Land Information New Zealand
Toitū te whenua

New Zealand Geospatial Research and Development Priorities and Opportunities 2016 – 2020

Working in partnership to grow benefits for end users

Section A – Overview

New Zealand Government

Section A

Supporting documents

This strategy has been published in three sections.
This is Section A, and the other information is available online in Section B - Appendix & Section C - Supplementary Information:

Section B - Appendix
Online PDF at: www.linz.govt.nz/grdpo-appendix

Section C - Supplementary Information
Online PDF at: www.linz.govt.nz/grdpo-supplementary-info

Preface

While working with government, the private sector, communities and research and development (R&D) providers, it has become apparent that there are many opportunities for new R&D projects that use geospatial information to help end users maximise the outcomes from their activities.[1]

Currently there is no single document that provides an overview of these opportunities and identifies geospatial R&D priorities. This gap has been the impetus behind the development of this document.

The R&D priorities and opportunities contained in this document reflect the views of a wide range of stakeholders. We are grateful to all those who have contributed to its development. In particular we would like to acknowledge the workshop facilitator and the two hundred or so workshop attendees who gave up their valuable time to share with us the rich information that has been used to inform this document.

[1] Across the public and private sectors there are already many R&D activities using geospatial information occurring. By publishing this document and implementing the 'next steps' we hope to raise overall awareness of these activities.

Overview

Geospatial information has the potential to add significant value to the social, cultural, environmental and economic fabric of New Zealand.

It allows us to grow more productive businesses; to deliver social and health services more efficiently; to manage our natural resources more sustainably; and to manage risk and respond to disasters more effectively.

To enable us to maximise these benefits in a technologically complex and rapidly changing environment requires an intentional focus on developing our R&D capability.

In 2014, we held fourteen themed workshops to help identify the priorities and opportunities for geospatial R&D in New Zealand. Over 200 participants attended these workshops, which focused on identifying key themes for where geospatial R&D would deliver the biggest benefits for end users.

We used the findings of these workshops to develop five overarching R&D priorities for geospatial research:

- understanding the value of geospatial information
- increasing the use of geospatial information
- increasing the collection, validation and analysis of data
- improving the availability and intensity of geospatial information
- improving the standardisation and interoperability of geospatial datasets.

To support their delivery we identified 40 associated R&D opportunities. We have also used the workshop findings to identify a further 140 specific R&D opportunities. These are contained in the Appendix to this document and are presented in seven specific topic areas[2] and the 12 workshop themes.[3] For those preparing proposals for R&D investment, more detailed information gathered through the workshops has been presented in the Supplementary Information document available for viewing and download at www.linz.govt.nz/grdpo-supplementary-info. These R&D opportunities will provide benefits to end users across a wide spectrum of sectors.

We recognise that there is already a considerable wealth of R&D material in the public domain and that government agencies, research providers and private sector organisations have R&D programmes focused on improving the quality, value and use of geospatial data and information. We hope that our work to identify these priorities and opportunities will result in R&D that significantly improves the value of geospatial data and information to end users, and as a result delivers stronger economic, social and environmental outcomes for New Zealand. We recognise that to achieve this will require ongoing work to:

- raise awareness of the value of geospatial information
- develop our pool of talented geospatial researchers and developers
- understand the extent of existing geospatial R&D, both in the private and public sectors
- understand the benefits geospatial R&D can deliver
- maximise the outcomes that can be achieved from the use of geospatial information
- encourage prioritised investment in geospatial R&D.

We are committed to making this happen, but we can't do this alone. We encourage researchers to engage with end users; end users to engage with providers of research; and investors to help end users and researchers realise their goals. We also encourage end users and researchers to consult with government about your needs and research proposals, as there may be initiatives underway which could answer your questions, address your problems or provide opportunities to collaborate.

[2] The seven specific topic areas are: Crowd-sourcing, Data Intensity, Data Management and Governance, Fundamental Datasets, High Value Manufacturing and Services, Interoperability and Standards, and Metadata.

[3] The 12 workshop themes are: Auckland Today and Tomorrow, Buildings and Urban Planning, Canterbury Earthquake Recovery, Culture, Heritage and Tourism, Energy and Minerals, Environment, Emergency Services and Related Services, Health and Society, National Infrastructure, National Resilience to Natural Hazards, Primary Industries, and Strategic Interests Beyond our Borders.

Introduction

Purpose of this document

This document has been developed as part of New Zealand's Geospatial Strategy to help inform future decisions about activity and investment in geospatial R&D. It will be particularly useful to researchers and end users, who will have access to ideas and opportunities that span the breadth and depth of geospatial activity across New Zealand. It will also enable R&D funders to gain a deeper understanding of the benefits that derive from, and the end user demand for, geospatial R&D. This document has a number of aims that contribute to the ongoing development of a broad-reaching, cross-sector geospatial R&D programme, designed to support the functioning of the geospatial system, including to:

- raise the visibility of geospatial R&D in New Zealand
- demonstrate how geospatial R&D can contribute to the New Zealand economy
- identify priority areas and opportunities for future geospatial R&D and investment to make the best use of our limited resources
- contribute to achieving increased uptake, use and value creation from geospatial data and information
- ensure that R&D projects are more closely aligned with end user needs
- connect researchers to end user driven research ideas
- increase investment in geospatial R&D
- grow geospatial R&D capability in New Zealand
- increase collaboration, connectivity and alignment between researchers and end users domestically and internationally
- identify challenges and constraints that may be impacting on developing and delivering geospatial data, information and services.

We believe that by working in partnership with researchers and end users we will create a thriving and well connected geospatial research community that will grow benefits for New Zealand. In section 5 we identify a number of steps we will take to support this approach.

Wider contribution

The priorities and opportunities identified in this document directly support the achievement of the LINZ Vision to achieve a tenfold increase in the value generated by location information in 10 years (by 2023). They are also closely aligned with the:

- New Zealand Geospatial Strategy
- New Zealand Government's Information and Communications Technology (ICT) Strategy and Action Plan
- New Zealand Data Futures Forum Principles and Recommendations
- New Zealand Government Open Access and Licensing (NZGOAL)
- National Statement of Science Investment
- New Zealand Business Growth Agenda
- He Kai Kei Aku Ringa: Crown-Māori Economic Growth Partnership
- Thirty Year New Zealand Infrastructure Plan
- New Zealand's National Security System
- UN Sustainable Development Goals
- Australia and New Zealand Cooperative Research Centre for Spatial Information (CRCSI) Strategic Plan.

