APPENDIX SEVEN

Waipā Catchment Project Assessments

Contents

WP 1 Priority: High	Waipā River erosion protection and remediation – Pirongia to Ngāruawāhia	BCR value
Relevant unit goal(s)	River margins prone to significant erosion are managed to minimise erosion risk, whilst enhancing aquatic habitat and retaining the natural character of river systems. Riparian planting of preferably indigenous species is undertaken to stabilise riverbanks, reduce erosion and enhance terrestrial and aquatic biodiversity. Water quality is such that waters within the catchment are swimmable and safe to take food from in all places.	
Name of feature	Waipā River – Pirongia to Ngāruawāhia	
Brief description of feature	This reach consists of 30km of Waipā main stem from Pirongia to Whatawhata and 28km from the Whatawhata bridge to the confluence with the Waikato River at Ngāruawāhia. The river here is well incised with some bank slumping in areas. Margins are not fully fenced and lack continuous vegetation. There is increased incidence of bank collapse following high flow events, especially where there is a lack of stabilising vegetation. Pest willow species are throughout the extent of this reach. This stretch of the Waipā provides a pathway for patupaiarehe, or spiritual beings, who travel between various maunga along the Waipā to Taupiri and other significant areas. There are historic pā sites along the margins such as Tangirau and Moehaki. Taniwha also traverse the Waipā and have resting places along its banks. The Waipā is also a main stem of travel for significant fisheries and tribes. Based on regular monitoring undertaken by Waikato Regional Council, the Waipā River along this stretch (at Whatawhata Bridge) is not safe for swimming due to unsatisfactory levels of E. coli. Clarity, TN and TP are also considered unsatisfactory.	
Desired state to achieve the Vision & Strategy	- A 58km stretch of river with stable, vegetated banks and where major erosion events are limited. - A riparian margin at least 10 metres wide that is well vegetated with native plants and exotic plants where required to prevent erosion. - The river is swimmable, fishable and has access for recreation. - Iwi and community have a strong connection to the river and are active in its use protection and restoration.	
Impact on Vision & Strategy	In a restored condition the Waipā River – Pirongia to Ngāruawāhia reach – would have a very high impact on	VS = 350

<table>
<tr><td></td><td>giving effect to the Vision & Strategy at a Waipā catchment level.</td><td></td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Mass bank erosion events and ongoing bank scouring</td><td>Estimated to yield approximately 25,000 tonnes sediment per year to the Waipā River and lower Waikato River.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 15 years of project commencement:
- The river has stable banks and a continuous vegetated (native and exotic for erosion control) 58km margin along the reach from Pirongia to Ngāruawāhia.
- Stock is excluded from 100% of the river and new fencing is set back at least 15m from the riverbank.
- Sediment to the Waipā River over this stretch is reduced by 15%.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

River erosion protection and remediation
- Based on surveys of Waipā catchment waterways and assuming that all unfenced bank will require new fencing, it is estimated that 53km of new fencing will be required along this reach of the main channel. Fence should be setback at least 15m from the riverbank. Fencing costs (5-wire, 2 electric at $8 per metre) are estimated at $426,880.
- Pole planting for bank stabilisation is estimated to be required over 22km of riverbank. Poles should be planted every 10m over erosion prone sites. This equates to 2200 poles ($30,800).
- It is estimated that 75% of the margin will require new planting which equates to 112ha of native planting. Cost is estimated to be $4,429,824. This assumes that sites will be weedy and require weed control prior to planting.

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 25% of the direct project costs.</td><td></td></tr>
<tr><td>Time lag for benefits to be realised</td><td>If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project</td><td>L = 13.5</td></tr>
</table>

	benefits would be seen approximately 13-14 years after project commencement.	
Effectiveness of works	The Waipā River (Pirongia to Ngāruawāhia) is currently in poor condition with few of the Vision & Strategy desired state aspects being met. The river is not swimmable, the banks are unstable in many places and stock have access to the river at a number of locations. The riverbanks are not well vegetated with native plants. Some deterioration in the river is expected over the next 20 years in the absence of this project, with impacts of the upper catchment and bank stability in the Waipā main stem likely to lead to further decline in water quality and habitat for fish. This decline is expected to be offset by the outcomes of this project which will improve aspects related to bank stability, stock exclusion and extent of native vegetation along the margins. Secondary benefits in E. coli reduction, fish habitat and biodiversity can also be expected. Overall, however, the upper catchment impacts will still be the biggest factor in water quality through this reach and it is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy.	W = 0.05
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding and/or erosion before they are established. This would be minimised by the fencing setbacks being at least 15m and by planting sterile willow poles to stabilise banks while native plantings establish.	F = 0.82
Adoptability	It is estimated that almost half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may be a challenge in terms of uptake, however, there are some existing projects along this reach that provide a good example of what can be achieved with larger riparian margins.	A = 0.45
Information quality	Average – estimates are based on aerial photographs, Waipā catchment riparian surveys and input from catchment officers who are familiar with the reach and are working with landowners to help them undertake similar works.	
Knowledge gaps and response	Unknown specifically how much fencing already exists. This would need to be established as part of the project planning.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	15 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost</th></tr>
<tr><td>Native planting (112ha)</td><td>4,429,824</td></tr>
<tr><td>Poplar/willow poles (2200)</td><td>30,800</td></tr>
<tr><td>Fencing (53km)</td><td>426,880</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>1,221,876</td></tr>
<tr><td>Total</td><td>$6,109,380</td></tr>
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<td>C = 6.11</td>
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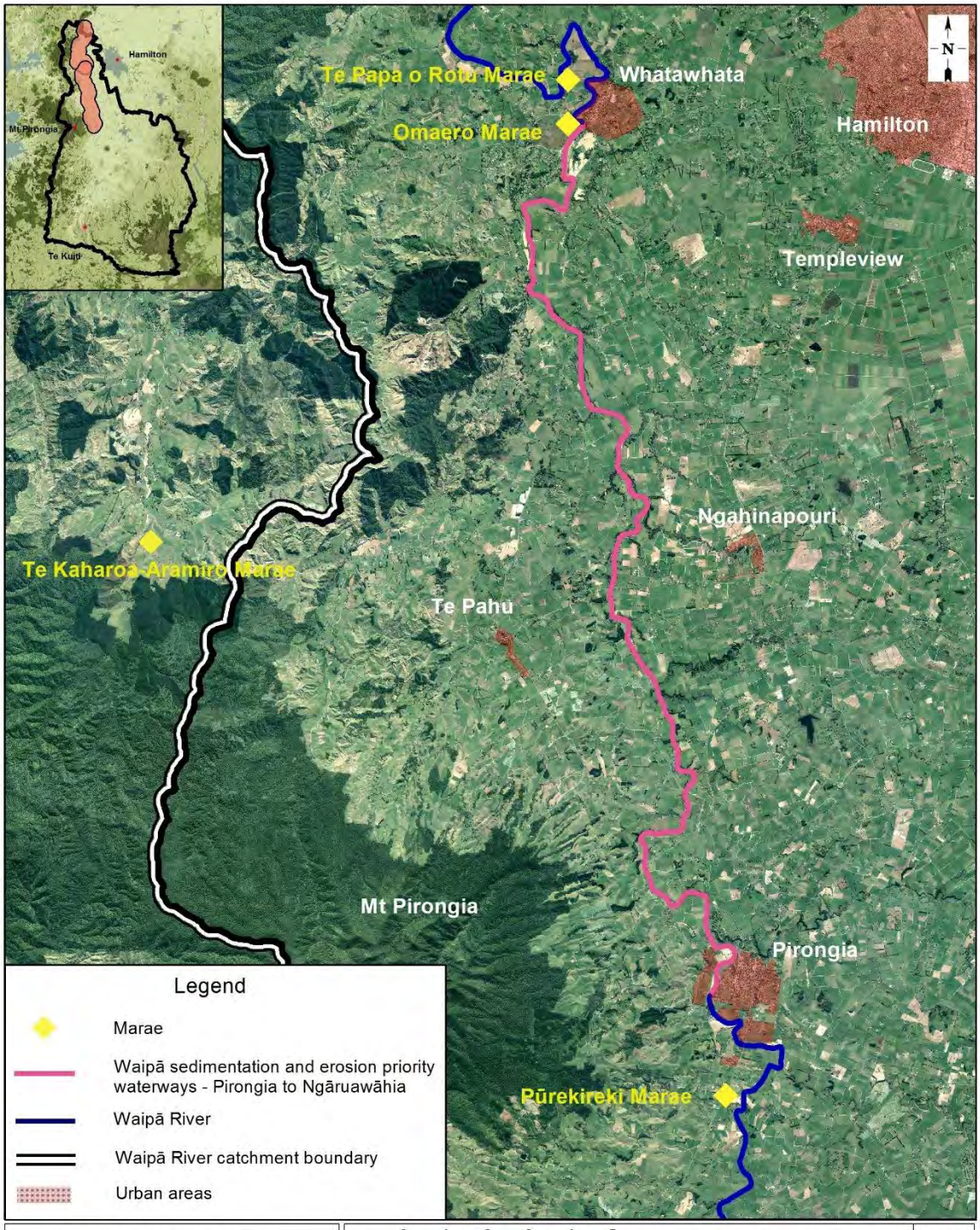

Waipā River erosion protection and remediation - Pirongia to Ngāruawāhia Map 1/2

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name: WWRRS.gws

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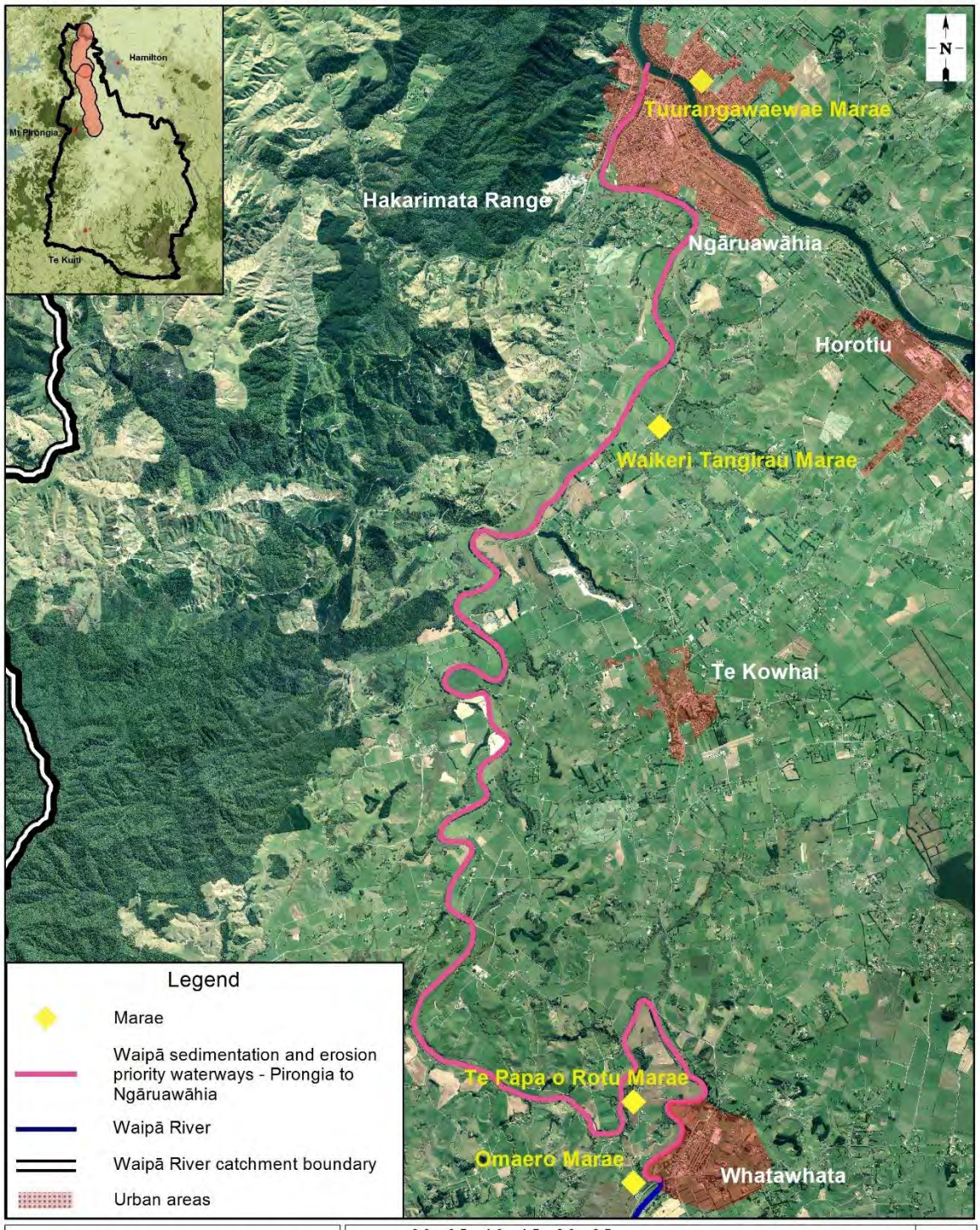
Kilometers

Scale 1:128,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato



Waipā River erosion protection and remediation - Pirongia to Ngāruawāhia Map 2/2

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name: WWRRS.gws

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Kilometers

Scale 1:70,000@A4 Portrait

A4

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Waipā River at Pirongia showing eroding and mostly devegetated banks where stock have access to the river. This project proposes that a priority for funding would be fencing and planting of this margin.

Example of devegetated banks of Lower Waipā main stem.

Waipā River erosion prone banks.

Lower Waipā main stem with example of plantings.

WP 2 Priority: High	Walkway from Te Kōwhai to Ngāruawāhia township via Te Otamanui gully and along Waipā River	BCR value
Relevant unit goal(s)	The river provides for recreational use and social needs, is widely used by the community, and is a place to gather kai, relax, plan and exercise.	
Name of feature	Waipā River Te Kōwhai to Ngāruawāhia and Te Otamanui Lagoon and gully	
Brief description of feature	This feature includes the Te Otamanui gully ecosystem between Te Kōwhai Village and the Waipā River (in the vicinity of Bedford Road) and a 5.3km section of the lower Waipā River from the Te Otamanui Stream inflow downstream to Ngāruawāhia township. The upstream section of the gully ecosystem comprises predominantly willow wetland and the Te Otamanui Stream with small pockets of remnant and planted native vegetation. The stream flows into the Te Otamanui Lagoon in the lower reaches and enters the Waipā River at Bedford Road. The lower reach of the gully has pockets of remnant and planted native vegetation (e.g. kahikatea and cabbage trees). A partially completed walkway extends along the true right bank of the gully and the Te Otamanui community group has carried out native planting along the completed sections of walkway. The lagoon exits to the Waipā where an historic papakāinga (settlement) was situated known as Kaitarakihi. This signals the importance of the area for providing food to the people of the area. The 5.3km section of Waipā River is fenced to exclude stock in most places and predominantly vegetated with a narrow margin of willow trees. There is opportunity to increase the recreation opportunities within the gully ecosystem and along the river by extending Te Otamanui walkway along the Waipā River to Ngāruawāhia township.	
Desired state to achieve the Vision & Strategy	- Stock is excluded from the Waipā River and Te Otamanui Stream and gully. - Waterways have well vegetated riparian margins that provides erosion protection, shade and shelter. - Native fish are abundant and there is a wide diversity of species present. - The waterways are swimmable, fishable and have access for recreation. - Iwi and communities have a strong connection to the waterways and are active in their use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition, the Waipā River from Te Kōwhai to Ngāruawāhia and Te Otamanui Lagoon would have a high impact on giving effect to the Vision & Strategy at a Waipā catchment level.	VS = 40

<table>
<tr>
<td>Key threats to the feature that this project addresses</td>
<td>
<table>
<tr><th>Key threat</th><th>Impact on the asset</th></tr>
<tr><td>People become disconnected from the waterways and see the area more as a resource than something that needs to be nurtured and cared for.</td><td>The opportunity for people to access, recreate and connect with the waterways are not realised.</td></tr>
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</tr>
<tr>
<td>Project goal/s</td>
<td>Within five years of project commencement there is a gravel walkway from Te Kōwhai village to Ngāruawāhia township alongside the Te Otamanui Stream and Waipā River.</td>
<td></td>
</tr>
<tr>
<td>Priority works for funding</td>
<td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole or in multiple smaller components.

