



Indigenous research methodologies in water management: learning from Australia and New Zealand for application on Kamilaroi country

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Abstract Indigenous Research Methodologies (IRMs) for considering cultural values of water are a missing component of water and wetlands management in Australia. On this dry, flat and ancient continent Traditional Knowledge has been passed on from generation to generation for millennia. The profound knowledge of surface and groundwater has been critical to ensuring the survival of Indigenous peoples in the driest inhabited continent, through finding, re-finding and protecting water. Indigenous Research Methodologies can provide a basis for the exploration of this knowledge in a way that that is culturally appropriate, and which generates a culturally safe space for Indigenous researchers and communities. The development of IRMs has been and continues to be limited in Australia in the water context, primarily due to the lack of Indigenous water practitioners, with non-Indigenous researchers dominating the sector. The intention of the paper is to shift and decolonise the research paradigm from studying Indigenous

peoples through non-Indigenous research methodologies, to partnering in developing methods appropriate to Indigenous knowledge systems. Indigenous Research Methodologies are rooted in Indigenous epistemologies and ontologies and represent a radical departure from more positivist forms of research (Wilson, *Can J Native Educ* 25:2, 2001). This allows the Indigenous researcher to derive the terms, questions, and priorities of what is being researched, how the community is engaged, and how the research is delivered. This paper provides an overview of Indigenous engagement in water management in Australia and Aotearoa (New Zealand), with reference to case studies. These more general models are used as the basis for developing an IRM appropriate to the Kamilaroi people in the Gwydir Wetlands of northern NSW, Australia.

Keywords Water · Traditional knowledge · Indigenous research methodologies · Cultural values · Kamilaroi · Aotearoa · New Zealand · Māori · Wetlands

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Introduction

Indigenous people have often felt that they are the objects and subjects of research under Western methodologies rather than the co-participants in research, leading to stifling of their voice (Datta 2017). Indigenous people in Australia are arguably the most

studied peoples in the world (Rigney 1999) and these western approaches to research are perceived by many Indigenous people as failing to adequately recognise the role of culture, language and relationship to land. Indigenous people have lost so much from colonisation including land and waters, knowledge, language and identity. Burgess et al. (2021), compares the colonisation of the lands and waters to that of the colonisation of Indigenous knowledges and that it is sustained and deliberate. Engagement in caring for country and water management by western agencies is often poorly informed and many policy decisions are made without Indigenous input (Datta 2017; Hemming et al. 2017). Western science and research can be described as the pursuit of knowledge or the answering of questions and is often characterised by dichotomous thinking, rationality, and individualism (Battiste 2000, 2013) honed according to western ideologies and belief systems (Alexander et al. 2019) and can also be described as ‘Eurocentric Science’ (Aikenhead and Ogawa 2007). Western approaches are often reductionist and focussed on simple cause-and-effect relationships. Indigenous Knowledge in contrast often emphasises the inter-relatedness of things, by not siloing and emphasises the connections between the physical (measurable) and spiritual (unknowable and observed) worlds. The First Peoples of Australia or Indigenous Australians (hereafter ‘Indigenous’) knowledge systems are built upon connection to place (‘Country’), cultural identity and language, and the complex social hierarchies and systems of respect that value particular knowledge holders (Moggridge and Thompson 2021; Rose 2004). The connection has ensured survival on the driest inhabited continent on earth through building thousands of generations of knowledge and observation to test, challenge and replicate to ensure that survival.

The evolution of Indigenous ways of knowing are built into Indigenous knowledge and ontology and evolve with the times and policies. Indigenous scholars such as Lester-Irabinna Rigney, Moana Jackson and Linda Tuhiwai Smith, Marcia Langton, Gail Tipa and Garth Harmsworth have frequently drawn attention to this. Western scientific methods tend to be more inflexible, time constrained and formulaic and reinforce existing colonial attitudes to knowledge and knowledge systems (Burgess et al. 2021). Indigenous ways of knowing are described as being suppressed

and replaced by colonial settler ways of knowing (Jackson 2016; Pihama 2019). The suppression of knowledge and differences in underlying philosophies can make it challenging for western science to engage with Indigenous people (Jackson and Langton 2011; Bark et al. 2012; Jackson et al. 2012). Indigenous knowledge, research and perspectives can be well placed to inform and complement western science, but finding this common ground is one of the struggles of cross-cultural research (Wilson 2008; Whyte et al. 2015).

Western academics attribute greater authority to written knowledge, particularly published knowledge and to a further extent more credibility to recent knowledge (Burgess et al. 2021) This emphasis and authority diminishes unpublished, visual and oral knowledge such as storytelling. Kimmerer (2013) explains this as a deprivation of the intergenerational knowledge held by Indigenous communities. Storytelling is a central focus of Indigenous epistemologies and research approaches (Iseke 2013). A quote from Tafoya (1995) describes a story cycle in circles:

Stories go in circles. They don't go in straight lines. It helps to listen in circles because there are stories inside and between stories and finding your way through them is as easy and as hard as finding your way home. Part of finding is getting lost, and when you are lost you start to open up and listen.

