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Waikato and Waipā River restoration strategy

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Waikato Regional Council
Te Kaunihera ā Rohe o Waikato

Waikato River Authority

DairyNZ

Prepared by:
Keri Neilson, Michelle Hodges, Julian Williams, Nigel Bradly
(Envirostrat Consulting Ltd)

For:
Waikato Regional Council
Private Bag 3038
Waikato Mail Centre
HAMILTON 3240

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Peer reviewed by:
Dr David Burger, Melinda Dresser and Aslan Wright-Stow (DairyNZ)
Dr Gerald Kauffman (University of Delaware)

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Date July 2018

Approved for release by:
Tracey May

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Contributors

Project Steering Group
Bob Penter, Tracey May, Dr Mike Scarsbrook/Dr David Burger.

Project Team
Keri Neilson, Michelle Hodges, Julian Williams, Dr Nigel Bradly.

Iwi Priorities Team – Led by Waikato-Tainui College for Research and Development
Anaru Begbie, Kevin Eastwood, Jo Kukutai, Ngati Tahu-Ngati Whaoa Runanga Trust, Nuki Nicholson, Taroi Rawiri, Dr Naomi Simmonds, Erina Watene-Rawiri.

Technical Advisory Group
Alice Barnett, Dr David Burger, Dr Bruno David, Tane Desmond, Dr Karen Fisher, Dr Reece Hill, Maui Hudson, Blair Keenan, Dr John Quinn, Dr Naomi Simmonds, Erina Watene-Rawiri.

Lakes Working Group
Dr David Burger, Tracie Dean-Speirs, Natasha Grainger, Keri Neilson, Dr Deniz Ozkundacki, Paula Reeves, Erina Watene-Rawiri.

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Executive Summary

The *Waikato and Waipā River Restoration Strategy* (the *Restoration Strategy*) identifies specific, technically achievable and prioritised actions for future on-the-ground restoration works throughout the catchment. It is intended to be used by organisations that either fund or undertake restoration activities for the health and wellbeing of the Waikato and Waipa rivers. Key objectives of the *Restoration Strategy* are:

- to inform decision making of the River Restoration Forum members engaged in restoration activities and ensure the most appropriate, logical, coordinated, effective and efficient approach to restoration is adopted
- to act as a guide for all groups engaged in delivering restoration initiatives
- to encompass an approach that allows groups much longer planning periods to prepare for funding applications and project implementation
- to further build on the development of the *Waikato River Independent Scoping Study* (NIWA, 2010), by focusing on non-regulatory actions and considering likely available funding
- to identify projects that are likely to make the greatest difference in improving the health and wellbeing of the Waikato and Waipā rivers, and reflect the values and goals of the iwi and communities within the catchment.

The *Restoration Strategy* is non-binding and does not in any way fetter the ability of any funder, organisation, iwi or landowner to fund or undertake any project that is a priority for them. However, it does provide direction for funders who are seeking important projects to fund, and to organisations, iwi, communities and individuals who are keen to undertake work and deliver high impact results.

The *Restoration Strategy* has been developed to a total value of $340 million. This is an estimate of the money that will be invested through non-regulatory restoration activities in the catchment over the next 25 years. This is based on $170 million from the Waikato River Clean-up Trust and $170 million from other funding sources.

The strategy covers a wide range of restoration and protection activities in the catchment and focuses on six core work streams: erosion and sedimentation, water quality, biodiversity, fish, access and recreation and cultural values. The projects identified and prioritised within the strategy have been conceived and developed by a range of stakeholders and technical and local experts, including individuals from iwi authorities and marae, central and local government, Crown Research Institutes, non-government organisations, industry and members of the community. Specific iwi priorities were also developed and prioritised by each river iwi.

Site specific actions identified as a priority for funding of non-regulatory activities include:

- 2200km of fencing wetlands and the riparian margins of streams, rivers and lakes
- 1300ha of riparian revegetation
- stabilising more than 20,000ha of erosion prone hill country through revegetation, open spaced pole planting and other location-appropriate techniques
- 1650km of fencing hill country seeps, wetlands and vegetation
- remediating more than 50 barriers to native fish passage
- eight new walkways/public access areas at lakes, rivers and wetlands

- pest fish removal programmes at three lakes, internal sediment load reduction at two lakes and re-establishment of native aquatic plants at four lakes
- identifying, protecting and acknowledging sites of significance to river iwi, including through the construction of pou, iPou and other forms of representation
- restoring the relationship that river iwi have with the Waikato and Waipā rivers, including through capturing, preserving and enhancing mātauranga Māori
- restoring the cultural activities associated with the river, including rongoā and weaving
- protecting and restoring mahinga kai species
- training iwi to fulfil responsibilities as kaitiaki
- working with Māori land trusts to provide support in improving sustainability practices.

Throughout the course of the development of the *Restoration Strategy*, knowledge gaps and research needs were identified for some locations and species. These have been included within the document, and are seen as important pieces of work for informing management decisions on future protection and restoration options.

Implementation of the *Restoration Strategy* will be an ongoing process. It is important that we understand the effectiveness of the strategy in helping to guide future restoration initiatives and in seeing the objectives of the *Vision & Strategy* achieved. The Report Card for the Waikato and Waipā Rivers (Williamson et al., 2016) provides a baseline from which to measure future progress of river restoration initiatives. It is intended that this will be repeated on a five-yearly basis to determine changes in the overall health and wellbeing of the river. In future the Report Card will be aligned with the *Restoration Strategy*.

1 Introduction

1.1 The journey to Te Ture Whaimana o Te Awa o Waikato – Vision & Strategy for the Waikato River

Tooku awa koiora me oona pikonga he kura tangihia o te maataamuri

The river of life, each curve more beautiful than the last

The story of the Waikato River begins with a romance between Taupiri and Pirongia. Taupiri had left her brothers in the central North Island to be with Pirongia, her lover, in the Tainui region. Sadly the lovers separated and Taupiri became unwell and longed for home. Tongariro sent forth waters from her home to comfort and heal her. However, the young river was curious and traversed widely across the new lands, running towards the coastal sounds of Hauraki before heading to Taupiri, and eventually Te Puuaha o Waikato (Port Waikato). The river has followed its current path ever since. It is said that the river was named 'Waikato' (sprinkling of water) during the whakarite (blessing ceremony) of the baby Wairere – the ancestor of Ngaati Wairere – just north of Raahui Pookeka (now known as Huntly). The river has continued to heal its people, bless our children and sustain communities since time immemorial.

Since the mid 1300s, the Waikato and Waipā rivers and their lands have been home to many iwi (tribes). Marae and communities were established near the safety and provisions of the rivers, which, like a mother, nurture, provide food, heal and comfort while continuing to create life everywhere their waters reach. The relationship was described by the late Sir Robert Te Kotahi Mahuta as:

> "Nō tātou te awa. Nō te awa tātou. E kore e taea te wehe te iwi o Waikato me te awa. He taonga tuku iho nā ngā tūpuna. E whakapono ana mātou ko tā mātou, he tiaki i taua tāonga mō ngā uri whakatupu."
>
> *We belong to the river and the river belongs to us. Waikato people and the river cannot be separated. It is a treasure that has been passed down by the ancestors. We believe that it is our responsibility to look after [the river] for future generations.*

With the arrival of European settlers, the political and social dynamics of the region rapidly changed. To manage and minimise the impact of the colonialists on Aotearoa, the idea of a Kīngitanga movement was deliberated amongst all tribes nationally. The Kīngitanga movement was established in 1858 in response to the continued loss of lands to new settlers, to prevent wars and to unite the Māori people. The tribes of the Tainui waka, in particular Waikato iwi, were asked to lead the movement with the appointment of Pōtatau Te Wherowhero (the first Māori King). The reign of Te Wherowhero was short and, as his sun set, a new sun arose through the anointing of his son, Taawhiao, who was the head of the movement during the most turbulent times in Aotearoa. The Crown, feeling threatened by the Kīngitanga, gathered all of their resources to invade the central North Island and subsequently confiscated Waikato lands, forcing the tribe to exile to the King Country. During the forced retreat, the Government assumed the rights to all natural resources and allowed the transfer of lands to private ownership. Subsequent land use activities led to drainage of wetlands, diversion of waters, destruction of forests and desecration of marae, pā and papakāinga.

The act of raupatu (confiscation) and its subsequent effects greatly accelerated the degradation of the Waikato and Waipā rivers, lakes and tributaries. The basis of the 1987 Waikato Treaty claim was to restore these injustices, receive an apology from the Crown for the unjust confiscation of

lands, and rebuild the economic, social and cultural aspirations of the iwi. This was partially achieved in the Waikato Raupatu Claims Settlement Act 1995. One of the outstanding matters from the original claim was settlement of the Waikato River. The Waikato-Tainui Raupatu Claims (Waikato River) Settlement Act 2010 focused on the health and wellbeing of the Waikato River, to rectify the degradation and mistreatment of the Waikato waters and reinstate the mana or power and prestige of the Waikato River and its people.

Through the Treaty settlement process between Waikato-Tainui and the Crown, the Guardians Establishment Committee was formed with the support of Ngāti Tūwharetoa, Raukawa, Te Arawa river iwi and Maniapoto. In 2009 this committee finalised *Te Ture Whaimana o te awa o Waikato*, otherwise known as the *Vision & Strategy for the Waikato River*. The Waikato River Authority and Waikato River Clean-up Trust were established under the Waikato-Tainui Raupatu Claims (Waikato River) Settlement Act 2010 with the purpose of acting as an independent entity on behalf of the river. To reflect the aspiration of co-management, the Board of the Authority consists of a representative of each of the five river iwi authorities (Tūwharetoa Māori Trust Board, Te Whakakitenga o Waikato-Tainui, Raukawa Settlement Trust, Te Arawa River Iwi Trust and Maniapoto Māori Trust Board) and five Crown representatives.

The Ngā Wai o Maniapoto (Waipā River) legislation was enacted in 2012 to include the upper catchment of the Waipā River through to its junction with the Pūniu River. The *Vision & Strategy* now applies to the whole of the Waikato and Waipā River catchments (Figure 1) and represents the primary policy setting document for both rivers and their catchments. It has the status of a National Policy Statement and prevails over any inconsistent provision in Resource Management Act planning documents.

The Waikato-Waipā *Vision & Strategy* envisages a future where a healthy Waikato River sustains abundant life and prosperous communities who, in turn, are all responsible for restoring and protecting the health and wellbeing of the Waikato River, and all it embraces, for generations to come.

The *Vision & Strategy* responds to four fundamental issues as set out below.

1. The degradation of the Waikato River and its catchment has severely compromised Waikato River iwi in their ability to exercise mana whakahaere or conduct their tikanga and kawa.
2. Over time, human activities along the Waikato River and land uses through its catchments have degraded the Waikato River and reduced the relationships and aspirations of communities with the Waikato River.
3. The natural processes of the Waikato River have been altered over time by physical intervention, land use and subsurface hydrological changes. The cumulative effects of these uses have degraded the Waikato River.
4. It will take commitment and time to restore and protect the health and wellbeing of the Waikato River.

In order to realise this vision, 13 objectives were developed to support the achievement of the *Vision & Strategy* (see Appendix 1). The objectives encompass all people of the Waikato River and their relationships with it, through their communities, industries and environmental, recreational, social and cultural pursuits.

The *Vision & Strategy* is effected through its consideration by, or incorporation into, at least 20 enactments which influence the management and use of the Waikato and Waipā Rivers. This includes policies, plans, regulations and/or bylaws where they impact these rivers.

The Waikato River Authority (WRA) was established as an independent entity and given two powerful tools to restore and protect the health and wellbeing of the Waikato River for future generations. Firstly, the *Vision & Strategy* would coordinate and influence all Acts and policy as

noted above. Secondly, the Crown allocated $220 million over 30 years to support the clean-up of the rivers. This funding is managed by the Waikato River Clean-up Trust (WRCuT), under the auspices of the WRA, to support and coordinate the restoration efforts of community and iwi and is in addition to the substantial funding also provided to river restoration activities by central and local government organisations, non-government organisations, iwi, private landowners and others.

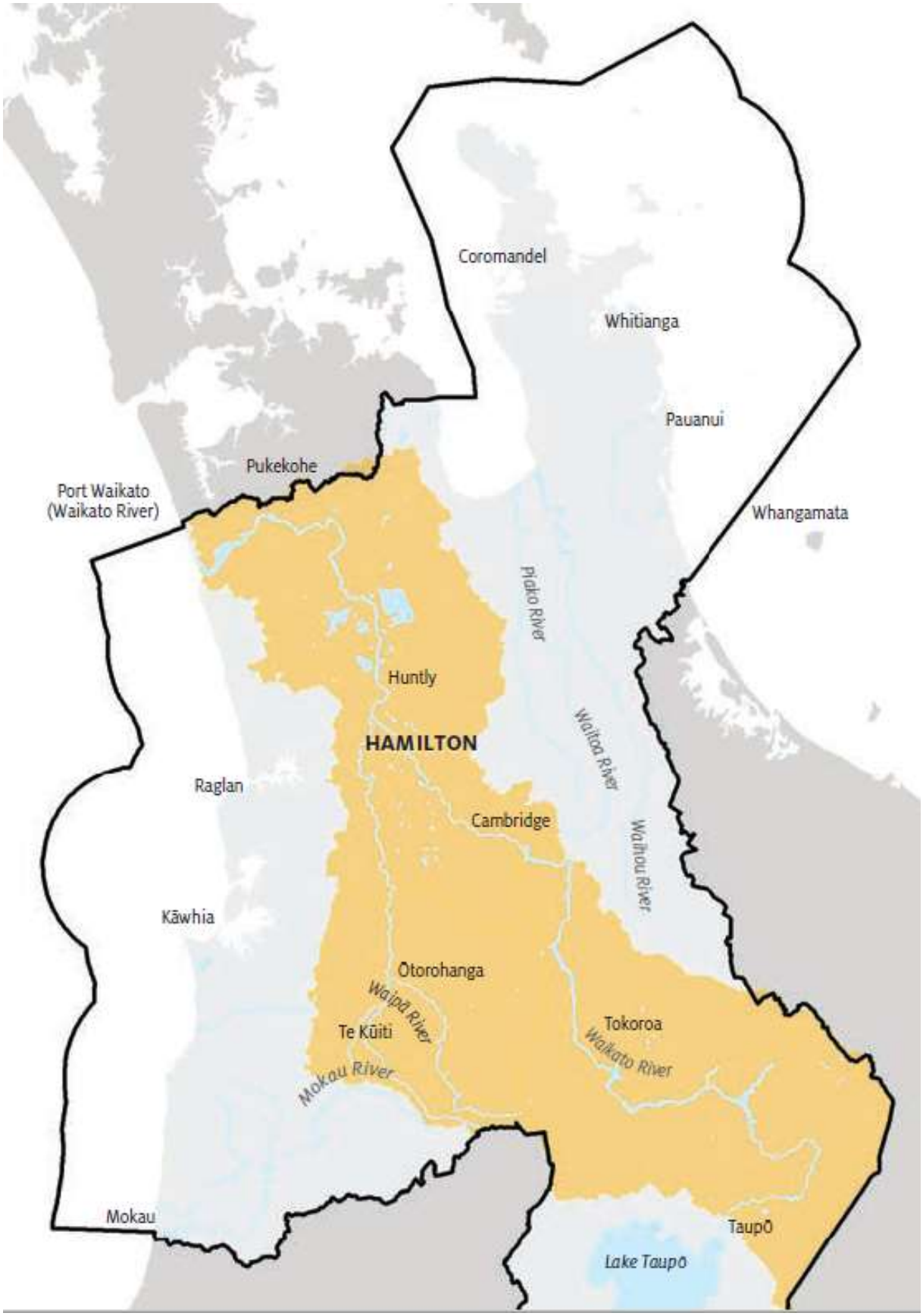

Figure 1. Map of Waikato and Waipā River catchment boundaries

1.2 Purpose and scope of the Restoration Strategy

When the WRA and WRCuT were established in November 2010 there was a strong desire from river iwi and community groups to see the funding of river clean-up initiatives commence as soon as possible. Following consultation with river iwi in February 2011, the first funding priorities were established by the authority and the first funding round opened in mid-2011. This added to the significant funds that were already being distributed catchment-wide for a range of non-regulatory restoration activities. As a result, numerous community groups have established and are successfully delivering local restoration initiatives. However, collaboration between the many funding agencies and those organisations legislatively tasked to give effect to the *Vision & Strategy* has not been as strong as it could have been. The board of the Waikato River Authority, river iwi and key stakeholders soon realised that an ad-hoc annualised funding approach would not successfully deliver on the *Vision & Strategy.*

The Waikato River Restoration Forum was established in 2014 with a purpose of maximising opportunities to realise the *Vision & Strategy* for the Waikato River catchment. The forum is made up of representatives from the five river iwi, the Waikato River Authority, Waikato Regional Council, DairyNZ, Fonterra, territorial local authorities, Mercury, Genesis Energy and the Department of Conservation. Shortly after the establishment of the River Restoration Forum, the group proposed that a medium-term strategic plan for river restoration initiatives be developed to support a more integrated and coordinated approach to funding and management. This would be a 5-20 year action plan for the Waikato and Waipā Rivers and their catchments, developed with wide stakeholder input.

The purpose of the *Waikato and Waipā River Restoration Strategy* (the *Restoration Strategy*) is to guide future 'on the ground' activities for all organisations funding or undertaking restoration activities throughout the catchment, through the identification of specific, technically achievable and prioritised actions. Key objectives of the *Restoration Strategy* are:

- to inform decision making of River Restoration Forum members engaged in restoration activities and ensure the most appropriate, logical, coordinated, effective and efficient approach to restoration is adopted
- to act as a guide for all groups engaged in delivering restoration initiatives
- to encompass an approach that allows groups much longer planning periods to prepare for funding applications and project implementation
- to further build on the work carried out in 2010 developing the Waikato River Independent Scoping Study (NIWA, 2010) by focusing on non-regulatory actions and considering the likely available funding
- to identify projects that are likely to make the greatest difference in improving the health and wellbeing of the Waikato and Waipā Rivers, and reflect the values and goals of the iwi and communities within the catchment.

The *Restoration Strategy* is non-binding and does not in any way fetter the ability of any funder, organisation, iwi or landowner to fund or undertake any project that is a priority for them. However, it does provide direction for funders who are seeking important projects to fund, and to organisations, iwi, communities and individuals who are keen to undertake work and want to deliver high impact results.

The *Restoration Strategy* has been developed to a total budget of $340 million. This is an estimate of the money that will be invested through non-regulatory restoration activities in the catchment over the next 25 years. This is based on $170 million from the WRCuT and $170 million from other funding sources.

While the development of this strategy has been funded by the Waikato River Authority, DairyNZ and Waikato Regional Council, all work and recommended projects underpinning this document

have been independently led and developed through engagement with all catchment stakeholders. It is anticipated that the *Restoration Strategy* will be reviewed every five years.

1.3 Scope

The *Restoration Strategy* covers the combined Waikato and Waipā River catchments as defined by the Waikato-Tainui Raupatu Claims (Waikato River) Settlement Act 2010, Ngāti Tūwharetoa, Raukawa, Te Arawa River Iwi Waikato River Act 2010 and Ngā Wai o Maniapoto (Waipā River) Act 2012.

The southernmost extent of catchment is at the Huka Falls near Taupō and the northernmost is Te Puuaha o Waikato. The Waipā River from its source to its connection with the Waikato River and the tributary catchments of both major rivers are included. All aquatic environments – wetlands, lakes, drains, spring-heads and streams – within the surface water catchments that eventually flow into the Waikato or Waipā Rivers were considered in scope.

The strategy covers a wide range of restoration and protection activities in the catchment and focuses on six core work streams.

1. Erosion and sedimentation – management of hill country and stream/river bank erosion beyond that required by current regulation.
2. Water quality – this focuses on non-regulatory mitigation of nitrogen (N) and phosphorus (P), and consideration for sediment and bacteria run off (i.e. from critical source areas). Development of the *Restoration Strategy* coincided with the formulation of *Waikato Regional Council Healthy Rivers Plan Change 1* (PC1). Although the final outcomes of PC1 are not yet known, the *Restoration Strategy* only includes mitigations that are not considered to be part of PC1 or actions that go beyond the non-regulatory actions currently being worked towards by industry, i.e. Sustainable Dairying Water Accord (DairyNZ, 2013).
3. Biodiversity – this focuses on protection and enhancement of biodiversity associated with aquatic environments, as well as connectivity between important ecosystems such as lowland rivers and forested headwater streams. Management of biodiversity not associated with aquatic environments was considered to be out of scope, as was ongoing animal pest control. Whilst management of terrestrial sites – particularly large forested areas – is seen as being critical for protecting water quality and aquatic biodiversity, a number of organisations already have existing responsibilities for this work. In addition, animal pest control was not included in the Waikato River Independent Scoping Study (NIWA, 2010) which estimated costs for achieving the *Vision & Strategy.*
4. Fish – protection and restoration of the habitat of all freshwater native fish species and other important freshwater mahinga kai species such as kōura. The management of pest fish was included for lakes where considered to be appropriate for water quality or biodiversity benefits. Enhancement of exotic freshwater sports fisheries for recreation was considered out of scope.
5. Access and recreation – opportunities for enhancing access to, and experience of, suitable aquatic environments were included. Developing commercial eco-tourism opportunities was out of scope.
6. Cultural values – physical protection and restoration of sites of significance, mahinga kai sites, aquatic environments associated with marae and recreational sites were all included within the scope. In addition, the protection and restoration of knowledge, stories, traditional practices and ability to act as kaitiaki in relation to the river were also included.

All forms of land tenure were considered in the development of the *Restoration Strategy*, including private, Māori and Crown owned land.

1.4 Structure of the technical report

This technical report is divided into three core parts. Part 1 (Chapters 1-4) provides a background to the *Restoration Strategy*, details the methods used to develop it, and provides guidance on how it should be used. Part 2 examines general priorities across four key units.

1. Upper Waikato covers the stretch of the river from Huka Falls to the Karāpiro Dam and all of the sub-catchment tributaries that flow into it. The hydro lakes are included in this unit.
2. Central/Lower Waikato covers the stretch of river from Karāpiro Dam to Te Puuaha and all of the sub-catchment tributaries that flow into it.
3. Waipā covers the waterways from Pekepeke springs through the main Waipā River and down to the confluence with the Waikato at Ngāruawāhia and all sub-catchment tributaries that flow into that stretch.
4. Shallow lakes covers lakes greater than 1ha and less than 10m in depth across the entire Waikato-Waipā catchment. Shallow lakes were separated out from other ecosystem types due to their generally poor current state and the unique challenges that they face for restoration.

Each unit is addressed in a separate chapter (Chapters 5 to 8).

Part 3 (Chapters 9-14) examines iwi priorities. These chapters represent the priorities of each of the five river iwi authorities, and lake priorities within Area A. These chapters include projects related to the cultural values work stream, but also incorporate outcomes relating to the other five work streams. It is important to understand that iwi interests are not restricted to cultural values. Iwi hold a holistic view on the natural environment and therefore the interests of iwi include all work streams identified in the strategy.

Iwi have overlapping areas within the Waikato and Waipā River catchments, and the area descriptions below should be considered as indicative for the purpose of providing guidance when using this strategy.

- Waikato-Tainui rohe (area) extends from Karāpiro to Port Waikato, and the Waipā River from the Puuniu stream to its junction with the Waikato River. In general the Waikato-Tainui area is on the lower Waikato and Waipā River catchments.
- Raukawa extend throughout the upper Waipā and central and upper Waikato River.
- Te Arawa River Iwi Trust covers predominantly the upper Waikato River catchment around Ōrākei Kōrako, Waikite valley, Ohakuri, Ātiamuri and Reporoa areas.
- Ngāti Tūwharetoa, while generally recognised as being synonymous with Lake Taupō, have marae and interests in the upper Waikato River catchment around Ōrākei Kōrako, Mokai, Nukuhau and Wairakei.
- Maniapoto covers the central and upper Waipā River catchment.

Supplementary technical information detailing all proposed projects included in Parts 2 and 3 is provided in Appendices 5 to 14.

1.5 Assumptions

The projects identified within the *Restoration Strategy* have been conceived and developed by a range of stakeholders and technical and local experts. These include individuals from iwi authorities and marae, central and local government, CRIs, NGOs, industry and members of the community. In most cases, contact has not yet been made with individual landowners about the possible scope of works identified as funding priorities and opportunities. Nor have individual funders been contacted to specifically identify projects that meet their criteria. Therefore, the assumptions that have been made in developing this strategy include:

- organisations or individuals looking to implement any of the identified projects will undertake all required landowner consultation during their project planning
- all works are entirely voluntary and non-regulatory, and private landowners are not obliged to provide permission or funding for any proposed works. Inclusion of a project in the *Restoration Strategy* should not be seen as an encumbrance on any landowners
- project implementers will be responsible for securing funding for projects that they wish to undertake. In developing the *Restoration Strategy* no assumptions have been made about who will pay for any particular component of any projects
- while there are some projects that would require input from particular organisations (as noted in the project assessment forms), it is assumed that any person or organisation could become involved in any of the projects identified. No project is tagged to any specific organisations for undertaking. It is expected that iwi priority projects would be led by iwi but this may be in collaboration with others.

1.6 Existing programmes of work

During the development of the *Restoration Strategy*, several significant existing projects or programmes of work which are ongoing have been identified that are making an important contribution to achieving the *Vision & Strategy*. In selecting priority projects it was assumed that these programmes would continue to operate under current levels of funding. These projects have therefore not been further considered for inclusion. However, we wish to highlight the importance of these projects being maintained at an existing or higher standard. This section provides an outline of each ongoing project or programme of work.

Maungatautari Ecological Island Restoration Project

This project established an ecological island by enclosing the perimeter of Maungatautari Mountain with a 47km pest-proof fence and creating a 3400ha reserve. Predator control has removed mammalian pests from within the fenced area and ongoing maintenance is being undertaken to provide a pest-free sanctuary. A range of species have been re-introduced to the maunga including kiwi, kākā, kōkako, takahē, hihi (stitchbird), kākāriki, tīeke (saddleback), Mahoenui giant weta and endangered native fish species such as giant and banded kōkopu.

Department of Conservation management of forest parks and reserve areas

The Department of Conservation (DOC) manages a large number of forest parks and nature reserves. Many of these were identified as being significant areas that should continue to be managed with the same or increased level of funding and resources. These areas include:

- Pureora Forest
- Ruakuri Bush Scenic Reserve
- Forest remnants surrounding Lake Rotokutukutuku in the Mangaokewa Scenic Reserve
- Mt Pirongia
- Te Kopia scenic reserve
- Rangitoto Range (headwaters of Mangatutu and Pūniu Rivers)

Eel transfer programme

The New Zealand Eel Enhancement Company carries out a voluntary programme to transfer elver eels from below Karāpiro Dam to upstream habitat areas. Many of the priority projects identified in the *Restoration Strategy* assume the continuation of this trap and transfer programme.

Waikato Regional Council priority possum control areas

Waikato Regional Council has implemented a large number of possum control schemes within the Waikato Catchment. The *Restoration Strategy* assumes continuation of these schemes particularly those located at:

- Te Tapui Reserve
- Te Miro-Whitehall
- Northwest Waikato North
- Ngutunui
- Waipā Pūniu II
- Honikiwi
- Mount Pirongia West Buffer
- Arohena Section 1
- Arohena Section 2

- Northwest Waikato Central
- Northwest Waikato South
- Mount Pirongia North Buffer
- Mount Pirongia
- Waikite Valley – Te Kopia Section 2
- Waikite Valley – Te Kopia Section 1
- Waotu

Waikato Regional Plan Change 1 – Healthy Rivers

During the development period of the *Restoration Strategy*, Waikato Regional Plan Change 1 was going through its development phase. As there is uncertainty around what the final set of Regional Plan rules will require, the *Restoration Strategy* does not make any assumptions that works will be required by regulation. Decisions regarding the funding of restoration activities, whether regulatory or not, are at the discretion of individual funders.

However, it is acknowledged that the implementation of PC1 plays an important role in achieving the *Vision & Strategy* for the Waikato River catchment over the long term and as such will be complementary to many of the projects identified in the Strategy.

Craters of the Moon – Wairakei Tourist Park

Craters of the Moon is a geothermal area managed by the Craters of the Moon Charitable Trust. It was identified as a high priority in the upper Waikato due to its biodiversity values. Existing management includes both environmental management (e.g. plant pest control) and management of the recreational facilities.

Wetland sites within forestry areas managed by Hancock Forest Management

There are a number of significant wetland areas within forestry blocks in the general vicinity of Tokoroa in the upper Waikato catchment. These are currently well managed by Hancock Forest Management (HFM) for their biodiversity values.

Tunawaea Project

The 1991 Tunawaea landslide in the south of the Waipā catchment is a specific erosion issue requiring long term priority management. The landslide occurred in the gorge in the lower reach of the Tunawaea Stream and an estimated 500,000 cubic metres of material dammed the Tunawaea Stream for approximately one year and subsequently failed in a small flood event when the 'dam' was overtopped. Waikato Regional Council has implemented a specific project to stabilise the material from the landslide in the upper Waipā Gorge and to provide a stable channel along the valley floor to prevent erosion of the terraces and help the river move its bedload through the system. The continuation of this project is an important part of the overall goal of reducing erosion and sedimentation in the catchment.

1.7 Restoration Strategy implementation

Although implementation of *Restoration Strategy* projects is non-statutory and therefore not required of any organisation, the intention is that a coordinated and consistent approach be followed. We anticipate that the Waikato River Restoration Forum members will utilise the *Restoration Strategy* to more effectively coordinate their restoration programmes including through aligning resources, funding and technical expertise. It is intended that the forum will meet and discuss projects and priorities on a regular basis.

The Waikato River Authority will provide staff time and resources to lead the Restoration Forum. They will also actively promote strategically important projects, engage with funding organisations and interested stakeholders, promote the funding and implementation of projects, track implementation of the *Restoration Strategy* and, where possible, quantify the impact of restoration initiatives.

1.8 The use of Māori words

The *Restoration Strategy* has had input and contributions from many iwi associated with the Waikato and Waipā Rivers, who have subtle differences in dialects and spelling variations, in particular the use of macrons or double vowels. The spelling variations throughout the *Restoration Strategy* have been purposefully included to reflect the preferred directive of each iwi, including the naming of places (lakes, lands, waterbodies) within their area. In general, the reader should note the following.

- Waikato-Tainui prefer the use of double vowels, e.g. waahi, ngaati, roopu, hapuu. This is reflected in the Waikato-Tainui iwi priorities, quotes provided from Waikato-Tainui kaumatua and also areas within the Waikato-Tainui area, e.g. Lake Waahi, Te Puuaha o Waikato. It should also be noted that references to Te Ture Whaimana (*Vision & Strategy*) and its objectives use double vowels as the initial wording of the *Vision & Strategy* was established and empowered from the Waikato-Tainui Raupatu Claims (Waikato River) Settlement Act.
- Ngati Tahu Ngati Whaoa do not use double vowels or macrons.
- Ngāti Tūwharetoa, Raukawa, Te Arawa river iwi and Ngāti Maniapoto all use macrons in their Māori words.

2 Development of the Restoration Strategy

2.1 Approach

The process for developing the *Restoration Strategy* is detailed in Chapters 2 and 3. A summary is outlined in Figure 2.

Technical experts were involved in all stages of the development of the *Restoration Strategy* with more than 20 organisations making staff available to contribute to the process. A project technical advisory group was established at the beginning of the project to oversee technical input and ensure that data and modelling used to inform decisions was relevant and robust. This group contained experts in water quality, freshwater ecology, soils, catchment management, freshwater fish, economics, catchment modelling and mātauranga Māori, and included representatives of each of the five river iwi. Due to the specific nature of the challenges and mitigations relating to shallow lakes, a lakes working group was also established to provide technical advice on the shallow lakes work stream.

Figure 2. Process for development of the Restoration Strategy

2.2 Goal setting

2.2.1 Purpose

The Waikato and Waipā Rivers *Restoration Strategy* is a 20-year action plan containing priority, non-regulatory restoration activities. The first step to identify these priorities was to determine the goals that would drive their selection. This was undertaken by reviewing existing management plans and by holding catchment-based hui with iwi and stakeholders.

2.2.2 Review of existing plans

Since the development of the *Vision & Strategy* there has been a lot of work undertaken to develop aspirations and goals across the catchment, and iwi, stakeholders and landowners have all contributed to this work. The *Restoration Strategy* looked to build on this effort and reconfirm or refresh goals across the lower/central Waikato, upper Waikato, Waipā and shallow lakes units. A broad range of plans and strategies were reviewed in order to identify common non-regulatory goals (Table 1).

Table 1. Publications reviewed in order to identify common non-regulatory goals

Iwi publications	Central and local government publications	Other publications
• Maniapoto Priorities for the Restoration of the Waipā River Catchment (NIWA, 2014) • Maniapoto Upper Waipā River Fisheries Plan (2015) • He Mahere Taiao – Maniapoto Environment Plan (2016) • Tai Tumu Tai Pari Tai Ao – Waikato-Tainui Environmental Plan (2013) • Raukawa Fisheries Plan (2012) • Te Rautaki Taiao a Raukawa – Raukawa Environmental Management Plan (2015) • Te Arawa River Iwi Trust Fisheries Plan (2015a) • Te Arawa River Iwi Trust Environmental Management Plan (2015b) • Te Aranga Ake i te Taimahatanga – Ngati Tahu – Ngati Whaoa Iwi Environmental Management Plan (2013) • Ngāti Tūwharetoa Environmental Iwi Management Plan (2003)	• Department of Conservation – Conservation Management Strategy, Waikato 2014-2024 • Healthy Rivers Plan for Change – Values and uses for the Waikato and Waipā Rivers (2017a) • Waikato Regional Council Upper Waikato Zone Plan (2014) • Waikato Regional Council Waipā Catchment Plan (2014) • Waikato Regional Council Central Zone Plan (2011) • Waikato Regional Council Lower Waikato Zone Plan (2011) • Waikato Regional Council Shallow Lakes Management Plan (2014)	• Sustainable Dairying: Water Accord (2015 Edition) • Waikato River Independent Scoping Study (NIWA, 2010)

Goals that were considered to be relevant and in scope for the *Restoration Strategy* were compiled and summarised according to the six core work streams. From here, common goals and themes were identified, and 4-5 goals per work stream were drafted that best reflected the spirit of what had previously been developed.

2.2.3 Goal selection

Within each of the four unit areas, iwi and stakeholder workshops were held during 2015-2016. The purpose of these was to review draft goals and refine these for the *Restoration Strategy.* Participants at these workshops included representatives of the following:

- river iwi trusts
- marae
- landowners (drystock, forestry and dairy sectors)
- Waikato Regional Council – staff and governors
- Department of Conservation
- territorial local authorities – staff and governors
- industry groups (farming and forestry)
- energy companies
- community groups and restoration trusts
- catchment committees
- non-government organisations.

Approximately 50-70 people participated in each workshop. Workshop stations were set up for each of the six work streams. Each station focused on the set of draft goals that had been developed from existing plans. Workshop participants were put into groups of 6-10 and rotated around the stations. Each station was facilitated and participants were asked to provide comment, changes and further input into the draft goals. At the completion of the workshop a set of revised goals was produced that reflected existing plans but also current views on the most urgent issues to address and important values to protect.

Revised goals were displayed for review at catchment workshops and each participant was given 20 coloured sticky dots with a nominal value of $50,000 each. They were asked to review goals and indicate which they saw as the highest priority for giving effect to the *Vision & Strategy* in their catchment over the next 20 years by placing sticky dots by the goals that they would spend money on. The results of this process were used to determine how important each goal was for the catchment iwi and stakeholders. Goals that received less than 1 per cent support were not included in the *Restoration Strategy.* The well supported goals for each of the in-scope areas were edited and checked against aspirations for desired state in the Waikato River Independent Scoping Study (NIWA, 2010) before being finalised.

2.3 Identification of potential priority locations and projects

2.3.1 Overall approach

The methods for identifying potential priority catchments and sites for restoration and protection varied according to each work stream. However, the overall philosophy was to first select sites that were likely to best address the individual areas of concern or value. This was achieved through modelling where available, and through the use of best professional judgement – an approach used in identifying programmes of work as part of the Waikato River Independent Scoping Study (NIWA, 2010).

Once potential priority locations were proposed, projects and actions were identified that would address the threats and protect and restore the site values and meet the goals for the site. These recommended actions were identified during workshops or technical meetings or pulled from best practice guidelines. Identifying project actions for each site was important so that funders and implementers are clear that it's not just that the location that is important – the kind of work to be undertaken there has to be of most value, too. It also enables costs to be estimated, and the cost benefit (value for money) of projects to be assessed against others. Where locations

made it through a filtering process (see Section 3.2.1) and appeared as a priority for two or more work streams they were later developed into integrated multiple outcome projects. Potential projects were developed and costed by the project team and in collaboration with other subject matter experts.

2.3.2 Erosion and sedimentation

Initial identification of potential priority catchments for erosion and sedimentation management actions was based on the GIS based framework outlined in Hill et al. (2015) and Hill and Borman (2016). The modelling approach involved a number of steps as follows:

- identification of existing spatial datasets
- updating these outputs using current land use data
- defining 'factors' (e.g. existing erosion, sediment yield, pasture on high erosion risk land) and assessing them both individually and in combination to inform the key issues for erosion protection and sedimentation
- spatial analysis to calculate factor scores for all sub-catchments
- ranking of sub-catchments according to the key issues for erosion protection and sedimentation
- producing graphs and data to assist decision making (prioritisation of sub-catchments).

For each sub-catchment, mitigations were proposed according to whether the key risk was hill country erosion, streambank erosion or both. Costings were developed based on input from catchment management staff who regularly undertake this kind of work and best practice and costing guidelines (e.g. Waikato RiverCare, 2014; Askin and Askin, 2014). Cost assumptions are described in Appendix 2. In some cases, costs were tailored for each catchment. For example, fencing is generally more expensive in the Lower Waikato. Estimates of works required were made using a desktop analysis of Land Use Capability (LUC) classes in pasture and of total lengths of waterways. Some assumptions were made around these estimates and they are outlined in Appendix 3.

