

Title

Environmental uncertainty and muddy blue spaces: health, history, and wetland geographies in Aotearoa New Zealand

Introduction

Since 1840, when the British colonisation of Aotearoa New Zealand formally commenced with the signing of the Treaty of Waitangi, there has been a significant reduction in the total area and health of wetlands (more than 90 per cent loss) as a result of drainage and river “improvement” schemes (Clarkson *et al.* 2013, Ausseil *et al.* 2015). These figures are amongst the greatest extent of wetland reduction in the developed world (Clarkson *et al.* 2013). The coupled social-ecological transformation of wetlands to grasslands and urban areas represents a familiar modernising development pathway adopted in different settler colonial societies, yet one which is often overlooked by scholars, natural resource managers, and members of the public. Indeed, the status of land and water (its availability, ownership, quality, management, degradation) receives far greater attention (Romero Lankao 2010, Parsons and Nalau 2016, Beattie and Morgan 2017). Yet, as I will outline in this chapter, wetlands (the muddy blue spaces of brown and green, in-between hybrid spaces between fixed land and fluid water) were and are fundamental components of healthy ecosystems interconnected to the health and wellbeing of both human and non-human communities.

When thinking about current environmental crises and future impacts of climate change, it is critical that we contemplate how certain human-environment relations (specifically perceptions, values, and practices around what constitutes healthy blue spaces) are institutionalised in dominant resource management policies. An historical perspective of how people (as individuals and members of wider social groups) perceived, interacted with, and related to specific freshwater spaces in the past provides important insights into current and future hydro-social cycles, path dependencies, and the multiplicity of healthy waters. In this chapter I provide an examination of drainage of the wetlands and re-configuration of floodplains of Aotearoa New Zealand, focusing specifically on the Rangitāiki wetlands 1910s-1940s. I document how the emergent settler colonial government and individual white settlers articulated and acted on specific geographical imaginations that determined what landscapes and waterscapes should look like and how those

spaces interacted with. Interventions (legal, engineered, and discursive) to define and reform wetlands (muddy blue spaces, liminal zones) into fixed straight blue lines running through neatly ordered green pastures filled with certain fauna (cows, sheep) involved the expression of particular values about what environments were deemed desirable, which were built on particularly understandings of health and "nature". These changes were reflective of different values Māori and European settlers (Pākehā) attached to the wetland blue spaces, and resulted in the disruption of pre-existing relationships of Māori communities with local wetlands, the diminishment of communities' hydro-resilience.

In Aotearoa New Zealand there are a variety of wetlands and associated ecosystems. These muddy blue spaces are spaces of transitions between waters and lands. Throughout the nineteenth and twentieth centuries in Aotearoa New Zealand the term "swamp" was used in a multitude of settings by Pākehā to refer to any area with pooled water and some associated vegetation cover. Technically, however, the term "swamp" now is used only in reference to wetlands that are forested with wooded vegetation (Park 2001, p. 26).. Scientists classify wetlands in different ways, such as palustrine (emergent plants over freshwater), estuarine (estuaries and lagoons), lacustrine (lakes and ponds), riverine, interior and coastal, or swamps, bogs, and mires (Clarkson *et al.* 2013). Mātauranga Māori (Māori knowledge) uses different terms of classification for wetlands, including poharu (palustrine), roto and moana (lacustrine), awa and manga (riverine), and wahapū, hāpua, and muriwai (estuarine). All major types of wetlands are found in Aotearoa New Zealand.

In this chapter I draw on environmental history, social history of medicine, cultural geography, indigenous geography, and global environmental change scholarships to weave together a narrative about how Māori and Pākehā imagined and interacted with the wetlands of the Aotearoa New Zealand in the nineteenth and first half of the twentieth centuries. Analysis centres on government reports, photographs and newspaper articles, as well as other documents, held by the National Archives of New Zealand as well as published memoirs and oral history collections. In particular, I concentrated on materials pertaining to the Rangitāiki Plains, which was formerly wetlands and encompasses the towns of Whakatāne, Matatā, Te Teko, and Edgecumbe, and is the area where I spent a great deal of time as a child and adult. Through these documents we can see

glimpses of larger changes in the ways wetlands, rivers, and floods were understood before and after drainage works were undertaken in the 1910s-1940s.

In this chapter, I firstly chiefly outline some of pertain historical and geographical scholarship examining anxieties about environmental conditions. I then proceed to discuss how various medical theories of disease-causation contributed to white perceptions of wetlands as unhealthy spaces throughout the nineteenth and early twentieth century. Finally, I analyse the drainage of the Rangitāiki wetlands between the 1910s and 1940s, and demonstrate how hydrological interventions contributed to the loss of resilience and increased vulnerability to flooding.