The R&D priorities also contribute to the achievement of Government priorities to *build a more competitive and productive economy*, to *deliver better public services*, and to *rebuild Christchurch*.

The value of geospatial information

Geospatial information, or at its simplest information about location, is changing how we see and interact with the world. It lets us know where things are and how they relate to one another. By combining geospatial information with other forms of data we can create the critical data infrastructure we need to create benefit. For example geospatial information can:

- enable the more efficient use of natural resources
- improve biosecurity and cybersecurity management
- enhance disaster preparedness, response, recovery and risk mitigation
- support growth in economic development
- deliver more efficient planning and community service delivery
- lead to more effective forecasting and policy formulation
- strengthen national security
- result in cheaper service delivery by government agencies.

The internet, mobile devices and location-based services are bringing people into direct contact with geospatial information on a daily basis. In-car navigation systems, dynamic maps, and geotagging of websites and apps have all been made possible by geospatial information.

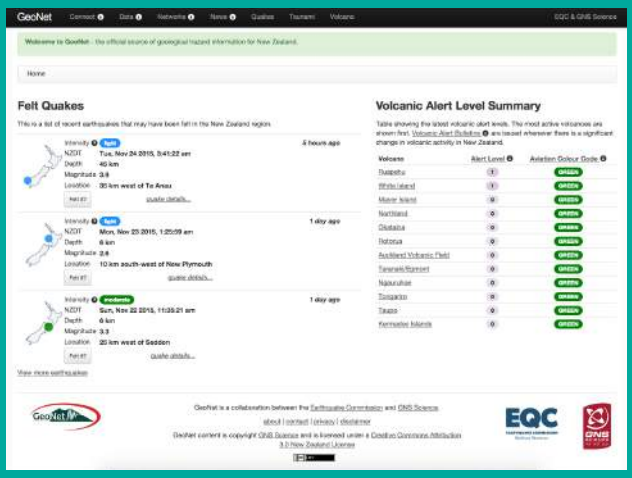
Collection, use and reuse of geospatial information are increasing at a rapid rate. The geospatial industry is estimated to be growing at a rate of 30% per annum globally.[4]

GEONET – MAKING GEOLOGICAL HAZARD INFORMATION UNDERSTANDABLE AND ACCESSIBLE

GeoNet is almost a household name in some parts of New Zealand. Established in 2001 by GNS Science and sponsored by LINZ and the Earthquake Commission, GeoNet supports a wide range of activities that contribute to a better definition of potential geological hazards in New Zealand and enhanced emergency management and disaster response.

It uses real-time geospatial information to communicate with people across New Zealand, and also collects information to extend the knowledge of the scientific community. The network of sensors that underpin GeoNet work alongside automated software and skilled staff to detect, analyse and respond to earthquakes, volcanic activity, landslides and tsunami.

This information is then communicated in a clear and intuitive manner to end users through a range of channels, including an interactive website and mobile phone app. These have been developed to enable a two-way communication with the public, who can report back to GeoNet on their experiences of a particular event, adding to the richness of information available.



[4] Oxera. (2013, January). *What is the economic impact of Geo services?*: Prepared for Google. Retrieved from http://www.oxera.com/Latest-Thinking/Publications/Reports/2013/What-is-the-economic-impact-of-Geo-services.aspx.

The value of geospatial information for economies

The geospatial sector is having a significant economic impact.[5] The Boston Consulting Group estimated in 2012 that broader geospatial services companies drive $1.6 trillion in revenues and $1.4 trillion in cost savings throughout the United States economy.[6] This represents 10% of the United States' gross domestic product (GDP). It is estimated that as much as 80% of government information has a geospatial component, such as an address or other reference to a physical location.[7]

McKinsey have estimated the value of personal location data to be greater than $100 billion per year in revenue and as much as $700 billion a year in the value to consumer and business end users.[8]

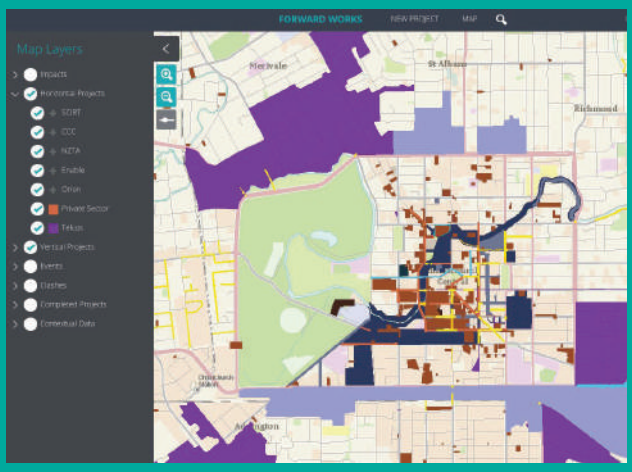
Geospatial information and related technologies are already adding significant value to the New Zealand economy – in 2008 it was estimated that the use and reuse of geospatial information was contributing $1.2 billion in productivity-related benefits; and that New Zealand could see a further $500 million dollars in economic growth per annum through improved productivity resulting from advances in geospatial information and technology.[9] This is in addition to the social, environmental and cultural benefits it can deliver.

THE FORWARD WORKS VIEWER – PARTNERSHIP DELIVERS PRODUCTIVITY GAINS

Coordinating building and infrastructure repair across multiple organisations under unprecedented conditions was the challenged faced after the Canterbury earthquakes. Enabling multiple parties to see a shared online view of the horizontal infrastructure repairs, planned buildings, and other construction planning was the solution the Forward Works Viewer (FWV) delivered.

The FWV helps users to identify conflicts between projects and planned network activity, thereby identifying opportunities to better coordinate their work and resources.

