Kuaha Matihiko: Digital Gateway

Final Report

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1. Introduction

New Zealand's rich natural heritage and unique biodiversity are under threat from various environmental challenges. The successful conservation and management of our land and water resources require access to accurate, comprehensive, and timely data. However, stakeholders across scales from catchment groups through to central government and policymakers face several challenges in accessing and utilising this critical data. For example, the complexity of land and water monitoring is amplified by the plethora of existing data, tools, frameworks and diverse user-groups in Aotearoa. Thus, implementing new tools and strategies to make land and water data more findable and accessible is a multifaceted and challenging.

- Complex Systems: The data landscape is fragmented and scattered across various platforms and systems, making it difficult for users to locate the necessary information.
- Complex Organisations: Multiple organisations engage in data collection and management, including universities, Crown research institutes, and other entities, contributing to a lack of a centralised repository and creating confusion.
- Hard to Find: Essential data such as biodiversity information, species distribution, habitat types, and ecological surveys are often buried in complex systems and tangled organisational structures, remaining elusive for those who need it the most.
- Hard to Know Who to Ask: With the involvement of multiple stakeholders, it's often unclear who the right point of contact is for specific data inquiries.
- Hard to Access: Even when data is located, accessing it can be a significant challenge due to a variety of formats, lack of standardisation, and possible restrictions.
- Hard to Know How to Use: The lack of proper documentation or user support can make it challenging for users to understand and utilise the data effectively. This is compounded by the absence of localised and region-specific data on the impacts of climate change on protected areas and biodiversity.

The lack of collaboration and accessibility by many stakeholder groups hinders progress towards sustainable land and water governance, management and use. The project team identified the urgent need for an integrated and user-friendly centralised gateway that provides easy access to all the relevant data a user needs to find. Consequently, this research's goal was to develop and validate a digital MVP (Minimum Viable Product) for a user-friendly, translatable, relevant, publicly accessible Digital Gateway (Kuaha Matihiko). To achieve this goal the project's objectives were to:

a) Implement a 'bottom-up' wānanga/engagement-focused research approach to explore how co-management and power-sharing aspirations of local, regional and national stakeholder groups involved in kaitiakitanga activities for land/water could be implemented through the co-design, adoption and use of existing technology.

b) Work across scales (with iwi/hapū and/or regional/central government and/or other relevant groups) to review and test the accessibility/uptake via a new purpose-built gateway to data/toolsets. Working across key stakeholder groups aimed to provide an understanding of the available data ecosystem for Land and Water; what already-available datasets, platforms and general infrastructure could be connected into; and to identify where the priorities for capturing new data lay.

c) Investigate the already validated land and water technology available to consolidate access to the many disparate systems and data layers through the digital gateway.

d) Develop and refine a business case for the continuation, support and extension of Kuaha Matihiko. The intention for this project was to take Kuaha Matihiko to an MVP stage where details on the partnerships and funding streams required to take a validated MVP through to commercialisation would be outlined in a business case.

2. Research Aim

The primary aim of this project was to develop a tool to provide enhanced accessibility to land and water data for stakeholders across scales, thereby increasing the adoption and use of information technology and systems to enhance the practice of kaitiakitanga of land and water resources in Aotearoa. New technologies (search engine and chatbot-based AI tools) were developed and implemented across scales to provide connections between data creators and consumers. Through stakeholder interactions we identified barriers and enablers for access to and utilisation of data/toolsets to address real world land and water issues and co-designed a digital platform with end users fostering improved access to and ongoing use of data/toolsets.

3. Impact of Research

All too frequently kaitiaki and multiple stakeholders with a vested interest in improving and reconnecting with the taiao are unable to meaningfully utilise available data due to it being inaccessible, costly to collect, difficult to locate, or not publicly available. By bringing the disparate datasets together with a single user-friendly interface, and in parallel with an effective implementation pathway, stakeholders across scales will be able to readily contribute and access data in a framework for a complete solution. In particular, this project was to addresses the ‘F’ findable and ‘A’ accessible components of the FAIR principles for land and water data utilisation and increase the adoption and use of information technology and systems to enhance the expression of kaitiakitanga. However, future uses for the digital gateway (Kuaha Matihiko) might also address the ‘I’ interoperable and ‘R’ reusable components. For example, post-MVP, the gateway might record land parcel scale data, which could be used for integrated farm planning, and communicating with existing tools such as FarmIQ, Mitigator, or Overseer. This would also assist iwi and hapū with realising the economic potential of their land through evidence-based sustainable management practices. These datasets could use an ecosystem service approach to land and water wellbeing assessments. Such outputs address the Future Landscapes and Pathways to transition OLW Research themes, by providing tools and pathways supporting resilient landscapes and resilient futures.