Works would need to be undertaken in accordance with the Waikato District Council Trails Strategy and should be done in collaboration with the Te Otamanui Community Group and Waikato District Council.

Works required for the Waipā River walkway between Ngāruawāhia and Te Otamanui Stream outlet include:
- project management – this includes liaison with landowners and obtaining landowner agreements as well as procurement of contractors (25% of overall project cost)
- construction of a 5.3km gravel at $150 per metre ($795,000)
- fencing 5.3km with post and batten fence at $25 per metre ($132,500)
- native planting alongside the track for aesthetic value (approximately 3000 plants ($26,500)
- development and erection of signage ($6,000)
- surveying ($20,000).

Works required for completion of the Te Otamanui walkway include:
- project management – this includes liaison with landowners and obtaining landowner agreements as well as procurement of contractors (25% of overall project cost)
- construction of the remaining track (3.6km) at $150 per metre ($540,000)
- fencing 3.6km with post and batten fence at $25 per metre ($90,000)
- native planting and releasing at least 2250 native plants ($18,000)
- signage ($3000)
- surveying ($10,000)

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project</td>
<td></td>
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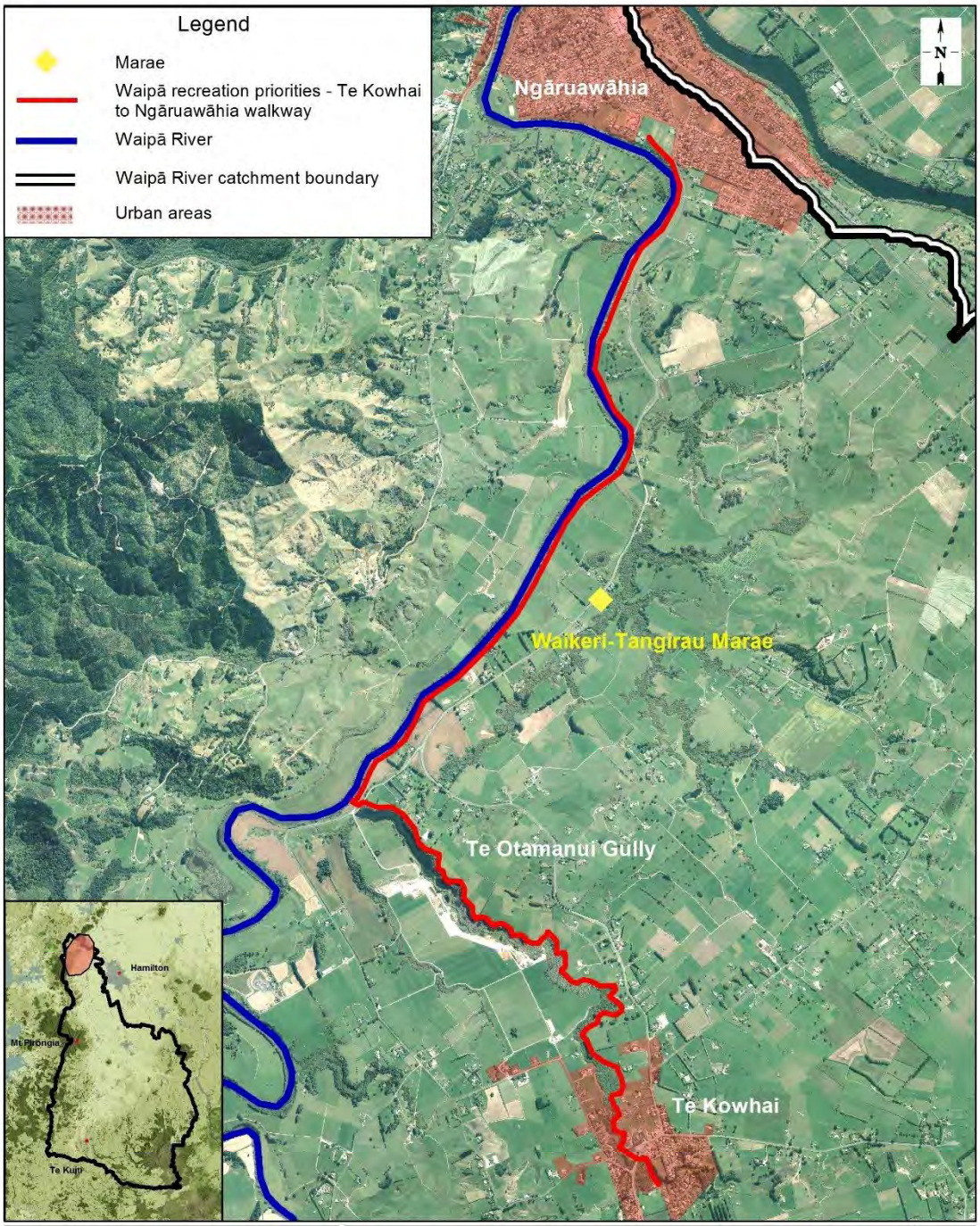
</table>

	reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately 3.5 years after project completion.	L = 3.5
Effectiveness of works	The Waipā River (Te Kōwhai to Ngāruawāhia) and Te Otamanui Lagoon are currently in poor condition with few of the Vision & Strategy desired state aspects being met. These waterways are not swimmable or 100% excluded from stock access, and access for recreation along this stretch of the Waipā River is limited. However, these sites still retain values with the river being of high cultural significance for iwi and the lagoon already being utilised by the Te Kōwhai community for walking. Some deterioration in these features are expected over the next 20 years in the absence of this project, with impacts of the upper catchment and bank stability in the Waipā main stem likely to lead to further decline in water quality and habitat for fish. Decline in values may still be expected even with the project proceeding as it will not address risks related to land use or habitat loss. However, this would be partially offset by an expected substantial improvement in recreation and education opportunities along the river and lagoon. The project outputs would be an asset for the communities providing a walking and biking track between Ngāruawāhia and Te Kōwhai. There would be benefits to this project being conducted in alignment with efforts to fence, stabilise and plant the Waipā River main channel (Project WP 1).	W = 0.05
Risk of technical failure	Similar walkways have been constructed along the Waikato and Waipā Rivers very successfully. Very low risk of project failure due to technical feasibility subject to the path being well set back from erosion prone parts of the riverbank.	F = 0.92
Adoptability	It is estimated that two thirds of landowners would adopt the works if they were fully incentivised. The key challenge is likely to be around getting agreement for a public track along private land, however, Te Otamanui Community Group has made good progress with this to date.	A = 0.675
Information quality	Very good – information provided by Te Otamanui Community Group and Waikato District Council	
Knowledge gaps and response	The exact route of the track along the Waipā River is yet to be determined.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	5 years	

Up-front cost – total for implementation phase/project duration		C = 2.04

Task	**Cost ($)**
Waipā River walkway	
- Track construction (5.3km)	795,000
- Fencing (5.3km)	132,500
- Native planting (2250 plants)	26,500
- Signage	$6000
- Surveying	20,000
Te Otamanui walkway	
- Track construction (3.6km)	540,000
- Fencing (3.6km)	90,000
- Native planting (3000 plants)	18,000
- Signage	3000
- Surveying	10,000
Project management/staffing/incidentals (25%)	410,250
Total	**$2,051,250**



Walkway from Te Kowhai to Ngāruawāhia Township via Te Otamanui gully and along the Waipā River

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name: WWRRS.gws

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Kilometers

Scale 1:35,000@A4 Portrait

A4

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Te Kaunihera ā Rohe o Waikato

Te Otamanui Lagoon near Bedford Road (facing upstream). Proposed walkway is on the left side of the photo.

WP 3 Priority: Medium	Enhancement of Waipā wetlands in priority nutrient catchments (Waikato district)	BCR value
Relevant unit goal(s)	The quality and flow of water is maintained and enhanced. 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. Wetlands are created or protected and actively managed to enhance multiple functions.	
Name of feature	Waikato district gully wetlands greater than 10 hectares within Waipā catchment	
Brief description of feature	This feature consists of 11 lowland gully ecosystems larger than 10 hectares in size that collectively cover an area of 286 hectares. They are located on the true right bank of the Waipā River within the Waikato district and contain native wetland remnants and native forest remnants (e.g. kahikatea). Catchment modelling undertaken by Waikato Regional Council has identified priority nutrient subcatchments in the Waipā River catchment (lower Mangapiko, Mangawhereo, North west Hamilton). These 11 large gully systems have been identified within the priority nutrient subcatchments as important for water quality. In addition, many of these gully systems are home to rare and/or threatened species such as mudfish, bats, tuna and spotless crake so are also important for biodiversity. In most cases pest willow trees occupy more than 50% of sites but there is a healthy understorey of native plant species. Some sites also have pockets of remnant kahikatea forest. Lakes and wetlands in the Waipā are of high cultural significance providing sustenance, areas of recreation and resources to iwi, hapu and marae. Pā and Papakāinga are common to areas where food is accessible in particular the lakes, wetlands and freshwater springs.	
Desired state to achieve the Vision & Strategy	- Gully wetland ecosystems are protected from stock grazing. - They have healthy native plant communities and healthy populations of native fish. They are also valued by the wider community for their aesthetic and cultural values. - Iwi and communities have a strong connection to the gully wetlands and are active in their use, protection and restoration.	

<table>
<tr><td>Value of the feature</td><td>In a restored condition the Waikato district gully wetlands in the Waipā catchment would have a high impact on giving effect to the Vision & Strategy at a Waipā catchment level.</td><td>VS = 25</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on the feature</th></tr><tr><td>Stock access</td><td>Destruction of native plant communities, introduction of weed species.</td></tr><tr><td>Willow trees</td><td>Shade out native species and spread to other sites.</td></tr><tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>- Within 15 years of project commencement all identified gully wetland systems are 100% fenced to exclude stock.
- Gully systems are well vegetated with native species where practicable (species that would have been naturally occurring within the gully ecosystem).
- Known mudfish habitat sites within these gullies are protected from disturbance, and where bats are known to be present site management provides for their habitat requirements.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Fencing
Gully wetland should be fenced at the top of the gully to exclude stock with a 5 wire (2 electric) wetland. Ideally this would be followed immediately by native planting and associated weed control.

Willow removal
This would be undertaken in circumstances where the willow trees were not providing habitat for a rare or threatened native species and where there was a dense native understorey beneath the willow canopy. Any willow removal should be undertaken in stages using ground based methods (such as treatment with x-tree basal).

Planting
Native planting should be carried out within open areas to create a native plant dominated ecosystem over the long-term. Planting at 1.5m spacing has been recommended using hardy species that would have naturally existed within the gully ecosystem (e.g. cabbage tree, kahikatea, flax, kānuka). Native planting costs have been estimated at $39,552 per hectare and include site preparation, plant purchase, planting</td><td></td></tr>
</table>

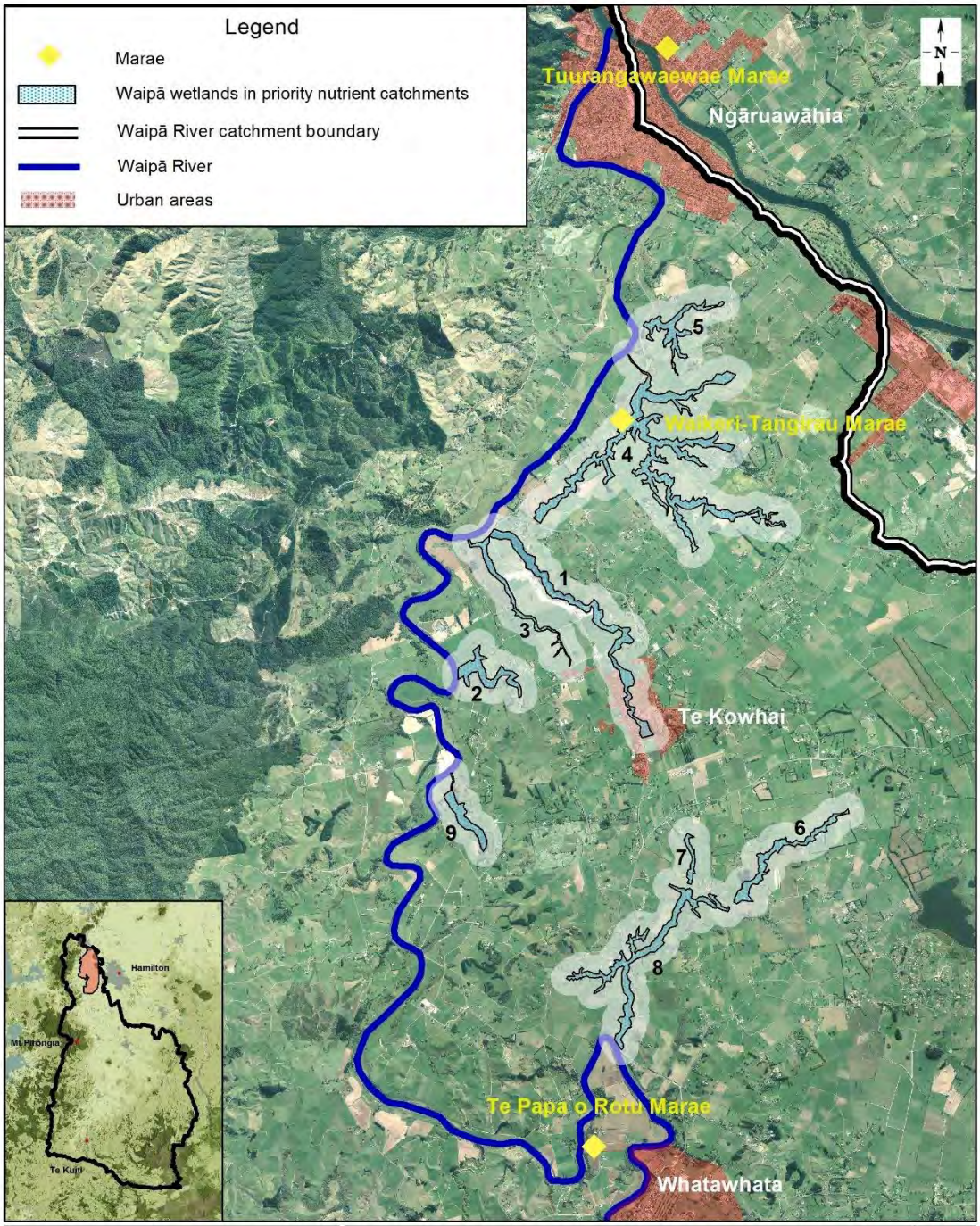
	labour and five releasing events. **Weed control** Most of the gully ecosystems identified have a range of weed species present so a comprehensive weed control plan (along with the native planting) will be essential to ensure success of the project. **Management plan development** For sites where there is no current management plan a management plan should be developed. Cost estimates for each site can be found below: Mapped area 1: Te Otamanui gully wetland (34ha) - 1km fencing ($8000) - 8ha of planting along gully banks ($316,416) - Animal pest control during plant establishment is $200/ha for 3 years ($20,400) Mapped area 2: Collie Road Wetland (13ha) - Assume 25% of the perimeter (1000m) requires fencing at $8 per metre ($8000) - Assume 10m wide buffer planting (1ha) next to new fence ($39,552) - Additional weed control over 30% of the site for 3 years ($58,500) - Animal pest control during plant establishment is $200/ha for 3 years ($7800) - Management plan ($10,000) Mapped area 3: Gully wetland west of Te Otamanui Stream gully - Assume 50% of the perimeter (2750 m) requires fencing ($22,000) - 1.3ha of native planting within open areas ($48,817) - Animal pest control during plant establishment is $200/ha for 3 years ($6000) Mapped areas 4 and 5: Crawford Road Wetland and Saulbrey Wetland (total area 100ha) - Assume 50% of the perimeter (16,500 m) requires fencing ($132,000) - Assume willow control over 50% of the site ($200,000) - Assume planting over 28% of the site ($1,107,456) - Assume additional weed control for 3 years over 10% of the site ($150,000) - Animal pest control during plant establishment is $200/ha for 3 years ($60,000) Mapped Areas 6, 7 and 8: Ohote Stream gully system	