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Environmental health and settler anxieties in the nineteenth century Aotearoa New Zealand

From the outset of European encounters with the wetlands of Aotearoa New Zealand, European explorers, missionaries, and settlers perceived the muddy fluid blue spaces as deeply problematic 'liminal zones'. Far from being therapeutic spaces, as perceived by Māori communities, living in or visiting wetlands was deemed by European settlers to be both "ruinous to health" (the cause of fevers, rheumatism and other illnesses) and "retarding settlement" (Anonymous 1879). In 1875, for instance, the outbreak of fever in the township of Napier (Hawke's Bay district) was blamed on the wetlands that surrounded the town and the colony's first drainage legislation was introduced as a result of public health fears (New Zealand Parliament 1875). Such environmental anxieties, and the links between colonial environments, climates, biota and health featured prominently in public and political discussions in other colonial societies, including Australia, Canada, and South Africa, and prompted similar attempts to control and re-engineer land, waters, and biota (Webster and Mullins 2003, Beattie 2005, Bonnell 2014, Giblett 2014, Flikke 2016). Such environmental anxieties were reflections of colonial actors' perceptions of their own vulnerabilities in new landscapes and waterscapes (Park 2002, Beattie 2008, Morgan 2013)

Popular medical and geographical discourses of the time period framed wetlands as unhealthy and unproductive spaces that required efforts to re-make them (Beattie 2005; Park 2002).

Miasmatic thinking, a popular theory of disease transmission throughout European societies until

the mid to late nineteenth century, understood ill-health as a result of exposure to miasma (bad airs), which could be generated from rotting vegetation and animal matter, human waste, stagnant water, and foul air from factories, people and so forth (Bashford 1998, Beattie 2008). Wetlands abundance of decomposing plants and torpid murky ponds was viewed and smelt (with olfactory sense fundamental) as the home of countless dangerous miasma. However, the connection between causation and transmission of diseases was not clearly defined nor indeed was this linkage viewed as being of particular importance. Rather emphasis was placed on the regulation of indoor and outdoor spaces, with wetland drainage, removal of indigenous vegetation, and the planting of certain healthy (non-indigenous) trees (oaks, eucalyptus, willows, pine) all deemed to be necessarily for improving the health of (white) bodies and modernising (and civilising) landscapes (Beattie 2005, 2008). The drainage of Rangitāiki wetlands in the first half of the twentieth century, which I will now discuss, is a prime example of how state-directed colonial hydrological interventions involved the consolidation of the power of the settler colonial state, the creation of new settler-dominated grasslands economies and landscapes, the marginalisation of Māori communities, and the diminishment of “hydro-resilience” (Beattie and Morgan 2017).

“Unwatering” and remaking muddy blue spaces of the Rangitāiki wetlands

The Rangitāiki wetlands, located in the Eastern Bay of Plenty in Aotearoa New Zealand’s North Island, traditionally comprised the area of 32,000 acres including the Tarawera River (western boundary), the Whakatāne River (eastern boundary) and the Rangitāiki River (which ran through the middle) (Parsons and Nalau 2016) (see Figure 1: Map of location of Rangitāiki Plains and present-day course of the three rivers). All three rivers left the mountain ranges as separate rivers but converged into a single wetlands area, which formed a number of lagoons. The wetlands drained into the ocean through three main channels at Orini, Awaiti and Mātātā, however the channels frequently shifted with flood events, storm surges, coastal erosion, and shifting sand dunes making for highly dynamic fluid waterscapes/landscapes.

[Insert Figure 1: Map of Location of Rangitāiki Plains (Source: Author created)]

For Māori the Rangitāiki wetlands, with its three awa (rivers), springs, muddy spaces, and biota were (and are still) central rather than liminal zones, both materially (as sites of cultivations, food

harvesting, and healing), and metaphysically (as places of spiritual meaning) significant to Māori health and wellbeing (Waitangi Tribunal 1999, Rangitaiki River Forum 2015). Archaeologists argue that unlike in European cultures where wetlands were marginal places, in Aotearoa New Zealand wetlands were central to Māori culture. Archaeological evidence identifies the existence of wetland pā (fortified villages) within the area, with artefacts found including buildings, canoe, and horticultural tools, highlighting the continuity of occupation in the area (Horrocks *et al.* 2004, Irwin 2013). In 1840, when British colonial rule formally commenced in Aotearoa, numerous different Māori iwi (tribe) and hapū (sub-tribe) lived within or near the three river catchments and used the resources of the Rangitāiki wetlands, with usage rights overlapping between different hapū. This includes hapū of Ngāti Awa, Ngāti Tūwharetoa, Ngāti Makino, Ngāti Pūkiao, Ngāti Manawa, and Tūhoe (Rangitaiki River Forum 2015). The wetlands were crucial resource gathering areas for Māori. A variety of plant species were harvested by Māori, for instance harakeke (New Zealand flax - *Phormium tenax*) was used for clothing, mats, baskets and rope, kuta (bamboo spike sedge - *Eleocharis spachelata*) for insulation and weaving, and raupō (*Typha orientalis*) for food and thatching. Similarly the Rangitāiki wetlands provided habitat for tuna (eels - *Anguilla spp.*), inanga (whitebait - *Galaxias spp.*) and other fish species which were important food sources for Māori, as well as numerous bird species (Park 2001, Clarkson *et al.* 2013, Parsons and Nalau 2016). The higher areas of land were used for cultivating crops (first kumara and taro, and later with the arrival of Europeans, potatoes, wheat, amongst others).