Indigenous storytelling has been perceived or portrayed as “Myth and Legend”, “Tall Tales”, “Legends”, “Folklore” and “Fables” in Australian literature and books (e.g. Langloh Parker 1896; Reed 1982). Phrasing Indigenous Knowledge this way devalues the importance of those stories and the intellectual property of the original storyteller. It also moves traditional scientific observation from the realm of science and into fiction, despite the fact that many stories represent thousands of generations of observation of Country. Cobern and Loving (2001) define a “standard account” of science that excludes Indigenous science on the grounds that it is not experimental or predictive. Science in Western society is seen as trustworthy because it provides testable and replicable knowledge backed up by studies and research. However modern definitions of science are far less exclusive and there is an increased awareness of the role of knowledge diversity in achieving better

systems understanding (Green 2008; Reyes-Garcia and Benyei 2019; Ulicsni et al. 2019).

Crucial to this ‘rehabilitation’ of traditional knowledge from myth back to data has seen several examples where Western scientific studies by non-Indigenous scholars have sort to validate Indigenous storylines. Hamacher and Norris (2016) related known cosmic impacts and meteorite falls to Australian Aboriginal stories. Scientific investigations have confirmed Traditional Knowledge of Quaternary volcanism by the Gugu Badhun people in Queensland, Australia (Cohen et al. 2017). Landscape features which feature in Indigenous stories have been identified beneath the sea at multiple locations around Australia, indicating that the stories pre-date the most recent period of post-glacial sea-level rise 7000 years ago, (Nunn and Reid 2016). Concurrently, anthropological and cultural studies of Indigenous groups have revealed sophisticated technological achievements in land management, fisheries and local agriculture (Pascoe 2014).

Smith (1999) and Whyte et al. (2015) place the paradigm shift at the interface of Indigenous and Western society from Indigenous people as ‘the researched’ to ‘the researcher’ has been slow and arduous. Indigenous ways of knowing and being often clash with Western epistemologies and Indigenous people are at greater risk to losing out to Western thinking. Despite these challenges and assumptions throughout dominant epistemologies Australia are oblivious of Indigenous traditions, stories and concerns and the research academy have been constructed for and by non-Indigenous Australian researchers (Rigney 1999). In recent times it has been shown that there are profound benefits in incorporating Indigenous knowledges into natural resource management and through participatory mapping (Robinson et al. 2015). This includes water management, pest management, native and cultural or threatened species recovery (Leiper et al. 2018) and fire management (Williamson et al. 2020). The use of Indigenous knowledge has been increasing, although there are continuing challenges for Indigenous knowledge holders to be recognised and respected as experts and key stakeholders (Australian Academy of Science 2019; Vertessy et al. 2019; Jackson and Head 2020). Indigenous knowledge represents observations and data collected over many millennia incorporating changes in climate and

health of Country and is increasingly being sought to provide solutions, particularly in water management (Moggridge et al. 2019, Russell et al 2020; Williams et al. 2019, Harmsworth et al. 2016, Tipa 2013 and Harmsworth et al. 2011). There remains an urgent need for the development of Indigenous Research Methodologies (IRMs) to engage Indigenous knowledge and empower Indigenous people to participate in debate around land and water management, monitoring and policy development.

This paper will provide an overview of Indigenous engagement in water management through brief histories with case studies from Australia and Aotearoa or New Zealand. This will include reviews of water focussed IRMs including the NSW Aboriginal Water Initiative (Moggridge et al. 2019), Australian Cultural Flows Research Project (NCFRP 2018), Aboriginal Waterways Assessments (Mooney and Cullen 2019) and the New Zealand Cultural Health Index (Tipa and Teirney 2002, 2006). Finally, the paper will describe a potential Kamilaroi methodology as a way to structure Indigenous engagement around water management issues in the Gwydir River Region of north-western NSW, Australia.

Indigenous Australians’ engagement in water management

The participation and inclusion of Indigenous people’s knowledge in Australian water management and decisions has been ‘rare’ (NWC 2009, 2011, 2014; PC 2017; Ayre and Mackenzie 2013) and there has been limited progress in the last 15 years (McAvoy 2006; Weir 2011; Tan and Jackson 2013, Moggridge et al. 2019; Moggridge and Thompson 2021; Jackson and Morrison 2007; Taylor et al. 2017). The progress that has been made is conventionally driven by a top-down approach by non-Indigenous government water agencies, that asks: “how do we engage Indigenous people?” and has culminated in the ineffective “consult” and “service delivery” processes evident in mainstream water management planning (Hemming et al. 2017). Water agencies therefore do not incorporate or address Indigenous concerns and “rely on an outdated consultation paradigm that seeks to identify sites for heritage protection” (Tan and Jackson 2013). The status quo process can be destructive as it further disempowers people (and wastes peoples’ time

and energy) and can have significant onflow effects including disengagement from future processes.

The Australian Constitution (1900) established the basis for the Federation of states and territories to appropriate, regulate, modernise and fully utilise water. The consequent allocations of water in Australia's largest water catchment (the Murray-Darling Basin) under an inter-governmental agreement and other water laws around Australia had no regard for the interests of Indigenous peoples (Jackson and Head 2020; Moggridge et al. 2019; Hemming et al. 2007).