Through the use of co-design wānanga case-studies, we were able to address data accessibility and platform-use problems to develop concrete examples of how to access and utilise data and adapt the platform to address practical needs of various stakeholder groups across scales, such as hapū and iwi, through to Regional Councils and central government. A bottom-up approach with co-design wānanga were used to underpin the values of kaitiakitanga, manaakitanga and whakawhanaungatanga, highlighting the shared kaupapa and co-management to enhance the mauri of the awa and provide opportunities to reconnect back to the taiao. These wānanga ensured the development of a trusted model for improved land and water data access. For Māori understanding how a range of relevant/translatable data information connected to a shared digital

platform may enable and support their responsibilities and kaitiaki was an intended outcome of this research project. Our co-design wānanga were structured in such a way to provide clear opportunities for stakeholders to share their land and water data requirements and provide solutions to how this might be achieved. The series of wānanga with stakeholders across scales created a sense of place for co-learning and connection. It also provided a platform to identify kaimahi already having some capability in the research space who could act as champions and disseminate the findings of our research further creating greater impact for Māori communities and wider.

We partnered with Pūhoro STEMM academy and rangatahi, who provided an important sounding board for effective platform UI/UX development through a digital stocktake survey and wire-frame drafting. To avoid issues with accessing land and water data, the Digital Gateway made use of existing creative commons datasets from www.data.govt.nz for the development and validation of the tools, utilising wānanga/workshops as the guide for UI/UX development. It now incorporates a web-based platform (www.finddata.co.nz), video, API (application programming interface), and mapping services to direct end-users to download or import relevant land/water data. This facilitates the integration of data from different sources and enables the creation of more dynamic and interactive applications. By incorporating end-user feedback whether directly or through regenerative prompting, the Gateway has been packaged in such a way as to be relevant and attractive to various groups to meet their needs. The ultimate impact of this research will be evidenced by improved knowledge of, access to, and use of relevant, timely and up-to-date data and toolsets by land and water users that meet land/water management, legislative and other reporting requirements.

A key strength of the team at the start of the project was the broad range of relationships with Māori, local and central government, and other stakeholders, several of whom had already shown interest in this research. These partnerships were foundational in bringing kaimahi and stakeholders together to participate in wānanga providing advice to our project team ensuring that the digital tool is of value and relevance. These groups included:

- Te Pumautanga o Te Arawa - Te Pumautanga o Te Arawa was formed as a post settlement governance entity to receive, hold and manage the assets negotiated on behalf of eleven Te Arawa Iwi and Hapū known as the Affiliate Iwi/Hapū.
- Te Arawa River Iwi Trust – Represents three Te Arawa iwi in the upper Waikato River catchment. They have recently invested in water quality monitoring technology that provides real time data on the quality of water along several main waterways in their rohe.
- Mana Tahuna is a Māori charitable trust located in Queenstown. Mana Tahuna are developing a freshwater monitoring network in Whakatipu Waimāori (Lake Wakatipu).

In collaboration with Māori partners, the project team's strong initial relationships and deep cultural understanding in the land and water data sphere, whether stemming from prior digital tool development or involvement in environmental restoration initiatives, laid the groundwork for co-design workshops. These facilitated swift progress towards the design phase of the Gateway project.

4. Land and Water Data Accessibility - Background

In Aotearoa New Zealand resource management system environmental monitoring is undertaken by a wide range of groups, including landowners; groups in the agri-food and food/fibre sectors; iwi/hapū/kaitiaki; local, regional and central government; NGOs; Catchment Care Groups; and the research community. However, the Parliamentary Commissioner for the Environment (PCE, 2019) described the reality of environmental monitoring in Aotearoa as being opportunistic, fragmented and passive rather than being systematically grounded and coordinated.

