Research for Resource Management

Regional Council Research, Science & Technology Strategy 2020

Foreword

In May 2020 as this strategy was being finalised it was apparent that the Covid-19 pandemic would have a profound impact on New Zealand and the global economy. The strategy was largely written prior to Covid-19 becoming a key driver for New Zealand and indeed the world. While many of the strategic priorities remain, there is now a new lens examining how best to respond to the health and economic crisis that we now face.

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 natural resources, and utilising science that may be incomplete and with ill-defined uncertainty. After close to 30 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 (but not necessarily accurately informed) with broad conflicting values and expectations and more constrained research resources. Sage decision-making requires sound science as input for reference and guidance. 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 an effective and efficient manner.

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 fourth edition of the Strategy.[1] As with previous versions, it sets out the broad context within which regional council operate, and 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 (SIGs). 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 Resource Managers Group (RMG), 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.

Iain Maxwell
Chair, Science Advisory Group (2020)

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1   Previous versions in 2009, 2011, 2016

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 contributing and respected "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 for identifying research priorities and capability requirements for the present and future of resource management.

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' Resource Managers Group.

Photo: Horizons Regional Council.

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 a number of wider reviews and investment decision-making processes for research at national level.

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. During the life of the previous Strategies, many Special Interest Groups (SIGs) have developed and operationalised their own science strategies and identified key research priorities. These have proved very useful, for example in contributing to the formulation of National Science Challenge programmes and to the development of specific projects. The revised 2020 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.

In times past, Regional and Unitary Councils had very little formal input to high-level central government science strategy and agendas, but this has changed with the implementation of each Research Strategy. Council representatives have been and are 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, DoC) and to also provide direct input 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 and impact 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 (SIGs) have identified through their own strategies, particular requirements and important needs that go beyond those discussed herein.

Photos: Horizons Regional Council.

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 research perspective, beyond science, to ensure that the research strategy extends across the applied sciences that inform environmental issues, and across the design, delivery, and testing 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 RS&T strategic priorities are expanded in the document and are presented in no particular order.

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Priority 1:
Influencing government science direction

Government invests about \$1.6b/yr in science, but this investment system is complicated, constantly changing, and tending to focus away from core regional councils needs to new 'transformational' research.

- For Regional Councils there is strong need for science investment to be nimble and match policy needs and respond to changing policy drivers.
- There is a need to maximise Regional Councils' influence over government science direction and spending to ensure our sector can function effectively and achieve the required outcomes for environment and community, by:
    - o Contributing to government science policy and in particular MBIE and HRC strategies.
    - o Maintaining a close dialogue with the Prime Minister's Chief Science Advisor and those of key government departments.
    - o Continuing to contribute to government department science strategies, particularly MfE, DOC, MPI.

This priority recognises there is an important need to ensure that science investment is matching policy needs and responding to the country's policy drivers. The need is not only to influence investment but also the science view around policy need and recognising that needs change. It is important that we keep an eye on the future to ensure our science responds early to inevitable and disruptive change. Central Government science leadership is required particularly in the complex area of land use and water quality, but other priority areas as well, as described in this document below.

2 Priority 2:
Incorporation of mātauranga Māori

Regional councils to:

- Prioritise the bridging of mātauranga Māori alongside of western science to support diverse knowledge and information systems that inform planning, policy and management.

- Increase Māori engagement and participation through a bicultural approach to using and understanding knowledge systems that include mātauranga Māori and Te Ao Māori perspectives.

- Key activities to advance the use and understanding of mātauranga Māori next to Regional Council science, planning and policy can include:

  o Developing regional objectives and goals that are informed by diverse knowledge systems and perspectives.

  o Engagement and collaboration with Māori (e.g., iwi/hapū) on projects and activities that include mātauranga Māori (e.g., Māori environmental frameworks) alongside of science.

  o Collectively understand complex issues (e.g. environmental, social, cultural) using mātauranga Māori and science to achieve desired or agreed management outcomes.

  o Investigating processes to co-develop appropriate regional monitoring programmes and indicators that achieve desired or stated outcomes.

  o Understanding mātauranga Māori and perspectives alongside of science to support community discussions, advice, and decision making.

The bridging of mātauranga Māori (Māori knowledge) alongside science is seen as a priority to answer complex questions, find holistic solutions, and achieve good environmental outcomes for Regional Councils. Drawing on and understanding mātauranga Māori alongside science creates an important Treaty perspective (to date often lacking) to inform effective regional council planning and policy. Adding the Māori perspective from Te Ao Māori will greatly contribute towards further emphasis on effective relationships and ultimately partnerships with hapū/iwi Māori. This is an evolving area of work that needs additional science support and coordination to provide the required knowledge and tools for effective implementation.

3 *Priority 3:*
Better science utilisation

- This priority recognises that it is not always more science that is needed. Extracting greater value from better utilisation of existing and new science is an opportunity that needs to be taken.
- The identification, collation, and consistent application of existing science to support Regional Councils' needs has been supported through Envirolink funded projects, but there is further demand and opportunity.
- **Driving better utilisation of existing and new science will be advanced by:**
    - o Facilitating better access to NZ and overseas research results to incorporate into decision support tools/processes.
    - o New mechanisms to engage university academics in relevant research.
    - o 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.
    - o 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.
    - o Consistency in application of basic tools that can be applied across all regions.

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. Improving the utilisation and extracting more value from existing science and optimising the uptake of new science is seen as a priority opportunity for Councils.

4 *Priority 4:*
Enhancing policy effectiveness

- Councils (and Government departments) need better approaches to assess the effectiveness and efficiencies of their policies across both the full range of environmental/community outcomes and Councils wide scope of practice.
- Further research is required to develop and improve the application of policy development methods, tools and processes used for the design and evaluation of policy or other decision responses to environmental management issues.
- **Research for enhancing policy effectiveness needs to focus on:**
    - o Better approaches for assessing the effectiveness and efficiencies of policy and its implementation, including a tool that can model and evaluate the likely impact of a full range of policy options in terms of effectiveness.
    - o Design and evaluation of resource allocation policy effectiveness taking consideration of dimensions of values and varying environmental situations.
    - o Design and evaluation of legal policy instruments that can be crafted into workable and acceptable policy responses.
    - o Social processes for iterating problems and solutions development and delivery.

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.

(5) Priority 5:
Integrated land and freshwater science for enhanced resource management

- A more integrated management approach supported by good science to fill knowledge gaps is required to meet the significant challenges Councils face with land and water management.
- This is an evolving priority area with increasing resource use pressure and new legislation requiring implementation.
- There is an urgent and long-standing need for improved land use information to facilitate progress.
- A number of research gaps have been identified by national and regional advisory groups.
- **Some key research needs in this area are:**
    o A clear understanding of the science so as to apply any additional freshwater NOF attributes in a defensible and well-considered manner, respecting both community aspirations and the scientific context, including limitation to their application.
    o 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.
    o Improving understanding of 'land–surface water-groundwater–surface water' interactions to provide tools for determining land-use effects, and to help better understand the vulnerability of groundwater to land use and establish ecologically sustainable.
    o 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.
    o Identifying future land use options to realise greater co-benefits, increase landscape resilience and grow productive value and understand the transitional requirements to implement these options.
    o Evaluate different land management practices against major land use effects (e.g. nutrient leakage, erosion, soil contamination), and the policy approaches used to manage them.
    o Improving understanding of the land-freshwater link to marine receiving environments, and particular environments, such as coastal wetlands and estuarine environments.
    o Understanding the wider benefits (ecological, productive and community) that can be achieved through integrated catchment management policy and practices and how these can fit within property scale sustainable land use practices.
    o Increased understanding of the implications of climate change on land use and integrated land/water outcomes and how such changes impact downstream ecosystems, values and risks.
    o Enhance the coverage, quality, and interoperability of soils information and improve performance of outcome (erosion/sediment, nutrient) modelling.

The integrated management of land and water to provide for enhanced sustainable production, meet the requirements of adjacent and downstream ecosystems, and supports the values of iwi and wider community is one of the greatest challenges facing Regional Councils. There are a significant number of research needs within this priority area.

6 — Priority 6:
Improving biosecurity and biodiversity

- Regional biosecurity faces significant challenges in managing existing animal and plant pests and preventing further pest incursions to protect our terrestrial and aquatic biodiversity and productive land uses.
- **The key research needs for this priority include:**
  - 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 prioritisation – terrestrial, marine, and freshwater.
  - Development of novel tools for scaling up: landscapes and seascapes – for biosecurity management.
  - Productive land management options to enhance biodiversity.

The issues and threats posed by current biosecurity challenges and potential new introductions have significant consequences for our productive land uses and native biodiversity. Our national biodiversity values are under pressure and is in decline in many areas. The impacts on biodiversity are closely related to biosecurity capability and actions.

7 — Priority 7:
Better hazard risk management

- Regional hazard risk management requires councils to identify the full range of hazards and development risk management approaches to these with their communities.
- **Focus areas to provide better hazard risk management are:**
  - 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.

The regional hazard risk management role requires councils to engage with potential affected communities on a range of natural hazards and develop risk reduction/mitigation options. There is limited science and

research currently available to support these processes which can result in difficulty in defining/modelling risk, impacts of some mitigation options not bring fully understood, and inconsistent approaches being applied across hazards.

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8 | *Priority 8:*
Improving coastal management

- The Coastal Marine Area (CMA) is diverse and complex across the regions, yet in many areas it is still poorly understood in terms of its baseline state or response to stressors.
- **Research priorities identified to improve the management if the CMA include:**
  - Baseline data and meaningful indicators to characterise the existing CMAs.
  - Nationally consistent state of the environment (SoE) monitoring and reporting and incorporating cost-effective technologies.
  - 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.
  - Incorporating customary knowledge in accordance with tikanga Māori into coastal and marine monitoring and management frameworks.

The Coastal Marine Area (CMA) includes a range of diverse and complex ecosystems, many of which are under pressure from upstream impacts and resource use demands. The CMA is a priority area for research to ensure a better understand the responses to these pressures and to create sustainable management approaches.

In order to manage ecosystems and resources, we need to quantify change, and understand how the 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.

9 *Priority 9:*
Cross-cutting themes: Adaptation and mitigation of climate change and improving data management

- **Climate Change – adaptation and mitigation**
  - Coordinate research between outcome areas to ensure efficient use of research funding and integration of findings and solutions.
  - Advocate for science and planning research that is required for adaptation and mitigation of climate change.

- **Data Management – actions to improve**
  - Advance the concept of a 'collective blueprint' for the environmental data sector.
  - Promote and coordinate the needs for improved data management across sectors/ outcomes and strategy priorities.

Climate change and data management are priority issues that cut across all science areas.

Our changing climate is having a significant impact on our environment across all domains: terrestrial, freshwater, and marine. We need to better predict how climate will change in order to prepare to mitigate and adapt to the impacts of climate change on the natural environment.

Managing the increasing quantities of data becoming available is a major challenge not only for Regional Councils but for all organisations involved environmental data collection as new technologies make it easier and less expensive to collect information.

10 *Priority 10:*
Retaining and building science capability and capacity

- Having adequate and targeted science capability and capacity across the full breadth of relevant research areas is critical for Councils to undertake their functions now and into the future.
- To ensure this occurs areas of focus under this strategy are:
  - Advance opportunities for greater sharing of scarce science resources between councils.
  - Ensure that Central Government decision-makers understand what is required in science capability and capacity now and in the future.

The Resource Management Amendment Act 2020[2] requires councils to consider in plan-making and consent decision-making a whole new range of Climate Change/Green House Gas emission matters. There needs to be greater science capability to deal with these matters, either in-house or external.

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2   http://www.legislation.govt.nz/act/public/2020/0030/latest/LMS259082.html

There is a continual need to retain and to build science capability and capacity as scientists retire, move to other jobs, and as new challenges demand new scientific approaches. There is also an opportunity for councils to share science capability and capacity by pooling resources. An approach could be to establish "centres of excellence" or establish a "shared-services model" in areas of expertise and invite other councils to share the resource. E.g., groundwater centre of excellence in ECAN. Suggested areas to consider for resource sharing include groundwater science, data management, mātauranga Māori, marine science etc.

Integration across priorities to goals

In setting in place the 10 research priorities it is recognised that strategy implementation needs to focus across these in an integrated way if the goals are to be achieved. The policy loop is a useful construct to evaluate the value of science undertaken to improve policy and operations implementation, and thereafter to refine science needs; i.e., a feedback loop.

Photo: Horizons Regional Council.

