Manaaki Whenua
Landcare Research

He awa ora, he tangata ora – Healthy rivers, healthly communities

Investigating the role of fluvial geomorphology in supporting kaitiaki led river restoration in the face of climate change

Prepared for: Manaaki Whenua Landcare Research

July 2024

He awa ora, he tangata ora – Healthy rivers, healthy communities

Contract Report: LC4487

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Ka mau tonu ngā taonga tapu o ngā matua tūpuna,
koinei ngā taonga i tuku iho, ngā te Atua

Hold fast to the treasures of the ancestors
for they are the treasures that have been handed down to us by God

Summary

Wet weather events are predicted to increase in frequency and intensity across Aotearoa New Zealand (hereafter 'Aotearoa'), which are likely to lead to increased flooding and erosion of river systems, posing a threat to vulnerable communities. Geomorphological insights into how rivers operate and function, and of the controls that influence river systems, can provide a useful underpinning for developing river restoration strategies that are robust, resilient, and adaptive to a changing climate. Recent studies have proposed that geomorphological concepts that promote creating space for rivers to move dynamically, can align well with te ao Māori ways of thinking about and managing rivers systems as living beings.

This research project explores the alignment between fluvial geomorphology and te ao Māori approaches to thinking about and practicing river restoration, as a platform to evaluate if and how geomorphological concepts and strategies could be useful for hapū, iwi or kaitiaki who are engaged in river restoration. This report has two main components. First, we conduct a literature review to evaluate the theoretical alignment and discrepancies between the different approaches. Second, we utilise the Hōteo River Sediment Reduction Project as a case-study to investigate to what extent this proposed alignment is evident in practice. The case-study includes a review of grey literature and interviews with four pūkenga (experts).

From the literature review, we identified key restoration concepts that align with both geomorphic and te Ao Māori approaches to river restoration: catchment scale, work with nature, making space for rivers, observational data, holistic approach. Our evaluation of the Hōteo Sediment Reduction Case Study demonstrated that it is useful and worthwhile to maximise the alignment between geomorphological and te ao Māori approaches. At the same time, a geomorphological approach alone will never be capable of fulfilling all of kaitiaki or iwi aspirations for restoration.

We contend that western science approaches, including fluvial geomorphology, must take a step back from dominating the restoration narrative, and instead be re-framed, grounded and applied within a te ao Māori world view and context. We suggest that this approach will enable the alignment between fluvial geomorphology and te ao Māori to be best realised in practice, leading to restoration strategies that are novel, adaptive and resilient to climate change. Whilst this restoration approach is complex, it is necessary to enhance the health and well-being of rivers across Aotearoa, and in ways that fulfil Treaty of Waitangi obligations, enabling Māori to enact their rights of rangatiratanga, mana motuhake (sovereignty), and kaitiakitanga.

1 Introduction

Wet weather events are predicted to increase in frequency and intensity across Aotearoa New Zealand (hereafter 'Aotearoa'), which are likely to lead to increased flooding and erosion of river systems, posing a threat to vulnerable communities (Naylor 2017; Neverman et al. 2023). Geomorphological insights into how rivers operate and function, and of the controls that influence river systems, can provide a useful underpinning for developing river restoration strategies that are robust, resilient, and adaptive to a changing climate (Brierley & Fryirs 2008; 2016; Naylor 2017; Neverman et al. 2023). Recent studies have proposed that geomorphological concepts that promote creating space for rivers to move dynamically, can align well with te ao Māori ways of thinking about and managing rivers systems as living beings (Hikuroa 2017; Brierley et al. 2018, Hikuroa et al. 2018, 2022; Salmond 2019, 2022; Wilkinson et al. 2020; Wilkinson 2021; Brierley, Hikuroa, et al. 2022; Brierley, Fuller, et al. 2022).

Tangata whenua[1] have rights under Te Tiriti o Waitangi (1840) to retain their rangatiratanga (sovereignty) and exercise kaitiakitanga (guardianship) over their natural resources, including freshwater (wai māori) (Te Aho 2010; Salmond 2014). However, it is only in recent years that these rights have been given effect to in natural resource management (NRM) policies, such as Te Mana o te Wai (TMotW) (Te Aho 2021), which direct state authorities to engage with local iwi to protect the mauri (life force) of water. Through these policies, statutory bodies, such as regional and local councils, are now required to partner more effectively with hapū and iwi, in ways that elevate mātauranga in natural resource management projects, including river restoration (Te Aho 2019).

This research project explores the alignment between fluvial geomorphology and te ao Māori approaches to thinking about and practicing river restoration, as a platform to evaluate if and how geomorphological concepts and strategies could be useful for hapū, iwi or kaitiaki who are engaged in river restoration.

Section 3 of this report presents a literature review that overviews Māori involvement in contemporary river restoration in Aotearoa, and describes the policy context that both supports and constricts their involvement. We overview both fluvial geomorphology and te ao Māori world views and founding concepts, as they relate to river systems, and underpin different restoration aspirations and practices. We then assess the similarities and differences between how these knowledge systems think about and approach river restoration, and consider how they can be used together to develop restoration strategies that are adaptive and resilient in the face of climate change, whilst at the same time fulfilling hapū and iwi river restoration aspirations.

Section 4 reviews the Hōteo River Sediment Reduction Project (hereafter, 'Hōteo Project') as a case-study to explore how well geomorphological and te ao Māori approaches align

[1] Appendix 1, provides a glossary of Māori words (kupu) to help readers less familiar with te reo, although some brief translations are provided in-text on first use.

in practice. The Hōteo Project is a unique case study as it is one of the only river restoration projects in Aotearoa to have incorporated a geomorphological restoration approach (through applying GEMS [Geomorphically Effective Management Solutions]), together with iwi co-leadership.

1.1 Research Question

Can fluvial geomorphology support kaitiaki-led river restoration strategies that are resilient to a changing climate?

1.2 Research Objectives

- Explore the alignment between fluvial geomorphology and te ao Māori approaches to thinking about and practising river restoration.
- Evaluate if and how geomorphological concepts can be useful for kaitiaki involved in river restoration.

2 Methods

This research used a mixed-methods approach. First, we conducted a literature review to summarise fluvial geomorphological and te ao Māori concepts that underpin these approaches to river restoration. Second, we used the literature review to identify and evaluate the theoretical alignment and discrepancies between fluvial geomorphological and te ao Māori approaches to river restoration.

Second, we used a case study approach, using the Hōteo River Sediment Reduction Project to evaluate whether the alignment between geomorphological and Te Ao Māori approaches to river restoration (as identified in the literature) is evident in practice. The case study included a review of grey literature, predominantly the 'Monitoring Plan for Geomorphologically Effective Management Solutions (GEMS)' (Simon & Chakraborty 2019), the 'Mana Whenua Workplan' (Hyslop & Taylor 2019), and the 'Cultural Health Monitoring Plan' (Hyslop & Taylor 2022); as well as interviews with four pūkenga (experts) to evaluate how well the GEMS and iwi approaches to river restoration were aligned in the Hōteo Project, and how well the participants thought the GEMS fulfilled their aspirations.

The interview participants were selected using the kaupapa Māori research principle of whanaungatanga (relationships), by building upon existing relationships that the researcher had developed with the pūkenga participants through earlier involvement with the Hōteo Project. Three of the pūkenga were interviewed kanohi-ki-te- kanohi (face-to-face), and one was interviewed over Teams. The kanohi-ki-te-kanohi interviews were recorded through note taking, and the Teams interview was recorded online and transcribed by the author of this report.

The interview style was unstructured or exploratory in nature, with some prompting from the interviewer, to prioritise what was important about the Hōteo Project from the participants' perspectives. The interview notes and transcript were analysed following an

iterative approach to thematic inquiry (Morgan & Nica 2020). Social ethics was approved through the Manaaki Whenua social ethics process in March 2024 (approval no. 2324/25).

3 Literature Review

The first section of this literature review overviews hapū and iwi involvement in contemporary river restoration in Aotearoa New Zealand (Section 3.1), including te ao Māori world view and key concepts (Section 3.1.1), the colonial legacy that many hapū and iwi are still working through today (Section 3.1.2), kaupapa Māori environmental frameworks (Section 3.1.3) and sources of historical data (Section 3.1.4). The literature review then presents an overview of key geomorphological concepts and tools (Section 3.2), and links these to the 'space to move' river management paradigm. The last section of the review (Section 3.3) reviews the alignment and discrepancies between geomorphological and te ao Māori approaches to river restoration.

3.1 Overview of Māori engagement in river restoration

Indigenous communities around the world are increasingly reclaiming their involvement in river restoration. In Aotearoa, restoration is particularly relevant for hapū and iwi as Aotearoa transitions to a post-Treaty climate, in which land and governance rights are returned to iwi through Treaty settlement claims (Salmond 2014). Land is often returned in degraded or marginal states and so restoration is a priority for many hapū and iwi (Salmond 2014). Although the Treaty of Waitangi (1840) grants iwi partnership status in Natural Resource Management (NRM), this has not always played out in practice.

Over the past decade in Aotearoa, the Government has explicitly recognised Māori customary rights and interests in NRM, and incorporated te ao Māori concepts, values and knowledge into policy. As a result, regional and local councils have increasingly recognised and given effect to iwi rights of rangatiratanga and kaitiakitanga of natural resources, including water.

For example, Te Mana o te Wai (TMotW) was introduced in 2020 as part of the National Policy Statement for Freshwater, and requires regional and district authorities to engage with iwi to protect the mauri, of water (Ministry for the Environment 2021). The implementation of TMotW is guided by six key principles:

- mana whakahaere – decision making authority of tangata whenua
- kaitiakitanga – tangata whenua obligated to protect freshwater
- manaakitanga – respect for freshwater and others
- governance – prioritise the health and well-being of freshwater into the future
- stewardship – all New Zealanders obligated to manage freshwater sustainably
- care and respect – responsibility of all New Zealand to care for freshwater.

Whilst nationwide policies such as TMotW lay an important foundation for giving effect to Māori perspectives, governance and management in NRM, some scholars have criticised TMoTW for being ambiguous – e.g. using the term 'engagement' rather than 'partnership',

and reducing Māori rights and interests to mere aspirations (Taylor 2022). Taylor (2022, p. 89) argued that regional councils should not 'hold the mana to recognise, articulate and restore TMotW' and that 'Māori concepts and approaches require Māori people, values, tikanga and knowledge' to articulate and implement the policies.

In addition, regional and local authorities, and even hapū and iwi, have struggled to implement TMotW in practice. This is because TMoTW is underpinned by a deep and complex te ao Māori knowledge system, which can be difficult for non-Māori to comprehend; and it is also hard for Māori who work within non-Māori organisations (such as Māori planners and practitioners working withing councils) to translate this knowledge into practice (National Science Challenge [NSC] & Poipoia Ltd. n.d.). To address these issues, new guidelines were developed by NSC and Poipoia Ltd. (n.d.) to provide clarity for both tangata whenua and regional councils implementing TMotW.