The National Water Initiative (COAG 2004) created the first high level vision for water management that incorporated Indigenous values, although there has been limited progress made against those objectives (Jackson and Barber 2013; Taylor et al. 2017). Between 2010 and 2017 the NSW government created and supported the Aboriginal Water Initiative (AWI) an Indigenous-led unit established to re-engage the NSW Aboriginal community in water management and planning (Moggridge et al. 2019; Taylor et al. 2017). The focus of the AWI was to employ Indigenous water practitioners to then identify and collate Indigenous water-dependent values to enable Indigenous participation in water planning. However, there was also a significant focus on building capacity of communities and cultural competency within government in the area of water management (Moggridge et al. 2019). The AWI generated a staged process for Indigenous engagement that focussed on Indigenous-led engagement on Country, strict formalisation of IP arrangements and databasing of Indigenous values through a standardised methodology (Moggridge et al. 2019). The AWI had three priorities and worked under six principles for culturally appropriate methods for engaging Aboriginal people in water including well-articulated governance structure (Moggridge and Thompson 2021). The AWI was discontinued in 2017 by the NSW government with a cut in funding and removal of the unit (Moggridge et al. 2019; Taylor et al. 2017; Moggridge and Thompson 2021).

In south-eastern Australia there are large water holdings/entitlements for the environment, the management of these holdings is highly regulated and closely monitored with many programs reviewing the delivery of the entitlements and its impact mainly for ecological reasons. Yet this governance structure to deliver environmental water does not sufficiently include Indigenous knowledge, values, rights and

interests, many studies have shown this (Jackson and Nias 2019; Moggridge and Thompson 2021). The National Cultural Flows Research Committee was established in March 2011 as a collaboration between three confederations of Indigenous nations along the Murray Darling River system and independently chaired. This included the Murray Lower Darling Rivers Indigenous Nations (MLDRIN), Northern Australia Indigenous Land and Sea Management Alliance (NAILSMA) and the Northern Basin Aboriginal Nations (NBAN), independently chaired through National Native Title Council (NNTC) (Mooney and Cullen 2019). At a later stage the government departments were invited to prepare The National Cultural Flows Research Project (NCFRP) of eight components. The NCFRP built on capacity building, Free, Prior Informed Consent and Indigenous led science and the 2010 Echuca Declaration which defines cultural flows as:

water entitlements that are legally and beneficially owned by Indigenous Nations of a sufficient and adequate quantity and quality, to improve the spiritual, cultural, environmental, social and economic conditions of those Indigenous Nations.

Through the seven-year (3 phases and 5 components see, Table 1) NCFRP project there was a concerted attempt to complete a national assessment of Aboriginal cultural water values, to develop robust methodologies for ecological, socioeconomic, health and wellbeing outcomes of cultural flows, to build water management capacity within Indigenous organisations and to recommend policy, legal, and institutional changes that would enable the implementation of cultural flows (NCFRP 2016). They can be found at www.culturalflows.com.au.

The two case studies chosen and assessed for the NCFRP project were on Nari Nari Country (Toogimbie) Southern NSW and on Murrwarri Country (Gooraman Swamp) Northern NSW. The resulting Aboriginal Waterways Assessment tool was heavily based on the Cultural Health Index (CHI) developed in New Zealand (Tipa and Teirney 2002, 2006). The research teams designed and trialled methods to determine cultural water values and produced a Cultural Flows Water Managers' Guide and a Cultural Flows Community Guide, which outline ten steps Aboriginal people and groups can work through to

Table 1 The 3 Phases and 5 components over 7 years of The National Cultural Flows Research Project (NCFRP 2018, p. 13)

Phase 1—Desktop review	
Component 1	Literature review
Phase 2—Field studies	
Component 2	Indigenous water interests' preliminary findings report. Ecological characterisation report
Component 3	Hydrological and hydraulic modelling report Gooraman Swamp cultural water monitoring plan Toogimbie Wetlands cultural water monitoring plan
Component 4	Field work results and findings report Field studies outcomes report Cultural flows—a guide for community Cultural flows—a guide for water managers
Phase 3—Policy and legal review	
Component 5	Legal and policy design—a multi-layer plan for cultural flows in Australia A pathway to cultural flows in Australia

calculate water needs and monitor outcomes of their cultural flows (NCFRP 2016). They can be found at www.culturalflows.com.au.

The NCFRP provided a framework that enables Aboriginal cultural water use and values to be described and measured with quantifiable water volumes for the first time (MDBA 2019). The findings of Cultural Flow case studies have provided a methodology developed by Indigenous people for the primary use of Indigenous people. There is a process for people to be trained in its methods and requires a dependence on scientists to assist in determining cultural flows (Mooney and Cullen 2019). The NCFRP methodology was primarily developed to establish cultural values of rivers or wetlands, and drew on the Māori Cultural Health Index (Tipa and Teirney 2002, 2006). The focus of the methodology on rivers and wetlands make it poorly suited for collection of groundwater linked cultural values.

More recently there have been examples of reconciliation around water management issues in Australia. This is evident in Victoria between the Crown and Indigenous peoples through the gazetting of the *Yarra River Protection (Wilip-gin Birrarung murron)* Act 2017 (Birrarung Act). The legislation: The Birrarung Act was described as 'an Australian first', by a Minister of the Crown (Wynne 2017) and an essential element of the Act is the creation of the Birrarung Council, a statutory body to be the 'independent voice for the river' (Wynne 2017). Of significance for Indigenous involvement in river management is the mandatory requirement for Traditional

Owner representation on the Council (O'Bryan 2017). The Birrarung Act does not grant legal personhood to the Yarra River (O'Bryan 2017) but provides a statutory independent voice (O'Bryan 2019), and the Traditional Owners the Wurundjeri with opportunities to embed cultural values through the Cultural Principles (s.12) and membership of the Birrarung Council (s.49 1. a).