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Introduction

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

In the latter part of 2019, the Parliamentary Commissioner for the Environment noted that central government has not done well in this space,[3] and called for a much greater national investment and that policymakers need an improved understanding of the linkages between wellbeing and those aspects of life (such as environmental quality) that contribute to it. The PCE's summary of significant gaps in our knowledge of our environment is attached in Appendix 1 of this Strategy.

> **If there is one thing that stands out from the first cycle of [national environmental] reports, it is the extent of what we don't know about what's going on with our environment…I am particularly concerned that there is no mechanism that links the ongoing demand environmental reporting makes for an understanding of complex ecological processes that evolve over decades, and a science funding system that is constantly searching for innovation, impact and linkages to the ever-changing demands of business and society.**
>
> (PCE 2019)

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3   Focusing Aotearoa New Zealand's environmental reporting system, November 2019. Parliamentary Commissioner for the Environment. Excerpts from Overview section.

Likewise, the Office of the Auditor-General has found shortcomings and challenges in the current design and prioritisation of national environmental research funding.[4] [5]

> **I am concerned that there is not enough information about freshwater at a national level to prioritise efforts on a national basis. Decision-makers do not have the information they need to prepare a national approach or long-term strategy to this significant environmental issue.**
>
> **A detailed national-level picture of freshwater quality is central to understanding the significance of factors affecting freshwater quality and the degree to which those factors are significant to particular regions. This picture would inform the prioritisation of action to address challenges and aid effective national level planning and decision-making to support the work of regional councils in managing freshwater quality.**
>
> (OAG, 2019)

> **To effectively manage water resources, good information is essential. By good information, we mean information that is relevant, reliable, timely, accessible, and, ideally, comprehensive…during our work, we saw incomplete information about the state of our freshwater resources at a national level.**
>
> (OAG, 2020)

This is the fourth version[6] of the Regional Councils' Research, Science & Technology strategy since the first one was compiled in 2009. Over the eleven-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. Issues are hypothesized even in the absence of robust science-based definition and quantification or are determined by social media outrage as much as by robust, objective analysis.

Environmental issues are now more politically charged as the various sectors of New Zealand society jostle for their say in how finite resources should be prioritised, allocated and treated. Resource management as espoused by councils must be credible and defensible more than ever. Objectives, policies, and methods of implementation and action are expected to be evidence-based. Questions are being asked about how to measure and ensure 'sustainability', providing for the enduring value and utilisation of the natural resources with which New Zealand is endowed. For example, in the water space irrigated dairy farming has rapidly expanded in several regions, highlighting issues of the efficient and effective use of soil resources and land management inputs, and of water allocation, but also of water quality and downstream impacts. The *National Policy Statement for Freshwater Management* establishes the resolution of such questions within the freshwater domain as nationally and regionally crucial.

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), following on in turn to reviews of regional coastal

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4   Managing freshwater quality: challenges and opportunities. September 2019, Office of the Auditor-General. Excerpts from Overview section.

5   Reflecting on our work about water management. February 2020, Office of the Auditor-General. Excerpt from Section 3: Understanding of water resources need to improve.

6   Previous versions in 2009, 2011, 2016.

plans, 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 across all domains 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 recognition, understanding and encapsulation 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 in part being advanced through treaty settlement legislation and/or other negotiated agreements and understandings, which are 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 (September 2019) draft consultation document '*New Zealand's Research, Science and Innovation Strategy*' and the development of the second tranche of research investment across many of the National Science Challenges during 2018–2019 have significant implications for how science is directed, funded, and conducted, and knowledge delivered to end-users for uptake and impact. MBIE has undertaken a review of the effectiveness of the Envirolink Fund, and at time of preparation of this Strategy has indicated that the review has been positive. The Science Advisory Group is keen to ascertain whether this might lead to an expanded scope of opportunities to utilise research through this or a similar funding mechanism. Each of 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.

Timely and insightful awareness of the expanding pool of research knowledge, 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 regional sector's Special Interest Groups (SIGs, which are subject and function-based technical and policy groupings) have developed strategies and research priorities of their own that need to be communicated and implemented in a coordinated fashion. As for previous Regional Council RS&T Strategies, there will be a process to review as new drivers emerge and to implement changes in direction through the Annual Operating Plan (appended).

Purpose of the Strategy

The purpose of the Strategy continues to be to pursue and 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 since the first Strategy in 2009 as the importance of good science for council decision making becomes ever more imperative 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, including the appended Annual Operating Plan, serves as the guide to achieve the goals and objectives.

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 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 both immediate and strategic 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, to the ultimate gain of the communities that councils serve.

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 the associated 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 and intervention optimisation to be addressed.

For the purpose of this strategy, 'environment' includes:[7]

*   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.

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7   Based on the definition in RMA Section 2, and noting also this Strategy is to support and inform the functions of regional councils pertaining to the sustainable management of natural resources as described in RMA Section 31.

Vision

The Regional Council vision is to be effectively involved in the identification, development, communication and implementation of research, science and technology that will serve as a foundation for 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.

(Science Advisory Group, on behalf of Regional and Unitary Councils)

Strategic goals

The goals for the RS&T Strategy remain largely 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. 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.

Current State of Regional Council Science

Key Parties

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.

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 in the eyes of New Zealanders, 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.

Regional council collectively employ several hundreds of scientifically trained staff, across a variety of roles: compliance-focused and regional state of the environment monitoring, analysis, and interpretation; advisors to policy development, consenting, investigative, river management, biodiversity, biosecurity, and civil defence departments, and research. Expenditure within scientific fields is in the tens of millions of dollars per year. Part of the purpose of this Strategy is to seek to utilise the regional councils' collective resources in an efficient, collaborative, and appropriately targeted manner, for the benefit of the councils and the communities they represent.

Staff across regional councils join for mutual support and development in Special Interest Groups, or SIGs, each comprising officers from particular specialist disciplines. There is further information on the SIGs and their own research strategies, on pages 26 and 27, and in Appendix 3.

Impact of Covid-19

The financial and social impacts of New Zealand's response to controlling the Covid-19 outbreak are enormous and far reaching for all levels of government, business and communities. The likely consequence of this response and the outcomes is that funding for science and research will come under increased pressure and scrutiny and perhaps greater funding will go to science to strengthen community and environmental resilience and the sustainability of our society.

The 2020 Budget announced on 14 May 2020[8] provides $1.1B to create 11,000 jobs in the regions. This includes regional environmental projects ($433M), weed and pest control ($315M), "Jobs for Nature" ($200M for DOC), enhancing biodiversity ($154M). The government sees this as not only supporting people in jobs but also lending nature a helping hand. But, what is lacking in the budget announcement is any indication of investing in innovation to help the environment. There is an opportunity for Regional Councils, through the revised RS&T Strategy, to influence the science agenda to improve community resilience and sustainability of our environment and productive sectors and improve the uptake of the One Health concepts.

These opportunities are referenced in the sections that follow.

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8   https://treasury.govt.nz/publications/budgets/budget-2020

Government science funding and regional councils

NZ Science Funding Review

A recent Regional Council Science Advisory Group (SAG) review of the New Zealand science funding system found it to be considered complex and constantly changing, making it difficult for end-users of government-funded environmental and natural hazards research to fully understand the system and to respond to signals and changes as timely as they might want to.

Science collaboration between councils, CRIs and government departments has improved in recent years and there is considerably more "joined-up" science than previously. This is especially evident in the freshwater science space but also in most other science areas. There is a need for even more of this, and particularly across disciplines to tackle some of the more difficult issues, such as land-use and freshwater/ estuaries/ marine interactions. Opportunities for greater staff sharing, joint monitoring (as well as research), and data sharing and data management are seen as advantageous.

The funding review also suggested that to have greater influence over science funding and direction it would be advantageous for Regional Councils to establish a "Chief Science Advisor" role as it exists for many government departments. The goal in establishing such a position would be to directly engage in high level discussions and decision-making along with other Departmental Chief Science Advisors that influence MBIE science funding policy. For example, being involved in the MBIE SSIF Panel would seem to be particularly relevant.

Focusing Aotearoa New Zealand's environmental reporting system November 2019

In November 2019 the Parliamentary Commissioner for the Environment produced a report "*Focusing Aotearoa New Zealand's environmental reporting system*".[9]

The report was critical of how the Government currently prioritises and funds science that highlights the preference for "exciting, novel

research ahead of the collection of essential underpinning data". One of the major issues identified by the PCE is that there are large gaps in environmental data and this limits our understanding of what is happening in our environment. This could be costing the country in the form of poorly designed policies or irreversible damage to society, the economy, and the environment. A key recommendation from the PCE report was that:

> **The Minister for the Environment and the Minister of Research, Science and Innovation should jointly task their officials to report within 12 months on the best way to link New Zealand's environmental reporting system with the science system to ensure that key knowledge gaps are incrementally closed.**

Implementing this recommendation would benefit Regional Councils and the environment. The PCE report has received wide endorsement from within the scientific community of New Zealand.

The MBIE draft research Science Investment Strategy September 2019

The science funding review also concluded that the focus of the national-level science funding system has been moving away from the needs of the Regional Council sector and that shift looks set to accelerate as MBIE pushes for greater funding to "transformational science". This prediction appears to be unfolding as in September 2019 MBIE issued a draft *Research Science Investment* (RSI) Strategy for comment. As stated in the document "The purpose of the RSI Strategy is to communicate the government's objectives for RSI in New Zealand; to highlight priorities for government action within the Research, Science and Innovation portfolio; and to signal its intentions and directions."

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9   https://www.pce.parliament.nz/publications/focusing-aotearoa-new-zealand-s-environmental-reporting-system Appendix 1 of this Strategy reproduces the PCE's listing of identified knowledge gaps.

The Investment System is shown in the diagram below (note, it doesn't include Envirolink apparently because of its small size).

According to the draft RSI, the science system consists of around 20,000 full-time equivalent (FTE) researchers (not including students), around 4,000 R&D performing businesses (with many more reporting innovation), eight Universities, seven Crown Research Institutes (CRIs), and many independent research organisations, business accelerators and incubators, and other support functions. Overall investment in this system was just under $4bn in 2018, with government investment accounting for around 45 per cent of this.

The draft RSI Strategy recommends focusing investment at the "frontier" – "the leading edge of what the world knows and can do". In our Science Advisory Group submission to MBIE in November 2019 we cautioned about a strategy that focuses investment at the frontier of world knowledge,

realising that New Zealand continues to depend on its land for a large portion of its revenue and has many land-based issues still to address. We identified the need for incremental science and the transfer of scientific knowledge from research providers to assist land managers to transition to profitable but more sustainable land use. NZ has urgent problems that need to be addressed to ensure enduring land use and freshwater, as well as increasing biosecurity threats that could impact our economy (plus hazard management/ community resilience, coastal). NZ science funding needs to focus continuing effort in these areas to protect what we have and build on existing knowledge, but also to ensure a sustainable future. Our submission also emphasised that we need to safeguard long-term data collection across all environmental domains if we are to better understand the complexity of the ecosystems we are dealing with and to evolve better knowledge, models and policies to support a transition to a cleaner future.