3.1.1 Te Ao Māori world view and river restoration

Key Māori values, including whakapapa, kaitiakitanga, mātauranga and mauri, can provide insights into how hapū, iwi and kaitiaki think about, know, and manage their river systems, when they are contextualised within an understanding of te ao Māori worldview. In particular, an understanding of te ao Māori explains the mutual interdependencies between Māori and the natural world, and of the spiritual dimensions that are integral to their ancestral relationships (Te Aho 2010; Salmond 2014; Salmond et al. 2019). Tipa (2013, p.44, in Salmond 2014) recounted kaumātua (elders) referring to freshwater as 'the lifeblood of the land'. Hikuroa et al. (2022) claimed that 'indigenous worldviews can offer a more generative way of viewing relationships framing humans as part of nature', incorporating socio-cultural relationships with rivers, and thus 'maximising socio-ecological functionality into the future'.

Te ao Māori, or the Māori world, begins with Māori cosmogony, from which Māori customs, values and attitudes originate (Roberts et al. 1995; Salmond 2014). Simply put, Māori trace their origins back to the atua (gods) Ranginui (Sky Father) and Papatūānuku (Earth Mother) and through this whakapapa (lineage), view themselves as not merely 'of the land' but 'as the land' (Te Aho 2010, p. 285). The intimate relationship that Māori people have with nature has been expressed in the following way:

> *…just as the foetus is nurtured in the mother's womb and after the baby's birth upon her breast, so all life forms are nurtured in the womb of Papatuanuku and upon her breast. Man is thus an integral part of the natural order and recipient of her bounty. He is her son and therefore as every son has social obligations to fulfil towards his parents, sibling and other members of the whanau (family), so has man an obligation to mother earth and her whanau to promote their welfare and good. (Marsden & Henare 1992, p.16, as cited in Roberts et al. 1995, p.10).*

As Hikuroa et al. (2022) also state: 'in the ontology of Māori language, people, land, and ancestors existentially overlap. In this way of being, rivers may be conceptualised as plaited ropes that entwine genealogical lines, tying land, people, and ancestors together' (Hikuroa et al. 2022, p. 72). Rivers have their own life force, or mauri, which come with

authority, prestige and sacredness, but that they are also intimately linked with hapū and iwi identities, so that the well-being of rivers are also intertwined with the well-being of the hapū and iwi (Te Aho 2010; Hikuroa et al. 2018, 2022).

The following key Māori values are defined as they relate to river systems (Awatere & Harmsworth 2014).

- Whakapapa: Ko au te awa, ko te awa ko au

Hapū and iwi are intimately and intricately interconnected with their river systems, through their whakapapa, which situates who they are in relationship to the natural world, as well as human relationships. Through these whakapapa relationships, Māori view rivers as living kin, for whom hapū and iwi have an obligation to care for through kaitiakitanga.

- Kaitiakitanga

Across hundreds of years of living closely with their local river system, hapū and iwi have developed robust and complex practices of kaitiakitanga for the ongoing well-being of the river system and all living and non-living beings that connect with the river, including taonga species and their habitats, human communities, and spiritual atua.

- Mātauranga

Through these practices which have spanned generations, hapū and iwi have developed knowledge, or mātauranga, underpinned by a te ao Māori world view, to understand rivers in all their dynamism as interconnected systems, with ecological, physical, anthropogenic, spiritual etc. dimensions that all work together for a functioning ecosystem.

- Maramataka

The maramataka is a framework based on the lunar calendar to mark time and systematically observe and record the dynamics of the natural world (Hikuroa 2017). Hapū and iwi have developed their own maramataka that reflect place-based dynamics (Hikuroa 2017). There has been increasing interest from hapū and iwi in recent years in reinstating the maramataka as a traditional natural resource management tool (e.g. to inform communities about the best times of the year for fishing, planting, or harvesting kai). Some hapū and iwi have begun to investigate how restoration practices can be monitored, assessed and practised according to their maramataka.

- Mauri

The concept of mauri directly connects human well-being with environmental wellbeing, and guides Māori interactions with, and their use of, natural resources, including river systems. Mauri refers to the 'internal energy or life force,' of all living and non-living things, which is derived from whakapapa, and binds together the physical and spiritual worlds (Awatere & Harmsworth, 2014, p. 7). For the mauri of rivers to flourish, all the physical and biotic components of river systems, as well as the communities that depend on them, must flourish together. More recently, concepts of mauri have been used as a central component of kaupapa Māori environmental frameworks that assess and monitor river health (see Section 3.1.3).

3.1.2 Colonial legacy

Even with the best policy intentions, restoration practices are not developed or practised in a vacuum. It is crucial that the omnipresent colonial legacies are acknowledged, as they continue to plague hapū and iwi involvement in restoration. Worldwide, including in Aotearoa, oppressive colonial histories have severely damaged indigenous peoples' connections to their culture and environments (Salmond 2014), which continues to have very real implications for restoration aspirations and practices today.

> *…it is particularly difficult to separate issues of restoration from other aspects of social and economic determination, especially in communities with histories of cross-cultural conflict, alienation, ecological loss, or denigrated cultural identity and its associated loss of political agency to drive biocultural restoration". Even with increasing efforts from government agencies to recognise Indigenous ways of knowing and doing, there often remains a legacy of mistrust that needs to be worked through. (Lyver et al. 2016, p. 8.)*

Parsons et al. (2021, p. 361) argued that ecological restoration is 'not a neutral (scientific, linear, universal) process, but one that is laden with power, authority, and ontological politics'. Thus, restoration for hapū and iwi can be deeply political (Fox et al. 2017). For many hapū and iwi, there are often fundamental issues and concerns that need to be aired, if not resolved, before meaningful partnerships with government agencies can be developed, and restoration can begin (Robb et al. 2015; Parsons et al. 2021). For example, many hapū and iwi were forcibly separated from their whenua and awa (rivers), and have recently had their whenua and awa returned in degraded states. For these hapū and iwi, re-connecting with their whenua and awa, and providing economic opportunities to encourage their rangatahi (young people) to return to their rohe (tribal area), can be of prime importance.

Figure 1 illustrates the array of factors and considerations that affect and shape hapū and iwi involvement in restoration. The bottom left oval identifies the impacts of Aotearoa's colonial legacy. These impacts are omnipresent, ongoing, and pervasive at every stage of the restoration process for hapū and iwi. They affect governance, relationships, aspirations of restoration, the use of mātauranga, and relationships with western science. Colonial histories and their legacy impacts are different for each hapū or iwi.

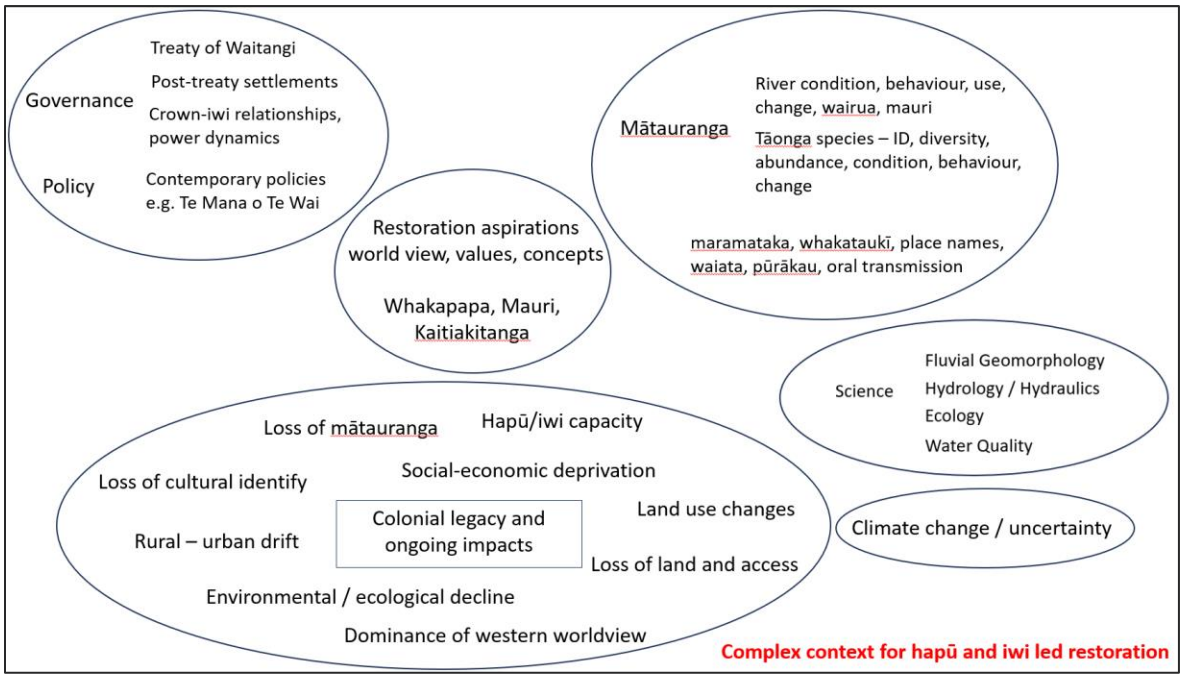

Figure 1. Conceptual diagram identifying some of the complexities and factors that affect hapū and iwi involvement in river restoration.

Hapū and iwi will probably need time and space at the outset of any restoration project to discuss how Aotearoa's colonial legacy has affected – and continues to affect – them. This process will look different for each hapū and iwi. For some, the restoration process could provide opportunities for healing (Parsons et al. 2021; Tadaki et al. 2022). When hapū or iwi are supported to lead their own restoration projects, they can apply their own knowledge systems and practices. Whilst western science is undoubtfully useful, it is important to enable hapū or iwi so they can steer restoration priorities and strategies to align with their own aspirations (Tadaki et al. 2022). Kaupapa Māori frameworks, discussed in the next section (Section 3.1.4), can provide the means to do this.

3.1.3 Kaupapa Māori environmental frameworks

Numerous kaupapa Māori frameworks and monitoring tools have been developed in recent decades to portray the unique belief systems, values, and cultural perspectives of Māori (Harmsworth & Tipa 2006; Kennedy & Jeffries 2009; Nelson & Tipa 2012; Rainforth & Harmsworth 2019; Wilkinson et al. 2020). A summary of selected kaupapa Māori frameworks can be found in the review by Rainforth & Harmsworth (2019). Kaupapa Māori frameworks address concerns with 'co-opting' into or 'tacking on' mātauranga Māori to preconceived western frameworks (Harmsworth et al. 2016; Bishop 2019).

Kaupapa Māori frameworks enable hapū and iwi to plan, prioritise, and monitor their restoration activities through a te ao Māori world view. They incorporate social and spiritual domains, together with more standard ecological and physical indicators – providing for more holistic inputs and outcomes than standard restoration approaches. Hapū and iwi will often use a combination of western science and cultural health indicators within these frameworks. It is the grounding of western science within a te ao

Māori, hapū or iwi perspective that makes the difference (Harmsworth 2002; Harmsworth et al. 2016; Bishop 2019; Tadaki et al. 2022).