In the Kimberly region of Western Australia, the Martuwarra/Fitzroy River has been the focus of an ongoing program of co-governance through the Fitzroy River Declaration (Lim et al. 2017) and based on being grounded in ancient First Law (Traditional Law, Customary Law, or Aboriginal Law) (Poelina et al. 2019) and to implement the Declaration, Traditional Owners established a new water governance body, the Martuwarra Fitzroy River Council (MFRC) in 2018. The Declaration represents a model whereby Traditional Owners manage potential individual and cumulative impacts in collaboration with government and other stakeholders through an Indigenous methodology that decolonises the dominant voice and providing a pathway for river management (Poelina et al. 2019). Despite these local successes, there remains relatively minor and limited engagement with Indigenous peoples in Australia and has been described as unfinished business in major debates around water rights, management and allocations in Australia (PC 2017).

In May 2020 the Productivity Commission released an 'Issues Paper' (PC 2020) to undertake an Inquiry into progress with the reform of Australia's

water resources sector with a view to ‘refresh’ the National Water Initiative (NWI), following on from the first national water reform Inquiry in 2017. Indigenous water uses and needs are components of the NWI with paragraphs 52–54 setting out the actions required by jurisdictions to provide for Indigenous access to water resources. The Issues Paper asked a series of questions for the refresh including: What progress are States and Territories making on including Indigenous cultural values in water plans, and how are they reporting progress? How could a refreshed NWI help Indigenous Australians realise their aspirations for access to water, including cultural and economic uses? (PC p. 19 2020).

Further advancements in water are illustrated by the publishing of the *Water for Victoria*, (DELWP 2016) policy in late 2016. Chapter 6 *Recognising and Managing for Aboriginal Values* included four key actions; recognising Aboriginal values and objectives of water, including Aboriginal values and traditional ecological knowledge in water planning, supporting Aboriginal access to water for economic development and building capacity to increase Aboriginal participation in water management. Action 6.4 in *Water for Victoria* (Victorian Government 2016) is the section of the Plan that provides for recognising and managing for Aboriginal values. The policy was associated with a funding program which totaled AUD\$9.7million, which included funding to create a targeted Aboriginal water unit (DELWP 2016; PC 2017). The establishment of the Victorian Aboriginal Water Officers Network (AWON) has been working to create a support network and sharing of information in water management across the state.

Aotearoa (New Zealand) Indigenous (Māori) engagement in water management

The Indigenous people of Aotearoa (New Zealand) (Māori) also have a rich and diverse set of relationships with water (*wai*). Water exists on a cultural and spiritual level and is a central component of lore, songs, dances and as art (Williams 2006). There are a number of shared, principles of the value of water between Indigenous Australians and Māori peoples including: lore, language, knowledge, gender custodial and intergenerational responsibilities, connectivity and evolving cultures. Rivers and lakes are

important parts of *iwi* (tribal) identity (Moggridge and Mihinui 2010). In an Australian context, upon greeting another Indigenous person is to identify “who is your mob and where you from?”. The equivalent in Māori is to ask “*Ko wai koe?*” which queries “Who are you?” but more literally translates as “Who are your waters?” (Ruru 2019).

With British colonisation from the early nineteenth Century, English colonial law was applied in New Zealand, initially through the government of NSW in Australia, and later directly through an NZ-based governor (from 1841) and then parliament (from 1854). Colonial law established different rules for how river and lake banks and beds, navigable flowing waters, and non-navigable rivers can be owned and managed (Memon and Kirk 2012; Ruru 2019). Land surveyors had an important role in determining land ownership around waterways, through implementation of the ‘Queen’s chain’, a strip of land along the coast, major rivers and significant lakes to be reserved from subsequent Crown land sales (Baldwin 1997). The people in Rotorua the Te Arawa explained that the lake beds can be owned, but not the water above it as per their Settlement (Sect. 25) with the Crown (Ministry of Justice 2006) and compared to an adjoining landowner (for example non-Māori) water is owned under entitlements—the riverbed up to the river’s middle flow. Here we see the differences between Māori Treaty Settlements (values based) and colonial/Crown law (ownership) and creates a bias and brings about inequality.

A key difference in the relationship between colonists and Indigenous peoples in Australia and New Zealand was the signing of a treaty between the Crown and Māori tribes in New Zealand. In 1840 the Treaty of Waitangi (hereafter the ‘Treaty’) was signed between the British Crown and about 540 Māori chiefs (*rangatira*) (Berke et al. 2002; Valentine et al. 2007 for reviews). In the Treaty Māori ceded the sovereignty of New Zealand to Britain and gave the Crown an exclusive right to buy lands they wish to sell. In return Māori were guaranteed full rights of ownership of their lands, forests, fisheries and other possessions and the rights and privileges of British subjects. Dispute arose almost immediately based on differences in meanings between the English and the Māori text, the latter of which was signed by the majority of *rangatira* (Stokes 1992). The word ‘sovereignty’ in the English text was translated to the

Māori ‘*kawanatanga*’ (governance). This led to a belief amongst Māori that they would have a greater degree of self-governance than eventuated. The English version guaranteed to Māori ‘undisturbed possession’ of their ‘properties’, which had a particular focus on physical features such as land and water, and access to resources such as fisheries. The Māori version guaranteed ‘*tino rangatiratanga*’ (full authority) over ‘*taonga*’ (treasures), which included both physical resources and spiritual relationships with the environment.