Figure 1: New Zealand science investment (from MBIE draft Research Science Innovation Strategy September 2019)
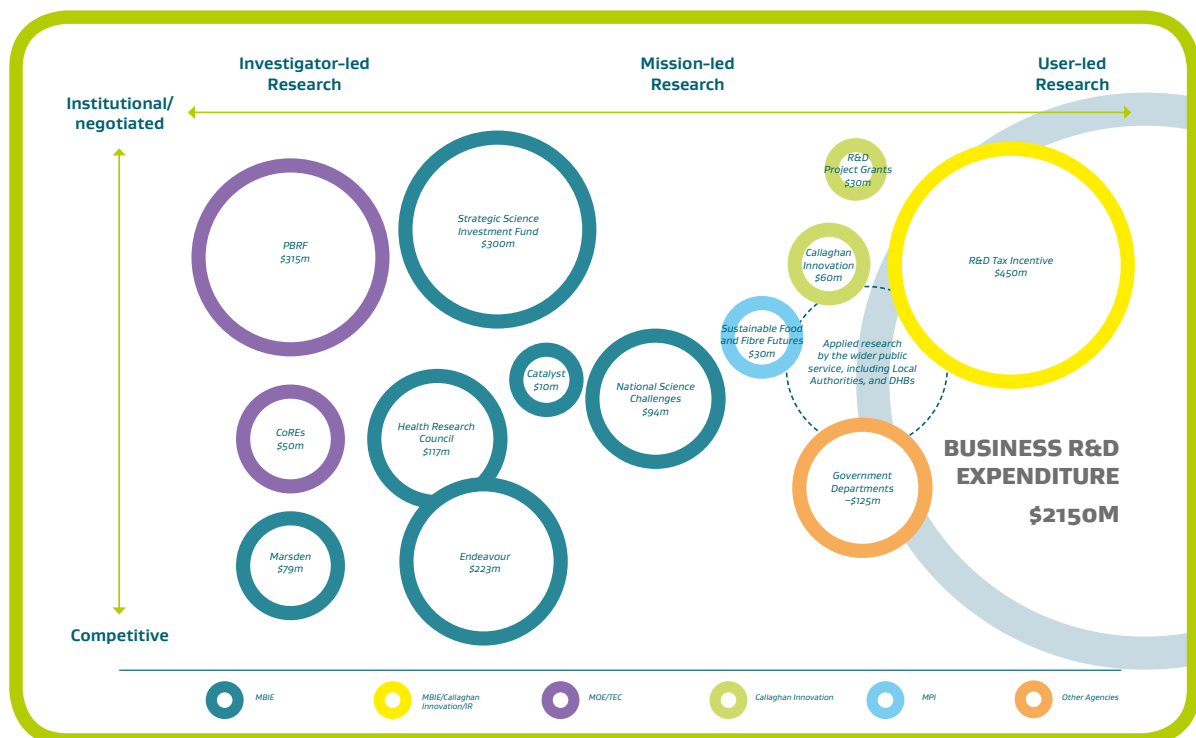
Science Funding Processes

As part of Budget 2020, the Government has announced a $299 million package over 4 years for research, science and innovation. This is targeted to assist R&D performing businesses to reduce the impacts of Covid-19 ($153M), to increase Strategic Science Investment Funds to CRIS ($79M), support databases and collections ($12M), capital investment for ESR ($25M), and expand the impact of Vision mātauranga ($33M). The Endeavour Smart Ideas fund ($18M) was cancelled by MBIE earlier in May in preparation for the new budget. Envirolink ($1.6M) continues as a funding scheme of considerable importance to Regional Councils.

The **National Science Challenges**, which were launched between 2014 and 2016, have entered their second tranche of funding to deliver on their respective goals. In general Regional Councils have struggled to make an impact and direct research across the relevant challenges primarily because of lack of resources on the council side but also in some cases because of the direction the challenges have chosen to take. The Biological Heritage NSC has taken a different approach than the other challenges and has funded several council scientists, as well as other stakeholders, to design a research programme for stage 2. Our Land and Water, Resilience to Nature's Challenges, Sustainable Seas, and Deep South have been less engaged, but are still considered important. The NSC Science for Technological Innovation has held a number of "mission labs" that council staff have attended and have made an impact.

Key Drivers for RS&T

Research strategy needs to respond to key drivers, and these change over time. The Covid-19 disease outbreak, which became a major disruptor in March 2020, is the most recent driver in a rapidly changing world and this pandemic, and the associated economic downturn will have a major impact on science investment direction in New Zealand and elsewhere.

In addition, since the last revision of the Regional Council RS&T Strategy in mid 2016 there has been a new government and a number of new policies implemented. Some of the drivers from 2016 have vanished (e.g., the Business Growth Agenda and Biosecurity 2025), but others persist and new ones have emerged. The list below identifies drivers for research both internal and external to the regional sector.

Key drivers:

- Covid-19 pandemic and associated global recession impact on environmental and science priorities in the short and longer term.
- Continually increasing public focus on the state of the environment, particularly water quality and the desire to see reversal of deteriorating trends.
- Additional national policy statements that will require environmental standards and application of scientifically robust and effective interventions at a regional level if they are to be given effect to.
- Increased 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.
- An increasingly stronger focus on freshwater management and increasing policy-based and societal expectations of councils to acquire and provide detailed and extensive knowledge of water systems and flows and proof of effective interventions.
- Need for land-use transformation, to uses that are more sustainable in the long term as well as supporting better receiving water quality outcomes. This includes achieving behavioural change.
- A greater focus on "well-being" vs economic growth alone.
- Challenges to connect all the land-use policies and transition to a lower emissions economy. Need to assess and measuring the cumulative effects of policies.
- A greater focus on environmental health (the effects of the environment on human health). Not only in the water domain but also across other domains such as air quality, contaminated land, and biosecurity.
- Increasing risk. This includes increasing risk from natural hazards, climate change, biosecurity, and social pressures. Adapting to these risks.
- Increasing recognition of the social, cultural and economic implications and consequences of our scientific research and increasing encapsulation of Mātauranga Māori in science.
- The need for ever increasing engagement with communities in decision-making and the need for greater science translation and communication.

Over the last decade 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.

The state of our environment's health

The national state of the environment report *"Environment Aotearoa"* (MfE 2019) highlighted the decline and increasing threats to our environment. Ecosystems and species are under threat, soil and water quality are degrading, waterways are polluted in rural areas, water abstraction is affecting freshwater ecosystems, and New Zealand has high per capita greenhouse gas emissions.

Since the publication of the last revision of the Regional Council RS&T Strategy there has been even greater attention to freshwater at the national and societal level.

In September 2019 MfE released the document *"Action for healthy waterways: A discussion document on national direction for our essential freshwater"*.[10] This document sets out proposals to stop the degradation of waterways and restore them to a healthy state. See further discussion under research priorities.

The DoC/MfE report 'Conservation and Environment Science Roadmap' (2017) recognised a range of challenges facing our natural heritage and resources, and set out an agenda for forward-looking, prioritised, widely adopted, and interdisciplinary research to deliver better environmental, economic and social outcomes for New Zealand.

Prime Minister Jacinda Ardern labelled 2019 as the Government's year of "delivery." A large number of the Government's initiatives relate to resource management. The most notable of those are the Action for Healthy Waterways package, a fair transition to a zero carbon economy, amendments to the RMA and also several national policy statements and national environmental standards under the RMA (e.g. NPSs on freshwater, urban development, highly productive land and indigenous biodiversity, NESs on freshwater, air quality and outdoor storage of tyres). Individually and collectively, these packages will have wide ranging impacts on many parts of regional councils' activities (e.g. environmental monitoring, data management, science investigations, policy and plan drafting, Māori engagement, communications, consents, compliance, etc). The National Policy Statement for Freshwater Management (Freshwater NPS) and proposed NPS for Indigenous Biodiversity[11] are seen as particularly key drivers for council science at national collective level and also local levels.

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10   https://www.mfe.govt.nz/publications/fresh-water/action-healthy-waterways-discussion-document-national-direction-our

11   https://www.mfe.govt.nz/publications/biodiversity/draft-national-policy-statement-indigenous-biodiversity

Post the October 2020 General Election, we can expect further progress on:

- A review of the Resource Management System,

- Three Waters review

- science discussion on DIN and DRP attributes for the Freshwater NPS

- finalisation of a revised New Zealand Biodiversity Strategy and preparation of its implementation plan to achieve various goals by 2025 and 2030

- finalisation of NPSs for Indigenous Biodiversity, Highly Productive Land and Urban Development;

- initiation of a review of the 2010 NZ Coastal Policy Statement,

- release of the first National Climate Change Risk Assessment, and then followed by the first National Climate Change Adaptation Plan

- plus a range of matters arising from second tranche of National Science Challenge programmes.

Environmental monitoring

The PCE report on environmental monitoring *"Focusing Aotearoa New Zealand's environmental reporting system"* (November 2019) was critical of New Zealand's broader environmental data and knowledge system, which it described as "largely fragmented with many providers gathering environmental information for a variety of purposes". It also referred to the country's national environmental reporting as a "passive harvest" system and makes recommendations on how this could be improved highlighting the need for active information gathering. This involves development

of a more comprehensive, nationally coordinated environmental monitoring system.

"This initiative should include:

- the development of a dedicated set of core environmental indicators for the purposes of national environmental reporting, along with –

- the design of a national-level monitoring network, and –

- the development, specification and mandating of consistent data collection standards.

This will ensure New Zealand has a comprehensive and representative national monitoring system with a standardised and consistent approach to collecting, managing and analysing data."

The report also identified data and knowledge gaps and mapped these against the priority environmental issues identified in Environment Aotearoa 2019 (see Appendix 1). These are very relevant to this strategy.

Increased focus on Wider Wellbeing

The Government's 2019 "**Wellbeing Budget**" represents a shift away from a focus primarily on sustainable economic growth and includes other factors that also affect people's wellbeing. A component of the budget is to transform New Zealand's economy and this focus is very relevant to the revised Regional Council RS&T Strategy. The budget recognises that New Zealand has one of the highest emissions of greenhouse gases in

CREATING OPPORTUNITIES FOR PRODUCTIVE BUSINESSES, REGIONS AND IWI AND OTHERS TO TRANSITION TO A SUSTAINABLE AND LOW-EMISSIONS ECONOMY

HIGHLIGHTS

| Over $1b boost in funding for KiwiRail | Helping farmers with the climate change challenge by investing in scientific research | Encouraging sustainable land use with a $229m package | Freshwater focus improving water quality in at-risk catchments |

The Wellbeing Budget May 2019, page 85

the OECD; that the quality of our waterways is not as good as it should be; that soil erosion at 720 tonnes per square kilometre is affecting both land productivity but also aquatic environments; and that our level of waste production has increased substantially since 2013. In particular the Government wants to see New Zealand transition to a sustainable and low-emissions economy.

Environmental health

Environmental health (the impacts of the environment on human health) has increased in significance and is highlighted in the Health Research Council's research prioritisation framework (December 2019).[12]

For Regional Councils environmental health science interests include drinking water source protection, recreational water quality, cyanobacteria, contaminated land, and air quality issues. Many of these also highlighted in MfE's *"Action for healthy waterways"*.[13]

Need to respond to climate change

The Climate Change Response (Zero Carbon) Amendment Act (November 2019) provides a framework by which New Zealand can develop and implement clear and stable climate change policies that contribute to the global effort under the Paris Agreement to limit the global average temperature increase to 1.5° Celsius above pre-industrial levels. This has significant implications to land-use and land management as in the first phase it will likely mean greater tree planting, and in subsequent phases a reduction in methane-producing land uses (i.e., cows). Under the Act the Climate Change Commission was established in December 2019 and as well as monitoring the implementation of national adaption plans it has the power to seek information on how organisations are identifying climate risks and preparing to adapt.[14]

Regional Councils needs to anticipate that they may be called on to assist with implementation and therefore should identify and seek to fill knowledge gaps in advance. In addition, they need to understand how this requirement relates to those under the RMA and other legislation including the management of significant risks from natural hazards etc.

Increasing risk

Increasing risk covers all kinds of risk including risk from natural hazards, climate change, biosecurity (including human pandemics) and social pressures. For New Zealand we have been conditioned to think of a natural event, like an earthquake, as potentially having a major impact on our society than a pandemic, although the warnings have existed for decades and even longer that a new pandemic was on the cards. In fact it has been suggested that Covid-19 is just a practise run for the "big one" and that we should use the current crisis to better prepare.[15] It is an opportunity for Councils to revisit their scope and role in managing risks and building community resilience.

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 Bio-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.

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12   https://www.hrc.govt.nz/sites/default/files/2020–01/NZ%20Prioritisation-Framework-FA-web_0.pdf

13   https://www.mfe.govt.nz/publications/fresh-water/action-healthy-waterways-discussion-document-national-direction-our

14   https://www.mfe.govt.nz/climate-change/climate-change-and-government/adapting-climate-change/adaptation-and-central

15   https://www.odt.co.nz/star-news/star-national/not-big-one-virologist-says-prepare-worse

Mātauranga Māori

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.

Mātauranga Māori has been defined, framed, and operationalised with varying success by Institutions. Although the overall definitions vary somewhat, the general premise is that these government agencies acknowledge that mātauranga Māori is Māori-specific knowledge that is adaptive and regionally distinct. This recognition is important as it reinforces the notion that Māori are not a homogenous group, and that mātauranga Māori will differ across Iwi.

For the vast majority of institutions, improving their understanding of mātauranga Māori is an important strategic aim that can help guide their decision making, management, and monitoring procedures. Achieving this aim helps recognise the innovative potential of Māori knowledge, its contribution to council activities, and the usefulness of culturally appropriate data.[16]

Covid-19 and economic impacts

It is difficult to speculate exactly how the impact of Covid-19 on the economy will unfold but there is no doubt it will be very significant.[17]

The other drivers discussed above will not disappear, but it is highly likely that economic recovery will take priority over environmental protection, although the government included $1.1B in the 2020 Budget for environmental projects with the aim of creating 11,000 jobs.

Globally Covid-19 has become a key driver for public health research and the development of testing kits, vaccines, and other measures to combat pandemics. In fact in New Zealand we are seeing science and technology that is regularly used in environmental monitoring now being modified to help combat this new pandemic by developing new tracking systems.[18] This will undoubtedly have spinoffs for environmental health research as technology developed for Covid will be able to be applied elsewhere. But in the meantime, it is highly likely that research to help lessen the impact of Covid-19 will reduce the amount of resources for other research areas.

