Strategic Roadmap for Land & Water Research



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Strategic Roadmap for Land and Water Research

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National Land Resource Centre

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Contents

1 Executive Summary

This project aims to support a refresh of the 2011 Regional Council RS&T Strategy and informs the review of the Special Interest Groups (SIGs) by providing:

- A review and update of 'research priorities' for the Land Management Group (LMG) and Land Monitoring Forum (LMF) in response to today's operating environment
- Specificity around which research priorities should be the primary focus for the LMG and LMF, including how to best address issues across the land-water continuum and ensure the uptake of science
- Pathways to align effort with other SIGs, Crown Research Institutes and other stakeholders to ensure delivery of these research priorities in the most effective way
- Recommendations on wider systemic changes needed to create impact in the land and water domain.

A strategic scan of government initiatives and strategies revealed the need for a more collaborative and consistent approach for research priority-setting and a greater focus on uptake and adoption within the innovation system. As a result of the scanning twenty research priorities were proposed and agreed to by a *Strategic Review Group*.

A secondary exercise identified research priorities that were critical to the core operation of each of the LMG and LMF. It identified research priorities focused on identifying, implementing and ensuring uptake of best management practices (such as whole farm planning) as critical to the LMG. Research priorities focusing on key data gaps, resource information and indicators for reporting ranked highly for LMF. These findings are consistent with the contrasting remit of each of the land-focused SIGs.

The scan also highlighted strong commonality in priorities across sectors and the increasingly dual focus on profitability and sustainability. To maximise these opportunities a *Strategic Roadmap for Land & Water* plots how effort can be aligned with other stakeholders to ensure delivery of the full twenty research priorities. The Strategic Roadmap offers a number of opportunities for the LMG and LMF to contribute to national goals and outcomes. Ten recommendations for further work are provided to ensure the intent of the project is realised and the Strategic Roadmap becomes a resource of enduring relevance and value to the LMG and LMF.

The project itself served as a basis to build mutual understanding and trust across SIGs, CRIs and other agencies who contributed, forming the foundation for the collaborations needed to deliver on the Strategic Roadmap.

2 Background

2.1 Project genesis and purpose

Regional Councils and Unitary Authorities through the Special Interest Groups (SIG) are currently revisiting the critical issues and research priorities that formed the basis for the 2011 Regional Council RS&T strategy and the subsequent 2012 update. As part of the strategy, the National Land Resource Centre (NLRC) worked closely with the Land Monitoring Forum (LMF) and Land Managers Group (LMG) SIGs in 2013 to survey regional council staff, test critical issues and research priorities, and develop the foundation for partnership. The resulting report, '*Alignment of Land Special Interest Groups and the NLRC Priorities*' (2013), made a number of recommendations, including the following:

- Develop a long-term land and soil research strategy that considers both immediate and long-term issues
- Bridge the science-implementation gap and work across the land and water domain
- Work collectively with others to ensure issues are identified and addressed through an inclusive and collaborative process

This project was established to address these three recommendations by providing a *Strategic Roadmap for Land & Water Research*. It aims to add a level of specificity around which research priorities should be the primary focus for LMG and LMF; how effort (capability, investment, etc.) can be aligned with other stakeholders to ensure delivery of these research priorities; and what wider systemic changes are needed to create research impact in the land and water domain.

The Strategic Roadmap for Land & Water Research will support planning and prioritisation of research by the LMG, LMF (and other related SIGs where appropriate) and provide a statement of priorities for consideration, discussion, and inclusion within development and decision-making in regard to the National Science Challenges (NSCs), particularly 'Our Land & Water', CRI core funding investment, the NLRC collaborative work programmes and central government's non-departmental investment streams.

2.2 Major drivers affecting research priority setting

Since the 2011 Regional Council RS&T strategy was released there have been several shifts in the operating environment against which land, soil and water issues and associated research priorities should be tested for enduring relevance. Major shifts, representing those changes most relevant to regional council and science practice, are illustrated in Figure 1 and include:

- *Increasing demands made on our land and soil assets:* Primary production sectors currently have a combined export value of $34B p.a. The government's Business Growth Agenda (BGA) sets an aspirational target to increase the ratio

of value of exports to gross domestic product from 30% in 2010 to 40% by 2025. This will require a doubling of export value in absolute terms (MBIE 2013) and demand changes in land use, land-use practices (e.g. greater irrigation) as well as research to drive growth, and understand and limit impacts.

- *Managing the impacts on freshwater:* To better manage freshwater, the National Policy Statement for Freshwater Management introduced by the Government in 2013 now requires Regional Councils to regulate freshwater use and quality within limits by 2030 and maintain or improve overall regional water quality. This requires more connected thinking across soil, land and water research and a greater level of consistency across regional council practice.

Figure 1 Timeline of major drivers and shifts since research priority setting.