	- Assume 20% (7.4ha) of gully requires willow control ($29,600) - Assume 50% of the perimeter (5500 m) requires fencing ($44,000) - Planting perimeter with a 10m wide (5.5ha) buffer of native plants ($217,536) - Assume additional weed control for 3 years over 30% (3.7ha) of the site (55,500) - Animal pest control during plant establishment is $200/ha for 3 years ($22,200) - Management plan ($10,000) Mapped area 9: Collie Road Wetland (10ha) - 1.7km fencing ($13,600) - 10m planted margin is 1.7ha planting ($63,838) - 2ha weed control over 3 years ($30,000) - Animal pest control during plant establishment is $200/ha for 3 years ($6000) Mapped Area 10: Gully wetland south of Whatawhata (approximately 38 ha, 15km perimeter) - Assume 50% requires fencing, 7.5km ($60,000) - Assume 20% requires ground based willow control ($30,400) - Assume planting a buffer of native plants in a 5m strip around the perimeter ($296,640) - Additional weed control over 30% of the area over 3 years ($171,000) - Animal pest control (for plant establishment) over 3 years ($60,000) - Management plan ($10,000) Mapped Area 11: Houghton Road Swamp (21ha, 11km perimeter) - Assume 10% (1100m) requires fencing ($8800) - Assume 20% requires ground based willow control ($16,800) - Assume planting a buffer of native plants in a 10m strip around the perimeter ($435,072) - Additional weed control over 25% of the area over 3 years ($75,000) - Animal pest control (for plant establishment) over 3 years ($12,600) - Management plan ($10,000) **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.	

	This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 2.5 years after project completion.	L = 17.5
Effectiveness of works	These wetlands are currently in a moderate condition when compared to desired state. It is not expected that this will change over the next 20 years if this project is not undertaken. However, if this project is successfully completed then it is expected that wetland condition in 20 years will be closer to the desired Vision & Strategy state than it is currently. These gully wetlands have been identified as a priority due to their importance in attenuating nutrients in these intensively farmed catchments, however they will benefit from stock exclusion and the proposed planting programmes. This project does not address wide-scale and long term pest plant control.	W = 0.15
Risk of technical failure	Risks are mostly related to weed control. There is a moderate risk of project failure due to technical feasibility if weed control isn't well planned and implemented until such time that native plants are well established.	F = 0.82
Adoptability	It is estimated that almost half of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas, however generally the benefits of avoiding loss of stock in wetlands are becoming well recognised.	A = 0.45
Information quality	Poor – management requirements and cost estimates are based largely on aerial photography.	
Knowledge gaps and response	Costings for most sites are largely based off aerial photography combined with some local knowledge. Further work is required during project planning to determine specific amounts of fencing, planting and weed control required.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	15 years	

Up-front cost – total for implementation phase/project duration		C = 5.0

Task	**Cost ($)**
Works at mapped areas 4 & 5	1,649,456
Works at mapped area 1	344,816
Works at mapped area 2	123,852
Works at mapped area 3	76,817
Works at mapped areas 6,7 & 8	378,836
Works at mapped area 9	113,438
Mapped Area 10	590,840
Mapped Area 11	558,272
Project management/staffing/incidentals (30% of total project cost)	1,150,898
Total	**4,987,225**



Enhancement of Waipā wetlands in priority nutrient catchments (Waikato District) Map 1/2

WWRRS Project Map

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

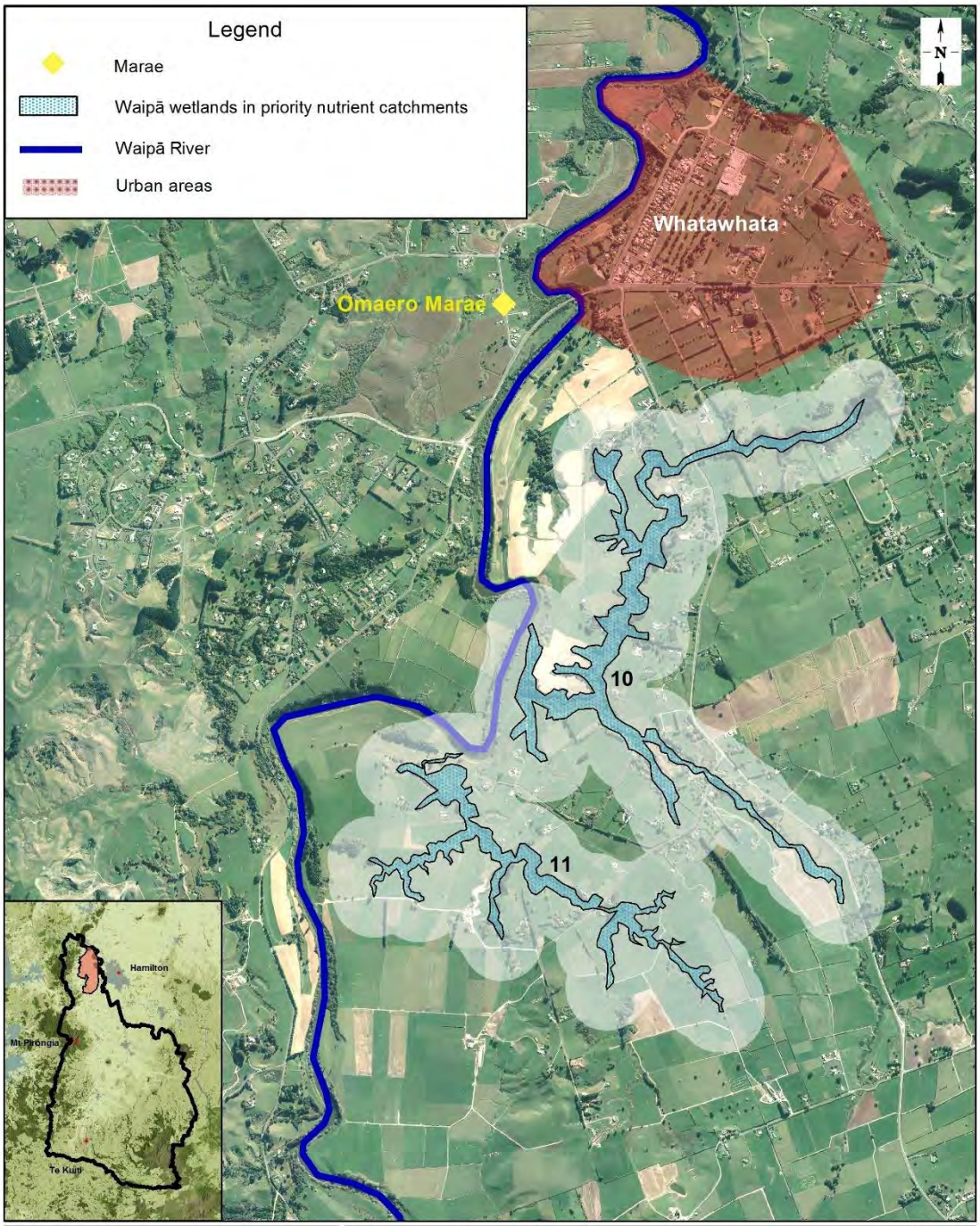
Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.5 1.0 1.5 2.0 2.5
Kilometers

Scale 1:65,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato



Enhancement of Waipā wetlands in priority nutrient catchments (Waikato District) Map 2/2

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.2 0.4 0.6 0.8 1.0
Kilometers

Scale 1:25,000@A4 Portrait

A4

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Typical images of all 11 gully wetlands.

Gully wetland 11: Houghton Road Swamp (21ha, 11km perimeter).

Part of gully wetland 4 and 5: Crawford Road Wetland and Saulbrey Wetland.

Gully wetland 9: Collie Road Wetland (10ha).

WP 4 Priority: High	Kaniwhaniwha catchment erosion protection and remediation	BCR value
Relevant unit goal(s)	The appropriate management of steep and erosion prone land is promoted and incentivised. Water quality is such that waters within the catchment are swimmable and safe to take food from in all places. Land uses are being adapted to match the capability of the land.	
Name of feature	Kaniwhaniwha subcatchment	
Brief description of feature	The Kaniwhaniwha is an 11,434ha catchment extending from the bush clad slopes of Mt Pirongia to the Waipā River. Approximately 2665ha of land is LUC 6e or 7 in pasture and the catchment has been identified as a priority sediment catchment in the Waipā Catchment Plan. The land use within the catchment is predominantly pastoral farming. 41% of the catchment is in indigenous vegetation. This area was home to many historic pā sites including Purakau and Koromatua. A renowned area for the collection of birds and fisheries for the Ngāti Mahanga, Ngāti Hikairo and Ngāti Apakura hapū. According to water quality monitoring data from Waikato Regional Council, E. coli concentrations of the Kaniwhaniwha Stream at Wright Road are unsatisfactory for swimming 100% of the time.	
Desired state to achieve the Vision & Strategy	- A subcatchment where land use matches capability - The stream network has a well vegetated riparian margin (dominated by native species) along its entire length (at least 5m wide) to assist in providing shade, shelter, food and habitat for native fish species. - Stock is excluded from all waterways within the catchment. - Native fish are abundant and there is a wide diversity of species present including piharau, kōkopu and kāeo (freshwater mussels). - There are no manmade barriers to native migratory fish. - The stream is swimmable, fishable and has access for recreation. - Native bush remnants are densely vegetated, connected to riparian corridors wherever practicable and protected from stock grazing. - Native plant regeneration is occurring naturally within native bush remnants. - Iwi and communities have a strong connection to the streams and are active in their use, protection and restoration.	

<table>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Kaniwhaniwha subcatchment would have a very high impact on giving effect to the Vision & Strategy at a Waipā catchment level.</td><td>VS = 200</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Hill country erosion</td><td>Estimated to yield more than 8000 tonnes of sediment per year to subcatchment streams and the Waipā River.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>There is a 25% reduction in suspended sediment in the Kaniwhaniwha Stream within 15 years of project commencement.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

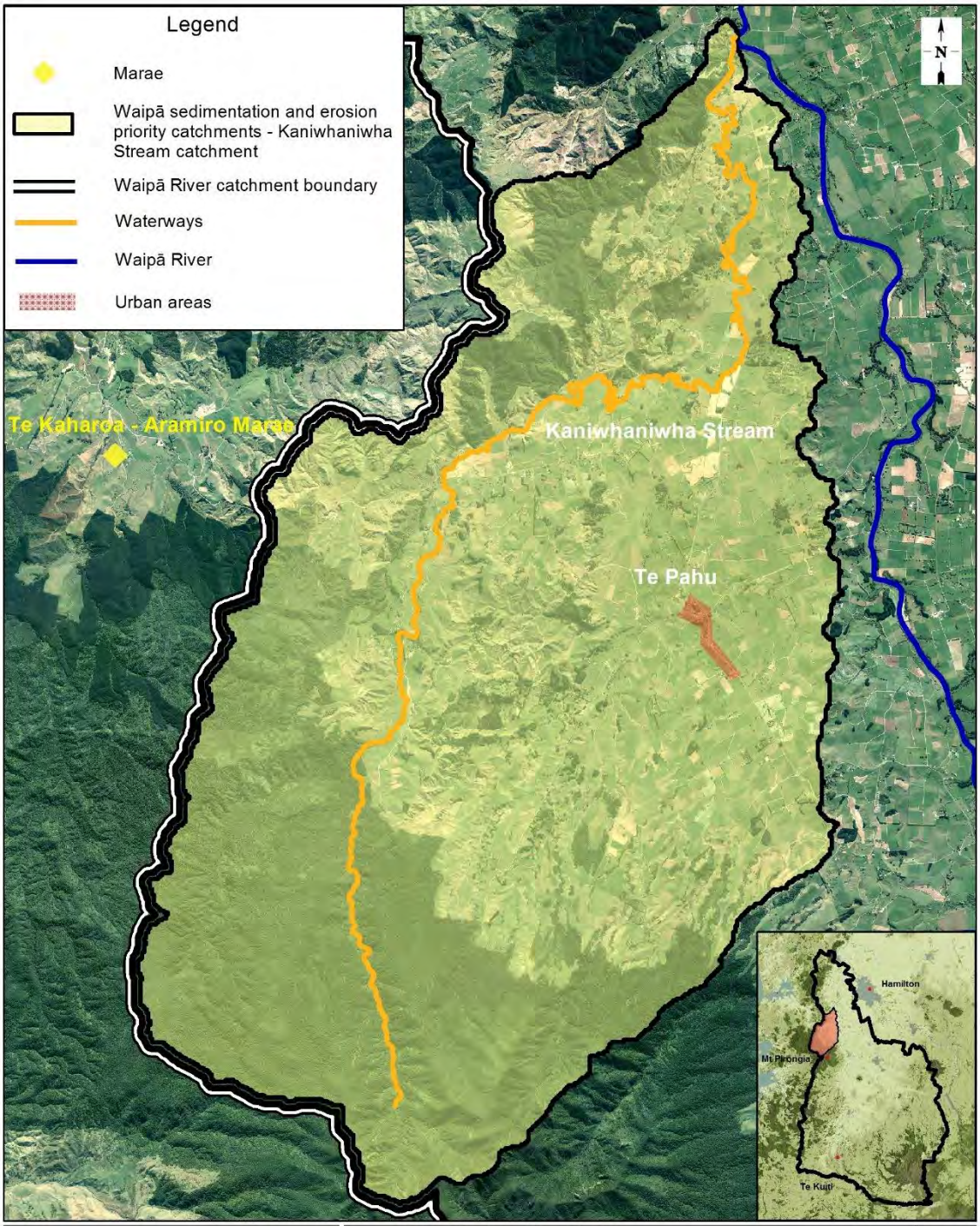
Hill country soil conservation
- 325ha LUC 6e managed with open space pole planting at $3000 per hectare ($975,000).
- 325ha LUC 6e managed with plantation species (pine or mānuka) at $3000 per hectare ($975,000).
- 65.5km of fencing the managed LUC 6e land at $20 per metre (8-wire and batten) ($1,310,000).
- 63ha LUC 7 managed with plantation species (pine or mānuka) at $3000 per hectare ($189,000).
- 8km of fencing managed LUC 7 land at $20 per metre (8-wire and batten) ($160,000).
- 85.5ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $5000 per hectare (e.g. dewatering, retiring seepages, etc) ($427,500).
- 28km fencing existing indigenous forest cover at $25 per metre (8-wire and batten) ($700,000).