16   https://researchcommons.waikato.ac.nz/bitstream/handle/10289/12192/How%20institutions%20frame%20ma%3Ftauran%20ga%20Māori_Final%20January%202017.pdf?sequence=2&isAllowed=y

17   https://treasury.govt.nz/publications/tr/treasury-report-t2020–973-economic-scenarios-13-april-2020

18   https://www.newshub.co.nz/home/new-zealand/2020/04/coronavirus-new-zealand-scientists-pioneer-wastewater-testing-to-track-covid-19-s-prevalence.html

Critical RS&T Opportunities for Councils

Critical opportunities:

- Building on opportunities in environmental innovation to make best use of the $1.1B for environmental projects and job creation announced in the 2020 Budget.
- Ensuring council priorities are recognised in the Government's science investment plan. This includes convincingly demonstrating the value of long-term research and datasets,
- Potentially partnering with the Health Research Council in "environmental health" research. This includes building on opportunities arising from the Covid-19 pandemic.
- Partnering with Māori to identify opportunities to apply mātauranga Māori (MM) to environmental understandings and issues alongside western science. Potentially building on the $33M for expanding MM identified in the 2020 Budget.
- Realising the opportunities in Tranche 2 of the National Science Challenges to help formulate research, contribute to specific projects, and ensure that knowledge is effectively transferred to contribute to decision-making and policies. The challenge for the councils is to resource this opportunity.
- Recognising and promoting the importance of soil management and research. Working with MfE and MPI to influence Government science funding.
- Inclusion of community values with physical science in research planning, priorities and outputs.
- Ensuring effective RS&T knowledge transfer to councils, including application of natural hazards science. Funding for tools to implement such knowledge.
- Identifying, coordinating, and/or leading new research programmes funded from external as well as council resources.

Influencing Government science funding/research providers

Government is signalling that any investment will be guided by themes of science excellence, impact, and connection, if it is to be considered as demonstrating significant benefit to New Zealand. It is also signalling a funding shift away from land-used and the biophysical environment, less emphasis on long-term environmental data sets, and less funding for applied science that addresses the real environmental issues. A critical issue is ensuring council priorities around incremental science and relevance to immediate or short-term application are recognised in the Government's science investment plan. Long-term research providing enduring datasets has proved invaluable to councils, and the PCE and OAG have highlighted their importance 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.

Health Research Council and environmental health

The Science Advisory Group science funding review identified an opportunity for Regional Councils to align with the Health Research Fund ($120M/year) in the area of environmental health (i.e., those aspects of the environment that have effects upon human health and wellbeing). SAG is currently investigating an opportunity to develop a research partnership with the Health Research Council in environmental health to realise the mutual benefits of conducting research in this area.

Covid-19

The Covid-19 crisis has highlighted the importance and benefits of working in collaborative, multisectoral, and trans-disciplinary ways to tackle the pandemic. But a wider opportunity exists to take this further towards the 'One Health' concept to ensure the ongoing health of people, the environment and its animals. Covid-19 has already identified opportunities to use environmental monitoring technology (eDNA) to potentially identify communities with the disease by monitoring wastewater. Councils have both a role and opportunity to link across disciplines and sectors to influence researchers and science funders to this wider concept.

> One Health is a collaborative, multisectoral, and trans-disciplinary approach – working at local, regional, national, and global levels – to achieve optimal health and well-being outcomes recognizing the interconnections between people, animals, plants and their shared environment.[19]

One Health is "the collaborative effort of multiple disciplines - working locally, nationally and globally- to attain optimal health for people, animals and the environment.
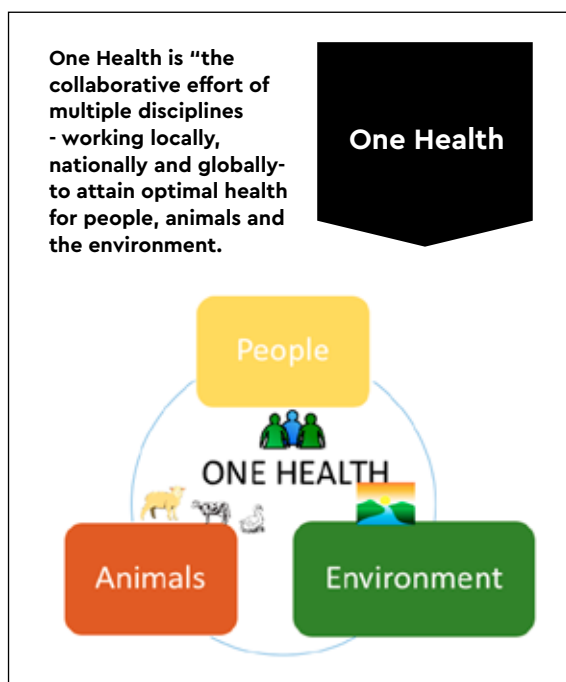
Partnering with Māori to identify opportunities to apply mātauranga Māori

The need for more understanding of Māori values, and to bring a wider Māori perspective into environmental planning, policy and implementation, is well recognised by Councils and "Mana Māori" is a key value in the 2019 Regional Sector Business Plan (Oct 2019), i.e., "recognising and promoting the important role of tangata whenua". It is realised that this is not an easy task to merge an indigenous knowledge system with western science, but New Zealand is well placed to see this happen.

> The interface of science and Indigenous knowledge is an obvious area where Aotearoa New Zealand is genuinely unrivalled. Mātauranga Māori – defined as Māori knowledge, Māori methods of knowledge creation, and Māori ways of knowing (Mercier & Jackson, this issue) – is the Indigenous knowledge system of this land. [However] One of the barriers is an inadequate understanding of Mātauranga within the broader science community.

Juliet Gerard and Tahu Kukutai (Foreword to New Zealand Science Review Special issue – Mātauranga and Science Vol 75 (4) 2019"

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19 https://www.onehealthcommission.org/en/why_one_health/what_is_one_health/

Photo: Waikato Regional Council

Involvement in National Science Challenges

Councils continue to have an excellent opportunity in the National Science Challenges to help formulate research, contribute to specific projects, and ensure that knowledge is effectively transferred to contribute to decision-making and policies. However, while the opportunity for council involvement in the NSCs 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.

Soil management and research

New Zealand is starting to take soil science more seriously than in the past. Following the publication of MPI's report "*Future requirements for soil management in New Zealand*" in 2015 there has been increased attention to the need for greater efforts in soil management and research including an MfE report in 2018 *"Our Land 2018"*. This report recognised the significant shifts that have occurred in land use in recent decades, the high amount of soil erosion from grassland, and the impact on farming intensification on soil quality indicators, and that indigenous biodiversity and ecosystems continue to be under threat. In 2019 MfE and Stats NZ published "Environment Aotearoa 2019" which recognised nine priority issues in need of attention including soil degradation and the reduction in versatile land. In addition in 2019 MPI and MfE released a discussion document "Valuing highly productive land" calling for submissions on the proposal to develop a *National Policy Statement on Highly Productive Land* (NPS-HPL). The Land Monitoring Forum SIG strongly supported the overall intent and purpose of the proposed NPS and submitted advice to MfE on how to define and identify highly productive land.

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.

Ensuring effective knowledge transfer and uptake

Knowledge awareness and 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

Opportunities to submit on Government science policy and initiatives have 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.

Special Interest Groups (SIGs) with a science focus have developed their own research strategies and have identified critical issues and research needs.[20] The following Special Interest Group science strategies are available, or will soon be available, at (www.envirolink.govt.nz/Research-Strategy/).

- National Air Quality (planning to update)
- Groundwater Forum (plan to update 2020/21)
- Land and Soil (updated 2018)
- Biosecurity & Biodiversity (being updated in 2020)
- Coastal
- Regional Policy Managers
- Natural Hazards
- River Managers (near final draft as of June 2020)
- Contaminated Land and Waste (June 2020)
- Surface Water Integrated Management (November 2020 and science priorities to be written in 2021)

SIG strategies and research priorities are linked to the umbrella Regional Council RS&T Strategy. Readers are directed to the URL (http://www.envirolink.govt.nz/Research-Strategy/) to drill down into specific detail for each SIG.

Photo: Waikato Regional Council

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20   See www.envirolink.govt.nz/research-strategy/

Strategic Priorities

This Regional Councils' *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.**

This has identified, in no particular order, 10 key priorities for the Regional Council Research Science & Technology Strategy:

1. **Influencing government science direction**
2. **Incorporation of mātauranga Māori**
3. **Better science utilisation**
4. **Enhancing policy effectiveness**
5. **Integrating land and water science for enhanced sustainable production**
6. **Improving biosecurity and biodiversity**
7. **Better hazard risk management**
8. **Improving coastal management**
9. **Cross-cutting themes: Adaptation and mitigation to climate change and improving data management**
10. **Retaining and building science capability and capacity**

The recent (October 2019) Council-driven Regional Sector Business Plan identifies six strategic priorities that underpin the sector's work: Science, Data and Information, Reputation and Relevance, Climate Change Adaptation and Mitigation, Freshwater, the 'Health of the Sector' and Advocacy, Partnerships and Relationships. As stated in the business plan *"these Strategic Priorities emphasise the collective set of outcomes we have committed to focussing on as a Sector. They also provide direction to our partners (central government and other stakeholders) as to where the Sector is channelling its resources and efforts."*

The goals and priorities of this Strategy are aligned with the strategic priorities of the Regional Sector Business Plan and provide more detail around science priorities.

In developing their research strategies 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 by multiple parties. 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. The priorities in these SIG strategies have been captured into this strategy. They are presented in no particular order.

WHAT ARE THE REGIONAL SECTOR'S KEY PRIORITIES?	1. CLIMATE CHANGE ADAPTATION AND MITIGATION	2. FRESHWATER	3. SCIENCE, DATA AND INFORMATION
	• Preparing the Sector to mitigate and adapt to the impacts of climate change on the natural environment. • Working with our partners and central government agencies on policy initiatives to address these effects. • Imbedding strategies for addressing climate change adaptation and mitigation across all strategic priorities.	• Ensuring sector views and expertise continue to be included in the highest-levels of decision making. • Continued involvement in the Essential Freshwater (EFW) policy package, the 'Rural package', Three Waters and related workstreams. • Readying the Sector for implementation requirements resulting from new policies and rules.	• We are the critical data holder for New Zealand's natural resources, and we collect, collate and produce a significant amount of information. • Ensuring the Sector's data and information plays an integral role in national policy development. • Improving the performance of the Sector as to how we collate and deliver data to the public and our partners. • The Sector progresses from being end users to partners with central government and research providers.

Rapid response to immediate issues as they emerge

HOW WE WILL IMPLEMENT THEM?	
	4. ADVOCACY, PARTNERSHIPS AND RELATIONSHIPS
	• Recognising the importance of relationships with iwi/hapū/Māori, communities, our partners and central government. • Nga Kairāpu ("the truth seekers") SIG recognises that the strengthening partnerships between the Crown and Māori requires the Sector to be more responsive to iwi, hapū and other Māori communities. • Continual advocacy of regional sector issues at central government level. • Provision of strategic and tactical advice to central government on natural resources and transport policy issues.
	5. REPUTATION AND RELEVANCE
	• Idenitifying platforms from which reputation and relevance of the Sector to our stakeholders, communities and central government can be built. • Enhancing the perception of our activities, functions and performance – so that we are viewed as a trusted and valued partner. • Lifting the way in which the Sector communicates its activities and functions.
	6. THE 'HEALTH' OF THE SECTOR
	• Recognising that our people are our greatest asset. • Bolstering existing capacity and capability. • Idenitification of skill shortages and gaps in the sector and strategies for addressing these. • Focus on initiatives that will lift the performance of the Sector including the introduction of new technology and tools. • Recognising the important role that strategic sector leadership and communication must play in ensuring the Sector functions effectively.

RCEOS Business Plan – November 2019.

PRIORITY 1

Influencing government science direction

Government invests about $1.6b/yr in science, but this investment system is complicated, constantly changing, and tending to focus away from core regional councils needs to new 'transformational' research.

For Regional Councils there is strong need for science investment to be nimble and match policy needs and respond to changing policy drivers.

There is a need to maximise Regional Councils influence over government science direction and spending to ensure our sector can function effectively and achieve the required outcomes for environment and community, by:

- Contributing to government science policy and in particular MBIE and HRC strategies.
- Maintaining a close dialogue with the Prime Minister's Chief Science Advisor and those of key government departments.
- Continuing to contribute to government department science strategies, particularly MfE, DOC, MPI.

