

## Expression of Interest

### Working Group 2: Technology to Enable an Environmental Monitoring Programme

#### Background

The Our Land and Water (OLW) National Science Challenge (Toitū te Whenua Toiora te Wai) has a vision which looks to a future where catchments contain mosaics of land uses that are more resilient, healthy and prosperous than today. This is a future in which all New Zealanders can be proud of the state of our land and water and share the economic, environmental, social and cultural value that te Taiao offers.

Te Taiao is the environment that contains and surrounds us. It has four major components, Whenua (land), Wai (water), Āhuarangi (climate) and Koiora (all living communities). It encourages us to aspire to a future where humanity and the natural world sustain each other in an interconnected relationship of respect.

To ensure the vitality of wai, land stewards need to be confident that their actions will be effective. In partnership with central government, we have identified critical knowledge gaps in the design of environmental monitoring capable of verifying the impact of action on the ground as well as the most appropriate technologies for facilitating verification of actions.

We know that improvements in the design and technology used in freshwater monitoring must give effect to Te Mana o Te Wai and push toward a holistic and connected view that supports the wellbeing of te Taiao. In doing so there is an opportunity to improve visibility of cultural values in monitoring design, and to improve the technology used to support cultural indicators.

As part of its Future Landscapes Research theme, OLW is establishing three streams of work. The first two working groups have been initiated. The third will be a new working group, followed by an integrated programme. Expressions of interest are currently available for working groups 1 and 2. The scope of working group 3 will be further refined before expressions of interests are called.

Working Group 1: Monitoring Design The design of environmental monitoring programmes to enable a holistic and more certain understanding of freshwater outcomes resulting from management actions taken within a catchment or Freshwater Management Unit (FMU).

Working Group 2: Monitoring Technology Defining what technologies are available (or soon will be) that can be successfully used for the measurement of holistic freshwater values, with specific regard to how useful these technologies would be for regulating water use or contaminant discharge.

Working Group 3 and Programme: Māori Knowledge in Freshwater Monitoring Options for embedding Māori assessments of water wellbeing into regional decision-making frameworks, including opportunities to improve technology use in assessment processes.

**In this document we are seeking expressions of interests from technical and cultural experts interested in joining Working Group 2: Monitoring Technology.** If you are interested in joining Working Group 1, there is a separate Expressions of Interest document. Expressions of Interest are not yet open for Working Group 3.

## Timeframe & Budget

Up to \$250k will be allocated among the working group as determined by the Lead Contractor to undertake this project for a period of 6 months between July 2020 and January 2021.

## General Scope and Deliverables

Key research topics to be addressed are:

1. Creation of a comprehensive inventory of available technologies, guided by Working Group 1: Monitoring Design, to enable holistic measurements and monitoring of freshwater use, contaminant discharge and mitigation activities, for a range of end users.
2. Identification on how these technologies could be used to meet a range of requirements for ensuring Te Mana o te Wai alongside resource management, including development of allocation/limit setting policy for both water quantity and quality. Identification of gaps in the technology inventory that will enable the inclusion and monitoring of cultural values, through appropriate mechanisms (to be further explored by Working Group 3).

The programme of work will deliver the following outputs:

- Either a manuscript ready for submission to a high-quality journal (preference) or a high impact report co-designed with key stakeholders. Emphasis is placed on public dissemination and presentation of the results, by providing open access to the results for use by the relevant New Zealand communities.
- Literature review and desktop investigation of technologies (on/in the ground or in rivers, lakes and estuaries) currently in use with specific regard to how useful these technologies would be to measure/monitor the efficacy for regulating of water use or contaminant load, as well as research currently underway to develop future technologies.
- Matrix ranking of technologies (based on research topic 1 above) including how each technology addresses user groups and their requirements; maturity of each technology (including cost, availability and reporting ease (experimental vs operational). These technologies should include remote (e.g. satellite) and in-situ (single or multiple sites) sensors; and their cost of scaling up from single systems to representative regional and national coverage.
- Testing whether the highest-ranking technologies could or could not be used to provide robust data for use in policy scenarios of limit setting and allocation regulation. This may involve a desktop test study leveraging off existing historic cases, e.g. at-risk catchments defined by Ministry for Environment (MfE). (*Note: No new field experiments are required for this study.*)
- An elaboration on how the provided techniques could be used in existing monitoring frameworks used in New Zealand. For example, State of the Environment (SOE) reporting, National Objectives Framework (NOF), National Environmental Standards (NES), Cultural Health Indicators, Overseer, National Groundwater Monitoring Programme, National River Water Quality Database, Freshwater Biophysical Ecosystem Health Framework, LAWA, or the Google Earth Engine (for satellite data).
- Make recommendations for further investigation, including field testing. Note that this programme will not include monitoring, field and analysis activities, which is covered in Working Group 1.