- *Appetite for collaborative effort:* The establishment of the Land & Water Forum (LAWF), the formation of the Natural Resource Sector (government departments with a remit for managing natural resources), and, more recently, the National Science Challenges demonstrate both the appetite for, and the potential of, collaborative leadership around national priorities.
- *Recognition of the importance of uptake:* "Science isn't finished until it's communicated", said UK Government Chief Scientific Adviser, Sir Mark Walport, recently. This confirms one of the primary findings of the 2013 NLRC report, as well as numerous international and New Zealand science reviews – inadequate attention is given to ensuring science uptake and bridging the gap between knowledge generation and its use.

3 Project approach, phasing and participants

3.1 Project approach

The project approach was to populate the framework below from articulation of *Goals & outcomes* back to the *Inputs* needed to achieve them:

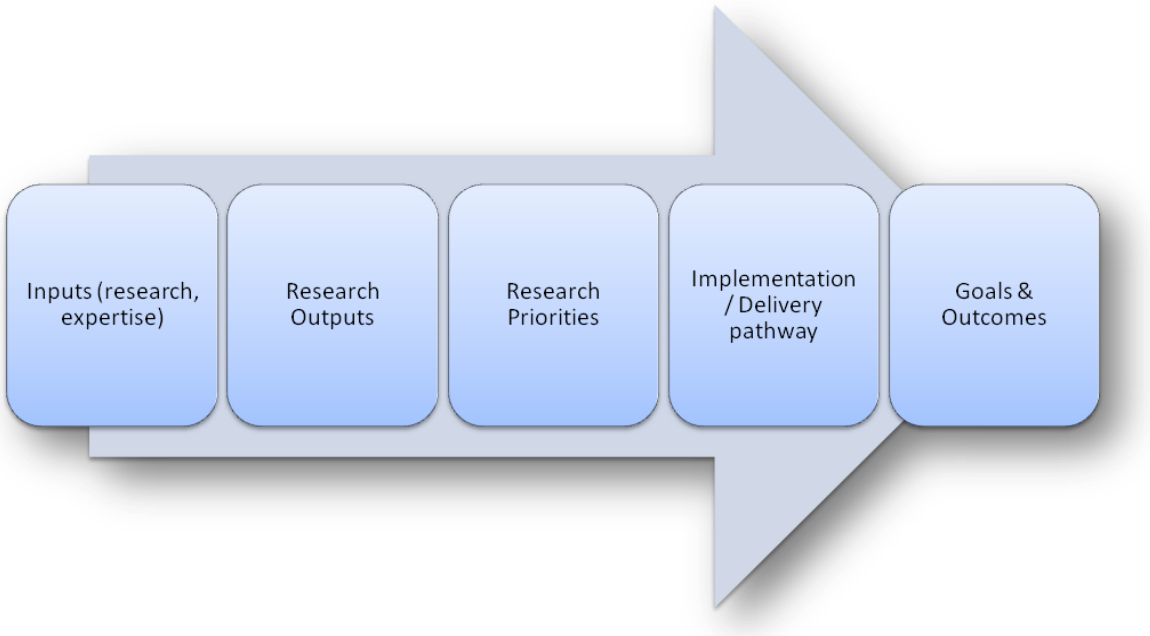


Figure 2 Strategy framework: from inputs to goals and outcomes

3.2 Roles

The project was led by the NLRC. To review outputs at each phase a Strategic Review Group was established, comprising a self-selected sub-group from:

- LMG: Campbell Leckie, Simon Stokes
- LMF: Reece Hill, Andrew Burton
- Regional Council Science Advisory Group: Bill Dyck

Contributions were also made by Graham Sevicke-Jones and John Hadfield of the Groundwater and Surface Water SIGs. The CRI sector was represented by the NLRC partners in:

- AgResearch: Richard McDowell & Richard Muirhead
- IGNS: Chris Daughney & Stewart Cameron
- Plant & Food Research: Warwick Nelson
- Scion: Tim Payn
- NIWA: John Quinn

3.3 Project phasing

Table 1 Project approach and phasing

Phase	Description	Purpose	Stage in strategic framework	Lead & mechanism
1. National strategic scan	*Review key government initiatives (e.g. Freshwater reforms, Environmental Reporting Bill)*	Determine a set of high level outcomes and goals to guide research priorities and alignment opportunities	Goals & outcomes	NLRC (with input from Strategic Review Group)
2. International scan	*Review of similar international strategies and reviews*	Determine a set of high level outcomes and goals to guide research priorities and alignment opportunities	Goals & outcomes	NLRC (with input from Strategic Review Group)
3. Critical review of keystone reports	*Review of agreed keystone reports for research priorities (e.g. PCE report on Soil Monitoring)*	Facilitate updating of research priorities	Research Priorities	NLRC (with input from Strategic Review Group)
4. Rudimentary map of research landscape	*Review of any available project databases (e.g. Envirolink & SFF)*	Facilitate updating of research priorities (by understanding research gaps)	Research Priorities	NLRC (with input from Strategic Review Group)
5. Development and testing of revised research priorities (Table 3)	*Consolidation of findings from phases 1 to 4 into a set of agreed research priorities*	Provision of a statement of research priorities	Research Priorities	Strategic Review Group workshops
6. Ranking critical research priorities (Table 4)	*Identification of research priorities critical to LMG & LMF core business*	Facilitate collective resourcing and targeted effort for LMG & LMF	Research Priorities & Implementation / delivery pathway	LMG & LMF workshops & discussions
7. Mapping and testing of implementation pathways (Figure 2)	*Generation and testing of strategic roadmap*	Guide more effective implementation of research priorities & alignment with others	Implementation / delivery pathway	Strategic Review Group & CRIs workshop
8. Rudimentary mapping of CRI interface (Table 5)	*Mapping of CRI interests, expertise and inputs against research priorities*	Facilitate more effective linkage between councils & CRIs to support Strategic Roadmap	Inputs (research, expertise)	CRI contributors
9. Report	*Consolidate of all information and key recommendations*	Ensure value of activities 1–8 to LMG & LMF	All	NLRC with contributions