Ensuring the ongoing maintenance and longevity of such a digital gateway after the end of this mahi, through appropriate stewardship and hosting agreements that ensure it is adequately funded and governed, was a critical requirement to building trust amongst potential users to contribute to and utilise it. As part of our longer-term engagement, a business case was developed and refined for the continuation, support and extension of Kuaha Matihiko. Such a digital service could facilitate the increasing prevalence of community-based data collection initiatives. and assist Māori and other land and water stakeholders to realise their economic, social, cultural and environmental goals. Our intention was that a digital service that was more integrative and collaborative would facilitate the increasing prevalence of community-based data collection initiatives and assist Māori and other land and water stakeholders to realise their economic, social, cultural and environmental goals.

Tangata whenua and community groups undertake monitoring activities to assess the health and resilience of land and water, becoming kaitiaki and establishing connections to the awa and whenua. Currently a lack of trust is apparent among community stakeholders with the current land and water information ecosystem. For example, through our co-design wānanga the gateway project design team were advised of the many barriers that Māori face to access relevant data and make it correlate with their community/rohe. For example, there was often an inherent suspicion of data made available by Regional Council monitoring in that it was not obtained from culturally important sites or from sites that were not representative of the rohe.

Both the process of Gateway design and ensuring broad UI/UX across scales were intended actions to address the principles of inclusivity and trustworthiness. Thus, the kaupapa underpinning programme was an intended use of participatory co-design through wānanga and engagement with multiple stakeholders across scales, to create a fit-for-purpose, open data open-source digital gateway. Such a gateway is needed to ensure efficient and transparent access to trusted data sources, that are publicly available, in formats that match the needs of the various end user groups, including: landowners; groups in the agri-food and food/fibre sectors; iwi/hapū/kaitiaki; local, regional and central government; NGOs; Catchment Care Groups; and the research community.

An interconnected research plan was implemented to undertake this project with Phase 1 encompassing the stakeholder engagement and the digital stocktake, and Phase 2 involving the implementation of recommendations from a selection of specific stakeholders for which land and water datasets of interest would be included in the developing gateway.

5. Stakeholder Engagement

Throughout the programme we engaged with the diverse network of creators and consumers of land and water data/toolsets many of whom the project team already liaise with. During the initial 6 months, case studies were selected with representation from such groups to ensure local-regional-national scale, and inclusion of Mātauranga Māori and western science. Three in-person case-study wānanga were undertaken with Mana Tāhuna (Queenstown, 14 December 2022); Te Pumautanga O Te Arawa, TPT (Rotorua, 31 March 2023) and Te Whānau-ā-Apanui (Whakatane, 15 May 2023). During the wānanga the project team were often able to provide immediate impact through assistance with access to datasets e.g. Mana Tāhuna - indigenous vegetation (LENZ, and the use of the Land Cover Database (LCDB) 16) for landscape rehabilitation and riparian planting purposes. Wānanga with TPT attended by seven Environmental Groups. The preliminary design stage of the gateway and associated videos were presented to attendees and was met with excellent support with suggestions to include te reo Māori pages. Examples of data required included information on groundwater sources in rohe and invertebrate biodiversity data for local bush areas undergoing pest-removal and rehabilitation.

Overall, there was strong enthusiasm and support for this kaupapa, and the bottom-up co-design approach taken to make land and water data more findable and accessible and providing guidance on what good data might look like – although this varied with different stakeholders.

The user-centric co-design case-studies provided an opportunity to pitch the gateway kaupapa and obtain end-user feedback on design improvements and prototype development. The instigation and positive attendance at each of the three wānanga was through an iterative bottom-up approach where the project team were able to:

(i) socialise the general idea of the gateway and the potential for what it could be,

(ii) promote interest of mana whenua in participating in a case study,

(iii) obtain a kaimahi lead from each case study to talk about it to others in their wider network and pull together the environmental groups who attended the in person wananga,

(iv) identify kaimahi to lead the ongoing liaison between their network and the project team as new ideas for the gateway were developed and

(v) support kaimahi to explore UI/UX and the overall utility, including prioritizing specific land and water data and factors related to regulatory requirements.