In Maori ontologies, social and ecological systems are indivisible wholes (Panelli and Tipa 2007, Salmond 2017). Unlike western scientific traditions, no clear division made between separate elements of freshwater systems, such as the water, riparian, river bed, wetlands, or estuaries. From Māori worldview, wetlands are perceived as being interconnected with other water sources, including rivers, streams and springs, and estuaries. Indeed, prior to the European colonisation in the plains of Aotearoa New Zealand (as the Rangitāiki wetlands example demonstrates) the majority of rivers and streams ran through areas of vast wetlands, and thus rivers were indistinguishable from wetlands (Clarkson *et al.* 2013, Denyer and Robertson 2016).

The metaphysical and material aspects of rivers, wetlands, and other blue spaces are woven together, and linked to the wellbeing of the local Maori. Māori conceptualisations of wellbeing, unlike those of Western scientific notions of individuals' physical and mental health status, centre on the health of the self, whanau (extended family), hapū (sub-tribe), and iwi (tribe) in connection

with their traditional lands and waterways (rohe) (Panelli and Tipa 2007); emphasis is placed on the interrelationships between individuals and collectives (human, ecological, and metaphysical communities) and on the responsibility of local Māori (tangata whenua) to maintain the mauri (life force) of their rohe (Rangitaiki River Forum 2015, Te Pahiopoto Hapu 2017). For whānau and hapū the muddy blue spaces of the Rangitāiki wetlands and three rivers were, thus, intertwined with their physical and spiritual health, providing basic provisions (food, shelter, water), as well as sites of healing and connections with the spiritual worlds. Waka (canoe) were used to traverse the wetlands and rivers, for both transport and trading. Whānau and hapū maintained customary usage rights to the resources and usage of particular places including tauranga ika (landing places for canoes), pa tuna (eel weirs), and fishing locations. Ngāti Manawa and Ngāti Whare, whose rohe (traditional lands and waters) is located in the middle and upper reaches of the Rangitāiki River, described their “eel culture” prior to their dispossession and the environmental degradation of the area. Elders report how tuna and tuna harvesting, and “the rivers have always been the lifeblood of the people”. Different varieties of eels and other fish species were identified as living in specific areas. “In different places, they tasted different; some were ordinary, some were special, but all were considered taonga” (meaning sacred) (Waitangi Tribunal 1998, p. 12). In addition to food harvesting, the waters of the Rangitaiki River were also used in healing and spiritual practices. Family members (whanau) ensured that those living outside the rohe were supplied with the water of the Rangitāiki River for special occasions. As an elder recounted to the Waitangi Tribunal:

“The water from the puna wai [water of the spring] of a whanau is considered to a taonga [a treasure] to that whanau as it carries the Mauri [life force] of that particular whanau [family]. Of course all the waters of the puna wai find their way into the river and thereby join with the Mauri of the river. In essence then the very spiritual being of every whanau is part of the river ... In this sense the river is more than a taonga[;] it is the people themselves.”(Waitangi Tribunal 1998, p. 13)

Wetlands and rivers are home to both the physical and the metaphysical (Te Aho 2014). Taniwha, supernatural beings who could be either friendly or hostile and often assume eel-like forms, dwell in the murky waters of awa and linked to specific hapū and iwi (Kolig 2007, Dodd 2010, Rangitaiki River Forum 2015, Salmond 2017). Blue spaces therefore were (and are) multiple things, assemblages, connections and relationships, with rivers the embodiment of ancestral relationships through genealogical connections (whakapapa) to specific whanau, hapu, and iwi, and wetlands places of home, healing, physical and spiritual healing. Rivers and wetlands all said to possess a mauri, which Māori were required to maintain through correct behaviours and practices. In these

complex fluid and interconnected landscapes-waterscapes, physical features were and are more than simply wetlands, rivers, streams, waterfalls, wetlands, they carry with them histories of past events, stories, and narratives that give meaning to places, and link them with whakapapa (Te Aho 2014, Parsons *et al.* 2017). Thus, the alteration of these places of meaning as a result of settler-led colonial policies and interventions, resulted in substantive losses (of access to resources, of places of recreation, of economic activities, and of spiritual connection) for Māori communities, including diminishing health and wellbeing.