For each technology assessed, the following needs to be investigated:

- Description of the technology: in-river, on land, under the ground surface, estuarine
- What are the costs of each technology, including purchase, installation, maintenance, processing and subscription costs
- The reliability of each technology
- Precision of the measurements created and associated uncertainty
- Scalability of each technology (cost of scaling up, i.e. from lake/wetland/farm to (sub-)catchment to representative regional and national coverage)

- Accuracy of the measurements created (both lab and field accuracy, if they differ)
- Level of capability required to implement the technology adequately, including capacity, IT and field support and communications within and between regulatory bodies and communities
- Level of decision-making support required to use the measurements effectively
- Current and foreseeable developments (within 5 years)
- Temporal and spatial scales at which the technology can work, extending to how well technologies are in a coherent nationally implemented monitoring approach
- Whether multiple sensors or technologies will be needed at farm-scale, and if so, how these technologies would need to be deployed spatially
- How the outputs from these technologies could relate to commonly used land management tools (e.g. Overseer and possibly other nationwide model approaches or interfaces such as CS-Vue used by some regional councils for resource consents)
- Relate to end-user requirements, for a range of end users, to specific technologies, indicating how needs would be met
- What the potential barriers are to adopting the technology over the top of current approaches. If so, how these barriers can be overcome in order to improve the likely adoption rate

Technologies should be earmarked in levels of 'technology readiness' (TR) defined as:

- TR 1: Conceptual (including in development)
- TR 2: Existing and proven
- TR 3: Operational and supported

We are aiming for technologies that could feasibly be fully implemented by 2025. This date is driven by MfE policy (their 2019 Essential Freshwater Package) timelines for noticeable (read: measurable) improvement in water quality.

This programme will need to collaborate with Working Group 1: Monitoring Design and will inform the work undertaken by Working Group 3: Māori Knowledge in Freshwater Monitoring (see section Background) in order to achieve alignment and consistency.

The scope does not include:

- Māori are engaging emerging technologies to support their understanding and obligations to uphold Te Mana o te Wai. In-depth assessment and implementation of technology pathways that support tangata whenua in their cultural monitoring practices is out of scope for Working Group 2 and will be included in Working Group 3.
- The design of an environmental monitoring system will be handled by Working Group 1.

## Eligibility Criteria of Working Group Members

Applicants must have a willingness to collaborate in mission led research and take a multi-disciplinary, co-innovation approach that has te ao Māori at its centre.

The intention is to form a team of individuals who hold a diverse, yet relevant, skill/competency set that includes knowledge about:

- Remote sensing
- IT in terms of knowledge of current public and closed freshwater databases and principles of software engineering pertaining to these databases
- Biometrics
- Numerical modelling or (geo)statistics to address uncertainty
- Expertise in in situ or remote sensing technologies for rivers, lakes, soils, and groundwater
- Policy data requirements at multiple scales (i.e. both regional and national)