In relation to the role of geomorphological indicators within kaupapa Māori frameworks, the Cultural Health Indicator (CHI) developed by Tipa and Teirney (2006a, 2006b) incorporates some measures of physical habitat, including the assessment of riparian margins, riverbed condition, river channel and flow conditions, which are useful for recognising changes in river health over a set time period.

Work still needs to be done to conceptualise and evaluate the 'interactions' between habitat components within the wider river system, in ways that integrate – rather than separate – physical, ecological, cultural and spiritual well-being (Salmond et a. 2019; Hikuroa et al. 2022). The central concept of mauri within many of the kaupapa Māori frameworks is a good start, although some Māori have raised concerns about the appropriateness of quantifying mauri (Hikuroa et al 2018). Many of the kaupapa Māori frameworks have taonga species at their centre, so this is a key component that could help to prioritise relevant geomorphological insight for hapū and iwi.

3.1.4 Sources of historical data and mātauranga Māori used in river restoration

Tipa (2013) used historical data and mātauranga-a-hapū (hapū specific knowledge) to understand traditional Ngāi Tahu relationships and practices in relation to the Waitaki River, to inform contemporary management. The study linked significant land use changes in the Waitaki catchment, including river damming, diverting and draining, to adverse impacts on Ngāi Tahu cultural beliefs, values and practices. This provided a rich background for some of the concerns that Ngāi Tahu face today, such as the impacts of ongoing resource use and development, as well as catchment restoration and resource management plans.

The data sources used for Tipa's 2013 research included knowledge held by whānau and hapū (although some of this has eroded over time), historic maps and photographs, manuscripts and journals (government, community and tribal) (Tipa 2013). These data were used to provide new insights into the nature and extent of cultural connections within the catchment. The combined sources of information were interpreted through a te ao Māori lens of cultural beliefs, values and practices.

In the Manawatū catchment, the Eastern Manawatū River Hapū Collective (2016) similarly sourced historical information and mātauranga-a-hapū to inform their Te Kāuru Taiao Strategy, including: iwi, hapū, whānau story-telling of cultural practices through time, historical documents, place names, waiata (songs) and whakataukī (proverbs). The mātauranga used was developed over multiple generations of living in close connection with their river, and provided clues about how the Manawatū River operated and looked in the past, and tracked changes through time in relation to wider landscape modifications (Eastern Manawatū River Hapū Collective 2016).

Haami (2022) developed a novel kaupapa Māori eco-musicological research framework for the Whanganui River, 'He Whiringa Hīnaki', which explored waiata as a vessel to narrate,

document and understand connections between people, place and well-being. Waiata were used as a health indicator of the whakapapa connections between Whanganui iwi and the Whanganui River, and provided insights into their cultural practices, and the significance of the local pā auroa (traditional eel weirs) and hīnaki (eel traps) for future generations.

3.2 Overview of fluvial geomorphology in relation to river restoration

Fluvial geomorphology is the study of river function and character in relation to flow, erosion and sediment deposition, and includes an understanding of the controls that affect these processes and resulting landforms through time. The physical structure of river systems and the processes that create and modify them, form the boundary conditions within which freshwater organisms and ecosystems function (McFarlane et al. 2011; García et al. 2021). Understanding the interconnections between river structures and the dynamics that cause change are integral for creating restoration strategies that work 'with' natural river processes (Brierley & Fryirs 2016).

In recent years, fluvial geomorphologists have started to consider how their knowledge of river system dynamics can support adaptive river restoration, management, and policy, especially in relation to flood risk (Newson 2021; García et al. 2021). In answer to the question, 'How applied should we become?' Newson (2021) replied that geomorphologists are primed to support the development of future river scenarios, and foster relationships between natural and social scientists.

Applied fluvial geomorphology has increasingly aligned with holistic and adaptive restoration paradigms that 'work with nature', including notions of 'rewilding' or providing 'space to move' (Newson 2021; Brierley, Hikuroa, et al. 2022; Brierley, Fuller, et al. 2022). This movement signals a growing shift away from traditional 'command and control' flood protection strategies that have dammed and straightened rivers, to 'living with floods and giving room to water' (Pahl-Wostl, 2006, p.1). Social perspectives of managing river dynamism are slowly changing, with growing awareness that confining rivers not only damages ecosystems, but can led to increased risk of catastrophic flooding (Brierley, Hikuroa, et al. 2022). Furthermore, Brierley, Hikuroa, et al. (2022) argued that engineered flood control has also promoted social and economic inequality and unsustainable outcomes.

Whilst change is evident in Aotearoa, river management still favours engineering solutions to flood protection, over more holistic solutions that consider the linkages between the environment, and social and cultural values (Brierley, Hikuroa, et al. 2022).

> *We contend that contemporary management practices in Aotearoa New Zealand put people and infrastructure on a collision course with rivers. Strangled rivers that create the conditions for future disasters reflect a lack of proactive and precautionary planning, limiting prospects to adapt to a changing climate that will include more frequent and more severe high flows. Reliance on conventional approaches to flood management, and associated instruments that leverage the past as a guide to future behavior, are hazardous*

ways to prepare for increasingly uncertain futures. (Brierley, Hikuroa, et al. 2022 p. 6.)

Brierley, Hikuroa, et al. (2022) proposed that economic risk could be a key reason for resisting change, in which landowners economically benefit from 'protected land'. They also suggested that engineering solutions can provide a false sense of order and certainty (i.e. if a structure can be built to known parameters, then a river can be predicted to act in a certain way). In contrast, geomorphologists think of rivers as dynamic and non-linear, and it is by acknowledging these uncertainties that adaptive management strategies can be developed, to best work with climate change into the future (Brierley, Hikuroa, et al. 2022).

Furthermore, the significance of fluvial geomorphological knowledge often remains undervalued in river condition assessments – in lieu of water quality and ecological measures (García et al 2021). Even as studies have demonstrated how knowledge of sediment transport can support common issues experienced in Aotearoa, such as bank stability and flooding, other studies have shown that geomorphic indicators are the least commonly assessed components of river health (McFarlane et al. 2011). McFarlane et al. (2011) reviewed the Aotearoa State of the Environment reporting of river condition across 12 regional councils and 5 unitary authorities, and found that only half of the authorities included some assessment of reach-scale morphology. Of these assessments, most were focused on the river channel, with little regard for channel-floodplain dynamics, sediment flux or catchment scale conditions. The National Objectives Framework (NOF) (Ministry for the Environment 2020) also does not include any reference to geomorphic monitoring for river health.

Despite this lack of policy directive, there is evidence that river managers within regional councils have increasingly recognised the need to incorporate fluvial geomorphology into river management (McFarlane et al. 2011). McFarlane et al. (2011) recommended the need for more holistic assessments of river condition that assess the interactions between hydrology, geomorphology, water quality and stream biology, and are framed by knowledge of long-term ecosystem evolution, and an awareness of the diverse range of rivers found across Aotearoa (McFarlane et al. 2011).

3.2.1 Overview of key geomorphological concepts and tools in relation to river restoration

Geomorphological knowledge can help to develop a picture of how river systems have looked and functioned through time, and can identify events and processes that drive change, such as climate or land use changes (Brierley & Fryirs 2005, 2008). This information can be used to predict how individual river systems are likely to respond to more frequent extreme weather events, such as increased flooding, in the future (Brierley & Fryirs 2016). In this way, fluvial geomorphology can underpin restoration interventions that are proactive, resilient and adaptive to climate change.

Whilst fluvial geomorphology has been advocated for adaptive river restoration (Brierley & Fryirs 2008; García et al 2021), a summary of what is can offer is somewhat elusive. This is in part because applications are context bound and scale specific. Brierley, Hikuroa, et al.

(2022) cautioned that whilst geomorphologists have established fundamental process understandings of the ways rivers look, function and change, there will always be inherent uncertainty in predicting individual river responses, as rivers by their very nature are 'nonlinear, contingent and emergent'. Thus, cause-and-effect processes will play out in distinctive ways for individual rivers, based on their unique catchment conditions (Brierley & Fryirs 2016; Brierley, Hikuroa, et al. 2022).

Newson et al. (2002) explained that whilst catchment scale drivers and impacts are relatively well known, there is less predictive certainty at smaller scales, because of this non-linear behaviour. This situation is changing because of extensive technological advances and new GIS tools over the past two decades (e.g. Kondolf & Piégay 2016; García et al 2021), but there is still a gap between conceptual geomorphological understandings and applied modelling tools (Fryirs 2017). Thus, fluvial geomorphologists promote the use of predictive tools, whilst at the same time advising caution in their use (Newson et al. 2002).

Applied geomorphology often spans multiple disciplines, including hydrology, ecology and geology. García et al (2021) described geomorphology as a 'synthetic discipline', suggesting that it is often developed on the margins of other disciplines. These factors help to explain why direct application of geomorphological knowledge in restoration is still not well established (García et al 2021). Even so, important geomorphological concepts useful for understanding river character and dynamics are listed in Table 1. (Note: this is a non-exhaustive and simplified list).

Table 1. Selected geomorphological concepts for understanding river character and dynamics

Geomorphological concept	Description
River sensitivity	Severity of response to disturbance (Fryirs 2017)
Disturbance and ability to 'recover', Resilience	Rivers constantly adjust morphology in response to disturbance and changes in boundary conditions (Lepper 2020)
Geomorphic thresholds	Conditions required for significant landform change (Schumm 1979, 2007)
Scale	• River systems behave different dependant on scale of enquiry, which largely impacts monitoring approach and results • Analysis at site scale alone, without reference to channel and catchment processes, does not provide insight into system processes and connectivity (Lepper 2020). • Brierley and Fryirs (2005) propose a nested scale of enquiry – site, reach, catchment
Systems thinking	A structured set of variables, their relationships and interactions, which operate together as a complex whole, according to an observable pattern (Chorley & Kennedy 1971)
(inter)Connectivity	• Landscape configuration and coupling (Fryirs 2013; Fryirs et al. 2022) • Lateral (floodplain and channel) and longitudinal (between reaches), vertical (groundwater and air), temporal (Lepper 2020) Interactions and feedbacks between different elements of the system
Fluvial dynamism Change	• River systems are complex and their variation of morphology and processes are difficult to quantify and classify • Monitoring data should be considered relative to what would be 'expected' for a given river type • Temporal and spatial change, interplay and feedback influences between controls, processes and landforms
Heterogeneity	'frequency, diversity, spatial arrangement, and turnover of morphological patches within a riverine landscape' (Lepper 2020) 'heterogeneity and geomorphic units are products of geomorphic processes such as sediment sorting, erosion, deposition, and hydraulic variability, in addition to vegetation interactions' (Lepper 2020)
Allogenic and autogenic controls	Autogenic (internal) drivers: discharge + sediment + boundary conditions (valley, slope, topography, bed and bank, riparian vegetation) + channel form (cross-section, slope, planform) (Newson et al. 2002) Allogenic (external) drivers: e.g. regional setting, climate change, tectonics, land use change
Sediment flux and budgets	Sediment supply, sediment flux, longitudinal sediment transportation, slope-channel coupling (Fryirs 2017)

Scientific tools and data sets, including topographic tools, machine-learning applications and modelling, have greatly advanced geomorphic application and precision (Newson 2021; Brierley, Hikuroa, et al. 2022). Some of these are listed in Table 2. Whilst these new technologies are able to generate geomorphological knowledge of river systems at the catchment scale, they are not commonly used to interpret river characteristics, processes, and evolution for predicting probable river trajectories into the future. Instead, fluvial

geomorphologists have tended to focus on relatively small-scale landform analyses (Fryirs 2017; Brierley, Hikuroa, et al. 2022).