Over the decades following the signing of the Treaty there was an ongoing process of dispossession of Māori, often in direct breach of Treaty principles (Crocker 2014). This included illegal land purchases and quasi-legal dispossession through the Native Land Court. Differences in perspective of ownership were the basis of many of these disputes. Māori beliefs were largely based on temporary stewardship of land and water, with no concept of governing the permanent sale of land. Land agents and settlers often purchased land from individual iwi members, without understanding Māori social structures (Cowie 2012; Crocker 2014). Considerable social disruption was fueled by strategic alliances between the Crown and iwi, and compounded the disruptions generated by the introduction of muskets and the proliferation of European diseases. This culminated in open warfare between Māori and Europeans in many parts of New Zealand through the 1860s and 1870s (‘the New Zealand Wars’ see Wright 2006).

Beginning in the 1950s, there was increasing recognition of injustices which Māori had experienced and a growing recognition of the Treaty as New Zealand’s foundational document. The Treaty of Waitangi Act (1975) established a permanent commission of inquiry to address breaches of the Treaty by the Crown and over the following decades this led to an often-contentious series of claims for redress (Cowie 2012). Several major settlements were awarded to *iwi* recognizing breaches of the key principles of the treaty (When and Hayward 2012).

A major period of environmental law reform in the last part of the 1980’s, led to the establishment of the New Zealand Resource Management Act (RMA) (1991). The RMA is consistent with the principles of the Treaty of Waitangi 1840 and sought to generate planning processes which were inclusive of Māori perspectives (Beverley 1997). The RMA does not

state who owns water but vests day-to-day control to local government and requires them to set enforceable quantity and quality limits to meet freshwater objectives. Ruru (2019) claims that despite the inclusivity of the RMA of the Treaty has done little to protect Māori interests. Love and Atiawa (2001) state that following a 10 year review the RMA promised a lot for Māori in terms of having the Māori voice heard in resource management matters. Many Māori are perhaps disappointed with how things have turned out. In part the provisions especially in Part II of the RMA, Sects. 6 (e), 7 (a) and 8, lacked the force to oblige local government in particular to develop a more partnership arrangement with Māori. However, Williams (2006), believes the RMA provides various levels of contemporary recognition that have been accorded Māori vis-a-vis and the management of waterways through five aspects:

- (1) *Taiapure*: local fishery areas, in estuarine or littoral coastal waters, which are of special significance to iwi or hapu as a source of seafood or for spiritual or cultural reasons.
- (2) *Deed of recognition*: This takes the form of a formal agreement between Kai Tahu and the Crown, providing a basis on which Kai Tahu has registered their right to advocate their interests, in a given area.
- (3) *Statutory acknowledgement*: An instrument that acknowledges Kai Tahu’s special relationship with an area and provides the tribe a standing, that is greater than that of the general public.
- (4) *Nohoanga*: Entitlements have been provided for 13 lakes and 19 rivers.
- (5) *Tōpuni*: In traditional times a topuni was a fine dogskin cloak issued to only a select number of Iwi, this is a metaphor to designate areas of exceptional values to Iwi.

Williams (2006) also states that there is an ongoing role for Māori in the management of waterways and adjoining riparian areas.

Harmsworth et al. (2016), describes further freshwater policy development in New Zealand in the 2014 National Policy Statement for Freshwater Management (NPS-FM), which identifies 13 values and uses for freshwater alone. There are calls for an increased role of Māori in decision making about natural resources including water, and for active

participation in co-governance (Memon and Kirk 2012; Te Aho 2010; Ruru 2009a, b, c, d; Ruru 2011a, b, Ruru 2012; Waitangi Tribunal 2011). There has been an increasing focus on co-governance and co-management of freshwater resources in New Zealand in the last 20 years through a range of wetland, lake, and catchment rehabilitation projects. In the case of the Whanganui River, the Te Awa Tupua (Whanganui River Claims Settlement) Act 2017 was passed as a Treaty of Waitangi settlement after eight years of negotiation between the Whanganui *iwi* and the Crown (O'Donnell and Talbot-Jones 2018).

However, little progression has been made on the Māori rights to water as an entitlement under colonial laws. Systems are already fully or over allocated and with no access to water entitlements, this is the case for Waikato Tainui and with only rights to lake beds and not the water itself, is the reality for Te Arawa in Rotorua.

In the South Island of New Zealand, the largest *iwi* by area is the Ngāi Tahu. Freshwater management for the Ngāi Tahu is of great concern with water resources highly contested within many catchments. Ngāi Tahu have formalised cultural values of water into the *Cultural Health Index* (CHI), which assesses the health of natural environments through a Māori methodology (Tipa and Teirney 2002). This recognises the challenge that “while qualitative descriptions of values provide a rich account of the relationships of people with the waterways that are important to them, they do not readily lend themselves to being expressed in a numerical form” Durette and Barcham (2009). The CHI was developed by identifying the indicators that Māori use to assess stream health through an interactive “conversation style” interview (Table 2).