Like elsewhere in the Aotearoa New Zealand, Māori used the geothermal springs (ngāwha, puia) located on the eastern and central edge of the Rangitāiki wetlands for cooking, bathing, laundry, recreation, healing and spiritual purposes. Many geothermal areas were important wahi tapu (sacred spaces) and relationships between people and places were active, ongoing, and multiple (Rockel 1986, Stokes 2000, Foley *et al.* 2011). While Europeans similarly valued hot springs, such interactions chiefly centred on visiting hot springs (at spa towns) for health purposes rather other purposes. In the Rangitāiki the Māori frequent use of these hot blue spaces was criticized by government doctor (Matthew Scott) in 1885 for being not only over-indulgent but also unhealthy. Māori living near the geothermal springs at Awakeri supposedly suffering from high rates of tuberculosis and “rheumatic affections” due to their bathing in the spring waters “as a pure matter of gratification, and not in any sense therapeutically” (Scott 1885, p. 10). Such engagements with these supposedly therapeutic blue spaces were deemed a breach of the correct self-care practices necessary to ensure good health, with emphasis placed on individuals being able to police their own behavior and keep emotions (and impulses) in check. In the Rangitāiki wetlands, actions were taken from the late nineteenth century to restrict the ability of Māori ability to access and use geothermal resources as part of the colonial making at the same time Europeans sought to narrate and market therapeutic landscapes (such as spa towns) on the basis of past native 'health' histories, which paralleled processes which occurred to Māori and other indigenous peoples elsewhere (Stokes 2000, Foley *et al.* 2011, p. 153).

In 1866 the settler colonial government, following on from the military invasion of the area in 1865 by colonial military forces assisted by Māori allies, enacted legislation that confiscated the majority of Rangitāiki wetlands from Māori iwi (Waitangi Tribunal 1999, Belich 2015, Parsons and Nalau 2016). Confiscation (raupatu) was used by the colonial government throughout the North Island of Aoteroa New Zealand in the 1860s as a means to punish iwi who supposedly challenged

British colonial rule, and also a mechanism to gain large tracts of Māori land for settlers (for further details see Parsons and Nalau 2016; Belich 2001b; O'Malley 2016; Waitangi Tribunal 1999). After the confiscation of Māori land and the imposition of colonial rule, the central government undertook land surveys in the Rangitāiki wetlands, and made leasehold and freehold lands available for European settlers in the 1890s.

Government drainage in the Rangitāiki: 1910s-1940s

Between 1894 and 1910 European settlers attempted, unsuccessfully, to drain the Rangitāiki wetlands. In 1910, following repeated requests from local settlers for assistance, the central government introduced specific legislation (Rangitāiki Land Drainage Act, 1910) and provided funding (both directly through grants and indirectly through taxes on landholders) to facilitate large-scale engineering and drainage works in the wetlands (see Figure 2: timeline of changes to Rangitāiki wetlands) (Department of Lands and Survey 1908, New Zealand Parliament 1910, AJHR 1911, Law 1962). As part of the wetlands drainage, river realignment, and flood control operations, the lower portions of the Rangitāiki, Whakatāne and Tarawera rivers were almost entirely re-engineered between 1910 and 1917 (AJHR 1911, 1918) (see Figures 3a, 3b, 3c: Government maps of Rangitāiki drainage scheme 1911, 1917 and 1919). Workers constructed canals using manual labour and new technologies (dredging machines specially imported from the US and England), straightened rivers, built levees, and cut a new outlet for the Rangitāiki River through the sand dunes to the sea so it flowed more directly to the ocean (see Figure 4: Dredging machine, Rangitāiki River, Bay of Plenty, circa 1911).

[Insert Figure 2: Timeline of Some of the Changes to the Rangitāiki Wetlands (Source: Author Created)]