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 25% of the direct project costs.</td><td></td></tr>
<tr><td>Time lag for benefits to be realised</td><td>If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 13-14 years after project completion.</td><td>L = 13.5</td></tr>
<tr><td>Effectiveness of works</td><td>The Kaniwhaniwha subcatchment varies in condition with the upper catchment being fully vegetated and largely meeting the objectives of the Vision & Strategy. Other parts of the catchment are in moderate condition with some of the Vision & Strategy desired state aspects being met, although the stream is not</td><td>W = 0.2</td></tr>
</table>

<table>
<tr><td></td><td>considered swimmable due to high levels of E. coli. It is expected that over the next 20 years there could be a slow deterioration in condition of the catchment in the absence of this project. Works included here address several threats to the feature and it is anticipated that if the project is fully completed the catchment will be close to the Vision & Strategy state being achieved for aspects related to land use matching capability and reduction of sediment to waterways. There would also be secondary benefits to biodiversity. There would be advantages in this project being carried out in alignment with Project WP 5 which addresses different values within the same subcatchment.</td><td></td></tr>
<tr><td>Risk of technical failure</td><td>Risks are mostly related to establishment of plantings or loss of works due to severe erosion before they are established. However, proposed priority actions are widely used and accepted for managing hill country erosion. There is a low risk of project failure due to technical feasibility.</td><td>F = 0.92</td></tr>
<tr><td>Adoptability</td><td>It is estimated that about a quarter of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low, however there is some momentum that has been created in the catchment in recent years that may provide encouragement for others. Flexibility in approach to managing erosion on farm is also encouraged and this should be addressed in the development of the project plan(s).</td><td>A = 0.225</td></tr>
<tr><td>Information quality</td><td>Average – estimates are based on modelled information and input from catchment officers who are familiar with the subcatchment and are working with landowners to help them undertake similar works.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>Estimates of LUC classes 6e, 7 and 8 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>15 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Pole planting erosion prone LUC class 6e land (325ha)</td><td>975,000</td></tr>
<tr><td>Plantation species on erosion prone LUC class 6e land (325ha)</td><td>975,000</td></tr>
<tr><td>Fencing managed LUC class 6e land (65.5ha)</td><td>1,310,000</td></tr>
<tr><td>Plantation species on LUC class 7 land (63ha)</td><td>189,000</td></tr>
<tr><td>Fencing managed LUC class 7 land (8km)</td><td>160,000</td></tr>
<tr><td>Treating erosion outside LUC class 6e, 7 and 8 land (85.5ha)</td><td>427,500</td></tr>
<tr><td>Fencing existing indigenous vegetation (28km)</td><td>700,000</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>1,184,125</td></tr>
</table>
</td><td>C = 5.9</td></tr>
</table>

	Total	**$5,920,625**	



Kaniwhaniwha catchment erosion protection and remediation

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.6 1.2 1.8 2.4 3.0
Kilometers

Scale 1:78,000@A4 Portrait

A4

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Topography of the Kaniwhaniwha catchment, including high erosion class land.

Open-space pole planting on high erosion class land in the Kaniwhaniwha catchment.

A retired wetland sidling in the Kaniwhaniwha catchment, reducing sedimentation outside LUC class 6e, 7 and 8 land.

WP 5 Priority: Very high	Kaniwhaniwha catchment streams fish habitat rehabilitation and restoration of forest remnants	BCR value
Relevant unit goal(s)	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. 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.	
Name of feature	Kaniwhaniwha subcatchment	
Brief description of feature	A 50km long stream network within the Kaniwhaniwha catchment has been identified by fish experts as being important habitat for native fish and a priority for fish habitat rehabilitation (where fish habitat is lacking). Waterways include: - Kaniwhaniwha Stream – a 20km long stream flowing from the forested slopes of Mt Pirongia (near the village of Te Pahu) to join the Waipā River near Whatawhata. - Rangitukia Stream – a 13km long stream flowing from Mt Pirongia in the vicinity of Corcoran Road, Te Pahu. Te Pahu Stream – a 10.6km long stream flowing from Mt Pirongia in the vicinity of Rolley Road, Te Pahu, to join the Rangitukia Stream near the end of Simmond Road, Te Pahu. - Te Kauri Stream – a 3.5km long stream flowing from Mt Pirongia in the vicinity of Limeworks Loop Road, Te Pahu, to join the Kaniwhaniwha Stream near Fillery Road. - Tawhitiwhiti Stream – a short stream with a steep gradient flowing from the bush line on Mt Pirongia for approximately 3.7km downstream to the Te Pahu Stream. There are also numerous forest remnants within the Kaniwhaniwha catchment. Five of these have been identified as being within the top 30% of biodiversity priorities within the Waikato and Waipā River catchments. These sites range in size from 0.7ha to 32ha. This area was home to many historic pā sites including Purakau and Koromatua. A renowned area for the collection of birds and fisheries for the Ngāti Mahanga, Ngāti Hikairo and Ngāti Apakura hapū. According to water quality monitoring results on the Waikato Regional Council website, the Kaniwhaniwha Stream is unsatisfactory for swimming 100% of the time due to high levels of E.coli.	

<table>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- The stream network has a well vegetated riparian margin (dominated by native species) along its entire length (at least 5m wide) to assist in providing shade, shelter, food and habitat for native fish species.
- Stock is excluded from all waterways within the catchment.
- Native fish are abundant and there is a wide diversity of species present including piharau, kōkopu and kāeo (freshwater mussels).
- There are no manmade barriers to native migratory fish.
- The stream is swimmable, fishable and has access for recreation.
- Native bush remnants are densely vegetated, connected to riparian corridors wherever practicable and protected from stock grazing. Native plant regeneration is occurring naturally within native bush remnants.
- Iwi and communities have a strong connection to the streams and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Kaniwhaniwha catchment Streams and adjoining forest fragments would have a very high impact on giving effect to the Vision & Strategy at a Waipā catchment level.</td><td>VS = 200</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on the feature</th></tr>
<tr><td>Lack of riparian vegetation, streambank erosion and sedimentation.</td><td>Degraded fish habitat</td></tr>
<tr><td>Lack of in-stream woody debris</td><td>Reduction in cover and habitat for native fish</td></tr>
<tr><td>Incorrectly installed waterway crossings are a barrier to native fish</td><td>Large areas of fish habit are unused. Fish unable to complete their life cycle.</td></tr>
<tr><td>Streambank erosion</td><td>Estimated to yield 932 tonnes of sediment per year</td></tr>
<tr><td>Fragmentation of forest remnants</td><td>Affects the viability of the forest fragment through increasing edge effects, increasing potential for weed and animal pest invasion. Also reduces the habitat available for native species.</td></tr>
<tr><td>Stock access to native forest remnants</td><td>Stock prevent native regeneration and open up areas to plant pests.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 15 years:
- Catchment streams are fully fenced to exclude stock with a minimum 5m fence setback.
- Riparian margins are vegetated on both sides with a mixture of exotic trees for erosion protection and native tree species that provide stream shade and enhance habitat for adult native fish (while allowing designated areas for recreational access).</td><td></td></tr>
</table>

	- Woody structures provide in-stream habitat for native fish at approximately 64 locations along the Kaniwhaniwha Stream. - There are healthy populations of native fish species including tuna (eel), kōura, banded kōkopu and piharau. - All identified forest remnants are fenced to exclude stock and connected to other forest remnants and riparian areas where possible. - Native planting fills in any open areas within forest fragments and provides a buffer around the outside from 'edge effects'.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Fencing waterways** Carry out fencing (at least 5 wire with 2 electric wires unless flooding is a common issue) along the waterways identified. This shall have a minimum 5m setback from the top of the streambank. Fencing costs are estimated at $8 per metre. Cost estimates assume that 50% of the waterways are unfenced or require fences to be moved back to allow for planting. Cost estimates are as follows: - Kaniwhaniwha Stream Fencing (20km fence length) – $160,000 - Rangitukia Stream Fencing (13km fence length) – $104,000 - Te Pahu Stream Fencing (10.6km fence length) – $84,800 - Te Kauri Stream Fencing (3.5km fence length) – $28,000 - Tawhitiwhiti Stream Fencing (3.7km fence length) – $29,600 **Planting waterways** Undertake native and exotic riparian planting within the fenced area and carry out associated weed control and maintenance. Costs assume that 50% of each waterway requires planting at a cost of $37,552 per hectare (including site prep, plant purchase, planting labour and five releasing events). - Kaniwhaniwha Stream Planting (10ha) – $375,520 - Rangitukia Stream Planting (6.5ha) – $244,088 - Te Pahu Stream Planting (5.3ha) – $199,025 - Te Kauri Stream Planting (1.75ha) – $65,716 - Tawhitiwhiti Stream Planting (1.8ha) - $67,593 **In-stream woody debris** Construct in-stream woody debris structures on Kaniwhaniwha Stream for native fish habitat (4 structures per 500 m from the corner of Fillery Road and Limeworks Loop Road downstream to Smith Road) over an 8km stretch. It is critical that design and construction of fish habitat is undertaken by a suitably experienced practitioner to ensure that it does not exacerbate bank erosion. Consent may be required for this work.	

	The estimated cost of woody debris structures (including site investigation, design and installation) is $236,712 plus $20,000 for resource consents. This cost estimate is generous and cost savings would be made if one resource consent application covered all woody debris structures and if multiple structures were installed at a time. **Remediation of fish barriers** Locations of barriers to fish passage are investigated and work undertaken to remedy these barriers. On the Rangitukia Stream at least three barriers are estimated to require being remedied. Remediation of fish barriers is estimated at $30,000 **Management of forest remnants** <u>Fencing forest remnants</u> Fence any unfenced forest remnants identified (see map) to exclude stock with a minimum 5 wire (2 electric) fence. - Forest remnant in the vicinity of Smith Road (32ha, 7km perimeter) – assume 70% (4.9km) of fencing or fence upgrade is required around the perimeter ($39,200). - Forest remnants in the vicinity of Grove Road and Te Pahu Road (totalling 6.4ha) – assume 500m of fencing is required ($4000). - Kahikatea fragments between Whittaker Road and Te Pahu Stream (1.7ha block and 0.7ha block) – assume 800m of fencing or fence upgrade is required ($6400). - Patchy forest remnants off Limeworks Loop Road (approximately 10ha and 4km perimeter if connected) – assume 50% of perimeter fencing is required ($16,000). - Forest fragments close to Martelletti Road on the Rangitukia Stream (8ha) – no fencing required. <u>Planting within and around forest remnants</u> Carry out native planting to fill gaps and protect forest remnants from edge effects if required. This is estimated to cost $37,552 per hectare including site preparation, plant purchase, planting labour and five releasing events. - Forest remnant in the vicinity of Smith Road (32 ha, 7km perimeter) – assume 10% (3ha) of the area requires planting ($112,656). - Forest remnants in the vicinity of Grove Road and Te Pahu Road (totalling 6.4ha) – assume 1ha requires infill planting ($37,552). - Kahikatea fragments between Whittaker Road and Te Pahu Stream (1.7ha block and 0.7ha block) – assume 0.5ha of planting is required ($18,776). - Patchy forest remnants off Limeworks Loop Road (approximately 10ha and 4km perimeter if connected) –	

	assume 20% (2ha) of the area requires native planting ($75,104). - Forest fragments close to Martelletti Road on the Rangitukia Stream (8ha) – no planting required. <u>Weed control in and around forest remnants</u> Some sites might be particularly weedy and require additional plant pest control to ensure success of native plantings and regeneration of native trees. A cost estimate of $2800 per hectare for weed spraying using a knapsack has been estimated per year for three years across the areas as follows: - Forest remnant in the vicinity of Smith Road (32ha, 7km perimeter) – weed control across 10% (3.2ha) of the site including within the 3ha planted area ($26,880). - Forest remnants in the vicinity of Grove Road and Te Pahu Road (totalling 6.4ha) – weed control across 20% (1.2ha) of the site including within the 1ha planted area ($10,080). - Kahikatea fragments between Whittaker Road and Te Pahu Stream (1.7ha block and 0.7ha block) – weed control across 20% (0.5ha) of the site ($4200). - Patchy forest remnants off Limeworks Loop Road (approximately 10ha and 4km perimeter if connected) – weed control across 20% (2ha) of the site ($16,800). - Forest fragments close to Martelletti Road on the Rangitukia Stream (8ha) – weed control across 10% (0.8ha) of the site ($6720). <u>Animal pest control</u> Possum control may be required within forest remnants to assist with the establishment of native plantings. The cost estimates provided below provide are $600 per hectare for 3 years of possum control using bait stations. The cost includes purchase and establishment of bait stations at one station per hectare and labour and bait to check and refilling of bait stations. - Forest remnant in the vicinity of Smith Road (32ha, 7km perimeter) – $19,200. - Forest remnants in the vicinity of Grove Road and Te Pahu Road (totalling 6.4ha) – $3840. - Kahikatea fragments between Whittaker Road and Te Pahu Stream (1.7ha block and 0.7ha block) – $1800. - Patchy forest remnants off Limeworks Loop Road (approximately 10ha and 4km perimeter if connected) – $6000. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.	

	This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 13-14 years after project commencement.	L = 13.5
Effectiveness of works	The Kaniwhaniwha subcatchment varies in condition with the upper catchment being fully vegetated and largely meeting the objectives of the Vision & Strategy. Other parts of the catchment are in moderate condition with some of the Vision & Strategy desired state aspects being met. It is expected that over the next 20 years there could be a slow deterioration in condition of the catchment in the absence of this project. Works included here address several threats to the feature and it is anticipated that if the project is fully completed then the catchment will be close to the Vision & Strategy state being achieved for aspects related to fisheries and biodiversity in 20 years' time. The project does not address land use in the middle to lower catchment, however the proposed fencing and planting works will assist in protecting and restoring water quality at this site. There would be advantages in this project being carried out in alignment with Project WP 4 which addresses different threats and values within the same subcatchment.	W = 0.17
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding. Construction of in-stream fish habitat is a relatively recently applied tool in these environments and there is still some uncertainty around their longevity. Risk of failure can be minimised by works being designed and constructed by an appropriately experienced practitioner.	F = 0.82
Adoptability	It is estimated that almost half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may be a challenge in terms of uptake. If there is already fencing close to the streambank in places (i.e. with a narrow riparian margin) landowners may be unwilling to move fences back to allow room for native planting. Loss of fences to flooding may also be a deterrent for landowners who are concerned about maintenance costs. This can be mitigated by the use of 5m setbacks and a fencing standard appropriate for the location. There are some existing projects along this reach that provide a good example of what can be achieved with larger riparian margins.	A = 0.45
Information quality	Average – estimates are based on aerial photographs, Waipā catchment riparian surveys and input from catchment officers who are familiar with the reach and are working with landowners to help them undertake similar works.	
Knowledge gaps and response	It is unknown specifically how much fencing already exists. This would need to be established as part of the project planning. Location of fish barriers, and location and design of in-stream woody debris structures would need to be determined in the early stages of the project.	