Estimates of reductions in sediment generation per sub-catchment were based on a modified version of the Sediment Reduction Model described in Hill and Borman (2016). The main improvement for the *Restoration Strategy* prioritisation was the inclusion of sediment estimates using the SedNet NZ model (Palmer et al., 2015). The reduction model estimated relative reductions in sediment generation pre and post mitigations for hill slope and streambank sources. This enabled a broad assessment of where the greatest gains could be made by implementing proposed management actions (mitigations) and allowed a comparison of cost benefits per hectare to reduce sediment. Generation and reduction estimates were adjusted against measured sediment load outputs (Hoyle et al., 2012; Hicks and Hill, 2010) for each of the three catchments assessed for the *Restoration Strategy.*

Workshops were held for each of the three geographical units in order to review modelling outputs and select the most appropriate catchments for inclusion in the *Restoration Strategy.* Workshop participants included technical experts, on-the-ground practitioners, iwi representatives and local catchment management staff. This group reality checked the model outputs, considered cost-effectiveness, and made recommendations on priority catchments for addressing erosion and sedimentation.

2.3.3 River and stream water quality

Initial identification of priority catchments for water quality (TN, TP and *E. coli*) management actions was also based on the GIS based framework outlined in Hill et al. (2015) and Hill and Borman (2016) and the same steps were followed:

- identification of existing spatial datasets
- updating these outputs using current land-use data

- defining ‘factors’ (i.e. total nitrogen, total phosphorus and *E. coli*) and assessing them both individually and combined together, to inform the key issues for water quality
- spatial analysis to calculate factor scores for all sub-catchments
- ranking of sub-catchments according to the key issues for water quality
- producing graphs and data to assist decision making (prioritisation of sub-catchments).

As for erosion and sedimentation, workshops were held for each of the three geographical units in order to review modelling outputs and select the most appropriate catchments for inclusion in the *Restoration Strategy.* A panel of subject matter experts from DairyNZ, Fonterra, NIWA and Waikato Regional Council workshopped non-regulatory mitigation options for high priority nutrient catchments. It was agreed that fencing and retirement of small wetlands and ephemeral streams was likely to be the most cost-effective option, given that these were not covered by existing industry requirements or regulation. Catchment based approaches to identifying these are detailed below.

Waipā

The sub-catchments identified in the Waipā as being the highest priority for nutrients and *E. coli* have mostly already been heavily modified through drainage activities. Other than those associated with the peat lakes, the most significant areas of wetlands in these sub-catchments are the gully wetlands of the Waipā and Waikato districts (refer Chapter 7). Stock exclusion and enhancement of these sites was recommended as the most beneficial non-regulatory actions for the Waipā catchment. Estimates of works required were made using aerial photographs and interviews with local experts.

Central/lower and upper Waikato

Wetlands, seeps and ephemeral streams are relatively numerous in most of the sub-catchments identified as priorities for nutrient and *E. coli* reduction in the central/lower and upper Waikato catchments. Estimates of fencing requirements for these sites were calculated through a desktop exercise using the Waikato Regional Council GIS layers for wetland probability and Biovege 2012. Potential wetlands greater than 0.25ha in size were identified and the combined perimeter of these sites calculated to produce the estimate of fencing required.

2.3.4 Fish

Overall approach

The overall approach for this work stream was to use existing information and work with freshwater fish experts through workshops and one-on-one meetings to identify potential priority locations and actions for fish habitat rehabilitation.

At least two workshops were held for each of the geographical units in the *Restoration Strategy.* Workshop participants came from a range of organisations including Waikato Regional Council, Waikato-Tainui College for Research and Development, University of Waikato, NZ Eel Enhancement Company, Waikato Raupatu River Trust, Maniapoto Māori Trust Board, NIWA, Waahi Whaanui Trust, Mercury, Eastern Region and Auckland/Waikato Region Fish & Game and the Department of Conservation.

Workshops utilised existing information to inform and guide discussions, including aerial maps showing locations of waterways, freshwater fish species distribution, cultural priorities (if available), marae, known barriers to fish migration, significant natural areas, water quality data, geothermal springs, stopbanks, floodgates and flood pumps. The outcome of this work was a list of potential priority projects for inclusion in the *Restoration Strategy.* These were filtered against pre-selection criteria (Section 3.2.1) before detailed site based plans and costings were developed for those sites and projects that met the criteria.

Site visits to potential restoration sites were made if required but, for most projects, plans were based on expert knowledge of the site, aerial photography and standard costings for the types of work recommended.

The approach undertaken was the same for each geographical unit with the exceptions noted below:

- Within the Waipā catchment, additional modelling work was commissioned to identify areas of land that becomes inundated with water on average at least three times per year. This work was used to inform the selection of sites for tuna (eel) habitat enhancement.
- Within the Central/Lower Waikato catchment, priority locations for rehabilitation of whitebait spawning habitat were identified through an existing project being undertaken by NIWA and Waikato Raupatu River Trust. This identified potential project sites that had suitable hydrological conditions for whitebait spawning (which had changed substantially since the installation of the Flood Control Scheme).

2.3.5 Biodiversity

Overall approach

The approach to identifying priority sites for biodiversity protection and enhancement began by utilising the results of GIS Zonation modelling undertaken by the Waikato Regional Council for the Waikato River catchment. This work provided a high-level assessment of indigenous biodiversity priorities within the Waikato region, with an emphasis on identifying sites at a broad scale that met the goal of protecting a representative range of indigenous ecosystems, both terrestrial and aquatic.

The model was rerun for the *Restoration Strategy* to determine biodiversity priorities within the Waikato and Waipā River catchments. The modelling factored in a range of variables to prioritise biodiversity sites, including ecological connectivity, rarity of ecosystem type and ecosystem condition (considering factors such as human population pressure, historic logging and current management activities). A full discussion on the methods undertaken to carry out the modelling can be found in the report by Leathwick (2016), *Integrated Biodiversity Ranking and Prioritisation for the Waikato Region*.

For each unit, workshops were held with biodiversity practitioners and experts, including staff from the Department of Conservation, Waikato Regional Council, Waipā District Council, South Waikato District Council, Hamilton City Council, Waikato Raupatu River Trust, Maniapoto Māori Trust Board, Ngati Tahu-Ngati Whaoa Runanga Trust, Hancock Forestry and QEII Trust. The purpose of the workshops was to look at the top 30 per cent of priority sites identified through the GIS Zonation project (for the Waikato catchment) and discuss the following for each site:

- biodiversity values present
- current condition
- threats
- current management
- future management actions required
- whether the management actions required were in scope for the *Restoration Strategy.*

There was also discussion around significant areas of biodiversity that did not appear in the top 30 per cent. Participants considered where these sites sat in the list of priorities and the drivers influencing their position. This resulted in some sites outside of the top 30 per cent being included due to factors not considered by the Zonation model, such as community desire for an emphasis on wetland protection, and inclusion of urban sites. The workshop teams also looked at whether the priorities would adequately protect biodiversity at a landscape scale (e.g. through

connecting sites). Where there were opportunities to connect ecosystems via aquatic corridors, these were also considered for inclusion.

The outcome of this work was a list of potential priority projects for inclusion in the *Restoration Strategy*. These were filtered against pre-selection criteria (Section 3.2.1) before detailed site-based plans and costings were developed for those projects that met the criteria.

Site visits to potential restoration sites were made if required, but for most projects, the plans are based on expert knowledge of the site, aerial photography and standard costings for types of work recommended.

The approach undertaken was the same for each unit with the exceptions noted below:

- Within the Waipā catchment, workshop participants noted a lack of wetland sites within the top 30 per cent, finding instead that most of the high priority wetland sites were located in the Lower Waikato catchment. However, large wetlands were identified in the water quality work stream (section 2.3.3), which included large gully wetlands (over 10ha) that were within catchments with high nutrient yields (i.e. protection of these gully wetlands would be important for nutrient attenuation and water quality). It was noted that there were additional biodiversity gains to be made from the protection of these sites.
- To adequately meet the community goals around expanding and re-establishing wetlands in the Central/Lower Waikato catchment, further wetland areas were considered and added from the Waikato Regional Council 'potential wetlands' GIS layer, which identifies the potential presence of wetland sites based on existing and historic vegetation.
- Within the upper Waikato catchment, workshop participants identified a large number of additional geothermal sites that could be included as priorities (due to their biodiversity significance). Geothermal sites with strong connections to waterways, or significant indigenous vegetation identified in the top 30 per cent, were considered.
- Biodiversity priorities for lakes were established during workshops for the other three units.

2.3.6 Access and recreation

Overall approach

For each of the four units the approach to identifying priority recreational projects involved contacting district councils, Department of Conservation and (where appropriate) Waikato River Trails. The objective was to determine whether there were any potential recreational projects associated with rivers and lakes that had strong community support but lacked existing funding or where additional funding would be an advantage. For a project to be considered for the *Restoration Strategy* it needed to:

- connect communities with waterways
- not be considered business as usual for another organisation
- meet the mandatory pre-selection criteria (section 3.2.1).

The strategy team worked closely with staff in the relevant organisations to prepare site-specific plans and costings for each potential project.

2.3.7 Shallow lakes

Management priorities for lakes were split into three core themes:

- protection and restoration of biodiversity and native fisheries
- reducing external nutrient (N and P) and sediment loading (catchment management)
- reducing internal sediment and nutrient loading (in-lake restoration options).

Biodiversity priority lakes and actions were predominantly drawn from existing plans, particularly the *Waikato Region Shallow Lakes Management Plan* (Dean-Speirs et al., 2014b), and with expert input via workshops and one-on-one interviews. Potential sites and projects were initially filtered using the criteria outlined in Section 3.2.1. More detailed restoration actions were developed using expert knowledge and through discussions with current and past lake managers.

To identify candidate lakes for catchment and in-lake management actions, the University of Waikato was engaged to undertake a water quality modelling study. The methodology and outcomes of this work are included in Lehmann et al. (2017). In summary, a catchment and lake modelling approach was applied to identify, evaluate and prioritise specific in-lake and catchment restoration options which could be applied to improve the water quality and ecological health of peat and riverine lake types within the Waikato River catchment. Four representative lakes were initially selected as case studies for this work based on their social, cultural and ecological significance, as well as the availability of historical monitoring data and the potential transferability of the study findings to similar lake systems. These lakes were Rotomānuka, Ngāroto, Waahi and Waikare. Water quality models and scenarios were completed for three of the lakes – with Lake Waikare being deferred to a separate and longer term project due to its complexity.

The study had the following six objectives for each of the three lakes:

1. Define baseline water quality and ecological health based on existing monitoring data and knowledge.
2. Determine the key pressures, drivers and processes governing lake water quality and ecological health.
3. Define, evaluate and rank the likely effectiveness of a range of in-lake and catchment management strategies to improve existing water quality and biodiversity values.
4. Evaluate the level of certainty around the suggested restoration strategies that meet the desired outcomes, as well as the time frames for implementation and longevity of outcomes.
5. Identify an achievable end state for water quality and ecological health, taking into consideration existing trophic state, legacies and catchment land use.
6. Provide an expert assessment on whether the strategies identified are also likely to be effective when applied to other similar Waikato lake types.

Scenarios were run across three broad management approaches:

1. External nutrient load reduction: associated with land use change or other nutrient loss reductions from improved management practices and/or targeted interventions, e.g., erosion control, critical source area management, constructed wetlands, denitrification beds.
2. Hydrological modifications: diversion of inflows away from the lake or increasing the water level to alter wind-driven resuspension of sediments.
3. Geochemical engineering: by using sediment capping to reduce internal loading and/or continuous low-dosage alum treatment to reduce dissolved P and increase flocculation in the water column.

Results of base models and scenarios were presented at several workshops throughout the study. Workshop participants included representatives of the Waikato River Authority, Waikato Regional Council, DairyNZ, Department of Conservation, University of Waikato, NIWA, Waikato Raupatu River Trust, Waikato-Tainui College for Research and Development and Ngaa Muka Development Trust. Final selection of priority lakes and actions were based on the scenarios that showed the most potential for improvement in water quality and/or ecological health.

Pest fish are considered a major impediment to restoration of shallow lakes. In order to identify priority sites and actions for pest fish management, Wildland Consultants Ltd were contracted to interview key subject matter experts and workshop options. Due to the limited options available for effective control and exclusion, adaptive management approaches using sustained removal have been recommended, along with some investigation needs (Chapter 8).

2.3.8 Iwi priorities

Iwi priorities for the *Restoration Strategy* were developed by Waikato and Waipā River iwi. They represent the aspirations of whanau, marae and hapū to restore and protect ngā wai (waters) under the korowai (cloak) of each iwi. These priorities were developed under the principle of mana whakahaere and were developed by iwi for iwi. The iwi-led approach recognises the historic and intrinsic relationship between iwi and their natural resources and also as Treaty partners bound to the land and waters. The work identifying iwi priorities was led by Erina Watene-Rawiri from the Waikato-Tainui College for Research and Development (the College) in collaboration with the river iwi. The iwi priorities stand alone in the *Restoration Strategy*, recognising the intricate associations of each iwi with their natural resources. It should be noted, however, that the general restoration priorities are also of significant value and interest to iwi.

The college developed an innovative approach to collate the priorities for each iwi while simultaneously building iwi capacity. This involved providing a master's scholarship opportunity for members of each iwi, funded by the Waikato River Authority. Students from Te Arawa River Iwi Trust (TARIT), Raukawa, Waikato-Tainui and Maniapoto were engaged. They collated their respective iwi priorities and developed research projects to complement their geography master's theses through the University of Waikato, supported by the Waikato-Tainui College for Research and Development.

Prior to engagement with marae and individual knowledge holders, the proposed engagement approach and associated questions were approved by the University of Waikato Human Ethics Committee. The students planned to undertake the following to identify and confirm restoration of priorities for iwi:

- hui to determine the most appropriate pathway for engagement with the iwi
- information collection and analysis:
    - holding multiple wānanga with iwi, hapū and marae ensuring all geographic areas of the iwi had an opportunity to participate
    - holding interviews with key knowledge holders in each iwi, and/or
    - researching archival documents held by iwi authorities, iwi and their affiliates
- regular writing retreats hosted by the Waikato-Tainui College for Research and Development.

Ngāti Tūwharetoa were unable to identify a student within the project time frames and therefore their prioritisation process was led by staff at the Tūwharetoa Maori Trust.

Each of the iwi prioritised their projects as outlined below.

Waikato-Tainui

At the Waikato-Tainui waananga, the tribal members developed priority themes to ensure that the outcomes of the waananga were aligned with these. Waikato-Tainui created four geographical areas for waananga to ensure priorities were reflective of local areas. Waananga were held in each of these areas:

1. Karapiro ki Ngaaruawaahia
2. Ngaaruawaahia ki Mercer
3. Mercer ki Te Puuaha o Waikato
4. Puuniu River junction to Ngaaruawaahia.

Once priority projects were identified, members received an equal number of sticky dots to allocate to projects. The dots were allocated based on how significant and valuable the project was to mana whenua. The project with the most allocated dots became the top priority, followed by the projects with the next highest amount. Each of the priority projects in the *Restoration Strategy* has been assigned a ranking of 'very high' or 'high'. Each of the four areas has put forward priority projects.

Maniapoto

Maniapoto derived their priority projects based on previously developed documents, which had strong input from marae and hapū. The projects are identified as very high priority and come from the Restoration Priorities Report (NIWA, 2014), Maniapoto Fisheries Plan (Maniapoto Māori Trust Board, 2015) and Environmental Plan (Maniapoto Māori Trust Board, 2016).

Raukawa

Raukawa undertook the initial approach described above and developed priority projects within their rohe. However, Raukawa decided to retain these projects internally within the iwi. For the *Restoration Strategy*, Raukawa provided two distinct funding priorities focused on:

1. Raukawa relationship with the Waikato River, and
2. mātauranga Raukawa and knowledge.

Each of these priorities promotes a list of potential project areas that are considered to achieve or contribute to the achievement of these objectives. The potential projects act as a guide to persons or organisations seeking funding or making funding decisions in the Raukawa area. More information is provided in Appendix 10.

Te Arawa River Iwi Trust

Two of the three iwi affiliates (Ngāti Kearoa-Ngāti Tuara and Tuhourangi) represented by Te Arawa River Iwi Trust undertook a similar approach to Waikato-Tainui. The iwi identified goals and projects, which were later prioritised, based on how significant and valuable the project was to the local waterbodies, and the value to the people and and the next generation.

The third iwi affiliate represented by the trust (Ngati Tahu-Ngati Whaoa) undertook a separate process consisting of identification of priorities through a workshop with iwi members based on priorities previously outlined in the *Ngati Tahu-Ngati Whaoa Iwi Environmental Plan*. This process involved one wānanga to confirm priority areas and projects and define further opportunities and needs. Ngati Tahu-Ngati Whaoa Runanga staff refined projects and reaffirmed the resulting projects with their board. Project assessment forms were compiled by Runanga staff and relative priority rankings formulated from wānanga kōrero and Runanga Board input.

Ngāti Tūwharetoa

The development of the Ngāti Tūwharetoa priorities was led by staff, alongside 'Te Kaihautu o te Awa o Waikato', a representative group of Ngāti Tūwharetoa mana whenua associated with the Waikato River. Ngāti Tūwharetoa had recently completed the the Tūwharetoa Action Plan for the Waikato River, which was collated through wānanga with marae and whanau. The kōrero from these wānanga, alongside the action plan, informed the iwi priorities for Ngāti Tūwharetoa. The Ngāti Tūwharetoa priorities were tested and prioritised with Te Kaihautu o te Awa o Waikato and approved by the Tūwharetoa Māori Trust Board.

Iwi project assessment forms

Once each of the iwi completed their hui, research and information collation, the iwi staff or students drafted project assessment forms (PAFs) detailing the recommended works and costing estimates for each project. The draft PAFs were submitted to the respective iwi authorities for comment and approval through the management teams and/or trust boards. The full iwi PAFs are included Appendices 7-12. As noted above, Raukawa did not submit PAFs for public consideration.

Iwi project assumptions

Each of the iwi were advised by tribal members and marae of the following key points with respect to the iwi projects:

1. The iwi projects should ideally be led by iwi, hapū or marae within the project area, e.g. upper Waipā iwi projects would preferably be led by Maniapoto iwi, hapū or marae.
2. Education of iwi members is a priority. Where possible, projects should improve the capability and capacity of tribal members through funding of education opportunities and training associated with the project. This may include:
    a. postgraduate studies such as doctorate or masters thesis
    b. qualifications in restoration related fields
    c. internships and cadetships
    d. school related activities, e.g. school planting days.
3. All projects must consider the cultural health and safety of any person associated with the project. This will require discussions with the iwi, hapū and marae.

2.4 Estimating costs

For each project included in the *Restoration Strategy*, an estimated cost has been provided for implementing the recommended works. Estimated costs are based on current market rates and actual costs incurred by similar projects and are intended as a guide only. Where there was a range of market rates for a particular action, the highest rate was used. Appendix 2 contains a table detailing the standard cost assumptions used throughout the *Restoration Strategy.*

Projects that address erosion and sedimentation issues are based on modelling, and a set of assumptions were used to estimate the mitigations required within each of the three catchments (e.g. Waipā, upper Waikato, central/lower Waikato). Detail around these assumptions is provided in Appendix 3.

The quantities of work required for each project were identified from a range of sources, including experts and/or people with local knowledge of the site, aerial photography, GIS modelling and works required for similar projects at other sites.

Prior to any project being undertaken, it is expected that detailed assessment of the work required should be completed by the project team including detailed costings.

3 Prioritisation of Restoration Strategy projects and locations

3.1 Introduction

A key component in the development of the *Restoration Strategy* was the prioritisation of potential locations or features where restoration could take place and the actions/projects that could be carried out at those sites. There are a number of existing tools that are available to assist with this process and these were considered by the project team, along with the option of developing a unique assessment method. The criteria for a preferred tool was that it be robust, transparent, stakeholder inclusive, have demonstrated value in similar projects and be able to assess a wide range of sites and projects over different outcome areas.

Based on this assessment, the project Technical Advisory Group selected INFFER (Investment Framework for Environmental Resources) for prioritising the projects that had been identified through the processes described in Sections 2.3.1-2.3.7. INFFER is a tool developed in Australia by Natural Decisions (Pannell et al., 2012). It was considered the strongest candidate due to meeting

the desired criteria and being easily accessible with user support readily available. INFFER has been scientifically peer reviewed and has had extensive application across Australia.

3.2 Investment Framework for Environmental Resources (INFFER)

INFFER (Investment Framework for Environmental Resources; www.inffer.com.au) assists decision makers to assess and rank environmental and natural resource projects, comparing aspects such as value for money, technical feasibility and the likelihood of achieving stated goals. INFFER is consistent with the principles of cost-benefit analysis and has been used extensively for the development of investment business cases in Australia, including by regional natural resource management bodies and state and national government. This includes evaluating projects involving a variety of different features (waterways, wetlands, habitat, agricultural land) and issues (water quality decline, habitat fragmentation, salinity, pest plants and animals), at a range of scales (from local through regional to large iconic assets such as the Great Barrier Reef).

INFFER focuses on features within specific areas of the natural environment that are considered to have high value from an iwi, stakeholder and community perspective. Features can include rivers, wetlands, forest remnants, threatened plants, endangered animals or areas of agricultural land. Provided the physical location of the feature can be described, INFFER can be used to develop and evaluate projects to conserve, manage or restore.

Comparing the relative merits of projects of different scales, durations and types has always been a challenge for managers of natural assets. The INFFER benefit:cost ratio (BCR) was designed specifically to solve this problem. It is intended to determine which environmental projects would produce the most valuable outcomes per dollar spent.

The BCR equation used in INFFER is as follows:

$$\text{BCR} = \frac{\text{V x W x A x F x B x P x G x DF x 20}}{\text{C+PV(M+E) x G}}$$

Where:
V = value of the feature
W = multiplier for impact of works
F = multiplier for technical feasibility risk
A = multiplier for adoption
B = multiplier for adverse adoption
P = multiplier for socio-political risk
G = multiplier for long-term funding risk
DF = discount factor function for benefits. This is calculated as DF = 1/(1 + r) L , where L = time lag until the majority of anticipated benefits from the project occur (years), and r is the real discount rate (3 per cent)
C = short-term cost of project
PV = present value function
M = annual cost of maintaining outcomes from the project in the longer term
E = compliance costs for private citizens, if the project involves enforcement of regulations

The variables that feed into calculation of the BCR are mostly specified as proportions, and are included in the index multiplicatively. Within this approach, there is no need to provide weights for each variable (as one might do in a multi-criteria analysis approaches). For the *Restoration Strategy*, regulatory approaches were out of scope and therefore parameter values B and E defaulted to a value of 1.

V, the feature value is often the most controversial and contested element when using INFFER. V is an all things considered judgment to reflect the relative significance or value of a feature when

in a restored condition. It encompasses environmental, cultural, social and economic values. The restored condition is used as a point of reference when the feature is valued, and when quantifying the impacts of works (W) to be undertaken to improve it.

3.2.1 Filtering projects

Before a project is fully developed for assessment through the INFFER process, the feature/site is considered against four 'filtering' criteria. These provide a test of whether there is likely to be value in progressing through to full development of a project assessment form (PAF). For each proposed feature the following questions are asked:

1. Will it be possible to define a goal for the feature that is SMART (specific, measurable, achievable, relevant and time-bound)?
2. Is there evidence to indicate that management actions can make a real difference? (For example, will it be technically possible to repair existing degradation, or prevent future degradation?)
3. If the desired management actions are mainly on private land, is it likely that those actions would be reasonably attractive to fully informed land managers when adopted over the required scale (assuming a realistic level of financial incentive)?
4. If the project requires change by other institutions (e.g. local government departments), is there a good chance that this will occur?

If the answer is no to one or more of these questions then the feature is either not considered further, more information is gathered to inform project consideration or, in the case the *Restoration Strategy,* a research or investigation need is identified for that work (Section 15).

3.2.2 Modifying INFFER for a Waikato context

Two key issues were identified in making INFFER more suitable for use in the Waikato and Waipā River catchments:

- a need to consider sites and projects in the context of giving effect to the objectives of the *Vision & Strategy*
- the allocation of scores and dollar values to features in assessing V; iwi representatives on the project Technical Advisory Group were uncomfortable with assigning a dollar value to sites or species and did not feel this was appropriate for a Waikato context.

Several workshops were held with iwi representatives, the project Technical Advisory Group and the developers of INFFER to agree on the most appropriate way of modifying the tool for the Waikato while still maintaining the integrity of the process. The following modifications were made:

- As noted in Section 1.4, the *Restoration Strategy* priorities were split into two key parts – one identifying iwi priorities, and another identifying other priority locations and actions for erosion and sedimentation, water quality, biodiversity, fisheries and access/recreation (referred to as general priorities). Iwi locations/actions were prioritised by iwi using their own preferred methodologies, and other features were prioritised by iwi, stakeholders and technical representatives using INFFER.
- An additional question was added to the feature/project filtering process: Does the proposed project give effect to at least three objectives of the *Vision & Strategy*? The purpose of this question was to ensure that feature and project selection didn't veer from the core purpose of the *Restoration Strategy.*
- The value (V) score was replaced with a VS score. This score was determined by estimating the impact that the restored feature would have on achieving the *Vision & Strategy* for the Waikato River. This recognises that no site or place is necessarily more valuable or significant than another, but that its restored state would have a greater impact on realising the *Vision & Strategy* than another. For example, a swimmable and fishable Waikato River through its entire length would have a greater impact on achieving

the *Vision & Strategy* than a swimmable and fishable tributary, or a restored 2ha wetland. A scoring framework was developed to assist with the evaluation of this (Table 2). The intention was that each feature (in its restored/benchmark condition) would be categorised according to its impact on achieving the *Vision & Strategy.* It is then assigned a VS score from within the available range for that category.

Discount rate

During early trials of the INFFER tool on Waikato features and projects, concern was noted about the impact of the discount factor rate on the final BCR score. Discounting is a standard economic approach that recognises that the costs and benefits of a project will occur at different times over the life of that project. The choice of discount rate can make a big difference as to how future costs and benefits are weighted in decision making. For example, a big infrastructure project might have very large upfront costs but benefits that are spread out over decades. Similarly, a water quality project that has significant upfront implementation costs may have benefits that won't be realised until many years from now. Discounting can work against these projects because the near-term costs aren't discounted much, while those benefits out beyond a few decades may be discounted into irrelevance. Conversely, a project that has some short term gains, but with sizeable long term losses (for example, because of environmental damage) may be favoured, if the long term losses are large enough.

The New Zealand Treasury provides guidance on suitable 'default' rates and how to calculate them (NZ Treasury, 2008). At the time of writing, the guidelines generally recommend a discount rate of 6 per cent.

However, the project Technical Advisory Group noted some discomfort with the concept of discounting where it related to non-financial future benefits – for example, of cultural values. The use of discounting implies that the assets being discounted are substitutable for other assets. In addition, it is accepted that achieving the *Vision & Strategy* will take 80-100 years and, as such, we do not want to overly penalise projects whose benefits will not be realised for decades. Guidance material for the INFFER tool suggests a discount rate of 5 per cent, while acknowledging that this may be varied according to the context and user needs. The Technical Advisory Group considered that discount rates provide a useful component of the prioritisation process (for example, for two projects that are otherwise identical they result in a higher ranking for a project that achieves its objectives sooner). But the importance of non-substitutable environmental and cultural values justified the use of a discount rate lower than the INFFER and Treasury guidelines suggest. Given this, the Technical Advisory Group recommended a discount rate of 3 per cent for the purposes of the *Restoration Strategy*.

Table 2. Vision & Strategy (VS) scoring framework for modified INFFER assessment

Impact on achieving the Vision & Strategy	**Feature example**	**INFFER Score (VS)**
Exceptional impact - Features in this category, in their restored/benchmark condition, would have an exceptional impact on giving effect to the *Vision & Strategy.*	Waipā River from Pekepeke Springs to Ngāruawāhia – swimmable and fishable, taonga species are locally abundant, iwi and communities have a strong connection to the river, native species have access to healthy connected habitats.	1000

Very high unit impact - The feature, in its restored/benchmark condition, would have a **very high impact on** giving effect to *the Vision & Strategy* in the Waipā, upper Waikato, lower Waikato or shallow lakes **unit (catchment).**	e.g. Whangamarino Wetland.	100-999
High unit impact - The feature, in its restored/benchmark condition, would have a **high impact on** giving effect to the *Vision & Strategy* in the Waipā, upper Waikato, lower Waikato or shallow lakes **unit (catchment).**	e.g. Lake Waikare.	25-100
Very high local impact - The feature, in its restored/benchmark condition, would have a **very high impact** on giving effect to *the Vision & Strategy* **at a local level.**	e.g. Upper Mangatutu River.	3-24
High local impact - The feature, in its restored/benchmark condition, would have a **high impact** on giving effect to the *Vision & Strategy* **at a local level.**	e.g. Series of lowland kahikatea fragments.	0.1-3

3.3 Project assessment forms (PAFs)

The project assessment form (PAF) is an integral part of the INFFER process and is used to collate and describe core information about the project that is proposed for the protection and restoration of a feature. It includes information about the key factors used to calculate the BCR.

Table 3 outlines an example PAF and explains the specific information that was sought and recorded for each *Restoration Strategy* feature and project that made it through the INFFER filtering stage.

In addition to information recorded in the PAF, each project also has a site map showing the geographic location of the feature/project and photos of the project site displaying issues and/or potential remediation options.

Table 3: Project assessment form (PAF) detailing the specific information that was sought and recorded for each *Restoration Strategy* project. The parameters that contributed to the benefit:cost score are shown in italicised text.

	Project Information
	Title of project
Relevant unit goal(s)	These are the goals from the iwi/stakeholder goal setting workshop that this project helps to address.
Name of feature	The feature/site/species that the project aims to protect and restore. For example, riparian planting and fencing on streams in the Mangapu catchment might aim to improve fish habitat and water quality in the Mangapu River. The feature would therefore be the Mangapu River.
Brief description of feature	General information about the feature including (where appropriate) size, extent, history, cultural values and the reasons the feature was selected as a potential priority.
Desired state to achieve the *Vision & Strategy*	This is the overall condition the feature would be in if all objectives of the *Vision & Strategy* were being achieved (through this project and others). The desired state should be as good as (or better than) the condition expected to be achieved following the most ambitious project for this feature, while taking into account the need for long term infrastructure to remain in place e.g. hydro dams and flood protection assets.
VS score	*The impact that the feature in its restored state would have on achieving the Vision & Strategy.*
Key threats to the feature that this project addresses	Threats addressed by the proposed project.
Project goal/s	This is what the proposed project aims to achieve. These are time-bound and measurable.
Priority works for funding	These are the actions that have been identified as being the highest priority at this site to meet the unit goals. These are directly linked to achieving the project goals.
Time lag for benefits to be realised	*The period of time following commencement of the project that it would take before the majority of benefits of the project are realised.*
Effectiveness of works	*The extent to which project works will contribute to an improvement in the feature condition – estimated as a proportional change in value 'with and without' the works.*
Risk of technical failure	*The risk that the project will fail to achieve its goal over the long term due to technical feasibility. This may be due to issues such as difficulty controlling weeds or other pests, lack of technically feasible mitigations, etc. This is expressed as a proportion, with a higher score indicating lower risk.*
Adoptability	*The proportion of landowners expected to adopt the proposed works if they were fully incentivised (i.e. no cost to the landowner).*
Information quality	This is a broad assessment of the quality of information used to put together the project information.
Knowledge gaps and response	Any gaps in knowledge relating to the project that need to be filled before the project can be undertaken.
Socio-political risks	*The risk that the project will fail to meet its goals over the long term due to socio-political risk. Examples of risks include organisations that would be required to work together failing to do so, public backlash, approval being required from unsupportive groups, etc. This score is expressed as a proportion, with a higher score indicating lower risk.*

Project duration (years)	*The time expected for project completion.*
Upfront cost – total for implementation phase/project duration	*The estimated cost for implementing the works described in the 'Works Required' section. Costs are based on a set of cost assumptions as at 2017. These are documented in Appendix 2 of the strategy.*

3.4 Process for scoring projects

For each unit of the *Restoration Strategy,* a joint iwi, stakeholder, landowner and technical expert hui was held. The purpose was to determine specific feature scores for the group of potential priority projects identified through the processes described in Sections 2.3.1-2.3.7. The hui participants were split into groups of 6-10 according to their geographical interests and knowledge. Each group was first asked to assign their features into one of the five VS categories (from Table 2). As required by INFFER, the features were categorised according to their benchmark condition. Summaries of proposed benchmark condition were provided as part of the feature/project information and are included in each PAF. Once this was completed, participants were asked to rank features within a category from highest to lowest impact on achieving the *Vision & Strategy*. If appropriate, features could be considered equal during this process. Numerical VS scores were later determined by the project Technical Advisory Group (TAG) based on the category and ranking by the workshop group.

The workshop participants were also asked to provide scores for adoptability (A) and socio-political risk (P). All other scores were assessed by the project TAG. The final outcome was a BCR score for each project.

3.5 Categorising restoration priorities

Projects within the *Restoration Strategy* have been categorised as very high, high or medium priority. While all of these projects are important, we recognise that there is neither the funding nor the capacity for all projects to be funded and implemented in year 1. The ranking category is intended to be a guide as to which projects should be considered first. For general projects assessed using INFFER, this categorisation was strongly informed by the BCR score. In general, projects with a benefit:cost ratio of greater than 25 were categorised as very high priority, projects less than 10 categorised as medium priority, and projects lower than 1 excluded from the strategy. The following exceptions were observed:

- Upper Waikato projects had higher BCR scores than other units. This appears to have been driven by the very high scores allocated for impact on the *Vision & Strategy* by catchment stakeholders. Consequently, some projects with scores higher than 25 have been categorised as high priority rather than very high.
- Where a project had an overall favourable BCR but a very low factor score for technical feasibility, adoptability or socio-political risk, the project could be moved into a lower category. This recognised that more time may be required to develop technical needs or landowner support, for example, before these projects are ready to implement.
- In the Lower Waikato, there was a considerably higher total cost for projects than the value to be included in the *Restoration Strategy* for the catchment. Consequently, there were some projects that had a BCR score between 1 and 10 that did not make it through into the Strategy.
- The project Steering Group had specifically requested that some urban projects be included in the strategy due to the importance of engaging these communities in river restoration and reconnection. Therefore, a small number of urban projects with a score

slightly less than 5 were selected ahead of projects that scored between 5 and 10. This also ensured a more even spread of project types were included in the *Restoration Strategy.*

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4 Using the Strategy

4.1 Structure and content

For each of the unit chapters in the *Restoration Strategy*, the project structure is presented as follows:

- An overview map of the geographical area of the catchment, with project locations identified and numbered. For many of the iwi projects, specific sites are yet to be identified and therefore overview maps are not included.
- Project summaries provide a brief overview of each project, including the name, number, description of location, summary of proposed actions and estimate of total project cost. These also include the priority category for the project. There are three categories – very high, high and medium – and these reflect the outcome of the prioritisation process (see Section 3.5)
- Full project assessment forms (PAFs) are appended for each chapter. The PAFs provide more detailed and technical information on each feature and project, and are intended to assist project implementers in selecting projects and planning works.

Works for each project are limited to specific activities addressing the issues identified as having the highest priority for that site. They do not include everything that could be done if funding was unlimited. This recognises that funding of non-regulatory activities needs to be invested in the highest priority actions and in projects with the greatest potential gain, in order to best give effect to the *Vision & Strategy* with available resources.

4.2 Information for implementers of restoration projects

This section sets out information for parties who are interested in implementing restoration projects (or parts of restoration projects) identified in the *Restoration Strategy*. Figure 3 outlines the process implementers should follow, and further information on each step is provided later in the section.

Figure 3. Process diagram for parties interested in implementing restoration projects

4.2.1 Choosing a project

Many organisations or individuals wishing to undertake river restoration projects will have already identified a general location of interest. This might be as broad as an entire catchment or

as focused as a stream behind a marae or within an individual farm boundary. The first step in using the *Restoration Strategy* is to go to the chapter that best matches your general area of interest (catchment and/or rohe) and view the overview map for projects that have been identified in that area. Each project number on the map corresponds to a project summary within this document and a project assessment form (PAF) within the Appendices.

Take note of the project numbers that are near or within your area of interest and go to the corresponding project summary within that catchment chapter to find a brief overview of the priority works for funding. This summary describes the nature and quantity of the work that has been recommended for this location. For the majority of projects, we suggest that the work can either be undertaken in its entirety or as cumulative, smaller pieces of work. For example, if the project identifies 20km of stream fencing and planting, this could be done as a single project or as multiple projects with different project leads. Project implementers can propose to undertake all or just a percentage of the work.

Once a project that matches the interests and skills of your organisation, group or whanau has been identified, more detailed information about the environmental feature and project is available in the PAF that sits within the appendix for that chapter. The information in the PAF should provide a good basis for putting together a project proposal and plan and applications for funding. If the chosen project is within one of the general priorities sections, you should check for alignment with iwi priority projects for the same geographical area and vice versa. Project partnerships are strongly encouraged, especially where multiple outcomes can be achieved.

For the projects that fall into the four general sections – upper Waikato, central/lower Waikato, Waipā and shallow lakes – it is anticipated that these works could be carried out by organisations, groups, landowners, marae and/or hapū. For projects identified as iwi priorities, it is anticipated that these projects would be either led by iwi or carried out with iwi as a partnership. The *Restoration Strategy* does not specify who can be contracted to undertake aspects of project delivery, however, for all projects local delivery is encouraged wherever possible. This helps to give effect to *Vision & Strategy* objectives relating to the restoration and protection of the relationship of iwi and communities to the rivers, including their economic, social, cultural and spiritual relationships.

4.2.2 Cultural health and safety

It is important that persons or organisations that intend to deliver a project within the Waikato River catchment dedicate some time and resources to considering cultural health and safety. Cultural health and safety upholds the 'tapu' quality of all things natural by doing things the right way under the principles of 'tikanga'. Therefore, when undertaking a project, we aim to achieve two things:

1. ensure the safety of people within the natural spaces they are working in
2. respecting the whole of nature to protect its fertility.

The Waikato and Waipā River catchment holds a richness in history that should be protected, acknowledged and respected. Māori occupation of the region shaped papatūānuku (earth mother) through the creation of pā (fortification), papakāinga (communal village), rua kai (food pits), mahinga kai (cultivation areas) and other physical constructions to support iwi, hapū and marae. Marae were generally established near waterbodies and natural resources to sustain the iwi and provide them with energy to protect, care for and live with one another. Many of these physical attributes of the community are no longer visible on the landscape. However, the pūrākau (legends), taonga tuku iho (treasures gifted) and presence of these areas will never be lost. It is highly likely that within the tīnana (body) of papatūānuku, many of these treasures, or artefacts and possibly kōiwi (human bones), are still resting with the potential for discovery. As

well as the physical and tangible aspects of the historic landscape, there are also spiritual and metaphysical worlds and beings to be aware of, and respectful to. Whatukura (male spiritual beings), māreikura (female spiritual beings), taniwha (spiritual kaitiaki), patupaiarehe (fairies) and other beings continue to live amongst our natural resources. Cultural guidance, to consider these spiritual spaces, will be required from marae associated within the project area.