Amidst all the engineered structures and other fixtures of settler colonialism (fences, roads, cows and sheep, factories, and townships), the issue of the persistent and resistant rivers and wetlands continued to be at the forefront of settler concerns. For many European settlers and visitors to the Rangitāiki Plains, the three rivers and wetlands were unlike their past experiences and personal expectations of rivers (Department of Lands and Survey 1908, AJHR 1911, Unknown Author 1928, Pontet and McCallion 1964). European rivers were recalled and imagined (and re-imagined) as

tamed, well-behaved and fixed healthy blue spaces, in contrast to the tortuous, unstable and (potentially) unhealthy blue spaces. In Britain, work to drain the East Anglia wetlands commenced in the sixteenth century and many settlers cited East Anglia as the model that should be adopted in Aotearoa New Zealand (Hursthouse 1861, Park 2002). The expansive, erratic, and porous wetlands and rivers of Rangitāiki floodplains bore little likeness to the now common and ubiquitous engineered, regulated, and straightened rivers of modern Europe. The construction of drainage canals, pumping stations, levees, factories, towns, roads, and other infrastructure raised expectations amongst settlers that the rivers (once divorced from the muddy wetland interlopers) would be steady presences in the landscape. Such advantages in engineering technology and knowledge created confidence that many aspects of “nature” (which was previously deemed capricious) were controllable and improvable for the advancement of settler society (Webster and Mullins 2003, Lavau 2011).

[Insert Figures 3a-c: Government maps of Rangitāiki drainage scheme 1911, 1917 and 1919 (Source: AJHRs, National Library, Ministry of Cultural Heritage. Creative Commons 3.0)]

[Insert Figure 4: Dredging, Rangitāiki River, Bay of Plenty, 1910 (Source: Tonks, Hylton Gary, 1940-:Photographs of dredging of Rangitāiki - Whakatane Rivers 1910. Ref: 1/4-016471-G. Alexander Turnbull Library, Wellington, New Zealand)]

Drainage of wetlands and river “improvement” works provided settlers with the possibility of correcting the unhealthy, undesirable, and unpredictable tendencies of muddy blue spaces. Informed by British agricultural traditions, urban design and tenure systems and technologies, individual settlers and both local and central governments considered efforts to drain the Rangitāiki wetlands and control the three rivers to be of pivotal importance (Hinton 1970, Opie 1983, Webster and Mullins 2003, Parsons and Nalau 2016). Drainage operations were seen as vital necessities for the creation of temperate agriculture, the establishment of settlements, and other developments. Most notably the creation and maintenance of healthy settler communities. Health and wellbeing, whilst not explicitly mentioned in legislation, underpinned policy discourse surrounding wetlands and rivers throughout the period. The Rangitāiki Land Drainage Act (1910) was reflective of central government’s developing policy (Land Drainage Acts 1893, 1904, and

1908) towards Aotearoa New Zealand's wetlands in the first half of the twentieth century (Park, 2001). There were four main tenets of this policy: first, the wetlands were "useless" in their existing indigenous states and were only valuable for their potential as flat fertile land for farming; second, wetlands did not possess any scenic value and therefore were not part of emergent preservation campaigns (to conserve forests, birds, and lakes for recreational purposes); third, that wetlands were legally potential land. This assumed potentiality meant that entitlements to wetlands (specifically Māori rights of access and usage) were deemed by the government and courts to transfer with titles to land (once "unwatered"); lastly, the development of wetlands into farmland was deemed of such national importance that it required central government intervention and funding to ensure its success. These tenets detrimentally impacted Māori communities in particular, who considered the (so-called unimproved) Rangitāiki ecosystems to be of immense value (economically, socially, and culturally significant spaces in terms of spirituality, health and wellbeing).

In contrast to Pākehā, Māori did not perceive wetland drainage and water engineering works as "improvements" on the existing waterscapes and landscapes. Throughout Aotearoa New Zealand Māori regularly petitioned members of parliament and government officials about their loss of lands, resources, and degradation associated with drainage and flood controls (Bamford & Brown 1909, Hone Te Anga 1914, Raukete te Hara 1916). In these petitions Māori challenged the ongoing privileging of scientific knowledge, technologies, values, and authority over Māori knowledge, values, socio-political governance structures, and ways of living (AJHR 1923, 1927, Waitangi Tribunal 1999, 2009). In addition to requests for the return of Māori lands and financial compensation for the loss of land and resources, petitioners expressed concern about their loss of access to resources as a consequence of government policies. Generations of Māori from the Rāngitāiki catchment wrote and spoke out about the negative consequences of drainage, flood controls, and other hydrological interventions on their *rohe* (traditional lands and waters), including the decline in indigenous flora and fauna, and loss of sites of cultural significance. The decreased in tuna (freshwater eels), piharau (lamprey), upokororo (grayling), papanoko (torrentfish), and inanga (whitebait) as a consequence of hard adaptations, loss of habitat, and pollution of waterways meant that Māori whanau, hapu and iwi were not able to undertake traditional harvesting practices (Downes 1918, Waitangi Tribunal 1993, 1993, 1999, Park 2001). While central government officials did sometimes acknowledge that Māori petitions had merit,

they repeatedly expressed the view that land development, drainage operations, and flood controls were more important (economically, socially, politically, and medically) to the nation and Whakatāne district than Māori livelihoods and wellbeing (Hone Te Anga 1914).