Through this process a set of indicators were developed which included geomorphology (river shape, sediment, riverbank characteristics), hydrology (flows, movement of water, sound of flow, flow regime), water quality (temperature, clarity, presence of pollutants), riparian condition (extent of native vegetation at a site and in the catchment) and ecosystem services (fish are safe to eat, water is safe to drink). Once the list of indicators was identified, a recording form was composed for community members to assess the health at each stream site. Because the objective was to develop a quantitative index the recording form differentiated between positive and negative statements and score indicators and the site overall on a numerical scale (1–5) (see Tipa and Teirney 2002 for more detail). The data were collected and retained by the community who then provided scores to the local government agency. An additional process sought to detect relationships between the CHI and monitoring data collected according to Western methodologies. Tipa and Teirney (2002) state the disparity found between cultural values and western science:

A fundamental aspect of the project is that Māori may have cultural and spiritual values that sit outside those identified and captured by western measures. This means that at times the CHI and western science results may not be exactly the same—and rightly so.

Applying tools like the CHI, Ngāi Tahu have increasingly engaged in a process of restoring rights of access to waterways. For example, the Waitaki River north of Dunedin has been dammed, stored, diverted, directed and drained with eight major power schemes above where Ngāi Tahu have water entitlements

Table 2 Questions used during development of the Cultural Health Index as applied in New Zealand/Aotearoa

1. If you drove up beside a beautiful healthy stream, what would it look like?
2. How do you assess a site and decide whether to fish there or not?
3. What has impacted on the health of streams and rivers?
4. What has impacted on your *mahinga kai*?
5. What traditional monitoring techniques have you heard of—specific to rivers?
6. What are some of the sites that you use or used in the past in the catchment? What was harvested from these areas?
7. What could *iwi* add to the management process?
8. What are the barriers that stop us participating now?

Taken from Tipa and Teirney (2002)

(ownership of water allocations) (Tipa, 2013). Tipa (2013) emphasises that development of natural resources affects Ngāi Tahu cultural beliefs, values, practices and impede their customary rights that derive from their connections to specific lands and waters. In 2014 amendments were made to the *Ngāi Tahu Claims Settlement Act 1998 (NTCS Act)* based on the history and association Ngāi Tahu have with the Waitaki and water needs for cultural practises and the food resources (*mahinga kai*). The amendments (clause 495 and 496 of *NTCS Act*) included a water allocation of 79m³/s for cultural uses and enhancing *mahinga kai* in the Waitaki, with a further 11m³/s reserved for enhancement of Wainono Lagoon (north of the Waitaki mouth) for *mahinga kai*.

Despite this progress, consultation with Ngāi Tahu revealed ongoing challenges. Senior members of Ngāi Tahu believe that the model of allocation is flawed because it separates land tenure and water allocations (similar to Australia's National Water Initiative 2004) meaning that the iwi have limited ability to use the allocations provided. Ngāi Tahu are aiming to purchase lands where they can use the entitlement. Gail Tipa, a Ngāi Tahu woman, cultural expert and water scientist believes that Ngāi Tahu must have a greater responsibility for their water resources and a say in how they are managed (Pers Comm 2019). There is an increasing frustration that Western governance constructs that separate rights to land and water are impeding iwi management. This is particularly problematic where catchment-scale land degradation is contributing to loss of culturally significant species and resources. As more pressure falls upon water resources and the management of them the spiritual and cultural connections that Indigenous people have to water have been largely overlooked within these water allocation systems globally (Jackson, 2005; Hemming et al. 2017; Moggridge et al. 2019). The Ngāi Tahu produced a Freshwater Policy (Te Rūnanga o Ngāi Tahu 2015) to begin the process of establishing protocols to ensure when engaging with governments the parties understand expectations and ethics of the engagement for freshwater. These types of *iwi* policy statements are increasingly seen as an important part of policy and management landscapes (Pham et al. 2019) and a key component of how *iwi* can work with resource management agencies.

How to influence Western ways through a Kamilaroi methodology

In the context of Indigenous Australians' engagement in water management, and drawing on insights from New Zealand, the first author sought to develop a Kamilaroi IRM as a way to structure Indigenous engagement around water management issues in the Gwydir River region of north-western NSW, Australia. The Gwydir River basin covers an area of 26,588 km² on the border of NSW and Queensland and flows 668 km generally northwest and west to join the Barwon River. Along much of its length the river flows over low gradient floodplains, forming a series of anabranches and waterholes, and supporting an extensive wetland complex (1021 km²), 800 km² of which is classified as a Wetland of International Importance under the Ramsar Convention of 1971. Completion of the 1364 Gigalitre Copeton Dam in the headwaters of the Gwydir in 1976 has significantly altered the hydrology of the river, with water being diverted to irrigate more than 30,000 hectares of agricultural land, primarily for the growth of cotton.

The Kamilaroi Nation (also referred to as but not limited to Gomeri, Gomilaroi, Comelroi or Gamilaraay—Tindale (1974) provides a list of over 30 names) comprise one of the four largest Indigenous nations in Australia and have occupied the Gwydir River valley and beyond for at least 45,000 years. At the time of European contact, it is estimated that the population of the region numbered more than 15,000 people, but due to the impacts of European diseases, loss of access to resources and organised programs of extirpation, this had declined to only 1000 by the early 20th Century (Fraser 1892).