It is the duty of the project manager of each project to take responsibility for consulting with relevant iwi to understand the significance of the place they are protecting or restoring. These aspects of the land are extremely significant to iwi. It is vital that the location of known sites are understood and have appropriate management mechanisms in place to ensure the safety of the site, and the people associated with the project.

Further advice provided in Section 4.2.7 is a guide only, to assist in discussions with iwi, hapū and marae. The decisions reached between the project manager and iwi, hapū and marae hold precedence.

4.2.3 Consultation

Once a project of interest is identified we recommend that preliminary consultation with affected and interested parties is undertaken. The PAF will sometimes make suggestions about who should be included as part of this and may include administrators of Crown land or community groups who have a history of working at that site. However, be aware that the PAFs do not list everyone who needs to be consulted. In general, at a minimum, consultation should include:

- Landowners (private/iwi or Crown) – if there are a small number of landowners involved then it is recommended that they are all approached prior to going any further with the project planning. Projects will not be able to proceed without their support. If there are a large number of landowners (e.g. for long reaches of waterways, large wetlands, sub-catchments) then it may not be necessary to talk to everyone prior to planning the project, but it is advisable to speak to some key landowners, a community board or catchment committee to get some advice on likely interest. Each PAF contains an estimate of anticipated uptake of work and some of the challenges that may exist in this.
- Iwi – more detailed information on iwi consultation during project planning, implementation and closure is provided in Section 4.2.7. Even if your proposed project is small and on your own private land, many funders will want to see that you have discussed the work with the local marae and have their support.
- Waikato Regional Council and your territorial local authority – each PAF identifies where it is expected that resource consent for works will be required. However, it is always advisable to check with the regional and local council if your proposed project involves earthworks or disturbance of the bed of a waterbody (including willow removal along streams and within wetlands). The councils may also be aware of other works that are being undertaken in the area that might align with or impact on your project. You will also be able to discuss potential funding options with council staff. If your proposed work is in a high priority site for Waikato Regional Council they may have a catchment management officer available to assist with a project or farm plan.
- Community groups – if you have an active community group in your area it is advisable to talk to them about any work they may have planned or whether they may be interested in being involved in your project. Community groups have a wide range of skills and potential access to volunteers and other resources.
- Research institutions – if your project involves a research or monitoring component it is recommended that you make contact with relevant research institutions to see if there is similar work currently being undertaken or new opportunities to partner with these organisations.

4.2.4 Planning a project

The individual PAFs provide guidance on the type of work that is considered a priority for funding for each feature or value and this can be used to help with project planning. They also provide recommended standards and estimate quantities of works required to maximise benefits. These standards are considered an important component of cost-effective project delivery. However, as part of individual project planning it is important to ground truth the proposed actions. This section provides some advice on doing this for some of the more commonly identified works. If you are intending to undertake a project identified in the *Restoration Strategy*, then you may also be able to get project planning advice from your iwi trust or your local Waikato Regional Council catchment management officer.

Restoration plan

Some projects will require a restoration plan, management plan or design work to be completed prior to undertaking works. Where this is required it has been included as a project cost in the PAF. It is anticipated that this would be undertaken by an appropriately qualified and experienced expert such as ecologist, engineer or mātauranga Māori knowledge holder.

Fencing

Within the PAFs, riparian fencing setbacks are set at 5m for streams and 10m for the main channels of the Waipā and Waikato rivers. There should be flexibility on this when working with landowners to ensure that fence lines are sensible, and therefore these distances should be viewed as average setbacks. The standard of fencing recommended in PAFs is generally 5 wire (2 electric) or 7 wire depending on the nature of the work. These are commonly required standards for many funders, particularly where native planting is proposed behind the fencing. Where fence damage caused by flooding is a significant issue a 3-wire electric fence is generally accepted. Note that the proposed *Healthy Rivers Plan Change 1* requires a 1m fence setback from permanently flowing waterways in areas where the terrain is flat and a 3m setback where slope is greater than 15 degrees. Works that do not exceed regulatory minimum will not generally be eligible for non-regulatory funding; however it is recommended this is checked with each funder prior to making an application.

Unless otherwise noted, estimates of fencing lengths included in the PAFs are based on modelled information (Appendix 3) or examination of aerial photographs. We recommend that more accurate estimates are obtained as part of project planning. If working with a small number of landowners then jointly examining an aerial photo or undertaking a site visit is recommended.

Planting and plant maintenance

Opinions vary on methods and standards for planting wetlands, riparian margins and hill country. For riparian and wetland plantings the recommendations included in the *Restoration Strategy* come from best professional judgement and are generally based on 4444 plants per hectare (1.5m spacings) and five releasing events. When planning your project, you may need to adjust these figures depending on the site. For example, you may need to factor in undertaking additional releasing events in places were plant growth is low or where problematic weed density is high, or alter spacing depending on the nature of the site. Further guidance on plant selection and spacing can be found in various guides such as Waikato RiverCare (2014) and the DairyNZ Riparian Planner (https://riparian-planner.dairynz.co.nz/). Your project plan should note the reasons you have chosen your plant densities and maintenance schedule.

Management and prevention of erosion

Sub-catchment PAFs estimate the quantities of fencing, plants and erosion control structures that are anticipated to have value for preventing and remediating erosion in that particular area. These have been based on modelled information and so should be treated as an overall estimate for the sub-catchment. On-the-ground works will be farm specific and need to be developed with interested landowners. There should be a flexible approach taken to this that considers the best overall plan for addressing erosion and sedimentation on farm. However, if you are planning to apply for funding to undertake works not included in the PAFs (e.g. water reticulation, stock crossings, dams), you should check with the funding organisations as to the kind of works that

meet their criteria. If a farm plan has already been developed for a property then this should provide a further guide to potential management options and quantities of works.

Project management/staffing/incidentals

Estimates of project management costs have been provided for all projects. These are broad and are based on the anticipated requirements for overseeing works, procurement and contract management, consulting with landowners, iwi and stakeholders and preparing farm or riparian planting plans. They also cover overheads such as administration, financial management and project reporting, and incidentals including fuel costs, office expenses and professional fees (see Appendix 2 for assumptions). It is important when planning your own project to treat these as a guide and to more accurately estimate the costs of these components for your work. If you are only undertaking a small part of a PAF, it may be that there is very limited landowner consultation required (e.g. there is one landowner and they are already supportive). Most funders will want to see some justification for your project management, staffing and incidentals costs.

4.2.5 Applying for funding

When you have completed your project plan and estimated the project costs, you will need to consider which components of the work can be carried out in kind through volunteer labour or advice and which components will require funding. Section 4.4 outlines some of the funders within the Waikato catchment that regularly fund river restoration projects. Each funder has different criteria and requirements for funding. However, most will require the project to have other sources of funding attached. You should look at the criteria of funders within your area of interest to determine whether you need to apply to one or more sources for funding.

When applying for funding to undertake a project identified within the *Restoration Strategy* you should emphasise this in your application, and note the priority category that the project sits in (very high, high or medium). Most funders are keen to know if a project has already been through a rigorous prioritisation process.

4.2.6 Project delivery and reporting

Once you have secured funding for your project and have begun project implementation, you will need to ensure you keep a detailed record of all project expenses, along with evidence of these expenses. It is essential you keep all supplier invoices and record in-kind hours spent on your project (e.g. volunteer hours, project management hours). Many funding organisations will require you to provide supplier invoices as evidence of expenditure before they release funding. They may also require a project report detailing information such as in-kind contributions, other cash contributions, photos of progress and any other project information you can provide.

Your final progress report should detail, at a minimum, your achievements against your goals and a summary of outputs including kilometres of fencing, hectares of planting and hectares of land retired.

4.2.7 Engagement with iwi, hapū and marae

Project planning

As you develop your project and begin to prepare applications for funding, it is important that you initiate discussions with the relevant iwi authority as early as possible. They will provide guidance on further engagement requirements, which may including discussions with hapū and marae. Locations and names of marae are displayed on all project maps in Appendices 5 to 14.

It is also important to be thoroughly prepared before meeting with iwi, hapū and/or marae.

- Clearly identify the intended project area and scope of activities/works.
- Read and consider the relevant sections of the relevant iwi environmental plan to familiarise yourself with iwi matters. For example, projects in the lower Waikato River

must consider the Waikato-Tainui Environmental Plan. These plans, and more, can be found on the Waikato Regional Council website: https://www.waikatoregion.govt.nz/Community/Your-community/iwi/Tangata-Whenua-Management-Plans/

- Relevant sections may include:
  - engagement with iwi, hapū and marae
  - sites of significance
  - customary activities
  - accidental discovery protocols.
- Contact the relevant iwi authority, hapū or marae to initiate discussion on the following:
  - the most appropriate manner of engagement
  - the project concept, location, objectives and time frames
  - identifying cultural expectations for the project, including tikanga (protocols) required prior to the commencement of the project, during the project and at its completion. This may also include incorporating iwi aspirations into the project.
  - protocols for archaeological discovery, kōiwi (bones) discovery, sites of significance and communication
  - providing for cultural induction of agreed protocols with all staff. This may include marae members providing historical and cultural context to the project area.
  - costs associated with iwi, hapū and marae engagement. All projects within the *Restoration Strategy* have factored in estimated costs for engagement with iwi and landowners. Actual costs will depend on the scope of the project and should be agreed with the iwi, hapū and marae prior to commencement.

Project implementation

It is advisable to re-establish engagement with iwi, hapū and marae prior to and during project implementation. This may include:

- implementing cultural safety requirements as agreed with iwi, hapū and marae, e.g. karakia with all staff present prior to turning the soil, followed by a hākari (feast) together
- maintaining regular contact to provide updates and build relationships
- holding cultural induction training for new staff members or contractors as required. This is particularly important for projects that are likely to include, or impact, the following:
  - stream diversions
  - sites of significance
  - major earthworks near historic settlements
  - establishing mahinga kai
  - traditional water areas for swimming or drinking.

Completion of project

- Implement cultural safety requirements as agreed with iwi, hapū and marae, e.g. karakia to close the project, with all staff present followed by a hākari (feast) together.
- Depending on the size and scope of the project, you may hold a final workshop to review progress against the initial objectives agreed with the parties.
- Provide a final project report to each of the parties as a record and resource for future generations.

Links to iwi authority contact details can be found on the Waikato River Authority website, in the links section: http://www.waikatoriver.org.nz/contact-us/

4.3 Information for funders

Organisations who fund river and catchment restoration and enhancement, cultural enhancement and capacity building of iwi in restoration are advised to review the *Restoration Strategy* to identify projects that are likely to be in scope for funding. This could be through the following ways:

- Geographically – each of the unit chapters contain all priority projects within that unit area
- Work stream – the map at the start of each chapter contains an overview of projects. Projects are coloured by work stream type, enabling easy identification of projects relating to erosion and sedimentation, water quality, fish, biodiversity and access/recreation
- Iwi priorities – these are presented as a chapter for each iwi and then an overall chapter on iwi priorities associated with lakes.

Funders are encouraged to reference *Restoration Strategy* projects that meet their funding criteria within their lists of priorities for funding.

Costings

Project assessment forms contain quantities of work and associated costings that are based on best available information at the time of *Restoration Strategy* preparation. Funders are encouraged to assess these against their own standards and seek evidence from applicants that they have undertaken more detailed planning and costings where required.

Project reporting

Organisations that provide funding for implementation of projects identified in the *Restoration Strategy* are recommended to ask recipients to include commentary on achieving strategy deliverables as part of their final reporting. The Waikato River Authority will maintain a record of progress against the *Restoration Strategy* and report on this annually through the Waikato and Waipā River Restoration Forum.

4.4 Sources of funding and support

Organisations and individuals looking to undertake projects identified in the *Restoration Strategy* are advised to seek funding from a range of sources and collaborate with iwi, agencies, organisations and the community where possible.

Within the Waikato catchment there are a range of agencies and organisations that have funding available for environmental restoration and enhancement projects. Funding organisations that regularly fund the kinds of projects identified in the *Restoration Strategy* are listed below. More detail about each funder and their funding criteria can be found in Appendix 4.

- Waikato River Clean-up Trust (WRCuT)
- Waikato Catchment Ecological Enhancement Trust (WCEET)
- Afforestation Grants Scheme (AGS)
- Trust Waikato
- Nga Whenua Rahui
- Ministry for the Environment – Freshwater Improvement Fund
- Ministry for the Environment – Community Environment Fund
- Waikato Regional Council – Integrated Catchment Management Directorate
- Waikato Regional Council – Natural Heritage Fund
- Queen Elizabeth II National Trust

- Iwi authorities – Te Arawa River Iwi Trust, Raukawa Charitable Trust, Maniapoto Māori Trust Board, Tūwharetoa Māori Trust Board and Waikato Raupatu River Trust.

5 Priority locations and projects – central and lower Waikato

5.1 Current state and pressures

5.1.1 Introduction

The central and lower Waikato River catchment covers approximately 347,757ha and extends from Karāpiro Dam in the south for 150km to Te Puuaha (Port Waikato) in the north (Figure 4). The catchment represents almost 25 per cent of the total Waikato River catchment (Waikato Regional Council, 2011; 2012). The dominant features in the catchment are the Waikato River main channel and its associated lakes and wetlands.

From Karāpiro Dam the Waikato River flows within a relatively steep sided and incised channel through the towns of Cambridge and Hamilton and on to Ngāruawāhia. At Ngāruawāhia the Waipā River joins the Waikato River and the Waikato River becomes wider and slower flowing. This was once a large flood plain ecosystem dominated by lakes and peat wetlands formed by alluvial dams. Today the area is still characterised by large lakes and wetlands but a substantial proportion of the land has been drained for agricultural production. Remaining lakes and wetlands are smaller than they were historically and are largely disconnected from the river by the flood levees and flood gates of the Lower Waikato-Waipā Flood Control Scheme (Waikato Regional Council, 2011; 2012).

Below Tūākau the river widens further and branches into a delta system with many small channels and islands. It then enters Maioro Bay and flows through a narrow and shifting channel at Port Waikato to join the Tasman Sea. This section of the river is influenced by daily tidal cycles and has an internationally significant wetland complex that is home to a wide range of native bird and fish species (Collier et al., 2010).

5.1.1 Cultural importance

To Waikato-Tainui the river is significant in a cultural, historic and spiritual sense. It is a tuupuna which holds mana and represents the mana and mauri of the people. The tribal name 'Waikato' is derived from the awa tuupuna.

"The river is a being, a mother, a complete and whole body comprising the water, the bed and the banks from its source to the sea. The life of the river and thus of the tribe is in its intactness – no limb struck from its body or the head separate from the heart." – the late kaumātua Kamira Henry Haggie (Deed of Settlement in relation to the Waikato River, 2009)

"Ngaa awa itiiti e pa ana ki te wai o Waikato, ko ngaa uaua o to taatou awa. To taatou awa he manawa." (All the little streams and rain that flow into the Waikato River are like the veins of the body. The river is our heart.) – the late Sir Robert Te Kotahi Mahuta of Waahi Marae (Deed of Settlement in relation to the Waikato River, 2009)

The central and lower Waikato River and lakes are populated with marae drawn to the resources which sustain the people and enable catering for manuwhiri (visitors). The wide corridors of the river provided an ideal highway for movement by waka. Historically, this encouraged trade and establishment of purposeful communities. Waikato-Tainui are well recognised for their ability to feed thousands of manuwhiri as demonstrated each year at the anniversary of the coronation of Te Kīngi Māori. Like all iwi Māori, there is an inherent duty to care for your waters and fulfil your obligations as kaitiaki (guardians).

5.1.2 Lower Waikato-Waipā Flood Control Scheme

The Lower Waikato-Waipā Flood Control Scheme is a comprehensive river control scheme designed to provide flood protection and drainage within the flood plains of the lower Waikato and Waipā rivers. The scheme consists primarily of stopbanks, pump stations, floodgates and main river channel works. Scheme construction was commenced in 1961 and completed in 1982. The original area of low lying land in the lower Waikato, comprising the floodplains of the Waikato River, its tributaries and substantial areas of wetland, was approximately 36,400ha. Today approximately 17,200ha of this area is directly protected by flood protection scheme works including the main access route between Auckland and the rest of New Zealand (State Highway 1) and the main trunk railway line. An additional 16,500ha of land is also protected from flooding through works designed to control ponding areas. Within the Mangawara River Valley the scheme provides protection to approximately 8300ha of rural land (Waikato Regional Council, 2011).

To iwi, the flood control scheme has significantly impacted the natural functions of Whangamarino and Waikare catchments. The ability of marae to access mahinga kai (food gathering area) and fresh drinking water and enjoy the river's waters have been limited. Lake Waikare, Lake Whangape, Lake Koopuera and the Whangamarino are synonymous with the invasion and bloodshed of Rangiriri. The lands and beds of the lakes now hold the kōiwi (bones) of Māori. General Cameron's forces broke through the trenches at Rangiriri to access the central North Island resources and lands, which triggered a string of events leading to the confiscation of Waikato ancestral lands. This area is historically significant in the darker side of the Government invasion of Waikato.

For the purpose of the strategy, the Lower Waikato-Waipā Flood Control Scheme infrastructure (e.g. flood gates, pump stations, drains, levees) has been considered part of the future environment and priority projects have been developed with this in mind.

5.1.3 Water quality

Water quality within the central and lower Waikato River is poor compared to the upper catchment (Vant, 2010). Concentrations of nitrogen, phosphorous and sediment increase as water flows downstream. Increases in nutrient concentrations from the upper catchment to lower catchment are likely to be the result of intensification of land use within the Waikato River catchment (Vant, 2010). Higher contaminant levels also result from other inputs including urban stormwater run off and sewage treatment plants (Waikato Regional Council, 2017b). Using data from 2007, the Ministry for the Environment ranked the state of all sites in NIWA's National River Water Quality Network. When the nutrients nitrate, total nitrogen, dissolved reactive phosphorus and total phosphorus were combined, the Waikato River at Hamilton ranked poorly at 60 out of 77 sites, while at Rangiriri it ranked 70 (NIWA, 2010).

Hydro dams on the Waikato River have been shown to contribute to the growth of phytoplankton (Gibbs et al., 2015). Before the dams were built it took approximately seven days for water to reach the sea from Lake Taupō. It now it takes several weeks. The increased time that water is held in dams allows for the growth of phytoplankton, especially during summer (Waikato Regional Council, 2017b).

Water clarity is also reduced by sediment inputs as the river travels north, and this is particularly noticeable in the lower part of the Waikato River downstream of Ngāruawāhia. High loads of sediment enter the Waikato River from the Waipā River at the confluence at Ngāruawāhia. Water clarity samples from 2012-2014 showed water clarity between Karāpiro and Ngāruawāhia to have a median of 1.5m. This reduces to 0.73m downstream of Ngāruawāhia (Williamson et al., 2016).

Water quality is not always satisfactory for swimming in the central and lower Waikato River, due to high bacterial counts. Downstream of Hamilton city, levels of *E. coli* bacteria are often above the level considered safe for contact recreation (Waikato Regional Council, 2017c). *E. coli* comes from the dung of farm animals and wildlife such as pigs, goats and waterfowl. Human sources

from treated sewage are generally a minor proportion of the total load of bacteria to rivers. In the Waipā River, the influence of farm animals is the likely dominant source of *E. coli* (Waikato Regional Council, 2017b).

Potentially toxic blue-green algae (cyanobacteria), which can dominate the phytoplankton assemblage in the lower river during summer months, may also pose a risk to public health when biomass is high (Waikato Regional Council, 2017b). High cyanobacteria biomass in the lower river originates mostly from blooms in the upstream hydro lakes or shallow riverine lakes.

Water quality in the lower Waikato River below Ngāruawāhia was given a C- grade in the Waikato River Authority Report Card in 2016, indicating that "people are exposed to a moderate risk of infection (less than 5 per cent risk) from contact with water during activities with occasional immersion and some ingestion (such as wading and boating)". Within the tributaries an overall D grade was given to water quality, indicating the risk of infection is greater than 5 per cent (Williamson et al., 2016).

Concentrations of nitrogen and phosphorus can exceed Waikato Regional Council standards for supporting aquatic flora and fauna (ecological health) in this part of the catchment. Water quality data from 2007-2011 presented on Waikato Regional Council's website showed that approximately 30 per cent of water quality samples taken in the lower Waikato River over this time were unsatisfactory for ecological health (Waikato Regional Council, 2017c).

Iwi have also noted the significant decline in water quality in the lower river, which in turn impacts the health of iwi. Iwi generally associate water quality with the health of the waterbody.

"If the wairua of the river is violated, the river suffers, becomes sick and, if ignored, will die." – the late kaumatua Pumi Taituha (Deed of Settlement in relation to the Waikato River, 2009).

5.1.4 Erosion and sedimentation

Much of the Central/Lower Waikato catchment consists of erodible soils derived from volcanic materials. Erosion is particularly significant on stream beds, banks and terraces throughout the catchment and collectively this has a significant impact on water clarity in the lower river. In the upper part of this catchment, erosion is limited mostly to the catchments east of Cambridge such as Karāpiro and the Mangaonua (Waikato Regional Council, 2012). Despite declining visual water clarity as the Waikato River flows downstream, the suspended sediment load entering the central Waikato River is lower than it would have been historically due to the settling of sediment caused by the slowing of flow behind the hydro dams (Hicks and Hill, 2010).

The Lower Waikato catchment is geologically diverse with a combination of volcanic materials, alluvial and unconsolidated sediments, greywacke or argillite, peat and sandstone/mudstone (Waikato Regional Council, 2011). Approximately two-thirds of the sediment load to the lower river comes from the Waipā catchment via the Waipā River and this is now the main contributor to the turbidity in the lower Waikato main stem. Conversely, it is estimated that approximately two-thirds of the sediment yield from the Matahuru, Mangatangi and Whangamarino rivers is deposited in Lake Waikare and the Whangamarino wetland and does not reach the Waikato River (Duncan, 1999, cited in Hicks and Hill, 2010).

During the 1960s-1980s, soil conservation works were implemented on properties across the Lower Waikato catchment. Many of these works are now at or near replacement. Significant works have also been undertaken both historically and recently to remediate and prevent streambank erosion issues in the tributaries of the Waikato River. This includes through fencing, planting and construction of rock revetments and groynes (Waikato Regional Council, 2011).

Waikato Regional Council's *Lower Waikato Zone Plan* identifies eight priority catchments for hill country and riverbank erosion. Across these catchments, 13,133ha (21 per cent) are identified as having severe erosion potential. Palmer et al. (2015) identified evidence of historic slope failures

in the Lower Waikato catchment, but concluded that present day erosion is mainly in the form of surficial erosion such as soil creep, rilling and mobilisation of sediment through stock trampling. SedNetNZ modelling identified relatively high erosion rates (>1000t/km$^{2/}$yr) in the southeast of the Lower Waikato catchment.

Palmer et al. (2015) concluded that although there wasn't substantial active hillslope erosion evident, the streams draining the upper catchments appear to have a high suspended sediment load. They also noted that valley floors in general were not well fenced and that stock are likely to contribute to disturbance and remobilisation of streambank sediments. Hicks and Hill (2010) concluded that the banks of the Waikato River main stem contributed minimal sediment to the river.

5.1.5 Fish

Nineteen species of native and 13 species of introduced freshwater fish are known to inhabit the Waikato River. Some of these fish species are fished recreationally and commercially and provide an important traditional source of kai for river iwi (NIWA, 2010).

Many fish species travel between headwaters and the sea or large lakes to complete their lifecycles so their survival depends on their ability to move unimpeded through catchment waterways. It is likely that the natural barrier that was once the Maungatautari Falls (now submerged beneath a hydro lake) was a significant barrier to upstream passage of most fish species, although many pre-European observations indicate that small numbers of eels were able to move upstream as far as Huka Falls (David and Speirs, 2010).

There has been a significant reduction in the abundance, diversity and distribution of native fish throughout the central and lower Waikato catchment over time. There are a number of factors which have caused this including (i) impediments to fish passage (e.g. floodgates, dams and perched culverts); (ii) introductions and transfers of introduced species (e.g. koi carp); and (iii) the loss of substantial areas of stream and wetland habitat caused by wetland drainage and clearance of bush-covered catchments for farming (David and Speirs, 2010).

One example of such a decline is the size of the whitebait catch in the lower Waikato River. Within the Waikato, whitebait is comprised of two main species: īnanga and banded kōkopu (with smaller numbers of giant kōkopu). In the 1930s and 1940s the whitebait catch in the Waikato River was estimated at 46 tonnes per year. This had reduced to approximately 10 tonnes per year by the 1980s and in 2000 was only 3 tonnes (NIWA, 2010).

Tuna (eel) consist predominantly of two species – shortfin and longfin. These are regarded as a taonga species to iwi. Not only were they recognised as a staple food, but in some instances they are recognised as taniwha. Tuna is another example of a fishery species in decline. The Waikato River supports New Zealand's most productive tuna fishery but during the last 20 years the numbers of edible-sized tuna have declined with the commercial catch of tuna from the Waikato River reducing by approximately 75 per cent since 1980 (NIWA, 2010).

The central and lower Waikato catchment's rivers and lakes are now home to a number of introduced fish species, including koi carp, brown bullhead catfish and goldfish. These are the three most abundant invasive fish species in the Waikato region and impact waterways in a range of ways including:

- increasing nutrients through excretion
- decreasing water clarity through stirring up of bottom sediment during feeding or selective consumption of large zooplankton, which results in more phytoplankton in the water column
- other modifications to the food-web through predation on other species and competing for food and habitat
- disturbance of submerged macrophytes (plants)

- direct competition with native fish species for food and habitat (Collier and Grainger, 2015).

Koi carp account for up to 70 per cent of the total fish biomass in the lower Waikato River and commonly inhabit slow, turbid water, shallow lakes and wetlands (Hicks et al., 2010). A recent study at Lake Ohinewai indicates that koi carp could be impacting on tuna (eel) populations. The study used a barrier to prevent adult koi carp from entering the lake following large-scale invasive fish removal over a six-month period. Five years later, a follow-up study found that mean weight of both shortfin and longfin eels increased significantly following the removal. The study also found there was an increased proportion of larger eels following the exclusion of koi carp (Tempero and Hicks, 2017).

5.1.6 Biodiversity

The central and lower Waikato catchment is well known for its network of lakes and wetlands. Many of the freshwater wetlands and lakes are important nationally and internationally for a range of factors, including their unique vegetation, nationally threatened and endemic indigenous flora and fauna, game bird populations and ecosystem services (Department of Conservation, 2014).

Freshwater wetlands are often located in areas that have been, and still are, highly desirable for farmland or other activities such as sand extraction. Consequently, many have been drained, converted to pasture and irreversibly altered (Beard, 2010). Wetlands within the Waikato region have reduced in extent by more than 75 per cent over the last 160 years (Leithwick et al., 1995). Drainage in the lower Waikato has led to the direct loss of many small lakes and reduced hydrological connectivity and filtering function of wetlands. Stock access to margins of streams and lakes has contributed to direct habitat disturbance as well as contributing nutrients and sediments (Clayton, 2002). Introduced plants that became weeds (such as yellow flag iris, alligator weed and woolly nightshade) have also been a major contributor to the degradation of native forest and wetland ecosystems (Clayton, 2002).

Wetlands are havens for biodiversity, providing spawning and nursery grounds for fish, and breeding grounds and habitat for a diverse range of birds, reptiles, insects and plants, many of which only occur within wetland habitats. Some 31 species of birds have been recorded as inhabiting the central and lower Waikato wetlands, including Australasian bittern, grey duck, New Zealand dabchick, North Island fernbird and spotless crake (Beard, 2010).

The wetlands and lakes of the lower Waikato are extremely important to Waikato-Tainui with the mauri of wetlands linked to the overall ecological health and wellbeing of their whakapapa. The indigenous plant and animal species found within and around them are valuable cultural resources (Waikato-Tainui, 2013). The massive loss of wetland area has impacted the wellbeing of the people and limited the transfer of knowledge in relation to the uses of wetland flora and fauna species for cultural purposes.

An example of the decline in the extent of wetlands in the central and lower Waikato is observed in lowland kahikatea forest. Historically, this wetland species covered 42,800ha of the catchment. Today only 1.3 per cent remains (GIS analysis undertaken by Waikato Regional Council, Daniel Tait pers.comm.).

Of the remaining lower Waikato wetlands, the Whangamarino Wetland, Opuatia Wetland and the tidally influenced lower portion of the Waikato River (from Rangiriri downstream to Port Waikato) are of particular significance. The Whangamarinfo Wetland is approximately 7200ha in size and is the second largest bog and swamp complex in New Zealand and the largest wetland connected to the Waikato River. This wetland provides habitat for more than 50,000 waterfowl and several rare and endemic bird species (Beard, 2010). It has one of the largest populations of North Island fernbird and is home to approximately 25 per cent of the remaining Australasian bittern population. Plant diversity is also significant at this site with 60 per cent of the 239 species

recorded as being indigenous to New Zealand. Many of these are rare including swamp helmet orchid, which is not known to occur anywhere else, and giant cane rush, known to occur naturally in only three other locations (Beard, 2010).

The Opuatia Wetland is approximately 950ha and contains diverse habitats including a small lake, a river, mineralised margins and surrounding peat bog. It contains several rare and endangered plants and is habitat for several threatened animal species (Beard, 2010).

The 56km stretch of the lower Waikato River from Rangiriri downstream to Port Waikato passes through mineralised swamp areas and swampy islands before entering the diverse delta habitat near Port Waikato. Some of the islands retain significant areas of kahikatea forest and collectively the lower Waikato River islands form an internationally significant wetland complex. The sandspit and tidal flats at Port Waikato are important for migratory wading birds such as dotterel, wrybill and bar-tailed godwit, and support both estuarine and freshwater plants and animals (Beard, 2010).

The report card for the Waikato River gave the section of river below Ngāruawāhia and its tributaries an overall grade of C. This indicates that it delivers on some but not all of the *Vision & Strategy* aspirations for a healthy Waikato River. This reflects that the lower river has diverse native fish (e.g. whitebait and tuna) but pest fish are prevalent and extensive drainage and flood control degrades ecological integrity (Williamson et al., 2016).

5.1.7 Recreation

The central and lower Waikato River is valued for the many recreational activities that occur along its length. It is popular for waka, motor boats, kayaking, rowing, fishing, walking, cycling and swimming when conditions are safe.

The freshwater wetlands and lakes in the catchment provide for a range of recreation opportunities including game bird hunting, walking, wildlife viewing and fishing (angling and bow hunting). However, public access to many sites is limited with permission often required to cross private land. Recreation in and around other catchment waterways is also limited due to access issues or lack of facilities. Improving access to lakes, wetlands and tributary waterways and developing new recreational opportunities such as walking tracks and picnic areas would increase visitor numbers to these areas (Williamson et al., 2016).

5.2 Goals

The following goals were developed by iwi, stakeholders and community representatives for the central/lower Waikato catchment:

Water quality

1. Wetlands are protected, enhanced, created and able to perform their water purification role.
2. The mauri/life supporting capacity of fresh water is protected and restored for aquatic species.
3. Water quality enhancement projects consider aspirations that provide for swimming, fishing, drinking and cultural values.

Erosion and sedimentation

1. Highly erodible land is effectively managed including through native or exotic reforestation and retirement of marginal lands.
2. Sediment inputs to wetlands and waterbodies are reduced by 50 per cent.
3. Riverbank and river island erosion is minimised whilst maintaining the natural character, habitat and cultural values of the river.

Fish

1. Aquatic habitats, including spawning grounds, are protected, enhanced, restored and accessible to native fish.
2. Pest/exotic fish are controlled or eradicated at priority sites.
3. The abundance of native fish, including taonga species, in the catchment is restored and protected.

Biodiversity

1. Wetlands are protected, enhanced and, where feasible, expanded and re-established.
2. Ecosystems, forest fragments and ecological corridors associated with aquatic environments are protected, enhanced and expanded.

Recreation

1. Places that provide for safe recreational activities are identified and accessible.
2. Connections between significant places are provided for.
3. Tribal and community histories proudly inform recreational users.

5.3 Priority projects

Thirty-one projects in the central/lower Waikato catchment scored a favourable cost benefit score and have been included in the *Restoration Strategy*. These are illustrated in Figure 4. Projects are listed in order from lower catchment to upper catchment and their priority ranking is provided in Section 5.3.1. Appendix 5 contains more detailed information on each project including recommended management actions and estimated costs.

Total project value is estimated at almost $116 million. Funding priorities include 690km of riparian/wetland fencing, 385ha of riparian revegetation, stabilising up to 7350ha of LUC class 6e land and 1800ha of LUC class 7 land, and more than 900km fencing of plantings, sidelings, seeps and existing vegetation in hill country. Additionally, remediation of nearly 30 barriers to native fish passage are included.

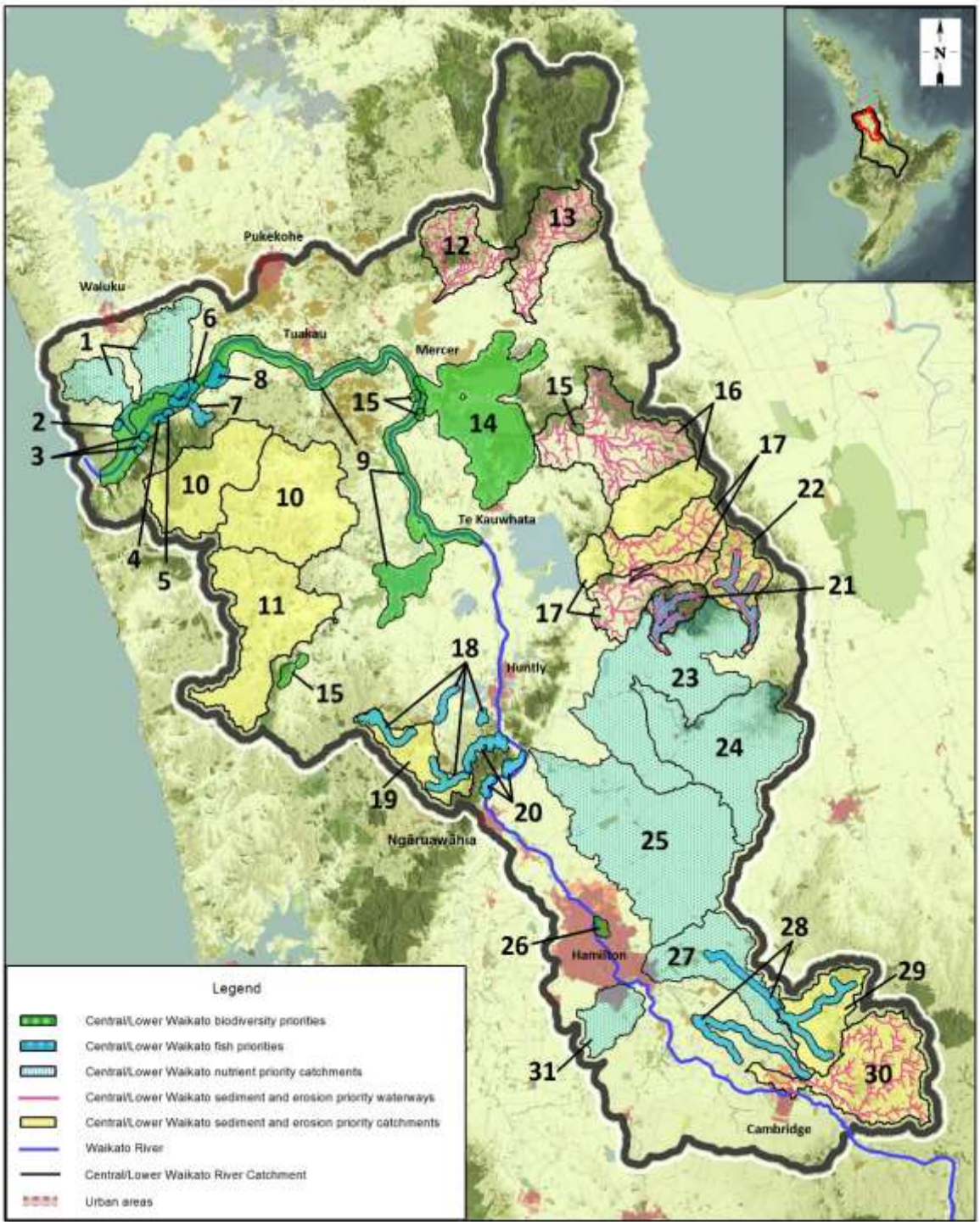


Figure 4. Location of priority projects in the central/lower Waikato catchment

5.3.1 Summary tables of priority projects

CLW 1	Water quality improvement in the Aka Aka catchment	High priority

Location: Wetlands greater than 0.1ha and ephemeral streams within the Aka Aka catchment.

Summary of priority works

- Fencing wetlands and ephemeral streams (55km)
- Project management/staffing/incidentals (25%)

Total estimated cost: $550,000

CLW 2	Īnanga spawning habitat rehabilitation – Hills Drain	High priority

Location: A 2ha section of streambank adjacent to Hills Drain at the end of Fisherman Road, on the northern bank of the Waikato River near Otaua.

Summary of priority works

- Develop restoration plan
- Fencing (640m)
- Weed control
- Native planting (50% of site at 0.75m spacing)
- Project management/staffing/incidentals (15%)

Total estimated cost: $179,458

CLW 3	Īnanga spawning habitat rehabilitation – Tūākau Bridge-Port Waikato Road: Site 3	High priority

Location: Two unnamed tributary streams feeding into the true left of the lower Waikato River near Port Waikato.

Summary of priority works

- Develop restoration plan
- Fencing (1,140m)
- Weed control
- Native planting
- Project management/staffing/incidentals (20%)

Total estimated cost: $211,977

CLW 4	Īnanga spawning habitat rehabilitation – Tūākau Bridge-Port Waikato Road: Site 2	High priority

Location: A 750m long section of an unnamed tributary stream and associated wetland along the true left margin of the lower Waikato near Te Kohanga.

Summary of priority works

- Develop restoration plan
- Fencing (670m)
- Weed control
- Native planting (60% of site at 0.75m spacing)
- Project management/staffing/incidentals (20%)

Total estimated cost: $842,270

CLW 5	Īnanga spawning habitat rehabilitation – Tūākau Bridge-Port Waikato Road: Site 1	Medium priority

Location: A 2.1ha section of stream bank consisting of one unnamed tributary stream entering the true left margin of the Waikato River near Port Waikato.