At the same time as technology continues to rapidly progress, traditional field skills of interpretation remain just as important. 'Geomorphological interpretation is not an algorithm', but a 'dark art' (Brierley et al. 2021). In fact, Brierley et al. (2021) cautioned that data alone is not meaningful, but requires cognitive processing and interpretation. This interpretation is influenced by a mixture of training, experience, and intuition, and therefore, *who* is doing the interpretation is important.

Table 2. Selection of geomorphic tools, databases and applications (Source: Summarised from Kondolf & Piégay 2016.)

Tool	Description
Mapping and imagery	GIS (Geographic Information System), QGIS (open source Geographic Information System), DEMs (Digital Elevation Model), LiDAR (Light Detection and Ranging), GPS (Global Positioning System), digital maps, aerial imagery/photography, photogrammetry, topographic imaging and remote sensing, bathymetric surveying, elevation models National databases: long-term national-scale data sets and toolkits such as the River Environment Classification (REC) and Freshwater Environments of New Zealand (FRENZ)
Geological dating	Stratigraphic, sedimentological, pedological dating tools
Field skills	'Reading the landscape' using geomorphological indicators Field measurement and interpretation of river morphology, shape, size and position of landforms, pattern of reaches, evolution, linkages within a catchment (Brierley & Fryirs 2005)
Geomorphic classification of river systems	A range of classification systems have been proposed. Distinction between descriptive and process based classifications of different river and stream 'type'.
Modelling catchment processes	Landscape evolution models – conceptual, empirical and numerical
Modelling fluvial morphodynamics	Predict changes to fluvial landscape - shape and character – through time
Flow and sediment interactions	Sediment supply and transport mode – tools for determining suspended, bedload and total sediment load Sediment budgets

Numerous geomorphological 'toolbox methodologies' have also been developed that have attempted to synthesis geomorphological and ecological characteristics, including: the River Habitat Survey (RHS), River Styles© Framework, Stream Ecological Valuation (SEV), Morphological Quality Index (MQI), Stream Habitat Assessment Protocol (SHAP), and NZ Geomorphic Toolbox (summarised in Lepper 2020). Lepper (2020) argued that due to the complexity of river systems, many of these toolboxes have not been able to account for the full range and diversity of rivers.

3.3 Exploring the alignment between fluvial geomorphology and te ao Māori concepts of river restoration

There are only a handful of researchers and studies that have considered fluvial geomorphology and indigenous knowledge together, and these have been predominantly based in Aotearoa (e.g. Hikuroa 2017; Brierley et al. 2018, Hikuroa et al. 2018; Salmond et al. 2019; Wilkinson et al. 2020; Wilkinson 2021; Brierley, Hikuroa, et al. 2022; Brierley, Fuller, et al. 2022; Hikuroa et al. 2022). These studies have been led primarily by geomorphologists, with input from Māori researchers, and have encouraged fluvial geomorphologists to recognise the value and need to work more closely with hapū and iwi. There are even fewer studies that have considered how geomorphic knowledge might be utilised by hapū and iwi to strengthen their river restoration practices. In the remainder of this section, we identify key restoration concepts within the literature that align to both fluvial geomorphological and te ao Māori approaches to river restoration.

Catchment scale

Restoration framed at the catchment scale aligns with both te ao Māori and geomorphological approaches to river restoration (Brierley et al. 2018; Hyslop & Taylor 2019). In te ao Māori, a river is understood as interconnected and living being. 'Through Māori eyes, rivers are generally seen as whole and indivisible entities, not separated into beds, banks and waters, nor into tidal and non-tidal, navigable and non-navigable parts. Through creation beliefs, the river is a living being, an ancestor with its own life force, authority and prestige, and sacredness' (Te Aho 2010). Geomorphologists also view rivers as connected systems within a wider catchment, and denote the importance of upstream-downstream and lateral-valley channel connectivity (Brierley & Fryirs 2005).

Work with nature

Fluvial geomorphological approaches increasingly consider how knowledge of flow erosion and sediment processes, and the controls that impact these processes and induce change, can underpin adaptive restoration strategies. In this way, applied fluvial geomorphology tends to align with strategies that 'work with nature', including 'space to move'.

For Māori, nature and people are not separate. Accordingly, all restoration inherently 'works with nature' and in doing so, can maximise socio-ecological functionality (Hikuroa et al. 2019).

Space to move

Providing rivers space to adjust, move and regenerate accounts for their inherent dynamism and non-linearity, which is not provided by conventional, engineering approaches that restrict river movement. Whilst 'making space' can be complex for river managers, Brierley, Hikuroa, et al. (2022) reported that this approach aligns well with Māori perspectives of river systems as living beings: 'Failure to embrace the potential of space-to-move interventions as a basis to address concerns for strangled rivers reflects an abjuration of guarantees made in Te Tiriti o Waitangi' (Brierley, Hikuroa, et al. 2022, p. 7).

Māori understandings of river are relational and stem from cosmology and whakapapa. This is an important and critical difference between te ao Māori and geomorphic perspectives of rivers and their management, as it points to a completely different way of understanding, relating, and managing rivers, to which no scientific discipline can compare. Where geomorphologists might ask 'How much space does a river need?', kaitiaki would reframe the question as 'How can we live with the river as a living, indivisible entitle?' (Brierley, Hikuroa, et al. 2022, p. 7).

Observational data

Early geomorphological understandings were based on observing and describing river processes and landforms, and linking these to theory, also referred to as the 'describe-explain-predict' approach (Brierley et al 2021). This approach has parallels with the way mātauranga is developed over centuries, through observation and description leading to explanation and prediction (Hikuroa 2017). Through their keen observations of environmental cause and effect, it is likely that kaitiaki would have used geomorphic insight and understanding as part of their mātauranga about the way river systems operate and function, yet these observations would have been interpreted within a te ao Māori lens (e.g. Hikuroa 2017).

Holistic approach

River restoration is simultaneously biophysical and sociocultural (Hikuroa et al. 2022). Māori consider river restoration across multiple and interconnecting dimensions that include physical and ecological river processes, together with human and spiritual dimensions. These connections are personified by the well-known Whanganui iwi whakataukī: 'Ko au te awa, ko te awa ko au' (I am the river, the river is me). From a Māori perspective, all living entities are imbued with mauri, and kaitiaki are obligated to ensure their activities enhance mauri (Environs 2011, in Hyslop & Taylor 2019). When natural resources have degraded mauri, this is often because kaitiaki have been disconnected from their environment, which in turn impacts rangatiratanga, whanaungatanga, and manaakitanga (Environs 2011, in Hyslop & Taylor 2019). Thus, opportunities for kaitiaki to reconnect with their whenua are important for supporting holistic environmental and ecosystem well-being.

Kaupapa Māori frameworks generally reflect holistic and multi-dimensional perspectives. Environmental monitoring and assessment indicators span physical, ecological, economic, community and spiritual dimensions. It is important that all these dimensions flourish together for successful restoration, rather than an individual dimension flourish alone. Social and spiritual dimensions of restoration are the least well incorporated by geomorphologists and other western scientists involved in restoration. Geomorphology commonly considers hydrological, hydraulic and ecological processes. However, a te ao Māori approach does not separate social and cultural dimensions and interactions from physical and environmental dimensions.

Table 3 summarises the restoration principles just described that align with both geomorphological and te ao Māori approaches to river management. In the next section,

we utilise a case-study approach to examine how these theoretical alignments and difference in perspectives play out in river restoration in practice.

Table 3. River restoration concepts that align with geomorphic and te ao Māori approaches to river restoration

Restoration concept	Geomorphic approach	Te ao Māori approach
Catchment scale	River systems viewed as connected systems – longitudinally (upstream to downstream) and laterally (valley to stream)	Rivers are interconnected and living beings with their own life force, authority and prestige
Work with nature	Management decisions driven by an understanding of how river character, processes and controls influence current and future river trajectories	Decisions recognise the importance of living and working with the unique mauri and history (whakapapa, genealogy) of the river. Tangata are not separated from nature and have obligations to care for and protect the environment (kaitiakitanga) in order to utilise natural resources
Making space for rivers	Rivers are inherently dynamic, nonlinear, and have natural capacity to adjust, regenerate, recover. Conventional (engineering) approaches that restrict rivers create conditions for future disasters.	Relational – reframes the managerial question 'How much space does a river needs?' into 'How can we live with the river as a living, indivisible entity' (Brierley, Hikuroa, et al. 2022, p. 7).
Observational data	Early geomorphic science developed through observation and description of river morphodynamics – link local observations with theoretical process principles	Mātauranga Māori, maramataka – keen observations of cause and effect over centuries, leading to explanation and prediction
Holistic approach	Siloed – Whilst some geomorphic studies consider hydraulic, hydrological and ecological processes working together, it still tends to view these disciplines as separate domains. Other geomorphic approaches focus on small scale, reductionist analyses.	Importance of interconnected and co-dependant physical, ecological, human and spiritual well-being. Does not separate social and cultural dimensions and interactions from physical/environmental dimensions. This is embedded in the concept of mauri.

4 Case Study – Hōteo Sediment Reduction Project

In this second part of this report, we examine the Hōteo River Sediment Reduction Project (Hōteo Project), as a unique case-study that utilised fluvial geomorphological insight and empowered iwi co-leadership (Te Uri o Hau, Ngāti Manuhiri, Ngā Maunga Whakahii o Kaipara Development Trust [Ngā Maunga Whakahii]). The project developed GEMS at selected restoration sites, together with a GEMS monitoring plan (Simon & Chakraborty 2019), and a parallel cultural monitoring plan (Hyslop & Taylor 2019, 2022).

4.1 Hōteo Project summary

The Hōteo Sediment Reduction Project was a 5-year Auckland Council project (2018–2023), co-funded by the Ministry for the Environment Freshwater Improvement Fund. The project identified a range of Geomorphically Effective Management Solutions (i.e. GEMS) at locations along a 12 km stretch of the Kōurawhero Stream in the Hōteo River Catchment, to stabilise stream banks and reduce fine-grained sediment loads from entering the Kaipara Harbour (Figure 2).