4 Results

4.1 Key findings from strategic scan

Table 2 summarises critical findings from the strategic scan of the national operating environment and relevant international findings.

Table 2 Summary of critical findings from strategic scan

Stakeholder / sector	Source	Enabling themes	Common goals
International	• Australian Soils stock-take • Global Soils Partnership Report • England & Wales Soil Strategy • UK – Soil Health report • AU – RD&E Framework • UK Soil Audit	• Uptake & adoption • Cross-disciplinary research • Capacity enhancement • Stock-take activities • Data infrastructure	• Social & cultural values Protection & resilience • Resource condition
Central government	• Our Land & Water NSC • NRS Brief to Incoming Ministers • MFE Freshwater Reforms • SCIs for MfE, MPI, MBIE	• Uptake & adoption, extension • Integrated & cross-disciplinary research • Economic, environmental, cultural & social benefits • Consistency across NZ	• Export growth • Optimise primary sector supply chains • Land & water management • Minimising impacts on freshwater • Effective environmental reporting • Social & cultural values
Regional councils	• RS&T Strategy 2011 • SIG priorities & critical issues 2011 • NLRC Alignment report 2013	• Collective Leadership • Uptake & adoption • Data & infrastructure	• Resource valuation • Policy effectiveness • Land use impacts on freshwater
Research organisations	• CRI SCIs & SCPs	• Collaboration • Cross-disciplinary research • Knowledge transfer • Data & infrastructure	• Efficient use of freshwater • Sustainable land resources & Ecosystem Services • Economic benefits from geological resources • Sustainable primary production • Social & cultural wellbeing

From the scan it became evident that while in overseas cases research priorities tend to be set nationally or regionally through workshops (e.g. in Australia or Europe), New Zealand priority-setting has tended more towards sector-based efforts. Despite this approach there is a strong commonality in priorities, although more analysis of primary sector goals and priorities is recommended (through sector strategies for example). This convergence in interest bodes well for the intent and development of the national science challenges.

The dual focus on profitability and sustainability, nationally and internationally, is tending to produce different demands on the underpinning research. This includes a more multi- or trans-disciplinary approach to research (to provide win-win options), incorporation of social, cultural, and economic values, and greater anticipation of future threats and opportunities.

Much of the material reviewed, highlighted the need for 'enabling themes' to support more effective prioritisation and implementation of research. Common enablers in the literature included stock-takes or audits; collective leadership; shared approaches to data management and infrastructure and a greater focus on ensuring uptake and adoption within the innovation system.

4.2 Research priorities

A set of research priorities were identified both to support planning and prioritisation of research by the LMG, LMF, and other related SIGs where appropriate, and to provide a statement of priorities for consideration, discussion, and inclusion within development and decision-making for the National Science Challenge (NSC) 'Our Land & Water', CRI core funding, the NLRC collaborative work programmes, and central government's non-departmental investment streams.

The findings from the strategic scanning (presented in Table 2) were used to guide the development of a set of overarching goals as a framework of national-scale priorities. These goals include:

- Facilitate more sustainable production
- Ensure integrity of ecosystem services & natural capital
- Reduce land-use impacts on freshwater
- Meet society, community and rural values and ensure uptake
- Anticipate and plan for future risks

A rudimentary gap analysis based on a review of key reports (e.g. Soil and Land Use Alliance 2012) and available project databases (e.g. 'Envirolink' and 'Sustainable Farming Fund') was used to add to the list of research priorities developed during the 2013 NLRC exercise. The list was tested with the strategic review group, and research priorities were modified, removed or added as a result. Table 3 presents the agreed list of research priorities, showing 20 priorities in total, some enduring, some modified, and some new. The 20 research priorities were also grouped under the five overarching goals.

It is worth noting that while a number of priorities focused on sustainable production and/or ecosystem services and natural capital, few addressed the need to integrate research across land and water. Almost all groundwater issues are causally related to land use and in turn have significant impacts on surface water. Reducing impacts of land use on freshwater requires an integrative research focus. Additional research priorities relating to the emerging issues of water quality are proposed to include:

- Develop improved input data on erosion (including stream-bank & farm track) and sediment generation (including flow paths) to enhance the performance of erosion/sediment modelling (Research Priority 11)
- Develop improved input data on faecal microbes and transmission pathways (Research Priority 12)
- Ensure better incorporation of N & P data within models and improved uptake of research outputs (Research Priority 13)
- Stratify/classify NZ catchments according to land use pressures and receiving area vulnerability – including the soil, vadose zone, shallow groundwater and coastal areas (e.g. estuaries) to provide a framework for transferring research outputs to like catchments (Research Priority 14)

New research priorities (or modifications) have also been identified in order to meet society, community, and rural values (Research Priorities 15–20). Understanding the values and motivation of the public is essential to developing robust science and tools that underpin management decisions of natural resources that aim to improve water quality.