Summary of priority works

- Develop restoration plan
- Fencing (350m)
- Weed control
- Native planting (50% of site at 0.75m spacing)
- Project management/staffing/incidentals (20%)

Total estimated cost: $188,096

CLW 6	Īnanga spawning habitat rehabilitation – island adjacent to Mawhitiwhiti Road	High priority

Location: A 188ha area of island adjacent to Mawhitiwhiti Road along the true right margin of the Waikato River near Aka Aka.

Summary of priority works

- Develop restoration plan
- Native planting over 60% of a 94ha area (at 0.75m spacing)
- Weed control
- Project management/staffing/incidentals (20%)

Total estimated cost: $8,863,878

CLW 7	Fish habitat rehabilitation on Whauwhautahi Stream	Very high priority

Location: Whauwhautahi Stream (a short stream approximately 5km long), flowing from hill country near Te Kohanga under Tūākau Bridge, Port Waikato Road and into the Waikato River near Motutieke Island.

Summary of priority works

- Fencing (10km)
- Planting (10ha)
- Weed control
- Investigation and remediation of fish barriers
- Project management/staffing/incidentals (20%)

Total estimated cost: $440,122

CLW 8	Īnanga spawning habitat rehabilitation – wetland opposite Elbow Hill	High priority

Location: A 140ha wetland along the true left margin of the lower Waikato River at the end of Kohanga Store Road, Te Kohanga.

Summary of priority works

- Develop restoration plan
- Fencing (4km)
- Weed control
- Native planting (60% of site at 0.75m spacing)
- Project management/staffing/incidentals (20%)

Total estimated cost: $13,799,040

CLW 9	Increased control of yellow flag iris and alligator weed within the lower Waikato river catchment	Very high priority

Location: Waikato River between Rangiriri and Port Waikato, Lake Whangape and Opuatia Wetland.

Summary of priority works

- Ground and water based herbicide control of yellow flag iris and alligator weed
- Project management/staffing/incidentals (20%)

Total estimated cost: $842,400

CLW 10	Upper and middle Opuatia catchment hill country erosion protection and remediation	Medium priority

Location: Upper and middle Opuatia catchments. This part of the catchment is 18,251ha in size and extends from the Port Waikato Hills (Klondyke Road) southeast to where SH22 crosses the Opuatia Stream.

Summary of priority works

- 1259ha LUC 6e land managed with pole planting
- 1259ha LUC 6e land managed with plantation species (pine or mānuka)
- Fencing managed LUC 6e land (225km)
- 319ha LUC 7 land managed with plantation species
- Fencing managed LUC 7 land (36km)
- Reducing sediment outside LUC 6e, 7 and 8 land (8ha)
- Fencing existing indigenous vegetation (54km)
- Goat control on treated 6e and 7 land
- Project management/staffing/incidentals (30%)

Total estimated cost: $21,550,340

CLW 11	Naike catchment hill country erosion protection and remediation	High priority

Location: Naike catchment – a 10,608ha catchment that extends from the west at the lower Waikato catchment divide and in the north at Matakitaki Road and travels east down to where the Maire Stream crosses under SH22 and becomes the Awaroa Stream.

Summary of priority works

- 730ha LUC 6e land managed with pole planting
- 730ha LUC 6e land managed with plantation species (pine or mānuka)
- Fencing managed LUC 6e land (133km)
- 392ha LUC 7 land managed with plantation species
- Fencing managed LUC 7 land (47km)
- Reducing erosion outside LUC 6e, 7 and 8 (3ha) land
- Fencing existing indigenous vegetation (38km)
- Goat control on treated 6e and 7 land
- Project management/staffing/incidentals (30%)

Total estimated cost: $14,437,654

CLW 12	Middle Mangatawhiri Stream erosion protection and remediation	Very high priority

Location: This 4305ha section of the Mangatawhiri catchment extends from the DOC reserve boundary in the headwaters, southwest and down to where the stream becomes stop banked.

Summary of priority works

- Riparian fencing (27km)
- Riparian willow/poplar pole planting (2369 poles)
- Native riparian planting (10ha)
- Erosion control structures
- Project management/staffing/incidentals (20%)

Total estimated cost: $776,619

CLW 13	Northern Mangatangi Stream erosion protection and remediation	Very high priority

Location: The 5200ha northern Mangatangi catchment extends southwest from the DOC reserve on the southern side of the Hunua Ranges at Workman Road to the Maramarua River at SH2.

Summary of priority works

- Riparian fencing (37km)
- Riparian willow/poplar pole planting (3325 poles)
- Native riparian planting (14ha)
- Erosion control structures
- Project management/staffing/incidentals (20%)

Total estimated cost: $1,101,931

CLW 14	Biodiversity enhancement of Whangamarino wetland	High priority
•	Location: Whangamarino wetland – a 7290ha wetland located between Meremere and Te Kauwhata. Summary of priority works • Fencing (35km) • Native planting (25ha) • Project management/staffing/incidentals (20%) Total estimated cost: $1,840,560	

CLW 15	Biodiversity enhancement of selected lowland forest fragments with strong connections to waterways	High priority

Location: Three forest fragments ranging in size from 0.5 to 36ha as follows:

- a cluster of kahikatea remnants near Meremere located in close proximity to each other (45ha in total)
- two neighbouring kahikatea remnants at Naike (16ha)
- kahikatea remnants at the end of Jefferis Road, Waerenga (6ha).

Summary of priority works

- Fencing (13.5km)
- Native planting (4ha)
- Weed control
- Possum control
- Project management/staffing/incidentals (20%)

Total estimated cost: $476,050

CLW 16	Waerenga catchment hill country and stream bank erosion protection and remediation	High priority

Location: Waerenga catchment – a 13,672ha catchment originating in the northern Hapuakohe Range. The main waterway is the Waerenga Stream, which extends northwest down the catchment and joins the Whangamarino River at Jefferis Road. The Taniwha Stream lies on the western boundary of the catchment and is a tributary to the Waerenga.

Summary of priority works

- 287ha LUC 6e land managed with pole planting
- 287ha LUC 6e land managed with plantation species (pine or mānuka)
- Fencing managed LUC 6e land (50km)
- Fencing existing indigenous vegetation (13km)
- Riparian fencing (101km)
- Riparian willow/poplar pole planting (7466 poles)
- Native riparian planting (38ha)
- Erosion control structures
- Project management/staffing/incidentals (30%)

Total estimated cost: $7,459,261

CLW 17	Matahuru catchment hill country and streambank erosion protection and remediation	High priority

Location: Matahuru catchment and selected tributaries to Lake Waikare. The total area of these catchments is approximately 9971ha.

Summary of priority works

- 452ha LUC 6e land managed with pole planting
- 452ha LUC 6e land managed with plantation species (pine or mānuka)
- Fencing managed LUC 6e land (76km)
- 655ha LUC 7 land managed with plantation species
- Fencing managed LUC 7 land (51km)
- Erosion control outside LUC 6e, 7 and 8 land (12ha)
- Fencing existing indigenous vegetation (18km)
- Riparian fencing (120km)
- Riparian willow/poplar pole planting (12,436 poles)
- Native riparian planting (44ha)
- Erosion control structures
- Project management/staffing/incidentals (30%)

Total estimated cost: $15,319,709

CLW 18	Rehabilitation of banded kōkopu habitat on selected inflows to Lake Puketirini and Lake Waahi	High priority

Location: Selected inflows to Lake Puketirini and Lake Waahi:

- Awaroa Stream from Waikokowai Road (near Rotowaro Coal Mine) to Lake Waahi (4.5km).
- Waitawhara Stream: flowing from rugged hill country southwest of Lake Waahi, it then flows alongside Rotowaro Road to join Awaroa Stream near Rotowaro Coal Mine.
- Mangakotukutuku Stream: flowing from Hakarimata Ranges downstream for approximately 2km where it enters the Rotowaro Mine site.
- 4.5km length of an unnamed tributary to Lake Puketirini immediately west of Hillside Heights Road and flowing under Rotowaro Road to Lake Puketirini.

Summary of priority works

- Fencing (23km)
- Native planting (6ha)
- Weed control
- Remediation of fish barriers
- Project management/staffing/incidentals (25%)

Total estimated cost: $653,640

CLW 19	Upper Awaroa (Waahi) catchment hill country erosion protection and remediation	High priority

Location: Upper Awaroa catchment in the headwaters above Lake Waahi – a 3536ha area extending from the west at the lower Waikato catchment divide northeast down to the confluence with Te Wha Stream.

Summary of priority works

- 153ha LUC 6e land managed with pole planting
- 153ha LUC 6e land managed with plantation species (pine or mānuka)
- Fencing managed LUC 6e land (29km)
- Goat control on treated 6e and 7 land
- Erosion control outside LUC 6e, 7 and 8 land (7ha)
- Fencing existing indigenous vegetation (6km)
- Project management/staffing/incidentals (25%)

Total estimated cost: $2,329,610

CLW 20	Rehabilitate fish habitat in streams flowing from Hakarimata Range to the Waikato River	Very high priority

Location: A selection of mostly short streams flowing from the steep forested headwaters of the Hakarimata Range to the Waikato River.

Summary of priority works

- Fencing (18km)
- Planting (8.5ha)
- Remediation of barriers to native fish
- Project management/staffing/incidentals (25%)

Total estimated cost: $616,490

CLW 21	Mangatea Stream integrated catchment programme	Medium priority

Location: Mangatea catchment – a 2086ha catchment extending from the west of the Hapuakohe summit downstream to its confluence with the Mangawara River.

Summary of priority works

- Riparian fencing (13km)
- Riparian willow/poplar pole planting (1200 poles)
- Native riparian planting (5ha)
- Erosion control structures
- Remediation of barriers to native fish
- Project management/staffing/incidentals (20%)

Total estimated cost: $526,276

CLW 22	Upper Mangawara integrated catchment programme	Medium priority

Location: The upper Mangawara catchment – a 2086ha area lying at the southern end of the Hapuakohe Range and along the eastern boundary of the lower Waikato catchment. The upper catchment is estimated to have an approximately 50km stream network including the Mangawara Stream itself.

Summary of priority works

- 124ha LUC 6e land managed with pole planting
- 124ha LUC 6e land managed with plantation species (pine or mānuka)
- Fencing managed LUC 6e land (30km)
- 145ha LUC 7 land managed with plantation species
- Fencing managed LUC 7 land (20km)
- Reducing sediment outside LUC 6e, 7 and 8 land (4ha)
- Fencing existing indigenous vegetation (17km)
- Riparian fencing (17km)
- Riparian willow/polar pole planting (1478 poles)
- Native riparian planting (6ha)
- Erosion control structures
- Remediation of fish barriers
- Project management/staffing/incidentals (30%)

Total estimated cost: $4,319,905

CLW 23	Water quality improvement in the middle Mangawara catchment	Very high priority

Location: Wetlands and ephemeral streams in the middle Mangawara catchment. The middle Mangawara Stream catchment covers 14,219ha and drains the Mangatea, upper Mangawara and Tauhei catchments.

Summary of priority works

- Fencing wetlands and ephemeral streams (11km)
- Project management/staffing/incidentals (25%)

Total estimated cost: $110,000

CLW 24	Water quality improvement in the Tauhei catchment	High priority

Location: Wetlands and ephemeral streams within the Tauhei catchment. The Tauhei catchment extends over 11,600ha from west of Morrinsville and drains into the Mangawara Stream at Orini.

Summary of priority works

- Fencing wetlands and ephemeral streams (8km)
- Project management/staffing/incidentals (25%)

Total estimated cost: $80,000

CLW 25	Water quality improvement in the Komakorau and Mangatoketoke catchments	High priority

Location: Wetlands and ephemeral streams within the Komakorau and Mangatoketoke catchments. This large catchment covering 19,143ha lies to the east of Hamilton and Ngāruawāhia with streams entering the Waikato River at Taupiri.

Summary of priority works

- Fencing wetlands and ephemeral streams (44km)
- Project management/staffing/incidentals (25%)

Total estimated cost: $440,000

CLW 26	Biodiversity enhancement of Kukutāruhe Stream and associated gully ecosystem	Medium priority

Location: Kukutāruhe Stream and associated 23ha gully ecosystem (from Fairfield College to the Waikato River).

Summary of priority works

- Develop a restoration plan
- Walkway construction
- Development and installation of signage
- Weed control
- Native revegetation
- Remediation of fish barriers
- Possum control
- Project management/staffing/incidentals (30%)

Total estimated cost: $775,973

CLW 27	Water quality improvement in the lower Mangaonua Stream catchment	Very high priority

Location: Wetlands and ephemeral streams in the lower Mangaonua Stream catchment. The Mangaonua is an 11,346ha catchment that lies to the southeast of Hamilton city. The lower catchment makes up 6615ha of this.

Summary of priority works

- Fencing wetlands and ephemeral streams (23km)
- Project management/staffing/incidentals (25%)

Total estimated cost: $230,000

CLW 28	Rehabilitation of fish habitat in the Mangaonua, Mangaone and Mangaomapu Streams	Medium priority

Location: Mangaonua, Mangaone and Mangaomapu Streams:

- Mangaonua Stream upstream of State Highway 1B near Matangi (approximately 22km) and a 7km tributary.
- Mangaomapu Stream between Racecourse Road (near Cambridge), downstream to its confluence with Mangaone Stream – approximately 7km in length.
- Mangaone Stream from its headwaters near St Kilder, Cambridge, to the confluence with Mangaomapu Stream near Tamahere.

Summary of priority works

- Riparian fencing (68km)
- Riparian planting (93ha)
- Remediation of fish barriers
- Resource consent
- Project management/staffing/incidentals (30%)

Total estimated cost: $2,663,086

CLW 29	Upper Mangaonua catchment hill country erosion protection and remediation	Medium priority

Location: The upper Mangaonua catchment – an 11,346ha catchment that lies to the southeast of Hamilton city, containing the Pukemoremore and Te Miro areas.

Summary of priority works

- 210ha LUC 6e managed with pole planting
- 210ha LUC 6e managed with plantation species (pine or mānuka)
- Fencing managed LUC 6e land (40km)
- Fencing existing indigenous vegetation (13km)
- Project management/staffing/incidentals (25%)

Total estimated cost: $3,231,250

CLW 30	Karāpiro catchment hill country and stream bank erosion protection and remediation	Medium priority

Location: Karāpiro catchment – an 8920ha catchment containing a 150km stream network. The headwaters arise southeast of Cambridge in the vicinity of Whitehall and the catchment extends northward toward Te Miro.

Summary of priority works

- 460ha LUC 6e land managed with pole planting
- 460ha LUC 6e land managed with plantation species (pine or mānuka)
- Fencing managed LUC 6e land (80km)
- 303ha LUC 7 land managed with plantation species
- Fencing managed LUC 7 land (40km)
- Reducing sediment outside LUC 6e, 7 and 8 land (4ha)
- Fencing existing indigenous vegetation (20km)
- Riparian fencing (52km)
- Riparian willow/poplar pole planting (5528 poles)
- Native riparian planting (19ha)
- Stream erosion protection structures
- Project management/staffing/incidentals (30%)

Total estimated cost: $10,982,146

CLW 31	Water quality improvement in the Mangakotukutuku catchment	Medium priority

Location: Wetlands and ephemeral streams in the lower Mangakotukutuku Stream catchment. The 2644ha Mangakotukutuku catchment lies to the south of Hamilton city, originating in agricultural land before entering the suburbs of Glenview, Bader, Melville, Sunnyhills and Fitzroy.

Summary of priority works

- Fencing wetlands and ephemeral streams (6km)
- Project management/staffing/incidentals (25%)

Total estimated cost: $60,000

6 Upper Waikato

6.1 Current state and pressures

6.1.1 Introduction

The upper Waikato River catchment covers an area of 436,000ha and extends from the Kaingaroa Plateau in the east to the Pureora and Rangitoto ranges in the west. It includes the eight hydro dams and lakes of Aratiatia, Ohakuri, Ātiamuri, Whakamaru, Maraetai, Waipapa, Arapuni and Karāpiro (Waikato Regional Council, 2014b). These were constructed between 1929 and 1964.

Much of the area is characterised by erosion prone soils including Taupō pumice, which makes up 68 per cent of the land area. The remainder is made up of other volcanic materials, including tephra and muds from the Rotorua Volcanic Centre. The catchment has a strong forestry and pastoral farming economy and in recent years there has been a marked increase in dairy conversions and intensification. Energy production (hydroelectricity and geothermal) is also a strong economic driver in the catchment (Waikato Regional Council, 2014b).

6.1.2 Cultural importance

The upper Waikato River and its catchment are of immense cultural, historical, traditional and spiritual significance to the people of Waikato-Tainui (Ngāti Koroki-Kahukura, Ngāti Hauā), Raukawa, the Te Arawa river iwi affiliates (Ngāti Tahu-Ngāti Whaoa, Ngāti Kearoa-Ngāti Tuarā and Tuhourangi-Ngāti Wāhiao) and Ngāti Tūwharetoa, who have lived along its banks for many centuries.

Tangata whenua historically used the river (and nearby wetlands) for spiritual and material needs, sustenance, a source of cleansing and healing, and a network for trade, travel and communication. The river was also an abundant source of food such as tuna (eel), kanae (mullet), porohe (smelt), īnanga (whitebait), kōura (freshwater crayfish) and watercress.

The upper Waikato River holds many stories of battles, romance, exploration and spiritual encounters. The relationship between iwi and its waters cannot be underestimated or described with as much reverence and passion as by the kaumatua and kuia of each iwi. The relationship is well referenced in oratory occasions every day, waiata (songs) sung by tamariki (children) and in karakia (prayer).

To iwi, the biggest impacts include that of the hydro dams, which have altered the relationship of iwi with the Waikato River. The direct impact of the hydro dams in the upper Waikato was immediate and created cultural impacts by severing the 'veins' of the river, altering the natural flow of its waters and impacting migration of tuna where natural barriers had not previously existed. Other catchment development issues, including clearance of native vegetation and other land use changes, have affected access of iwi to the river, degraded water quality, desecrated sites of significance and greatly impacted taonga fisheries (Collier et al., 2010; Ngati Tahu-Ngati Whaoa Runanga Trust, 2013; Raukawa Charitable Trust, 2015).

6.1.3 Water quality

Water quality monitoring of the tributaries to the upper Waikato River show considerable spatial and temporal variability across the catchment. Although having elevated nitrogen and phosphorus levels some or all of the time, upper catchment streams such as the Pueto, Torepatutahi and Wai-O-Tapu are all considered safe for swimming. In contrast, further down the catchment, streams such as the Mangaharakeke and Tahunātara are not currently safe for swimming due to high levels of *E. coli* (Waikato Regional Council, 2017c).

Relative to the lower reaches of the Waikato River, water quality in the main stem of the upper Waikato catchment is still generally of high quality. Using data from 2007, the Ministry for the Environment ranked 77 sites in NIWA's National River Water Quality Network to assess water quality state. When the nutrients nitrate, total nitrogen, dissolved reactive phosphorus and total phosphorus were combined, the Waikato River near Taupō ranked sixth highest nationally compared to other large New Zealand rivers. In contrast, monitoring locations further downstream at Hamilton city ranked sixtieth out of 77 sites nationally (NIWA, 2010).

Water quality in the assessed tributaries of the Waikato River between Huka Falls and Ohakuri were recently given an overall C grade by the Waikato River Authority Report Card, indicating that only some of the *Vision & Strategy* aspirations for water quality are currently being met. The main stem of the Waikato River for the same section was given an A- grade, indicating that it is close to delivering in full on the *Vision & Strategy* aspirations for water quality in the river (Williamson et al., 2016).

Further downstream, tributaries entering the river between Ohakuri and Karāpiro were given an overall report card grade of C- for water quality. The main stem of the Waikato River in this section was given a B grade, reflecting moderate water quality conditions and a decline relative to upstream (Williamson et al., 2016).

Visual water clarity also declines as water travels down river. Between 2012 and 2016, clarity in the river was excellent when it left Lake Taupō, decreased significantly between Lake Taupō and Ohāki, then declined gradually in the lower part of the river (Waikato Regional Council, 2017b: Figure 5).

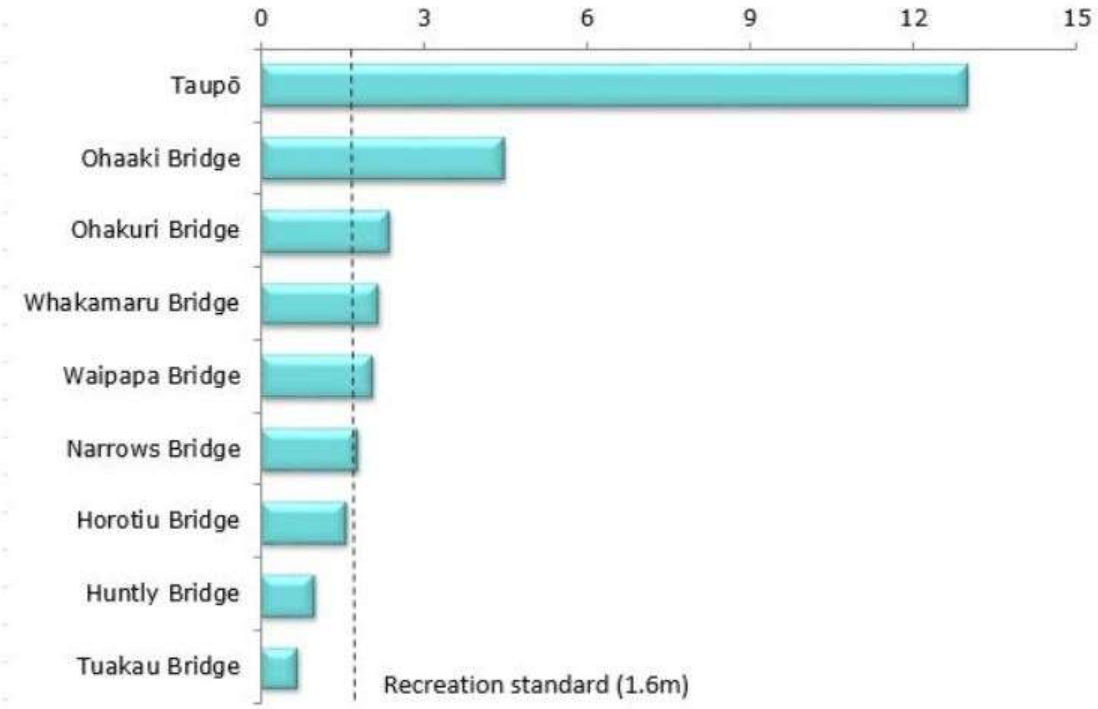


Figure 5. Median visual water clarity in the Waikato River (2012-16)

Note that the section from Taupō to Waipapa falls within the upper Waikato section of the *Vision & Strategy*, whereas the Narrows to Taukau sections fall within the central/lower Waikato sections. The dotted line represents the minimum regional council standard for contact recreation. Source: Waikato Regional Council, 2017b

Prior to the development of the hydro dams, water flowed from Lake Taupō to the sea within approximately six days, whereas it now takes several weeks. The increased retention time of water within hydro lakes contributes to the growth of algal cells (called phytoplankton), especially during the summer. Phytoplankton makes the water appear greener and reduces its visual clarity (Waikato Regional Council, 2017b).

The majority of nutrient and sediment inputs into the upper Waikato River come from diffuse sources (e.g. land run off). Changes in land use in the upper Waikato, particularly the change from forestry to pastoral farming, have contributed to the downward trend in water quality indicators for this area (Waikato Regional Council, 2014b). The geothermal nature of this catchment (for example, Wai-O-Tapu Stream) is also a natural contributor to the reduction in quality as the river travels from its relatively pristine upper reaches to the lower receiving waters, contributing to heavy metal loading as well as elevated water temperatures in small tributaries (Waikato Regional Council, 2014b).

6.1.4 Erosion and sedimentation

Much of the upper Waikato catchment is characterised by young, soft and loose soils made up of Taupō pumice and other volcanic materials that are prone to erosion. The catchment contains many short steep catchments that are prone to heavy rainfall events which exacerbate erosion and soil loss and this has led to widespread sedimentation in upper catchment (Waikato Regional Council, 2014b).

Gully erosion has historically been the biggest erosion issue in the upper Waikato catchment, with land conversion from native forestry to pasture causing significant increases in sediment loads (Hicks and Hill, 2010). Large soil conservation schemes established in the 1970s and 1980s addressed much of the issue at that time. However, new conversion from exotic forestry to pasture in the last decade, and the associated recontouring of this land, has increased the risk of new gullies developing following high rainfall events (Palmer et al., 2015). In areas of extensive conversion, significant erosion processes such as rilling are being observed. Steep slopes within these areas are especially vulnerable to further erosion under pasture cover (Palmer et al., 2015) and major soil erosion issues are now emerging.

The Waikato Regional Council's *Upper Waikato Zone Plan* (2014b) identifies the following as key erosion and sedimentation issues for the catchment:

- stock access to waterways
- management of steep land
- conversion of pine to pasture, particularly on LUC class 6-8 soils
- loss of small seeps and wet areas adjacent to streams
- declining effectiveness of historic soil conservation works on private land.

6.1.5 Fish

Prior to the damming of the upper Waikato River for hydropower generation, the river was rough and turbulent. There were numerous rapids between Huka Falls and Karāpiro Dam which prevented many fish species from accessing the upper parts of the river. Only species with a strong swimming ability could navigate the rapids and occupy the upper reaches. Other species found upstream of the rapids were those that do not have a marine phase (and have no need to navigate past the dams) and those that were transferred by Māori and Pākehā (Te Arawa River Iwi Trust, 2015a).

Native fish species presently recorded in the upper Waikato River and tributaries include kōaro, kōkopu, piharau, pōrohe (smelt), common bully, Cran's bully and tuna (eel), although tuna are dependent on catch and transfer past the Karāpiro Dam. Introduced species recorded include brown and rainbow trout, brook char, brown bullhead catfish, rudd, gambusia and guppy (Te Arawa River Iwi Trust, 2015). Rainbow and brown trout were introduced into New Zealand between the mid to late 1800s. Following their introduction to the Waikato River catchment, many native taonga fish in the upper river became scarce. This has been attributed to the predatory nature of the trout (Te Arawa River Iwi Trust, 2015a).

Kōura are also found within the upper Waikato catchment and were once common in tributary streams as well as the main stem of the Waikato River and hydro lakes. Like many of the fish species, they are important traditional kai species for local iwi. The species has experienced a major decline in abundance (Clearwater et al., 2014; Hawes et al., 1999) and although little is known about the reasons for this decline (NIWA, 2010), eel predation as the result of the trap and transfer programme may be an important contributor among other factors (Clearwater et al., 2014; Hawes et al., 1999). This programme involves the transfer of elvers into parts of the river where they may not have been present in such numbers historically (Ngati Tahu-Ngati Whaoa Runanga Trust pers. comm., 2017).

Ngati Tahu-Ngati Whaoa iwi members have reported a decline in kai availability from local waterways over time. In particular tuna, kōura and kākahi are now more difficult to find in their rivers and tributaries. They also report that the size and abundance of longfin and shortfin tuna has reduced in recent years (Ngati Tahu-Ngati Whaoa, 2013). Longfin tuna are now listed as a declining species in the Department of Conservation Threat Classification System (Goodman et al., 2014). Kōura are listed as at risk-declining (Grainger et al., 2014).

Loss of habitat is a significant threat to native fish populations and can be caused by a range of factors both within waterways and on adjacent land. Such factors include drainage of wetlands, clearance of riparian vegetation, physical modification of waterways, pest plant invasion and land use that impacts on water quality (Raukawa Charitable Trust, 2012). The Te Arawa River Iwi Trust Fisheries Plan (2015a) also mentions heavy metals, pest fish and fluctuations in river levels as potential contributors to declining numbers of native fish.

6.1.6 Biodiversity

Most of New Zealand's geothermal systems are located within the upper Waikato (and Taupō) areas and have unique ecosystems and ecological features associated with them (Ngati Tahu-Ngati Whaoa Runanga Trust, 2013). Examples include Te Kopia reserve, which comprises 10 per cent of the remaining geothermal vegetation present in the Waikato Region, and Lake Rotokawa, which is a site of national significance due to its nationally uncommon habitat types including fumaroles, geothermally heated dry ground, geothermal stream margins and a wetland on the lake shore (Ngati Tahu-Ngati Whaoa Runanga Trust, 2013).

Many geothermal ecosystems and associated surface features have been lost or damaged as a result of track building, stock damage, draining of geothermal springs, wetlands and seeps, plantation forestry operations and extraction of geothermal fluids. A number of the remaining geothermal features are still under threat (Waikato Regional Council, 2014b).

Conversions from forestry to pasture have placed pressure on indigenous fauna and many tributary streams have been converted from shaded channels to open channels and exposed to higher light levels, resulting in warmer water and increased aquatic plant growth (Waikato Regional Council, 2014b). Within the upper Waikato catchment, large remnants of native vegetation now only exist within the Pureora Forest Park and Maungatautari Ecological Island (Waikato Regional Council, 2014b).

Ngati Tahu-Ngati Whaoa (2013) iwi recall that in the past there was an abundance of native flora and fauna within their rohe with ti kouka, mānuka, flax and raupō being very common plants and podocarp forest being widespread. Along the river wetland, plants and animals were common and there were many geothermally active areas where geothermal vegetation could be found.

The Waikato Regional Council's *Upper Waikato Zone Plan* (2014b) identifies several key issues associated with biodiversity loss in the catchment, including:

- reduction, fragmentation and isolation of indigenous ecosystems and habitats
- loss of corridors or connections linking indigenous ecosystems and habitats
- loss or disruption to migratory pathways in water, land or air
- effects of changes to water flows, levels and quality on ecosystems
- an increased threat from animal and plant pests.

The report card for the Waikato River gave the section of river between Huka Falls and Karāpiro an overall grade of C+ for ecological integrity, indicating that with regards to ecological health it delivers on only some of the *Vision & Strategy* aspirations for a healthy river (Williamson et al., 2016). In particular, this part of the river scored lower on aspects relating to fish passage, invasive aquatic plants and wetland buffers.

6.1.7 Recreation

Access to the Waikato River within the section between Huka Falls and Ohakuri is difficult due to the incised and fast flowing nature of the river. However, between Ohakuri and Karāpiro there are extensive bike trails, reserves, beaches and boat ramps. The hydro lakes are popular for fishing, boating and other watersports and Lake Karāpiro is a world-renowned rowing venue (Williamson et al., 2016), although aquatic weeds such as hornwort require ongoing management (Hofstra and de Winton, 2016).

Overuse at some of these spots is becoming an issue especially during the warmer months and there is potential to provide further recreational opportunities and facilities to meet the growing demand (Williamson et al., 2016).

Within the tributaries of the upper catchment there are some areas that are popular for fishing and picnicking. However, access to these areas is thought to be declining due to access restrictions associated with land use change, presence of vegetation growth in riparian areas and health and safety issues (Williamson et al., 2016).

6.2 Goals

The following goals were developed by iwi, stakeholders and community representatives for the upper Waikato catchment:

Water quality

1. Water quality across the upper Waikato has improved, and areas where fresh water allows the taking of food, swimming and recreation are more widespread.
2. Significant 'hotspots' (e.g. sub-catchments or tributaries) have been identified and targeted cleanup activity progressed.
3. Freshwater quality enables habitats for indigenous plants and animals to thrive.
4. Constructed wetlands are created to reduce sub-catchment sediment and nitrogen discharges.

Fish

1. The fisheries of the upper Waikato and their habitats are valued, enhanced and protected to enable long term sustainable use.
2. Collaborative education and research opportunities increase knowledge and understanding of fisheries in the upper Waikato.

Erosion and sedimentation

1. Erosion from land and sedimentation to water is reduced, with an emphasis on full retirement and revegetation of steep (LUC class 7, 8) land and gully heads.
2. Education, farm planning and capacity building programmes assist communities in reducing erosion in the upper Waikato.

Sustainable land management

1. Land and water management is integrated and undertaken at a sub-catchment level.
2. Education and innovation underpins best practice riparian and wetland management.

Biodiversity

1. Ecological networks include the full range of freshwater and terrestrial ecosystem types found throughout the upper Waikato catchment, are in a healthy functioning state and support representative native flora and fauna.
2. An active and engaged community is involved in biodiversity protection, enhancement and restoration work including the incorporation of mātauranga Māori practices.
3. Existing wetlands are protected and enhanced and new wetland habitat is created in appropriate locations.

Social and recreational

1. Rivers and waterways are widely used by the community and are a place to relax, play, exercise, recreate and gather kai.
2. Aquatic and riparian pest species are controlled/eradicated.
3. River restoration activities enhance the economic wellbeing of the upper Waikato.

6.3 Priority projects

Thirty-two projects in the upper Waikato catchment scored a favourable cost-benefit score and have been include in the *Restoration Strategy*. These are illustrated in Figure 6. Projects are listed in order from lower to upper catchment and their priority ranking is provided in Section 6.3.1. Appendix 6 contains more detailed information on each project including recommended management actions and estimated costs.

Total project value is estimated at almost $53.5 million. Funding priorities include 990km of riparian/wetland fencing, 270ha of riparian revegetation, stabilising and fencing (where required) up to 1950ha of LUC class 6e land and 2100ha of LUC class 7 land, four new walkways/public access areas and a tuna transfer programme.

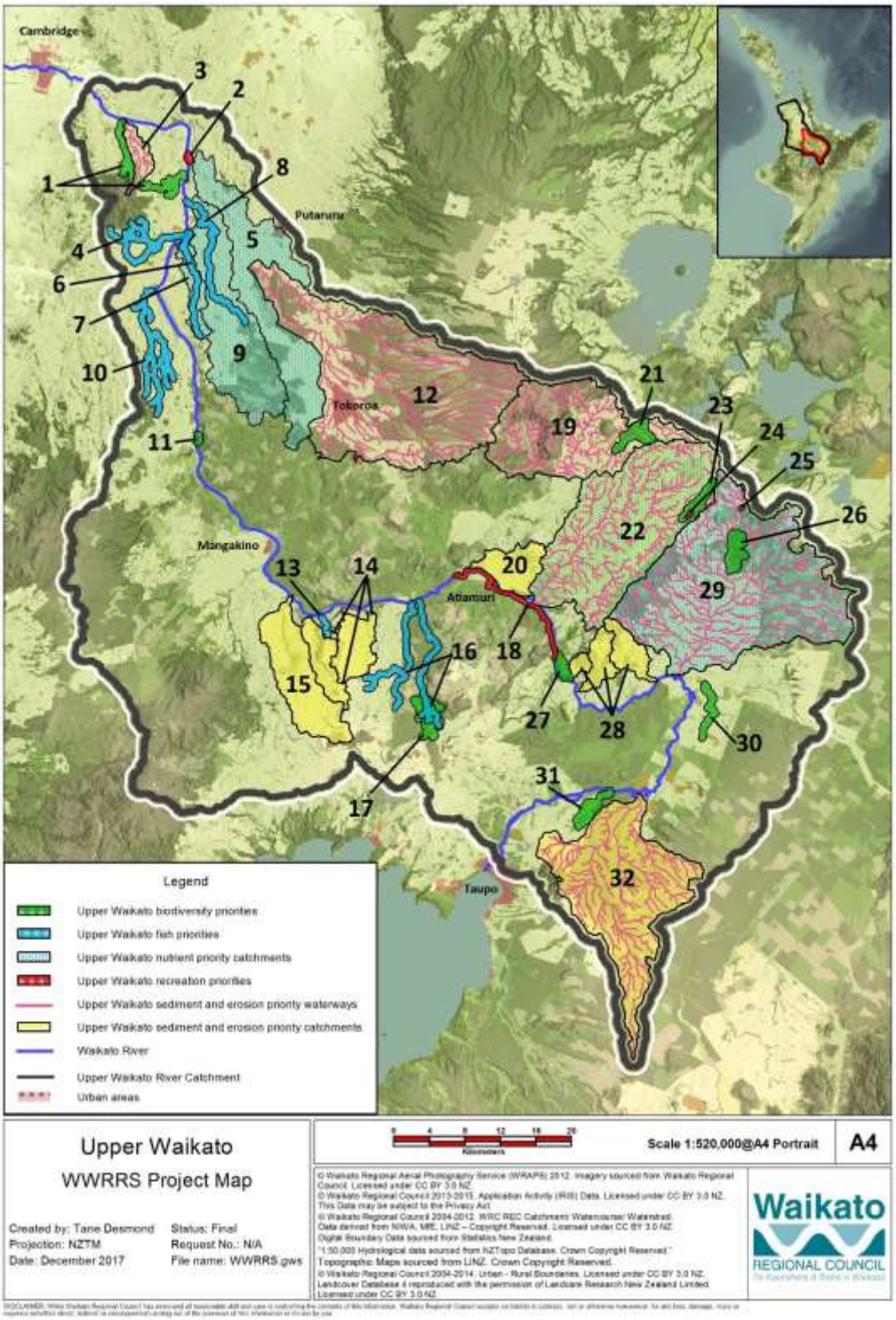


Figure 6. Location of priority projects in the upper Waikato catchment

6.3.1 Summary tables of priority projects

UW 1	Riparian management along selected tributaries flowing from Maungatautari into Lake Karāpiro	Medium priority

Location: Two stream networks (totalling 23km) including Wairakau Stream and an unnamed tributary to Lake Karāpiro directly upstream of Finlay Park camp.

Summary of priority works

- Riparian fencing (37km)
- Revegetation (18.5ha)
- Possum control
- Project management/staffing/incidentals (25%)

Total estimated cost: $1,252,265

UW 2	Development of Aniwaniwa Reserve (Lake Karāpiro)	High priority

Location: Waikato River at Lake Karāpiro.

Summary of priority works

- Cultural history assessment
- Install vault toilet
- Install park furniture
- Construct car park and road access
- Earthworks and development of camping area
- Boat ramp development
- Native planting and landscaping
- Creation and installation of interpretation panels/plaza area
- Project management/staffing/incidentals (20%)

Total estimated cost: $481,200

UW 3	Waione Stream erosion protection and riparian enhancement	High priority

Location: Waione Stream – this stream rises on the northern flank of Maungatautari and flows north-northeast to Lake Karāpiro.

Summary of priority works

- Riparian fencing (10km)
- Riparian willow/poplar pole planting (260 poles)
- Native riparian planting (3ha)
- Project management/staffing/incidentals (25%)

Total estimated cost: $235,933

UW 4	Fish habitat rehabilitation within Waiteti Stream catchment, Arapuni	High priority

Location: Waiteti Stream catchment – a 27km long network consisting of streams flowing from headwaters on Maungatautari mountain to the Waikato River immediately downstream of Arapuni Dam. The network of streams include Te Umutawa Stream and Otautora Stream, which enter Waiteti Stream and flow into the Waikato River.

