operability of S-map)		3	1										
Develop and test better input data on erosion and sediment generation to enhance modelling		5	2										
Establish a cost-effective and easy to implement indicator of soil health			3										
Monitoring, predicting, behaviour of contaminants in soils				1									
More affordable investigations and monitoring of land contaminants				2									
Controlling organic/inorganic hazardous waste				4									
Establishing ecologically sustainable nutrient allocation and establishing the time lag to reverse nutrient effects – (SW - Investigating linkages between nutrient inputs, periphyton growth, and ecosystem health)					1	3							
Establishing the transport and fate of nutrients and pathogens in a variety of groundwater and hydraulically connected surface water systems					2								
Effects of groundwater abstraction on surface water in-stream values – (SW - Models able to operate at different levels of complexity but integrate groundwater and surface water)					3	1							
Establishing sustainable groundwater allocation limits					4								
Vulnerability of groundwater and supply bores to land use					5								

Topic	RP	LM	LF	WC	GW	SW	CM	RM	EM	HR	BS	BD	AQ
Encapsulating Mātauranga Māori alongside traditional science in advice for community discussions – (CM Investigate processes to co-develop appropriate indicators and monitoring programmes for Māori marine environmental frameworks)						2	7, 8, 9					4	
Environmental drivers for toxic benthic cyanobacteria. Beyond biochemistry; need to look at wider environmental drivers						4							
Specific tools for management (beyond planning) e.g., RIVPACS for comparing observed invertebrate scores with predicted. Science information to be packaged into usable tools						5							
Develop nationally consistent frameworks (including determining core parameters and quality assurance) for both regional and spatially targeted coastal monitoring that incorporates cost-effective technologies							1						
Characterising CMAs by collecting appropriate baseline data.							2						
Identify relevant and meaningful indicators to describe the state and condition and assess change over time of the CMA							3						
Environmental thresholds and establishing appropriate and relevant limits /standards for stressors impacting on the CMA, including those derived from land-based activities							4						
Identifying the effects of stressors in the CMA - spatial and temporal context. Understanding synergistic and cumulative effects of multiple stressors and developing tools to manage.							5						
Improve ecological outcomes and reduce the environmental impact of flood mitigation works								1					
Forecasting rainfall events to improve community response to floods. Mapping weather events just before and as they occur. Prediction modelling to forecast rainfall depths 24-48 hours in advance of weather events, including orographic distribution of rainfall across catchments.								3					
Understanding future geomorphological change to improve the long-term outcomes of flood management decisions								4					
Paleohydrology: To anticipate the effects of potential climate change (natural or anthropogenic) on catchment hydrology and to assess hydrologic trends will require an understanding of past long-term hydrologic variability.									1				
Topographic Data: Investigate LiDAR and other technologies to ascertain what is the recommended resolution of data for hazards including flooding, coastal inundation, tsunami and sea level rise.										1			
Natural Hazards Policy Platform: The risk-based approach is difficult to implement by planners due to a lack of supporting research and methodology. Further research on legislative policy gaps is required.										2			

Topic	RP	LM	LF	WC	GW	SW	CM	RM	EM	HR	BS	BD	AQ
Hazards Information Portal: Development of a single information portal. A toolbox that would be supported by legal research into information disclosure and responsibilities of regional, territorial and unitary authorities.										3			
Improved surveillance and detection – terrestrial, marine, and freshwater											1	11	
Pathway analysis - terrestrial, marine, and freshwater. To implement the "pathways management" approach. Quantification of movement mechanisms for priority pests											2	6	
Novel tools, tactics and strategies for pest and weed control, and improvement of existing tools, tactics and strategies											3	5	
Risk analysis and prioritization - terrestrial, marine, and freshwater. Improved risk assessment tools to target effort											4		
Development of novel tools for scaling up: landscapes and seascapes – for biosecurity management											5	10	
Data management – dealing with large volumes of data											6	2	
Ecological monitoring. Cost-effective monitoring tools, technologies and strategies that are simple to use and sufficiently sensitive to changes in the resource indicators. This includes development (or in some cases refinement) of cultural indicators of biodiversity and Mātauranga approaches.												4	
Social science and citizen science											9	7	
Influencing behaviour/barriers to change: determine how to best influence perceptions and behaviour of householders and identify the barriers to adopting clean heat, including how they can be overcome.													1
PM2.5 and health impacts: review the state of knowledge of PM2.5 impacts and its sources in NZ and establish what guideline, standard or policy NZ should have to address the impacts of PM2.5.													2
PM2.5 information gaps: review PM2.5 monitoring in NZ and what it tells us, and determine the relationship between PM2.5 and PM10 (how it changes with location, season and sources).													3
Understanding anthropogenic contributions: review the cost-effectiveness and reliability of emission inventories and modelling as evaluation methods, and identify if better methods linking emissions to concentrations exist.													4