Table 3 Research Priorities Needs Assessment

Goals	Research priority	Origin
A. Facilitate more sustainable production	1. Identify and quantify the costs and benefits of different best management practices, including whole farm planning, to increase uptake of best practice tools and technologies	2013**
	2. Develop farm-scale S-map coverage and interoperability with farm models and practices, and ensure uptake and use by farmers and landowners	2013*
	3. Determine the rate and impact of the loss of high class soils/versatile land on both economic potential and ecosystem services	2014***
	4. Improve the fitness for purpose of the NZLRI and LUC to better account for contemporary and alternative land use options and allow for use in regulating nutrient loss	2014***
B. Ensure integrity of ecosystem services & natural capital	5. Enhance the coverage, quality and interoperability of resource information including soil (S-map), land cover and land-use data	2011*
	6. Quantify the value of soil natural capital stocks, as well as key ecosystem services for water quality, primary production, biodiversity and carbon outcomes	2011*
	7. Determine the impact of cumulative effects of on- and off-site activities on the diversity and resilience of ecosystems	2011*
	8. Develop improved knowledge of the spatial and temporal distribution & accumulation of contaminants	2011*
	9. Establish a cost-effective and easy to implement indicator of soil health for national reporting	2014***
C. Reduce land-use impacts on freshwater	10. Research to provide a robust scientific basis for the setting of water quality limits and targets in all water bodies (Overarching)	2014***
	11. Develop & test better input data on erosion and sediment generation to enhance the performance of erosion/sediment modelling	2013**
	12. Develop improved input data on faecal microbes and hormone and transmission pathways	2014***
	13. Ensure better incorporation of N & P data within models and improve the uptake of research outputs	2014***
	14. Classify NZ catchments according to pressure, state and impact to enable more research to be transferred between like catchments	2014***
D. Meet society, community, and rural values and improve uptake	15. Understand farmer motivation and behaviour including social, economic and psychological factors (e.g. succession, risk, etc.) and use to improve uptake of best practice tools and technologies including whole farm planning	2014***
	16. Understand and support Maori values (e.g. mahinga kai, kaitiaki) and land development need under crown settlement to ensure cost-effective and collaborative implementation of the FW reforms	2014***
	17. Understand and support community and public values across land and water, including the science needed to ensure cost-effective and collaborative implementation of the FW reforms	2014***
	18. Understand and develop the science and tools to support increased policy effectiveness across land and water policy	2014***
E. Anticipate and plan for future risks	19. Provide a framework to explore future land use options, e.g. irrigation potential and provide in a usable form to guide decision-making	2013**
	20. Analyse potential scenarios resulting from global trend analysis and NZ foresight work to identify the impacts on future land use and management (e.g. primary production, pest control and flooding)	2013**

Origin:

* 2011 in the original Regional Council RS&T Strategy/ SIG priorities

** 2013 resulting from the project: Alignment of Land Special Interest Groups and the National Land Resource Centre Priorities

*** 2014 resulting from the December workshop: Strategic Roadmap for Land and Water Research

4.3 Core LMF/LMG Priorities

A secondary exercise identified research priorities that were critical to the LMG and LMF and their core business. This was done in the case of the LMG via a group voting process, while LMF priorities were arrived at through informal discussion. The intent of identifying critical priorities for each SIG was to provide specificity on which the LMG and LMF, independently and/or in collaboration with each other, will drive and:

- Collectively resource, including identifying within budgets
- Target external funding opportunities such as SLMACC
- Recommend for inclusion in the national science challenges
- Guide discussions with CRIs and their core funding investment decisions.