Summary of priority works

- Fencing (26km)
- Planting (13ha)
- Project management/staffing/incidentals (25%)

Total estimated cost: $902,720

UW 5	Water quality improvement in the Lower Pokaiwhenua catchment	High priority

Location: Lower Pokaiwhenua catchment (from Arapuni Road downstream) – a 13,558ha area of moderately steep land draining westward from the upper catchment and Mamaku plateau to enter the Waikato River at Lake Arapuni.

Summary of priority works

- Fencing wetlands and ephemeral streams (58km)
- Project management/staffing/incidentals (25%)

Total estimated cost: $580,000

UW 6	Fish habitat rehabilitation on Huihuitaha Stream	Medium priority

Location: Huihuitaha Stream – a 15km stream flowing from headwaters near Waotu to enter the Waikato River immediately downstream of Arapuni Dam.

Summary of priority works

- Fencing (24km)
- Native planting (12ha)
- Project management/staffing/incidentals (25%)

Total estimated cost: $833,280

UW 7	Water quality improvement in the Huihuitaha catchment	Medium priority

Location: Huihuitaha sub-catchment – a 2,007ha catchment located near Arapuni, consisting of a 31km stream network. The main Huihuitaha Stream enters the Waikato River below Lake Arapuni.

Summary of priority works

- Fencing wetlands and ephemeral streams (5km)
- Project management/staffing/incidentals (25%)

Total estimated cost: $50,000

UW 8	Fish habitat rehabilitation on Little Waipā Stream	Medium priority

Location: Little Waipā Stream – a 23km stream flowing from headwaters near Waotu to enter the Waikato River at Lake Arapuni, approximately 5km downstream of Arapuni Dam on the east side of the river.

Summary of priority works

- Fencing (11.5km)
- Planting (5.75ha)
- Project management/staffing/incidentals (20%)

Total estimated cost: $383,309

UW 9	Water quality improvement in the Little Waipā catchment	High priority

Location: Little Waipā catchment – a 12,152ha catchment that lies adjacent and to the west of the Huihuitaha. The main stream enters the Waikato River at Lake Karāpiro.

Summary of priority works

- Fencing wetlands and ephemeral streams (88km)
- Project management/staffing/incidentals (25%)

Total estimated cost: $880,000

UW 10	Longfin eel habitat rehabilitation in Mangare Stream catchment	Medium priority

Location: Mangare Stream catchment – located on the western side of the Waikato River near Lake Arapuni. The Mangare Stream is 18km long, flowing from its headwaters near Arohena north to the downstream end of Lake Arapuni.

Summary of priority works

- Riparian fencing (30km)
- Native planting (20ha)
- Eel trap and transfer programme
- Project management/staffing/incidentals (30%)

Total estimated cost: $2,046,902

UW 11	Biodiversity enhancement of Jack Henry wetland	Very high priority

Location: Jack Henry wetland, located next to the Waikato River at the upper end of Lake Arapuni.

Summary of priority works

- Management plan development
- Weed control
- Project management/staffing/incidentals (15%)

Total estimated cost: $63,020

UW 12	Upper Pokaiwhenua stream bank erosion protection and riparian enhancement	Very high priority

Location: The main channel and tributaries of the upper Pokaiwhenua Stream (generally between Tokoroa and Putaruru).

Summary of priority works

- Riparian fencing (127km)
- Riparian willow/poplar pole planting (3,187 poles)
- Native riparian planting (32ha)
- Project management/staffing/incidentals (25%)

Total estimated cost: $2,827,852

UW 13	Kōura habitat rehabilitation on Uanui Stream	High priority

Location: Uanui Stream – a 2.6km long stream flowing into the western side of Lake Whakamaru.

Summary of priority works

- Site evaluation and planning
- Riparian management (520m fencing and 0.3ha native planting)
- In-stream works (including obtaining resource consent)
- Liaison with landowners and community
- Project management/staffing/incidentals (20%)

Total estimated cost: $43,818

UW 14	Hill country erosion protection and remediation in the Maraemanuka, Okama and Uanui catchments	Very high priority

Location: Maraemanuka, Okama and Uanui catchments – on the western side of the Waikato River near Lake Whakamaru.

Summary of priority works

- 11 erosion control structures on LUC 6e land
- 268ha LUC 6e land managed with plantation species
- 184ha LUC 7 land managed with plantation species
- Fencing retired LUC 8 land (22km)
- Erosion control outside LUC 6e, 7 and 8 land
- Fencing existing indigenous forest remnants (5.6km)
- Project management/staffing/incidentals (30%)

Total estimated cost: $2,691,000

UW 15	Mangakowhiriwhiri catchment hill country erosion protection and remediation	Medium priority

Location: Mangakowhiriwhiri catchment – a 6934ha catchment draining into the Waikato River near the small town of Whakamaru.

Summary of priority works

- 16 erosion control structures on LUC 6e land
- 412ha LUC 6e land managed with plantation species
- 96ha LUC 7 land managed with plantation species
- Fencing retired LUC 8 land (24km)
- Erosion control outside LUC 6e, 7 and 8 land (32ha)
- Fencing existing indigenous (4km)
- Project management/staffing/incidentals (30%)

Total estimated cost: $3,081,000

UW 16	Kōura habitat rehabilitation in Waipapa, Mokauteure and Ongarahu Streams	Very high priority

Location: 45km of waterways consisting of Waipapa Stream below Tirohanga Road, and Mokauteure and Ongarahu Streams below Forest Road. Mokauteure Stream is a tributary to Waipapa Stream which has headwaters east of Mokai and flows into the Waikato River immediately downstream of Tram Road Bridge (downstream of Ātiamuri Dam). Ongarahu Stream is in a neighbouring catchment to the east and flows into the Waikato River upstream of Waipapa Stream.

Summary of priority works

- Site evaluation and planning
- Fencing (4.5km)
- Planting and weed control (2.25ha)
- Liaison with forest managers
- In-stream works (including resource consent)
- Project management/staffing/incidentals (20%)

Total estimated cost: $196,670

UW 17	Biodiversity enhancement at Forest Road wetland	High priority

Location: Forest Road wetland is a 196ha wetland complex located approximately 6.5km east of Mokai.

Summary of priority works

- Management plan development
- Fencing upgrade and new fencing (53km)
- Planting (8ha)
- Ground-based weed control
- Possum control
- Aerial willow control
- Project management/staffing/incidentals (20%)

Total estimated cost: $1,522,099

UW 18	Cycleway/walkway along the Waikato River between Ātiamuri and Orākei Kōrako	High priority

Location: A 20km length of the Waikato River between Ātiamuri and Orākei Kōrako.

Summary of priority works

- Project planning including scoping the trail route, obtaining agreement from landowners, undertaking cultural impact assessment and securing project funding.
- Legal requirements and procurement – formalising land access agreements, preparing and lodging resource consent applications, tender processes.
- Walkway construction including signage and riparian planting.
- Project management/staffing/incidentals (30%)

Total estimated cost: $2,591,550

UW 19	Upper Tahunātara Stream erosion protection and riparian enhancement	High priority

Location: The upper Tahunātara and Pokaitu Stream catchment located to the northeast of Ātiamuri and containing a 569km stream network.

Summary of priority works

- Fencing (57km)
- Native planting (14.25ha)
- Pole planting (1425 poles)
- Project management/staffing/incidentals (25%)

Total estimated cost: $1,263,832

UW 20	Ātiamuri catchment erosion protection and remediation	Medium priority

Location: Ātiamuri catchment – a 1709ha catchment located on the northeastern side of the Waikato River upstream of Ātiamuri township.

Summary of priority works

- 4 erosion control structures on LUC 6e land
- 99ha LUC 6e managed with plantation species
- 122ha LUC 7 land managed with plantation species
- Erosion control outside LUC 6e, 7 and 8 land (7ha)
- Fencing existing indigenous forest remnants (1km)
- Project management/staffing/incidentals (25%)

Total estimated cost: $840,625

UW 21	Biodiversity enhancement of Kapenga wetland and nearby Hamills wetland	High priority

Location: Kapenga and Hamills wetlands are located approximately 9km south of Rotorua near Kapenga.

Summary of priority works

- Fencing (1.4km)
- Willow control
- Native riparian planting (22ha)
- Infill planting (4.1ha)
- Weed control
- Project management/staffing/incidentals (15%)

Total estimated cost: $1,493,053

UW 22	Whirinaki integrated catchment programme	High priority

Location: The Whirinaki catchment – a 23,403ha catchment flowing into the Whirinaki Arm and then into Lake Ohakuri.

Summary of priority works

- 33 erosion control structures on LUC 6e land
- 834ha LUC 6e land managed with plantation species
- 797ha LUC 7 land managed with plantation species
- Fencing retired LUC 8 land (76km)
- Erosion control outside LUC 6e, 7 and 8 land (107ha)
- Fencing existing indigenous vegetation (75km)
- 25 sediment traps
- Fencing wetlands and ephemeral streams (97km)
- Riparian fencing (124km)
- Riparian willow/poplar pole planting (3093 poles)
- Native riparian planting (31ha)
- Project management/staffing/incidentals (30%)

Total estimated cost: $14,050,288

UW 23	Biodiversity enhancement in the upper Otamakokore Stream catchment (above Corbett Road in the Waikite Valley)	Medium priority

Location: The project site is located in the Otamakokore Stream catchment upstream of Waikite hot pools.

Summary of priority works

- Fencing (5km)
- Revegetation (45ha)
- Wilding conifer control
- General weed control
- Project management/staffing/incidentals (20%)

Total estimated cost: $2,371,837

UW 24	Walkway around Waikite geothermal wetland	Medium priority

Location: The project site is a 13ha wetland near Waikite hot pools (south of Rotorua in the upper reaches of the Otamakokore catchment).

Summary of priority works

- Walkway design and resource consenting
- Construction of walkway, boardwalk and wooden bridges
- Development and installation of interpretation signage
- Development of picnic areas
- Re-fencing (20m)
- Project management/staffing/incidentals (20%)

Total estimated cost: $335,520

UW 25	Lake Ngāhewa walkway	Medium priority

Location: Lake Ngāhewa is a volcanic lake located to the north of the Wai-O-Tapu thermal area.

Summary of priority works

- Walkway design and resource consenting
- Construction of walkway and boardwalk
- Development and installation of interpretation signage
- Development of seating areas
- Project management/staffing/incidentals (20%)

Total estimated cost: $531,600

UW 26	Restoration of Wai-O-Tapu South geothermal area	Very high priority

Location: The Wai-O-Tapu South geothermal area is located along SH5 between Rotorua and Taupō.

Summary of priority works

- Hand pulling of wilding pine seedlings
- Wilding pine control – maintenance
- Felling wilding pine
- General plant pest control
- Project management/staffing/incidentals (15%)

Total estimated cost: $198,375

UW 27	Biodiversity enhancement at Orākei Kōrako and Red Hills	Very high priority

Location: Orākei Kōrako and Red Hills is a 162ha area consisting of geothermal ecosystems and native vegetation alongside the bank of the Waikato River.

Summary of priority works

- Wilding conifer control
- General weed control
- Fencing (1.8km)
- Surveillance
- Project management/staffing/incidentals (15%)

Total estimated cost: $117,990

UW 28	Hill country erosion protection and remediation in the Whakapanake, Waitakahi and Wharekaka catchments	High priority

Location: The Whakapanake, Waitakahi and Wharekaka catchments have a combined area of 4014ha and are located at the southern end of the Paeroa Range.

Summary of priority works

- 5 erosion control structures on LUC 6e land
- 134ha LUC 6e land managed with plantation species
- 336ha LUC 7 land managed with plantation species
- Fencing retired LUC 8 land (10km)
- Management outside LUC 6e, 7 and 8 land (5ha)
- Fencing existing indigenous vegetation (3km)
- Project management/staffing/incidentals (30%)

Total estimated cost: $2,080,000

UW 29	Water quality improvement and riparian protection and enhancement in the Wai-O-Tapu catchment	Very high priority

Location: The Wai-O-Tapu catchment is 33,145ha and has a 537km stream network. It is located in the vicinity of Reporoa.

Summary of priority works

- Riparian fencing (120km)
- Riparian willow/poplar pole planting (3010 poles)
- Native riparian planting (30ha)
- Wetland fencing (135km)
- Project management/staffing/incidentals (30%)

Total estimated cost: $4,171,310

UW 30	Biodiversity enhancement on the lower reach of Ruatawhiri Stream and part of Torepatutahi Stream	Very high priority

Location: A 8.5km length of waterway encompassing the lower end of Ruatawhiri Stream (2km upstream of Allen Road) downstream to the confluence with Torepatutahi Stream and part of Torepatutahi Stream (a 1.3km length downstream of the Ruatawhiri tributary).

Summary of priority works

- Management plan development
- Riparian fencing (5.1km)
- Riparian planting (4.2ha)
- Willow control (18.6ha)
- Weed control
- Project management/staffing/incidentals (25%)

Total estimated cost: $395,373

UW 31	Biodiversity enhancement at Lake Rotokawa and Lake Rotokawa North	Very high priority

Location: A geothermal area located approximately 7km east of Wairakei.

Summary of priority works

- Fencing (4km)
- Wilding pine control
- Weed control
- Project management/staffing/incidentals (15%)

Total estimated cost: $357,420

UW 32	Pueto catchment hill country and stream bank erosion protection and remediation	Very high priority

Location: Pueto catchment – a 19,900ha catchment lying east of Lake Taupō with an estimated 128km of streams flowing through pasture.

Sumary of priority works

- 7 erosion control structures on LUC 6e land
- 181ha LUC 6e land managed with plantation species
- 596ha LUC 7 land managed with plantation species
- Erosion control outside LUC 6e, 7 and 8 land (55ha)
- Fencing existing indigenous vegetation (2km)
- Riparian fencing (64km)
- Riparian willow pole planting (1603 poles)
- Native riparian planting (16ha)
- Project management/staffing/incidentals (30%)

Total estimated cost: $4,560,106

7 Waipā

7.1 Current state and pressures

7.1.1 Introduction

The Waipā catchment covers 306,569ha and is dominated by the Waipā River channel and associated tributaries. The Waipā River is the single largest tributary of the Waikato River. It begins at Pekepeke Spring in Maraeroa at the ancient home of Taporapora at the foot of Rangitoto Mountain. It flows past many significant areas, whare and pā of chiefs, below the mountain of Pirongia o Kahu towards Ngaati Mahanga near Whatawhata, and finally converging with the Waikato at Ngāruawāhia, the footstool of the Kīngitanga, 115km from its headwaters in Pekepeke (Collier et al., 2010).

The Waipā catchment contains 4825km of mapped stream and river channels. Almost three-quarters of this stream length consists of small first and second order channels, draining primarily pastoral land dominated by dairy, beef and sheep farming (Waikato Regional Council, 2014a).

Since the arrival of Europeans, the catchment has been transformed from a landscape dominated by native forest, scrub and tussock with significant areas of wetland in the north to a landscape where low-lying valleys are now dominated by pasture for agricultural use (McGlone, 1989, as cited in NIWA, 2014). Approximately 78 per cent of the catchment area is in pasture, 21 per cent in native vegetation, scrub and other land uses, and 1 per cent is in production forestry. Almost all of the significant wetland areas have been drained for agricultural purposes, with only pockets of wetland and shallow peat lakes remaining (Waikato Regional Council, 2014a).

The lower reaches of the main tributaries to the Waipā River are characterised by relatively low gradient, sinuous and sluggish channels that have been significantly modified in some locations through historic works. Those works typically included clearing, enlarging and straightening to improve channel efficiency and reduce flooding and damage to the pastoral land (Waikato Regional Council, 2014a).

7.1.2 Cultural importance

Iwi with affiliations to the Waipā River are Waikato-Tainui, Maniapoto and Raukawa. Iwi have overlapping interests along the Waipā River; however, it is generally accepted that Waikato-Tainui interests extend from Ngāruawāhia to the Pūniu River and Maniapoto's to the upper (southern) reaches of the catchment. Raukawa interests include the catchment area to the eastern side of Te Awamutu to Waipapa and down to Maraeroa.

Waipā River iwi have a strong relationship with their river and regard the river as their awa tūpuna (ancestral river). It is seen as an indivisible entity and any harm to the mauri (life force) of the river is harm to the mauri of the iwi. Anything which damages the river also affects the spiritual wellbeing of the people.

Mana whenua have identified a number of concerns around declining water quality in the Waipā including effects on populations of taonga species in the catchment, reduced opportunities to use land and water, impact on marae drinking water supplies and the use of water resources that are highly valued because of particular properties such as healing or rongoā. The decline of native flora and fauna is also a concern for iwi (NIWA, 2014).

Many significant and historic sites have been damaged, destroyed or are no longer accessible including wāhi tapu, urupā, historic access points and river crossings, and kāinga (home or dwelling, gardens, pā and named river features).

7.1.3 Water quality

Water quality in the tributaries of the Waipā River was recently given an overall C- grade in the Waikato River Authority Report Card, indicating that only some of the *Vision & Strategy* aspirations for water quality are being met. The main stem of the Waipā River was given a D grade, indicating that it does not deliver on the *Vision & Strategy* aspirations for water quality in the river. The report card scores reflect that water quality and clarity are unsafe for swimming in the main stem and many tributaries (Williamson et al., 2016).

In general, water quality in the Waipā River declines from the upper reaches to the lower reaches. In particular, the Waipā River has high sediment inputs from stream bank and hill country erosion (Waikato Regional Council, 2014a), which significantly impacts on water clarity. The Ministry for the Environment, using data from 2007, ranked water quality state across 77 sites in NIWA's National River Water Quality Network nationally. When the nutrients nitrate, total nitrogen, dissolved reactive phosphorus and total phosphorus were combined, the Waipā River at Otewa ranked 56 and at Whatawhata ranked 74 out of the 77 sites (NIWA, 2010).

Long term monitoring by Waikato Regional Council shows rising trends in total nitrogen in the Waipā River and tributaries at 10 of the 16 monitoring stations over the period from 1993 to 2012. The river also has moderate but reasonably stable levels of phosphorus at some sites, although P is increasing at the most downstream monitoring sites (Vant, 2013).

Changing land use and intensification from hill country farming to dairy farming is increasing nutrient loads from the catchment, particularly nitrogen (Waikato Regional Council, 2014a). Between 2003 and 2012, run off and leaching from pastoral land in the catchment accounted for about 75 per cent of the mass flows of nitrogen and 59 per cent of the mass loads of phosphorus to the river. There are three discharges of treated sewage wastewater and one of industrial wastewater in the catchment and together these contribute about 2 per cent of the total nitrogen and 7 per cent of the phosphorus load to the river (Vant, 2014). The remaining loads derive mostly from natural sources (Vant, 2014).

Faecal contamination (measured by *E. coli*) is high but stable in the catchment. The predominant source of this is from diffuse losses from agricultural land (Waikato Regional Council, 2014a).

Aquatic macroinvertebrate monitoring indicates that the habitat quality of streams in the Waipā catchment is below average when compared to other streams in the Waikato region. It ranges from poor to excellent across the catchment, depending in part upon the upstream and adjacent land use (Waikato Regional Council, 2014a).

7.1.4 Erosion and sedimentation

Historical accounts of the Waipā River describe the water as dark brown in colour and peat-stained (Hochstetter, 1867). However, large reaches of the main stem of the mid-lower river were still regularly used for swimming until 20-30 years ago. Even today, some of the Waipā River discolouration is natural. However, it is also exacerbated by human activity such as vegetation clearance in erosion-prone areas, increasing flood flow and stream and river bank erosion (NIWA, 2010). From 2002 to 2008, an estimated 1000ha of the catchment land was converted from plantation to pasture, almost 60 per cent on erosion-prone LUC class 6e and 7 land. From 2001 to 2008, intensification occurred on 31 per cent of pastoral land in the catchment, 32 per cent of which was on LUC 6e and 7 land (Waikato Regional Council, 2014a).

Sixty-seven per cent of the sediment load in the Lower Waikato River comes from the Waipā River catchment and studies show that the majority of this comes from the upper Waipā (Hicks and Hill, 2010). The soft mudstone geology of the catchment makes it more erosion prone, with landslides and stream bank erosion the biggest issues in generating sediment, especially in pastoral landscapes (Waikato Regional Council, 2014a). Investigations undertaken by Palmer et al. (2015)

suggested that bank erosion was likely to be the dominant source of sediment in the most heavily sediment-laden streams.

A major contributor of sediment in the upper Waipā catchment is the Tunawaea landslide. In 1991 this caused an estimated 500,000 cubic metres of material to dam the Tunawaea Stream for about a year. It eventually overtopped in a flood event and failed, and the material washed downstream, raising the riverbed. This material has continued to move down the Waipā River since this time. This has caused ongoing sediment issues including adding at least 200,000 cubic metres to the river system. Waikato Regional Council has implemented a specific project to stabilise the material from the landslide in the upper Waipā Gorge and to provide a regular, stable channel along the valley floor. The aim is to prevent erosion of the terraces and help the river move its bedload through the system effectively and with a minimum of damage to the channel (Waikato Regional Council, 2014a).

The Waipā Catchment Plan (Waikato Regional Council, 2014a) lists the following implications of erosion and sedimentation in the Waipā catchment:

- loss of natural soil resource that takes hundreds of years to create, and associated loss of productivity and land use options
- impacts on water quality
- impacts on the habitats of taonga species in the catchment
- potential negative effects on indigenous biodiversity, river recreation and flood risks, as well as future pastoral productivity and community prosperity
- deposition of sediment (aggradation) in the main channel, leading to increased erosion and flood hazards.

7.1.5 Fish

The Waipā River and tributaries are home to many different species of fish, including at least 19 native species and at least 10 species of introduced fish. Many of these species, along with other aquatic species such as kōura and kāeo, are important as a traditional source of kai for river iwi. Tuna was particularly significant for iwi and once plentiful along the rivers and streams of Maniapoto (e.g. Pūniu and Waipā river catchments). The Maniapoto Fisheries Plan (2014) recounts tuna being so highly regarded that intertribal wars were fought over access to their fishing grounds.

Many of the larger native fish species found in the Waipā catchment, including shortjaw, banded and giant kōkopu, are found in medium to small-sized tributary streams flowing from Mt Pirongia. These streams provide cool, clear water and a complex natural in-stream habitat, which these species prefer (David and Speirs, 2010).

Many native fish species (and other aquatic species) have been declining in abundance over the last few decades. This includes the Waikato and Waipā River tuna fishery, which is thought to have declined by about 75 per cent in over this period. The causes of decline include forest clearance, sedimentation, predation by pest fish, loss of wetland and lowland habitat and poor fishery management. However, the most significant reason for decline in abundance is thought to be the degradation of habitat (NIWA, 2010).

Many of New Zealand's native freshwater species are diadromous and must spend part of their life cycle in the sea. Either they go to sea to spawn (e.g. tuna) or larvae go there to grow and develop (e.g. whitebait, smelt, bullies). Barriers such as culverts and dams therefore also have an impact on native fish abundance and diversity. The two known barriers to fish passage on the Waipā River main stem are the water supply weir at Ōtorohanga and Owens Falls, a further 36km upstream (West et al., 1993, cited in Collier et al., 2010).

7.1.6 Biodiversity

The Waipā River once flowed through a catchment containing a diverse range of indigenous ecosystems including streams, rivers, lakes, wetlands, karst, forest and shrublands. These ecosystems provided critical habitats for indigenous fauna and flora. They also provided a range of fundamental ecological services including reducing erosion and downstream sedimentation, and nutrient storage and recycling (Waikato Regional Council, 2014a).

Within the Waipā catchment, clearance of indigenous forest and draining of peat bogs, wetlands and lakes has been very extensive and the condition of rivers, streams and lakes is declining (Waikato Regional Council, 2014a). The *Waipā Catchment Plan* identifies a range of threats to the remaining indigenous ecosystems, including:

- grazing by livestock
- ongoing vegetation removal
- habitat fragmentation
- increased edge effect
- altered hydrology
- nutrient enrichment of low nutrient ecosystems
- plant pests
- predation and browsing by pest animals (Waikato Regional Council, 2014a).

Despite this, the headwaters of many tributaries of the Waipā contain high quality water and, correspondingly, in-stream biodiversity values are highest in these areas. In the western ranges (e.g. Pirongia), and the Rangitoto Range in the southeast, high water quality and stream health conditions are associated strongly with locations of intact indigenous forests (Waikato Regional Council, 2014a).

On the west of the Waipā catchment is one of New Zealand's major karst areas, containing caves, blind valleys, disappearing streams and sculptured rock outcrops. This area has unique geomorphological and ecological features and processes (Department of Conservation, 2014). The type of vegetation and flora present is influenced by the lime-rich, alkaline soils formed from the weathering of limestone. This, combined with the diverse range of parent materials, has led to a wide diversity of plant species, possibly unmatched anywhere else in the Waikato region (Clarkson, 2002). Many plant species that grow in this area, such as fern *Asplenium cimmeriorum* and Awaroa hebe (*Hebe scopulorum*) are only found in karst environments (Department of Conservation, 2014). Threats to karst areas include damage to caves, changes to surface vegetation, farming and forestry, sedimentation, flooding, mining and recreation and tourism activities that are not well managed to protect the environment (Department of Conservation, 2014).

The largest remnants of indigenous forest and shrubland are found on the predominantly steeper areas of the upper catchment, e.g. Pirongia and the Rangitoto ranges. Lowland remnants are very small and fragmented within a predominantly pastoral landscape. The small size of many of these remnant habitats is an issue that will be difficult to address in the long term as many have a pronounced 'edge effect', which can lead to an increase in pest plant numbers, light availability, wind and extremes of temperature and humidity (Waikato Regional Council, 2014a).

The Waikato River Authority Report Card for the river gives the Waipā main stem a C+ and the tributaries a B- for ecological integrity. This indicates a low to moderate rating and suggests that only some of the *Vision & Strategy* aspirations for a healthy river are being met (Williamson et al., 2016).

7.1.7 Recreation

When compared with the Waikato River main stem and tributaries, recreation undertaken on the Waipā River and tributaries is limited. The upstream reach above Ōtorohanga is popular for trout fishing and used for picnicking and swimming during summer. Below Ōtorohanga, there is a small amount of boating activity but this is limited by river morphology and lack of boat ramps – only one well maintained public boat ramp is currently in place, located at Ngāruawāhia. The ability for people to utilise the Waipā River for recreational activities is also limited by poor water quality in the river (Williamson et al., 2016).

7.2 Goals

The following goals were developed by iwi, stakeholders and community representatives for the Waipā catchment:

Water quality

1. The quality and flow of water is maintained and enhanced.
2. Water quality is such that waters within the catchment are swimmable and safe to take food from in all places.

Fish

1. Indigenous fish have access throughout the river catchments (except where natural barriers exist) and the catchment has an abundance of taonga species such as kōkopu, piharau, tuna, kōura and kāeo.
2. There is a programme of restoration, enhancement and protection of fish habitat, pā tuna and other significant fishing sites.

Erosion and sedimentation

1. The appropriate management of steep and erosion-prone land is promoted and incentivised.
2. River margins prone to significant erosion are managed to minimise erosion risk, whilst enhancing aquatic habitat and retaining the natural character of river systems.
3. Riparian planting of preferably indigenous species is undertaken to stabilise riverbanks, reduce erosion and enhance terrestrial and aquatic biodiversity.

Sustainable land management

1. Wetlands are created or protected and actively managed to enhance multiple functions.
2. Land uses are being adapted to match the capability of the land.

Biodiversity

1. The catchment has an interconnected network of healthy, indigenous ecosystem types (forest, shrubland, wetlands, lakes, river and stream habitats and margins) supporting native flora and fauna.
2. Where possible, the natural functioning of floodplains and other ephemeral wetland sites is restored and maintained.

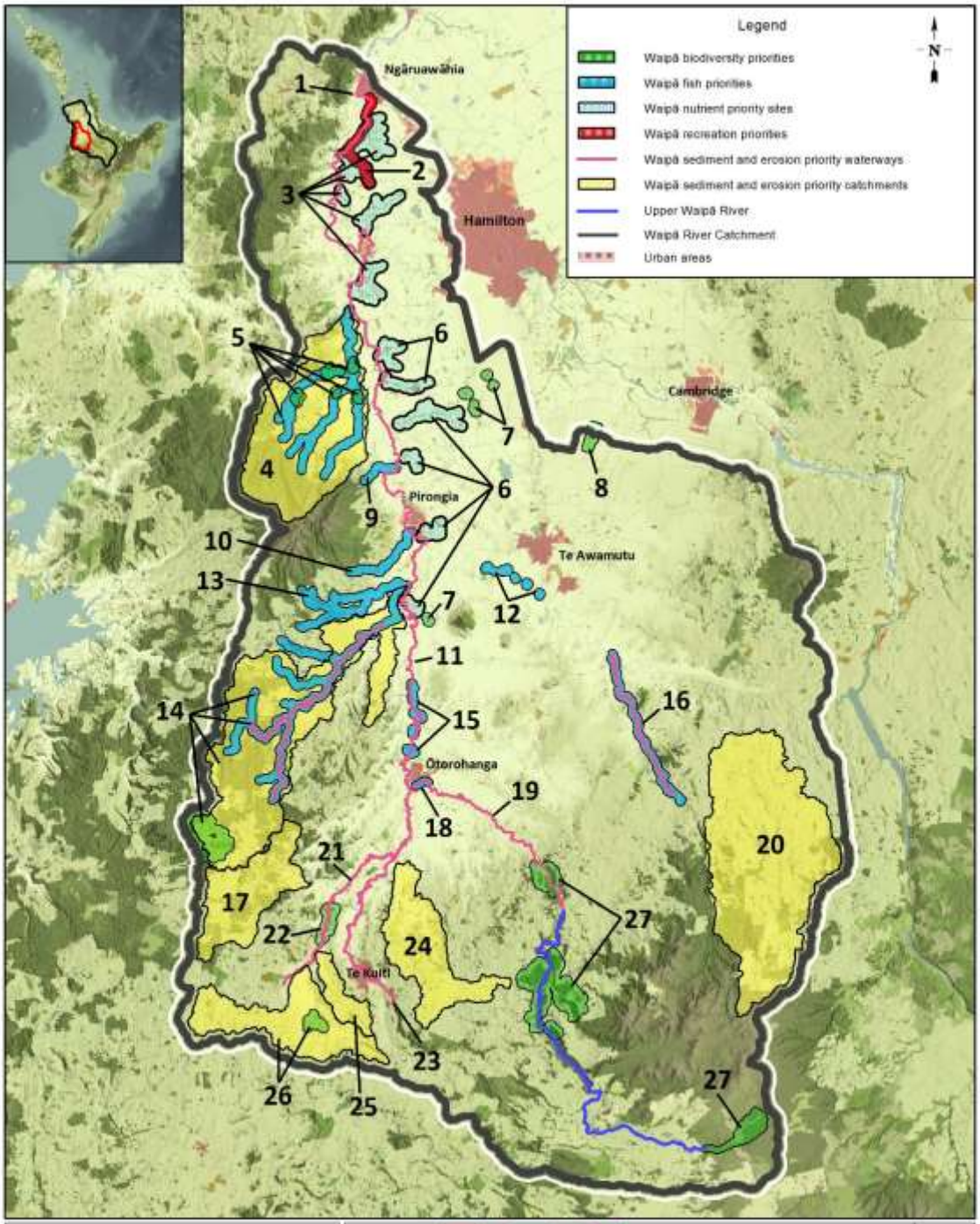
Education and capacity building

1. Restoration initiatives maximise opportunities for education and capacity building within the catchment.

7.3 Priority projects

Twenty-seven projects in the Waipā catchment scored favourable cost:benefit scores and have been included in the *Restoration Strategy*. These are illustrated in Figure 7. Projects are listed in order from lower catchment to upper catchment and their priority ranking is provided in Section 7.3.1. Appendix 7 contains more detailed information on each project including recommended management actions and estimated costs.

Total project value is estimated at just over $90 million. Funding priorities include a new river walkway from Ngāruawāhia to Te Kōwhai, 450km of riparian/wetland fencing, 410ha of riparian revegetation, stabilising of up to 4800ha of erosion-prone LUC class 6e land and 3050ha of LUC class 7 land, more than 750km of fencing of plantings, sidelings, seeps and existing indigenous vegetation in hill country, enhancement of 17 river oxbows, remediation of up to 20 barriers to native fish passage, and addressing 100km of riverbank erosion through vegetation or rock structures that also provide habitat for fish.



Waipā

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017

Status: Final
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File name: WWRRS.gws

Scale 1:425,000@A4 Portrait

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Waikato Regional Council

7.3.2 Summary tables of priority projects

WP 1	Waipā River erosion protection and remediation – Pirongia to Ngāruawāhia	High priority

Location: A 30km reach of the Waipā River from Pirongia to Whatawhata bridge and a 28km reach from Whatawhata bridge to the confluence with the Waikato River at Ngāruawāhia.

Summary of priority works

- Fencing (53km)
- Poplar/willow pole planting (2200 poles)
- Native planting (112ha)
- Project management/staffing/incidentals (25%)

Total estimated cost: $6,109,380

WP 2	Walkway from Te Kōwhai to Ngāruawāhia township via Te Otamanui gully and along the Waipā River	High priority

Location: Te Kōwhai to Waipā River through Te Otamanui gully and then along the Waipā River to Ngāruawāhia township.

Summary of priority works

- Walkway construction (8.9km)
- Fencing (8.9km)
- Signage
- Native planting (5,250 plants)
- Surveying
- Project management/staffing/incidentals (25%)

Total estimated cost: $2,051,250

WP 3	Enhancement of Waipā wetlands in priority nutrient catchments (Waikato District)	Medium priority

Location: Selected Waikato district gully wetlands greater than 10ha and located within high nutrient yielding sub-catchments within the Waipā catchment (11 wetlands in total).

Summary of priority works

- Management plan development
- Fencing
- Willow control
- Weed control
- Native planting
- Possum control
- Project management/staffing/incidentals (30%)

Total estimated cost: $4,987,225

WP 4	Kaniwhaniwha catchment erosion protection and remediation	High priority

Location: Kaniwhaniwha catchment – an 11,434ha catchment extending from the bush clad slopes of Mt Pirongia to the Waipā River.

Summary of priority works

- Pole planting erosion prone LUC 6e land (325ha)
- Plantation species on erosion prone LUC 6e land (325ha)
- Plantation species on LUC 7 land (63ha)
- Fencing existing indigenous vegetation (28km)
- Fencing managed LUC 6e land (65.5km)
- Fencing managed LUC 7 land (8km)
- Treating erosion outside LUC 6e, 7 and 8 land (85.5ha).
- Project management/staffing/incidentals (25%)

Total estimated cost: $5,920,625

WP 5	Kaniwhaniwha catchment streams fish habitat rehabilitation and restoration of forest remnants	Very high priority

Location: A 50km long stream network within the Kaniwhaniwha catchment and selected forest remnants ranging from 0.7ha to 32ha in size.

Summary of priority works

- Waterway fencing (50.8km)
- Riparian planting (25.4ha)
- Installing in-stream woody debris
- Possum control
- Fencing forest remnants (10.2km)
- Remediation of fish barriers (3 barriers)
- Weed control
- Project management/staffing/incidentals (30%)

Total estimated cost: $2,705,588

WP 6	Enhancement of Waipā wetlands in priority nutrient catchments (Waipā District)	Medium priority

Location: Selected Waipā District gully wetlands greater than 10ha and located within high nutrient yielding sub-catchments within the Waipā catchment (8 gully wetlands in total).

Summary of priority works

- Management plan development
- Fencing
- Native planting
- Willow control
- Weed control
- Possum control
- Project management/staffing/incidentals (30%)

Total estimated cost: $3,498,025

WP 7	Restoration of priority lowland kahikatea remnants (and associated wetlands) between Te Kūiti and Templeview	Medium priority

Location: Selected Waipā River catchment kahikatea remnants and associated wetlands.

Summary of priority works

- Fencing (9.9km)
- Possum control (2.2ha)
- Weed control for 3 years
- Native planting (1.5ha)
- Project management/staffing/incidentals (20%)

Total estimated cost: $214,114

WP 8	Enhancement of water levels in the Moanatuatua wetland	High priority

Location: Moanatuatua Wetland – a 140ha peat bog wetland located east of Ōhaupō.

Summary of priority works

- Site surveys to determine height and design for a weir
- Weir design plans
- Resource consent
- Weir construction x 2
- Project management/staffing/incidentals (30%)

Total estimated cost: $78,000

WP 9	Mangakara Stream fish habitat rehabilitation	High priority

Location: A 3.7km reach of Mangakara Stream, flowing from the bush line on Mt Pirongia (near Grey Road, Te Pahu) to the Waipā River.

Summary of priority works

- Riparian fencing (6km)
- Native planting (2.4ha)
- Remediation of fish barriers
- Project management/staffing/incidentals (20%)

Total estimated cost: $177,748

WP 10	Mangauika Stream fish habitat rehabilitation	Medium priority

Location: A 9km reach of Mangauika Stream flowing from Mt Pirongia in the vicinity of Te Tahi Road to join the Waipā River at Pirongia Village.

Summary of priority works

- Riparian fencing (13.5km)
- Native planting (6.75ha)
- Remediation of fish barriers
- Project management/staffing/incidentals (25%)

Total estimated cost: $464,345

WP 11	Waipā River bank erosion protection and remediation – Ōtorohanga to Pirongia	High priority

Location: A 37km reach of the Waipā River from Ōtorohanga to Pirongia.

Summary of priority works

- Riparian fencing (24km)
- Native planting (24ha)
- Design and install fish habitat structures (30)
- Plant poplar/willow poles (2400)
- Design and install erosion protection structures (10)
- Vegetation management and disposal (12km)
- Project management/staffing/incidentals (30%)

Total estimated cost: $2,590,702

WP 12	Tuna habitat rehabilitation within 7 Pūniu River oxbows	High priority

Location: A collection of historic oxbows along the Pūniu River southwest of Te Awamutu.

Summary of priority works

- Development of project plans
- Excavation
- Fencing
- Native planting
- Weed control
- Culvert installation
- Resource consent
- Project management/staffing/incidentals (30%)

Total estimated cost: $296,151

WP 13	Ngakoaohia Stream (and selected tributaries) fish habitat rehabilitation	Medium priority

Location: Ngakoaohia Stream and selected tributaries (flowing from Pirongia mountain near Ngutunui).