This priority recognises there is an important need to ensure that science investment is matching policy needs and responding to the country's policy drivers. The need is not only to influence investment but also the science view around policy need and recognising that needs change. It is important that we keep an eye on the future to ensure our science responds early to inevitable change. Central Government science leadership is required particularly in the complex area of land use and water quality but other priority areas as well, as described in this document below.

The Government currently invests in the order of $1.6 billion/year in science through various funding mechanisms. Regional Councils need a strong and coordinated voice to influence science direction to ensure that excellent science is focussed on priority topics.

New Zealand's science investment system is complicated and constantly changing leading to considerable uncertainty for stakeholders and particularly scientists. The Regional Councils through the Science Advisory Group (SAG) have not been consulted as much as is desirable to have an influence in how science is being directed, despite

repeated requests to MBIE. Recently (September 2019) MBIE released a draft *Research Science and Innovation Strategy* for consultation. The SAG's submission (November 2019) was particularly critical of the proposal to shift funding away from areas of most relevance to Regional Councils (and the country's primary sectors) to "transformational research" where MBIE sees opportunities to lead the world. Over the last few years it has become apparent that Regional Councils can have much greater influence on central government science policy if a Chief Science Advisor position was established to represent Regional Councils' interests at the Prime Minister's Chief Science Advisor Forum. A proposal has been submitted to Regional Council CEOS for consideration.

As stated in the recent (November 2019) PCE Report *"Focusing Aotearoa New Zealand's environmental reporting system"*: [21]

"The way we fund the collection of environmental data at a national level suffers from at least three main problems:
- A preference for funding exciting, novel research ahead of the collection of essential underpinning data.
- The stagnation of datasets due to a lack of proper maintenance.
- A lack of secure ongoing funding for important new datasets."

Currently there are very significant science issues around the "essential freshwater package" requirements, in particular, understanding the effects of land use on multiple ecosystem health attributes and the development of cost-effective ways to monitor these. The OAG has recently noted[22] *'We consider that the Government and New Zealanders need a detailed national picture of freshwater quality to help develop national-level freshwater quality policy and to monitor the effects of that policy over time. No public organisation has accountability for developing a strategy to address shortfalls in information about our freshwater quality at the national level, to consider how it will be funded, and to decide what systems and tools are needed to collect quality data'.*

There is insufficient strategy thinking and leadership now on this and other science areas and there needs to be co-leadership between Regional Councils and MfE. Greater Regional Council influence of science direction is required.

Looking forward, if the Regional Council sector is to function effectively and achieve the required outcomes for environment and community, they will need to maximise their influence over government science direction and spending. This influence will be achieved by:

- Contributing to government science policy and in particular MBIE and HRC strategies.
- Maintaining a close dialogue with the Prime Minister's Chief Science Advisor and those of key government departments.
- Continuing to contribute to government department science strategies, particularly MfE, DOC, MPI.

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21   https://www.pce.parliament.nz/media/196940/focus-ing-aotearoa-new-zealand-s-environmental-reporting-sys-tem.pdf
22   https://www.oag.govt.nz/2020/water-management/docs/water-management.pdf – page 14

PRIORITY **2**

Incorporation of mātauranga Māori

Regional councils to:

Prioritise the bridging of mātauranga Māori alongside western science to support diverse knowledge and information systems that inform planning, policy and management.

Increase Māori engagement and participation through a bicultural approach to using and understanding knowledge systems that include mātauranga Māori and Te Ao Māori perspectives.

Key activities to advance the use and understanding of mātauranga Māori next to Regional Council science, planning and policy can include:

- Developing regional objectives and goals that are informed by diverse knowledge systems and perspectives.
- Engagement and collaboration with Māori (e.g., iwi/hapū) on projects and activities that include mātauranga Māori (e.g., Māori environmental frameworks) alongside of science.
- Collectively understand complex issues (e.g., environmental, social, cultural) using mātauranga Māori and science to achieve desired or agreed management outcomes.
- Investigating processes to co-develop appropriate regional monitoring programmes and indicators that achieve desired or stated outcomes.
- Understanding mātauranga Māori and perspectives alongside of science to support community discussions, advice, and decision making.

The bridging of mātauranga Māori (Māori knowledge) alongside science is seen as a priority to answer complex questions, find holistic solutions, and achieve good environmental outcomes for Regional Councils. Drawing on and understanding mātauranga Māori alongside science creates an important Treaty perspective (to date often lacking) to inform effective regional council planning and policy.

Adding the Māori perspective from Te Ao Māori will greatly contribute towards further emphasis on effective relationships and ultimately partnerships with hapū/iwi Māori. This is an evolving area of work that needs additional science support and coordination to provide the required knowledge and tools for effective implementation.

Across most SIGs, including an understanding of mātauranga Māori with distinct examples alongside science will elevate the quality of discussions, engagement, and advice at the community level and is seen as a high priority. For example, the 2018 combined Land Monitoring and Land Managers SIG's new roadmap for 2018–2020 recognised that there are numerous drivers that stress the need to increase Māori engagement in discussions

Waitangi treaty grounds in Paihia.
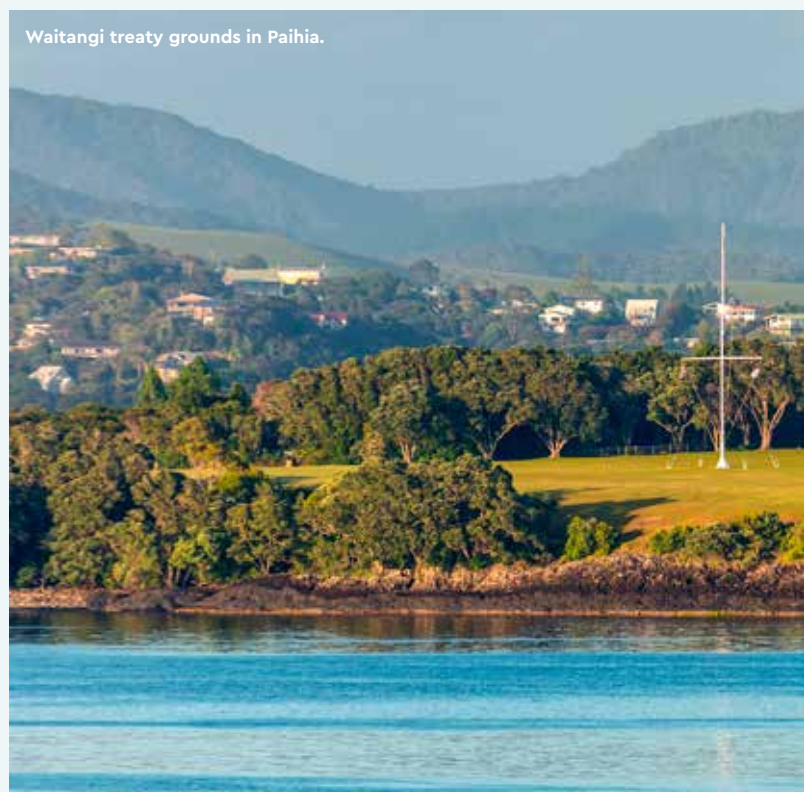
around the dimensions of land (whenua) soil (oneone), and water (wai) within taiao (the wider environment), especially in terms of land management to help facilitate the increasing need to make the mainstream shift from "ownership to stewardship" and to recognise and understand the inter-generational principles of kaitiakitanga and other important values. These drivers include: the Environmental Reporting Act 2015; the Future Requirements for Soil Management in New Zealand 2015; etc.

MBIE's recent (December 2019) review of the Envirolink scheme (para 180, 2019) highlighted the importance of Māori knowledge transfer:

> **An untapped opportunity is for Envirolink to support knowledge transfer of environmental mātauranga Māori: In general, respondents recognised a need for mātauranga Māori to become more integrated into regional council planning and policy development, and the evaluators received feedback about this.**

Challenges remain in staying abreast of current Māori research, in facilitation of understanding by environmental managers and scientists, and of how to include mātauranga Māori based perspectives next to science and other knowledge systems. A key objective is that Māori research can be explained, and better understood and incorporated into regional council work programmes, in particular to address key priorities and issues of relevance to regional councils, such as, plan changes, Treaty settlements, regional economic growth strategies, vision statements and regional development initiatives, and response to national policy, goals and strategies.

Advancing the incorporation of mātauranga Māori into regional council science, policy and decision making requires increased coordination of existing research, additional research capacity and development of indicators/frameworks that can be readily used by Councils. Currently there are few Māori researchers to provide environmental mātauranga Māori advice and to support the needs for further science research.

Some key focus areas for mātauranga Māori Research are:

- Provide lessons where mātauranga Māori and science have been used collectively to understand environmental issues and develop management outcomes.
- Investigate processes to co-develop appropriate indicators and supporting monitoring programmes for Māori environmental frameworks.
- Determine the generality and applicability of currently developed indicators (such as, but not limited to, Cultural Health Indices).
- Increase the capacity of Māori researchers to provide environmental mātauranga Māori advice.

PRIORITY 3

Better science utilisation

This priority recognises that it is not always more science that is needed. Extracting more value from better utilisation of existing and new science is an opportunity that needs to be taken.

The identification, collation, and consistent application of existing science to support Regional Councils needs has been supported through Envirolink funded projects, but there is further demand and opportunity.

Driving better utilisation of existing and new science will be advanced by:

- Facilitating better access to NZ and overseas research results to incorporate into decision support tools/processes.

- New mechanisms 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.

- Consistency in application of basic tools that can be applied across all regions.

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. Improving the utilisation and extracting more value from existing science and optimising the uptake of new science is seen as a priority opportunity for Councils.

It is not always more science that is needed but in many cases better utilisation of existing science. In particular, experience has shown that the most useful resource management tools are those that are the most basic ones that all councils can use. Ideally tools will be consistent in methodology, in their messaging, and in being able to accommodate the sheer diversity of Regional Council environments. One model is unlikely to fit all purposes, but at least the approach to utilising and interpreting the model should be consistent.

Photo: Horizons Regional Council.

A challenge for all research providers and users is ensuring value is gained from any research effort. Better utilisation of science requires the application of research to collate existing threads together into forms or tools that are useful, and to understand why some science uptake is low and how to reduce the identified barriers.

In particular, in this priority research area, there are three 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 risks, and including:

    o 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.

    o 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.

3. Understanding the barriers to research uptake and identifying methods to improve utilisation of science and information.

PRIORITY 4
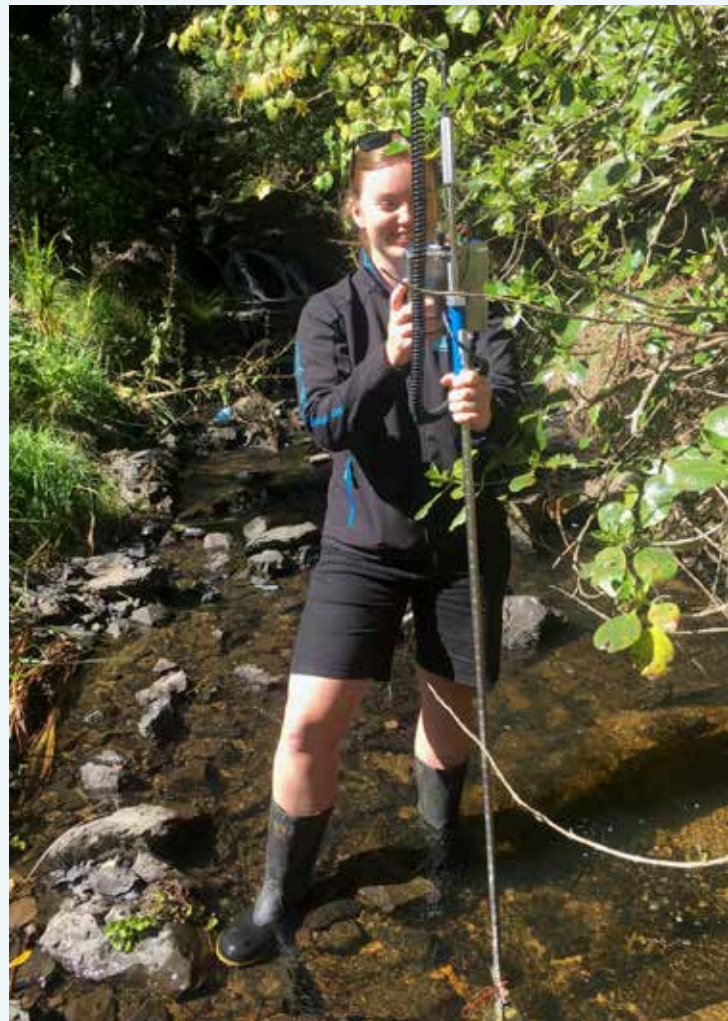
Enhancing policy effectiveness

Councils need better approaches to assess the effectiveness and efficiencies of their policies across both the full range of environmental/community outcomes and Councils wide scope of practice.