Kamilaroi people today are spread far and wide as well as living on Kamilaroi Country, as the second largest Nation on the eastern seaboard the descendants are many, as there is no census data for Kamilaroi, it is difficult to determine modern demographics. The Kamilaroi Nation's governance is difficult as it is sparse over a large area (approximately 78,000 square kilometres) and across many landscapes and Elders and Traditional Owners that identify with areas of Kamilaroi have the right to speak for Country. At the time of writing this paper there is a claim for Native Title by the Gomeri Nation (Tribunal File: NC2011/006, NNTT 2011) and the claim is awaiting

the hearing and a judgement by the High Court of Australia (Federal Court file No: NSD37/2019).

There are two approaches to deriving water for cultural values, both of which recognise the important role of Kamilaroi and Indigenous Storytelling as evidence.

- (1) The first relies on the non-physical (spiritual) water dependent values identified through storytelling, which characterise the natural state of the waterway. This also strongly connects to the ways Māori produce evidence, collect stories to then influence and manage freshwater. Like the relevant Iwi in Aotearoa, the Kamilaroi people provide guidance on what the natural flow is including frequency, duration and timing, to determine the cultural health of a waterway. This is a holistic approach that is heavily based on traditional knowledge, which is held and regulated by elders and not shared beyond the Nation or relevant community.
- (2) The second approach is more reductionist and focuses on a single or small set of measurable values i.e., totemic value, food source or fishing for *Thagaay* (Yellow belly/golden perch; *Macquaria ambigua ambigua*, Fig. 1). These values are identified from Kamilaroi stories and used as the focus of an ecological response model which calculates the optimal flow for the Indigenous value. This process is more strongly based on principles of co-design, where Kamilaroi values are shared into a Western scientific framework. Either of these approaches may be valid for particular places, and both require an approach

strongly based on collaboration between Kamilaroi people and governments that control water.

The authors propose a simple yet flexible framework for engaging with Kamilaroi cultural water needs and integrating these into water management practice (Fig. 2). This focusses on identifying reaches and reviewing existing knowledge before engaging in a formal way with the relevant Indigenous people. Recognising that there may not be a strong history of trust, this initial engagement is formalised into a research agreement to protect Intellectual Property and to establish ground rules/protocols for governance and the nature of engagement, examples of engagement and building trust through principles with Indigenous communities can be found in Moggridge et al. (2019) and Jackson et al. (2012). Existing knowledge can then be discussed and supplemented through workshoping with communities, allowing the development of a shared understanding of the cultural values spatially and temporally.

Defining target values needs to be a collaborative process where stories, Traditional Knowledge and contemporary knowledge are shared. This may require development of a scoring system such as the Māori CHI methodology in order to identify key water-related drivers within a holistic understanding of cultural health of a site. Alternatively, single species may be identified as a priority focus for a particular area or time. Experience in developing the CHI in New Zealand suggests that there can be challenges in prioritising target values, and that the use of a quantitative and qualitative approach can assist communities in achieving consensus around values,

Fig. 1 Kamilaroi painting of a *Thagaay*, Golden Perch or Yellow Belly (Moggridge 2004)



the methodology will require flexibility in collecting target values.

Once target values are defined, then there needs to be a process of identifying the hydrologic needs of the target. This can be done largely based on Traditional Knowledge, which may be sufficient to identify key times of year for watering, or key sites which should be targeted to maintain their spiritual and environmental health. Alternatively, existing eco-hydrologic models for the target may exist (e.g., flow thresholds for stimulating spawning of *Thaagay*, Fig. 1) which can be developed and refined in consultation with the relevant Indigenous people (Kamilaroi), before being used to develop qualitative flow guidelines. This information can then be integrated into existing water planning processes (Stewardson and Guarino 2018) which designs water delivery around a set of hydrologic and environmental objectives.

Key challenges in delivering water to meet cultural values are managing risk to infrastructure and other values and ensuring that water use is both effective and efficient. Recognising this, the first author propose drawing on the Kamilaroi tradition of adaptive management ('learning through doing') but also drawing on the Western formalisation of adaptive management (sensu Walters and Hilborn 1978; Walters 1986). This means adopting a deliberate experimental management approach that includes a priori risk assessments and experimental designs that include control sites (where feasible) and monitoring before and after delivery of flows. There is considerable potential and a moral obligation to actively engage Kamilaroi people in both planning and monitoring of outcomes. Reporting of outcomes needs to be transparent and robust, ensuring that benefits of cultural water are reported in an understandable way such that they can be justified within the water planning process.