Summary of priority works

- Fencing (26km)
- Native planting (13ha)
- Remediation of fish barriers
- Project management/staffing/incidentals (30%)

Total estimated cost: $1,015,528

WP 14	Moakurarua integrated catchment programme	Very high priority

Location: Moakurarua catchment – a 14,974ha catchment in the upper Waipā River catchment with a stream network of 277km.

Summary of priority works

- River erosion control (26km)
- Pole planting erosion prone LUC 6e land (665ha)
- Plantation species on erosion prone LUC 6e land (665ha)
- Fencing managed LUC 6e land (131km)
- Plantation species on LUC 7 land (647ha)
- Fencing managed LUC 7 land (91km)
- Treating erosion outside LUC 6e, 7 and 8 land (22ha)
- Streambank fencing (72km)
- Riparian planting river/streams (36ha)
- Fencing existing indigenous vegetation (38km)
- Goat control on LUC 6e and 7 land
- Project management/staffing/incidentals (30%)

Total estimated cost: $18,162,054

WP 15	Tuna habitat rehabilitation within 10 Waipā River oxbows	High priority

Location: A collection of historic oxbows along the Waipā River between Pirongia and Ōtorohanga.

Summary of priority works

- Development of project plans
- Excavation
- Fencing
- Native planting
- Weed control
- Culvert installation
- Resource consent
- Project management/staffing/incidentals (30%)

Total estimated cost: $372,184

WP 16	Mangatutu River erosion protection, remediation and management, and rehabilitation of fish habitat	Very high priority

Location: A 20km reach of the Mangatutu River from Pūniu to Wharepuhanga Road.

Summary of priority works

- River erosion protection/remediation (16km)
- Willow management (7km)
- Stream bank fencing (14.7km)
- Willow/poplar pole planting (1,422 poles)
- Native planting (16ha)
- Project management/staffing/incidentals (30%)

Total estimated cost: $1,558,050

WP 17	Waitomo River – headwaters to caves erosion protection and remediation	Very high priority

Location: Waitomo catchment and caves – a 4434ha catchment situated southwest of Ōtorohanga, upstream of Waitomo village, and containing the Waitomo Glowworm Caves.

Summary of priority works

- Pole planting erosion prone LUC 6e land (60ha)
- Plantation species on erosion prone LUC 6e land (60ha)
- Fencing managed LUC 6e land (10km)
- Plantation species on LUC 7 land (92ha)
- Fencing managed LUC 7 land (19km)
- Treating erosion outside LUC 6e, 7 and 8 land (3.6ha)
- Project management/staffing/incidentals (25%)

Total estimated cost: $1,542,500

WP 18	Rehabilitation of fish habitat at Ōtorohanga (Waipā River)	High priority

Location: The 1.3km section of Waipā River between Ōtorohanga rail bridge and the weir.

Summary of priority works

- Installation of structures for fish habitat (13 structures)
- Resource consent
- Project management/staffing/incidentals (20%)

Total estimated cost: $66,120

WP 19	Waipā River bank erosion protection and remediation – Toa bridge to Ōtorohanga	High priority

Location: A 21km reach of the Waipā River from Toa bridge to Ōtorohanga.

Summary of priority works

- Erosion protection structures (21km)
- Native planting behind structures (4ha)
- Willow management (8km)
- Poplar/willow pole planting (1,600 poles)
- Fencing (13.3km)
- Native planting behind new fences (13ha)
- Project management/staffing/incidentals (30%)

Total estimated cost: $1,956,843

WP 20	Upper Pūniu catchment erosion protection and remediation	Medium priority

Location: The upper Pūniu catchment – a 16,857ha catchment situated southeast of Te Awamutu and bordering the eastern boundary of the Waipā catchment.

Summary of priority works

- Pole planting erosion prone LUC 6e land (688ha)
- Plantation species on erosion prone LUC 6e land (688ha)
- Fencing managed LUC 6e land (116km)
- Plantation species on erosion prone LUC 7 land (1857ha)
- Fencing managed LUC 7 land (172km)
- Treating erosion outside LUC 6e, 7 and 8 (52ha) land
- Fencing indigenous forest remnants (34km)
- Goat control on treated LUC 6e and 7 land
- Project management/staffing/incidentals (30%)

Total estimated cost: $21,657,448

WP 21	Mangapu River erosion protection and riparian enhancement	High priority

Location: A 35km reach of the Mangapu River broken up into two reaches. The top reach is 21km and extends from Waitomo Valley Road to Trooper Road. The lower reach is 14km long and is downstream of Waitomo Valley Road.

Summary of priority works

- River erosion management and protection (27km)
- Willow management (5.25km)
- Fencing (25km)
- Willow/poplar pole planting (1799 poles)
- Native planting (25ha)
- Project management/staffing/incidentals (25%)

Total estimated cost: $1,714,357

WP 22	Biodiversity restoration within lowland kahikatea fragments in Mangapu catchment	Very high priority

Location: Selected lowland kahikatea remnants in Mangapu catchment and their associated wetlands.

Summary of priority works

- Management plan development
- Fencing (15.6km)
- Native planting (4ha)
- Weed control
- Possum control
- Project management/staffing/incidentals (20%)

Total estimated cost: $410,890

WP 23 Mangaokewa Stream erosion protection and remediation — High priority

Location: Mangaokewa Stream – a 23km reach of stream which flows from the Viaduct Reserve through the Te Kūiti township to the confluence with the Mangapu River at Hangatiki.

Summary of priority works

- River erosion management and protection
- Willow/poplar management (3.5km)
- Willow/poplar disposal
- Fencing (21.2km)
- Willow/poplar pole planting (1,533 poles)
- Native planting (10.6ha)
- Project management/staffing/incidentals (25%)

Total estimated cost: $984,391

WP 24 Mangarapa catchment erosion protection and remediation — Medium priority

Location: Mangarapa catchment – a 5306ha catchment situated to the south of Ōtorohanga and East of Te Kūiti.

Summary of priority works

- Pole planting erosion prone LUC 6e land (325ha)
- Plantation species on erosion prone LUC 6e land (325ha)
- Fencing managed LUC 6e land (54km)
- Plantation species on erosion prone LUC 7 land (78ha)
- Fencing managed LUC 7 land (14km)
- Erosion outside LUC 6e, 7 and 8 land (18.5ha)
- Fencing indigenous bordering LUC 6e land (14.5km)
- Goat control on treated LUC 6e and 7 land
- Project management/staffing/incidentals (25%)

Total estimated cost: $4,991,435

WP 25 Mangatea catchment erosion protection and remediation — Medium priority

Location: Mangatea catchment – a 1326ha catchment situated to the southwest of Te Kūiti.

Summary of priority works

- Pole planting erosion prone LUC 6e land (76ha)
- Plantation species on erosion prone LUC 6e land (76ha)
- Fencing managed LUC 6e land (14km)
- Plantation species on erosion prone LUC 7 land (5ha)
- Fencing managed LUC 7 land (2km)
- Erosion outside LUC 6e, 7 and 8 land (12.4ha)
- Fencing indigenous forest remnants (3.4km)
- Goat control on treated LUC 6e and 7 land
- Project management/staffing/incidentals (25%)

Total estimated cost: $1,181,680

WP 26	Mangarama catchment erosion protection and remediation	Medium priority

Location: Mangarama catchment – a 5439ha catchment southwest of Te Kūiti.

Summary of priority works

- Pole planting erosion prone LUC 6e land (264ha)
- Plantation species on erosion prone LUC 6e land (264ha)
- Fencing managed LUC 6e land (42km)
- Plantation species on erosion prone LUC 7 land (315ha)
- Fencing managed LUC 7 land (31km)
- Erosion outside LUC 6e, 7 and 8 land (3.1ha)
- Fencing indigenous forest remnants (6.2km)
- Goat control on treated LUC 6e and 7 land
- Project management/staffing/incidentals (25%)

Total estimated cost: $5,237,625

WP 27	Biodiversity restoration of priority sites in the Upper Waipā Catchment	High priority

Location: Selected upper Waipā River forest remnants, wetlands and associated tributary streams.

Summary of priority works

- Fencing (21.2km)
- Native planting (0.75ha)
- Ground based willow control
- Project management/staffing/incidentals (20%)

Total estimated cost: $539,717

8 Shallow lakes

8.1 Current state and pressures

8.1.1 Introduction

The Waikato and Waipā River catchments contains 52 shallow lakes greater than 1ha in size. The majority of these lakes have been formed in association with the Waikato River system and its floodplain and the formerly extensive peat bogs of the region (Figure 8). The catchment's shallow peat and riverine lakes are the largest remaining collection of their type in New Zealand. The physical characteristics of 36 lakes for which data exists is shown in Table 4.

Shallow lakes provide for a range of values – as habitat for native flora and fauna including taonga and game species, recreation, and also for water supply, commercial and traditional fisheries, and flood control. Shallow lakes also perform nutrient cycling and other ecosystem processes that contribute to the life supporting capacity of the wider environment.

The shallow lakes within the Waikato catchment make up approximately 30 per cent of New Zealand lakes that have been categorised as having poor to extremely poor water quality and having undergone substantial declines in ecological condition. Many of these lakes have shifted from a clear-water macrophyte-dominated state to a turbid, phytoplankton-dominated state as land use intensification has increased (Dean-Speirs et al., 2014a).

The freshwater wetlands associated with our shallow lakes are a stronghold for threatened, at risk and rare plant communities. These include plants that are specifically adapted to peat wetlands, such as “threatened” swamp helmet orchid and “at risk” giant cane rush (Department of Conservation, 2014). Highly valued native bird populations such as “threatened” wuxia/New Zealand dabchick, matuku/Australasian bittern, “at risk” mohopereru/banded rail, pūweto/spotless crake and mātātā/North Island fernbird are also present along with extensive game bird populations. These freshwater wetlands also provide important habitat for a range of fish species including the black mudfish and migratory species such as the longfin eel, shortfin eel and galaxiids (Department of Conservation, 2014).

Shallow lakes function differently to deep lakes in that their depth provides for them to be:

- capable of supporting submerged aquatic plants over most of the lake bed as their shallow depths allow sufficient light penetration for plant growth, assuming all other habitat and ecological requirements are favourable (i.e. substrate, disturbance, water levels)
- regularly stirred up by wind and wave action which prevents prolonged periods of thermal stratification and serves to recycle nutrients from the bottom sediments to the overlying water column. The large interface between the lake bed and water column acts to amplify the influence of bed sediments on lake water quality
- very susceptible to changes in hydrology due to catchment land use and climatic conditions
- more heavily impacted by invasive species such as pest fish and plants.

As a result of these factors, they are particularly vulnerable to deterioration, and require a specific management approach (Dean-Speirs et al., 2014a).

A range of factors have been identified as contributing to the ongoing decline of the health and wellbeing of many shallow lakes in the Waikato catchment, including:

- high loads of diffuse contaminant inputs of nutrients, sediment and bacteria from catchment run off and livestock access to the lakes
- internal regeneration of nutrients from sediment resuspension (by wind action or pest fish) and/or release of nutrients as a result of low oxygen events at the lakebed
- high abundance of pest fish (e.g., koi carp and catfish), and/or aquatic weeds (alligator weed, oxygen weed, hornwort)
- reduced water depth due to drainage and/or reduced flushing due to water control structures and artificial regimes such as the Lower Waikato Flood Control scheme
- past development of large exotic weed beds that create deoxygenation events and often precede a switch to turbid, nutrient enriched conditions
- removal of vegetation filtering potential in the catchment through drainage of marginal wetland vegetation, agricultural development and grazing access (NIWA, 2010).

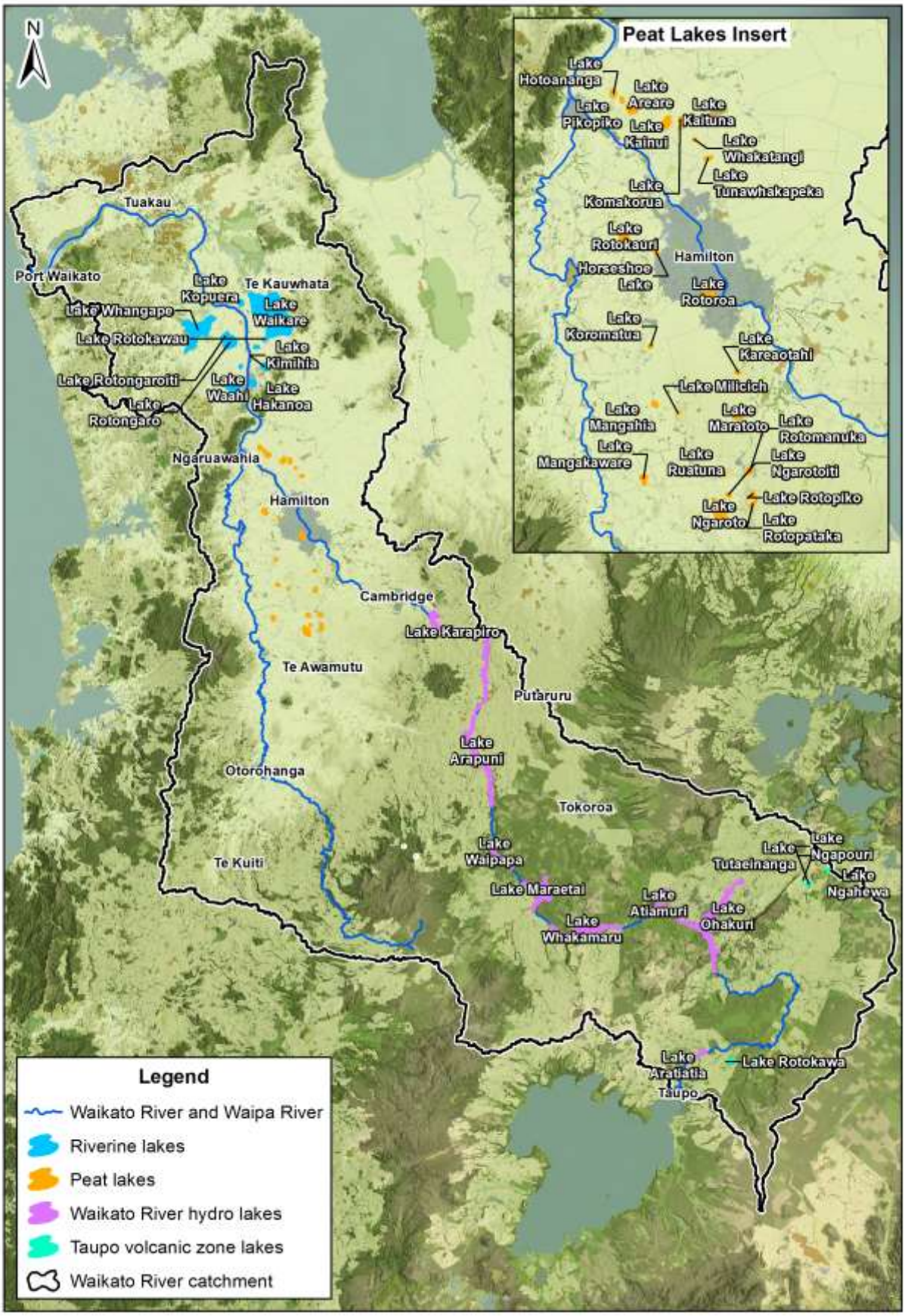

Figure 7. Location of lake groups within the Waikato catchment

Table 4. Characteristics of 36 Waikato/Waipā catchment shallow lakes. Current vegetation state is based on recent results of the standardised lake SPI macrophyte survey programme as of 2015 (source Waikato Regional Council).

Lake	Lake type	Lake area (ha)	Lake depth (m)	Catchment area (ha)	Current vegetation status
Areare	Peat	33	5.1	262	Non-vegetated
Hakanoa	Riverine	52	2.5	613	Non-vegetated
Kainui	Peat	25	6.7	132	Non-vegetated
Kaituna	Peat	12	1.3	580	Non-vegetated
Kimihia	Riverine	58	1	1485	Non-vegetated
Koromatua	Peat	10	0.8	200	Non-vegetated
Mangahia	Peat	8.4	1.8	354	Non-vegetated
Mangakaware	Peat	13	4.8	238	Poor
Maratoto	Peat	18	7.1	88	Non-vegetated
Milicich	Peat	2.2	2.3	54	Non-vegetated
Ngāhewa	Volcanic	8.4	5.5	746	Moderate
Ngāroto	Peat	108	4	1846	Non-vegetated
Ohinewai	Riverine	16	4.5	347	Non-vegetated
Okowhao	Riverine	21	2.2	Unknown	Non-vegetated
Penewaka	Riverine	4	1	Unknown	
Puketirini	Artificial	54	80	95	Poor
Rotokauri	Peat	42	4	933	Non-vegetated
Rotokawau	Peat	22	1.2	1804	Non-vegetated
Rotokotuku	Peat	11	8	18.5	
Rotomanuka North	Peat	12.3	8.7	479	Non-vegetated
Rotomanuka South	Peat			479	
Rotoroa	Peat	55	6	258	Moderate
Ruatuna	Peat	13	3.2	190	Non-vegetated
Rotopiko East	Peat	1.6	4.4	163	High
Rotopiko North	Peat	5	5	163	Excellent
Rotopiko South	Peat	8.3	3.3	163	High
Te Kapa	Riverine	1	1.5	Unknown	Non-vegetated
Te Koutu	Riverine	6	1.5	416	
Tunawhakaheke (Lake E)	Peat	7	1	100	Non-vegetated
Tutaeinanga	Volcanic	3.1	11	501	Non-vegetated
Waahi	Riverine	522	5	9221	Non-vegetated
Waikare	Riverine	3442	1.8	21055	Non-vegetated
Waiwhakareke (Horseshoe)	Peat	3	3	66	Non-vegetated
Waiwhata	Riverine	9	0.8	Unknown	Non-vegetated
Whakatangi	Peat	2.7	3.4	170	
Whangape	Riverine	1450	2.7	31767	Non-vegetated

8.1.2 Cultural importance

Lakes are an integral component within the whakapapa of rivers and wetlands. Due to the concealing nature of wetlands and lakes, iwi would store and preserve taonga within them, thus ensuring their safety. (Waikato-Tainui, 2013). Historically there have been many battles around

the lake areas, including Hingakaka (Battle of Hingakaka), Waikare and Kōpuera (Battle of Rangiriri), in which the bones of tribal ancestors currently lie preserved in state.

A number of lakes have pā sites associated with them. These pā are usually found around the lake margin, either on a natural or a 'built' mound (Environment Waikato, 2007). The lakes are commonly identified as food baskets for marae and communities. They are recreational playgrounds and contribute to the health and wellbeing of marae. Unfortunately, due to the degradation of lake waters, the ability of lakes to provide healthy food (tuna, kōura and kaeo) has diminished.

8.1.3 Water quality

Lake water quality state is generally determined by the degree of water column nitrogen (N) and phosphorus (P) enrichment. The enrichment process, known as eutrophication, occurs naturally over long time scales but is greatly accelerated by increases in nutrient loading from anthropogenic activities in the catchment. Elevated water column nutrient concentrations stimulate excessive plant growth leading to poor water clarity, reduced dissolved oxygen concentrations in the bottom waters during summer months, and an increase in nuisance algal blooms and scums (e.g. Cooke et al., 2005).

Water quality for most of the Waikato lakes for which monitoring data is available is generally poor, as indicated by high water column N and P concentrations, and consequently high chlorophyll a (Chl a) biomass and poor water column transparency.

Values of the trophic level index (TLI) (Burns et al., 2000), a New Zealand-specific measure of lake trophic state based on mean annual TP, TN, Chl a and Secchi depth, indicate 21 of the 22 monitored Waikato catchment lakes, including all peat and riverine lakes, are eutrophic or supertrophic (TLI score >4.0). Only one lake is mesotrophic (moderate trophic level, TLI 3-4; artificial Lake Puketirini) and no lakes are oligotrophic (TLI <3, low trophic status). Water column transparency, as measured by Secchi disk depth, is poor (less than 1m) across almost 70 per cent of monitored lakes (data from Waikato Regional Council, 2017).

Most Waikato monitored lakes are not compliant with the national bottom line for lake ecosystem health under the National Policy Statement for Freshwater Management (2011) – National Objectives Framework (NOF; New Zealand Government, 2014). Sixteen of the 22 lakes (73 per cent) fail the national bottomline (D Band) for all three ecosystem health attribute states (annual median TN, TP and Chl a).

Trends in lake TN, TP, Chl a and Secchi disk for 11 Waikato lakes with sufficient monitoring data available over the last 10 years (2008-2017) have been relatively stable for most systems despite high trophic levels. There was no significant (>1 per cent change per annum) deteriorating trend for TN, TP or Chl a in 10 of the 11 lakes analysed. A significant increase in TN is observed in Lake Hakanoa. Significant trends were also detected for water column transparency across five unvegetated lakes but these did not correspond to increasing TN, TP or Chl a in the same lakes. The results also indicated a large degree of inter-annual variability over time, especially in the larger riverine lakes (Whangape and Waikare).

Blue-green algae

Blue-green algae (cyanobacteria) often dominate the phytoplankton community in eutrophic lake systems. Several species are known to produce a range of toxins such as dermatoxins, hepatoxins and neurotoxins, as well as undesirable tastes, odours and surface scums. Potential risks to human health may occur following exposure through primary or secondary contact recreation, including respiratory, irritation and allergy symptoms (Huisman et al., 2005).

An assessment of human health risk for secondary contact recreation is carried out on five Waikato-Waipā lakes by Waikato Regional Council on a regular basis (Lakes Hakanoa, Ngāroto, Waahi, Waikare and Whangape). Monitoring results show that high cell counts (blooms) of

potentially toxic cyanobacteria species occur frequently in all five lakes during summer months. As such, health warnings are issued for these lakes regularly. Health warnings are not always constrained to summer and may also be issued during other seasons as well. Noteworthy is Lake Waikare, for which a health warning is in place all year round (Waikato Regional Council pers. comm.).

8.1.4 Biodiversity

Volcanic lakes

Both of the shallow volcanic lakes of the catchment are located in the volcanic/geothermal area around Maungakakaramea (Rainbow Mountain) and Wai-O-Tapu, in the upper Waikato River catchment. Native vegetation in these catchments is very low (<5.2 per cent). However, Lake Ngāhewa is *c.* 100m from the forested Maungakakaramea and there are five lakes within a 5km radius, including Lake Tutaeinanga (Dean-Speirs et al., 2014b).

Lake Ngāhewa has a low-moderate diversity of vegetation types adjoining the lake, including a flax and cabbage tree wetland and raupō reedland along the lakes margin. Tutaeinanga has only a narrow band of riparian vegetation, which is currently being managed to remove weeds and replant with native plants (Newland, 2016). Both lakes have a low abundance and diversity of submerged plants. Ngāhewa contains only a few shoots of a native pondweed while Tutaeinanga has beds of the weed egeria occurring in the shallow margins (Burton et al., 2015). Both lakes also occur upstream of multiple hydro dams and the Wai-O-Tapu geothermal field, resulting in a depauperate fishery. In the past kōura, kakahi, common smelt and rainbow trout have been recorded at the lakes. Recent surveys have only found kakahi remaining at Lake Tutaeinanga, and kakahi and rainbow trout at Lake Ngāhewa, the later stocked by the Eastern Bay of Plenty Fish and Game Council (Newland, 2016).

Ngāhewa has a high diversity of zooplankton (22 species), unlike Tutaeinanga with only 13 species (Duggan, 2008).

The lakes and surrounding reserves provide habitat for a range of other fauna including long tailed bat, and the following bird species of conservation significance: New Zealand dabchick, black shag, little black shag, North Island fernbird, spotless crake and Australian coot. Native and introduced waterfowl are common at both lakes (Newland, 2016).

Riverine lakes

There are 13 shallow riverine lakes in the Waikato River catchment, mostly located in the lower Waikato River catchment north of Te Kōwhai. The riverine lakes are part of an extensive nationally significant, interconnected system of open water, wetlands and waterways that provide important habitats for native plants and animals.

The most common wetland types that occur at the riverine lakes are floodplain marshes and swamps. At a few lakes, such as Whangape and Rotongaro, some of the swamps transition into fens. Plant species diversity is typically lower in the marshes, which are often dominated by a suite of exotic plants including crack willow, willow weeds, gypsywort, water purslane, water primrose and *Juncus* species. Native species tend to be localised and include emergent rushes and reeds such as raupō, jointed twig rush, kuta and *Carex* species.

Swamps typically have a higher plant species diversity and native species are more abundant. Common native plants include mānuka, cabbage tree, flax, swamp coprosma, *Carex* sp., *Machaerina* sp., *Eleocharis* sp. and *Juncus* sp. Several of the exotic species that commonly occur in swamps are ecosystem changing weeds and include grey willow and royal fern. Grey willow is likely to be present at all riverine lakes; royal fern is less widespread.

Several nationally rare plant communities occur at the riverine lakes. These include floodplain kahikatea forest at Lake Whangape, and amphibious turfs that occur on seasonally exposed

shorelines of some of the larger lakes such as Whangape, Rotongaro, Rotongaroiti and Waahi. It is within the amphibious turfs that most riverine lake plant species of conservation significance occur (e.g. *Fimbristylis velata*, *Ranunculus limosella*). Most threatened plant species that have been recorded in the past at riverine lakes, such as *Myriophyllum robustum* and *Gratiola concinna,* are now only found in the lower Waikato in the large remaining wetlands such as Whangamarino.

Almost all riverine lakes have poor water clarity and as a result none, except Te Otamanui Lagoon, are known to still contain submerged plants. It is possible that Lake Opuatia may still have submerged plants but this lake has not been surveyed since 1991 when it was found to have a low diversity (four species) of native and exotic plants (Champion et al., 1993).

Wetlands associated with riverine lakes are vastly reduced from their former extent. However, along with open water, they still provide habitat for many bird species. Recent bird surveys at a few riverine lakes have found them to contain a moderate diversity of native and exotic species (Richardson, 2017). Common water birds include black swan, Canada geese, mallard, pūkeko and paradise shelduck. Less common but present at many lakes are grey teal, little shag, black shag and kingfisher. There are recent records of the presence of birds of conservation significance (e.g. New Zealand dabchick, Australasian bittern, marsh crake, spotless crake, North Island fernbird, little black shag, black shag) at some lakes but they are unlikely to be as widespread as recorded in surveys undertaken by the Wildlife Service and others in the 1980s and 1990s, given the collapse of submerged plants and reduction of wetland habitat at most riverine lakes.

The riverine lakes are located within the New Zealand 'hot spot' for pest fish. Most lakes contain an abundance of the pest fish species koi carp, brown bullhead catfish, mosquito fish and goldfish. Rudd are also common and a notable population of European perch occur at Lake Waahi. Native fish species also occur at riverine lakes – the most common include shortfin eel and common bully. Other native fish species common in riverine lakes include common smelt and longfin eel. Less common are īnanga, grey mullet, black mudfish and lamprey (Waikato Regional Council, 2014b).

Kaeo (freshwater mussels) would have been widespread in riverine lakes in the past. They are now known only from Lake Waikare (Waikato Regional Council, 2014b).

The most frequently occurring macroinvertebrate taxa found in riverine lakes are oligochaetes and *Chironomus* sp. Other frequent occurrences included nematodes, nemerteans, platyhelminthes, Cyclopoidea and *Daphnia* (Hamilton et al., 2010).

Peat lakes

There are 37 peat lakes in the Waikato River catchment. Most occur in the Waipā and Waikato districts and were originally associated with the extensive Komakorau, Rukuhia and Moanatuatua bogs. In their natural state they have naturally acidic water that is low in nutrients and dissolved oxygen and stained by tannins. A number of highly specialised plant and animal species are associated with peat lakes in their natural state due to their ability to live in these conditions.

Today most of the peat lakes have high fertility and pH measurements more typical of riverine lakes. As a result they have contain similar plant and animal species. There are, however, some notable differences discussed below.

Seven of the peat lakes retain submerged plants. Rotopiko East and Rotopiko North both have diverse and abundant native submerged floras although the invasive weed *Utricularia gibba* has established in these lakes within the last 10 years (Burton et al., 2015). Lakes Pataka and Hotoananga both contained sparse covers of native charophytes and pondweeds when they were last surveyed (2007 and 2010). Rotopiko South, Mangakaware and Rotoroa all contain a mix of native and introduced plants with the invasive aquatic weed egeria occurring in Mangakaware and Rotoroa (Burton et al., 2015).

A legacy of stock grazing to the water edge at most peat lakes up until the last 10-20 years has resulted in a significant loss of wetlands associated with these lakes. It has also resulted in a loss of diversity in plant species and plant community types. Many of the plant species associated with low fertility wetlands are now absent or very uncommon. Some remain at Rotopiko East, Lake Milicich, Ngāroto and Maratoto, which still contain one or more of the following: sphagnum, sundews, wirerush and *Machaerina teretifolia* (Paula Reeves pers.comm.).

The peat lakes are less well connected for fish passage than the riverine lakes. As a result many of the Waipā peat lakes do not contain koi carp and Lake Koromatua does not contain any introduced fish (Waikato Regional Council, 2014b).

8.2 Goals

The following goals were developed by iwi, stakeholders and community representatives for the shallow lakes:

1. Nutrient and sediment inputs to lakes are reduced by a proportion that leads to noticeable improvements in lake water quality so that lakes are safe for swimming and gathering of Taonga species.
2. Natural hydrology at key lakes is restored including through enhancing the size and extent of wetlands and margins and increasing water levels.
3. Koi carp biomass is reduced by 80 per cent in key lakes and maintained at this level. The impacts of other pest fish on lake water quality are managed.
4. Innovative interventions are developed, tested and implemented to improve lake values, including options such as flocculants, dredging and enhancing lake embayments.
5. Important lake species such as kāeo and native aquatic plants are re-established.
6. Integrated catchment management programmes protect and enhance priority shallow lakes and their catchments.
7. Flagship lakes catchments are established and used for educational and promotion purposes.
8. A full range of ecosystem types associated with lakes in the catchment are protected and maintained with a focus on high value natural environments.
9. Communities have access to lakes for a range of recreational purposes including swimming and gathering of food.

8.3 Priority projects

Twenty-two projects relating to shallow lakes in the Waikato catchment scored a favourable cost-benefit score and have been include in the *Restoration Strategy*. These are illustrated in Figure 9. Projects are listed in order from lower to upper catchment and their priority ranking is provided in Section 8.3.1. Appendix 8 contains more detailed information on each project including recommended management actions and estimated costs.

Total project value is estimated at just over $31 million. Funding priorities include improved or new recreation facilities at three lakes, 87km of lake margin fencing, 230ha of revegetation, 330ha of plant pest control, pest fish removal programmes at three lakes, large constructed wetland treatment systems on the inflows of four key lakes, internal sediment load reduction at two lakes, re-establishment of native aquatic plants at four lakes and increasing tuna habitat at two lakes.

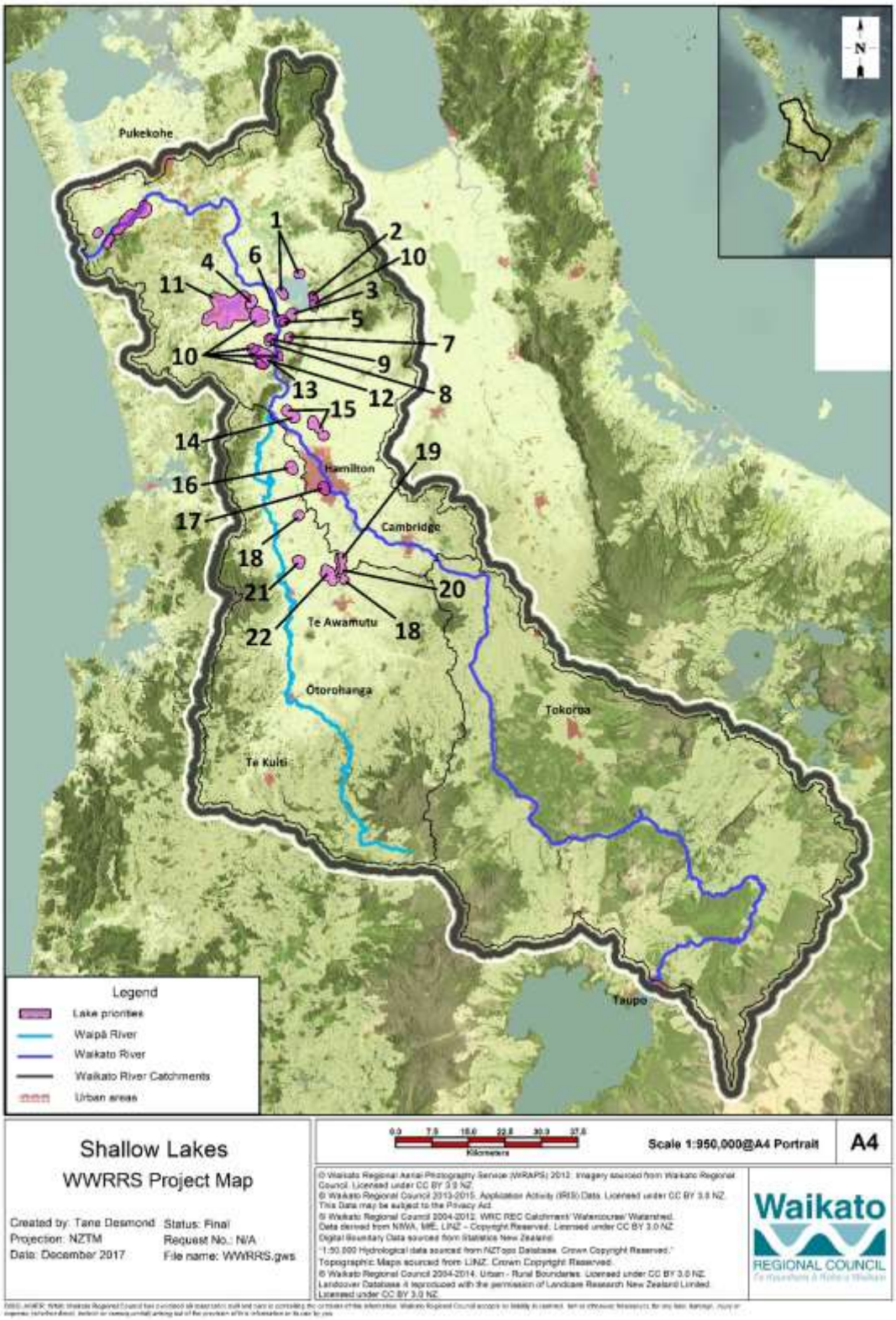

Figure 8. Location of priority projects around shallow lakes

8.3.1 Summary tables of priority projects

L 1	Increase eel habitat in Lake Waikare	Medium priority

Location: Lake Waikare – a 3442ha lake located to the southeast of Te Kauwhata township (and connected to the Whangamarino Wetland by the Pungarehu Canal).

Summary of priority works

- Fell alder trees into the lake and anchor in place to form eel habitat
- Native planting
- Resource consent
- Project management/staffing/incidentals (25%)

Total estimated cost: $103,200

L 2	Development of Lake Waikare South Reserve for recreation	High priority

Location: A Waikato District Council reserve located on the eastern side of Lake Waikare between the lake and Waikare Road.

Summary of priority works

- Boardwalk construction (85m)
- Gravel walkway construction (415m)
- Fencing (450m)
- Native planting (20,600 trees)
- Picnic area development
- Resource consent
- Project management/staffing/incidentals (15%)

Total estimated cost: $423,031

L 3	Biodiversity enhancement of Lake Rotokawau	High priority

Location: Lake Rotokawau and surrounding wetland – a 22ha peat lake and 145ha wetland situated southwest of Lake Waikare and connected to Lake Waikare by a 500m channel.

Summary of priority works

- Investigate isolating the lake from surface flows
- Implementation of isolation measures
- Fencing (3.5km)
- Native planting (2ha)
- Weed control
- Project management/staffing/incidentals (20%)

Total estimated cost: $367,597

L 4	Enhancement of wetland habitat at Lake Te Kapa and Lake Waiwhata	Medium priority

Location: Lake Te Kapa (0.7ha) and Lake Waiwhata (2.2ha) – two peat lakes located between Lake Whangape and Lake Rotongaroiti, about 10 minutes north of Huntly.

Summary of priority works

- Fencing (1.15km)
- Willow control
- Weed control
- Native planting (6.45ha)
- Project management/staffing/incidentals (25%)

Total estimated cost: $325,877

L 5	Increase eel habitat in Lake Ohinewai	High priority

Location: Lake Ohinewai – a shallow (4.5m deep) 16ha peat lake located within a pastoral catchment (347ha in size) near the township of Ohinewai.

Summary of priority works

- Investigate and design appropriate woody debris structures that can be installed for eel habitat.
- Resource consent
- Install structures
- Project management/staffing/incidentals (25%)

Total estimated cost: $55,000

L 6	Development of Lake Ohinewai Reserve for recreation	Medium priority

Location: Waikato District Council and Department of Conservation reserve located next to and around Lake Ohinewai

Summary of priority works

- Development of reserve concept plan
- Access road construction
- Re-vegetation (25ha)
- Installation of walkways, picnic and viewing areas
- Additional planting and installation of amenity structures
- Project management/staffing/incidentals (20%)

Total estimated cost: $2,094,960

L 7	Restoring minimum water level at Lake Kimihia	High priority

Location: Lake Kimihia – a 44ha riverine lake on the northeastern outskirts of Huntly.

Summary of priority works

- Site investigation and ground level surveys for weir design
- Design weir and bund
- Resource consents
- Bund construction
- Weir construction
- Maintenance
- Project management/staffing/incidentals (20%)

Total estimated cost: $150,000

L 8	Water quality and habitat enhancement at Lake Okowhao	High priority

Location: Lake Okowhao – an 8ha riverine lake located north of Huntly.

Summary of priority works

- Design and construct treatment wetland
- Resource consent
- Weed control
- Willow control
- Native planting (5ha), fencing (1.5km)
- Project management/staffing/incidentals (20%)

Total estimated cost: $1,285,302

L 9	Provide fish passage past Lake Okowhao outlet stream pump station and floodgate	High priority

Location: Lake Okowhao outlet stream pump and floodgate near Te Ohaaki Road, north of Huntly.

Summary of priority works

- Installation of fish friendly floodgate
- Installation of fish friendly flood pump
- Project management/staffing/incidentals (15%)

Total estimated cost: $280,600

L 10	Biodiversity enhancement of selected wetlands around shallow lakes	Very high priority

Location: Selected wetlands around Lakes Hakanoa, Rotongaro and Rotongaroiti, Waahi and Waikare (see Appendix 9 for detail on which wetlands are a priority).