Further research is required to develop and improve the application of policy development methods, tools and processes used for the design and evaluation of policy and for other decision responses to environmental management issues.

Research for enhancing policy effectiveness needs to focus on:

- 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.
- Design and evaluation of allocation policy taking consideration of dimensions of values and varying environmental situations.
- Design and evaluation of legal policy instruments that can be crafted into workable and acceptable policy responses.
- Social processes for iterating problems and solutions development and delivery.

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.

The policy-relevant research needs are focused on improving the environmental management across both the full spectrum of environmental outcome areas (air, land, water, coast etc) and the wide scope of practice (evaluating/monitoring, policy development, implementation and review).

This breadth of interest requires research that integrates across disciplines and is focused on the tools and processes of environmental management rather than the supporting science required to inform such management.

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.

Key focus areas include:

- Defining 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.

- Design and evaluation of allocation policy or other decision options which consider the relevant dimensions of value within plausible widely varying environmental situations.

- Design and evaluation of policy instruments 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.

- 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.

Photo: Horizons Regional Council.

PRIORITY 5

Integrated land and water science for enhanced sustainable production

A more integrated management approach supported by good science to fill knowledge gaps is required to meet the significant challenges Councils face with land and water management.

This is an evolving priority area with increasing resource use pressure and new legislation requiring implementation.

There is an urgent and long-standing need for improved land use information to facilitate progress.

A number of research gaps have been identified by national and regional advisory groups.

Some key research needs in this area are:

- 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.

- 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.

- Improving understanding of 'land–surface water-groundwater–surface water' interactions to provide tools for determining land-use effects, and to help better understand the vulnerability of groundwater to land use and establish ecologically sustainable.

- 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.

- Identifying future land use options to realise greater co-benefits, increase landscape resilience and grow productive value and understand the transitional requirements to implement these options.

- Evaluate different land management practices against major land use effects (e.g. nutrient leakage, erosion, soil contamination), and the policy approaches used to manage them.

- Improving understanding of the land-freshwater link to marine receiving environments, and particular environments, such as coastal wetlands and estuarine environments.

- Understanding the wider benefits (ecological, productive and community) that can be achieved through integrated catchment management policy and practices and how these can fit within property scale sustainable land use practices.

- Increased understanding of the implications of climate change on land use and integrated land/water outcomes and how such changes impact downstream ecosystems, values and risks.

- Enhance the coverage, quality, and interoperability of soils information and improve performance of outcome (erosion/sediment, nutrient) modelling.

The integrated management of land and water to provide for enhanced sustainable production, meet the requirements of adjacent and downstream ecosystems, and supports the values of iwi and wider community is one of the greatest challenges facing Regional Councils. There are a significant number of research needs within this priority area.

The Science and Technology Advisory Group (STAG) that provided advice to the MfE "*Action for healthy waterways*" document provides a list of key knowledge gaps that currently constrain our ability to effectively manage freshwater and the health of freshwater ecosystems:

- Ecological flows (variability and minimum flows) for rivers and levels for lakes, wetlands and groundwater.
- Guidelines for the management of recreational waters.
- Toxic cyanobacteria in rivers, monitoring methods, tools for and evaluating risks, and thresholds for management action.
- Understanding and protecting groundwater quality, which is a need that goes well beyond simply preventing nitrate-nitrogen elevation in spring-fed streams and rivers.
- Nationally consistent methods for monitoring compulsory values, guidance on the design of systems for data generation and analysis and applied science to describe what is required to lift ecosystem health to meet community objectives and support adaptive management.

The document also includes a list of areas requiring additional work including: New and emerging contaminants; Ecosystem metabolism; Lake mid-hypolimnion conditions; Wetland hydrology, mapping (delineation and condition) and attribute break points at different scales; 'Source to sea' understanding of sediment transport; Threatened indigenous aquatic species (not included in the NPSFM); Invasive species, (not addressed by the NPSFM); Physical habitat; Fish passage; Sediment-bound phosphorus and its role in controlling periphyton/macrophyte growth; Biotic indicators of ecosystem health, especially in lake environments. These are all relevant to Regional Council science needs.

Currently there are very significant science issues around the "essential freshwater package" requirements, in particular, understanding the effects of land use on multiple ecosystem health attributes and the development of cost-effective ways to monitor these. The issue was also highlighted in the PCE Report (November 2019)[23]:

> *"As recently as June this year (2019) the Government's Freshwater Science and Technical Advisory Group called for urgent work to fill the identified knowledge gaps that currently constrain our ability to effectively manage freshwater and the health of freshwater ecosystems".*

The report also recognised that the need for urgent work goes beyond freshwater and highlighted the need to fill knowledge gaps around soil health etc.

> *"Fundamental knowledge gaps around soil health, including the factors that affect soil structure and functioning under different land uses, are particularly worrisome – soil is one of our greatest assets, and it is also a non-renewable resource."*

There is insufficient strategic thinking and leadership now on this and other science areas and there needs to be co-leadership between Regional Councils and MfE. Greater Regional Council influence of science direction is required.

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,

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23   https://www.pce.parliament.nz/media/196940/focusing-aotearoa-new-zealand-s-environmental-reporting-system.pdf

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 Regional Groundwater Forum 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.

The need to change to more sustainable land use is recognised and highlighted in the *Our Land and Water National Science Challenge Strategy*.[24]

> **The change imperative. In all facets of the Challenge's work, we are acutely aware that change is coming, and coming fast. Accelerating rates of climate change are driving a fundamental rethink of global foodways, including the rapid rise of animal-free proteins. Moves toward a global bioeconomy are gaining pace. It is a law of both ecology and economy that change must be met by change, and the risk for New Zealand is that we may mistake our geographical isolation for insulation from global threats, and therefore a feeling that we can 'buy time.' Such thinking would be a mistake.**
>
> **The message is that the physical and biological environment will no longer be picking up the tab for unsustainable farming practices.**
>
> **This is the economic and political context in which the Challenge exists. Our vision is large, our motivation is strong, and our strategy is tested. We are ready to take it to the next level of effectiveness, excellence and impact.**

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24   https://ourlandandwater.nz/wp-content/uploads/2019/02/OLWStrategy2019–2024.pdf

Progress is being made, for example *"Defining the key environmental qualities of New Zealand products has clarified what sustainable production means to our markets and helped refine the Red Meat Story of Beef and Lamb NZ"*. However, to ensure New Zealand's primary producers are well-rewarded for producing high-value products in sustainable ways much more research is required as identified in the OLW Strategy (page 18).

A significant gap identified is the 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.

Also required is 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.

A key requirement for integrated land and water management is the concept of "managing within limits". This concept needs to be explored 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.

In addition to research needs, and to facilitate change and improved water quality, there is an urgent need for better land-use information. There is currently a lack of consistent, accessible, and up-to-date spatial land-use information at an appropriate scale of resolution, e.g., regional land-use maps that are regularly updated. This gap will remain a 'hand-brake' on the implementation/application of some of the land and water research priorities listed in the strategy until the issue is resolved.

Other priorities for integrated land and water research include (Based on Land (2017) and SWIM and River Managers (draft) strategies):

- Identifying future land use options to realise greater co-benefits (ecosystem services, community values), increase landscape resilience and grow productive value, and understand the transitional requirements to implement these options.
- Evaluate different land management practices against major land use effects (e.g. nutrient leakage, erosion, soil contamination), and the policy approaches used to manage them.
- Improving understanding of 'land–surface water-groundwater–surface water' interactions to help establish ecologically sustainable limits for nutrients and water use, and to better understand the vulnerability of groundwater to land use.
- Enhance the coverage, quality, and interoperability of soils information and improve performance of outcome (erosion/sediment, nutrient) modelling.
- Understanding the wider benefits (ecological, productive and community) that can be achieved through integrated catchment management policy and practices and how these can fit within property scale sustainable land use practices.
- Increased understanding of the implications of climate change on land use and integrated land/water outcomes and how such changes impact downstream ecosystems, values and risks.
- Assessment of the implications of increased competition for land and water use to ensure sustainable outcomes and optimal achievement of community needs.

PRIORITY 6

Improving biosecurity and biodiversity

Regional biosecurity faces significant challenges in managing existing animal and plant pests and preventing further pest incursions to protect our terrestrial and aquatic biodiversity and productive land uses.

The key research needs for this priority include:

- 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.
- Productive land management options to enhance biodiversity.

The issues and threats posed by current biosecurity challenges and potential new introductions have significant consequences for our productive land uses and native biodiversity.

Our national biodiversity values are under pressure and are in decline in many areas. The impacts on biodiversity are closely related to biosecurity capability and actions. The pressure of intensifying urban and rural land uses is also impacting on biodiversity outcomes and mitigation of this link to the integrated management of our land and water resources.

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 prioritisation – 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.

The Biomanagers SIG is currently updating their science roadmap (as of September 2020).

PRIORITY 7

Better hazard risk management

Regional hazard risk management requires councils to identify the full range of hazards and development risk management approaches to these with their communities.

Focus areas to provide better hazard risk management are:

- 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.

The regional hazard risk management role requires councils to engage with potential affected communities on a range of natural hazards and develop risk reduction/mitigation options. There is currently a lack of science and research to support these processes which can result in difficulty in defining/modelling risk, impacts of some mitigation options not bring fully understood, and inconsistent approaches being applied across hazards.

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 are 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 addition it is recognised that it is becoming increasingly difficult to get funding for the implementation of research which often doesn't seem to have as much funding as the research itself, or the production of guidelines, e.g. Govt putting more money now into researching earthquake resilience (e.g. developing methodologies to quantify system-level performance of infrastructure networks when subject to natural hazards and cascading impacts), but local authorities still find it to difficult fund the application of this sort of research into asset management plans. This highlights the need for a HazardLink scheme.

There is an opportunity to adopt a risk register or advocate for a national risk register similar to that in the UK which has proved a powerful tool to guide policymakers in the prioritisation of public policies aimed at improving risk management, and enabling the prioritisation of preventive measures, which is particularly useful in a budget-constraint environment. Prioritisation of risk using consistent methodologies also gives clear direction to local government-led work programmes in terms of risk reduction and readiness activities.

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

- 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.

- Investigate Light Detection and Ranging (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.

- Identify effective methods to reduce existing and new risk through both planned and adaptive management.

- Develop tools and methods to build community resilience and create better risk informed decision making.

- Improve ecological outcomes and reduce the environmental impact of flood mitigation works.

- Forecasting rainfall events to improve community response to floods and nationally consistent methods to assess catchment behaviour.

- Understanding future geomorphological change to improve the long-term outcomes of flood management decisions.

Granity coastline
Photo: Hami Tangiora

PRIORITY 8

Improving coastal management

The Coastal Marine Area (CMA) is diverse and complex across the regions, yet in many areas it is still poorly understood in terms of its baseline state or response to stressors.

Research priorities identified to improve the management if the CMA include:

- Baseline data and meaningful indicators to characterise the existing CMAs.

- Nationally consistent state of the environment (SoE) monitoring and reporting and incorporating cost-effective technologies.

- 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.

- Capturing customary knowledge in accordance with tikanga Māori into coastal and marine monitoring and management frameworks.

The Coastal Marine Area (CMA) includes a range of diverse and complex ecosystems, many of which are under pressure from upstream impacts and resource use demands. The CMA is a priority area for research to ensure a better understand the responses to these pressures and to create sustainable management approaches.

In order to manage ecosystems and resources, we need to quantify change, and understand how the 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. 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. Climate change is likely to have significant impacts on the CMA with changes in both source catchment inputs and wider oceanic change. There is a need to research the regional impacts of these and any proposed adaptation strategies that may be considered.

As with 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 reasonably high probability of Marine Protected Areas (MPA) legislation updates and specific significant proposals to increase marine protection under the new government post 2020 (e.g., Sea Change Hauraki Gulf).

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.

- Greater emphasis on climate change e.g.,
  - o Understand the potential implications to CMA, particularly on intertidal and estuarine habitats, of climate change and sea level rise.
  - o Identify the scope and consequences of changing climate and likely land use/ catchment outcomes on CMA.
  - o Identify the at-risk areas from sea level rise and understand range of options to minimise impact on CMA (which also relates to priorities 7 and 9).