The FWV demonstrates how the private and public sectors can partner to solve big challenges, in this case the $40 billion rebuild of Christchurch. As at 30 June 2015, the FWV has generated more than $13 million of quantifiable benefits, a figure that is set to grow in coming years.



[5] Dasgupta, A. (2013, May). *Economic Value of Geospatial Data: The great enabler.* Geospatial World. Retrieved from http://geospatialworld.net/Magazine/MArticleView.aspx?aid=30534.

[6] Henttu, H., Izaret, J.M., Potere, D. (2012, June) *Geospatial Services: A $1.6 Trillion Growth Engine for the US Economy: How Consumers and Business Benefit from Location-Based Information.* Boston Consulting Group. Retrieved from http://www.bcg.com/documents/file109372.pdf; p 2.

[7] Folger, P. (2012, April). *Issues and Challenges for Federal Geospatial.* Congressional Research Service. Retrieved from http://www.fas.org/sgp/crs/misc/R41826.pdf.

[8] Zeiss, G. (2013, May). *Economic Value of Big Geospatial Data Could Reach $700 billion/yr by 2020.* Between the Poles. Retrieved from http://geospatial.blogs.com/geospatial/2013/05/economic-value-of-big-spatial-data.html

[9] ACIL Tasman. (2009, August). *Spatial Information in the New Zealand Economy: Realising productivity gains.* Retrieved from http://www.linz.govt.nz/about-linz/our-location-strategy/geospatial-projects/spatial-information-new-zealand-economy.

The value of geospatial information for Māori

Geospatial information makes a major contribution to Māori, particularly through data/information, knowledge, science and innovation, and the Māori economy (eg He Kai Kei Aku Ringa).[10]

Geospatial information has the potential to deliver significant economic and social benefits for Māori and enhance decision-making by Māori for determining their aspirations.

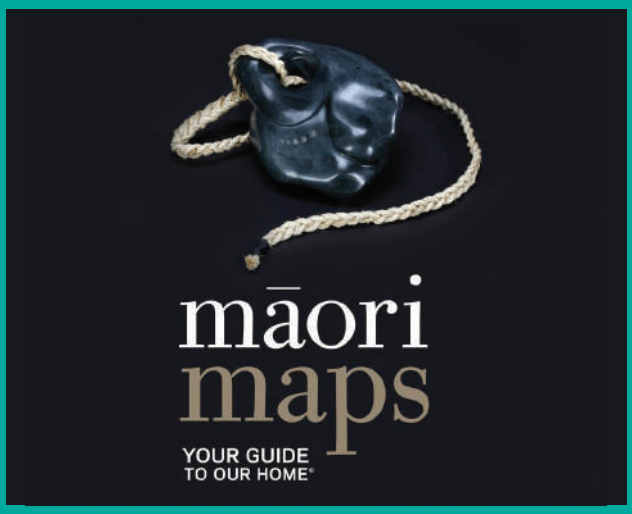
For example, geospatial information makes a major contribution to understanding Māori land.[11] Currently a large proportion of Māori owned land has been characterised as under-utilised or unproductive. Geospatial information provides the underlying knowledge to increase the utilisation and productivity of this land.[12] A number of strategies and actions can be used to achieve this including:

- identifying land potential
- resetting New Zealand's property rights system to accelerate Māori development
- developing innovative and holistic systems thinking approaches to sustainable land management
- implementing novel, natural resource, co-management operating models
- documenting the rich indigenous cultural history, such as Māori values, ancestral stories and geographic place names, that can strengthen the connection between Māori and the land and support Māori economic development aspirations.

MĀORI MAPS – HELPING MĀORI CONNECT TO THEIR ANCESTRAL MARAE

Māori Maps (www.maorimaps.com) is a portal that uses geospatial information to help Māori connect with their ancestral marae and provide information to visitors.

The initiative, which commenced in 2007 with the founding of Te Potiki National Trust, went live in 2013 and since then it has attracted 1600–2000 users per week. It now houses details of 766 ancestral marae scattered throughout the country. Marae communities are welcoming the greater visibility and descendants are finding it easier to locate their tūrangawaewae. There are plans to add new layers of information and mapping in future.



[10] Further information can be found at http://www.mbie.govt.nz/info-services/infrastructure-growth/maori-economic-development

[11] Examples include Māori Land Online: http://www.maorilandonline.govt.nz/gis/home.htm; and the Visualising Māori Land tool: http://whenuaviz.landcareresearch.co.nz/.

[12] LINZ. (2015). *Maori and Iwi Development.* Retrieved from http://www.linz.govt.nz/about-linz/m%C4%81ori-and-iwi-development.

The value of geospatial information for sectors

A 2013 study[13] of the contribution of geospatial data and technology to the Canadian GDP found the sectors most impacted by productivity improvements were, in order of magnitude:

- mining, quarrying, oil and gas extraction
- transportation and warehousing
- utilities
- public administration
- construction
- agriculture, forestry, fishing and hunting
- management of companies and enterprises.

To realise similar gains in the New Zealand economy requires an ongoing commitment to the development of the geospatial infrastructure and associated technologies.

As the end users of geospatial research are spread across the whole spectrum of public, not-for-profit and private sector organisations, businesses, communities and individuals our challenge is to capture their needs so they feed into the development of future geospatial R&D opportunities and priorities.