6. Digital Stocktake

As part of Phase 1 of the project to undertake a data/software stocktake, two summer internship students from the Pūhoro Charitable Trust undertook a desk-top search for all digital land and water products and services available in NZ. The students undertook a user-centric review of each product and service identified to ascertain best-practice functionality and UI/UX. Land and water websites included those developed by NGOs, CRIs, industry levy bodies (e.g. Zespri, Fonterra, Miraka Dairy, HortNZ etc.), universities and Regional/City/Territorial Councils.

The same websites with accessible land and water data also represented potential gateway stakeholders as above but in addition Energy Providers, Treaty Settlement Learning Institutes, Philanthropists, NZ environment-associated industries, and professional associations. Mandated organisations to manage land and water assets were also identified, mainly Government Ministries such as StatsNZ, DoC, MfE, MPI, but also NZ Landcare Trust, NZ Fish and Game etc., and

NZ Environmental Service Companies such as NZ Forest and Bird, He waka eka noa, Beef and Lamb NZ, Greenpeace, and Federation of Māori Authorities. These land and water data providers and/or potential stakeholders were brought together in a stakeholder directory of 105 different entities. The data stocktake also provided an opportunity to identify resources to identify Māori organisations/stakeholders through Te Kāhui Mangai - a directory of iwi (tribes) and Māori organisations, including 'find a marae.'

The stocktake step was extremely useful in that it allowed the project team to better understand the available data ecosystem for Land and Water management, including what private or public datasets, platforms and general infrastructure we could connect into, and where the priorities were to capture new data. It was also important to consider the various standardised data formats to help users understand and assess the data's quality and relevance and to inform the creation of an online ecosystem capable of becoming a centralised gateway (in Step 4) for ease of access to these systems.

In parallel, a survey questionnaire tool was also made available on the finddata website (www.finddata.co.nz) between late January and mid-April 2023 which sought information on the various digital products used for visualising and manipulating land and water data. Over 500 responses were obtained which included research (27%), government (21%) and consultant (15%) as given organisation types. (Together with kaimahi/environmental groups, these end users were subsequently identified as key Phase 2 stakeholders for specific focus). A specific survey question asked which platform(s) the respondents used to visualise and manipulate land and water data, and in total, over 200 different platforms were mentioned. Together, the survey and digital stocktake were to assist with refining stakeholders and to ensure the prioritisation of land and water datasets for gateway inclusion. Alongside the stakeholder engagement, the Puhoro students took the data from the stocktake and used it in the defined how the Miro wireframes and gateway will feel e.g. UI/UX.

Thus, the gateway design process required that it be nimble and flexible enough to provide data accessibility using a number of different options:

- API access through the gateway to other third-party software or database for the delivery of land and water datasets or functionality
- Access through licensing agreements
- Direct access within gateway to land and water data through publicly available data repositories

Coupled with the stakeholder survey, the various huis, zooms and wānanga allowed the project team to understand the breadth of potential end-users who would utilise the gateway. The stakeholder land and water data survey also provided further information on general software/platforms respondents were currently utilising and key requirements that the gateway might address. This initial phase (Phase 1) of identifying stakeholders and gateway end-users was refined (Phase 2) to target four main end-user groups (kaimahi, environmental groups; policymakers; researchers; and environmental consultants). These end users were identified from their overall survey response proportions and diverse land and water needs from the stakeholder survey. As part of the tailoring of the gateway to these Phase 2 end users, personas/avatars were developed to assist with prioritising land and water data requirements, identifying data gaps and developing an example of a data request drawn from the data stocktake.

In addition to the user-centric case-study wānanga and scheduled hui and zoom meetings, more informal engagement took place between the project and potential end users where the gateway was discussed and information gathered which helped the project team identify key end user groups, identify their needs and develop the gateway prototype.