Table 4 Summary of research priorities critical to LMG & LMF core business

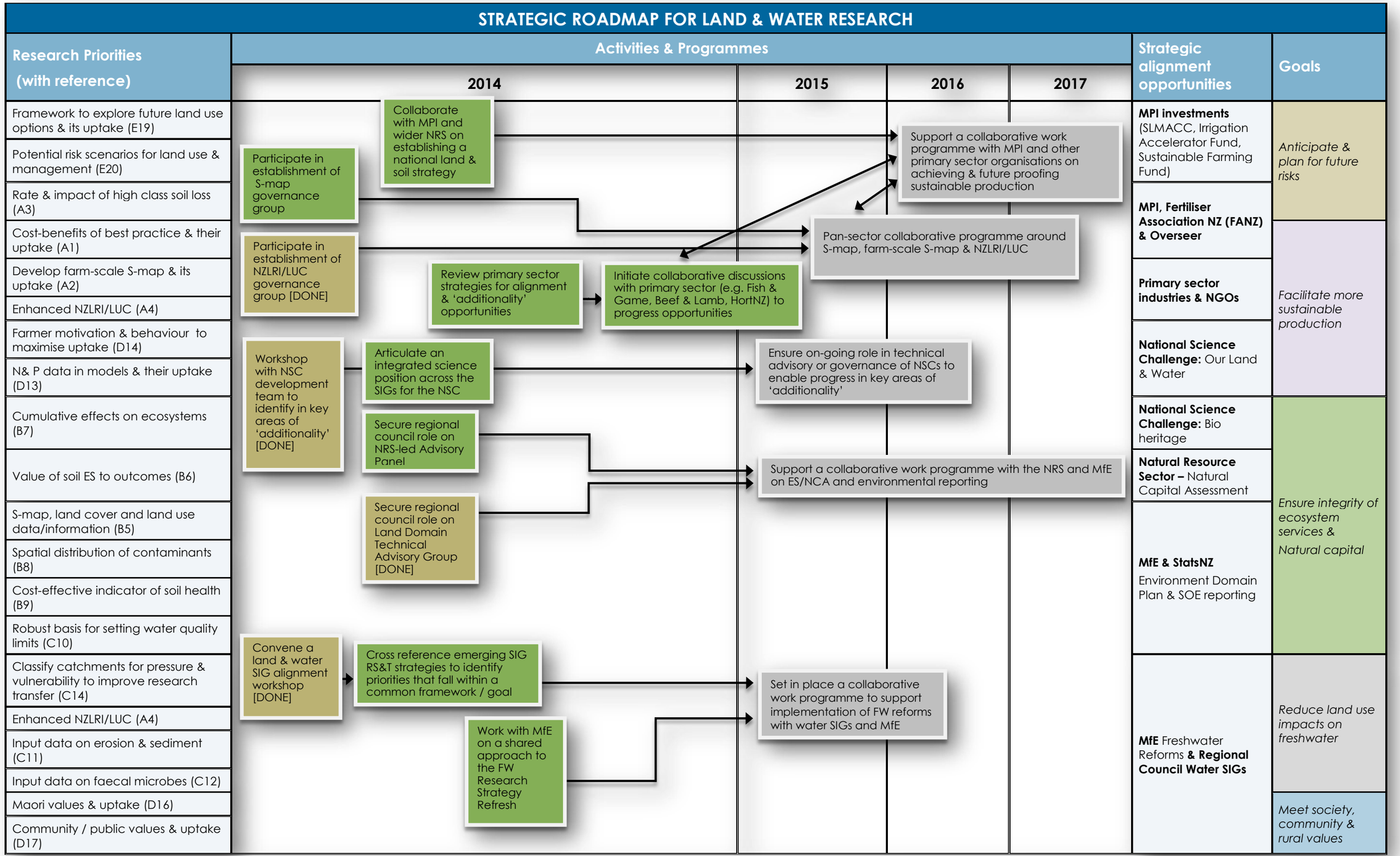
No.	Research Priority (RP)	Owner(s)
1	Identify and quantify the costs and benefits of different BMPs, including whole farm plans	LMG
3	Determine rate and impact of the loss of high class soils, change in ownership and land fragmentation on economic potential and ecosystem service provision	LMF
4	Test alternative options / refresh NZLRI and LUC to better account for contemporary and alternative land uses and allow use in regulating nutrient loss	LMG & LMF
5	Enhance the coverage, quality, and interoperability of S-map, land cover and land use information	LMF
6	Quantify the value of ES to water quality, production, biodiversity & carbon outcomes	LMF
9	Establish a cost-effective and easy to implement indicator of soil health	LMF
11	Develop improved input data on erosion and sediment generation to enhance the performance of erosion and sediment modelling	LMG & LMF
14	Classify NZ catchments according to pressure, state and impacts	Cross-SIG
15	Understand farmer motivation, behaviour, and psychology to improve uptake of BMP and technologies	LMG

For the LMG the exercise identifies critical research priorities focused on identifying, implementing and ensuring uptake of best management practices (such as whole farm planning). Research priorities focusing on key data gaps, resource information and indicators ranked highly for LMF. These findings are consistent with the contrasting remit of each SIG.

4.4 Strategic Roadmap to achieve alignment

The Strategic Roadmap for Land & Water proposes how effort (capability, investment, etc.) can be aligned with other stakeholders to ensure delivery of these research priorities and what wider systemic changes would enable impact in the land and water domain.

Figure 3 Strategic Roadmap of alignment activities and programmes



4.5 Key activities and programmes 2014-2017 for land and water

The Roadmap (Figure 3) shows some potential activities and programmes for 2014–2017, with a particular focus on key establishment activities in the first and second halves of 2014. Key activities for 2014–17 include:

- Ensuring participation in relevant *national science challenges* to enable progress in key areas of 'additionality' (both LMG & LMF)
- Supporting a collaborative work programme with *MPI and other primary sector organisations* on achieving and future-proofing sustainable production (primarily LMG)
- Collaborating in pan-sector programmes to extend and refine *resource information* such as S-map and the NZLRI/LUC (both LMG & LMF)
- Strengthening collaboration with the *Natural Resource Sector and MfE* in key areas such as *ecosystem services, natural capital and environmental reporting* (primarily LMF)
- Initiating collaborative efforts with *MfE, surface and groundwater SIGs* to support implementation of the *Freshwater reforms* (both LMG & LMF)

The 2014 year is critical for forging alignment, given many cross-sector initiatives are in the establishment phase (for example, national science challenges, environmental reporting and the implementation of the freshwater reforms). The pace of progress is also rapid, with some of the activities listed on the Roadmap already completed during the course of this project (indicated as [DONE]). To ensure ongoing utility it is recommended that the Roadmap remains a live document and is updated and added to as alignment opportunities become apparent.