<table>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>15 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Kaniwhaniwha Stream fencing (20km)</td><td>160,000</td></tr>
<tr><td>Kaniwhaniwha Stream planting (10ha) including plant establishment</td><td>375,520</td></tr>
<tr><td>Rangitukia Stream fencing (13km of bank)</td><td>104,000</td></tr>
<tr><td>Rangitukia Stream planting (6.5ha)</td><td>244,088</td></tr>
<tr><td>Rangitukia Stream fish barrier remediation</td><td>30,000</td></tr>
<tr><td>Te Pahu Stream fencing (10.6km of streambank)</td><td>84,800</td></tr>
<tr><td>Te Pahu Stream planting (5.3ha)</td><td>199,025</td></tr>
<tr><td>Te Kauri Stream fencing (3.5km of streambank)</td><td>28,000</td></tr>
<tr><td>Te Kauri Stream planting (1.75ha)</td><td>65,716</td></tr>
<tr><td>Tawhitiwhiti Stream fencing (3.7km of streambank)</td><td>29,600</td></tr>
<tr><td>Tawhitiwhiti Stream planting (1.8ha)</td><td>67,593</td></tr>
<tr><td>In-stream woody debris</td><td>236,712</td></tr>
<tr><td>Resource consent for weedy debris structures</td><td>20,000</td></tr>
<tr><td>Remediation of fish barriers (3)</td><td>30,000</td></tr>
<tr><td>Fencing forest fragments (10.2km)</td><td>65,600</td></tr>
<tr><td>Planting in and around forest remnants</td><td>244,088</td></tr>
<tr><td>Weed control in and around forest remnants</td><td>64,680</td></tr>
<tr><td>Animal pest control</td><td>31,800</td></tr>
<tr><td>Project management and planning (30%)</td><td>624,366</td></tr>
<tr><td>Total</td><td>2,705,588</td></tr>
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</td><td></td></tr>
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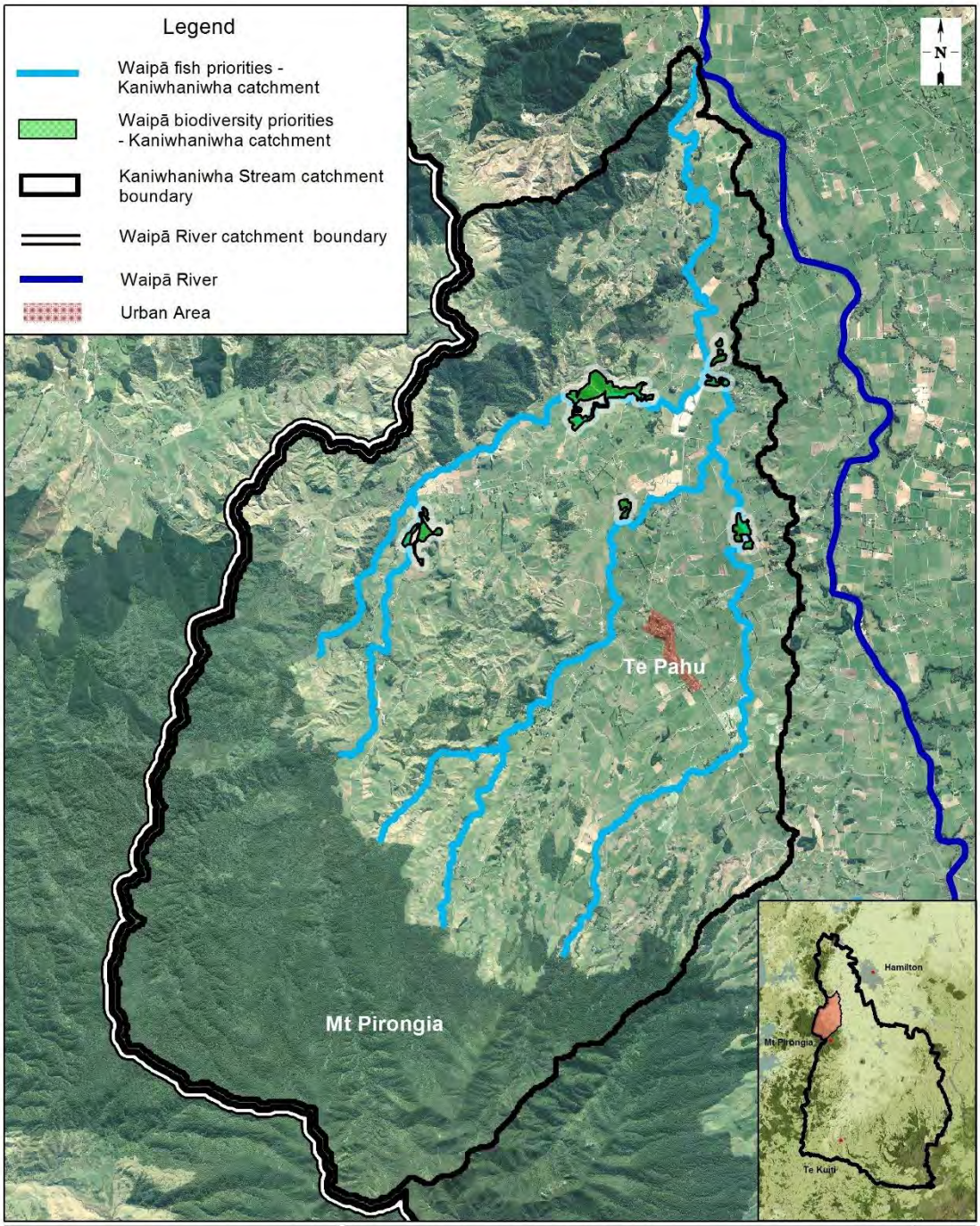

Kaniwhaniwha catchment streams fish habitat rehabilitation & restoration of forest remnants

WWRRS Project Map

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

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The middle reaches of the Kaniwhaniwha Stream, with a forest remnant in the top right corner of the photo.

An unfenced section of Kaniwhaniwha Stream. The water levels are higher than usual in this photo.

An unfenced section of Rangitukia Stream.

A section of Te Pahu Stream where it is recommended that the riparian fence be moved back and the margin planted in native plants.

Te Pahu Stream in the foreground and native kahikatea forest remnants in the background.

WP 6 Priority: Medium	Enhancement of Waipā wetlands in priority nutrient catchments (Waipā district)	BCR value
Relevant unit goal(s)	The quality and flow of water is maintained and enhanced. 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. Wetlands are created or protected and actively managed to enhance multiple functions.	
Name of feature	Waipā district gully wetlands greater than 10ha and located within Waipā catchment priority nutrient areas.	
Brief description of feature	Eight gully ecosystems containing remnant wetlands and forest fragments. The total area covered by these sites is 215ha. These are located on the true right bank of the Waipā River and contain wetlands with remnants of native wetland vegetation, and remnant forest fragments (e.g. kahikatea). Catchment modelling undertaken by Waikato Regional Council has identified priority nutrient subcatchments in the Waipā River catchment (lower Mangapiko, Mangawhereo and northwest of Hamilton). These large gully systems have been identified within the priority nutrient subcatchments as important for water quality. In addition, many of these gully systems are home to rare and/or threatened species such as mudfish, bats, tuna and spotless crake so are also important for biodiversity reasons. In most cases pest willow trees occupy a large proportion of sites but there is a healthy understorey of native plant species. Some sites also have pockets of remnant kahikatea forest. Historically, the gullies and wetlands of the Waipā River catchments provided sustenance for iwi, hapū and marae. Tuna, and birds were the staple foods for tāngata whenua. These were active areas for gathering foods.	
Desired state to achieve the Vision & Strategy	- Gully wetland ecosystems are protected from stock grazing. - They have healthy native plant communities and healthy populations of native fish. - They are valued by the wider community for their aesthetic and cultural values. - Iwi and communities have a strong connection to the gully wetlands and are active in their use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition the Waipā district gully wetlands would have a very high impact on giving effect to the Vision & Strategy at a Waipā catchment level.	VS = 25

<table>
<tr>
<td>Key threats to the feature that this project addresses</td>
<td>
<table>
<tr><th>Key threat</th><th>Impact on the feature</th></tr>
<tr><td>Further clearance of native vegetation within gully wetlands</td><td>Reduced habitat for native flora and fauna and game birds, loss of nutrient attenuation areas, loss of wetland areas to slow flood flows.</td></tr>
<tr><td>Stock access</td><td>Destruction of native plant communities, introduction of weed species.</td></tr>
<tr><td>Willow trees</td><td>Shade out native species and spread to other sites.</td></tr>
<tr><td>Weed species</td><td>Compete with native plant communities and are a threat to agriculture.</td></tr>
</table>
</td>
<td></td>
</tr>
<tr>
<td>Project goal/s</td>
<td>Within 15 years of project commencement:
- All identified gully wetland systems are fenced to exclude stock and protected from extensive land drainage practices (e.g. large scale drain digging).
- Gully systems are well vegetated with native species where practicable.
- Known mudfish habitat sites within these gullies are protected from disturbance.
- Where bats are known to be present site management provides for their habitat requirements.</td>
<td></td>
</tr>
<tr>
<td>Priority works for funding</td>
<td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Fencing
Gully wetland should be fenced at the top of the gully to exclude stock. Ideally this would be followed immediately by native planting and associated weed control. Fencing should generally be a minimum of 5 wire (2 electric) and this has been estimated to cost $8 per metre

Willow removal
This would be undertaken in circumstances where the willow trees are not providing habitat for a rare or threatened native species and where there is a dense native understorey beneath the willow canopy. Any willow removal should be undertaken in stages using ground based methods (such as treatment with x-tree basal). The estimated cost of this is $4000 per hectare.

Planting
Native planting should be carried out within open areas to create a native plant dominated ecosystem over the long term. Planting at 1.5m spacing has been recommended using hardy species that would have naturally existed within the gully ecosystem (e.g. cabbage tree, kahikatea, flax, kānuka). Native</td>
<td></td>
</tr>
</table>

	planting has been estimated to cost $39,552 per hectare including site preparation, plant purchase, planting labour and five releasing events. **Weed control** Most of the gully ecosystems identified have a range of weed species present so a comprehensive weed control plan (along with the native planting) will be essential to ensure success of the project. Weed control costs are generally estimated at $5000 per hectare. This is based on using a knapsack sprayer and assumes that the site is very weedy. **Animal pest control** Possum control may be required in areas where native planting is to be undertaken. The estimated cost for this work is $600 per hectare for three years using bait stations. **Management plan development** For sites where there is no current management plan a management plan should be developed. Assumptions and cost estimates for each site can be found below. Mapped area 12 – Tuhikaramea Stream tributary gully (38.7 ha, 14km perimeter). - Assume 5% (800 m) requires fencing ($5600). - Assume 35% (13.5ha) requires ground based willow control ($54,180). - Assume 25% of the area requires native planting, 13.5ha ($533,952). - Additional weed control over 30% (11.6ha) of the area over 3 years at a cost of $5000 per hectare using a knapsack ($174,150). - Animal pest control (for plant establishment) over 3 years ($23,220). - Management plan ($10,000). Mapped area 13 – Mangahia Stream gully (36ha, 13km perimeter). - Assume 10% requires fencing, 1.3km ($10,400). - Assume 40% (14.4ha) requires ground based willow control ($57,600). - Assume planting a buffer of native plants 5m wide around the perimeter, 6ha ($237,312). - Additional weed control over 40% (14.4ha) of the area over 3 years ($216,000). - Animal pest control (for plant establishment) over 3 years ($21,600). - Management plan ($10,000).	

	Mapped area 14 – Mangaotama gully and wetland (total area 80ha). - Assume the area downstream of State Highway 39 (35ha and 10km perimeter) is 10% unfenced, requires some infill planting (approx 5ha) and weed control (e.g. willow) 20% of the area. - Assume the area upstream of Hams Road (4.2ha and 1.5km perimeter) is 90% unfenced, requires 1.5ha native planting (10 m wide riparian margin) and additional weed control over 20% of the area). - The middle section between Hams Road and the state highway is already being intensively managed and only requires animal pest control for plant establishment. Total fencing cost (2350 m) is $18,800 Total planting cost (6.5ha) is $245,222 Total weed control over 3 years (in addition to native plant establishment) (20% of area is 7.8ha) is $117,000 Animal pest control for native plant establishment (80ha at $200/ha) is $48,000 Management plan is $10,000. Mapped area 15 - Patterson Road Wetland (17 ha, 6.7km perimeter) - Assume 30% (2km) requires fencing ($16,081). - Assume 20% (3.4ha) requires ground based willow control ($13,600). - Assume planting a buffer of native plants 5m wide around the perimeter, 3.4ha ($134,476). - Additional weed control over 20% (3.4ha) of the area for 3 years ($51,000). - Animal pest control (for plant establishment) over 3 years ($10,200). - Management plan ($10,000). Mapped area 16 – gully wetland, forest fragment and waterway in between (near Frontier Road, Pirongia) - Assume 50% (5.3km) requires fencing ($42,400). - Assume planting a buffer of native plants 10m wide around 50% (5.3ha) of the perimeter ($209,625). - Additional weed control over 10% (2.7ha) of the area for 3 years ($40,500). - Animal pest control (for plant establishment) over 3 years ($16,560). - Management plan ($10,000). Mapped area 17 – Mangawhero Stream lower catchment margins (15ha, 6km perimeter) - Assume 50% (3km) requires fencing ($24,000). - Assume 30% (4.5ha) requires ground based willow control ($18,000).	

	- Assume planting a buffer of native plants 10m wide around the perimeter, 6ha ($237,312). - Additional weed control over 20% (3ha) of the area for 3 years ($45,000). - Animal pest control (for plant establishment) over 3 years ($9000). - Management plan ($10,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately 5 years after project completion.	L = 15
Effectiveness of works	These wetlands are currently in a moderate condition when compared to desired state. It is not expected that this will change over the next 20 years if this project is not undertaken. However, if this project is successfully completed, then it is expected that wetland condition in 20 years will be closer to the desired Vision & Strategy state than it is currently. These gully wetlands have been identified as a priority due to their importance in attenuating nutrients in these intensively farmed catchments, however they will benefit from stock exclusion and the proposed planting programmes. This project does not address wide-scale and long term pest plant control.	W = 0.15
Risk of technical failure	Risks are mostly related to weed control. There is a high risk of project failure due to technical feasibility if weed control isn't well planned and a focus given to key high priority weeds that can be managed to very low levels until native plants dominate.	F = 0.82
Adoptability	It is estimated that almost half of landowners would adopt the works if they were fully incentivised. Some may be concerned by loss of marginal grazing areas however generally the benefits of avoiding loss of stock in wetlands are becoming well recognised.	A = 0.45
Information quality	Poor – management requirements are based on expert knowledge but quantity of work required is based largely on aerial photography.	
Knowledge gaps and response	Costings for most sites are largely based off aerial photography combined with some local knowledge. Further work is required during project planning to determine specific amounts of fencing, planting and weed control required.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85