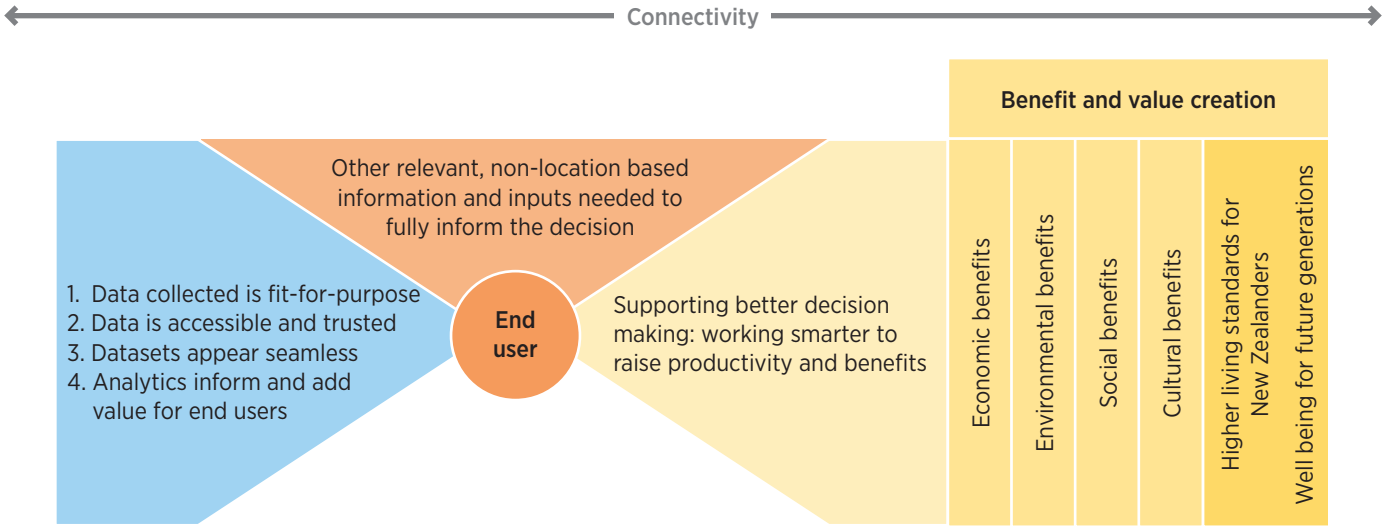
[13]Geo Connections. (2015, March). *Canadian Geomatics Environmental Scan and Value Study.* Natural Resources Canada. Retrieved from http://ftp2.cits.rncan.gc.ca/pub/geott/ess_pubs/296/296426/cgdi_ip_41e.pdf

The geospatial R&D ecosystem

Geospatial infrastructures are by their nature complex; they require a pool of talented private and public sector researchers delivering targeted and focused geospatial R&D to support their development. A study commissioned by the Spatial Industries Business Association (SIBA) and LINZ in 2012[14] identified that New Zealand has a geospatial skill shortage that is constraining the industry. As a result LINZ has initiated a number of schemes, in partnership with other organisations, which are aimed at increasing capability across the sector; for example the multi-university Geographical Information System (GIS) Masters programme.[15]

A successful and well-functioning geospatial R&D community is one that is well-connected, particularly across the public and private sectors, and has a strong focus on growing benefits for end users, whether these are economic, environmental, social or cultural. Figure 1 demonstrates how such a system can work.

Figure 1: Growing benefits for ends users and New Zealand



[14] de Roiste, M. (2012, July). *The Geospatial Skills Shortage in New Zealand.* LINZ and SIBA. Retrieved from http://www.victoria.ac.nz/sgees/about/staff/pdf/Geospatial-SkillsShortageReport.pdf#Geospatial%20skills%20shortage%20in%20New%20Zealand%20report.

[15] Further information can be found at http://www.mgis.ac.nz/.

Data collected is fit-for-purpose

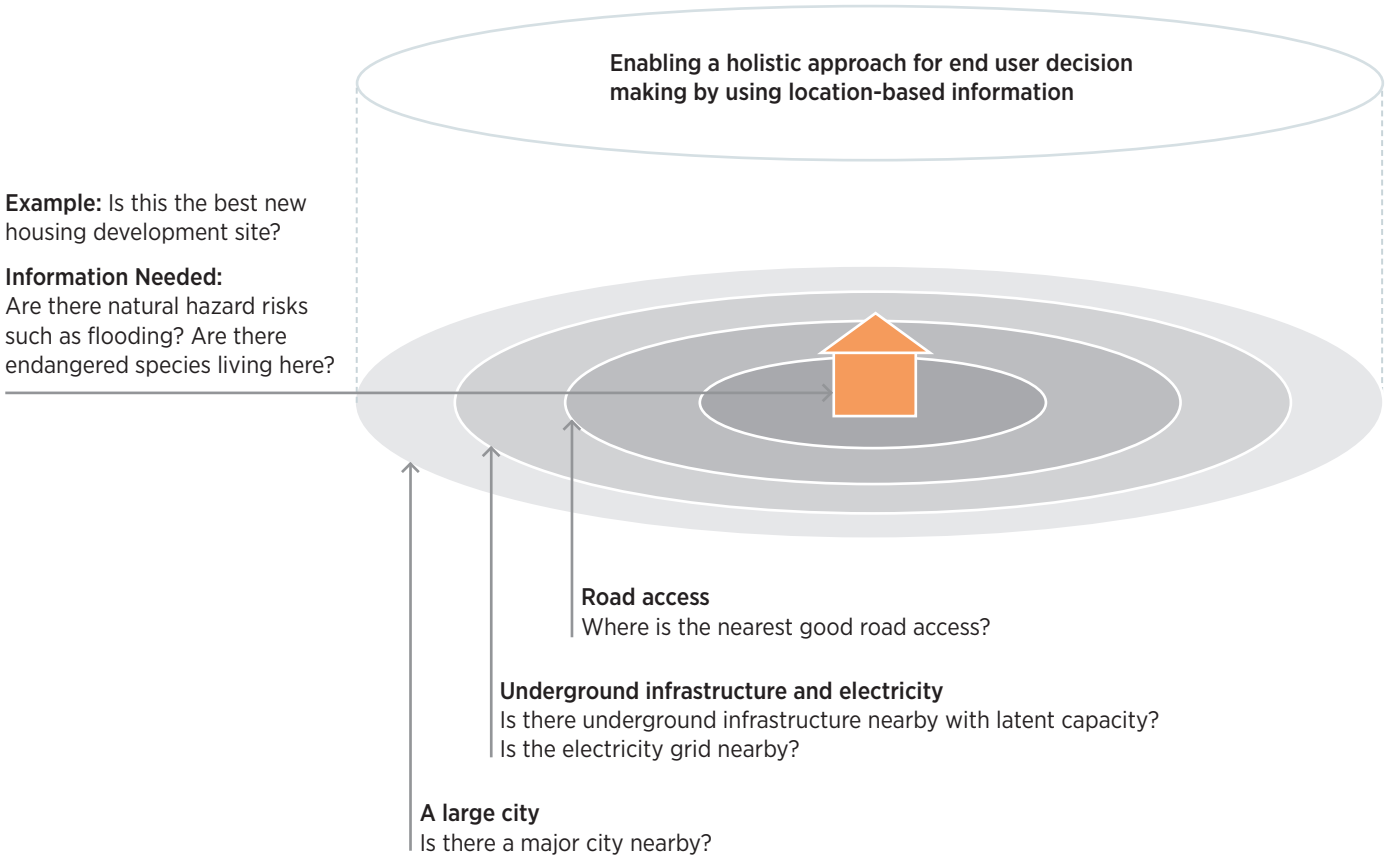
Data can be, and is being, collected in many different ways. Sensors are being embedded across our cities to collect data on how we move and interact with our environment; and mobile devices and apps are being designed to transmit increasing amounts of data to support the development of future services and offerings. This is leading to large collections of data, known as 'big data'.