4.6 Interfacing with the CRIs

During the course of the project it became obvious that a more collaborative research effort across the CRIs and with other agencies was both desirable and possible. The NLRC partnership provides an opportunity for collaboration, as do the national science challenges; however, without an expert directory knowing where the right expertise sits and who to contact remains a barrier. The CRIs contributing to this project therefore felt it was useful to identify interests, existing research and/or contacts for each of the research priorities (see Table 5). While this mapping was done without any template and is reflected in the variable nature of what is provided it provides a starting point for a more thorough and consistent directory of expertise that could usefully be extended to include other providers such as the universities.

Table 5 Preliminary map of interests, existing research and/or contacts for each of the research priorities

Research priority	AgResearch	GNS Science	Landcare Research	NIWA	Plant & Food	Scion
Primary contacts	**Richard Muirhead, Liz Wedderburn, Philip Weir**	**Chris Daughney**	**Alison Collins, Chris Phillips & Suzie Greenhalgh**	**John Quinn, Mal Green, Bob Wilcock & Murray Hicks**	**Warwick Nelson, Paul Johnstone; Mike Beare; Brent Clothier; Roger Williams**	**Tim Payn**
1. Best management practices & whole farm plans	Overseer, FarmMax, MitAgator, LEP tool kit	N/A	Interest – Suzie Greenhalgh Greenhalghs@landcareresearch.co.nz	Significant ongoing work around specific land & water aspects e.g. Effluent treatment; riparian restoration; stream rehabilitation; irrigation reservoir design guidance, farm weather IT.	Significant contributory work ongoing in this area including Matrix of Good Management; LUCI programme (core); SLURI core) , MBIE, levy and commercial funded work	Forest Industry and Informatics **graham.west@scionresearch.com** steve.wakelin@scionresearch.com juan.monge@scionresearch.com andrew.dunningham@scionresearch.com
2. Farm-scale S-map	Overseer, FarmMax, MitAgator, LEP tool kit	N/A	Core funding programme - Sam Carrick & Sharn Hainsworth Carrickc@landcareresearch.co.nz Hainsworths@landcareresearch.co.nz	Link to CHES (Cum Effects Hydraulic Simulator) to evaluate irrigation potential and supply surety. This is an OL&W project idea.	N/A	
3. Versatile land	Ecosystem Services	Troy Baisden Mike Sim	Core funding programme - John Dymond , Daniel Rutledge & Anne-Gaelle Ausseil dymondj@landcareresearch.co.nz	N/A	SLURI (core), especially ecosystem services of soils; Hydrophobicity studies – RSNZ and other funding	
4. NZLRI & LUC	Overseer, FarmMax, MitAgator, LEP tool kit	Troy Baisden	Core funding programme - James Barringer, David Medyckyj-Scott & Andrew Manderson barringerj@landcareresearch.co.nz	N/A	LUCI and SLURI – PFR core funding, alongside regional council and other funded aspects	Forest Industry and Informatics **barbara.hock@scionresearch.com** simeon.smaill@scionresearch.com
5. Resource information including soil (S-map), land cover & land use data	N/A	Stewart Cameron	Core funding programme - Sam Carrick, Linda Lilburne, David Pairman, Robert Gibb Medyckyj-scottd@landcareresearch.co.nz	N/A	N/A	Forest Industry and Informatics **barbara.hock@scionresearch.com** duncan.harrison@scionresearch.com marie.heaphy@scionresearch.com
6. Value of soil natural capital stocks & ES	Ecosystem Services	Troy Baisden Mike Sim	Core funding programme - Duane Peltzer, Anne-Gaelle Ausseil, John Dymond, Suzie Greenhalgh Ausseila@landcareresearch.co.nz	N/A	Current programmes, expertise & interest in eco-verification	Forest Systems **richard.yao@scionresearch.com** sandra.velarde@scionresearch.com loretta.garrett@scionresearch.com
7. Cumulative effects	N/A	Matt Stott Chris Daughney	Core funding programme - Chris Phillips, Les Basher phillipsc@lancareresearch.co.nz	Cumulative Effects and Aquatic rehabilitation programmes align with this. Also a theme of the NZBH NSC	N/A	Forest Systems **loretta.garrett@scionresearch.com** thomas.paul@scionresearch.com brenda.baillie@scionresearch.com
8. Distribution of contaminants	MitAgator	Karyne Rogers Mike Sim Chris Daughney	Core funding programme -Jo Cavannagh, Jackie Aislabie cavannaghj@landcareresearch.co.nz	Cumulative Effects and land use effects on Water Quality programmes. Also includes attenuation processes.	N/A	Green Technologies. **gerty.gielen@scionresearch.com**
9. Soil health indicator	Ecosystem Services	Troy Baisden	Core funding programme - Sam Carrick, Bryan Stevenson carricks@landcareresearch.co.nz	N/A	N/A	Forest Systems **loretta.garrett@scionresearch.com** simeon.smaill@scionresearch.com
10. (Overarching) – water quality limit setting	N/A	Chris Daughney Stewart Cameron	Core funding work & interest - Suzie Greenhalgh, Andrew Fenemor fenemora@landcareresearch.co.nz	Wide expertise and modelling tools (CLUES, TRIM).	Matrix of Good Management and associated LUCI and SLURI activities	Forest Systems **brenda.baillie@scionresearch.com**