PRIORITY 9

Cross-cutting themes: Adaptation and mitigation of climate change and improving data management

Climate change – adaptation and mitigation

- Coordinate research between outcome areas to ensure efficient use of research funding and integration of findings and solutions.
- Advocate for science and planning research that is required for adaptation and mitigation of climate change.

Data management – actions to improve

- Advance the concept of a 'collective blueprint' for the environmental data sector.
- Promote and coordinate the needs for improved data management across sectors/outcomes and strategy priorities.

Climate change and data management are priority issues that cut across all science research areas.

Climate change:
Our changing climate is having a significant impact on our environment across all domains: terrestrial, freshwater, and marine. We need to better predict how climate will change in order to prepare to mitigate and adapt to the impacts of climate change on the natural environment. The implications of a hotter and stormier climate indicate a need to consider changes to land use, in terms of the crops we grow and where we grow them, and how we prepare for associated drought, stormier weather, and flooding. Rising sea levels are inevitable and will have consequence for coast environments, including estuaries as well as infrastructure and other aspects of the built environment.

The need is to continually improve our ability to predict change and to identify research to potentially mitigate the impacts of climate change. Such research will cover a wide range of topics from land-use change, to hazard mitigation, to biodiversity and biosecurity management.

Another aspect of climate change is how the Government responds to international agreements to limit greenhouse gas emissions and how this in turn translates to regions. This could have dramatic impacts on livestock numbers and land use and, in the case of the 1 Billion Tree programme, could see farmland converted to trees.

Science is required to help facilitate a smooth transition, both to protect the ecological environment, but also to ease any social transition should communities be impacted. The recently formed Climate Change Commission will oversee preparation of a National Climate Change Adaptation Plan and subsequent six-yearly reviews.

Regional councils are already taking action for adapting to a changing climate (for example, in water security modelling, management and capital projects, dealing with coastal erosion and rising sea levels, biosecurity threats in warmer drier climates, flood management with projections of increased storm intensities etc). Impacts of a changing climate will vary across different

parts of the country. Adaptation actions will require tailoring for local environmental contexts and community needs. Regional Councils will continue to be at the forefront of local planning initiatives adapting to impacts of climate change. The Climate Change Minister may direct local authorities to provide information on climate change adaptation as part of the Minister's reporting responsibilities under the amended Climate Change Response Act.

At the local government level, a number of councils have declared a climate emergency. This highlights climate change as an important issues and acts as a catalyst for action and the need for greater science to understand mitigation measures.

Data management:
Managing the increasing quantities of data becoming available is a major challenge not only for Regional Councils but for all organisations involved environmental data collection as new technologies make it easier and less expensive to collect information. There are currently a number of projects underway to improve both the standardisation of data collection across the sector but also investigate new technologies for data collection.

Land Air Water Aotearoa (LAWA) is a good example of collaboration between regional councils/ unitary authorities, MfE, and Cawthron to share environmental data. The vision of the Environmental Data Management System project is to provide *"A collective blueprint for the environmental data sector, addressing capability scale and ensuring efficiency, credibility, access and reusability- creating a futureproof approach to environmental data."* (Regional Sector Business Plan Oct 2019). There is a great deal that needs to be done.

Great view for the West Coast Regional Council hydro team as they complete annual maintenance on the rain gauge (right of picture) at Deelaw.

PRIORITY 10

Retaining and building science capability and capacity

Having adequate and targeted science capability and capacity across the full breadth of relevant research areas is critical for Councils to undertake their functions now and into the future.

To ensure this occurs areas of focus under this strategy are:

- Advance opportunities for greater sharing of scarce science resources between councils.
- Ensure that Central Government decision-makers understand what is required in science capability and capacity now and in the future.

The Resource Management Amendment Act[25] came into force 1 July 2020 and means that councils have a whole new range of Climate Change/Green House Gas emission matters to consider in plan-making and consent decision-making. There needs to be greater science capability to deal with these matters, either in-house or external.

There is a continual need to retain and to build science capability and capacity as scientists retire, move to other jobs, and as new challenges demand new scientific approaches. There is also an opportunity for councils to share science capability and capacity by pooling resources. An approach could be to establish "centres of excellence" or establish a "shared-services model" in areas of expertise and invite other councils to share the resource e.g. groundwater centre of excellence in ECan. Suggested areas to consider for resource sharing include groundwater science, data management, mātauranga Māori, marine science etc.

In addition to sharing resources are opportunities to work more closely together on strategic priorities. This would also ensure greater consistency in methodologies etc between councils.

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.

25 http://www.legislation.govt.nz/act/public/2020/0030/latest/LMS259082.html

Integration Across Priorities to Goals

In setting in place the 10 research priorities it is recognised that strategy implementation needs to focus across these in an integrated way if the goals are to be achieved.

The policy loop is a useful construct to evaluate the value of science undertaken to improve policy and operations implementation, and thereafter to refine science needs; i.e., a feedback loop. The relationship between strategy goals and priorities and how they are expected to integrate together is shown in Figure 2.

For example, having processes in place that will clearly define the 'priority science research needs', such as development and review of SIG strategies will directly inform work on 'Influencing government science direction' and 'Better science utilisation' and assist in the achievement of Goals 1–3.

The development of the Annual Operational Plan will highlight the actions required to create this integration between priorities and support the achievement of goals and objectives of the strategy.
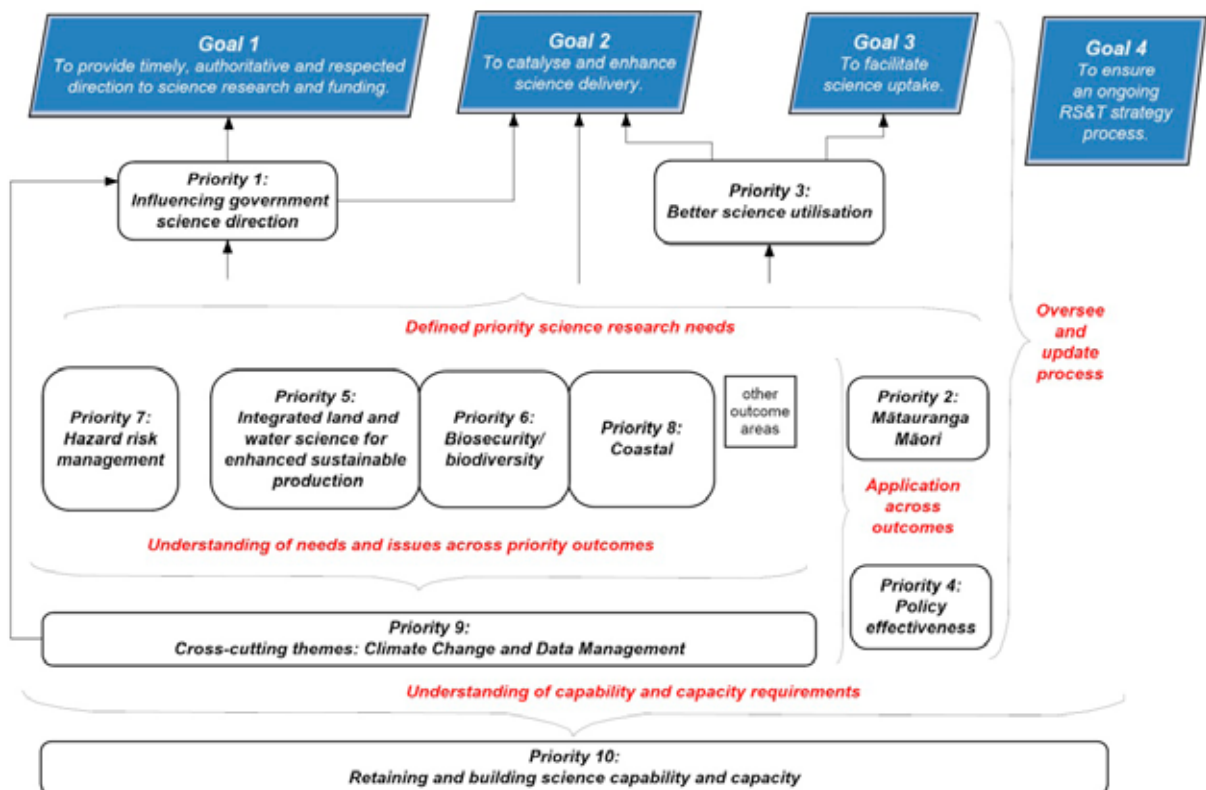

Figure 2: Relationship between identified priorities and achieving strategy goals.

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 National Science Challenges (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. SIGs need to also communicate to central govt depts with urban focus – Transport, Housing and urban Development (growth related).

The NSC's 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.

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 reviewing an Annual Operating Plan (AOP) for this RS&T Strategy.

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.

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 process for determining higher-level strategic research needs.

Acknowledgements

The strategy was developed following a process of interviews and other consultation with Regional Council Special Interest Group (SIG) convenors, council science managers, and external sources including individuals from government departments and research providers. Several SIG convenors provided input to draft versions as did several science managers.

Appendix 1

PCE November 2019 Report 'Focusing Aotearoa New Zealand's environmental reporting system'

Table 3.1 below is reproduced from the 2019 report by the PCE examining New Zealand's reporting of environmental data and knowledge. This summary is by its nature more limited than a cataloguing of environment-related, research needs, but serves as an illustration and starting point for identifying some such research gaps.

Table 3.1: Data and knowledge gaps mapped against the priority issues (as identified in Environment Aotearoa 2019).

Biodiversity and ecosystems	

Data gaps
 • Limited monitoring coverage of lakes by regional authorities.
 • Ecosystems and species:
   – limited surveying of New Zealand's marine environment
   – conservation status of many marine species cannot be assessed
   – terrestrial invasive species (location, number of species).
	Knowledge gaps
	 • There is incomplete knowledge of the condition of:
	   – freshwater ecosystems, habitats and invertebrate communities
	   – remaining wetlands
	   – large rivers and biology of groundwater systems.
	 • Impact of climate change on native species and biodiversity.

Changes to vegetation and impact on soil and water quality	

Data gaps
 • Timely measure of land cover.*
 • Nationally consistent measure of land use to link local activities to local changes.*
 • Limited number of monitoring sites that measure erosion.
 	
  * Although not specifically mentioned as gaps under this particular issue, measures of land use and land cover can provide important contextual information.
	Knowledge gaps
	 • Impact of removing vegetation on:
	   – the flow of ecosystem services from native vegetation
	   – te ao Māori and sites of cultural importance (e.g. impact of increased sedimentation on customary fishing sites).
	 • Attribution of erosion between natural (e.g. earthquakes) and human-induced processes.
	 • Inability to assess management effectiveness of mitigation strategies (e.g. riparian planting).
	 • Impact of climate change on erosion and related processes.

Urban growth and impact on versatile land and biodiversity	
Data gaps • Timely measure of land cover.	**Knowledge gaps** • Impact of land fragmentation and productivity of lifestyle blocks.

Water quality in farming areas

Data gaps
- National datasets for some variables relating to ecosystem health (including deposited sediment, dissolved oxygen and algal biomass).
- National database or map of farm management practices to explain water quality.
- Nationally consistent measure of land use to link local activities to local changes.
- Limited monitoring of contaminants like *E.coli* in New Zealand lakes.
- Limited monitoring of emerging contaminants (e.g. pesticides and pharmaceuticals).

Knowledge gaps
- Impact of water pollution on:
  - the health of ecosystems
  - te ao Māori.
- Interacting and cumulative effects of water pollution and other pressures on ecosystem health.
- Impact of specific land management practices on water quality.
- Attribution of water quality trends between natural and human activities.
- Hydrological information regarding pollutant flows.

Environmental quality in urban areas

Data gaps
- Limited spatial coverage of monitoring sites in urban areas.
- Lack of monitoring of land and soil.
- Lack of time-series datasets for some pollutants.
- No coverage of new issues (e.g. indoor air quality) and emerging contaminants in fresh water and on land.

Knowledge gaps
- Impact of pollution on:
  - ecosystems
  - cultural values.
- Cumulative impact of multiple pollutants and other pressures (e.g. habitat modification).

Water extraction and impact on freshwater ecosystems

Data gaps
- The actual quantity of water taken from all our rivers, lakes and groundwater.
- Total amount of water stored in aquifers that is potentially available for use.

Knowledge gaps
- Impact of low flows on:
  - mātauranga Māori and cultural values
  - habitats and ecosystems.
- Cumulative impacts of reduced water flow and pollution on water quality.
- The effects of projected climate change on the flow of water in rivers and aquifers.

Fishing and the health of marine ecosystems

Data gaps
- About half of our fish stocks have too little information to reliably assess their stock status.