Summary of priority works

- Fencing (16.6km)
- Native planting (76.55ha)
- Willow control
- Weed control
- Hydrological re-instatement
- Project management/staffing/incidentals (30%)

Total estimated cost: $4,193,523

L 11	Water quality and habitat enhancement at Lake Whangape	Very high priority

Location: Lake Whangape – the second largest lake (1450ha) in the lower Waikato River catchment, located 5km west of Rangiriri township.

Summary of priority works

- Fencing (26.1km)
- Alligator weed control
- Weed and willow control
- Native planting (12.02ha)
- Project management/staffing/incidentals (20%)

Total estimated cost: $1,826,471

L 12	Water quality and habitat enhancement at Lake Waahi	Very high priority

Location: Lake Waahi – the third largest lake (522ha) in the lower Waikato catchment, located west of Huntly township.

Summary of priority works

- Reduce external sediment loads by undertaking hill country soil conservation work and riparian fencing and planting
- Add flocculent to lake inflow
- Project management/staffing/incidentals (15%)

Total estimated cost: $5,364,566

L 13	Intensive removal of pest fish at Lake Waahi	Very high priority

Location: Lake Waahi – the third largest lake (522ha) in the lower Waikato catchment, located west of Huntly township.

Summary of priority works

- Develop a detailed project plan
- Engineering assessments and design of pest fish barrier
- Consultation and cultural assessment
- Resource consents/permits
- Intensive removal of pest fish
- Monitoring for koi carp population changes and overall ecosystem effects of the work
- Landowner reparation
- Project management/staffing/incidentals (30% in Year 1 and 20% in Years 2-10)

Total estimated cost: $2,642,732

L 14	Water quality and habitat enhancement at Lake Areare	High priority

Location: Lake Areare – a 33ha peat lake in the Horsham Downs area.

Summary of priority works

- Design and construct a treatment wetland
- Resource consents
- Native planting (1.7ha)
- Project management/staffing/incidentals (20%)

Total estimated cost: $277,220

L 15	Wetland enhancement at Horsham Downs lakes	High priority

Location: Lakes Pikopiko, Hotoananga, Kaituna, Tunawhakaheke, Whakatangi and Komakorau. These small peat lakes are located in the Horsham Downs area and collectively cover 71.7ha. All of the lakes discharge to the Waikato River near Taupiri.

Summary of priority works

- Fencing (1.25km)
- Native planting (6.7ha)
- Weed control
- Possum control
- Project management/staffing/incidentals (20%)

Total estimated cost: $492,458

L 16	Development of Lake Rotokauri Reserve for recreation	High priority

Location: Lake Rotokauri – a 41.7ha lake located on the northern boundary of Hamilton city and the southern boundary of Waikato district.

Summary of priority works

- Walkway construction (2km)
- Native planting (6ha)
- Installation of picnic and viewing areas
- Possum control
- Additional planting and installation of amenity structures
- Project management/staffing/incidentals (20%)

Total estimated cost: $1,319,185

L 17	Water quality and habitat enhancement at Lake Rotoroa	Very high priority

Location: Lake Rotoroa (Hamilton Lake) – a 55ha lake situated in central Hamilton

Summary of priority works

- Public information campaign to increase awareness of the impact of waterfowl on lake water quality
- Management of pest fish
- Eradication of egeria and native plant re-establishment
- Project management/staffing/incidentals (20%)

Total estimated cost: $1,075,200

L 18	Wetland enhancement at Lakes Rotopataka, Pataka and Posa	Medium priority

Location: Lake Pataka (4.6ha) and Lake Posa (2ha) are located south of Templeview. Lake Pataka flows into Lake Posa and discharges to the Waipā River. Lake Rotopataka (2.8ha) is located north of Te Awamutu and discharges to the Waikato River.

Summary of priority works

- Fencing (795m)
- Native planting (5.5ha)
- Willow control
- Project management/staffing/incidentals (20%)

Total estimated cost: $330,901

L 19	Protecting and enhancing water quality at Lake Rotomanuka	Very high priority

Location: Lake Rotomanuka – located near Ōhaupō, this is a complex of two separate lake basins (Lake Rotomanuka North and Lake Rotomanuka South [Lake Gin]) that are hydrologically connected through a 10ha shallow seasonally flooded wetland.

Summary of priority works

- Purchase of land (6ha)
- Fencing (1.5km)
- Native planting (8ha)
- Construction of treatment systems on drains
- Resource consents and consultation for constructed treatment systems
- Baseline survey of Lake Rotomanuka North to establish fish densities
- Annual fishing of Rotomanuka North
- Submerged plant translocation
- Project management/staffing/incidentals (20%)

Total estimated cost: $1,323,967

L 20	Lake Rotopiko pest fish eradication	Medium priority

Location: Lake Rotopiko peat lake complex – situated south of Ōhaupō. The complex consists of three permanent lakes named North (5.3ha, 4m deep), East (1.6ha, 4.4m deep) and South (8.3ha, 3.6m deep). There is an ephemeral wetland area between North and South lakes that connects the two lakes during wet seasons (referred to as Winter Lake).

Summary of priority works

- Consultation and cultural assessment
- Resource consents/permits
- Pest fish eradication
- Monitoring success of pest fish eradication
- Return indigenous fish species
- Landowner reparation
- Project management/staffing/incidentals (20%)

Total estimated cost: $496,328

L 21	Restoration of wetland and aquatic plant ecosystems at Lake Mangakaware	Very high priority

Location: Lake Mangakaware – a 12.9ha peat lake located west of Te Awamutu.

Summary of priority works

- Fencing (2.05km)
- Native revegetation of lake margin/reserve (27.3ha)
- Construction of treatment systems on drains
- Resource consents and consultation for constructed treatment systems
- Annual maintenance of sediment basins/silt traps for 10 years
- Eradication of egeria (including resource consent, scoping survey,hand weeding, barrier control and monitoring)
- Project management/staffing/incidentals (20%)

Total estimated cost: $1,488,402

L 22	Water quality and habitat enhancement at Lake Ngāroto	Medium priority

Location: Lake Ngāroto – the largest of the peat lakes in the Waikato region with an area of 108ha, located approximately 5km north of Te Awamutu.

Summary of priority works

- Land purchase (19ha)
- Fencing
- Construction of treatment systems on drains
- Resource consents and consultation for constructed treatment systems
- Annual maintenance of sediment basins/silt traps for 10 years
- Alum dosing
- Project management/staffing/incidentals (20%)

Total estimated cost: $5,639,540

9 Waikato-Tainui priorities

9.1 Goals

The following goals were developed for Waikato-Tainui priorities:

1. The life creating, and life supporting, capabilities of mauri is protected and restored.
2. Taonga species are enhanced, accessible and sustained to ensure intergenerational preservation and future use.
3. Cultural and environmental values are given priority in decision making for natural resource management and use.
4. Traditional water sources for cultural purposes are protected in all projects.
5. Maatauranga Maaori and tikanga are incorporated in natural resource use and restoration projects. This includes traditional methods for site preparation, restoration techniques, health and safety.

9.2 Priority projects

Waikato-Tainui has identified 36 projects totalling $29,542,168. These are summarised in Section 9.3. A more comprehensive plan for each project can be found in Appendix 9.
The Waikato-Tainui rohe was divided into four areas covering Karāpiro to Ngaaruawaahia, Ngaaruawaahia to Mercer, Mercer to Te Puuaha o Waikato and Puuniu River junction to the confluence with the Waikato River in Ngaaruawaahia. In each of these areas, these projects generally focus on large scale planting (160ha total), fencing (189km total), protection and acknowledgement of sites of significance (120 pou) and capacity training of iwi to fulfil responsibilities as kaitiaki. There are also tribally wide projects which focus on education of rangatahi (youth) and supporting particular areas and activities associated with the Kīngitanga.

9.2.1 Summary tables of priority projects

Waikato-Tainui – overall rohe

WT 1	Enabling manawhenua to engage in river restoration – Waikato-Tainui	Very high priority

Central and lower Waikato, Waipaa: Area A and Area C
Location: Waikato-Tainui area of the Waikato River from Karapiro to Te Puuaha and the Waipaa River from the Puuniu Junction down to Ngaaruawaahia.

Summary of priority works

- Creation of education package
- Waananga to determine education areas
- Purchasing resources to support training
- Delivery of education programme
- Project management/staffing/incidentals (30%)

Total estimated cost: $4,725,000

WT 2	Waikato-Tainui river education programme	Very high priority

Central and lower Waikato, Waipaa: Area A and Area C
Location: Waikato-Tainui area of the Waikato River from Karapiro to Te Puuaha and the Waipaa River from the Puuniu Junction down to Ngaaruawaahia.

Summary of priority works

- Develop education curriculum
- Delivery of education programme
- Create education package
- Resources required to support programme
- Project management/staffing/incidentals (25%)

Total estimated cost: $5,800,000

WT 3	Waikato-Tainui river champions	Very high priority

Central and lower Waikato, Waipaa: Area A and Area C
Location: Waikato-Tainui area of the Waikato River from Karapiro to Te Puuaha and the Waipaa River from the Puuniu Junction down to Ngaaruawaahia.

Summary of priority works

- Organise celebratory dinner
- Carve tohu for champions
- Create champion celebration format
- Project management/staffing/incidentals (20%)

Total estimated cost: $160,000

WT 4	Mana o te Awa – Water quality monitoring – Waikato-Tainui	High priority

Central and lower Waikato, Waipaa: Area A and Area C
Location: Waikato-Tainui area of the Waikato River from Karapiro to Te Puuaha and the Waipaa River from the Puuniu Junction down to Ngaaruawaahia.

Summary of priority works

- Waananga to establish kaitiaki
- Water quality field testing kits
- Acquire SHMAK kits
- Capacity building
- Project management/staffing/incidentals (20%)

Total estimated cost: $723,456

Waikato-Tainui – Te Puuaha Marae (Mercer ki Te Puuaha o Waikato)

WT-TP1	Tuatahi – tuna habitat ponds – Te Puuaha Marae	Very high priority

Central and lower Waikato: Area A
Location: Waikato River and all tributaries between Mercer and Port Waikato.

Summary of priority works

- Pond construction (15)
- Planting (4.5ha)
- Fencing (6km)
- Capacity building
- Project management/staffing/incidentals (30%)

Total estimated cost: $842,108

WT-TP2	Tuarua – 10ha wetland creation, restoration and protection – Te Puuaha Marae	Very high priority

Central and lower Waikato: Area A
Location: Waikato River and all tributaries between Mercer and Port Waikato.

Summary of priority works

- Fencing (4km)
- Cultural training and safety
- Wetland planting (10ha)
- Capacity building
- Project management/staffing/incidentals (30%)

Total estimated cost: $768,976

WT-TP3	Tuarua – identification, restoration and protection of waahi tapu and sites of significance – stage 1 – Te Puuaha Marae	Very high priority

Central and Lower Waikato: Area A
Location: Waikato River and all tributaries between Mercer and Port Waikato.

Summary of priority works

- Waananga to identify sites (10)
- Photographing and mapping of sites
- Interview knowledge holders
- Capacity and capability building
- Project management/staffing/incidentals (30%)

Total estimated cost: $252,980

WT-TP4	Tuarua – restoring and protecting waahi tapu and sites of significance – stage 2 – Te Puuaha Marae	Very high priority

Central and lower Waikato: Area A
Location: Waikato River and all tributaries between Mercer and Port Waikato.

Summary of priority works

- Fencing of 20 sites (20km per site)
- Riparian planting around 20 sites (20ha)
- iPou or carved pou
- Capacity and capability building
- Project management/staffing/incidentals (30%)

Total estimated cost: $676,423

WT-TP5	Tuarua – 30 puna restoration – Te Puuaha Marae	High priority

Central and lower Waikato: Area A
Location: Waikato River and all tributaries between Mercer and Port Waikato.

Summary of priority works

- Fencing of puna (6km)
- Waananga to identify puna
- Riparian planting around puna
- Capacity and capability building
- Project management/staffing/incidentals (30%)

Total estimated cost: $662,090

WT-TP6	Tuatoru – 10km riparian and taonga species habitat restoration – Te Puuaha Marae	High priority

Central and lower Waikato: Area A
Location: Waikato River and all tributaries between Mercer and Port Waikato.

Summary of priority works

- Installation of fish habitat structures
- Planting (5ha)
- Fencing (10km)
- Capacity building
- Project management/staffing/incidentals (30%)

Total estimated cost: $704,457

WT-TP7	Tuatoru – 20 watercress restoration projects – Te Puuaha Marae	High priority

Central and Lower Waikato: Area A
Location: Waikato River and all tributaries between Mercer and Port Waikato.

Summary of priority works

- Waananga to identify sites
- Grow watercress seedlings
- Watercress restoration
- Capacity building
- Project management/staffing/incidentals (25%)

Total estimated cost: $100,000

Waikato-Tainui – Ngaaruawaahia ki Mercer

WT-M1	Tuatahi – 10ha wetland creation, restoration and protection – Ngaaruawaahia ki Mercer	Very high priority

Central and lower Waikato: Area A
Location: Waikato River and all tributaries between Ngaaruawaahia and Mercer.

Summary of priority works

- Fencing (4km)
- Cultural training and safety
- Wetland planting (10ha)
- Capacity building
- Project management/staffing/incidentals (30%)

Total estimated cost: $768,976

WT-M2	Tuatahi – restoring access to the Waikato River through waka taua – Turangawaewae	Very high priority

Central and lower Waikato: Area A
Location: Turangawaewae Marae.

Summary of priority works

- Construction of waka taua shed facilities
- Waananga with whanau
- Paaharakeke planting (1ha)
- Capacity and capability building
- Project management/staffing/incidentals (15%)

Total estimated cost: $722,400

WT-M3	Tuatahi – restoring access to Waikato River and waka taua – Waahi Paa	Very high priority

Central and lower Waikato: Area A
Location: Waahi Paa.

Summary of priority works

- Engineering and landscape design
- Gather information for pou
- iPou and carved pou
- Building boat ramp and waka landing
- Project management/staffing/incidentals (30%)

Total estimated cost: $531,974

WT-M4	Tuatahi – identification, restoration and protection of waahi tapu and sites of significance – stage 1 – Ngaaruawaahia ki Mercer	Very high priority

Central and lower Waikato: Area A
Location: Waikato River and all tributaries between Ngaaruawaahia and Mercer.

Summary of priority works

- Waananga to identify sites (10)
- Mapping and photography of sites
- Interview knowledge holders
- Capacity and capability building
- Project management/staffing/incidentals (30%)

Total estimated cost: $252,980

WT-M5	Tuarua – restoring and protecting Waahi Paa's waahi tapu – stage 2 – Ngaaruawaahia ki Mercer	Very high priority

Central and lower Waikato: Area A
Location: Waahi Paa.

Summary of priority works

- Site fencing (0.6km)
- Installation of cultural symbolism
- Site preparation and planting of urupa
- Waananga with whanau
- Project management/staffing/incidentals (30%)

Total estimated cost: $676,423

WT-M6	Tuarua – restoring and protecting waahi tapu and sites of significance – stage 2 – Ngaaruawaahia ki Mercer	Very high priority

Central and lower Waikato: Area A
Location: Waikato River and all tributaries between Ngaaruawaahia and Mercer.

Summary of priority works

- Fencing of 20 sites (20km per site)
- Riparian planting around 20 sites (20ha)
- iPou or carved pou
- Capacity and capability building
- Project management/staffing/incidentals (30%)

Total estimated cost: $676,423

WT-M7	Tuarua – 30 puna restoration – Ngaaruawaahia ki Mercer	High priority

Central and lower Waikato: Area A
Location: Waikato River and all tributaries between Ngaaruawaahia and Mercer.

Summary of priority works

- Waananga to identify puna
- Fencing of puna (6km)
- Riparian planting around puna
- Capacity and capability building
- Project management/staffing/incidentals (30%)

Total estimated cost: $662,090

WT-M8	Tuatoru – tuna habitat ponds – Ngaaruawaahia ki Mercer	High priority

Central and lower Waikato: Area A

Location: Waikato River and all tributaries between Ngaaruawaahia and Mercer.

Summary of priority works

- Pond construction (15)
- Planting (4.5ha)
- Fencing (6km)
- Capacity building
- Project management/staffing/incidentals (30%)

Total estimated cost: $842,108

WT-M9	Tuatoru – 10km riparian and taonga species habitat restoration project – Ngaaruawaahia ki Mercer	Very high priority

Central and lower Waikato: Area A

Location: Waikato River and all tributaries between Ngaaruawaahia and Mercer.

Summary of priority works

- Installation of fish habitat structures
- Planting (5ha)
- Fencing (10km)
- Capacity building
- Project management/staffing/incidentals (30%)

Total estimated cost: $725,257

WT-M10	Tuatoru – 20 watercress restoration projects – Ngaaruawaahia ki Mercer	High priority

Central and lower Waikato: Area A

Location: Waikato River and all tributaries between Ngaaruawaahia ki Mercer.

Summary of priority works

- Waananga to identify sites
- Grow watercress seedlings
- Watercress restoration
- Capacity building
- Project management/staffing/incidentals (25%)

Total estimated cost: $100,000

Waikato-Tainui – Karapiro ki Ngaaruawaahia

WT-K1	Tuatahi – 10km riparian and taonga species habitat restoration project – Karāpiro ki Ngaaruawaahia	Very high priority

Central and lower Waikato: Area A
Location: Waikato River and all tributaries between Lake Karapiro and Ngaaruawaahia.

Summary of priority works

- Installation of fish habitat structures
- Planting (5ha)
- Fencing (10km)
- Capacity building
- Project management/staffing/incidentals (30%)

Total estimated cost: $725,257

WT-K2	Tuatahi – identification, restoration and protection of waahi tapu and sites of significance – stage 1 – Karapiro ki Ngaaruawaahia	Very high priority

Central and lower Waikato: Area A
Location: Waikato River and all tributaries between Lake Karapiro and Ngaaruawaahia

Summary of priority works

- Waananga to identify sites (10)
- Mapping at photographing sites
- Interview knowledge holders
- Capacity and capability building
- Project management/staffing/incidentals (30%)

Total estimated cost: $252,980

WT-K3	Tuarua – restoring and protecting waahi tapu and sites of significance – stage 2 – Karapiro ki Ngaaruawaahia	Very high priority

Central and lower Waikato: Area A
Location: Waikato River and all tributaries between Lake Karapiro and Ngaaruawaahia.

Summary of priority works

- Fencing of 20 sites (20km per site)
- Riparian planting around 20 sites (20ha)
- iPou or carved pou
- Capacity and capability building
- Project management/staffing/incidentals (30%)

Total estimated cost: $676,423

WT-K4	Tuarua – 10ha wetland creation, restoration and protection – Karapiro ki Ngaaruawaahia	Very high priority

Central and lower Waikato: Area A
Location: Waikato River and all tributaries between Lake Karapiro and Ngaaruawaahia.

Summary of priority works

- Fencing (4km)
- Cultural training and safety
- Wetland planting (10ha)
- Capacity building
- Project management/staffing/incidentals (30%)

Total estimated cost: $768,976

WT-K5	Tuarua – tuna habitat ponds – Karapiro ki Ngaaruawaahia	Very high priority

Central and lower Waikato: Area A
Location: Waikato River and all tributaries between Lake Karapiro and Ngaaruawaahia.

Summary of priority works

- Pond construction (15)
- Planting (4.5ha)
- Fencing (6km)
- Capacity building
- Project management/staffing/incidentals (30%)

Total estimated cost: $842,108

WT-K6	Tuatoru – 20 watercress restoration projects – Karapiro ki Ngaaruawaahia	High priority

Central and lower Waikato: Area A
Location: Waikato River and all tributaries between Lake Karapiro and Ngaaruawaahia.

Summary of priority works

- Waananga to identify sites
- Grow watercress seedlings
- Watercress restoration
- Capacity building
- Project management/staffing/incidentals (25%)

Total estimated cost: $100,000

WT-K7	Tuatoru – 30 puna restoration – Karapiro ki Ngaaruawaahia	High priority

Central and lower Waikato: Area A
Location: Waikato River and all tributaries between Lake Karapiro and Ngaaruawaahia.

Summary of priority works

- Waananga to identify puna
- Fencing of puna (6km)
- Riparian planting around puna
- Capacity and capability building
- Project management/staffing/incidentals (30%)

Total estimated cost: $662,090

Waikato-Tainui – Puuniu ki Ngaaruawaahia

WT-P1	Tuatahi – tuna habitat ponds – Puuniu ki Ngaaruawaahia	High priority

Waipaa: Area C
Location: Waikato River and all tributaries between Puuniu junction on Waipaa River and Ngaaruawaahia.

Summary of priority works

- Pond construction (15)
- Planting (4.5ha)
- Fencing (6km)
- Capacity building
- Project management/staffing/incidentals (30%)

Total estimated cost: $842,108

WT-P2	Tuatahi – 30 puna restoration – Puuniu ki Ngaaruawaahia	High priority

Waipaa: Area C
Location: Waikato River and all tributaries between Puuniu junction on Waipaa River and Ngaaruawaahia.

Summary of priority works

- Waananga to identify puna
- Fencing of puna (6km)
- Riparian planting around puna
- Capacity and capability building
- Project management/staffing/incidentals (30%)

Total estimated cost: $662,090

WT-P3	Tuatahi – tuna educational ponds – Whatawhata	Very high priority

Waipaa: Area C
Location: Whatawhata.

Summary of priority works

- Earthworks to create ponds
- Planting (1ha)
- Fencing of ponds (8km)
- Capacity and capability building
- Project management/staffing/incidentals (25%)

Total estimated cost: $112,379

WT-P4	Tuatahi – identification, restoration and protection of waahi tapu and sites of significance – stage 1 Puuniu ki Ngaaruawaahia	Very high priority

Waipaa: Area C
Location: Waikato River and all tributaries between Puuniu River junction on the Waipaa River and Ngaaruawaahia.

Summary of priority works

- Waananga to identify sites (10)
- Interview knowledge holders
- Photograph and map of sites
- Capacity and capability building
- Project management/staffing/incidentals (25%)

Total estimated cost: $252,980

WT-P5	Tuatoru – restoring and protecting waahi tapu and sites of significance – stage 2 – Puuniu ki Ngaaruawaahia	Very high priority

Waipaa: Area C
Location: Waikato River and all tributaries between Puuniu River junction on the Waipaa River and Ngaaruawaahia.

Summary of priority works

- Fencing of 20 sites (20km per site)
- Riparian planting around 20 sites (20ha)
- iPou or carved pou
- Capacity and capability building
- Project management/staffing/incidentals (30%)

Total estimated cost: $676,423

WT-P6	Tuarua – 10ha wetland creation, restoration and protection – Puuniu ki Ngaaruawaahia	Very high priority

Waipaa: Area C

Location: Waikato River and all tributaries between Puuniu River junction on the Waipaa River and Ngaaruawaahia.

Summary of priority works

- Fencing (4km)
- Wetland planting (10ha)
- Cultural training and safety
- Capacity building
- Project management/staffing/incidentals (30%)

Total estimated cost: $768,976

WT-P7	Tuarua – 10km riparian and taonga species habitat restoration – Puuniu ki Ngaaruawaahia	High priority

Waipaa: Area C

Location: Waikato River and all tributaries between Puuniu River junction on the Waipaa River and Ngaaruawaahia.

Summary of priority works

- Installation of fish habitat structures
- Planting (5ha)
- Fencing (10km)
- Capacity building
- Project management/staffing/incidentals (30%)

Total estimated cost: $725,257

WT-P8	Tuatoru – 20 watercress restoration projects – Puuniu ki Turangawaewae	High priority

Waipaa: Area C

Location: Waikato River and all tributaries between Puuniu River junction on the Waipaa River and Ngaaruawaahia.

Summary of priority works

- Waananga to identify sites
- Grow watercress seedlings
- Watercress restoration
- Capacity building
- Project management/staffing/incidentals (20%)

Total estimated cost: $100,000

10 Raukawa priorities

10.1 Priority projects

Raukawa have identified 13 priority areas to support the key themes of restoring the relationship with the Waikato awa and capturing and sharing knowledge. These priority areas include empowering the iwi through kaitiakitanga wānanga, capturing and sharing mātauranga-a-Raukawa, restoring mahinga kai, identifying significant sites, planting and fencing, and reconnecting with the entire river and its waters.

Raukawa have developed two sets of potential project areas within the Raukawa rohe (area). To Raukawa, the relationship with the awa was of paramount importance, and this is reflected in the priority areas listed below.

Iwi, hapū, whanau and uri of Raukawa are encouraged to develop projects as guided by these project areas. Further information on these priorities is provided in Appendix 10.

Funding priority one: relationship

The objective for funding priority one is the enhancement and restoration of the relationship between Raukawa uri, whanau, marae, hapū, iwi and the Waikato and Waipā River catchments.

Potential project areas

In the table below, there are a selection of projects that are considered to contribute to achieving the above objective. This is not a definitive list of potential projects, but is intended to act as guidance to people or organisations seeking funding or making funding decisions in the above priority area.

POTENTIAL PROJECT AREAS	SUMMARY OF POTENTIAL PROJECTS
Mahinga kai restoration	Tuna restoration: The restoration of tuna stocks within the catchment. The objective could include increasing tuna habitats within the Raukawa takiwā and would need to include wānanga on traditional methods of gathering and preparing tuna. Watercress restoration: Raukawa uri are able to harvest watercress from their traditional and/or hydroponic sites. Kōura restoration: Investigate why kōura populations have decreased in areas. Establishing fenced riparian margins in areas which support healthy kōura populations, and monitor kōura.
Reconnection to ngā awa o Raukawa	Restoring the relationship between Raukawa marae/hapū with the various awa that surround marae. This could include disability accessways from marae to awa, enhancing and restoring the mauri by riparian planting and fencing, and the restoration of traditional swimming holes.
Raukawa waka hauora	The creation of a Raukawa waka hauora programme. It could include a wānanga programme that utilises the healing qualities of the Waikato River to aid the health and wellbeing of the Raukawa uri, utilising Raukawa tikanga and kawa.
Raukawa Marae waka ama	Raukawa to assert their mana whakahaere along the awa through waka ama. Raukawa iwi/marae/hapū to regularly use the awa for recreational purposes and allowing uri to gain an understanding of the importance of the awa to the iwi.

POTENTIAL PROJECT AREAS	SUMMARY OF POTENTIAL PROJECTS
Raukawa kaitiaki enhancement	Raukawa marae/hapū become more effective kaitiaki as guardians, educators and nurturers of life. This could include the creation of nurseries to enable marae to undertake riparian planting while creating a whakapapa for plants to whakahono marae to the awa, along with ensuring that Raukawa kaitiaki are trained to carry out these activities which would include putting kaitiaki through the New Zealand Certificate in Conservation.
Raukawa Historical Site Visualisation	Raukawa Historical Site Visualisation will provide cultural assets that may be displayed and kept in a Raukawa taonga room and/or for inclusion on a future website. The project will help facilitate a connection to the history and land for the people. It will provide a visual narrative of sites along the Waikato River as they would have appeared historically. This will be achieved through the use of latest computer technologies available including 3D modelling.
Raukawa reconnection with Ngā Wāhi Tūturu	Restoring the relationship between Raukawa marae/hapū with the various historical sites of significates within the catchment. This project would see improved access to sites throughout the takiwa and ensure the cultural integrity of the sites are restored and protected (where appropriate). This may be achieved through legacy planting, site identification or whare kōrero.

Funding priority two: mātauranga Raukawa and knowledge

The objective of funding priority two is the enhancement and restoration of mātauranga Raukawa, knowledge and its application. For this purpose of this priority, mātauranga Raukawa is defined in *Te Rautaki Taiao* and is set out below. Knowledge is defined as all other sources of information.

Mātauranga Raukawa

Mātauranga is ancestral and traditional information and knowledge that has been developed through the centuries and generations. Mātauranga Māori is a term that describes the body of knowledge originating from ancestors, including the Māori worldview and perspectives, Māori creativity and cultural practices. Mātauranga Māori embraces individual, local, and collective knowledge, Māori values, cultural expressions, perspectives, observations, being traditional, historical and contemporary.

For Raukawa mātauranga, Raukawa would include:

- practical common sense, based on teachings and experience passed on from generation to generation
- knowledge of the whenua, covering knowledge of the environment and the relationship between things
- a holistic perspective. It cannot be compartmentalised and cannot be separated from the people who hold it. It is rooted in the spiritual health, culture and language of the people. It is a way of life
- an authority system. It sets out the rules governing the use of resources, respect, an obligation to share. It is dynamic, cumulative and stable
- a way of life. Wisdom is using knowledge in good ways. It is using the heart and the head together. It comes from the spirit in order to survive, and gives credibility to people.

Potential project areas
Below is a selection of potential projects areas that are considered to achieve or contribute to the achievement of the above objectives. It is not a definitive list of potential projects but is meant to act as a guide to potential people or organisations seeking funding or making funding decisions in the above areas.

POTENTIAL PROJECT AREAS	SUMMARY OF POTENTIAL PROJECTS
Mātauranga Raukawa restoration	A series of wānanga held annually throughout the year. Each wānanga will focus on certain aspects of mātauranga Māori.
Mātauranga Raukawa; Matea ako o Raukawa Kaitiaki Raukawa Education: The Learning Needs of Raukawa Kaitiaki	Developing a new approach to education that both embodies the unique place of the awa in Raukawa cultural identity. This approach would also need to recognise the opportunities for new knowledge to be created through collaboration for our awa, our iwi, our people. This multi-year project will establish an education programme delivered using mātauranga Raukawa and the latest scientific technology.
He Tira Hoe o Nga Iwi o Te Awa o Waikato	Iwi waka on a tira hoe along the awa, beginning at the source and travelling along its length to Te Pūaha. The tira hoe will provide the opportunity for iwi to exercise and share their mana whakahaere, mātauranga, kōrero. This could be a biannual event.
Mātauranga Raukawa pukapuka	Investigates the creation of a mātauranga Raukawa pukapuka. The pukapuka could share and record mātauranga Raukawa to ensure this knowledge is retained for future generations.
Marae monitoring station	Marae monitoring stations to assist marae/hapū to become more effective kaitiaki by giving marae the tools and knowledge to monitor the condition of their awa. This will include the development and testing of Cultural Health Indicators for the Raukawa areas of interest in the Waikato River catchment.
Mobile monitoring station	An extension of the marae monitoring programme will see a more advanced marae monitoring station established. The station will utilise the latest scientific methods and cultural indicators to monitor the health and wellbeing of the Waikato and Waipā rivers.

Decision making

A number of considerations need to be taken into account when assessing which projects should take priority. The overarching consideration is whether a project contributes to the restoration and protection of the health and wellbeing of the Waikato and Waipā rivers as required under *Te Ture Whaimana.*

For Raukawa, the essence of the Ngā Mana o Ngā Atua model as well as the Raukawa values and principles must be given effect and any funding decisions within the Raukawa takiwa must be consistent with these if they are to deliver on the Raukawa priorities. Both of these elements are outlined below.

Ngā Mana o Ngā Atua

The Ngā Mana o Ngā Atua model is the framework which guides contemporary Raukawa environmental and resource management. Mana (prestige, integrity) is attributed in the Raukawa view within three spheres – Ngā Mana o Ngā Atua, Ngā Mana o Te Whenua and Ngā Mana o Ngā Tangata.

Ngā Mana o Ngā Atua is bestowed from the gods or spiritual realm with Ngā Mana o te Whenua coming from the earth or Papa-tū-ā-nuku, the earthly realm. Ngā Mana o Ngā Tāngata comes from belonging to an extended family. In this way, the people of Raukawa understand that all realms of the spiritual, the land, and the people are inherently interconnected. For example, the whenua, or afterbirth, of a baby is buried in ancestral land and thus brings the full circle to a close, closing the connection between the giving or birth of life and the connection between the land and the spiritual domains of life.

As individuals, we as Raukawa identify through the realms of the mana bestowed by the atua, or spiritual realm, the land of our tūpuna/ancestors, its life giving mana; and through our extended whānau/hapū/iwi, or tangata. Raukawa do not identify ourselves as isolated individuals. We identify with our communities that encompass both living members and ancestors who have passed away.

Raukawa values and principles

Te Rautaki Taiao discusses in detail the values and principles of Raukawa and where these originated. For Raukawa, the land and landforms remind us of our histories, genealogies, and ultimately of Papa-tū-ā-nuku. How we should operate with and use our environment remains firmly within our histories, geographies and cosmologies.

The values and tikanga that govern our relationship with the natural world are applicable in today's context and can provide a road map for the iwi moving into the future. These values and tikanga assist us in defining and/or regulating acceptable or unacceptable behaviour in relation to the use and management of the environment. These values and tikanga can also provide opportunities and potential for the growth and prosperity of the iwi and the community moving forward.

These tikanga and oral forms of communication will continue to be significant and will influence how Raukawa moves forward in the environment through restoration and incorporating the values and tikanga into the decision making of whānau, hapū, and iwi.

The values and tikanga remain unchanged. They are as relevant in the modern world as they were in the times of our ancestors. They are the foundations for the principles of operation for resource management today. These principles are highly interdependent and interconnected, and reflect the inextricability of people from the environment and from the spiritual realm.

These values and principles, as guided and informed by our worldview, influence and impact on all decisions pertaining to environmental and resource management issues. They guide us in how we conduct ourselves and our long term aspirations. They remind us to consider the environment and our footprint on it at all times.

These key values and principles are:

- mātauranga Raukawa

- whenua, mana whenua and tangata whenua
- tikanga
- whakapapa
- whanaungatanga
- rangatiratanga
- kaitiakitanga
- manaakitanga
- ūkaipō
- pūkenga
- kotahitanga.

The background outlined above illustrates how Raukawa makes decisions in respect of its guardianship role over the environment. These values and principles provide guidance and essential considerations that are taken into account when considering the use and management of the many ecosystems which make up the environment.

It is expected that projects will recognise and give effect to Raukawa values and principles. It is also expected that projects will address the following:

1. How will the proposed activity/project contribute to the vision and objectives of *Te Ture Whaimana.* That is, how will the activity/project contribute to the restoration and protection of the health and wellbeing of the Waikato and Waipā rivers.
2. How will the proposed activity/project contribute to the integrated restoration and management of the Waikato and Waipā River catchments? This reflects the interconnected and integrated approach required under Ngā Mana o Ngā Atua.
3. Is the proposed activity consistent with the values and principles of Raukawa? Discussion with Pūtake Taiao at Raukawa Charitable Trust is strongly encouraged.

FUNDING CONSIDERATIONS

The funding considerations below are intended to assist funding and project providers with the information that should be addressed if they are looking to assist in delivery of Raukawa priorities. The considerations should be applied to both funding priority one 'relationships' and funding priority two 'mātauranga Raukawa and knowledge'.

Objective

To ensure that all applications and funding decisions recognise and provide for the Raukawa values and principles.

Criteria

There are three criteria that are seen as essential by Raukawa to be met through applications for proposed funding. These are:

1. discussions by the applicant with Raukawa Charitable Trust over the proposed activity/project
2. recognition of and provision for mātauranga Māori
3. that the effects from the proposed activity/project do not adversely affect or destroy a site of cultural significance.

Where relevant, the following considerations will need to be achieved in any application proposing to deliver on Raukawa priorities:

1. To ensure water quality is maintained and enhanced as a result of the proposed activity.
2. Seek to enhance existing access to cultural sites of significance and kai gathering places.
3. Provide access to sites where there is currently no access; where appropriate, an activity should provide access.
4. Provide the ability for Raukawa to carry out its cultural practices as appropriate.
5. Recognises and provides for Raukawa ability to exercise its mana whakahaere.
6. Provide, where possible, the opportunity for Raukawa to have ongoing involvement with the proposed activity. For example, Raukawa marae could assist in the monitoring of water quality.
7. The restoration and enhancement of existing ecosystems occurs.
8. Where the activity is adjacent to a waterbody, that riparian planting is undertaken where it is required.
9. Where possible, provide educational opportunities on mātauranga Māori and Raukawa tikanga and kawa.
10. Assist with the restoration of sites used traditionally for certain purposes, where appropriate. For example, the restoration of traditional water holes.
11. Provides training opportunities for marae and hapū to develop capacity in a number of different areas, including but not limited to project management, funding applications and resource management.
12. Actively provides educational opportunities for Raukawa through schooling and tertiary education.

Outcomes

Raukawa seeks the following outcomes.

- That all parties have an inherent understanding of the mauri of the Waikato River.
- Raukawa uri are regularly accessing and using the awa and its resources for recreational and cultural purposes.
- All Raukawa uri are knowledgeable of the traditional practices of tūpuna and are able to apply these practices in a contemporary setting.
- Raukawa uri are able to enjoy the awa in a manner that fits their cultural memory.
- Raukawa values and principals are known, upheld and expressed.
- Raukawa uri are able to practise their tikanga and kawa and maintain their mana whakahaere.
- Raukawa uri are knowledgeable on western science and are able to apply it to the restoration of the awa in conjunction with mātauranga Raukawa.
- Raukawa is involved in the decision making in their areas of interest and association.

11 Te Arawa River Iwi Trust priorities

11.1 Priority projects

Te Arawa River Iwi Trust (TARIT) has identified eight projects to support Tuhourangi-Ngati Wahiao and Ngati Kearoa-Ngati Tuara, totalling $1,302,868. These are summarised in Section 11.2

TARIT has a strong interest in restoring natural resource sites including those important for mahinga kai, capturing knowledge from their people and recognising their sites of significance through installation of iPou.

Ngati Tahu-Ngati Whaoa are an affiliate to TARIT and have identified 10 priority projects totalling $2,782,425. These are also summarised in Section 11.2. The projects focus on restoring the relationship with the Waikato River through capturing kōrero and holding waka ama events, the restoration of mahinga kai (tuna and kōura) and cultural activities including use of rongoā (natural medicines) and weaving, and physical restoration of key sites of significance.

A more comprehensive plan for each project can be found in Appendix 11.

11.1.1 Summary tables of priority projects

NKNT & TNW 1	Ngāti Kearoa-Ngāti Tuarā kōura and tuna restoration	High priority

Upper Waikato: Area B
Location: Māori owned farm site known to Ngāti Kearoa-Ngāti Tuarā Trust.

Summary of priority works

- Tuna and kōura pond project plan
- Transfer tuna and kōura
- Construct tuna and kōura pond
- Capacity building
- Project management/staffing/incidentals (25%)

Total estimated cost: $187,696

NKNT & TNW 2	Ngāti Kearoa-Ngāti Tuarā watercress restoration	High priority

Upper Waikato: Area B
Location: Upper Waikato River catchment within the area of Ngāti Kearoa-Ngāti Tuarā.