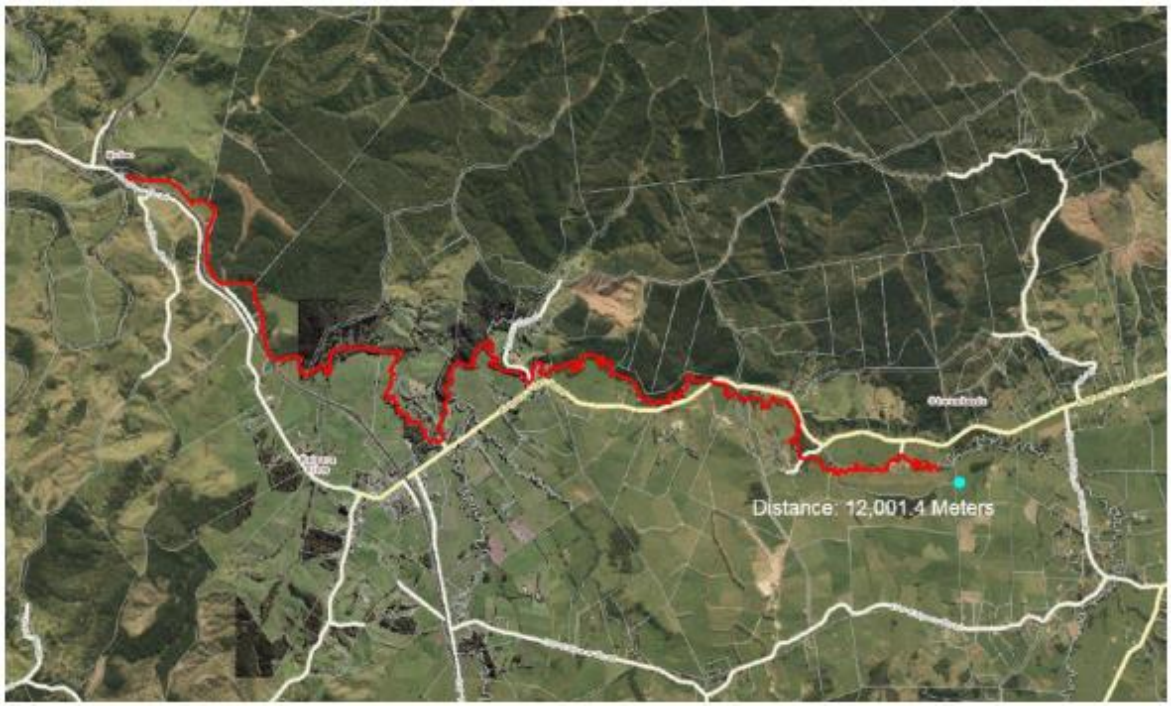

Figure 2. The 12 km stretch of the Kōurawhero Stream in the Hōteo River catchment. (Photo sourced with permission from Sarah Nolan, Auckland Council)

The aims of this project, according to the Auckland Council Annual Work Plan (2021), are stated below.

1 The amount of fine grained sediment discharging from the Hōteo River Catchment via Kōurawhero Stream bank erosion processes is reduced through a range of interventions.

2 The mitigation sites that are implemented are sustainable and there is local ownership for each site and the project.

3 The project positively influences the actions and decisions of others who are wishing to reduce stream bank erosion.

4 The project positively incorporates and encourages kaitiaki cultural aspirations and practises to reduces sedimentation.

Representatives from Ngā Maunga Whakahii, Te Uri o Hau, and Ngāti Manuhiri (referred to as kaitiaki, but inclusive of all pūkenga – knowledge holders) were involved in the project from the beginning as members of the Hōteo Project Steering Group (PSG),

together with representatives from other interested parties (i.e. the Integrated Kaipara Harbour Management Group – IKHMG, the Forest Bridge Trust, Sustainable Business Network, Beef and Lamb NZ, and Auckland Council). The aim of the PSG was to 'enhance the impact, effectiveness and reach of the sediment reduction initiatives in the Kōurawhero Stream through sharing perspectives, experience, knowledge, resources and networks and to ensure our respective work programmes are aligned and synergistic' (Auckland Council 2021). In addition, the iwi representatives agreed to 'support the development of the mātauranga Māori component of the project' (Auckland Council 2021).

Cardno (US fluvial geomorphologists) were contracted to develop site-specific GEMS to reduce erosion and fine-grained sediment delivery into the Kōurawhero Stream (which is a tributary of the Hōteo River), and to develop a monitoring plan to evaluate the effectiveness of the GEMS through time (see the Cardno Monitoring plan for GEMS, in Simon & Chakraborty 2019). Kaitiaki from each iwi were given opportunities to be involved in the GEM's reconnaissance, baseline monitoring, construction process and ongoing monitoring.

Wānanga were facilitated with kaitiaki (after the GEMS approach had been decided on) to understand their aspirations for the Hōteo Project and to develop a Mana Whenua Work Plan (Hyslop & Taylor 2019). It was found that although kaitiaki were well-represented on the Hōteo PSG, they had struggled to provide advice on the GEMS because the project was not framed from a te ao Māori perspective (Hyslop & Taylor 2019). It was suggested that kaitiaki would be better placed to provide advice and utilise their mātauranga if the Cardno Monitoring Plan for GEMS (Simon & Chakraborty 2019) could be re-framed from a perspective that considered how well the GEMS tools can work for kaitiaki aspirations, rather than trying to retrofit kaitiaki aspirations into the existing GEMS framework (Hyslop & Taylor 2019).

With this feedback, Auckland Council supported the development of a Cultural Health Monitoring Plan (Hyslop & Taylor 2022), which was developed in parallel to the GEMS, and based on kaitiaki aspirations. 'The Ngā Taonga Tuku Iho' Framework was used to monitor how well the project tracked towards (or away) from their aspirations. This framework assessed progress across three dimensions: Tangata Ora (Healthy People), Taiao Ora (Healthy Environment) and Mauri Ora (spiritual well-being), and was based on the premise that all dimensions must flourish together. Monitoring indicators and techniques were selected from the Stream Health Monitoring and Assessment Kit (SHMAK) water quality testing (NIWA 2019), Cultural Health Indicators (CHI) (Tipa & Teirney 2006a, 2006b), and the Cardno Monitoring Plan for GEMS (Simon & Chakraborty 2019) to correlate with kaitiaki aspirations. A section on the importance of developing a mātauranga-based environmental baseline was included.

4.2 Comparing the GEMS and kaitiaki cultural monitoring plans

This section evaluates the alignment and discrepancies between the Cardno Monitoring Plan for GEMS (Simon & Chakraborty 2019) and the Cultural Health Monitoring Plan (Hyslop & Taylor 2022), in relation to the restoration concepts that were identified as being important for both approaches (Table 3).

4.2.1 Catchment scale

Geomorphic approach	Te ao Māori approach
River systems viewed as connected systems – longitudinally (upstream to downstream) and laterally (valley to stream).	Rivers are interconnected and living beings with their own life force, authority and prestige.

It was unclear whether the GEMS were underpinned by catchment-scale analyses. The GEMS were developed based on previous studies that had investigated bank erosion, sediment delivery and potential erosion control throughout the Hōteo River (Simon and Chakraborty 2019). These investigations used the BSTEM-Dynamic model (Bank-stability and Toe Erosion), which included field measurements of channel bank resistance and daily flow data to quantify bank erosion rates at 25 sites throughout the Hōteo catchment. Rapid geomorphic assessments (RGAs) were conducted to identify erosion 'hot spots'.

The field and modelled data indicated that the lower reaches of the Kōurawhero Stream were important contributors of fine-grained sediment. This led to additional field investigations at 13 'hot spot' sites of the lower 12 km of the Kōurawhero Stream, and included ground-truthing a potential knickpoint (Simon et al. 2019, cited in Simon and Chakraborty 2019). The field investigations at each of the 13 sites included rapid geomorphic assessments (RGAs), and measurements of bank height, bankfull width, and total length of recent banks failures. Together, the field and modelling data were used to better understand stream bank stability and longitudinal channel conditions, used for identifying the effectiveness and suitability of different erosion-control measures, collectively known as GEMS.

The GEMS monitoring plan (Simon & Chakraborty 2019) acknowledges that streams are dynamic and there is a need to understand how the Kōurawhero stream will adjust to change. However, the plan does not evaluate the impact of the GEMS at the catchment scale, but is limited in scope to the 12 km of the Kōurawhero Stream, where the GEMS will be implemented. It is possible that the 12 km stretch was identified based on catchment-scale appraisals originally (this is unknown to the author), but exactly how the selected 12 km monitoring fits within the wider catchment context is not explicit.

The kaitiaki were asked to short-list three out of the five 'hot spot' sites that had been prioritised by the geomorphologists for GEMS development (see Hyslop & Taylor 2019). The kaitiaki expressed confusion about the prioritised sites, and were unsure how the five sites had been selected in relation to the wider Hōteo River catchment. According to the kaitiaki, the short-listed sites and proposed GEMS seemed ad hoc, piecemeal and interventionist (Hyslop & Taylor 2019). There was confusion about whether the primary aim of the Hōteo Project was to reduce sediment, or for education purposes to showcase the GEMS approach, which would likely lead to different site-prioritisation criteria (Hyslop & Taylor 2019).

The kaitiaki found it difficult to further prioritise the short-listed sites, because they were unclear about how they had been short-listed in the first place. The kaitiaki were not content with the geomorphic monitoring plan only targeting the short-listed site locations, and instead wanted to extend their cultural monitoring throughout the wider Hōteo River catchment. They were interested in how the GEMS would impact the Hōteo

River at a catchment scale. This freedom to increase the number of monitoring sites was enabled through the Cultural Monitoring Plan (Hyslop & Taylor 2022).

4.2.2 Work with nature

Geomorphic approach	Te ao Māori approach
Management decisions driven by an understanding of how past river character, processes and controls influence current and future river trajectories.	Decisions recognise the importance of living and working with the unique mauri (life force) and history (whakapapa, genealogy) of the river. Tangata (people) are not separated from nature and have obligations to care for and protect the environment (kaitiakitanga) in order to use natural resources.

The basic theory underpinning the GEMS is that different geomorphological strategies can be implemented to modify the channel boundary, in order to balance forces of erosion (e.g. boundary shear stress, such as the force of flowing water on the river bed and banks), with forces that resist erosion (e.g. boundary resistance, such as riverbed and banks, which exert friction and slow flow). When aiming to reduce overall erosion, such as in the Kōurawhero Stream, this means implementing GEMS that simultaneously reduce the drivers of erosion and increase drivers of resistance. Developing the GEMS requires working with process-based understandings of how the stream is likely to react to change.