But is all of this data 'fit-for-purpose'? This is not an easy question to answer; therefore for the purposes of this document we have defined fit-for-purpose as data that allows the end users to make well informed decisions. This may include information relating to the:

- frequency of data measurement
- degree of data resolution
- accuracy and completeness of data
- provenance of data
- accessibility of data
- data cost and/or end user affordability.

Figure 2 illustrates this by providing an example of how an end user considering building a housing development in a specific location may need to take a systems view, which takes into account information about other related objects or attributes and their locations.

Figure 2: Geospatial information enabling a holistic approach to end user decision making



Data is accessible and trusted

There are many obstacles to increasing the uptake and use of geospatial information including concerns about data privacy, data ownership, the liability for the use of data and data confidentiality. In addition, datasets need to be discoverable so that they can be reused for other purposes, thereby increasing their value.

SEA CHANGE – TAI TIMU TAI PARI – NEW ZEALAND'S FIRST MARINE SPATIAL PLAN

Sea Change[17] will be New Zealand's first Marine Spatial Plan (MSP) when it is delivered in 2016. It is centred on the 1.2 million ocean hectares of the Hauraki Gulf, which supports a range of wild life, as well as human activities such as tourism, boating, aquaculture and fishing.

This jewel in Auckland's crown is under pressure as it faces challenges from increased accumulation of toxic metals, reduction in species, changes in natural habitats, and impacts of shipping on marine mammals.

The MSP is focused on finding ways to share and care for a marine environment now so it is available for future generations. MSP is a proven methodology that has been used around the world. Mana whenua, and local and central government are working in partnership to secure a healthy, productive and sustainable resource for now and future generations.

Datasets appear seamless

The collection and management of geospatial data are considered by many to be the costliest components of a GIS; some experts attribute close to 80% of GIS total costs to data acquisition.[18]

Implementing shared standards for metadata and understanding the connectivity between datasets and data layers are key enablers that will increase the value we can get from using and reusing data. They allow data to appear seamless, and enable users to more easily work across different datasets, and extract information from them with higher levels of confidence.

Analytics inform and add value for end users

End users need to have access to reliable and understandable information that supports them to make more informed decisions. If information cannot be quickly and easily understood, or if it is unreliable or inaccurate, then this may impact on decision making, resulting in unintended consequences and outcomes.

The quality and availability of analytical and decision support tools is critical for some end users to enable them to extract value from geospatial data and information.

[17] Further information can be found at http://www.seachange.org.nz/.

[18] New York State Department of Environmental Conservation, Center for Technology in Government. (1995), *Sharing the Costs, Sharing the Benefits: the NYS GIS Cooperative Project.* Project Report 95-4. Retrieved from http://www.ctg.albany.edu/publications/reports/sharing_the_costs/sharing_the_costs.pdf

Geospatial R&D priorities

Fundamental principles

To determine and help develop New Zealand's R&D priorities we identified the following fundamental principles for geospatial R&D.

1. Value is created by end users when they generate economic, environmental, cultural or social benefits from their activities.
2. Geospatial information and analytics have to be fit-for-purpose, easily understood and usable in order to create benefit for end users.
3. Geospatial R&D should contribute to the desired tenfold increase in the value gained from the use and reuse of geospatial data and information by 2023.
4. End users have a key role to play alongside R&D specialists in informing priorities for geospatial-related R&D investments.
5. There should be a core tier of well-validated fundamental datasets, for example space (x, y, z) and time (t), which should be freely available to all New Zealanders.
6. The governance of New Zealand's geospatial data, information and systems should align to the principles and objectives of the NZGOAL framework.
7. Interoperability between geospatial and non-geospatial datasets is critical given that most uses of geospatial data and information involve the integration of more than one of these datasets.
8. It is critical that we understand and can model the relationships between different data layers.
9. Geospatial data and information should, where possible, be easily discoverable, actively promoted, accessible and reuseable.
10. The use of resources should be maximised by minimising duplication of R&D effort and by leveraging off R&D conducted both domestically and internationally.