<table>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Mapped area 12</td><td>801,102</td></tr>
<tr><td>Mapped area 13</td><td>552,912</td></tr>
<tr><td>Mapped area 14</td><td>439,022</td></tr>
<tr><td>Mapped area 15</td><td>235,356</td></tr>
<tr><td>Mapped area 16</td><td>319,085</td></tr>
<tr><td>Mapped area 17</td><td>343,312</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>807,236</td></tr>
<tr><td>Total</td><td>3,498,025</td></tr>
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</td><td>C = 3.50</td></tr>
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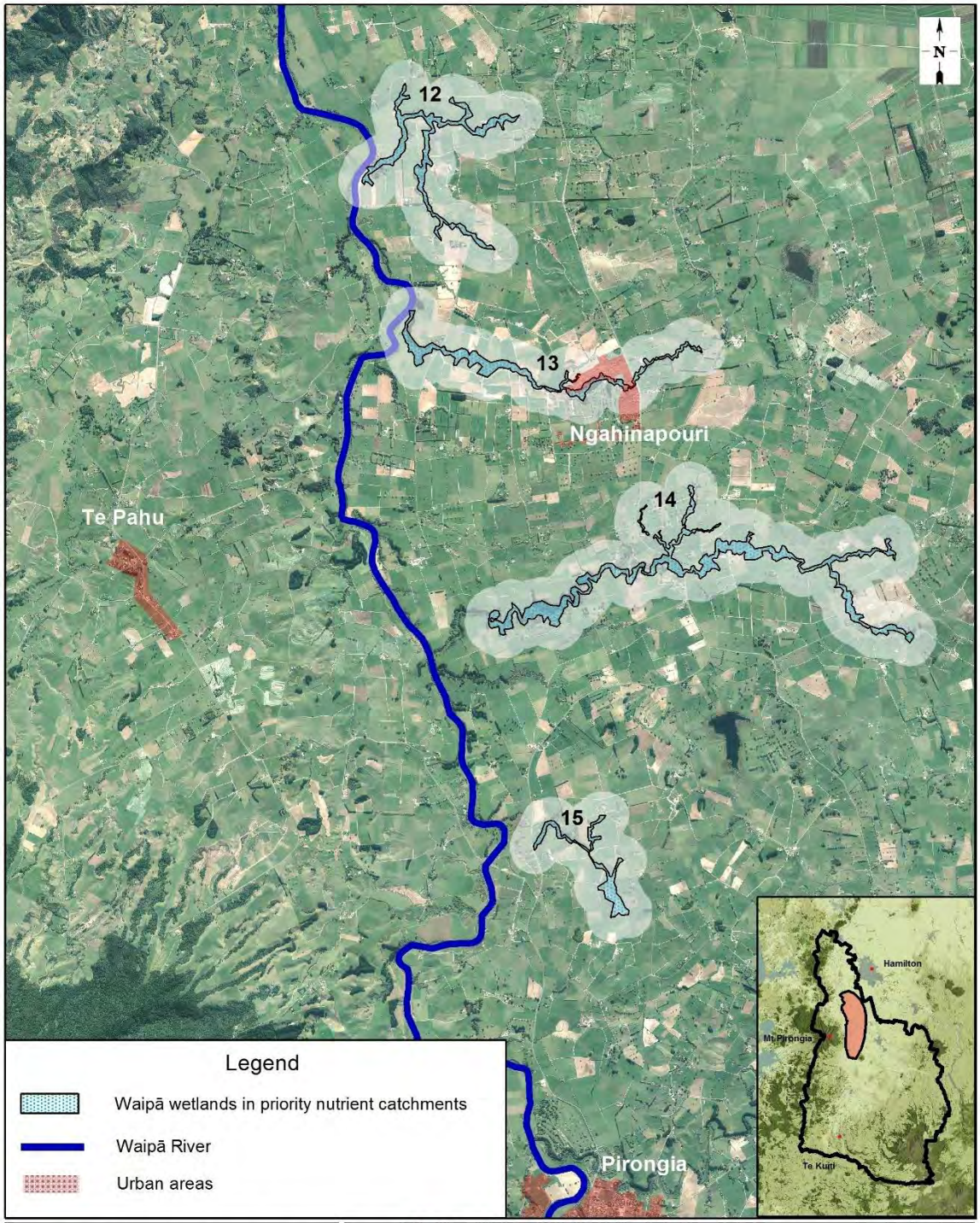

Enhancement of Waipā wetlands in priority nutrient catchments (Waipā District) Map 1/2

WWRRS Project Map

Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws

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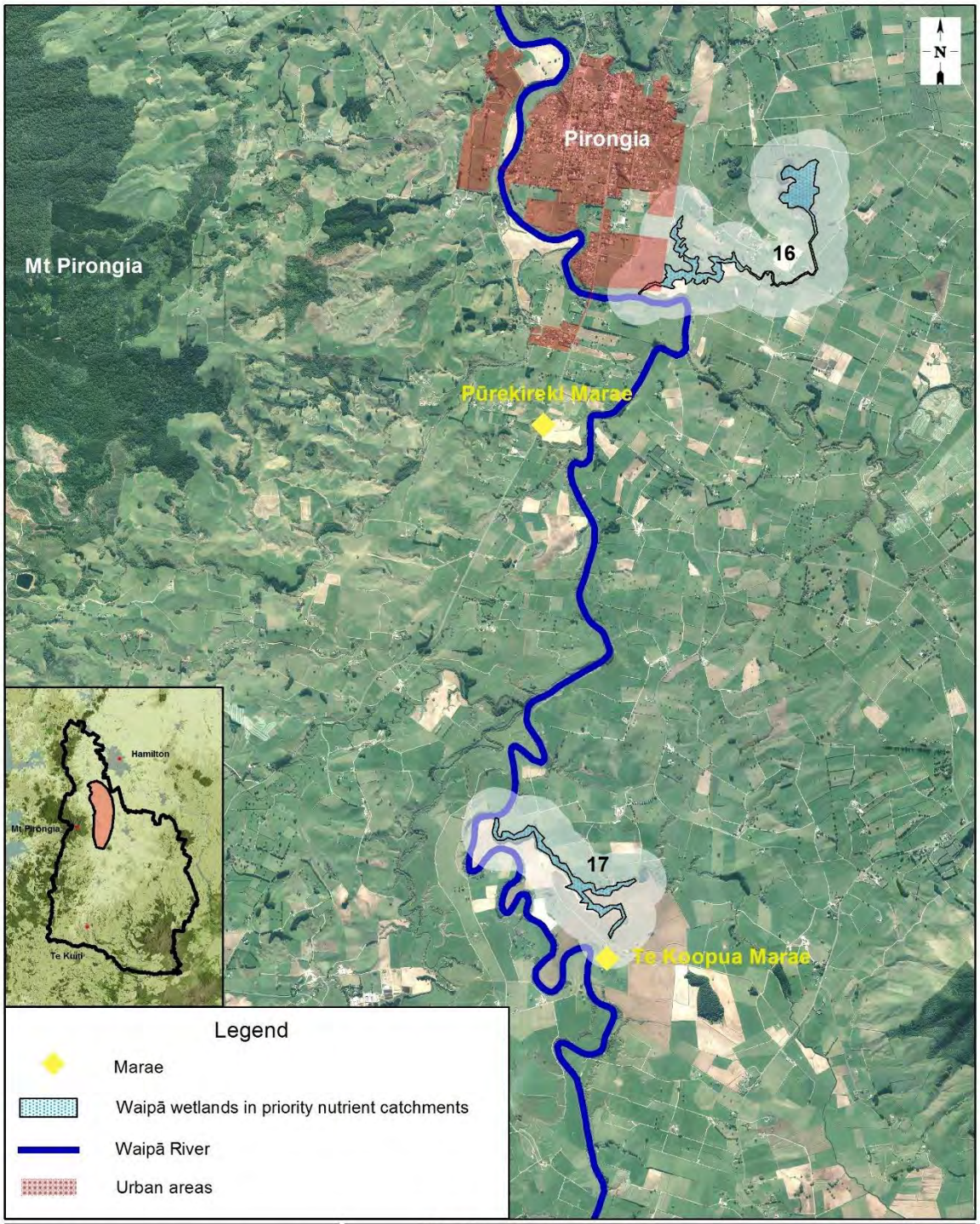
Kilometers

Scale 1:65,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato



Enhancement of Waipā wetlands in priority nutrient catchments (Waipā District) Map 2/2

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name: WWRRS.gws

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Kilometers

Scale 1:50,000@A4 Portrait

A4

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Gully wetland 14 (downstream section): Mangaotama gully and wetland (total area 80ha).

Gully wetland 15: Patterson Road Wetland (17 ha, 6.7km perimeter).

WP 7 Priority: Medium	Restoration of priority lowland kahikatea remnants (and associated wetlands) between Te Kūiti and Templeview	BCR value
Relevant unit goal(s)	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.	
Name of feature	Waipā River catchment kahikatea remnants and associated wetlands	
Brief description of feature	Within the Waipā catchment only 2.07% of the conifer-dominated forests (kahikatea) remain (approximately 170ha). Most have been cleared for pastoral farming and most of what remains has been degraded by grazing, land drainage weed infestation and animal pests. Most remaining kahikatea forest remnants are small (less than 10ha) and fragmented and require further management to ensure their existence long term. The remnants selected for this project include 10 small kahikatea remnants (and associated wetlands) totalling an area of 62.5ha, located within the Waipā River catchment between Te Kūiti and Whatawhata. These remnants have been identified as being within the top 30% of biodiversity sites in the Waikato catchment and/or important habitat for the 'at risk' black mudfish. Five of the remnants are located near McGregor Road near Hamilton, four are located near Te Kūiti (one of which has an associated wetland where there is a healthy population of mudfish) and one other is located near Kakepuku Mountain south of Te Awamutu. Kahikatea provide an important food resource in the kōroi berry which was skilfully harvested by Māori and also enticed birdlife to the tree, for capture.	
Desired state to achieve the Vision & Strategy	- Kahikatea remnants and their associated wetlands are densely vegetated with native vegetation, connected to riparian corridors wherever practicable and protected from stock grazing. - Native plant regeneration occurs naturally within the native forest remnants and associated wetlands. - Where wetlands retain healthy populations of black mudfish these are protected. - Iwi and communities have a strong connection to these areas and are active in their use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition the Waipā River catchment kahikatea remnants and associated wetlands would have a high impact on giving effect to the Vision & Strategy at a local level.	VS = 1.5

<table>
<tr>
<td>Key threats to the feature that this project addresses</td>
<td>
<table>
<tr><th>Key threat</th><th>Impact on the feature</th></tr>
<tr><td>Further fragmentation of forest fragments</td><td>Affects the viability of the forest fragment through increasing edge effects, increasing potential for weed and animal pest invasion. Also reduces the habitat available for native species.</td></tr>
<tr><td>Stock access to native forest fragments</td><td>Stock prevent native regeneration and open up areas to plant pests.</td></tr>
</table>
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</tr>
<tr>
<td>Project goal/s</td>
<td>Within five years of this project commencing:
- All forest remnants identified and their associated wetlands are 100% fenced to exclude stock.
- Edge effects have been reduced through native planting within canopy gaps and around the perimeter of kahikatea remnants.</td>
<td></td>
</tr>
<tr>
<td>Priority works for funding</td>
<td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Further investigation is required to determine the amount of fencing, planting and weed control required. However, based on aerial photographs and local knowledge the following estimates and assumptions have been made:

Fencing
Fencing should generally be a minimum of 5 wire (2 electric) and has been estimated at a cost of $8 per metre.

McGregor Road sites – 50% of the perimeter still remains to be fenced. This equates to 2.8km of fencing ($22,400).

Kahikatea remnants/wetlands near Te Kūiti – fencing is required around the 7.1km perimeter of these areas ($56,800).

Planting
McGregor Road Sites – some infill planting will be required around the perimeter of these sites. This is estimated to total 1.5ha of planting. The cost of this is estimated at $37,552 per hectare ($56,328) including site preparation, native plant purchase, planting labour and five releasing events.

Weed control
McGregor Road Sites – general weed control is estimated to be required over 10% of the sites (2.2ha) using a backpack sprayer at approximately $2800 per hectare ($6160) for three years ($18,480).</td>
<td></td>
</tr>
</table>

	Kahikatea remnant near Kakepuku – weed control is estimated to be required over 10% (1ha) of the site to promote regeneration of native species. Using a backpack sprayer this is estimated to cost $8400 over three years. Kahikatea remnants/wetlands near Te Kūiti – some weed control is likely to be required within the site once it is fenced to promote the regeneration of native species around the perimeter. Using a vehicle with spray unit to treat a 5m wide area around the perimeter (3.5ha) is estimated to cost $1400 per hectare ($4900) per year for three years ($14,700). **Animal pest control** McGregor Road sites – possum control may be required at these sites to assist with native plant establishment. The cost of this using bait stations is estimated at $200 per hectare per year for three years (2.2ha x $200 per ha x 3 years is $1320). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen within 1 year of project completion.	L = 5.5
Effectiveness of works	These fragments are currently in a poor condition when compared to desired state. They also remain at risk of further fragmentation and loss of important hydrological conditions to sustain them, and as a result it is expected that they will deteriorate slowly over the next 20 years if this project is not undertaken. If this project is successfully completed, then it is expected that these kahikatea fragments will be in an improved condition in 20 years' time due to increased regeneration of native species and reduction in weeds. However, this project does not address the concerns around retention of wetland hydrology at these sites.	W = 0.1
Risk of technical failure	Risks are mostly related to failure to control weeds. There is a low risk of project failure due to technical feasibility.	F = 0.92
Adoptability	It is estimated that about two thirds of landowners would adopt the works if they were fully incentivised. Some landowners may be concerned about the perceived loss of shelter areas for stock, or the practicalities of smaller fenced areas on farm. However generally there is good support for this type of work and for the retention of these rare features.	A = 0.63

<table>
<tr><td>Information quality</td><td>Average information – based on judgement of an expert with some local knowledge. Fencing and planting requirements are based on aerial photographs.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>Specific quantities of fencing, planting and pest control required would need to be established as part of the project planning.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Fencing (9.9km)</td><td>79,200</td></tr>
<tr><td>Possum control (2.2ha)</td><td>1320</td></tr>
<tr><td>Weed control for 3 years</td><td>41,580</td></tr>
<tr><td>Native planting (1.5ha)</td><td>56,328</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>35,686</td></tr>
<tr><td>Total</td><td>214,114</td></tr>
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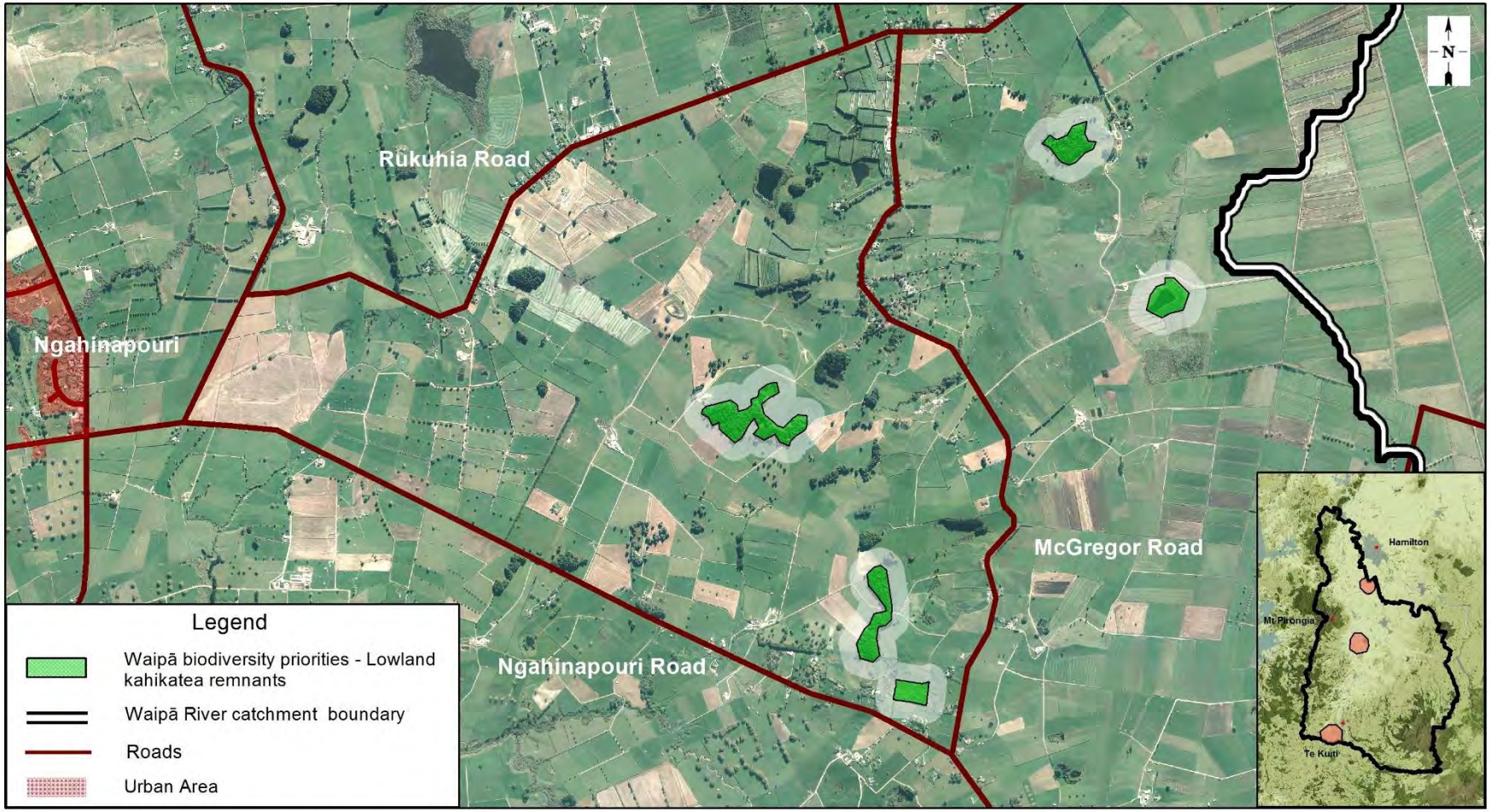