The suite of GEMS can include both low-impact strategies (such as introducing large wood or rocks that increase channel friction and boundary resistance, slowing water) and large-scale engineering interventions (such as altering banks and channels, or even hydrology and land use) (Simon & Chakraborty 2019). Whilst some GEMS work with the 'natural' functioning of river systems more than others, geomorphologists contend that more 'interventionist' strategies are sometimes required when humans have created so much

Kaitiaki expressed concerns about some of the more interventionist GEMS, such as engineering the river channel to reduce flows, or the engineered bank stability measures. It was explained in wānanga that these 'stronger' interventions were deemed necessary because of the degree of human modification of the river system, and that some of the downstream GEMS sites had been selected to reduce bed inundation further upstream in the catchment. However, it is likely that more information about the GEMS in general, and whether they had been designed to 'work with nature' where possible, would have been helpful.

4.2.3 Making space for rivers

Geomorphic approach	Te ao Māori approach
Rivers are inherently dynamic, non-linear, and have natural capacity to adjust, regenerate, recover. Conventional (engineering) approaches that restrict rivers create conditions for future disasters.	Relational – reframes the managerial question 'How much space does a river needs?' into 'How can we live with the river as a living, indivisible entity' (Brierley, Hikuroa, et al. 2022, p. 7).

The GEMS were specifically developed for the existing channel and bank boundaries (e.g. bank toe reinforcement), and did not consider the potential for broader land use changes, such as changing forestry practices, retiring pasture to widen riparian margins, or increasing floodplain connectivity. It is possible that this was either outside of the

geomorphologists' brief, or else the GEMS approach does not incorporate these wider landscape considerations. However, the wider Hōteo Project, outside of the GEMS, had a focus on building strong relationships with landowners to promote fencing and riparian planting and communicating the value of increasing riparian margins.

For kaitiaki, aspirations for a 'thriving Hōteo' could capture the concept of making space for rivers, but it was not explicitly mentioned in their monitoring plan. Hapū and iwi do not own the land adjacent to the Hōteo, so it is possible that any aspirations relating to 'putting land aside for the river' might be outside of their scope.

4.2.4 Observational data

Geomorphic approach	Te ao Māori approach
Early geomorphic science developed through observation and description of river morphodynamics – link local observations with theoretical process principles.	Mātauranga Māori, maramataka – keen observations of cause and effect over centuries, leading to explanation and prediction.

The GEMS relied on both field and modelling data. There were opportunities throughout the project for kaitiaki to join the geomorphologists in the field for reconnaissance surveys, to set up monitoring equipment, and to record baseline data. It is possible that these field activities provided opportunities for geomorphologists and kaitiaki to share knowledge and mātauranga with each other, but the author of this report was not privy to this information.

Kaitiaki were interested in undertaking their monitoring in alignment with the maramataka, which inherently observes natural processes and seasonal rhythms. This approach was still in development at the time of writing this report.

4.2.5 Holistic approach

Geomorphic approach	Te ao Māori approach
Siloed – Whilst some geomorphic studies consider hydraulic, hydrological and ecological processes working together, the geomorphic approach still tends to view these disciplines as separate domains. Other geomorphic approaches focus on small-scale, reductionist analyses.	Importance of interconnected and co-dependant physical, ecological, human and spiritual well-being. Does not separate social and cultural dimensions and interactions from physical/environmental dimensions.

Whilst the GEMS were narrowly focussed on sediment reduction, the wider Hōteo Project was holistic and traversed multiple dimensions. The project was cognisant of empowering kaitiaki – connecting with hapū and iwi values and wider communities values was integral. The PSG, which was set up to drive the project, included representatives from community groups, landowners and the three iwi. However, the iwi representatives found it difficult to fully engage in the PSG (Hyslop & Taylor 2019).

The cultural monitoring plan (Hyslop & Taylor 2022) followed the Ngā Taonga Tuku Iho Framework, which was a name inspired by a Māori whakataukī given by a kaumātua (elder) of Kaipara uri (descendent): 'Ka mau tonu ngā taonga tapu o ngā matua tūpuna, koinei ngā taonga i tuku iho, ngā te Atua – Hold fast to the treasures of the ancestors for they

are the treasures that have been handed down to us by God' (Hyslop & Taylor 2019, p.7). The framework grouped kaitiaki aspirations into three groupings (see Section 4.1). The cultural monitoring report noted that the Ngā Taonga Tuku Iho Framework is a work in progress and will probably be modified by kaitiaki to use in ways that are even more holistic (Hyslop & Taylor 2022).

4.3 Key insights from participant interviews

Interviews were conducted with four pūkenga (knowledge holders) who were involved in the Hōteo River Sediment Reduction Project, to gain insight into their perspectives of the Hōteo Project; including what worked well, what could have been improved, and how well they thought the GEMS approach fulfilled the aspirations of their iwi. We were interested in finding out whether the participants thought geomorphological information was useful or important for river restoration. The interviews were unstructured, with some prompts from the interviewer, in order to explore what the participants were most interested in sharing about the project. This approach was deliberately exploratory in nature, as we did not want to constrain or influence the participants' opinions and/or experiences of the project.

Overall, the participants all agreed that the Hōteo Project was positive and benefited all groups involved. One participant described the project as a 'win-win-win' for community (landowners), iwi and Auckland Council. There was a shared sentiment that the Cultural Monitoring Plan and the Hōteo Project as a whole had paved the way forward for iwi engagement in restoration projects, by fostering strong relationships, and providing space, time and resourcing for kaitiaki to be involved. There was also recognition that there was room for improvements. Key insights from the interviews are discussed below under separate headings.

4.3.1 Building capability and empowering kaitiaki

All the participants described a positive experience with the Hōteo Project. This was related to the opportunities that the Hōteo Project provided for kaitiaki, including upskilling their monitoring skills, potential ongoing resourcing for the project to continue, and potential employment opportunities. As Participant 4 expressed it: 'Kaitiakitanga isn't dependent on funding, but to survive as people in this world we still need to put food on our tables so it's a bit of a balance.. and then you get into conversation around supporting our people to actually living back there and having sustainable living models.'

Several of the participants noted that kaitiaki confidence had grown as a result of their involvement in the project. They had observed that kaitiaki increasingly expressed their opinions at hui (meetings), which was described as mana enhancing (legitimising). One participant noted that kaitiaki increasingly realised how important their unique mātauranga was, above and beyond what science and scientists could quantify.

4.3.2 The importance of strong relationships

A shared theme across all the participants was the importance of having the 'right personalities' for developing strong partnerships between Auckland Council and kaitiaki. It was noted that the two different Auckland Council projects managers were excellent communicators, demonstrating passion for the project, a genuine desire to partner with kaitiaki, and – it was felt – that these managers had the best interests of kaitiaki at heart. Being upfront with the project finances and transparent with the project's wins and losses were also positively regarded traits of a good partnership. As Participant 4 expressed:

> *Council reps are really important to a project, they can make or break a project with kaitiaki, and Sarah is an absolute asset to the project. She not only has the ability to listen, but she really hears us, and because of that we can confidently leave things with her knowing that she will try her best to advocate for us.*

Participant 4 continued, it can be difficult to work with kaitiaki – 'we are not easy partners'. There can be diverse perspectives within each iwi, including different operations, governance and individual perspectives, and there are deep historical and contemporary differences between iwi that need to be negotiated. As such, iwi often operate on different time frames to councils, who are usually timebound by funding requirements. If kaitiaki are rushed, then people get left behind. It was apparent, overall, that the Hōteo Project did well at managing these complexities, highlighting the importance of a strong project manager who acknowledged, communicated, and allowed for these along the way.

4.3.3 Who sets the agenda?

One of the main areas identified for improvement was the lack of kaitiaki engagement at the outset of the project. The participants all agreed that it was important for kaitiaki aspirations to drive the project. One participant described that for Māori, knowledge is place based and 'not up for external negotiation'. Science must fit this context to be relevant and meaningful. The participants agreed that they want to work with scientists, but in a way that informs their own priorities (and not be a 'tick in the box' for scientists).

Whilst the cultural monitoring plan enabled kaitiaki to lead and develop their own monitoring aspirations and actions, there was minimal opportunity for kaitiaki to engage with and drive the decisions that underpinned the GEMS component of the project. The GEMS were designed by geomorphologists to manage key erosion hotspots along the Kōurawhero Stream. This process was not well communicated or understood by kaitiaki in ways that made sense to them – based on how they understand or aspire to use the Hōteo River. According to Participant 3, 'the science drove the project', with kaitiaki aspirations secondary and only gathered after the GEMS approach had been decided upon.

Participant 4 reflected that before the GEMS were decided upon and kaitiaki were asked for their input into the GEMS process, it would have been useful to hold a 'baseline wānanga' with kaitiaki and whānau, with Māori researchers capturing what was being said. This wānanga would have been useful to develop the project scope, and better connect the potential GEMS with kaitiaki aspirations and priorities from the beginning (rather than

trying to retrofit the kaitiaki aspirations to the GEMS later into the project). It is likely that by doing it this way, the GEMs would have had more relevance for the kaitiaki involved.

Additionally, it was suggested that baseline wānanga could have provided a space for kaitiaki to express any mamae (hurts, historical injustices) that were not directly related to the project at hand. In these ways, the restoration process can be just as important for kaitiaki as the outcome. As noted by Participant 4:

> *Some mana whenua I've worked with previously, they have this real taumaha (burden) on their shoulders that they feel like they've got to take into different kaupapa, and it's this burden that they consistently talk about and are emotional about, around the past hurts or mamae that organisations have done, or they've felt wronged by…also voicing the mamae that comes with the state of the environment and how it got to that point, because if you're allowing it to be released in a proper way that's facilitated by tikanga, then you're allowing that person to be a little less burdened by that going forward in the project, so that they know that everyone here understands their position and what has happened.*

4.3.4 Siloed versus holistic approaches

The Hōteo Project emphasised sediment reduction, which privileged a science/geomorphic perspective from the outset, over iwi perspectives. Participant 3 thought that the sediment reduction focus was driven by funding needs, which is important. However, by framing the project in this way, it did not speak to kaitiaki. One participant reflected that the 'momentum for the project was never from kaitiaki'.

The disconnection between the kaitiaki and the GEMS was particularly evident during the interviews, when the participants admitted that they did not really understand what the GEMS were. After the participants had been provided with introductory information about the GEMS and their purpose, the participants shared comments, questions and relevant mātauranga. Somehow, these conversations had not been well facilitated through the project. This is probably because the way that the GEMS had been explained to the kaitiaki had not connected with their own world views.

The participants all agreed that erosion and sediment are important issues for the Hōteo River and Kaipara Moana, but explained that kaitiaki do not think about the river or restoration through such a siloed focus. Kaitiaki tend to think bigger picture and more holistically, rather than focus on singular dimensions. For example, Participant 3 explained that whilst managing sediment and erosion at the site is useful, they believed it would have been better to focus on managing humans and human activity, as it is human activity that has aggravated erosion. They considered that addressing erosion at the site scale, rather than addressing the source of the issue, was a 'band aid' reaction.