Implementing the proposed methodology poses some immediate challenges, including:

- it is not clear which Indigenous organisation or individuals will manage the logistics of the cultural watering, and how this would fit within existing models of water management and governance;
- There is a need for Indigenous communities to have a seat at the water allocation table alongside environmental water managers, farmers/irrigators and mining companies;

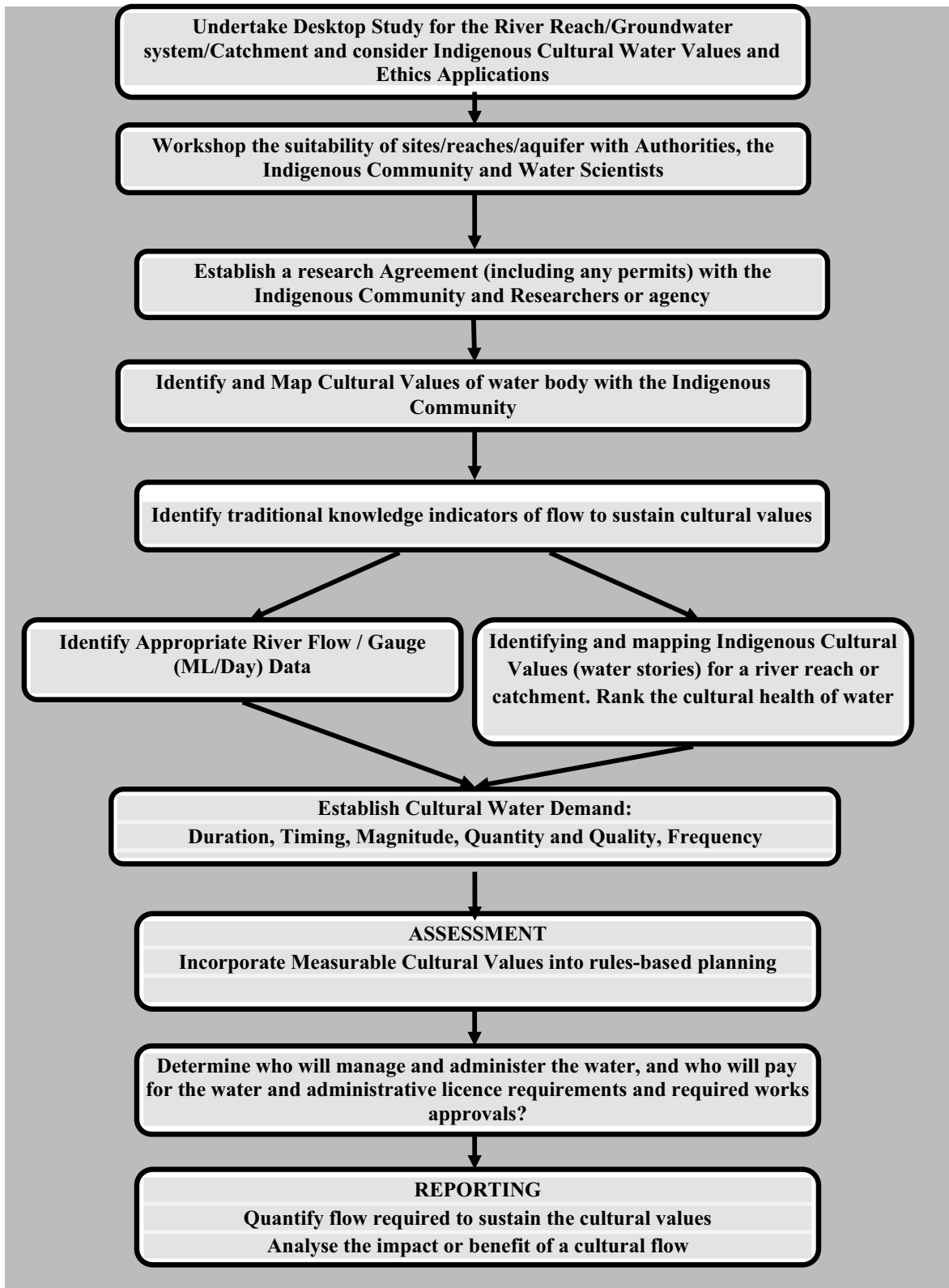
- There remains substantive uncertainty around the relationship of water to Native Title; including whether water could be traded for commercial benefits to Kamilaroi (O'Donnell 2013); and
- There are also knowledge gaps that require addressing for future research.

Future research needs to understand how cultural water may interact with environmental water allocations, flows and the qualification of those flows. Finally, there is a need for sharing information about Kamilaroi values with the community, and for Kamilaroi to develop skills and competencies in the complex area of Western water management, a two-way learning model. The Kamilaroi methodology must be tested by Kamilaroi researchers, with Kamilaroi people on Kamilaroi Country.

Conclusion

Through looking at the Māori and Kamilaroi experiences in water Maclean and Bana Yaralji Bubu (2011) explain that the values and knowledge continue to be relegated to traditional or pre-colonial paradigm within existing planning approaches, whereas ways of knowing and relating to water continue to evolve. The evolution of Indigenous ways of knowing water is becoming a part of the Indigenous knowledge's, it can appear complex and challenging to outside observers, but is well worth any efforts to include in water management.

Indigenous Research Methodologies provide the basis for engaging with Indigenous knowledge systems that can complement and enhance natural resource management. The history and thousands of generations of observation can assist western methods of managing and sharing water. Indigenous storytelling from an Australian and Aotearoa (New Zealand) perspective can further complement western ways. Indigenous people of Australia have much to learn from their Māori counterparts and vice versa with considerable potential for further collaboration. At a national and regional scale Indigenous paradigms can impact the way society can value water and manage it. If this were to be incorporated into water planning Indigenous and non-Indigenous Australians would benefit through the protection and recognition



◀**Fig. 2** A Kamilaroi methodology for informing cultural water delivery (see text for details)

of different types of flows. So too, would water itself in its many forms.

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Declarations

Conflict of interest No potential conflict of interest was reported by the authors.

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