Restoration of priority lowland kahikatea remnants (and associated wetlands) between Te Kuiti and Templeview Map 1/3

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name:WWRRS.gws

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Kilometers

Scale 1:30,000@A4 Landscape

A4

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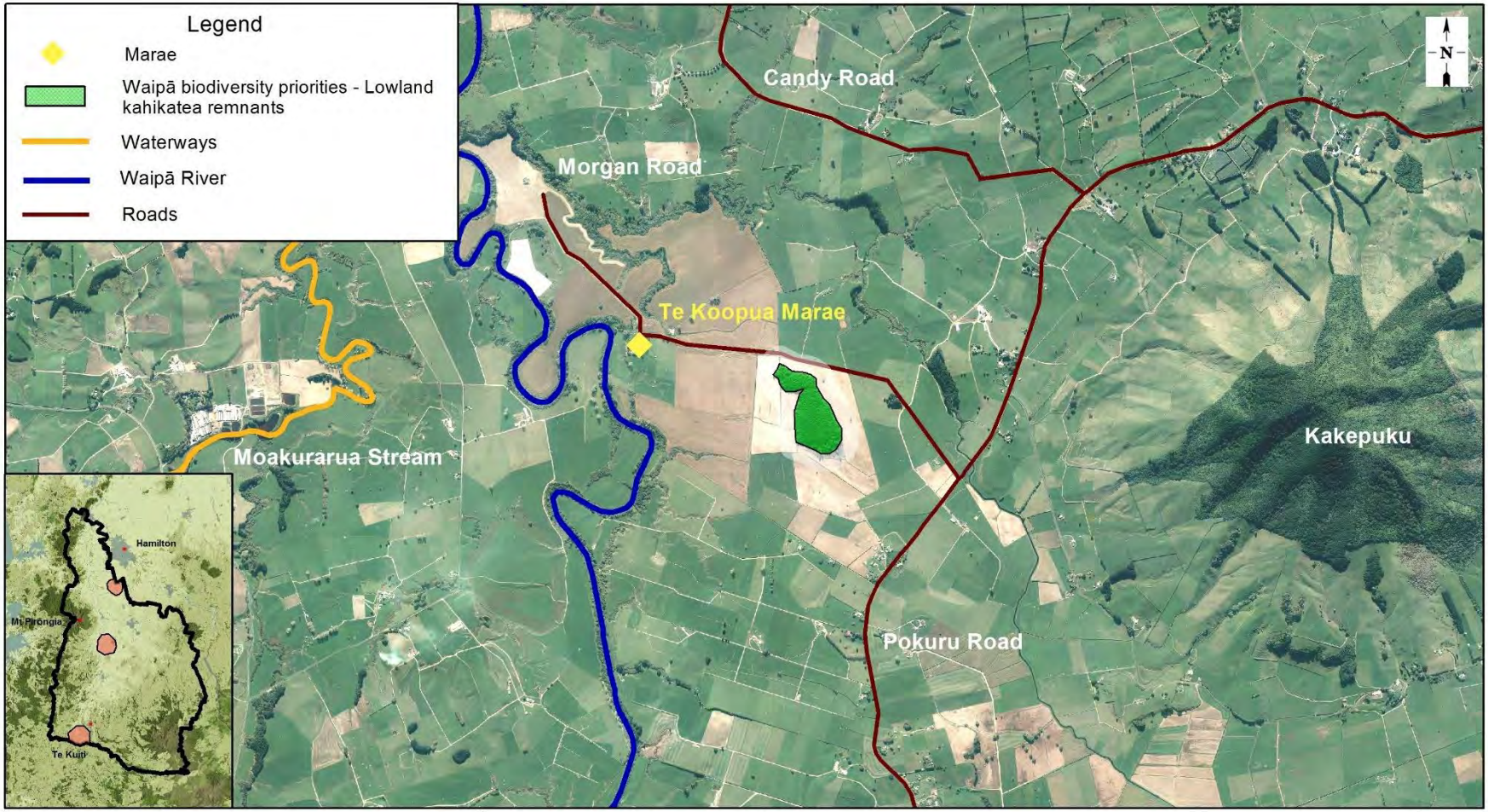
Te Kaunihera ā Rohe o Waikato



Restoration of priority lowland kahikatea remnants (and associated wetlands) between Te Kuiti and Templeview Map 2/3

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name:WWRRS.gws

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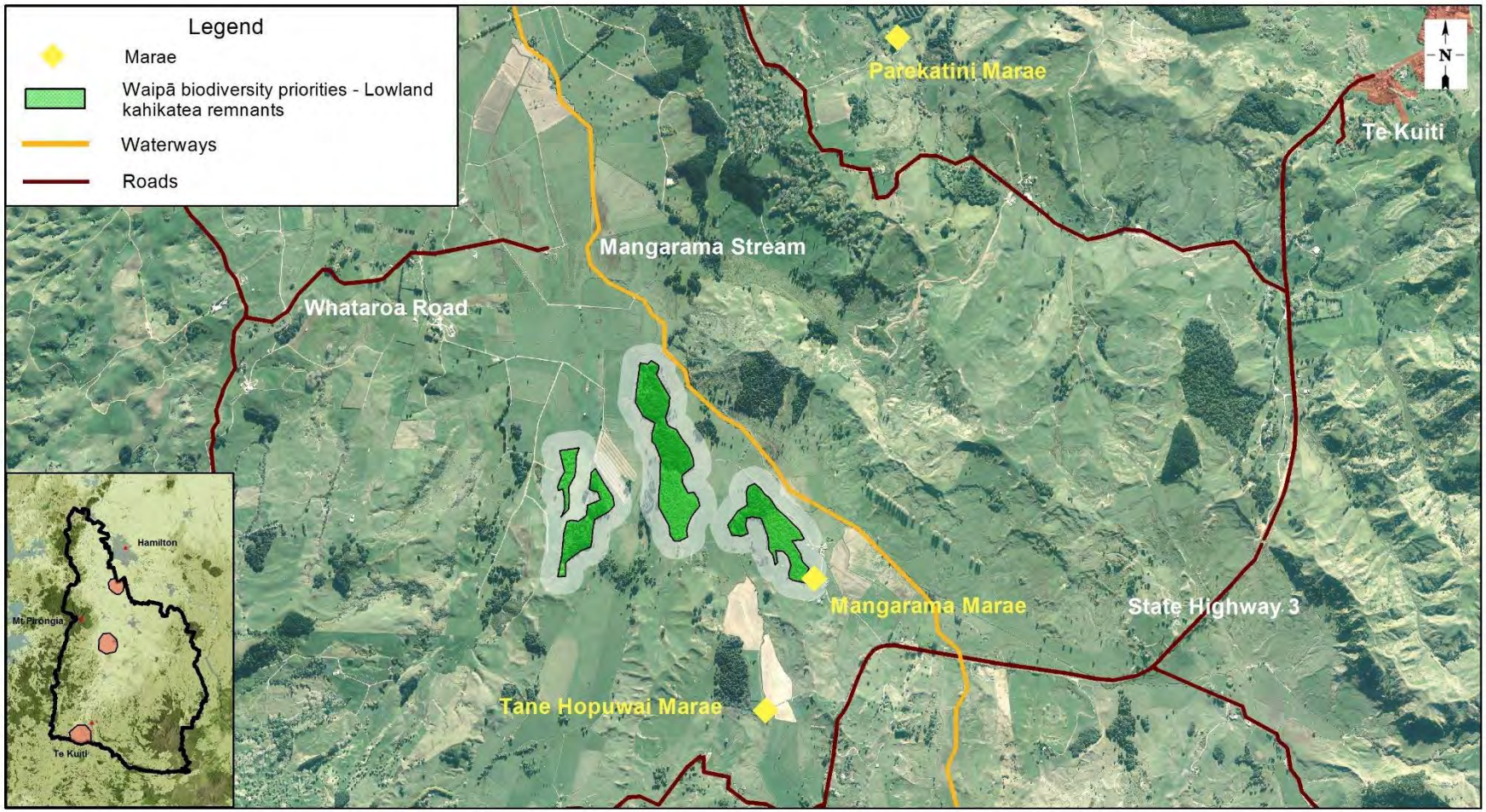
Kilometers

Scale 1:30,000@A4 Landscape

A4

ACKNOWLEDGEMENTS AND DISCLAIMERS

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato



Restoration of priority lowland kahikatea remnants (and associated wetlands) between Te Kuiti and Templeview Map 3/3

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.0 0.3 0.6 0.9 1.2 1.5
Kilometers

Scale 1:30,000@A4 Landscape

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

<table>
<tr><td>WP 8
Priority: High</td><td>Enhancement of water levels in the Moanatuatua Wetland</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>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.

Wetlands are created or protected and actively managed to enhance multiple functions.

Where possible, the natural functioning of floodplains and other ephemeral wetland sites is restored and maintained.</td><td></td></tr>
<tr><td>Name of feature</td><td>Moanatuatua Wetland</td><td></td></tr>
<tr><td>Brief description of feature</td><td>The Moanatuatua is an approximately 140ha peat bog – the only remaining of its type that once covered 50,000ha in the Hamilton ecological district. The rare peat-forming Sporodanthus is still found there. Ownership is split between Department of Conservation (114ha) and Waikato-Tainui (23ha).

Both remnants are ring-drained and lack buffer zones. Due to their small size and ongoing lowering of the water table they are extremely susceptible to fire.

Historically, the wetland provided sustenance and rongoā (medicines) to tāngata whenua with its unique species of plants. The soils were also used for cultural activities including the creation of dyes and strengthening of taonga (treasures).</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- Peat bog is being maintained with adequate water levels to sustain peat formation and retain rare plant communities.
- Iwi and community have a strong connection to the wetland and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on the Vision & Strategy</td><td>In a restored condition the Moanatuatua Wetland would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 20</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on the feature</th></tr><tr><td>Land drainage</td><td>Lowers water levels in the bog causing peat oxidation and changes to vegetation.</td></tr><tr><td>Fire</td><td>Could destroy existing native vegetation. Currently no nearby seed sources to revegetate.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 2 years of project commencement there are structures in place to maintain water levels throughout the wetland.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>In order for this project to proceed private landowners would be required to give consent for a weir to be installed in the drain between their property and the reserve. This project is recommended to be undertaken as one complete piece of work.</td><td></td></tr>
</table>

	Weir design and construction - Site surveys to determine land and drain invert heights and depth of peat ($15,000). - Weir design by engineer ($10,000) - Resource consent for the weir may be required (damming and diverting water ($5000)). - Construction of up to two wooden weirs in the outlet drains of the wetland ($15,000 per weir). **Project management/Staffing/Incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs due to the expected degree of consultation and negotiation required.	
Time lag for benefits to be realised	If works were implemented over a 2-year period, it is estimated that the majority of the project benefits would be seen soon after project completion.	L = 2
Effectiveness of works	The Moanatuatua Wetland is in a degraded state with land drainage having resulted in significant drying of the margins and changes in plant communities. Without this project it is expected that there will be continued and potentially rapid deterioration over the next 20 years, with the wetland at risk of losing important values. If this project is successfully completed then some significant improvement can be expected in wetland condition over the next 20 years. However, this will likely need to be supported by improvement and enforcement of rules around wetland drainage.	W = 0.3
Risk of technical failure	Moderate risk of project failure due to technical feasibility. Risks are mostly related to failure of the weirs to maintain water levels due to losses through other sources such as groundwater flows. This is especially so at this site due to the substantial peat shrinkage on adjacent farmland. However, similar weirs on the outflows of nearby peat lakes have been successful in improving minimum water levels at these sites.	F = 0.82
Adoptability	There may be significant challenges in getting key landowners to agree to this work being undertaken. This would need to be resolved during the early stages of project planning.	A = 0.04
Information quality	Average – based on site knowledge of local experts who are experienced in constructing weirs in peat drainage systems.	
Knowledge gaps and response	On site investigations would be required to get a more accurate estimate of costs and to inform a weir design and height.	
Socio-political risks	There is a high risk that the project will fail to meet its goals over the long term due to socio-political risks. It would require co-ordination of agencies, enforcement of existing rules and approval of consent that may be challenging to obtain.	P = 0.37

<table>
<tr><td>Project duration (years)</td><td>2 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Site surveys to inform weir height and design</td><td>15,000</td></tr>
<tr><td>Weir design plans</td><td>10,000</td></tr>
<tr><td>Weir construction (wood and machinery) x 2</td><td>30,000</td></tr>
<tr><td>Resource consent</td><td>5000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>18,000</td></tr>
<tr><td>Total</td><td>78,000</td></tr>
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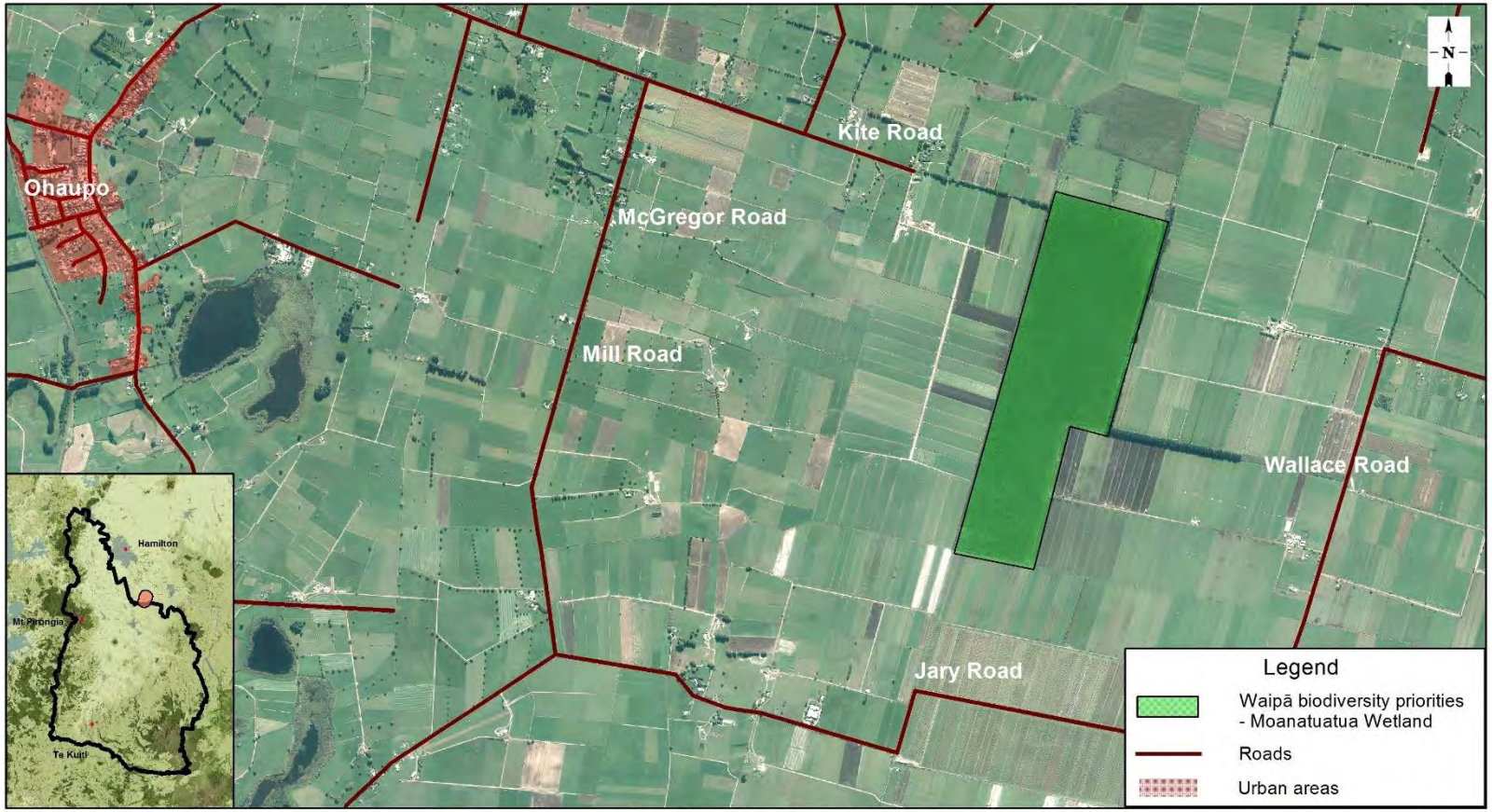