Some of the participants suggested that an emphasis on 'taonga species' or mahinga kai (food gathering) sites would have been more relevant for kaitiaki. For example, one participant noted that the health of inanga, tuna and kokopu should have driven decisions for the GEMS, which would have inherently included decisions about sediment

management, rather than focusing on technical knowledge of sediment processes to drive the GEMS decisions.

Participant 4 reflected that it would have been valuable to examine how the science could have supported mātauranga, rather than how mātauranga could complement the preordained science approach. They thought it would have been helpful to spend more time early in the project 'pulling out the mātauranga', before introducing the western science. They noted that putting time and resources into these early design stages of the project is important. From their perspective, they explained that there are many different interpretations of what defines mātauranga and that kaitiaki don't often think of their mātauranga in defined ways, because it is so innate in their practices, ways of doing, and knowing. They further explained that kaitiaki have the ability to observe and understand nature as it is and how they, and the generations that have gone before them, have connected with it every day – 'a lot of whānau can do this'. They surmised that is therefore important to hold wānanga in spaces and ways that enable kaitiaki to be empowered and in control, to define what they know, and build the restoration narrative around this innate knowing. This was a sentiment shared by the other participants also.

Participant 3 shared that a 'pivotal connection' for kaitiaki was when Richard Nahi (Auckland Council member and mātauranga holder of Ngā Maunga Whakahii) shared stories at the Kaipara Flats hui about iwi history and connection with the Hōteo and Kourawhero awa, such as what the Project meant for the red crayfish (the meaning of Kōurawhero). In contrast, Participant 3 reflected that when the Cardno geomorphologists had spoken about the GEMS, with no reference to taonga species or of the cultural connection to the area, the kaitiaki in attendance didn't seem to understand how the GEMS fit within their narrative. Participant 3 explained that the kaitiaki became increasing involved in the project as they saw their values increasingly reflected, such as through stories and mātauranga that were shared during field trips.

Participants 1 and 2 shared some ideas about how the GEMS could have been designed differently, or tested/trialled together with mātauranga, which could have led to novel research. For example, they suggested that it would have been interesting to investigate whether middens, which are culturally important, could have been used in the rock piling structures, which were one of the GEMS for reducing sediment from entering the channel. They were also interested in investigating their wider ecosystem role, such as which invertebrates would naturally feed off the middens.

4.3.5 Capacity and timing

Participants 1 and 2 reflected that a lack of capability and capacity had limited their involvement at the outset of the project. For Te Uri o Hau, they were not structurally set up at the start of the project to have their 'mātauranga at the ready', nor did they have the time or resources to 'mobilise' it. When the Hōteo Project commenced, none of the iwi representatives had the capacity/time to be involved the project as fully as they would have liked, despite identifying their awa – the Hōteo River – as culturally significant. As Participant 4 noted:

Often times, kaitiaki are involved in many projects and wear many hats. It is an ongoing challenge to be across all projects that are important, to choose which project will provide the most important outputs, and to be involved to the depth and detail that they would like to be.

The three different iwi involved in the project were at different stages of growth, which meant that their capacity to be engaged in wānanga and hui was different. The project allowed for this as iwi representatives were able to dip in and out of the project as their capacity allowed. In the words of Participant 1:

Given the way the funding and Council priorities worked in this project, I would say that a huge benefit of the Auckland Council partners in the Hōteo Project is that they have been flexible to accommodate for where iwi are at and to support them from this starting point, rather than demanding external-set outcomes for iwi to have to meet to be involved.

The Te Uri o Hau participants explained that they had increased their capacity over the past 5 years, and currently employed approximately 46 kaitiaki (many of those are short-term, fixed positions). They were interested in developing new cultural monitoring methodologies to 'test' their mātauranga. For example, rather than using the 'standard western science' bird count to provide information about abundance and health, they were interested in physically dissecting different bird species, to investigate their food sources, and to use those observations to interpret changing feeding patterns over time, which would provide clues about species' responses to land use and climate change. In relation to the ongoing development of the Cultural Monitoring Programme, the participants noted: 'The kaitiaki have a lot of mātauranga amongst them that we would like to incorporate into the project. What is needed now is a dedicated Project Manager'. It was hoped that ongoing funding would provide this.

5 Discussion:

In this section, we discuss how well the GEMS and cultural monitoring approaches aligned within the wider Hōteo Project, and suggest ways to increase the relevance of geomorphological knowledge for kaitiaki. We consider that it is equally important to acknowledge the limitations of the geomorphological approach for Māori aspirations and measures of success. We propose a re-framing of fluvial geomorphological, or 'western science' approaches to restoration in general, within a wider te ao Māori context.

5.1 Alignment and discrepancies between geomorphic and te ao Māori perspectives in practice – the importance of narrative

The Hōteo case study supported the findings from the literature review that there are 'restoration concepts' that are important for both geomorphological and te ao Māori approaches to river restoration. These included: catchment scale, working with nature, making space for rivers, observational data, and a holistic approach. The case study

demonstrated that kaitiaki were more likely to be interested in and engage with the GEMS when the link between the GEMS and the aligning 'restoration concepts' were clear.

However, the participant interviews also highlighted that there was also a lot about the GEMS approach that was not well understood by kaitiaki in the project. This was particularly evident when some of the kaitiaki participants interviewed were unsure about what exactly the GEMS were and how they were relevant for their own aspirations. When the interviewee explained the GEMS approach in relation to the 'restoration principles', the same participants acknowledged their value and identified some of the ways that their mātauranga could be used and tested together with the GEMS.

In another example, the GEMS methods and outcomes were solely focused on sediment reduction, which did not 'speak' to the kaitiaki. Whilst kaitiaki were aware that sediment is an issue in the Kōurawhero Stream and Hōteo River catchment, they do not consider sediment in isolation, but in relation to how sediment impacts taonga species, or mahinga kai sites and related cultural practices. If the GEMS had been framed and communicated in relation to improving habitat for taonga species, it is likely that kaitiaki would have related to the GEMS more. Thus, it is important to get the narrative right, i.e. language and context matters (Hikuroa et al. 2022).

Scientists and kaitiaki often 'talk past each other'. It is likely that this relates to a lack of awareness about each other's different world views and priorities, and the impact that world view can have on the narrative that someone tells, and in shaping restoration (Te Aho 2010; Hikuroa 2017; Stronge et al. 2020). Many scientists do not understand restoration priorities from a te ao Māori world view; but equally, it can be difficult for kaitiaki to connect with narrow scientific narratives. Whilst scientists and kaitiaki do not need to fully understand each other's world views, we propose that a basic awareness that we all have different world views is an integral start. From here, empowering kaitiaki to plan and develop their own restoration priorities is essential. Fluvial geomorphologists and kaitiaki can then work together to identify how fluvial geomorphological knowledge can be best used.

There are different ways to do this. One way, such as was done in the Hōteo Project, is to start with a shared vision, and then develop the science and mātauranga, or cultural monitoring, separately. The limitation of this method is that the scientific approach can miss what is relevant for kaitiaki or iwi, and kaitiaki or iwi can miss out on using the science for their own purposes. Additionally, this method does not foster novel ways of using science and mātauranga together. In the Hōteo Project, the GEMS and Cultural Monitoring Plan were developed independently from each other. Whilst each approach was valid in its own right, there was little connection or understanding between the approaches. This approach was perhaps unavoidable in this instance, because of the capability and capacity constraints that the iwi partners faced at the outset of the project. However, the kaitiaki were also not given many opportunities to have input into the development of the GEMS. Although iwi were represented through the PSG, the GEMS were developed from a purely geomorphological narrative, completely siloed from any te ao Māori world view.

5.2 The limitations of fluvial geomorphology for fulfilling Māori aspirations

Analysis of the Hōteo case-study demonstrated that whilst maximising the alignment between geomorphological and te ao Māori approaches is worthwhile, a geomorphological approach alone will never be capable of fulfilling all of kaitiaki or iwi aspirations.

All the case-study participants thought that the Hōteo project was positive and successful overall. When asked why, they identified the reasons as being that the project empowered kaitiaki, built capability, and developed strong relationships. The Hōteo Project demonstrated that it is not enough to just establish good relationships at the beginning of a project, but parties must work continuously at these relationships throughout the course of the project (Harmsworth et al. 2016). The interview participants acknowledged that this was done well by Auckland Council staff throughout the project. As discussed earlier (Section 3.1.1), these relational and social aspects of the restoration process are often just as important for kaitiaki, as the restoration results themselves (Lyver et al. 2016; Fox et al. 2017; Parsons et al. 2021).

These findings validate the view that if the project scope is limited to geomorphological, or science driven perspectives of success, then the more holistic factors that are important for Māori will be missed (e.g. Harmsworth et al 2020; Stronge et al. 2020; Tadaki et al. 2022). This highlights a fundamental difference between western science and te ao Māori approaches: in western science, approaches (including geomorphology) are generally restricted to ecological or physical outcomes; whereas te ao Māori approaches view people and environment as inseparable (thus, social, cultural and economic dimensions of restoration are just as important as the ecological or physical domains) (Salmond et al. 2019, 2022; Hikuroa et al. 2022; Tadaki et al. 2022). Whilst the discipline of fluvial geomorphology is multi-dimensional across hydrology, hydraulics, ecology, geology, climate etc., it does not often incorporate social or cultural domains (e.g. Fuller et al. 2019). In order for the geomorphic component to be relevant for kaitiaki, it needs to be developed in a way that asks the right questions, and in ways that align with how kaitiaki think about river systems.

'Western science' is already utilised by many kaitiaki involved in river restoration, as tools within their cultural monitoring kete (basket) – see Section 3.1.3. We argue that geomorphological knowledge has been underused by kaitiaki, and that there is scope to reframe many geomorphic concepts and applications to be of more direct relevance for kaitiaki. To do so requires starting with a te ao Māori context.

5.3 Locating science in a te Ao Māori context

We contend that science should be contextualised within a nested te ao Māori context. Such a context provides a more holistic and multi-dimensional context for restoration, than any western science discipline can provide (Salmond et al. 2019, 2022; Stronge et al. 2020). Figure 3 conceptualises a nested hierarchy for considering restoration. It depicts how a te ao Māori world view provides the overall context for understanding of all things, within which interconnections between environment and society are understood, and

within which taonga species and mahinga kai provide practical applications for framing science.