7. Adaption to Policy and Legislation

Our original approach strived to understand current and future land and water legislation and regulations relating to chosen end user needs and preferences. We then linked specific legislation to potential end user questions, requirements and functionalities, flowing through into how land and water datasets are prioritised for inclusion in the gateway. This iterative process ensured that the end user requirements were integrated into the wireframes and designs, the most relevant land and water datasets could be made available, but that refinements could occur through ensuring gateway prototypes/MVP iterations were tailored to our chosen Phase 2 end-user groups. However, the life of this project coincided with environmental governance/management undergoing considerable legislative and policy change during a change of government, which will have significant knock-on impacts at multiple scales (e.g., several pieces of recent legislation such as the Natural and Built Environments Act, Strategic Planning Act, and Climate Adaption Act, as well as policy frameworks such as Te Mana o te Wai and He Waka Eke Noa were or are proposed to be repealed or rewritten) with sustainable management activities temporarily applied against the Resource Management Act 1991 (RMA). Thus, enhanced accessibility to land and water data might be considered even more critical in this time of sweeping legislative change (e.g. kaimahi responses in relation to any changes in Te Mana o te Wai). Developing an understanding of the impact of these legislative changes is critical to ensure that the Digital Gateway can adapt to the shifting informational requirements of new legislation/policy.

8. Digital Gateway Design and Implementation

Our prior activities during the previous steps allowed the project team to understand the key requirements of cross-scale end-users for the gateway. This information was pivotal in the development and branding and website components:

i) Design: User research and information architecture

- Design brief. Incorporate the key requirements and deliverables for core stakeholders.
- User personas. These emerged from our user research findings and ensured that with well-documented user personas, UX/UI designers can meet the needs of groups/people the gateway is designing for.
- User journey and user flow. These visuals are to map how our target audience can use the gateway to fulfil their needs. Visuals are essential to design a solution that feels more personalised. These stags were heavily driven by the rangatahi from Pūhoro who provided insights into the functionality of current land and water data repositories.
- Wireframes. A wireframe shows the main structural blocks of what will later become the MVP.
- UI/UX design. Consistent, simple, and tailored to our user personas and journeys. Great UX design eliminates the time for our target audience to get used to it and begin using it.

ii) Development: Minimum Viable Product (MVP)

Being able to demonstrate an initial website design to wānanga participants and other end users was important for ensuring the envisioned 'bottom-up' approach for gateway development and that key stakeholder/end user requirements are included at an early stage of product development. Case study findings from the stocktake and wānanga/workshops with key stakeholders were used to derive the Information System framework for the MVP. The gateway was intended to be a fully-fledged MVP with detailed design and functionality, and allowed the team to provide access to our target audience to ensure what works best for their pain points. These wananga provided the basis for integrating the AI-functionality (see below) with regenerative prompting and allowed the tailored training of the MVP by the Phase 2 personas.

9. Validation/use of the Digital Gateway

An important part of the development process was the participation of the case study contributors (i.e., key land and water data creators/consumers) to validate the Digital Gateway, focusing on the suitability of the platform to address data requirements; organisational and operational viability; and feasibility of the technical software for end user requirements. UI flows were developed to outline the user journey and interactions with the application, and UI/UX videos were produced in parallel and widely accessible on the MVP.

Over the past few years there have been significant changes in the way in which data is sought, made available, and tailored specifically to the end-user. Many of these data accessibility and functionality changes have been driven by the wide-spread availability and use of artificial intelligence tools and large language model (LLM) APIs, starting with OpenAI and ChatGPT (Generative Pre-trained Transformer) in late 2022. OpenAI has become the standard for LLM APIs through the development of accessible, high-quality language models like GPT-3 and GPT-4, with unparalleled natural language and generation capabilities coupled with safety and ethical AI development practices. Thus, in mid-2023 the project team agreed to enhance the MVP with the inclusion of an AI chatbot in addition to the general land and water data search function (Figure 1). This additionality was not envisioned when the proposal was originally written in early 2022 but was made necessary due to improved general AI-driven data accessibility changes and the need to position the gateway as tool that could be trained through user prompts.