European settler society's devaluation of wetlands resulted in the interconnected freshwater blue spaces not only being drained and re-engineered, but also being used as "sinks" (disposal places) for waste products (Giblett 2014, Pulido 2017). Urban (town sewerage), agricultural (effluent from livestock and chemical run off from farms) and industrial wastes (from saw mills and dairy factories) were discharged into the rivers and dumped on top of the remaining wetlands (so-called 'land reclamation' works). Such actions inevitably contributed to declining ecological health, as well as human health, particularly amongst Māori communities for whom wetlands were mahinga kai (food gathering sites). There were outbreaks of infectious diseases (including typhoid fever in the 1914, 1919 and 1926) amongst Māori communities linked to the harvesting of shellfish contaminated by human effluent. In some instances, local government issued temporary bans on harvesting activities to prevent further infections and deaths (New Zealand Herald 1919, Death from Typhoid. 1926, Ban on Shellfish 1943, Poisoned Shellfish 1943). As Beattie and Morgan (2017) have observed that colonial freshwater management schemes across the British Empire, incidentally or by design, impacted on people's resilience (their capacity to cope with and managed shocks and disruptions be it a flood, an infectious disease outbreak or an economic recession) (Colding *et al.* 2003, Berkes and Ross 2013, Beattie and Morgan 2017). Indeed, the unevenness of freshwater and land management schemes (which included wetland drainage and river "improvements") meant that some social groups in colonial societies benefited whereas others did not. In Aotearoa New Zealand settler colonial policies (be it environmental, education, health, or social welfare) more often than not privileged Europeans/Pākehā/whites and disadvantaged Māori and other non-whites (Dow 1999, McClure 2013, Came 2014, Salmond 2017).

(Un)successful separation: maintaining the division between green and blue spaces 1940s-2000s

By the 1940s more than 90 per cent of the Rangitāiki wetlands were drained. Government officials and local settlers (as Pākehā residents chose to self-identify up until the 1960s) declared the

Rangitāiki drainage scheme a wholesale “success” (AJHR 1918, p. 192, Bay of Plenty Beacon 1945a, Clarkson *et al.* 2013). One European visitor in 1928, for instance, recounted the “transformation” of the Rangitāiki wetlands into grasslands as a story of a wasteland “redeemed” through settler labour and scientific knowledge. The “wilderness” of “far-spreading area of marsh and lagoon and creek”, “threaded by muddy water courses”, and “eel-swamps” was, in less than two decades, “unwatered with scientific skill, by canals and a network of deep drains ... [and] straightened” river courses. The result was an “expanse of rich grass land, with its grazing dairy herds, ... orchards and homesteads” “under cultivation and habitation, a region of industry and wealth, the home of scores of prosperous settler-families” (Unknown Author 1928). This narrative of linear (settler colonial) progress mobilized individuals and institutions in a teleological expectation of irreversible social and ecological transformation, with advances in scientific knowledge and engineering technology providing the means to facilitate such radical changes to social-ecological systems (Veracini 2010). Yet, this narrative of ongoing modernizing progress (found on colonial productivist landscapes) did not allow for the possibility or acknowledgement of the (intended or unintended) negative consequences of actions to transform the existing hybrid muddy blue and green environments of the Rangitāiki and elsewhere in Aotearoa New Zealand.

From the perspective of Pākehā settlers these new and improved blue spaces, however, remained problematic environments. Whereas in the nineteenth century the hazardous potentialities of wetlands centred on the health risks (associated with miasmas, dirt, germs) were the primary concerns of settlers and governments, by the early twentieth century the risk of flooding (to property, lives, dry landscapes) was the principal concern. Settler place attachment and feelings of belonging were attached to the “improved” landscapes that they, their families, and neighbours had created, and thus the return of meandering, changeable, mobile blue spaces represented more than just an unruly annoyance (as was suggested by Lavau in regards to Australia’s Goulburn River), but a physical and discursive threat the (imagined) settler colonial order of things (Lavau 2011). Unruly blue spaces, in the form of raupo (indigenous reeds) growing on grasslands and regular flooding events (which damaged roads, houses, infrastructure, and killed introduced grasses, crops, and livestock) rendered the re-configured Rangitāiki Plains (home to grids of canals, farmlands, and physical structures) in a state of persistent unmaking, and instability, and unsettlement. On 24 February 1944, a regional newspaper reported, “heavy rain from the high back country ... transformed the three main rivers [of the Rangitāiki Plains] into roaring torrents of