11. Input data on erosion	N/A	Mike Sim Chris Daughney	Core funding programme & collaborations - Chris Phillips, Les Basher, John Dymond phillipsc@lancareresearch.co.nz	Interests in sediment transport, river channels, coastal consequences of altered sediment supply (ecological and geomorphological)	Poplar and willow work associated with aspects, funded by MPI and NZPWRT	Forest Industries and Informatics. **duncan.harrison@scionresearch.com** marie.heaphy@scionresearch.com barbara.hock@scionresearch.com
12. Input data on faecal microbes & hormones	*E. coli* risk index and MitAgator	N/A	Core funding programme & collaborations - Malcolm McLeod, Jackie Aislabie mcleodm@landcareresearch.co.nz	NIWA, AgRes, ESR and Massey collaborate in faecal microbe transmission pathways	N/A	N/A
13. Incorporation of N & P data within models and uptake	Overseer, FarmMax, MitAgator, LEP tool kit	Chris Daughney Stewart Cameron Mike Sim	Some core funding - Duane Peltzer peltzerd@landcareresearch.co.nz	Interest in models such as CLUES and TRIM	LUCI and SLURI, MGM, SLMACC, NZAGRC; Tech transfer aspects of SFF projects,	Forest Systems **simeon.smaill@scionresearch.com** peter.clinton@scionresearch.com jianming.xue@scionresearch.com
14. Classify NZ catchments	Establishing baselines for water quality	Chris Daughney Stewart Cameron	Core funding & databases & collections - David Medyckyj-Scott, Linda Lilburne, Anne-Gaelle Ausseil Medyckyj-scottd@landcareresearch.co.nz	Interest and tools such as REC.	N/A	Forest Systems **tim.payn@scionresearch.com** tim.barnard@scionresearch.com barbara.hock@scionresearch.com loretta.garrett@scionresearch.com steve.wakelin@scionresearch.com
15. Understand farmer motivation & behaviour	Co-learning and co-innovation	Fiona Coyle	Interest & expertise -Adam Daigneault daigneaulta@landcareresearch.co.nz	N/A	N/A	Forest Systems **tim.barnard@scionresearch.com** **lisa.langer@scionresearch.com** karen.bayne@scionresearch.com juan.monge@scionresearch.com
16. Understand & support Maori values	Maori Research	Rawiri Faulkner Stewart Cameron	Interest & expertise - Garth Harmsworth harmsworthg@landcareresearch.co.nz	Involved in research on Maori values (including in NOF context) and with supporting Maori land development via use of weather data etc.	Work funded through Vision Matauranga and associated with Te Raranga Ahumara	Forest Systems **lania.holt@scionresearch.com** tim.barnard@scionresearch.com lisa.langer@scionresearch.com brenda.baillie@scionresearch.com
17. Understand and support community & public values	Rural futures, Deliberation Matrix	Fiona Coyle	Interest & expertise - Adam Daigneault daigneaulta@landcareresearch.co.nz	Interest in values across research programmes and via LCR led VMO. Focus of OL&W.	N/A	Forest Systems **lisa.langer@scionresearch.com** brenda.baillie@scionresearch.com **tim.barnard@scionresearch.com** karen.bayne@scionresearch.com
18. Policy effectiveness	Rural futures	Chris Daughney Stewart Cameron Mike Sim	Core funding - Suzie Greenhalgh, Adam Daigneault daigneaulta@landcareresearch.co.nz	Interest in policy support tools across programmes	LUCI/SLURI; MGM	Forest Systems **tim.barnard@scionresearch.com** tim.payn@scionresearch.com
19. Future land use options	Rural futures	Stewart Cameron Chris Daughney	Core funding - Daniel Rutledge, John Dymond, Alex Herzig rutledged@landcareresearch.co.nz	Flow tools such as CHES, Env Flows Assessment Platform (EPSAP); TopNet; and impact prediction tools on water quality effects CLUES and TRIM. Integrating these is proposed as a OL&W project	SLURI	Forest Industry and Informatics **graham.west@scionreserch.com** stefania.pizzirani@scionresearch.com
20. Potential scenarios	N/A	Troy Baisden Mike Sim	Core funding & collaborations - Daniel Rutledge, Bob Frame rutledged@landcareresearch.co.nz	Climate effects on primary production and flooding and aquatic plant biosecurity threats.	LUCI/SLURI and B3 (Bioprotection), plus associated commercial funding	Forest Systems **tim.payn@scionresearch.com** juan.monge@scionresearch.com graham.west@scionresearch.com steve.wakelin@scionresearch.com karen.bayne@scionresearch.com

4.7 Role of the NLRC

The strategic scan revealed a number of 'enabling' themes (see Table 2) to support more effective prioritisation and implementation of research. These themes offer wider systemic change, would help deliver on the Strategic Roadmap, and are within the current operational scope of the NLRC. Table 6 therefore highlights some recommended activities to support the Strategic Roadmap.