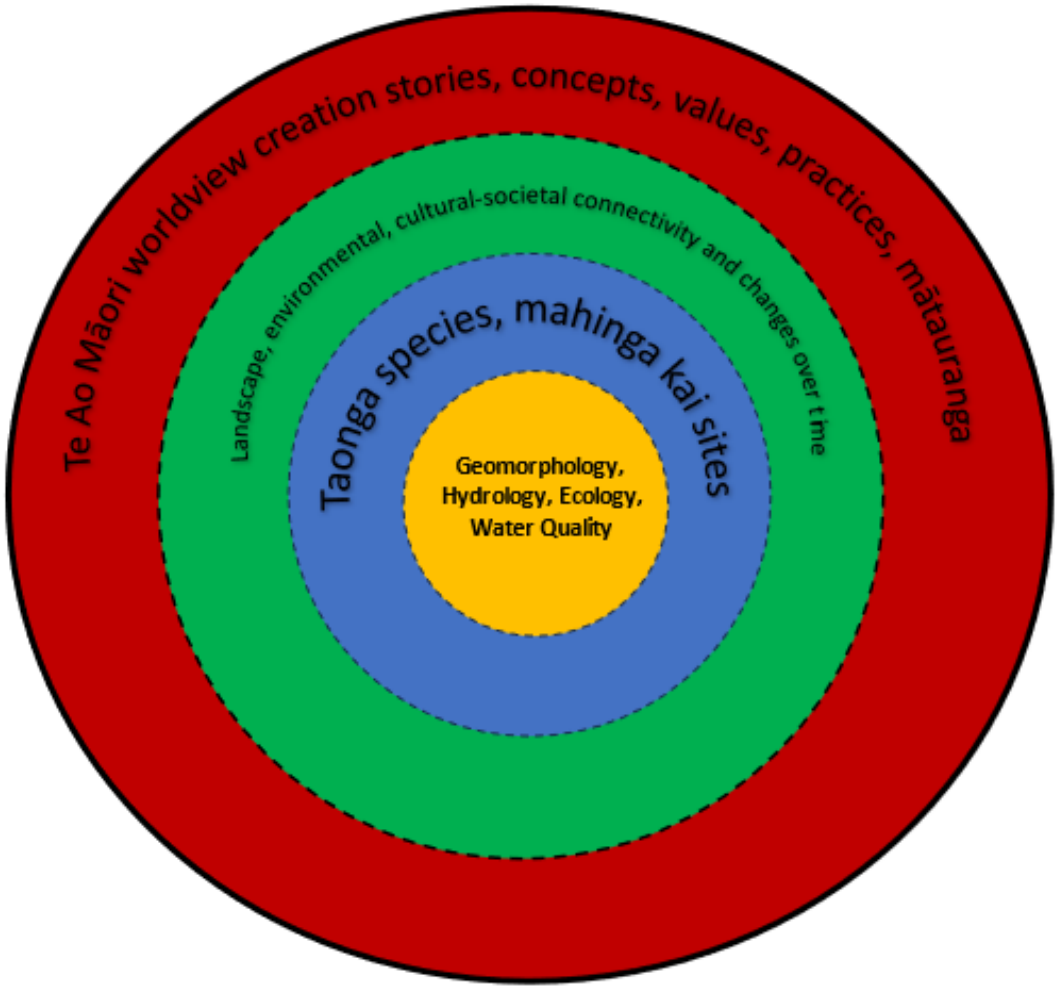

Figure 3. Conceptual diagram illustrating nested hierarchy of how science tools can support restoration of taonga species and mahinga kai sites, which are managed by understanding landscape and people connections, all framed within a te ao Māori world view.

5.4 Importance of strong and enduring partnerships

Figure 3 sets the imperative for a strong partnership approach that bring hapū, iwi or kaitiaki together with scientists, kairangahau Māori (Māori researchers), and other partners (e.g. councils, community), to assess how science can be framed in ways that are relevant for hapū, iwi, and the wider community. The role of the kairangahau Māori, or of project managers experienced in working with Māori, can be helpful for translating concepts between the scientists and hapū and iwi partners.

The importance of creating strong, trusting and enduring partnerships was highlighted in the literature. This was a component of the Hōteo Project that was done exceptionally well. The Hōteo Project built strong and enduring relationships between Auckland Council, iwi, kaitiaki and the wider community. Kaitiaki felt empowered and resourced to carve out

their own space and to drive the Cultural Monitoring Plan. The relationships between kaitiaki and the geomorphic scientists were not so well developed, which probably contributed to the fact that the science and cultural components were siloed from each other. The Auckland Council project manager tried to foster relationships by resourcing kaitiaki to help the geomorphologists in the field with reconnaissance and implementing field monitoring tools; however, the field methods were science driven.

5.5 Baseline wānanga important for hapū and iwi engagement

The literature review highlighted a host of legacy issues that can limit hapū and iwi involvement in projects (Fox et al. 2017; Parsons et al. 2021). In the Hōteo case study, some of the kaitiaki participants identified that capability and capacity issues limited their involvement. Hyslop and Taylor (2022) discussed how, for some kaitiaki who have continued to live in close proximity with their river, their mātauranga may be more 'readily available' to be used for planning, assessing, and monitoring river health and restoration needs (Tipa & Teirney 2006a, 2006b). By contrast, for others, who have been disconnected from their river, they may need more time and funding for (re)connecting with their mātauranga and how it can inform river health.

One way to address this, or to at least acknowledge and plan for these limitations, is to begin any restoration project with 'baseline' wānanga for the hapū or iwi (e.g. Tipa & Teirney 2006a, 2006b). The priorities for these wānanga will be different for each hapū or iwi, depending on their needs, and thus the agenda will need to be organised by the hapū or iwi. Baseline wānanga are integral to setting project goals and aspirations, and as one of our participants identified, can be important for acknowledging and moving on from historical injustices. With the opportunity to engage in baseline wānanga, kaitiaki will be better equipped to meet with scientists to discuss, plan, and drive the project. Whilst the Hōteo Project included wānanga to elicit kaitiaki aspirations (summarised in Hyslop & Taylor 2022), these were not initiated at the outset of the project. This means they did not have the opportunity to influence the direction or development of the GEMS approach. They did, however, underpin the cultural monitoring project.

6 Conclusions

In the context of river restoration, only Māori can know or understand their needs and aspirations. Fluvial geomorphology, as with any 'western science' discipline, is unable to capture the deep, intricate, and relational relationships that Māori have with their environment, which underpin their river restoration practices and aspirations. Thus, it is essential that Māori are empowered to lead their own restoration projects. It is also important that kaitiaki are well resourced and that there is a focus on developing strong and enduring partnerships between hapū, iwi or kaitiaki, scientists, councils, and the wider community.

Fluvial geomorphologists do not need to fully comprehend all the ways that Māori have come to know and understand their environment and develop their mātauranga, nor do Māori need to have a detailed understanding of the technical information that underpins

geomorphological models and decision making. Instead, we contend that the similarities between the geomorphological and te ao Māori approaches to river restoration can be highlighted by bringing key restoration concepts that are important to both approaches to the forefront. These include: catchment scale, working with nature, making space for rivers, observational data, and a holistic approach. Doing so will enable mātauranga and science to be better used together.

For Māori, it is evident that 'standard' physical or ecological outcomes are not the only way of measuring restoration success. For many Māori, restoration can be used as a vehicle for empowerment, such as providing opportunities for building capability and capacity, reconnecting with their river and whakapapa, and engaging with mātauranga. Thus, geomorphological approaches to restoration will never fulfil all Māori aspirations, irrespective of how well they align with te ao Māori concepts.

Accordingly, we contend that western science approaches, including fluvial geomorphology, must take a step back from dominating the restoration narrative, and instead be re-framed, grounded and applied within a te ao Māori world view and context. We suggest that this approach will enable the alignment between fluvial geomorphology and te ao Māori to be best realised in practice and thus, lead to restoration strategies that are novel, adaptive and resilient to climate change. Whilst this restoration approach is complex, it is necessary to enhance the health and well-being of rivers across Aotearoa, and in ways that fulfil Treaty of Waitangi obligations, enabling Māori to enact their rights of rangatiratanga, mana Motuhake (sovereignty), and kaitiakitanga.

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Appendix 1 – Glossary of Māori words/kupu

Atua – God, supernatural being. Many Māori trace their ancestry from atua in their whakapapa and they are regarded as ancestors with influence over particular domains.

awa – river, stream.

hapū – kinship group, clan, tribe, subtribe; section of a large kinship group and the primary political unit in traditional Māori society.

hīnaki – eel trap.

hui – to gather, congregate, assemble, meet; such a gathering.

iwi – extended kinship group, tribe, nation, people, nationality, race; often refers to a large group of people descended from a common ancestor and associated with a distinct territory.

kairangahau Māori – Māori researcher.

kaitiaki – guardian, custodian, caregiver.

kaitiakitanga – guardianship, stewardship, trusteeship, trustee.

Kanohi-ki-te-kanohi – in person, face-to-face.

kaumātua – adult, elder, elderly man, elderly woman, old man; a person of status within the whānau.

kaupapa – topic, subject.

kaupapa Māori – Māori approach, Māori ideology.

kete – basket, kit.

mahinga kai – food-gathering place.

mamae – hurt, pain.

manaakitanga – hospitality, kindness, generosity, support; the process of showing respect, generosity and care for others.

mana – prestige, authority, influence

mana motuhake – autonomy, sovereignty, *mana* through self-determination and control over one's identity.

mana whakahaere – governance, authority, jurisdiction

mana whenua – territorial rights, power from the land, authority over land or territory, jurisdiction over land or territory; power associated with possession and occupation of

tribal land. Sometimes used to describe those associated with such rights/authority; or (more loosely) with tribal links to a specific area.

maramataka – Māori lunar calendar, a planting and fishing monthly almanac.

mātauranga – Māori knowledge; the body of knowledge originating from Māori ancestors, including the Māori world view and perspectives, Māori creativity and cultural practices.

mātauranga-a-hapū – Hapū-specific body of knowledge, perspectives and practices.

mauri – life principle, life force, vital essence, special nature, a material symbol of a life principle, source of emotions; the essential quality and vitality of a being or entity.

pā auroa – eel weir.

pūkenga – specialist, expert.

rangatahi – younger generation, youth.

rangatiratanga – 1. (noun) chieftainship, right to exercise authority, chiefly autonomy, chiefly authority, ownership, leadership of a social group, domain of the rangatira, noble birth, attributes of a chief. 2. (noun) kingdom, realm, sovereignty, principality, self-determination, self-management.

rohe – boundary, region, territory.

tangata – person.

tangata whenua – people born of the whenua (land).

taonga – treasured object, resources, ideas.

taonga species – species with cultural significance to Māori

taumaha – burden, heaviness.

te ao Māori – the Māori world, Māori world view.

tikanga – custom, protocol, lore

uri – ancestry, descendant

waiata – song, chant.

wai māori – freshwater

wānanga – forum, meet and discuss.

whakapapa – genealogy, place in layers, give history.

whakataukī – proverb.

whānau – extended family, family group, a familiar term of address to a number of people; the primary economic unit of traditional Māori society. In the modern context the term is sometimes used to include friends who may not have any kinship ties to other members.

whanaungatanga – relationship, kinship, sense of family connection - a relationship through shared experiences and working together which provides people with a sense of belonging.

whenua – land.