water which swept across the landscape in a destructive flood". The rivers remained unruly, with the porous (and persistent) muddy blue spaces, threatening the established and imagined Pākehā agricultural order of things, which drew strict lines between land and water. Farmers "suffered serious losses, involving hundreds of head of valuable high producing dairy stock". The most severe flooding occurred along the Rangitāiki River, where the river overflowed its levees and flooded the township of Edgecumbe (Bay of Plenty Beacon 1945a). "Settlers", the journalist reported, in Edgecumbe waged an "all-night battle ... against the flood water" using sandbags to fill the gaps in the levees. However, ultimately their efforts were futile and water "inundated the[ir] ...houses and shops" (Bay of Plenty Beacon 1944a). In refusing to remain confined to the newly straightened and carefully engineered channels, the Whakatāne, Tarawera and Rangitāiki rivers flouted the newly founded boundaries (of fences, pastures, townships, roads and railways, land and waterways) and sought to reassert their muddy blue origins. The re-formed rivers and newly created grasslands, therefore, did not always accord to the "settled expectations" of European settler communities of the Rangitāiki Plains (see figure 5 showing the small community of Thornton on the banks of the straightened and leveed Rangitāiki River in 1965) (Lavau 2011).

[Insert Figure 5: Thornton, Bay of Plenty, road bridge over Rangitāiki River, looking inland in March 1965 (Source: Whites Aviation Ltd: hotographs. WA-37436-F. Alexander Turnbull Library, Wellington, New Zealand)]

The mobility of the rivers and constant reoccurrence of muddy blue spaces (flooded pastures, re-growth of indigenous flora) caused European residents much distress (Evening Post 1925, Northern Advocate 1925, Bay of Plenty Beacon 1944, 1945a, Maori Television 2017). Many farmers bemoaned the rivers as self-destructive perils that compromised productive agricultural land. In 1961, for instance, one "wet country" farmer on the Rangitāiki Plains described the need for "constant vigilance by the occupier; if there is any easing up, the pasture will soon revert to rushes and weed grasses and the soil will become waterlogged" (Reynolds 1961). The omnipresent threat of floods and the return of the former landscape (of wetlands, lagoons, meandering rivers, and indigenous biota) served as further justification for decisions to favour engineered flood infrastructure over other approaches (such spatial planning, different types of farming, and housing designs). Indeed, the beginnings of path dependencies were evident in the design and implementation of the technocratic wetland drainage/river management scheme

centred on engineering experiences. Such path dependencies (lock-in effects) were not only technological but also social. The ideology of improvement, and the emerging dependence of certain groups of people on such technologies fostered behaviours, practices, and social expectations that in turn led to further demands for more engineering works (see figures 2 and 6). European farmers in the Rangitāiki Plains, for instance, regularly petitioned officials and wrote letters to newspapers requesting the establishment and reinforcement of drainage and flood control works, which focused keeping unruly, fluid, muddy waters away from people, property, and industry, rather keeping people away from rivers through spatial planning and other non-engineering measures (Bay of Plenty Beacon 1945a, 1945b, Pontet and McCallion 1964, Opus International Consultants 1987). These actions to repeatedly intervene in the functioning of dynamic systems (climatic, freshwater, terrestrial, biophysical, ecological and social) frequently did not meet with people's expectations, and sometimes interventions resulted in the opposite outcomes, with negative consequences on communities.

A wealth of geographical and environmental history scholarship demonstrates how the hydrological engineering water works that occurred within the Rangitāiki wetlands often served to heighten the vulnerability of communities to climate-related hazards (most notably floods and droughts) (Laska and Morrow 2006, Costanza *et al.* 2008, Lahiri-Dut 2014, Parsons and Nalau 2016, Beattie and Morgan 2017). Since wetlands traditionally absorb excess water and “slow the speed and reduce the height and force of floodwaters” (Clarkson *et al.* 2013, p. 195) the loss of wetlands, combined with biota change, the development of industrial structures and urban areas (in Whakatāne, Edgecumbe, Mātātā and Te Teko) on the floodplains, all contributed to significantly alter river flow and behaviour, and increased flood vulnerability. In the Rangitāiki Plains there has been a pattern of persistent and worsening flood events coinciding with drainage works (see Figure 2: Timeline of changes in Rangitāiki wetlands); in April 2017 the Rangitāiki River breached one of its levees and flooded the township of Edgecumbe, which resulted in the evacuation of 1600 people and widespread destruction of homes (see Figure 6: Photograph of a levee in Edgecumbe rebuilt following the April 2017 flood) (Evening Post 1925, Bay of Plenty Beacon 1944a, Akuhata, Karla 2017). Each flood event was met with political and public discussions about how to solve the flood hazard, government inquiries, and ultimately the reinforcement of the existing institutional arrangements and engineering solutions (Department of Lands and Survey 1925, Bay of Plenty Beacon 1945a, Opus International Consultants 1987, Rangitāiki River Scheme Review Panel 2017). Indeed, as late as 2017, emphasis remained firmly

fixed on structural interventions designed to separate land/water, despite Māori complaints that such flood infrastructures (rockwalls, levees) destroy tuna (eel) habitat and contribute to declining numbers of freshwater fishes (see Figure 6: Levee in Edgecumbe following April 2017 flood) (Askey, Peter 2011, Bay of Plenty Regional Council 2017, Te Pahiopoto Hapu 2017).