Summary of priority works

- Identification of watercress sites (20 sites)
- Acquisition of seed stock
- Marae and landowner engagement
- Construction of watercress sites
- Project management/staffing/incidentals (25%)

Total estimated cost: $100,000

NKNT & TNW 3	Sharing our story – the Ngāti Kearoa-Ngāti Tuarā/TARIT river iPou	High priority

Upper Waikato: Area B
Location: Upper Waikato River and its tributaries within the area of Ngāti Kearoa and Ngāti Tuarā.

Summary of priority works

- Wānanga to collate information
- Information technology integration
- Fabricate iPou (20)
- Capacity building
- Project management/staffing/incidentals (25%)

Total estimated cost: $360,100

NKNT & TNW 4	Identification and protection of Ngāti Kearoa-Ngāti Tuarā sites of significance	Very high priority

Upper Waikato: Area B
Location: Upper Waikato River and its tributaries within the area of Ngāti Kearoa and Ngāti Tuarā.

Summary of priority works

- Wānanga to collate information
- Interviews and literature review
- Mapping and capturing wāhi tapu sites
- Capacity building
- Project management/staffing/incidentals (20%)

Total estimated cost: $135,750

NKNT & TNW 5	Te Arawa River iwi champions	Very high priority

Upper Waikato: Area B
Location: Upper Waikato River and its tributaries within the area of Te Arawa River iwi affiliates.

Summary of priority works

- Project plan for recognition ceremony
- Tohu for champions
- Champions awards dinner
- Project management/staffing/incidentals (25%)

Total estimated cost: $140,000

NKNT & TNW 6	Enabling Tuhourangi-Ngāti Wahiao to reconnect with the Waikato River	Very high priority

Upper Waikato: Area B
Location: Upper Waikato River and its tributaries within the area of Tuhourangi-Ngāti Wahiao.

Summary of priority works

- Acquisition of waka ama (4 x 6 person)
- Establish training and wānanga
- Acquisition of associated safety equipment

Total estimated cost: $121,786

NKNT & TNW 7	Enabling Ngāti Kearoa-Ngāti Tuarā to reconnect with the Waikato River	Very high priority

Upper Waikato: Area B
Location: Upper Waikato River and its tributaries within the area of Ngāti Kearoa-Ngāti Tuarā.

Summary of priority works

- Acquisition of waka ama (4 x 6 person)
- Establish training and wānanga
- Acquisition of associated safety equipment

Total estimated cost: $121,786

NKNT & TNW 8	Kōrero taonga tuku iho	Very high priority

Upper Waikato: Area B
Location: Upper Waikato River and its tributaries within the Tuhourangi-Ngāti Wahiao rohe.

Summary of priority works

- Wānanga to collate information
- Interviews and literature review
- Mapping and capturing wāhi tapu sites
- Capacity building
- Project management/staffing/incidentals (25%)

Total estimated cost: $135,750

NTNW 1	Investigation and construction of tuna/kōura ponds (kai bowl) for cultural harvest	Very high priority

Upper Waikato: Area B
Location: Waikato River catchment within Ngati Tahu-Ngati Whaoa area.

Summary of priority works

- Investigation of mahinga kai farming
- Identification of sites
- Construction of ponds (6)
- Project management/staffing/incidentals (20%)

Total estimated cost: $277,572

NTNW 2	Rehabilitation/restoration of key mahinga kai sites	Very high priority

Upper Waikato: Area B

Location: Mangahoanga, Mangakara, Kawaunui, Orakonui, Mangatoetoe, Pueto, Torepatutahi, Mangamingi and the mouths of all inflowing streams into Te Awa o Waikato.

Summary of priority works

- Collate information on historic mahinga kai sites
- Assess state of identified sites
- Distribute information and wānanga
- Implementation of enhancement measures
- Project management/staffing/incidentals (30%)

Total estimated cost: $66,560

NTNW 3	Geothermal Matauranga	Very high priority

Upper Waikato: Area B

Location: Ōrākei Kōrako, Waihunuhunu, Red Hills, Wai-O-Tapu, Maunga Kakaramea, Waikite, Mangaongaonga, Rotokawa, Ohaki, Whangairorohea, Ngatamariki, Golden Spring, Waimahana, Te Kopia, Ātiamuri.

Summary of priority works

- Wānanga and capture mātauranga
- Implementation of enhancement measures
- Comparison with western science knowledge
- Distribute information and wānanga
- Project management/staffing/incidentals (30%)

Total estimated cost: $80,600

NTNW 4	Wetlands – Ngati Tahu-Ngati Whaoa matauranga – rongoā and weaving	Very high priority

Upper Waikato: Area B

Location: Red Hills Conservation Covenant, Deep Creek/Torepatutahi, Waikite, Ngahewa, Ohaki, Tutukau Z East, Takapou/Te Toke, Wai-O-Tapu, Ruatawiri.

Summary of priority works

- Wānanga and capture wetland mātauranga
- Assessment of identified wetland sites
- Implementation of enhancement areas
- Distribute information and wānanga
- Project management/staffing/incidentals (30%)

Total estimated cost: $80,600

NTNW 5	Cultural history research and documentation	Very high priority

Upper Waikato: Area B
Location: Waikato River catchment within Ngati Tahu-Ngati Whaoa area.

Summary of priority works

- Collation of historic marae and pa sites
- Work with landowners to acknowledge sites
- Establish kohatu or pou
- Share information with marae and public
- Project management/staffing/incidentals (30%)

Total estimated cost: $119,600

NTNW 6	Waka paddle, korero sharing and building connection with Te Awa o Waikato	Very high priority

Upper Waikato: Area B
Location: Waikato River catchment within Ngati Tahu-Ngati Whaoa area: Nga awa Purua to Ātiamuri.

Summary of priority works

- Cultural and water safety training
- Catering for attendees
- Provision of waka and safety equipment
- Project management/staffing/incidentals (25%)

Total estimated cost: $143,500

NTNW 7	Ngatamariki Scenic Reserve/Orakonui catchment rehabilitation/enhancement	Very high priority

Upper Waikato: Area B
Location: Lower Orakonui Stream Catchment/Ngatamariki Scenic Reserve.

Summary of priority works

- Control of weeds (6 years)
- Establish appropriate signage
- Planting and maintenance
- Develop walkway to geothermal area
- Project management/staffing/incidentals (30%)

Total estimated cost: $645,417

NTNW 8	Support of Ngati Tahu-Ngati Whaoa land blocks/trusts to achieve sustainability outcomes	Very high priority

Upper Waikato: Area B
Location: Tutukau Z East, Takapou, Ohaki Tribal Trust, Tauhara No 2 Trust, Paeroa South, Tahorakuri 2, Whanau trusts, Tauhara Moana and some smaller blocks.

Summary of priority works

- Develop restoration strategies
- Implement restoration activities
- Project management/staffing/incidentals (20%)

Total estimated cost: $509,208

NTNW 9	Establish planted corridors for all streams from the Paeroa Range within the rohe and Te Awa o Waikato catchments	Very high priority

Upper Waikato: Area B
Location: Paeroa Range and associated tributaries flowing from the range within the NTNW rohe.

Summary of priority works

- Fencing of streams
- Work with agencies to achieve vision
- Planting of native plants and creating corridors
- Project management/staffing/incidentals (20%)

Total estimated cost: $149,760

NTNW 10	Ohaki Wetland enhancement and restoration	Very high priority

Upper Waikato: Area B
Location: Ohaki Wetland, Broadlands Road, Broadlands.

Summary of priority works

- Planting and maintenance of wetland (15ha)
- Control of willow within wetland
- Project management/staffing/incidentals (20%)

Total estimated cost: $709,536

12 Ngāti Tūwharetoa priorities

12.1 Priority projects

Ngāti Tūwharetoa have identified five projects totalling $1,921,864. These are summarised in Section 12.2. A more comprehensive plan for each project can be found in Appendix 12.

Projects include capturing mātauranga a Ngāti Tūwharetoa by holding multiple wānanga and acquiring knowledge held by external entities. There is also a strong focus on consolidating natural resource knowledge and training rangatahi to become Ngāti Tūwharetoa kaitiaki. It is proposed that 80km of fencing be installed to protect sites of significance to Ngāti Tūwharetoa.

12.1.1 Summary tables of priority projects

Tūwharetoa 1	Enabling descendants of Ngāti Tūwharetoa to enhance the mauri o ngā whenua me te Taiao	High priority

Upper Waikato: Area B
Location: Waikato River within Ngāti Tūwharetoa area.

Summary of priority works

- Conservation training
- Kaitiaki training
- Project management/staffing/incidentals (20%)

Total estimated cost: $384,444

Tūwharetoa 2	Wānanga for all 8 Ngāti Tūwharetoa Area B marae	Very high priority

Upper Waikato: Area B
Location: Waikato River within Ngāti Tūwharetoa area.

Summary of priority works

- Wānanga (8 marae)
- GIS spatial mapping
- Project management/staffing/incidentals (15%)

Total estimated cost: $46,460

Tūwharetoa 3	Multi phased Ngāti Tūwharetoa archives project	Very high priority

Upper Waikato: Area B
Location: Waikato River within Ngāti Tūwharetoa area.

Summary of priority works

- Interview tribal kaumatua
- Preserve captured information
- Collate external Ngāti Tūwharetoa related information
- Project management/staffing/incidentals (25%)

Total estimated cost: $506,597

Tūwharetoa 4	Fencing of Ngāti Tūwharetoa's sites of significance	High priority

Upper Waikato: Area B
Location: Waikato River within Ngāti Tūwharetoa area.

Summary of priority works

- Fencing of sites of significance (80km)
- GIS mapping of sites
- Project management/staffing/incidentals (15%)

Total estimated cost: $764,750

Tūwharetoa 5	Ngāti Tūwharetoa mātauranga and science educational wānanga	High priority
Upper Waikato: Area B Location: Pueto Stream. Summary of priority works • Design curriculum with two colleges • Hold wānanga • Gather field data • Undertake field sampling • Project management/staffing/incidentals (30%) Total estimated cost: $219,613		

13 Maniapoto priorities

13.1 Goals

The following goals were developed for Maniapoto priorities:

1. The ability of mana whenua to undertake customary activities and have kaitiaki over resources is protected and enhanced, particularly on, in, under and around waterways, including wetlands.
2. Culturally and historically significant sites are identified, protected and restored.
3. The river provides for recreational use and social needs, is widely used by the community, and is a place to gather kai, relax, play and exercise.
4. The mauri of the river and its landscape is protected and enhanced.

13.2 Priority projects

Maniapoto Māori Trust Board has identified eight priority projects totalling $3,854,559. These are summarised in Section 13.3. A more comprehensive plan for each project can be found in Appendix 13.

Priorities include supporting improved access of marae to safe water supplies, implementing erosion remediation programmes including planting (32ha), fencing (57km) and engineering solutions, and working with their Māori land trusts to support them in improving sustainability practices. Kaitiaki training and protecting sites of significance are also important aspirations for the iwi.

13.2.1 Summary tables of priority projects

Maniapoto 1	Marae and community water supply: protection, enhancement and education programme – Mangapū River catchment	Very high priority

Waipā: Area C
Location: Puna and swimming areas in Waitomo and Oparure in the Mangapū River catchment.

Summary of priority works

- Wānanga to confirm puna (3) and swimming (4) sites
- Planting (5000 plants)
- Fencing
- Information panels
- Project management/staffing/incidentals (25%)

Total estimated cost: $85,613

Maniapoto 2	Marae and community water supply: protection, enhancement and education programme – Waipā River catchment	Very high priority

Waipā: Area C
Location: Puna and swimming areas in the Waipā River catchment.

Summary of priority works

- Wānanga to confirm puna (2) and swimming (7) sites
- Planting (5000 plants)
- Fencing
- Create and install information panels
- Project management/staffing/incidentals (25%)

Total estimated cost: $99,612

Maniapoto 3	Waitomo Stream – erosion protection and remediation with riparian planting	Very high priority

Waipā: Area C
Location: Waitomo Stream in the Waipā River catchment.

Summary of priority works

- Riverbank erosion remediation (18.6km)
- Planting (12.5ha)
- Fencing (25km)
- Wānanga
- Project management/staffing/incidentals (25%)

Total estimated cost: $1,185,500

Maniapoto 4	Middle Pūniu River – erosion protection and remediation with riparian planting	Very high priority

Waipā: Area C
Location: Middle Pūniu Stream in the Waipā River Catchment.

Summary of priority works

- Riverbank erosion remediation (8km)
- Planting (16ha)
- Fencing (32km)
- Wānanga
- Project management/staffing/incidentals (25%)

Total estimated cost: $1,445,367

Maniapoto 5	Piharau restoration and protection – upper Waipā River catchment	Very high priority

Waipā: Area C
Location: Kahotea, Te Keeti, Purekireki, Hiona, Te Kauae Marae in Ōtorohanga, Pirongia, Puketotara, Waitomo.

Summary of priority works

- Wānanga to confirm piharau sites (8 sites)
- Planting (5000 plants)
- Capacity building including interviews
- Project management/staffing/incidentals (25%)

Total estimated cost: $84,688

Maniapoto 6	Pou Whenua – upper Waipā River catchment (iPou project)	Very high priority

Waipā: Area C
Location: Upper Waipā River catchment.

Summary of priority works

- Wānanga to confirm 20 sites
- Fabricate iPou
- Collate information with marae
- Unveiling of iPou
- Project management/staffing/incidentals (25%)

Total estimated cost: $721,250

Maniapoto 7	Kaitiaki training – implementation of the Maniapoto Cultural Health Indicator tool – Mangaōkewa River	Very high priority

Waipā: Area C
Location: Mangaōkewa River.

Summary of priority works

- Wānanga-a-marae
- Record, transcribe and share wānanga information
- Capacity and capability training
- Project management/staffing/incidentals (10%)

Total estimated cost: $186,450

Maniapoto 8	Better farming practices programme for governors/managers of Māori land blocks – upper Waipā River catchment	Very high priority

Waipā: Area C
Location: Māori land trusts in the upper Waipā River catchment.

Summary of priority works

- Wānanga with land trusts
- Identify future land use options
- Develop governance training programme
- Record, film, transcribe information gathered
- Project management/staffing/incidentals (20%)

Total estimated cost: $46,080

14 Iwi priorities for shallow lakes

14.1 Priority projects

The shallow lakes iwi work stream identified 16 priority projects with a value of $8,016,957. These are summarised in Section 14.2. A more comprehensive plan for each project can be found in Appendix 14.

The projects focus on the recognition of sites of significance to iwi, wetland restoration planting (27ha), fencing of wetland areas (33km), collating of knowledge, education and training. These projects apply to lakes in the Waipā and lower Waikato River catchments.

14.1.1 Summary tables of priority projects

Iwi lakes 1	Waikato-Tainui shallow lakes project – collecting, storing and sharing of traditional kōrero regarding our lakes	High priority

Shallow lakes: Area A
Location: Within the Waikato-Tainui rohe (area).

Summary of priority works

- Mātauranga interviews
- Publication of resources
- Photographing and mapping lakes
- Book and digital platform launch
- Project management/staffing/incidentals (25%)

Total estimated cost: $170,000

Iwi lakes 2	Kainui Lakes – pā harakeke and other native plant restoration and enhancement project	High priority

Shallow lakes: Area A
Location: Kainui (Horsham Downs) peat lakes (8 lakes) in Waikato-Tainui rohe (area).

Summary of priority works

- Site preparation (willow control)
- Re-seed sites with watercress seedlings
- Riparian planting (4ha)
- Restoration wānanga
- Project management/staffing/incidentals (20%)

Total estimated cost: $328,108

Iwi lakes 3	Kainui (Horsham Downs) lakes project – collection, storing and sharing of traditional kōrero regarding our lakes	High priority

Shallow lakes: Area A
Location: Kainui (Horsham Downs) Peat Lakes (8 lakes) in Waikato-Tainui rohe (area).

Summary of priority works

- Mātauranga interviews
- Publication of resources
- Photographing and mapping lakes
- Book and digital platform launch
- Project management/staffing/incidentals (25%)

Total estimated cost: $162,500

Iwi lakes 4	Recognising and honouring our sites of significance – Kainui (Horsham Downs) lakes iPou project	High priority

Shallow lakes: Area A

Location: Kainui (Horsham Downs) peat lakes (8 lakes) in Waikato-Tainui rohe (area).

Summary of priority works

- Wānanga to collate information for 10 iPou
- Cultural training and safety
- Embed technology into iPou
- Fabricate and install iPou
- Project management/staffing/incidentals (30%)

Total estimated cost: $182,000

Iwi lakes 5	Lake Kimihia, Lake Whangape and Lake Waikare – tuna ponds	High priority

Shallow lakes: Area A

Location: Lake Kimihia (Huntly), Lake Waikare (Rangiriri/Te Kauwhata) and Lake Whangape (Huntly).

Summary of priority works

- Construction of ponds – earthworks (5000m^2)
- Planting around ponds (4.5ha)
- Fencing of ponds (6km)
- Capacity and capability development
- Project management/staffing/incidentals (30%)

Total estimated cost: $842,107

Iwi lakes 6	Lake Ngāroto and Lake Mangakaware pā harakeke and other native plant restoration and enhancement	High priority

Shallow lakes: Area C

Location: Lake Ngāroto (Te Awamutu), Lake Mangakaware (Paterangi) within the Waipā River catchment.

Summary of priority works

- Site preparation (willow clearance)
- Re-seed sites with watercress seedlings (10 sites)
- Riparian plantings (4ha)
- Restoration wānanga
- Project management/staffing/incidentals (25%)

Total estimated cost: $320,592

Iwi lakes 7	Restoration of pā harakeke, watercress and raupō around Lake Waahi lake margins	Very high priority

Shallow lakes: Area A
Location: Lake Waahi (Huntly).

Summary of priority works

- Site preparation
- Fencing (2km)
- Riparian planting (3ha) and raupō (1ha)
- Watercress seedling (10 sites)
- Project management/staffing/incidentals (25%)

Total estimated cost: $385,592

Iwi lakes 8	Lake Waikare pā harakeke and other native plant restoration and enhancement project	Very high priority

Shallow lakes: Area A
Location: Lake Waikare (Te Kauwhata).

Summary of priority works

- Site preparation
- Fencing (4km)
- Riparian planting (8ha)
- Re-seed sites with watercress seedlings (10 sites)
- Project management/staffing/incidentals (20%)

Total estimated cost: $730,557

Iwi lakes 9	Kaitiakitanga in action through reducing koi carp (and other pest fish) in the lower Waikato lakes	Very high priority

Shallow lakes: Area A
Location: Lake Waahi (Huntly), Lake Whangape (Huntly) and Lake Waikare (Te Kauwhata).

Summary of priority works

- Detailed project plan
- Equipment required for kaitiaki
- Koi gate design and installation
- Wānanga
- Project management/staffing/incidentals (25%)

Total estimated cost: $1,675,000

Iwi lakes 10	Recognising and honouring our sites of significance – lower Waikato lakes iPou project	High priority

Shallow lakes: Area A
Location: Significant shallow lakes in the Waikato River catchment.

Summary of priority works

- Wānanga to collate information for up to 20 iPou
- Cultural training and safety
- Embed technology into iPou
- Fabricate, carve and install iPou
- Project management/staffing/incidentals (30%)

Total estimated cost: $962,000

Iwi Lakes 11	Ngaa Tapu Wae o Te Wherowhero project	High priority

Shallow lakes: Area A
Location: Lake Waahi (Huntly).

Summary of priority works

- Project plan design
- Installation of iPou (4)
- Walkway (4.5km)
- Stream planting (1ha)
- Project management/staffing/incidentals (25%)

Total estimated cost: $954,539

Iwi Lakes 12	Ngaa Rauwiri o Te Riu o Waikato-Tainui	Very high priority

Shallow lakes: Area A
Location: Lake Waahi (Huntly), Lake Whangape (Huntly).

Summary of priority works

- Project plan design
- Cultural safety and training
- Establish pā tuna (one per site)
- Waananga
- Project management/staffing/incidentals (25%)

Total estimated cost: $208,750

Iwi Lakes 13	Waikato-Tainui – Te Wharekura o Rakaumangamanga and Kura – tuna ponds project	High priority

Shallow lakes: Area A
Location: Waahi Stream, Huntly. Te Wharekura o Rakaumangamanga.

Summary of priority works

- Earthworks to create 4 ponds
- Planting (1.2ha)
- Fencing (16km)
- Capacity and capability development
- Project management/staffing/incidentals (30%)

Total estimated cost: $227,762

Iwi Lakes 14	Waipā peat lakes project – collection, storing and sharing of traditional kōrero regarding our lakes	High priority

Shallow Lakes: Area C

Location: Waipā peat lakes, in particular Lake Ngāroto and Lake Mangakaware.

Summary of priority works

- Mātauranga interview
- Print and publish resources
- Photograph and map lake sites
- Book and digital platform launch
- Project management/staffing/incidentals (25%)

Total estimated cost: $163,000

Iwi Lakes 15	Lake Whangape weir project	Very high priority

Shallow lakes: Area A

Location: Lake Whangape (Huntly).

Summary of priority works

- Project plan and design for weir
- Cultural training and safety
- Site investigation and survey
- Installation of weir
- Project management/staffing/incidentals (25%)

Total estimated cost: $231,250

Iwi Lakes 16	Recognising and honouring our sites of significance – Waipā peat lakes iPou project	High priority

Shallow lakes: Area C

Location: Significant Waipā peat lakes in the Waipā catchment.

Summary of priority works

- Wānanga to collate information for up to 10 iPou
- Cultural training and safety
- Embed technology into iPou
- Fabricate, carve and install iPou
- Project management/staffing/incidentals (30%)

Total estimated cost: $473,200

15 Knowledge gaps and research needs

Throughout the course of the development of the *Restoration Strategy* a number of knowledge gaps and research needs were identified. These are detailed below and have been included as a way of highlighting research needs to researchers, research institutions and funders of research.

Central/Lower Waikato/Waipā

Information gap 1: Solutions for reducing the need for mechanical desilting of land drainage areas such as the Komakorau Stream/drainage network.
Information required: The Komakorau Stream network provides significant habitat for the native fish species banded kōkopu and giant kōkopu. Mechanical desilting for land drainage purposes is a large threat to these fish populations. These fish species could be further protected if there were methods of reducing sediment from land drainage areas that involved less extensive mechanical cleaning. Fish experts have suggested potential solutions such as a targeted education programme as well as installation of V-shaped woody debris structures that provide habitat for fish and also perform a gradient control/sediment trapping function upstream of the structure, thus reducing drain cleaning to just these locations. Such solutions need further thought, socialisation and trialling.

Information gap 2: The benefits of off-channel habitats such as ponds and oxbows for tuna populations. How can these areas be designed and managed to benefit native fish species without exacerbating pest fish species?
Information required: Iwi and fish experts have recommended the creation and enhancement of off-channel habitats (e.g. ponds, cut-off oxbows) for providing habitat for tuna (eel) and cultural tuna harvesting opportunities. More information is required to quantify what impact these ecosystems have on eel populations (i.e. do eel populations increase or do eels simply move to these habitats from elsewhere?). More information and guidance is also required on the design and management of these habitats so that they benefit native fish species (e.g. eel) without exacerbating pest fish species (e.g. koi carp).

Upper Waikato

Information gap 3: The effect that water level variability in the Waikato River hydro lakes has on smelt and their habitat
Information required: There is concern that water level fluctuations in the Waikato River may be negatively impacting on smelt habitats. Before any environmental enhancement work can be undertaken to improve smelt habitat a better understanding is required of how they are impacted by water level fluctuations caused by the day to day management of the Waikato River hydro dams.

Shallow lakes

Information gap 4: Understanding the causes for the decline in water quality in the three Te Arawa lakes

Information required: The three Te Arawa lakes are in a degraded condition. However, the causes of their current water quality state are not entirely clear. It is difficult to propose remediation options in the absence of comprehensive information on cause of decline. Therefore a project investigating catchment loads and sources and identifying remediation options for these lakes is recommended. This needs to be undertaken in consultation with the Te Arawa Lakes Trust.

Information gap 5: The potential of aeration to improve water quality in Lake Ngāhewa

Information required: Aeration of bottom waters has been suggested as a possible restoration option for Lake Ngāhewa. However, this technology has not been tested in New Zealand and therefore the efficacy in our Waikato lakes is unknown. Investigation into the suitability of aeration in lakes that thermally stratify with a view for potential use at Lake Ngāhewa is recommended.

Information gap 6: The contribution that waterfowl make to *E. coli* levels in Lake Rotoroa (Hamilton Lake)

Information required: Unsatisfactory levels of *E. coli* in Lake Rotoroa are often an impediment to safe contact recreation and reducing these levels will be a critical component of bringing the lake to a swimmable standard. Expert consensus is that the most significant source of this *E. coli* will be from the large populations of waterfowl on the lake. Management of these birds would be a very sensitive issue for the Hamilton community, therefore before robust recommendations can be made the sources of *E. coli* should be confirmed and quantified. A project focused on faecal source tracking and contaminant load estimation has been recommended by the project Lake Working Group.

Given public concerns about heavy metals in the lake sediments from historic exotic weed management it is also recommended that water column heavy metal concentrations be established.

Information gap 7: Effective barriers to pest fish in shallow lakes

Information required: Pest fish are a major impediment to restoration of Waikato shallow lakes. Attempts to eradicate or undertake sustained removal of these species are restricted by the lack of available options for preventing fish from accessing the lakes. This is complicated by the need to still provide access for native fish species. Investigations and trials on the design of an effective barrier for pest fish are recommended – with a focus on preventing transfer of koi, rudd and catfish.

Information gap 8: The efficacy of flocculants and sediment binding agents in Waikato shallow lakes
Information required: Sediment capping is a widely used method to reduce internal phosphorus loads and improve lake ecological state. It has been successfully used in some New Zealand lakes but was recently found to be ineffective in the highly organic environment of a Waikato peat lake. Given that the Waikato region has a gradient of lakes ranging from riverine to peat and sediment, and capping agents are an important tool for aiding in the rehabilitation of degraded lakes, it is important to know in which lakes these products will and will not work. Two projects have been identified in the *Restoration Strategy* that involve the addition of alum to lake inflows to reduce in-lake internal P loads. However, this work cannot proceed without further investigation of the efficacy of such agents for Waikato lakes at laboratory and mesocosm scale.

Information gap 9: Public access to shallow lakes
Information required: There are a number of shallow lakes with paper roads and public reserves but with no public access. Further work needs to be undertaken to investigate opportunities for realising access opportunities to these lakes.

All units

Information gap 10: Location of all barriers for native migrating fish
Information required: WRC and NIWA have undertaken some work to identify barriers but this work has focused on particular geographic areas or particular types of barriers. There still remains large information gaps, particularly around barriers on private land and small barriers such as culverts. One option identified to fill this gap is to analyse the GIS dataset showing fish species predicted to be in a particular waterway and compare it to the actual fish catch data for the waterway. Where species that are predicted to be in a waterway appear absent this may indicate the presence of a migration barrier. Field surveys could then be undertaken to determine the presence and type of barriers.

Information gap 11: Reasons for decline of kōura populations
Information required: Since the late 1990s there has been an observed decline in kōura from stream and lake ecosystems and the reasons for this are yet to be conclusively determined. NIWA recently undertook a research project investigating the extent of kōura populations within the Waikato River hydro lakes of Aratiatia, Ohakuri and Ātiamuri as well as repeating surveys at locations where kōura had been found in the 1990s and examining other potential kōura habitat. The research provides initial information about the status of kōura populations in relation to the commercial eel fishery and other fish predators in the hydro lakes, and provides some information about the reproductive and disease status of kōura remaining in the Waikato River mainstem. Further work is required to build on the findings of this research and to action the recommendations made within the report by Clearwater et al. (2014).

Information gap 12: The benefits to eel and kōura populations of adding woody debris to the beds of lakes and large rivers.
Information required: Anecdotal evidence from New Zealand shows that in lakes and rivers, eels are always found where there is cover. Trials of wood installation in streams have shown benefits for a range of species so scientists expect there to be habitat benefits for a range of biota in lakes, including hydro lakes, and large river systems. More information is required around appropriate design and techniques for adding woody debris (e.g. type of wood, anchoring systems) in New Zealand situations. Field based trials are recommended along with effectiveness monitoring.

Information gap 13: The impact of seepage wetlands on nutrient attenuation
Information required: Protection of small seepage wetlands is recommended as a tool for reducing nutrient run off from agricultural land. However, further work is required to quantify the nutrient attenuation benefits of different seepage wetlands in different farming situations.

16 Monitoring the outcomes

Implementation of the *Restoration Strategy* will be an ongoing process over a 15-20 year time frame. It is important that we understand the effectiveness of the strategy in helping to guide future restoration initiatives and priorities across all organisations with an interest in seeing the *Vision & Strategy* objectives achieved. We need to know that the *Restoration Strategy* projects are being implemented, by whom, and how effective restoration activities are in achieving their expected outcomes and in achieving the overall objectives of the *Vision & Strategy.*

The Report Card for the Waikato and Waipā Rivers (Willimason et al., 2016) provides a baseline from which to measure future progress of river restoration initiatives. It is intended that this will be repeated on a five-yearly basis to determine changes in the overall health and wellbeing of the river, and in future will be aligned with the *Restoration Strategy*. The developers of the existing report card acknowledge that there are components for which adequate data was not available at the time to assess state. This particularly applies to indicators for measuring the state of cultural health and wellbeing. In these instances, new methods and cultural monitoring programmes designed and implemented by Waikato River iwi will be required. The report card framework is flexible and can incorporate the addition of new information and indicators in future versions (Williamson et al., 2016).

A revised effectiveness monitoring framework that will underpin future report cards will be developed in the near future and will be closely aligned with the *Restoration Strategy* to ensure effectiveness monitoring incorporates the identified priority projects.

Glossary

Technical terms

Barriers to fish passage – any structure which prevents the movement of freshwater fish e.g. perched culvert, flood gate.

Biodiversity – biodiversity, or biological diversity, is the variety of life. It is the variability among living organisms from all sources including, inter alia, terrestrial and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Ecological integrity – the abundance and diversity of organisms and the ability of the ecosystem to absorb and rebound from pressure and disturbances. Measures for ecological integrity referred to in the *Restoration Strategy* include water temperature, contaminant levels, dissolved oxygen, riparian condition, connectivity, aquatic plants, fish and water birds.

Farm plan – a plan that identifies on-farm environmental risks and sets out a programme to manage those risks.

Fishable – for a waterway to be fishable it must be safe to take and eat food from. Water quality must be of a standard to sustain populations of fish.

Fish habitat structures – structures placed within waterways for the purpose of providing habitat for fish. These can be made from a range of products including wood, plastic and concrete.

Hard engineering structures – hard engineering structures used for erosion control purposes are generally made from non-living material such as rock, metal or milled timber. Examples include rock riprap, gabion baskets and retaining walls.

LUC – Land Use Capability – a tool used to assess the potential uses of a unit of land and to determine its capacity for long term sustained production. LUC takes into account the physical limitations of the land and is measured using various indicators, including rock type, soil type, slope, erosion degree and type, and vegetation.

For further information on the various land use capability classes visit http://www.landcareresearch.co.nz/publications/books/luc

PAF – project assessment form.

Releasing – this is the action of weeding around native plants to reduce competition from weed species.

Riparian margin – this is the area of land next to a waterway.

Shallow lake – a natural lake less than 10m deep

Soft engineering structures – soft engineering structures installed for erosion control purposes are generally made from live plant material and over time blend into the environment, e.g. vegetation groynes.

Swimmable – for a waterway to be swimmable the water must be of a quality that it is safe to swim in during all seasons (with the exception of during flood conditions) without the risk of becoming sick. It must also have safe access for swimming.

Willow/poplar pole – a young poplar or willow pole is a young tree stem between 1m and 3.5m long, which roots and sprouts when planted in the ground. Erodible hillsides can be stabilised by

poles and sustained as farmland because the extensive root systems of these trees bind and hold the soil in place.

Woody debris structure – a structure made from live or dead tree material that is placed and anchored in a waterway for the purpose of providing habitat for fish. Structures can vary in size depending on the size of the waterway.

Vegetation management for erosion control purposes – this generally refers to the removal of vegetation (e.g. willow trees) that is causing (or likely to cause) erosion and/or planting of new vegetation for erosion control purposes.

Papakupu

The papakupu (glossary) contains Māori words that are used within the *Restoration Strategy* and also words commonly associated with the environment. It is intended to assist users to better understand Māori words associated with the Māori names of areas, mountains, streams, lakes, wetlands and places. This should better inform project leaders of the historic context or importance of natural features to iwi, hapū and marae.

Aroha	Show sincerity and mutual respect, love.
Atāhua	Beautiful, pleasant, lovely.
Atua	Gods, deities with responsibilities for different physical and spiritual realms or elements.
Awa	River, stream, waterways, freshwater bodies.
Hākari	To have a feast, banquet, celebratory meal.
Hapori	Community, society, section of a kinship group.
Hapū	Subtribe, usually containing a number of whānau (family unit) and marae with a common ancestor or ancestors.
Harakeke	Flax.
Hau kāinga	True home, local people of a marae, home people.
Hauanga kai	The customary and contemporary gathering and use of naturally occurring and cultivated foods.
Hīkoi	To step, walk, march.
Hui	Gather, assemble, meet.
Ika	Fish or fisheries.
Iwi	A tribe. A large group of people descended from a common physical or spiritual ancestor.
Kai	Food, eat.
Kaitiaki	Caretaker, caregiver, the role of protecting and nurturing the mauri of all living things and surrounding environments or natural resources. A guardian.
Kaitiakitanga	The exercise of kaitiaki roles and responsibilities. The exercise recognises the intricate balance and integral relationship between all natural resources.
Karakia	Recite ritual chants, say grace, pray.
Kaumātua	Elders (male and female).
Kawa	Customs and protocols, in particular those related to formal activities.
Kīngitanga	King Movement, established in the 1850s with a focus to stop the loss of land, promote Māori authority, maintain law and order, and promote traditional values and culture.
Kōiwi	Human bones, corpse.

Kōrero	To tell, say and speak.
Korowai	Cloak.
Kōura	Freshwater crayfish
Mahinga kai	A place where food is gathered, a cultivation.
Mana	Authority, protective power and prestige.
Mana motuhake	Tribal region; generally in this plan the tribal region of Waikato-Tainui, including the rohe of constituent marae and hapū.
Mana whakahaere	The exercise of rights and responsibilities to ensure that the balance and mauri (life force) of the rohe (area) is maintained.
Mana whenua	The tāngata whenua (indigenous people) group or groups with primary mana whakahaere (rights and responsibilities) over an area.
Manāki	To support, take care of, look out for.
Manga	A stream, or branch of a river, creek.
Manu	Bird or birds.
Manuwhiri	Visitors.
Māori	Native, indigenous and belonging to New Zealand.
Marae	Traditional and contemporary gathering places that may hold a wharenui (meeting house), wharekai (dining room), wharepaku (ablution block), and whare (other houses or structures).
Māreikura	An order of female supernatural beings.
Mātauranga	Knowledge, understanding.
Mātauranga Māori	Traditional and contemporary Māori knowledge, knowledge systems and knowledge bases. This includes the body of knowledge originating from Māori ancestors, including Māori worldview and perspectives, Māori creativity, and cultural and spiritual practices.
Maunga	Mountain.
Mauri	Life force of both animate and inanimate things or objects.
Moana	Sea, ocean.
Ngahere	Forest.
Noa	Unrestricted, to be free from the extensions of tapu.
Pā	A fortified place or fortification. Also a large groupings of plants valued by Māori weavers e.g. pā harakeke, pā kuta, pā raupō.
Papakāinga	Original home, home base, village, communal Māori land
Pāpātuanuku	Earth or earth mother and wife of Ranginui – all living things originate from them.
Patupaiarehe	Fairy folk, mythical people who move at night and generally live in forests and mountains.
Powhiri	Welcoming ceremony of visitors on a marae.
Puna	Spring, a well, pool of water.
Pūrākau	Legend, myth, ancient legend, story.
Rahui	Prohibition placed on access to an area or resource. Prohibition placed on activity within, in, or on an area or with a resource. An important method of managing behaviour and resources.
Rakau	Tree.
Rangatahi	Youth, younger generation.
Rangatira	Chief (male or female), chieftain (male or female). The qualities of a leader are of concern to the integrity and prosperity of the people, the land, the language, and other cultural treasures (e.g. oratory and song poetry).
Ranginui	The sky father and husband of Pāpātuanuku.
Raranga	To weave, plait.
Raupatu	Confiscation, usually in relation to lands, and its subsequent effects.
Repo	Swamp, bog, marsh.
Rohe	Area, boundary, territory or border of land.

Rongoā	Traditional medicine, remedies.
Rōpū	Group, party of people, company, association, entourage, organisation.
Roto	A lake.
Rua kai	A food pit.
Taiao	Environment, nature, natural world.
Taiohi	Youthful in the adolescent sense.
Tangata	Person.
Tāngata	People.
Tangata Whenua	Local people, hosts, indigenous people – Māori and their whānau (families), hapū (subtribe), iwi (tribe) that whakapapa, or have genealogical connections, back to the land by virtue of first or primary occupation of the land.
Taniwha	A water spirit, powerful creature, sometimes used in reference to powerful leaders or chiefs.
Taonga	Treasure – applied to anything considered to be of value including socially or culturally valuable objects, resources, phenomenon, ideas and techniques.
Taonga Tuku iho	Heirloom, gifts or something handed down, cultural property.
Tikanga	The customary system of values and practices that have developed over time and are deeply embedded in the social context.
Ti kouka	Cabbage tree.
Tinana	The main part of something, the body.
Tohu	Sign, mark, symbol, indicators of an event.
Tuna	Eel.
Tupuna	Ancestor/ancestors.
Waerea	Protective incantation for specific activities.
Wāhi tapu	Culturally important areas for cultural and spiritual purification, cleansing and/or ceremonial purposes, activities, natural places, fisheries and food gathering sites, burial sites.
Wahine	Lady, women.
Wai	Water.
Waiata	Song or songs.
Wairua	Spirit.
Wānanga	Seminar, conference, forum, educational seminar.
Whakapapa	Lineage and geneology. An essential knowledge within any tribal or Māori society.
Whakāro	Thought, opinion, plan, idea, intention.
Whānau	Family unit, not always immediate family, and may include those that are family by marriage, adoption, fostering, or other close relationship.
Whānui	Wide, extended.
Whatukura	An order of male supernatural beings.
Whenua	The land, the ground.

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