## Guiding Principles

1. The work must recognise Te Mana o te Wai. Upholding Te Mana o te Wai requires that in using water you may be required to also monitor some aspects of Te Hauora o te Taiao (the health of the environment), Te Hauora o te Wai (the health of the waterbody) and Te Hauora o te Tangata (the health of the people).
2. The review of technologies must recognise the need to monitor interactions, ki uta ki tai (from the mountains to the sea) between fresh water, land, associated ecosystems and the coastal environment.
3. The work must recognise that Te Mana o te Wai incorporates a range of “shared values” (of tangata whenua and the wider community) in relation to each water body that will require technologies to be implemented in appropriate ways.
4. The monitoring technologies must incorporate measurements of:
  - a) Management Actions (on the land and within freshwater ecosystems)
  - b) Environmental indicators and information, including, but not limited to Freshwater Attributes from the National Objectives Framework (Appendix 2 of the NPSFM) and mātauranga Māori records, measures, cultural values and their indicators.
5. The work must identify how the above monitoring technologies will be guided and appropriately applied to monitor shared values.
6. The work must identify barriers and gaps to using cultural and/or values-based information for monitoring purposes. It should identify the scalability of the technologies within and across catchments and regions.
7. It is acknowledged that work in this area is incomplete, and the monitoring technologies should identify the gaps in our technical ability to monitor Te Mana o te Wai, and may suggest an approach based on key principles and a range of cultural and/or values-based tools that may be used (“holistic toolbox” approach) that will be further developed by Working Group 3.

## What Happens Next

The Challenge has appointed Dr Rogier Westerhoff (GNS) as the Lead Contractor, who will manage the programme of work and bring together a team of about 6 technical experts to collaborate to deliver the work. Expressions of interest should be made via email to [ourlandandwater@agresearch.co.nz](mailto:ourlandandwater@agresearch.co.nz) by **9am on the 22nd of June 2020**.

If you require any further information regarding this EOI, please contact:

- Rogier Westerhoff (Lead Contractor – Monitoring Technology) [R.Westerhoff@gns.cri.nz](mailto:R.Westerhoff@gns.cri.nz) (+64 7 376 1793)
- Dave Houlbrooke (Theme Leader ‘Future Landscapes’ – OLW) [David.Houlbrooke@agresearch.co.nz](mailto:David.Houlbrooke@agresearch.co.nz) (027 4544630)
- Richard McDowell (Chief Scientist – OLW) [richard.mcdowell@agresearch.co.nz](mailto:richard.mcdowell@agresearch.co.nz) (021 569680)

Expressions of Interest should provide a CV and brief description of relevant technical experience including evidence of collaboration, delivery and impact.

We expect to notify people of the outcome of the selection process in late June, with GNS commencing with contracting successful individuals for the Working Group from July 2020. OLW will put you in touch with Rogier Westerhoff for this process.

## Advisory Group

A small advisory group of stakeholders and technical experts will be appointed to cover both Working Group 1: Monitoring Design and Working Group 2: Monitoring Technologies. The advisory group will include the MfE and the Waikato River Authority. As part of this Advisory Group, members are expected to attend and contribute at regular meetings and forums, by challenging thinking and sharing their expert advice.

OLW also welcomes expressions of interest for this group. If you are interested in joining the advisory group please submit a separate application including a CV and brief description of relevant technical and/or cultural experience including evidence of collaboration, delivery and impact to [ourlandandwater@agresearch.co.nz](mailto:ourlandandwater@agresearch.co.nz) by **9am on the 22nd of June 2020**.

## Appendix I: Additional background information

Recent documents that were critical in shaping this document are:

- National Policy Statements for Freshwater Management (NPS-FM, [\[URL link\]](#));
- OLW 2019-2024 Strategy. [\[URL link\]](#)
- Controller and Auditor General report on freshwater management [\[URL link\]](#)
- Controller and Auditor General report on government investment freshwater clean-up. [\[URL link\]](#)
- Ministry for the Environment (MfE) Essential Freshwater Package [\[URL link\]](#)
- Environmental reporting and State of the Environment (SOE) Reports 2019 [\[URL Link\]](#)
- PCE report on Aotearoa environmental reporting. [\[URL Link\]](#)

These documents outline the need for improvement, a set of guiding principles for freshwater values and attributes, as well as monitoring and reporting requirements. These will need to be considered and covered by this EOI. In brief, these documents describe that:

- Regional councils must, through engagement and discussion with the community, including tangata whenua, develop and implement regional plans which identify freshwater values, objectives and management methods, e.g. limits, that will allow these objectives to be met. These regional plans must give effect to and recognise Te Mana o te Wai in the management of fresh water.
- The 2019 Essential Freshwater Package signalled an expectation that measurable water quality improvements would be achieved within 5 years; in several cases regional plan development would need to be fast-tracked. MfE and other organisations are developing substantial work programmes focused on improving water quality in catchments that are at risk or already degraded.
- The Our Land and Water National Science Challenge (OLW), Toitū te Whenua Toiora te Wai, has a vision that future landscapes contain mosaics of land use that are more resilient, healthy and prosperous than today. This is a future in which all New Zealanders can be proud of the state of our land and water and share economic, environmental, social and cultural value from them. OLW describes the need for a transformational shift in water management that incorporates a Māori world view so that we better protect our land and water assets. This places the kaitiaki role, stewardship/guardianship, first. Te Mana o Te Wai principles as put forward by e.g. NPS-FM (section 0) and by the MfE, are a focus on incorporation of mātauranga Māori in central government environmental directives and policy intended to achieve freshwater sustainability
- Recently Parliament (Controller and Auditor General) reports advocate that clearer guidance from central government regarding water management and freshwater clean-up is required – at present there is no agreement across central and local government about the vision for New Zealand’s water resources. This lack of clarity leads to inconsistency between councils regarding information requirements, and the data and monitoring required to meet sustainable water management goals.
- There is a requirement for freshwater management and freshwater clean-up to be more consistent across regions – a national framework or strategy is recommended. This consistency should be extended to include investment in technology, as well as in implementation and use for monitoring and data acquisition.

For a measurable improvement in freshwater quality to be achieved by 2025 (government policy according to 2019 MfE’s Essential Freshwater Package), an increase in adoption of good farming

practices and mitigation tools is required. Robust monitoring methods will also be required to ensure that the anticipated environmental improvements are being achieved.

Data gaps, along with inconsistent data collection and analyses, make it hard to construct a uniform national picture of the state of our environment; whether it is getting better or worse overall, and which areas require implementation of more intensive mitigation. Beyond the acquisition of high-quality data at greater spatial intensity, we also need to be able to interpret these data and generate information.

Working groups, led by OLV and hosted by MfE, gathered in a series of three workshops to identify key research questions for current and future freshwater monitoring. The result is this document.

### **Critical drivers: the NPS-FM and Essential Freshwater Package**

The current (2014, updated 2017) National Policy Statement for Freshwater Management ('2017 NPSFM') recognises the national significance of freshwater and sets Te Mana o te Wai as guiding principle.

Te Mana o te Wai is the integrated and holistic well-being of a freshwater body. Upholding Te Mana o te Wai acknowledges and protects the mauri of the water. This requires that in using water you must also provide for Te Hauora o te Taiao (the health of the environment), Te Hauora o te Wai (the health of the waterbody) and Te Hauora o te Tangata (the health of the people). Te Mana o te Wai incorporates the values of tangata whenua and the wider community ("Shared Values") in relation to each water body.

The NPSFM sets a spatial management framework, composed of freshwater Management Units (FMUs). Within each FMU, the 2017 NPSFM requires that:

- The NPSFM be fully implemented no later by 2025 (or 2030, if certain criteria are met)
- Water quality be maintained or enhanced overall
- Freshwater values and objectives must be identified and formulated through discussions with communities, including tangata whenua
- Freshwater quality and quantity limits must be set by the regional council to give effect to the objectives
- Values be identified, which
  - must include two compulsory Values of National Significance (Ecosystem Health and Human Health for Recreation), and
  - may include other values, including the 11 Other National Values (defined in Appendix A1 of the NPSFM);
- Freshwater objectives be formulated, which
  - must include, at a minimum, the attributes listed in the National Objectives Framework (defined in Appendix 2 of the NPSFM) that are applicable to each value identified for the FMU, and
  - any other attribute that the regional council considers appropriate.
- Monitoring plans be developed by regional councils to monitor progress towards, and the achievement of, freshwater objectives and the extent to which the Values are being provided for. Monitoring methods, must include at least:
  - surveillance of microbial health risks to people at primary contact sites;
  - macroinvertebrate communities;
  - measures of the health of indigenous flora and fauna; and
  - mātauranga Māori.
- Monitoring plans must identify monitoring sites that are representative for each FMU and recognise the importance of long-term trends in monitoring results.