Importance Legend:

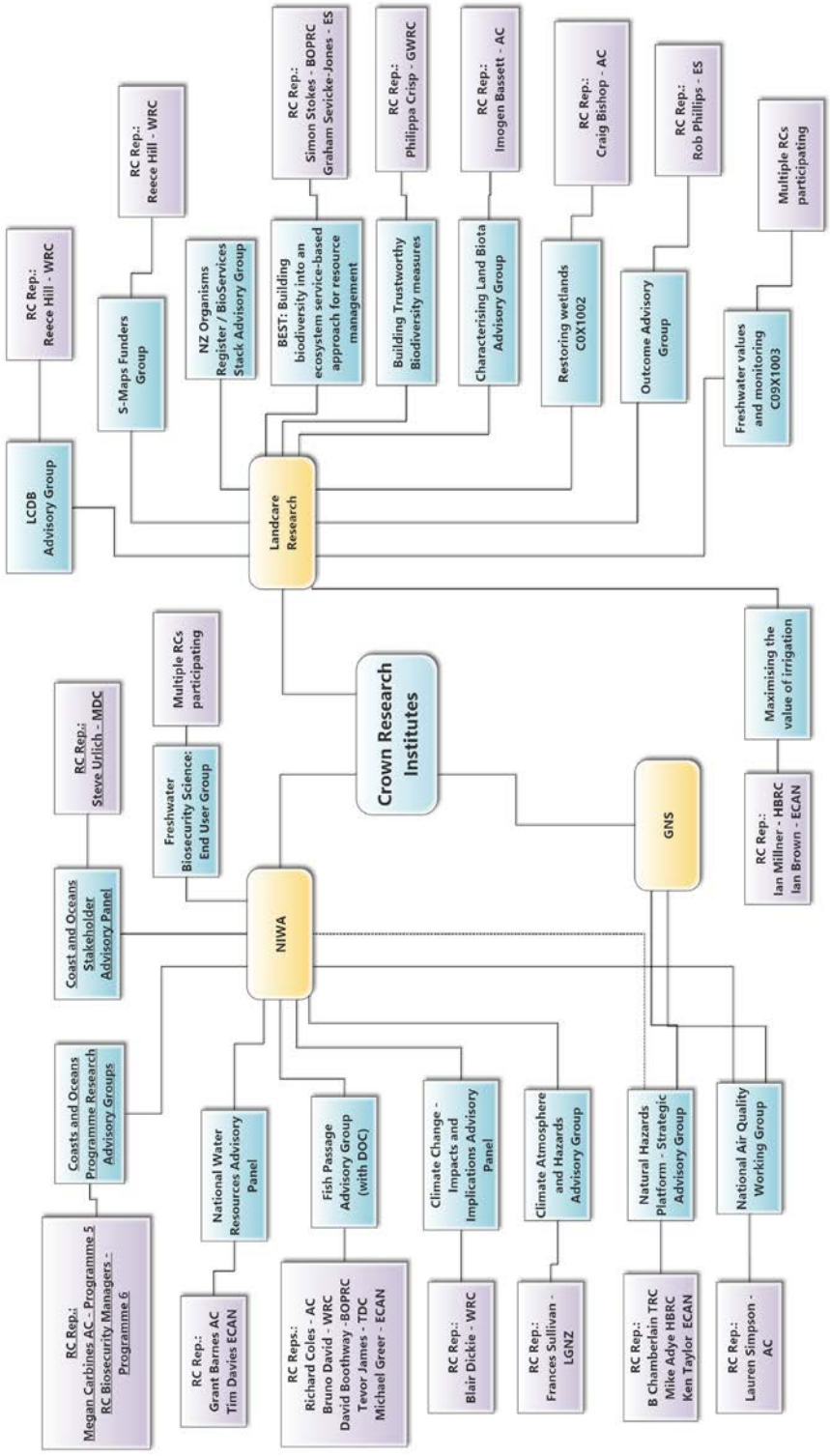
1	Directly relevant to SIG – identified as a priority; number = priority
	Indirectly relevant to SIG – not specifically a high priority

SIGS Legend: RP = Regional Policy Managers; LM= Land Managers Group; LF = Land Monitoring; WC = Waste and Contaminated Land; GW = Groundwater Forum; SW = Surface Water Integrated Management; CM = Coastal Management; RM = River Managers; EM = Environmental Monitoring; HR = Hazard Risk Management; BS = Biosecurity; BD = Biodiversity; AQ = Air Quality