[Insert: Figure 6: Photograph of a levee in Edgecumbe that rebuilt following the April 2017 flood (source: Author's own)]

Climate change necessitates that governments and communities contemplate alternative ways of managing not only existing flooding risk, but also projected changes in climate variability and environmental risks, and the consequences of environmental changes on people's relationships to places they value. This includes the impacts of sea level rise, the increased frequency and/or severity of extreme weather events (including drought, flooding, tropical cyclones), and increased incidence of water-/vector-/food-borne diseases due to warmer temperatures (Curtis and Oven 2012, Bennett *et al.* 2014). The impacts of climate change may include the loss or radical changes to places (and biota) of economic, socio-cultural and spiritual significance. As Māori experiences of environmental dispossession in the Rangitāiki wetlands attest, environmental changes inevitably result in unintended outcomes and can contribute to diminishing health and wellbeing when people's relationships to particular spaces of economic, social, and spiritual significance are disrupted.

The recently established Rangitāiki River Forum, a new co-governance arrangement between various iwi and local governments that emerged following Treaty Settlements¹, signals a potential shift away from engineering solutions, scientific knowledge, and settler colonial values to encompass different knowledges, values, and relationships in freshwater management (Rangitāiki River Forum 2015, 2016). The Rangitāiki River Forum states in its guiding document that its purpose is to enhance and protect “the environmental, cultural, and spiritual health and wellbeing of the Rangitāiki River and its resources for the benefit of present and future generations”, no

¹ A Treaty settlement refer to a legal package given by the NZ government to an individual Māori iwi, which includes a formal apology, financial compensation, and other financial and legal components (including the right to buy back assets, the transfer of land, and sometimes the right to co-govern parks, rivers, or other sites of significance). Treaty settlements are a form of apology and reparations by the New Zealand Government to a Māori iwi for historical injustices (including the confiscation of land, colonial violence, loss of resources, and racially discriminatory policies) committed by the government against Māori, which breached the articles of the Treaty of Waitangi. See Parsons and Nalau, 2016.

mention is made of wetlands (Rangitaiki River Forum 2015). While water is a hot topic of discussion across academic, political, media, and activist forums, murky water that is neither one environment nor another is not of particular interest. Wetlands remain largely at the periphery to discussions of healthy blue and green spaces in Aotearoa New Zealand. Yet these muddy blue spaces are highly contested and contestable spaces, with the majority of the country's townships and cities located on floodplains, and flooding the most common hazard. There is therefore a need to balance the diverse meanings and values attached to these spaces in ways that address the needs the historical and contemporary environmental injustices experienced by Māori, as well as the current and future risks associated with climate change to people and other living beings (Meredith 2002, Salmond *et al.* 2014, Strang 2014, Bollen 2015, Knight 2016).

Conclusion

In this chapter I briefly discussed some of the multitude of hydrological interventions that were undertaken as part of the settler colonial project in Aotearoa New Zealand, but countless others (technical, ecological, and socio-political) are outlined by other environmental historians and geographers including Beattie, Knight, Pawson, Holland, and Roche (Roche 1987, Beattie 2003, Pawson and Holland 2005, Peden and Holland 2013, Knight 2016). The colonial hydrological works undertaken in the Rangitāiki wetlands saw European settlers, engineers, and governments imposing their scientific, technological, and environmental knowledges, and socio-cultural values onto the muddy blue spaces they encountered in the belief that they were spreading civilisation, progress, and correcting environmental deficits. Yet, those beliefs about wetlands and settler-led actions, however, resulted in the lasting negative outcomes (including the loss of resilience, increased flood risk, decreased biodiversity) which make the communities of the remade Rangitāiki Plains more vulnerable to the negative impacts of climate change.

This chapter is a small story of larger global stories about wetland loss and environmental changes. In writing it I sought to demonstrate the importance of telling "small stories" about past experiences of environmental conditions and changes, which provide tangible connections to the past, and to complex mechanisms that might otherwise be beyond our ability to comprehend (Cameron 2012, Morgan 2013). By telling a story about how people understood, related to, and interacted with muddy blue spaces in Aotearoa New Zealand, I wanted to explore the factors that

contributed towards environmental loss and change (from the Rangitāki wetlands to Plains), as well as to help make sense of what could be learnt to inform the ways in which we approach the uncertainties and anxieties associated with the Anthropocene.

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