Knowledge gaps
- Marine biodiversity is poorly understood due to limited information:
  - marine species have yet to be discovered and identified
  - information on characteristics and extent of marine habitats is lacking.
- Commercial fish stock assessments do not account for interactions between different species and their environment.
- Impact of fishing activities on:
  - mātauranga Māori and cultural values
  - marine ecosystems (e.g. impact of seabed trawling on seabed habitats).

Greenhouse gas emissions

Knowledge gaps
- Understanding of how global emissions will change in the future.
- Information on the relative strengths of different carbon sources and sinks.
- Understanding of global tipping points.

Climate impacts

Knowledge gaps
- Understanding of how global emissions will change in the future and projected impacts of increasing greenhouse gas concentrations.
- Information on cumulative and cascading impacts (e.g. how flooding affects local communities and built infrastructure).

Appendix 2

AOP - Regional Council RS&T Strategy Operating Plan – 2020/21

Goal 1: To provide timely, authoritative and respected direction to science research and funding

Objective	Action
Objectives for Goal 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.	**(To be completed by 30 December 2021)** Launch the new strategy to key staff in MBIE, MPI, MfE, DOC and Regional Councils and promote key messages in order to drive science and funding direction.
To be recognised as a trusted partner, not just an end user, and a unified voice as to how research funding should be allocated.	Promote RC involvement in key NZ science initiatives, such as the NSCs.
To be viewed as real partners by research providers and funders.	Pursue a research partnership in environmental health with HRC.
To be integrally involved in MBIE negotiated investments.	Promote RC involvement in key MBIE negotiated investment schemes at any opportunity.
To be recognised as an integral component of the science planning and implementation system.	Plan meetings with MBIE at key budget times – and other opportune times to influence budget allocation.
To secure and direct appropriate funding towards science goals to: • Understand current issues and cultural values (socio-economic) of the resources and implications to the future • Develop tools to manage the environment and broader roles and responsibilities of Regional and Unitary Councils • Develop new monitoring technologies • Develop pragmatic solutions for problems • Provide for more effective delivery of science • Provide more certainty with uncertain information • Provide for scenario testing	Continue to work with MBIE, RPs, and RCs to direct funding to cross-sector SIG priorities including, • 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.
To maximise leverage on existing and new RC research funding to provide greater science direction.	Work with SIGs and all Councils to avoid duplication – and seek additional funding opportunities, such as NSCs and also HRC, to leverage RC funds.

Goal 1 continued...

Objective	Action
To influence research providers and funding agencies on the culture required to meet Regional and Unitary Councils needs.	Continue to promote a clear message on culture to research providers – in particular a message on partnership and effective research delivery.
To advocate for multiple-provider team approach for effective use of science capability.	Continue to promote appropriate team approach through NSCs and other mechanisms. In 2020 take opportunities with the Biological Heritage NSC in biosecurity.
To meet tomorrow's problems as well as today's.	Promote the SIG strategies to ensure new research is implemented to deal with tomorrow's problems. Plan a Future's workshop for 2021.
To foster the optimal use of science between councils.	Work with RMG and the relevant SIGs to identify opportunities to ensure knowledge sharing. 2021 focus on MM and data management.
To develop a system for ongoing prioritisation of research for RC's needs.	Continue to work with SIGs on research prioritisation – plan a SIG workshop for 2021.
To be a voice to deal with outside agencies – such as MfE, DOC, MPI.	Meet with MfE, DOC, MPI on key RS&T issues as appropriate. At least one meeting with each organisation during 2021.
To establish clear intellectual property guidelines to ensure that Regional Councils' interests are protected.	Continue to communicate RC's IP policy to RPs – particular for Envirolink tool projects signed in 2021.
In a collegial manner, to systematically and regularly identify knowledge gaps in: • Characterising NZ's natural resources; • Identifying inventories and trends; • Improving knowledge of processes and systems that shape the resources; • Continually evaluating and updating that knowledge; • Achieving and sharing consensus on practices that lead to sustainable resource management (while identifying and incorporating regional differences and distinctiveness).	Continue to work with SIGs and RMG to identify knowledge gaps in environmental and resource management science; identify these in SIG research strategies and communicate to key research providers, government departments and funders.
To lead and coordinate new research efforts where and when appropriate.	Identify opportunities and submit at least one proposal to lead a national research programme. In particular explore opportunities in environmental health with HRC in 2021.

Goal 2: To catalyse and enhance science delivery

Objective	Action
Objectives for Goal 2:	**(To be completed by 30 December 2021)**
To maintain and build capability and ensure resources are targeted to most effectively deliver environmental outcomes.	Continue to communicate to MBIE, MPI, CRIS and universities capability needs as identified in RC RST strategy and SIG strategies. In particular, in 2021, highlight the need for greater capability in data management and in mātauranga Māori.
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.	Progress the concept of RCs as key knowledge hubs for areas of expertise; in 2021 identify key expertise in councils/SIGs.
To encourage partnerships and collaborative research effort.	Work with HRC towards a research partnership in environmental health.
To empower SIGs to develop and implement research strategies.	Encourage SIGs to update research strategies and to continue to communicate priorities to RPs and Government departments. Finalise at last two revised SIG research strategies in 2021.
To assess and manage risk associated with the provision of science.	Work with MBIE, NSC's and others to develop a mechanism to address risk associated with science. In 2021 discuss strategy with PM Chief Science Advisor, particularly around maintaining public confidence.
To set up a system of advocating over public good science for maintaining capability.	SAG to use the Strategy to advocate for key areas of science capability need, particularly in 2021, mātauranga Māori and data management.
To collectively advocate to MBIE, relevant ministries, and Chief Executive Environmental Forum (action – to identify the vehicle to advocate).	SAG to continue in its key advocacy role with key government departments and forums. In 2021 meet with at least three senior science staff in key government departments.
To establish mechanisms for greater council interaction.	In 2021 promote greater interaction science with a least three SIGs and identify project opportunities.
To establish processes for validation of research results (e.g., peer review vs. contract report).	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.
To prioritise and target science that reflects and has regard to: • Strategic importance for all RC's collectively but also for specific problems of wide significance • Existing research capacity • The likely benefits • The ability of users to capture the benefits.	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 SIGs or councils before 30 December 2021.

Goal 3: To facilitate science uptake

Objective	Action
Objectives for Goal 3:	**(To be completed by 30 December 2021)**
To encourage the implementation of schemes such as Envirolink.	In 2021 promote the findings from the Envirolink review (Nov 2019) and promote HazardLink and other knowledge transfer mechanisms.
To promote the development and utilisation of knowledge management systems.	Continue to improve and promote the Envirolink website to RC Staff RPs and others; seek out and implement additional opportunities.
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.	Encourage greater interaction between the Policy SIG and other SIGs. In 2021 promote greater effort in integrated land and water science.
To improve the way the sector communicates science to its communities including making better use of mātauranga Māori as a vehicle to improve science communication to iwi where there are complementary science/mātauranga measures or indicators.	Identify key opportunities and mechanisms to improve sector science communication to communities and build on the success of LAWA. In 2021 work with the Communication SIG and promote science knowledge transfer, including Envirolink.
To use the Strategy to advise Regional and Unitary Councils to think about end use before defining product in a contract.	Continue to promote this message to RC staff and provide examples of best practice. In 2021 report on current situation. Is it still an issue?
To influence central government funding on appropriate output, particularly in regard to Science Policy and push for greater emphasis on excellent science quality.	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.
To ensure effective RS&T output from government-funded science programmes relevant to Regional Councils.	Continue to communicate to NIWA, Landcare, and others as to what effective RS&T is and provide examples of best practice.
To develop and implement a continuum model to work with scientists on key research projects.	Continue to promote this concept through the NSCs ensuring RC staff involvement from design through to implementation on key projects. In 2021 involve RC staff in at least three new NSC projects.
To advocate to councils that science knowledge is valuable and necessary for sound evidence-based decision making.	Promote this message to councils and identify where the greatest needs are. By council and by knowledge area. By 30 December 2021 communicate this to at least 8 SIGs and/or councils.
To develop new mechanisms to attract central government funding for knowledge transfer and implementation.	Publicise the benefits of Envirolink as a knowledge transfer mechanism as stated in the Envirolink Review (Nov 2019).

Goal 3 continued...

Objective	Action
To ensure greater transparency and exchange as to who is doing what – e.g., between research providers and councils etc.	In 2021 update register of key RC staff science contacts on the EL website.
Continue to develop National Environmental Monitoring Standards (NEMS) to provide national consistency for acquisition and archiving of uniform datasets across the environmental monitoring sector.	Work with RC staff to help source funding. In 2021 investigate Envirolink opportunities.

Goal 4: **To ensure an ongoing RS&T strategy process**

Objective	Action
Objectives for Goal 4: To follow a process to review, refine, and update the strategy.	**(To be completed by 30 December 2021)** SAG to review Operating Plan before 30 December 2021. Update RC RS&T Strategy before end of 2023 as necessary.
To provide the necessary resource to ensure the strategy process is successful.	Research Coordinator on board – or a Chief Science Advisor.
To provide a governance mechanism to oversee the strategy process.	SAG to provide governance and report to RMG.

Appendix 3

Special Interest Group Structure (as of November 2020)

Regional Sector Special Interest Group (SIG) Network Structure Chart
(as at 9 November 2020. Contact: natasha.muir@horizons.govt.nz)

RCEO Group
Mike McCartney, HRC

SIG Network Virtual Team
Mike McCartney, HRC

River Managers
Graeme Campbell, GWRC
Mike McCartney, HRC
Vin Smith, WCRC

Coastal Management
Oliver Wade, MDC
Stacey Faire, BOPRC
Dave Allen, AC

Resource Managers
Clare Barton, NCC
James Palmer, HBRC
Chris McLay, WRC

Environmental Data
Mike Ede, MDC
Ged Shirley, HRC

Transport
Anke Kole, GW
Grant Fletcher, GW
Greg Campbell, GW
Megan Tyler, AC

Consent Managers
Philip Burge, ECAN
Heather McKay, WCRC

Corporate & Finance
Mike Nield, TRC
Malcolm Nicolson, NRC
Nedine Thatcher-Swann, GDC

Bio-Managers
Jon Roygard, HRC
[Vacant]
Chris Ingle, BOPRC
Rob Phillips, ES
Steve Ruru, TRC

Implementation
Jon Roygard, HRC
Chris Ingle, BOPRC
Fiona McTavish, BOPRC
Rob Phillips, ES

Contaminated Land & Waste
Victoria McKay, TRC
Fred McLay, TRC

Land Monitoring
Haydon Jones, WRC
Richard Saunders, ORC

Land Managers
Grant Cooper, HRC
Jon Roygard, HRC

Nat Air Quality
Belinda Harper, HBRC
Kathleen Kozyniak, HBRC
Katherine Trought, ECAN

Ground Water
Rebecca Morris, GW
Mike Scarsbrook, WRC

Surf Water Int Mngmnt
Jean-Charles Perquin, NRC
Mike Scarsbrook, WRC

Science Advisory
Iain Maxwell, HBRC

Policy Managers
Gavin Ide, HBRC
Pere Hawes, MDC

Compliance & Enforcement
Alex Miller, BOPRC
Gina Ferguson, MDC

HR/Health & Safety
Colin Morris, HRC

Info Technology
Robert Body, ORC
John Crane, WRC

Biosecurity
Greg Corbett, BOPRC
Kane McElrea, NRC

Biodiversity
Patrick Whaley, WRC

Navigation & Safety
Jim Lyle, NRC
Richard Barnett, WRC
Sarah Gardner, ORC
[Vacant]
Tony Phipps, NRC

Ngā Kairapu (Māori SIG)
Katarina O'Brien, BOPRC
David Perenara-O'Connell, ECAN
Nedine Thatcher-Swann, GDC
Stephanie Rixecker, ECAN

Communications
Christine Morrison, HRC
Drew Broadley, HBRC
Mike McCartney, HRC
Sarah Gardner, ORC

CDEM
Ian Macdonald, HB CDEM Group
Janine Dowding, TDC
Mark Wheeler, MDC

Hazard Risk Management
Iain Dawe, GWRC

RMA Reform
Naumouta Poutasi,
BOPRC
RMG

Climate Change
Al Cross, GW
RMG

Freshwater
Iain Maxwell,HBRC
& Nic Peet, HRC
RMG

Key:

Lead SIGs reporting to RCEO Group
SIG Convenor
RCEO Sponsor
RCEO Alternate Sponsor

Stand-alone SIGs reporting to RCEO Group
SIG Convenor
RCEO Sponsor
RCEO Alternate Sponsor
Second Tier Support

Sub-SIGs reporting to RMG/Lead SIGs/Stand-alone SIGs
SIG Convenor
RMG Link

Working Groups
Convenor
Reports to