Priorities and opportunities – sector views

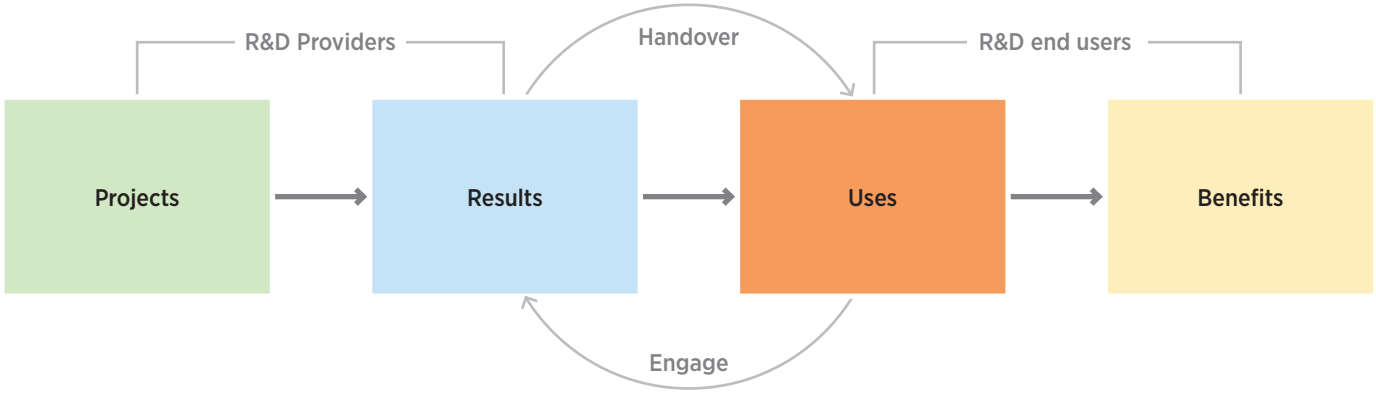
Fourteen themed workshops were held in 2014 to help identify the priorities and opportunities for geospatial R&D. Over 200 participants attended these workshops, which primarily focused on identifying end user needs. This allowed us to develop a greater understanding of the benefits that would accrue to end users from access to appropriate geospatial information.

The outcomes of these workshops are captured on the following pages and are presented in more detail within the Supplementary Information document available from www.linz.govt.nz/grdpo-supplementary-info.

Critical to determining these priorities and opportunities in the workshops was the recognition that how the R&D will be used by end users informs what researchers prioritise and undertake. Therefore an important element of gathering information to inform this document was to ensure strong alignment between the end use and benefits of R&D and the projects and results (Figure 3).[19] The stronger the alignment, the more seamless the adoption of the R&D project outputs by the end user, and the greater the value generated.

A high-level view of workshop findings applying this model is presented in Figure 4.

Figure 3: Turning project results into end user benefits



[19] The methodology developed by Phil Driver, OpenStrategies, was used in this process. Phil Driver also facilitated these workshops.

Findings from the workshops

A number of common themes and topics emerged from the workshops.

1. Stakeholders agreed that the potential exists to extract greater value from the use of geospatial information. However the achievement of the targeted tenfold growth will be dependent on a significant increase in the amount of information and data that is available, within the context of a well-functioning spatial data infrastructure (SDI) where:
   - all fundamental geospatial datasets have been identified, are readily discoverable, accessible, interoperable and useable, and are being promoted widely
   - governance issues relating to geospatial information including data ownership, privacy, confidentiality, discoverability, access and liability have been resolved
   - datasets are fit for purpose, for example they are up-to-date, liability-free, precise, accurate, complete, standardised, interoperable and have the appropriate resolution.

   The work required to develop and implement a national SDI is being implemented through the New Zealand Geospatial Strategy.

2. It wasn't fully understood where the greatest value creation will come from eg commercial, public or individual use.

3. Overall there was a low awareness of the work-streams related to the New Zealand Geospatial Strategy, for example strategic goals and actions focussed on establishing fundamental datasets, data standards and dataset interoperability.

4. A number of New Zealand wide initiatives were identified as being needed to support the planned growth.

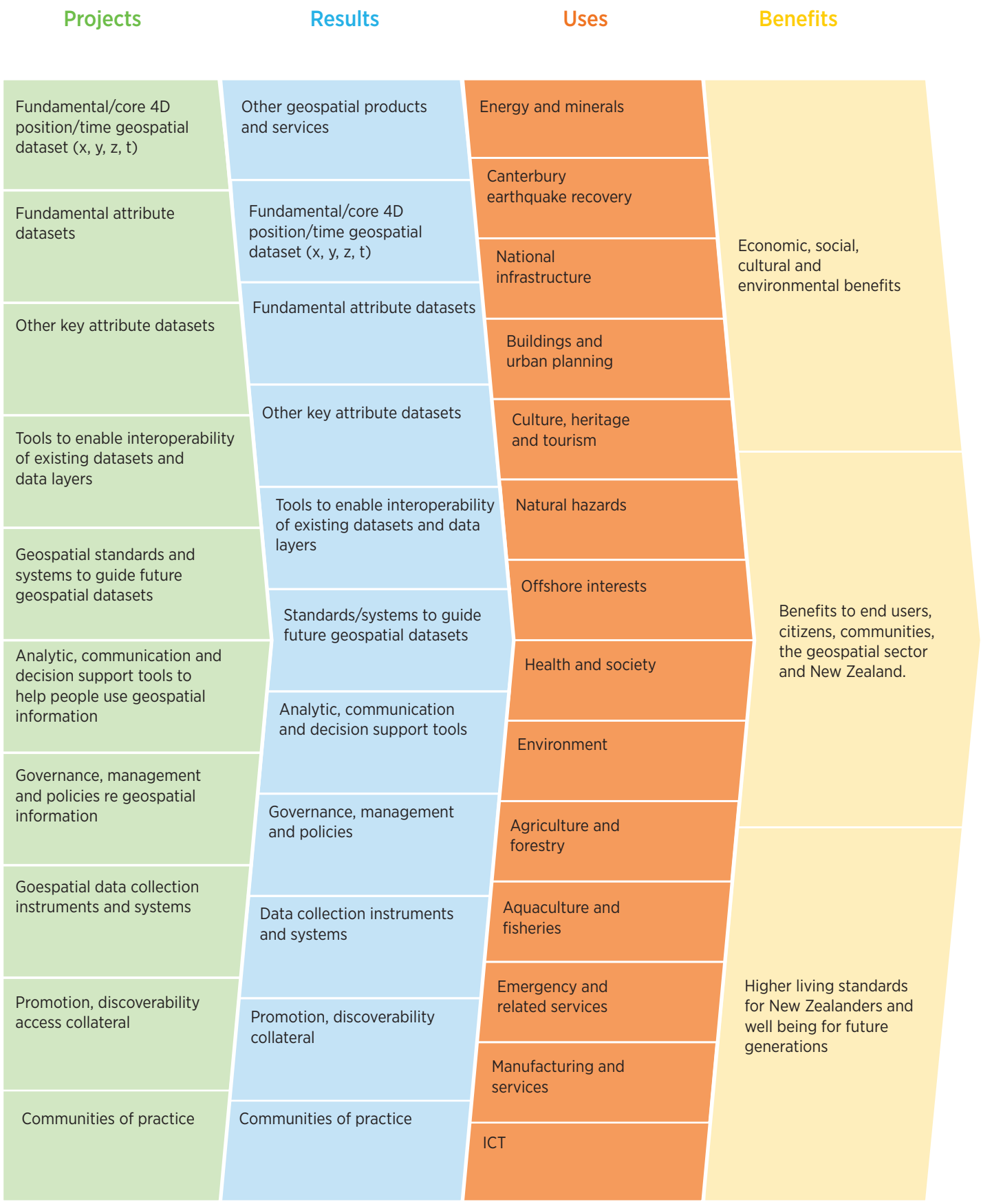
5. Raising general awareness to demonstrate and articulate the additional value geospatial information and analytics can create. For example:
   - increased connectivity and coordination between domestic and international research teams to increase the value created by R&D
   - coordination of the collection of key datasets across multiple agencies so that efficiencies can be gained through reducing duplication of resources, facilitating interoperability, sharing standards and assuring quality
   - a single portal, or 'one door approach', to make all online access of geospatial information quick, easy and reliable
   - a system-wide stocktake of datasets and their interrelationships, feeding into a comprehensive up-to-date and maintained 'catalogue'
   - geospatial communities of practice to accelerate knowledge and best practice sharing and capability building across different organisations
   - use of a common language and definitions, for example what does 'data quality' mean, to develop a common and shared understanding
   - the development and application of consistent data standards for all future geospatial datasets so that they are automatically interoperable.