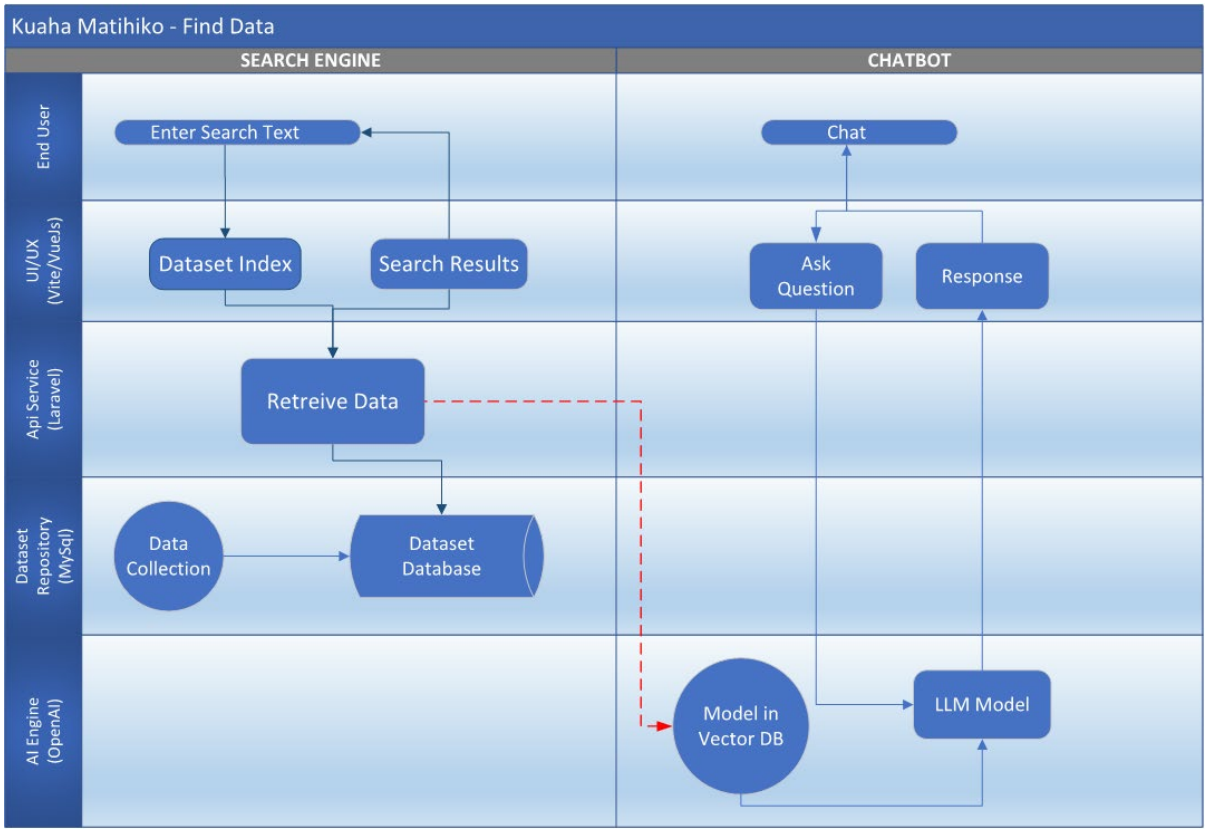

Figure 1: *Flow diagram providing a summary of the functionality and workings of the Kuaha Matihiko platform search engine and chatbot.*

The rapid progress with AI-based technologies offers a suite of improved UI/UX opportunities:

- Revolutionised Search Capabilities: The introduction of AI to the digital gateway refines the accuracy, precision, and relevance of search outputs. This ensures that users are able to obtain results that are directly aligned with their queries, minimising data noise.
- Enhanced User Experience: AI allows for a more interactive and intuitive user experience. It streamlines data access, dramatically reducing the time users spend searching for pertinent datasets.
- Intelligent Data Utilisation: The AI system enables advanced features, such as data visualisations and auto-generated reports. This facilitates a deeper understanding of data, aiding users in drawing meaningful conclusions.
- User-Centric Design: Recognising the diverse needs of users, the AI is designed and trained to cater to a spectrum of user personas. This adaptability ensures optimal satisfaction across varied user interactions.
- Foundation for Future Innovation: The AI backbone not only provides immediate enhancements but also sets the stage for continual future upgrades.
- Ongoing Development: Support to refine the AI, widen data categories, and augmenting features, ensuring the platform's relevance and efficacy so when the MVP expands from 4 personas, the needs of an expanding audience can be met.