- Regional councils must maintain and operate a freshwater quality and quantity accounting system.

The **2019 Essential Freshwater Package**, comprising a draft NPSFM, National Environmental Standard (NES) and RMA Section 360 regulations, was released in late 2019. Although still a draft for consultation, the 2019 Essential Freshwater Package signals the following policy directions:

- It maintains Te Mana o te Wai as guiding principle, but establishes a hierarchy of obligations within its framework: to waterbodies first, then to the essential needs of people, and finally for other uses
- Strengthens the direction to maintain or enhance water quality everywhere (as opposed to “overall” in the 2017 version)
- Introduces additional Compulsory Values of Threatened Species, and Mahinga Kai/Tangata Whenua value
- Revises the description of the existing compulsory Ecosystem Health value to identify five biophysical components that are necessary to all be managed. These are: water quality, water quantity, habitat, aquatic life and ecological processes (Appendix 1A of the NPSFM)
- Sets additional water quality and ecological Attributes and associated National Bottom Lines (Appendix 2A and 2B of the NPSFM)
- Introduces the requirement to develop plans to manage some attributes
- Introduces a requirement to avoid the loss or degradation of natural inland wetlands
- Requirements for managing fish passage, including monitoring
- Requires that the extent and ecosystem health of rivers and streams, and their associated freshwater ecosystems, are at least maintained
- Requires detailed reporting for each FMU of state and trends of Attributes, progress against any targets, and actions taken to implement the NPSFM

The primary mechanism for implementing the existing NPSFM, the proposed reform package, and other land and water management legislation and regulations is through regional councils developing and implementing regional policy statements and regional plans. This process occurs in two main phases, each with specific monitoring and reporting requirements:

- First, the development of statutory plans (and associated consultation and decision-making processes): This phase requires robust environmental monitoring data to define the state of values and attributes within each FMU, as well as the type and amount of resource used. It also requires a predictive capability to link management options (e.g. limits placed on land use) with freshwater outcomes (e.g. indicators of ecological health) and assess their respective costs and benefits. (What freshwater outcomes do we want for the FMU, and how will we get there?)
- Second, the implementation of statutory plans and associated plan effectiveness monitoring and reporting: Have we achieved/ are we progressing towards the desired freshwater outcomes? Where an improvement is required, are the management actions working and when do we expect we will measure an improvement?

Importantly, the existing and proposed legislative framework places a strong emphasis on engagement with tangata whenua to ensure that tangata whenua values and interests are identified and reflected in the management of waterbodies and freshwater ecosystems. Te Mana o te Wai is identified as the fundamental guiding principle of the NPS-FM and mātauranga Māori must form part of the monitoring methods.



In the last few years, the development and implementation of regional land and water policy has placed a strong emphasis on engagement processes, typically through catchment or FMU-based collaborative processes.

This has meant that environmental monitoring data needs to be accessed, understood and used by a wide range of stakeholders and interest groups. Data derived from environmental monitoring and modelling must provide reliable estimates towards key attributes and values and aid in obtaining an understanding of cause/effects processes and inform catchment models. Environmental data are increasingly used in planning and/or legal processes such as regional plan development or resource consent processes and, as such, rigorous quality assurance and quality control standards must be met. At a national level, there is also growing demand from central government agencies such as Ministries or Statistics NZ for environmental data that may be used for national scale data analysis, reporting and policy development.

Non-regulatory processes have also led to the formation of catchment or sub-catchment stakeholder groups within which there is a strong desire to better understand and measure the benefits that specific management actions have on water quality (e.g. erodible land retirement, nutrient management, riparian and wetland restoration). This understanding is critical in order to better tailor a management response to the nature and scale of the issue and the characteristics of the catchment, prioritise actions and promote their uptake.