6. Application of the principles of NZGOAL[20] to both fundamental and non-fundamental geospatial datasets created by public sector organisations and encouragement to creators of non-government datasets to apply the principles of NZGOAL.

7. The workshops provided some insights into the needs of end users:
   - End users are constrained by their ability to understand the information being conveyed; "intuitive use" was mentioned often. Decision support tools were also noted as being needed for some end users.
   - Whilst some end users are constrained by their ability to use the information provided, there was a widely held belief that the uptake and use of geospatial information can be increased by making key geospatial information available in a relatively unprocessed form.
   - Data of the appropriate scale and resolution is needed to support specific end user needs, for example, a farmer might need sub-paddock level data about the nature of soils.
   - Each sector has specific requirements, for example the farming industry requires a greater understanding of the soil variability on individual farms.
   - Most end uses of geospatial information require the overlaying of multiple, interoperable sets of geospatial information.
   - Geospatial datasets need to be interoperable with non-geospatial datasets.
   - What end users want in relation to geospatial information and what the providers of geospatial information are delivering is sometimes disconnected.

[20] Further information can be found at: https://www.ict.govt.nz/guidance-and-resources/open-government/new-zealand-government-open-access-and-licensing-nzgoal-framework/.

Figure 4: High-level view of workshop findings



Overarching R&D priorities and opportunities

We have identified five overarching priorities for R&D using geospatial information:

- understanding the value of geospatial information
- increasing the use of geospatial information
- increasing the collection, validation and analysis of data
- improving the availability and intensity of geospatial information
- improving the standardisation and interoperability of geospatial datasets.

A number of the key opportunities for R&D that respond to these priorities are presented below. Further details on the R&D opportunities that came out of these workshops are summarised in the Appendix which is available at www.linz.govt.nz/grdpo-appendix. More in-depth information about this material is provided in the Supplementary Information document, which is available from www.linz.govt.nz/grdpo-supplementary-info.

Researchers and end users should note that the opportunities presented in this document may not take into account what R&D projects have been undertaken, are currently underway, or are being planned. We urge researchers and end users to undertake their own investigation and take this into account when scoping up new R&D proposals. We also plan to undertake work to develop a deeper understanding about the extent of geospatial R&D and related activities across New Zealand.

Understanding the value of geospatial information

By understanding the value geospatial information can create for end users it is possible to understand the value and potential of each dataset, and the relationships between datasets.

RESEARCH QUESTIONS

a) What are the benefits to New Zealand from investments that support the wider use of geospatial data and information over the next 10 years and how are these best articulated?
b) Which fundamental geospatial datasets will deliver the greatest end user benefit?
c) What is the net value to users of each fundamental dataset and which ones need to be interoperable?
d) Which governance arrangements and business models deliver the most value from geospatial data and information?
e) What is New Zealand's uniqueness in terms of geospatial information and what opportunities exist to develop and exploit this?

DEVELOPMENT OPPORTUNITIES

a) Building upon what has already been conducted in government, develop approaches to establish a hierarchy of fundamental datasets and interoperable clusters of key fundamental datasets.

Increasing the use of geospatial information

There are many constraints that limit the use of geospatial information. By fully understanding these we can develop and implement strategies and approaches to significantly increase the use and value-add of geospatial data and information.

RESEARCH QUESTIONS

a) What are the sector-specific barriers (technical, scientific, social, economic and cultural) to greater use of geospatial information by end users and what can be done to raise end user awareness of the benefits of geospatial information within each sector?
b) How can current and future R&D be made more relevant to end users?
c) How can R&D outcomes be effectively disseminated to end users?
d) How can end users be empowered to make more use of geospatial information?
e) What R&D is required to support the development of products and services that are intuitive for end users and support decision making?
f) How can developments in technologies, such as the semantic web, improve the usability of geospatial information?
g) What approaches are needed to standardise and ensure the use of a common language within the geospatial community and amongst end users?

DEVELOPMENT OPPORTUNITIES

a) Marketing programmes to increase the use of geospatial information.
b) Projects to improve geospatial resource discoverability and access.
c) Approaches to improve geospatial data processing and visualisation.

Increasing the collection, validation and analysis of data

There are many approaches to creating, collecting, validating and analysing geospatial data and information. We need to develop a greater understanding of the strengths and weaknesses of the various mechanisms and approaches.