The initial pool of testers encompassing the project team was expanded to also include validated end-users representing the four end user personas selected for Phase 2 (research, kaimahi, consultants, policy makers). This selection was made based on those who participated in wānanga, digital hui, and who completed the initial survey for the project. The initial group, including the research team and ten additional participants, were chosen to initiate testing and training of the AI chatbot for the gateway. Notably, the AI chatbot was being trained to provide insightful responses, particularly in the realm of relevant NZ land and water data. Ultimately having representatives of the four personas training the MVP ensures a trusted decision-making process and improved understanding for end-users across scales. The prompts and queries posed by testers actively contributed to refining the AI's understanding and response capabilities (Figure 2). Through active user engagement, we gathered significant feedback pertaining to user experience and the functionality of the AI chatbot's interaction with the data. One-on-one training and review by the Waka Digital Team was offered to each tester to ensure the system for feedback to the team easy for each individual tester to do. These insights were invaluable in steering the iterative improvement process.

The AI component of the MVP was developed to access the capabilities of large language models, such as text generation, understanding, and translation within the land and water datasets. However, to ensure that the initial MVP datasets were of good quality, over 11,000 land and water datasets originating from multiple agencies were sourced from the www.data.govt.nz website to initially populate the back-end of the MVP. Thus, the use of creative commons land and water data as part of the optimised closed vector database with clear data boundaries, provided a trusted model for users, ensured that no sensitive information or privacy concerns arose and eliminated issues with data access.

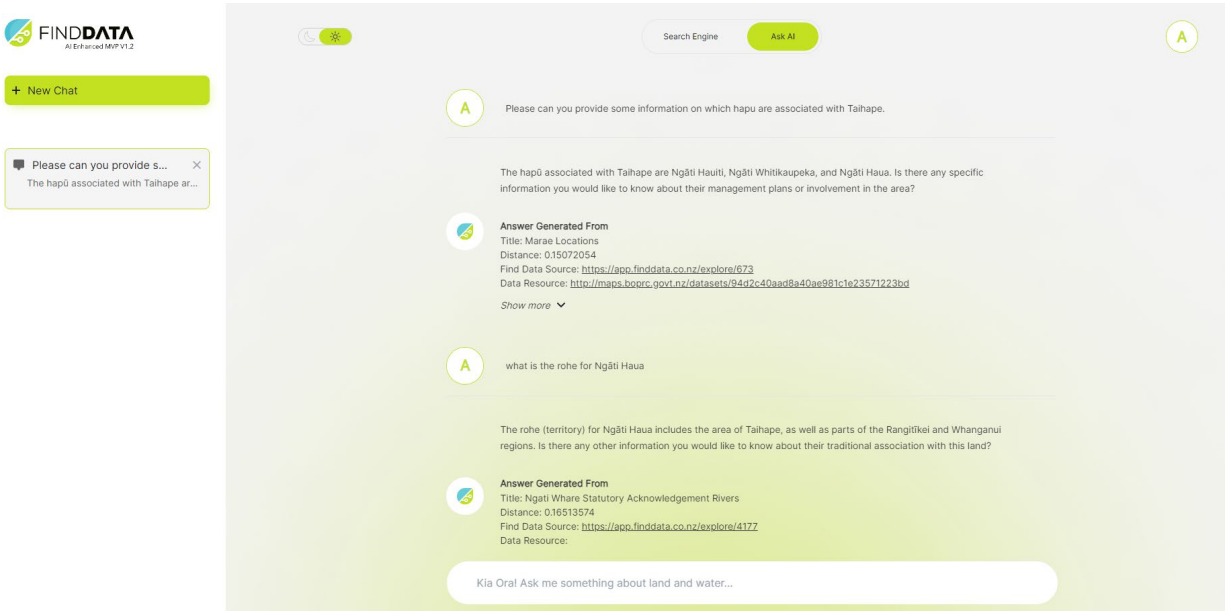

Figure 2: *Example of prompts to generate required data as part of AI chatbot platform.*

10. Business Case Development

Throughout each stage of project development, a clearer picture of who the key group/s are that will be involved in the ongoing management and maintenance of the Digital Platform has occurred, and with the MVP now in the beta testing phase where end-users have validated the usability and effectiveness of the gateway, a full business case has been developed. An initial draft of the business case focussed on a sustainability vs commercial focus, and the larger goal of enhancing efficiencies in finding and accessing land and water data. A main driver for the business case was the introduction of AI and how end-users who gain tremendous value from targeted, AI-driven insights. Currently the project team are investigating potential revenue streams through partnerships, licensing, and possibly subscription models tailored to specific user groups. This business case has already been presented to those groups agreed to be best positioned to drive the national uptake and impact of the MVP. Options include validating a commercial or non-commercial model or hybrid of the two.