Table 6 Enabling programmes and activities

Programme of work	Recommended activity	Purpose – key systemic change
Human capital	Develop a pan-sector knowledge transfer strategy	To increase uptake and adoption of science information and tools, thereby increasing the value and impact of research
	Identify and address regional council needs for capability development to use science tools and information	
Information capital	Explore opportunities for shared data infrastructure and services between CRIs, regional councils and other agencies	To maximise the utility of data and information from research
	Develop principles and technologies to bring together and analyse heterogeneous data	
Organisational capital	Initiate a cross-agency stock-take of research in land and water, including analysis of implementation pathways and possible additionality gains	To ensure the right science is being done and additionality gains are maximised
	Facilitate discussions and progress in each of the alignment opportunities outlined in Strategic Roadmap	To ensure the most effective implementation pathways are being used and alignment opportunities are utilised

At the time of writing, discussions are underway on a number of these activities. Most notable is a recent Ministry for Primary Industries request for proposals to identify '*Future Requirements for Soil Management in New Zealand*', which would contribute towards a cross-agency stock-take of research.

5 Conclusions & Recommendations

5.1 Concluding remarks

Given the need to review and refresh the 2011 Regional Council RS&T Strategy, the significant shifts in the operating environment and 2014 as a year of establishing initiatives, this project is very timely.

Emerging collaborative efforts (sector alliances and science reforms) and the need for consistency, particularly in regard to the implementation of national policies, standards and reforms, provide both the willingness and demand for the LMG and LMF to be significant contributors to a national effort in the land and water domain. The Strategic Roadmap offers a number of pathways for the LMG and LMF to ensure this contribution is realised. The rudimentary review, analysis, and ranking of research priorities will ensure the relevance of LMG and LMF programmes of work to the operating environment.

The project itself served as a basis to build mutual understanding and trust across SIGs, the CRIs, and other agencies, forming the foundation for the collaborations needed to deliver on the Strategic Roadmap. The work highlights the promise of partnership approaches within the innovation system, where the roles of knowledge providers and users are fluid and reinforcing. At the time of writing a number of the recommended alignment activities are already underway.

5.2 Recommendations

Ten recommendations for further work are provided to ensure the intent of the project is realised and the Strategic Roadmap becomes a resource of enduring relevance and value to the LMG and LMF, including:

Strategic roadmap

1. Key activities within the Strategic Roadmap are endorsed, resourced and leaders or 'owners' from within the LMG and LMF appointed to drive them

2. Recommended activities such as discussion with key government agencies and the primary sector are endorsed at a senior level within regional councils, are targeted and well-facilitated to ensure adequate progress

3. Strategic and international scans are periodically undertaken to ensure the Roadmap and associated research priorities remain relevant to the changing environment

Research Priorities

1. LMG, LMF, Ground and Surface Water SIG RS&T strategies are reviewed and cross-referenced to optimise alignment opportunities across land and water domains

2. A coordinated and strategic programme of work is sought to give effect to research priorities identified as critical to the LMG and LMF – either through collective resourcing, a more coordinated and proactive input into Envirolink decision-making, or targeting of external funding opportunities

3. As a starting point for 5, a stock-take of the 'knowledge frontier' and likely impact is assessed for each of the research priorities including: an assessment of the scope and size of projects to address key research and/or implementation gaps and a set of options for funding

4. Given the dependence on behaviour change and uptake to achieve research priorities 1–2, 13, and 15 (particularly for LMG), discussions are held to determine the shape of a collaborative effort with MPI and the primary sector industries

Systemic changes

1. The LMG and LMF support and/or contribute towards relevant activities that emerge in the wider environment, e.g. the MPI request for proposals on the Future Requirements for Soil Management in New Zealand and relationships with and through the NLRC, including the National Science Challenge 'Our Land & Water' are maintained to ensure ongoing connectivity with the science sector

2. Support is provided for enabling programmes of work (as described in Table 6) such as the development of a consistent and accessible (through the NLRC website) directory of experts (to facilitate a more transparent and open interface with the wider group of CRIs and research providers)

3. This project, the relationships that underpinned it, the partnership approach and the strategic outputs are widely communicated at relevant forums (e.g. NZARM and NZSSS conferences) and to key stakeholders (e.g. through the SIG review, to Chief Executives, central government partners and the Land and Water Forum) as an exemplar of a different way of working within the innovation system.

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