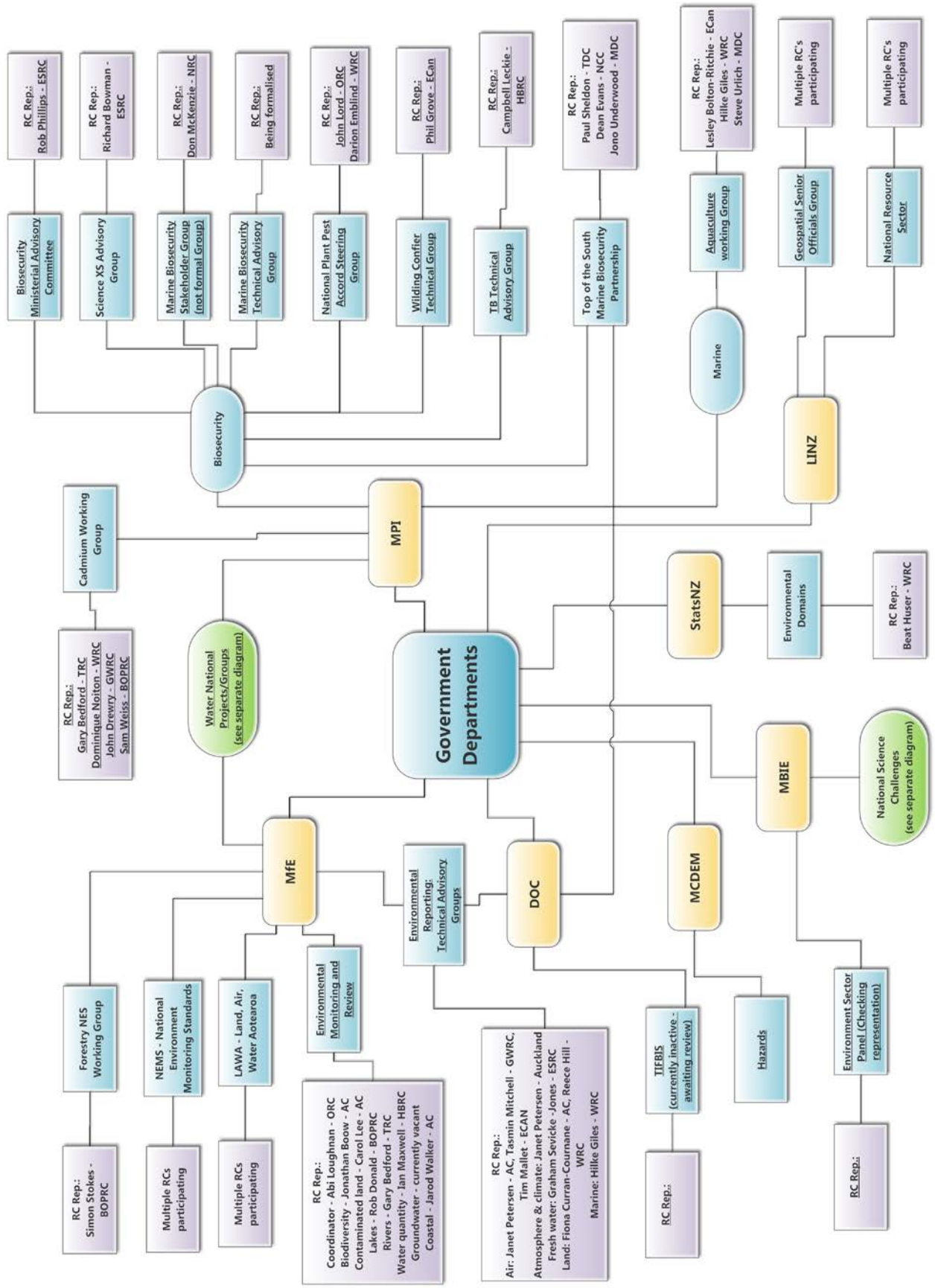
Appendix 4. Regional Council Staff in NZ Science

Regional Council staff are formally involved in many NZ science and technical advisory groups with CRIs and Government Departments. In addition, staff are involved in Governance and advisory positions in the National Science Challenges. Involvement is shown in the following diagrams, which are constantly requiring updating as new groups are formed and staff involvement changes. The Envirolink website provide a more up to date link (http://www.envirolink.govt.nz/Regional-Council-Science-Linkages/).

Crown Research Institute Linkages (as of May 2016)



Government Departments (as of May 2016)



Science Challenges (as of May 2016)