The preferred hybrid model is designed to cater to a wide range of users and uses, from individual researchers and environmental consultants to large organisations and government bodies. It provides financial stability through diverse revenue streams and opportunities for reinvestment into the platform to ensure its long-term viability and growth.

11. Communication of Land and Water Data Results - Future Development Opportunities

The way in which land and water data are communicated through the MVP to the different Phase 2 personas will require some refinement. The co-design kaupapa used throughout this project will form the basis of how we will also use this approach to develop communication processes that are suited to end user group and deliver maximum impact; e.g., different groups may prefer email and/or social media updates, and others may prefer written reports or workshops. Remembering that the gateway itself is a communication tool; it will use web, survey tools, video and social media services to collect and disseminate information to our target audience/s. Ultimate project success will be delivery of the MVP and business case to address problems with the identified current environmental management data/toolkits.

The business case has been developed to specifically explore mechanisms ensuring maximum uptake and impact from the outputs produced in this programme. Future assistance might be through networking via workshop/conferences and negotiations with potential long-term hosting and maintenance arrangements, including provision of any legal/contract considerations regarding continuing access to data/toolsets via our new Digital Platform; and the roll out of the business case.

Future work envisages exploring improving accessibility to the many other land and water datasets which are available, either through licensing agreements, or at least pointing land and water data consumers to where the data may lie, providing options for data access and reducing duplication. Other opportunities include harnessing the AI-powered predictive models to analyse historical data to forecast trends in land and water conditions – this allows for improved proactive decision-making by anticipating changes and enabling personas/stakeholders to devise and implement preventative measures. Although the MVP provides improved accessibility for data, further development could allow AI to integrate data from diverse sources e.g. historical water quality monitoring data, current sensor networks and spatial map layers. This holistic approach and enhanced data depth with for

example, enhanced report writing capabilities, enables a more comprehensive analysis, and improved efficiencies mitigations.

We also envisage the gateway to be an API Platform and mapping service that can be utilised by end-users. This API management platform would aim to serve and facilitate the development of new software and APIs around NZ. Data creators and developers could use it to improve efficiency, promote innovation and streamline the process of managing the catalogue of land and water services and availability of APIs in Aotearoa - i.e., the “home base” for all land and water API management needs. It could:

- Provide developers/stakeholders with requisite tools to create and optimise Land and water APIs.
- Streamline data sharing.
- Ensure secure transfer of data to trusted third-party sources/partners.
- Nurture the existing API management ecosystem for land and water in NZ.
- Develop new capabilities for existing technologies.
- Maintain a running catalogue of all the API platforms and services used throughout NZ.
- Monitor security risks and threats.
- Automate responses to active security threats.
- Set permissions for different stakeholder organisations and users so everyone has access to the data they need.

The new platform, and user led design processes, could also be leveraged to help the environmental data system transform in response to criticisms that it has been largely passive and opportunistic. An example of how we envisage a data system could be improved to bring about transformative changes on the ground is presented by considering StatsNZ data – it is currently produced in meshblocks that do not correlate with iwi/hapū boundaries. We would consider whether current and future data could be captured or translated better in the future to meet end user needs. Beyond the potential for identifying where data could be better organised to meet the needs of users, the platform also opens up the opportunity to identify limitations in existing data sources and proactively encourage other agencies to invest in data generation that meets the emerging future needs of users.

12. Acknowledgements

The project team would like to acknowledge the many, many users and creators of land and water who participated in this kaupapa and who provided important feedback on the various iterations of the finddata website and platform. Many thanks also to our wānanga hosts who provided clear examples of how these tools would benefit their mahi.

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