RESEARCH QUESTIONS

a) What are the most effective mechanisms and processes for rapidly collecting geospatial information and what are the associated governance and management issues?
b) How can geospatial information be cost-effectively extracted from existing geospatial datasets (eg crowd-sourced supermarket data)?
c) What are the unique characteristics of crowd-sourced data and what is its potential value and impact?
d) How can crowd-sourced geospatial data be combined with existing non-crowd-sourced datasets and how can the metadata of such a combined set be 'mashed up'?
e) What protocols/tools/methods are needed for the 'mash-up' of metadata when geospatial datasets are inter-linked?
f) How can we remove duplication and ensure key datasets are collected only once?
g) What are the best protocols, methods and procedures for addressing the trust/liability/validation issues associated with all types of geospatial information?
h) Why aren't metadata standards being widely adopted? Are existing metadata standards appropriate for end user needs?
i) What are the best ways of conveying 'validation' or 'fitness-for-purpose' concepts to those delivering products and services to end users?
j) How can the adoption of standards be best incentivised?
k) How are needs and uses for data evolving and what new data might be required in the future?

DEVELOPMENT OPPORTUNITIES

a) New data collection approaches and technologies for the creation, collection, validation and dissemination of geospatial data.

Improving the availability and intensity of geospatial information

The availability and intensity of geospatial datasets varies across New Zealand, for example urban areas may require datasets with higher levels of accuracy and resolution than remote national parks such as Fiordland.

RESEARCH QUESTIONS

a) What is the concept of 'data intensity' and what are the data management challenges that come with increasing data intensity?
b) What data do we have, what is its intensity, and to what extent is it enabling end users to generate value?
c) What is the ideal intensity for different geospatial datasets based on the correlation between end user needs and value generated?
d) What are the priorities for future geospatial data?
e) How much geospatial data is withheld and what is the impact of not sharing this information?
f) How can we best improve the governance and management of geospatial resources?

DEVELOPMENT OPPORTUNITIES

a) Approaches that create more (or less) intense geospatial datasets for identified, high value uses.

Improving the standardisation and interoperability of geospatial datasets

Ideally datasets should be standardised and fully interoperable. However, the scale of work needed to achieve this outcome needs to be understood and alternative approaches need to be explored to achieve a similar outcome in the short to medium term.

RESEARCH QUESTIONS

a) How can we best understand and model the data relationships between different layers of data?
b) What are the impacts of non-standardised geospatial information?
c) What approaches can be used to make non-interoperable geospatial data at least partially interoperable?
d) How does the adoption of interoperability standards for fundamental datasets drive the adoption of interoperability standards for non-fundamental datasets?
e) What are the costs and benefits of investing in full interoperability versus developing interoperability tools or upskilling end users to use non-interoperable, or partially-interoperable, geospatial data?

DEVELOPMENT OPPORTUNITIES

a) Approaches that make non-fundamental datasets more useable and interoperable.

Next steps

The workshops identified a rich list of R&D priorities and opportunities, both overarching and sector specific.

The overarching priorities capture the pieces of research that will help to increase the value that can be gained from the use of geospatial information.

Our challenge is to influence key decision-makers so that these pieces of research are integrated into the work-streams of relevant government agencies.

We believe that the priorities identified in *Understanding the value of geospatial information* should be given early attention in order to inform the prioritisation of effort across sectors and within sectors.

We will continue to work in partnership with end users and research providers to ensure their needs are understood and well communicated. More specifically we will:

- continue to raise awareness about the value geospatial information can create through engaging with stakeholders, investors and end users
- review this document every 5 years and the Appendix and Supplementary Information document annually
- focus efforts on growing capability with the aim of increasing engagement between researchers and end users both here and internationally, for example we will strengthen engagement with the CRCSI and tertiary education providers
- gain a deeper understanding of the extent of, and develop a baseline for, geospatial R&D and related activities in New Zealand, for example through assessing levels of investment within topics and sectors
- ensure ongoing governance of the implementation of this document and its ongoing development.

End users are encouraged to explore how geospatial information can add value to your ventures. If you identify specific R&D opportunities then we invite you to bring them to our attention or to the attention of R&D providers or investors.

Glossary

There are a number of technical terms used in this document. An explanation of these is given below.

Data
Information in raw or unorganised form (such as alphabets, numbers, or symbols) that refers to, or represents, conditions, ideas, or objects. Very large collections of data are sometimes called 'big data'.

End users or R&D end users
People who use R&D results to create economic, cultural, social or environmental benefit for New Zealand. For example: policy-makers in local and central governments and 'people in the field' such as farmers, foresters and service providers.

Fundamental geospatial datasets
Nationally-significant geospatial data that is critical to the effective running of New Zealand, and works together to help support growth in the economy.

Gross Domestic Product (GDP)
One of the primary indicators used to gauge the health of a country's economy. It represents the total dollar value of all goods and services produced over a specific time period; you can think of it as the size of the economy.

Geospatial
The terms 'geospatial', 'spatial information', 'location information' and 'location-based information' are often used interchangeably. In this document we have primarily used the term 'geospatial'.

Geographic Information Systems (GIS)
A system designed to capture, store, manipulate, analyse, manage, and present all types of spatial or geographical data.

Interoperability
The ability of different information technology systems and software applications to communicate, exchange data, and use the information that has been exchanged.

Metadata
Data that describes other data. Metadata summarises basic information about data, which can make finding and working with particular instances of data easier.

New Zealand Government Open Access and Licensing (NZGOAL)
The government guidance for agencies to follow when releasing copyright works and non-copyright material for reuse by others. See https://www.ict.govt.nz/guidance-and-resources/open-government/new-zealand-government-open-access-and-licensing-nzgoal-framework/ for more information.

Researchers or R&D providers
These are people or organisations that conduct research and development. They can be from both the public and private sectors. For example, universities and Crown Research Institutes (CRIs) as well as companies that operate in this area.

Spatial data infrastructure (SDI)
An SDI can be broadly defined as a network of components that allows people to find, share and use spatial data.

Supporting Documents

This strategy has been published in three sections.
This is Section A, and the other information is available online
in Section B - Appendix & Section C - Supplementary Information:

Section B - Appendix
Online PDF at: www.linz.govt.nz/grdpo-appendix

Section C - Supplementary Information
Online PDF at: www.linz.govt.nz/grdpo-supplementary-info

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