Enhancement of water levels in the Moanatuatua wetland

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.0 0.3 0.6 0.9 1.2 1.5
Kilometers

Scale 1:30,000@A4 Landscape

A4

ACKNOWLEDGEMENTS AND DISCLAIMERS

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

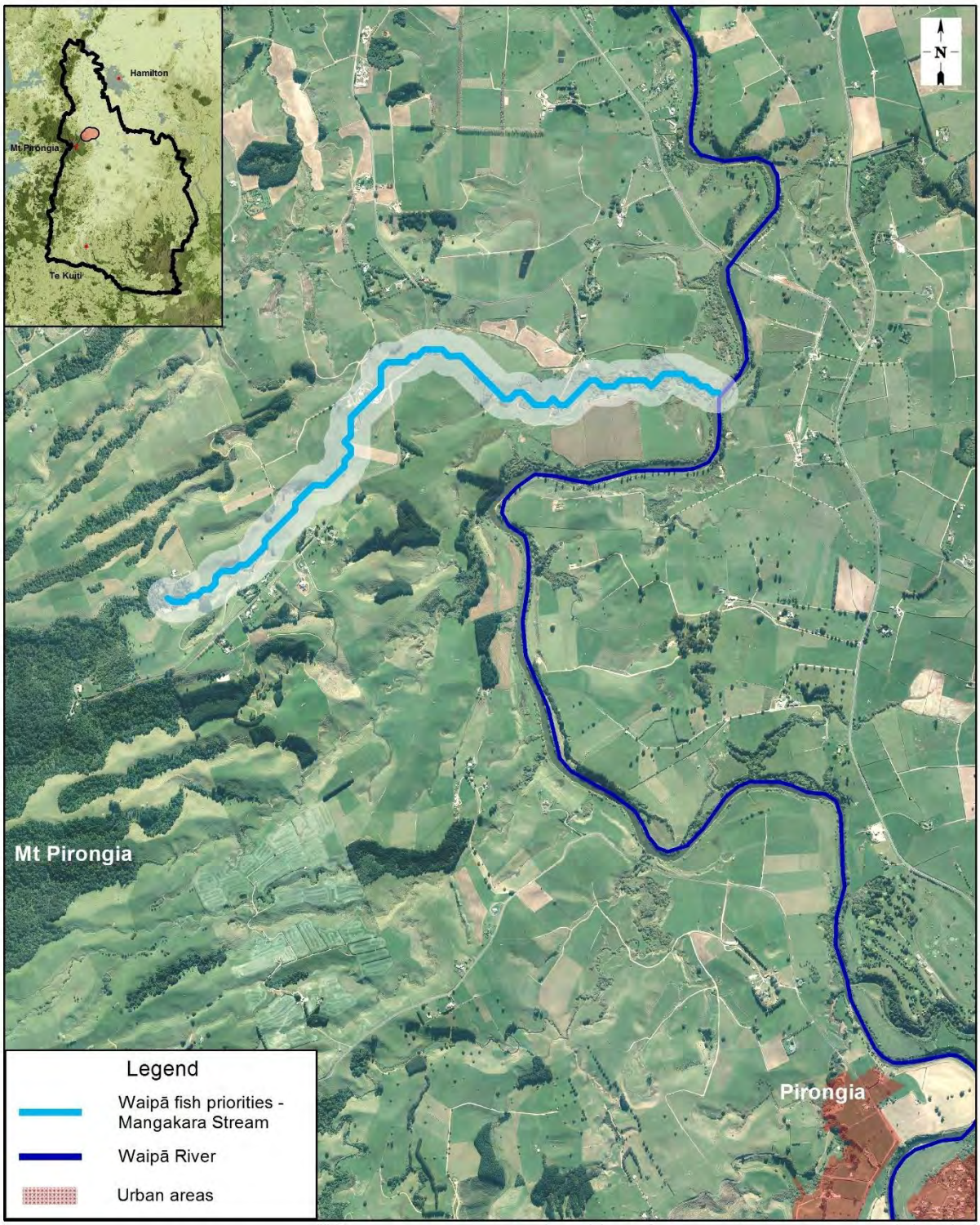
A deep drain between a bog and adjoining farm.

<table>
<tr><td>WP 9
Priority: High</td><td>Mangakara Stream fish habitat rehabilitation</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>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.</td><td></td></tr>
<tr><td>Name of feature</td><td>Mangakara Stream, Te Pahu</td><td></td></tr>
<tr><td>Brief description of feature</td><td>A 3.7km long stream flowing from the bush line on Mt Pirongia (near Grey Road, Te Pahu) to the Waipā River. The land use is predominantly pastoral farming.

This waterway was identified by fish experts as important habitat for native freshwater species such as tuna, kōura and bullies, and it has been identified by Maniapoto iwi as a historic fishing area for piharau. There are opportunities to increase native fish abundance and diversity by remediating barriers and providing increased and high quality fish habitat.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- The stream is fenced to exclude stock from its entire length. It has a well vegetated riparian margin along its entire length that provides erosion protection, shade and shelter.
- Native fish are abundant and the full range of species expected to be found in the waterway can be found there.
- There are no manmade barriers to native migratory fish.
- The stream is swimmable, fishable and has access for recreation.
- Iwi and communities have a strong connection to the stream and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Value of the feature</td><td>In a restored condition the Mangakara Stream, Te Pahu, would have a high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 1.5</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on the feature</th></tr><tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr><tr><td>Vegetation clearance</td><td>Reduced cover, habitat and food (invertebrates) for native fish species.</td></tr><tr><td>Culverts and crossings that are a barrier for native fish</td><td>Native fish unable to access upstream areas.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of the project commencing:
- The full 3.7km length of Mangakara Stream is fenced to exclude stock and has a riparian margin (at least 5m wide) vegetated with predominantly native plant species.
- All manmade barriers to fish migration are remedied.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This</td><td></td></tr>
</table>

	project could be undertaken as a whole, or in multiple smaller components. **Riparian management** - Undertake up to 6km of riparian fencing to a standard of at least 5 wires (2 electric) and set back at least 5m from the top of the streambank ($48,000). Include adjoining wetland areas within the riparian fencing. - Undertake native riparian planting at 1.5m spacing. Based on the assumption that 80% of the riparian margin requires planting, approximately 2.4ha of native planting is required at a cost of $37,551 per hectare ($90,124). **Fish barriers** Determine the location and type of barriers to fish passage. It is estimated that there are two barriers to fish passage (Grey Road culvert and potentially a farm crossing) on this watercourse. Undertake works to remedy fish barriers ($10,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately 3.5 years after project completion.	L = 8.5
Effectiveness of works	The Mangakara Stream has its headwaters in native bush and is currently in good condition with some of the Vision & Strategy desired state aspects already being met, including being swimmable and fishable. Condition is not expected to signficantly decline or improve over the next 20 years in the absence of this project. However, if this project is successfully completed then the Mangakara Stream is expected to be in excellent condition and very close to desired state in 20 years' time, with aspects related to fish habitat and passage and stock exclusion all being addressed.	W = 0.3
Risk of technical failure	Risks are mostly related to establishment of plantings. There is a low risk of project failure due to technical feasibility.	F = 0.92
Adoptability	It is estimated that about half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may be a challenge in terms of uptake. If there is already fencing close to the streambank in places (i.e. with a narrow riparian margin) landowners may be unwilling to move fences back to allow room for native planting.	A = 0.5

<table>
<tr><td>Information quality</td><td>Poor – riparian management requirements based predominantly on review of aerial photography. Limited knowledge regarding the location of fish migration barriers.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>It is unknown specifically how much fencing already exists. This would need to be established as part of the project planning and costings confirmed accordingly. Location of fish barriers would need to be determined in the early stages of the project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Riparian fencing (6km)</td><td>48,000</td></tr>
<tr><td>Native planting (2.4ha)</td><td>90,124</td></tr>
<tr><td>Remedy of fish barriers</td><td>10,000</td></tr>
<tr><td>Project management/staffing/incidentals (20%)</td><td>29,624</td></tr>
<tr><td>Total</td><td>177,748</td></tr>
</table></td><td>C = 0.18</td></tr>
</table>



Mangakara Stream fish habitat rehabilitation

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.2 0.4 0.6 0.8 1.0
Kilometers

Scale 1:25,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

An unfenced section of Mangakara Stream,

A section of Mangakara Stream where it is recommended fences be moved back and native riparian planting undertaken.

<table>
<tr><td>WP 10
Priority: Medium</td><td>Mangauika Stream fish habitat rehabilitation</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>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.</td><td></td></tr>
<tr><td>Name of feature</td><td>Mangauika Stream, Pirongia</td><td></td></tr>
<tr><td>Brief description of feature</td><td>A 9km long stream flowing from Mt Pirongia in the vicinity of Te Tahi Road (and the water reservoir) to join the Waipā River at Pirongia village. The land use either side of the stream is predominantly pastoral farming with some remnants of native vegetation.

This waterway was identified by fish experts as important habitat for native freshwater species such as tuna, kōura and bullies and it has been identified by Maniapoto iwi as a historic fishing area for piharau and freshwater mussels. There are opportunities to increase native fish abundance and diversity by remediating barriers and providing increased and high quality fish habitat.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- The stream is fenced to exclude stock from its entire length. It has a well vegetated riparian margin along its entire length that provides erosion protection, shade and shelter.
- Native fish are abundant and the full range of species expected to be found in the waterway can be found there.
- There are no manmade barriers to native migratory fish.
- The stream is swimmable, fishable and has access for recreation.
- Iwi and communities have a strong connection to the stream and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Mangauika Stream, Pirongia, would have a high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 1.5</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on the asset</th></tr><tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish.</td></tr><tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr><tr><td>Vegetation clearance</td><td>Reduced cover, habitat and food (invertebrates) for native fish species.</td></tr></table></td><td></td></tr>
</table>

	Culverts and crossings that are a barrier for native fish: Native fish unable to access upstream areas.	
Project goal/s	Within 5 years of the project commencing: - The full 9km length of Manguika stream is fenced to exclude stock and has a riparian margin (at least 5m wide) dominated by native plant species to assist in providing, food, shade, shelter and habitat for native fish. - All manmade barriers to fish migration are remedied.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Riparian management for fish habitat purposes** Carry out riparian fencing with a minimum 5m setback from the top of the streambank (at least 5 wire with 2 electric wires). Include adjoining wetland areas within the riparian fencing. Undertake native riparian planting within the fenced area and associated weed control and maintenance. Further investigation is required to determine the length of stream requiring treatment. However, based on aerial photographs and known information about the catchment it is estimated that 75% of the stream (6.75km stream length or 13.5km of streambank) remains to be fenced and planted. Fencing – 13.5km at $8/m ($108,000). Planting of a 13.5km riparian margin that is at least 5m wide equates to 6.75ha of planting at $37,552 per hectare ($253,476). This cost includes site preparation, plant purchase, planting labour and five releasing events. **Remedy fish barriers** Investigate the locations of barriers to fish passage and undertake the required work to remedy these barriers. This is estimated to cost up to $10,000 (based on remediation of two barriers). Actual costs will depend on the number and type of fish passage barriers that require remediation. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.	

	This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen approximately 3.5 years after project completion.	L = 8.5
Effectiveness of works	The Mangauika Stream is currently in moderate condition with some of the Vision & Strategy desired state aspects being met, including being swimmable at times and fishable. Condition is not expected to either decline or improve over the next 20 years in the absence of this project. However, if this project is successfully completed then the Mangauika Stream is expected to be in very good condition and closer to desired state in 20 years' time, with aspects related to fish habitat and passage and stock exclusion all being addressed. The stream travels through pastoral land over its entire extent and so this project will not fully address the potential impacts of this on water quality.	W = 0.3
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings. The risk of losing works due to flooding are mitigated somewhat by the proposed 5m setbacks for fencing and planting.	F = 0.92
Adoptability	It is estimated that about half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may be a challenge in terms of uptake. If there is already fencing close to the streambank in places (i.e. with a narrow riparian margin) landowners may be unwilling to move fences back to allow room for native planting. This would need to be determined during the project planning phase and costs adjusted accordingly for moving of fences.	A = 0.5
Information quality	Poor – riparian management requirements based predominantly on aerial photography. Limited knowledge regarding the location of fish migration barriers.	
Knowledge gaps and response	It is unknown specifically how much fencing already exists. This would need to be established as part of the project planning. Location of fish barriers would need to be determined in the early stages of the project. The water reservoir is one known barrier but there may be another on the water reservoir access track.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	5 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Description</th><th>Cost ($)</th></tr>
<tr><td>Remedy fish barriers</td><td>10,000</td></tr>
<tr><td>Fencing (13.5km)</td><td>108,000</td></tr>
<tr><td>Native planting (6.75ha)</td><td>253,476</td></tr>
<tr><td>Project Management/staffing/incidentals (25%)</td><td>92,869</td></tr>
<tr><td>Total</td><td>464,345</td></tr>
</table>
</td>
<td>C = 0.46</td>
</tr>
</table>

Mangauika Stream fish habitat rehabilitation

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.0 0.3 0.6 0.9 1.2 1.5
Kilometers

Scale 1:25,000@A4 Landscape

A4

ACKNOWLEDGEMENTS AND DISCLAIMERS

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

Sections of Mangauika Stream where further riparian fencing and planting is recommended.

<table>
<tr><td>WP 11
Priority: High</td><td>Waipā River bank erosion protection and remediation – Ōtorohanga to Pirongia</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>River margins prone to significant erosion are managed to minimise erosion risk, whilst enhancing aquatic habitat and retaining the natural character of river systems.

Riparian planting of preferably indigenous species is undertaken to stabilise riverbanks, reduce erosion and enhance terrestrial and aquatic biodiversity.

Water quality is such that waters within the catchment are swimmable and safe to take food from in all places.</td><td></td></tr>
<tr><td>Name of feature</td><td>Waipā River – Ōtorohanga to Pirongia</td><td></td></tr>
<tr><td>Brief description of feature</td><td>This is a 37km stretch of the Waipā main stem lined with mostly exotic nuisance vegetation with many specimens at maturity and frequent collapse into the bed. This instigates bank instability and sedimentation of the main channel. The river is deeply incised through this stretch.

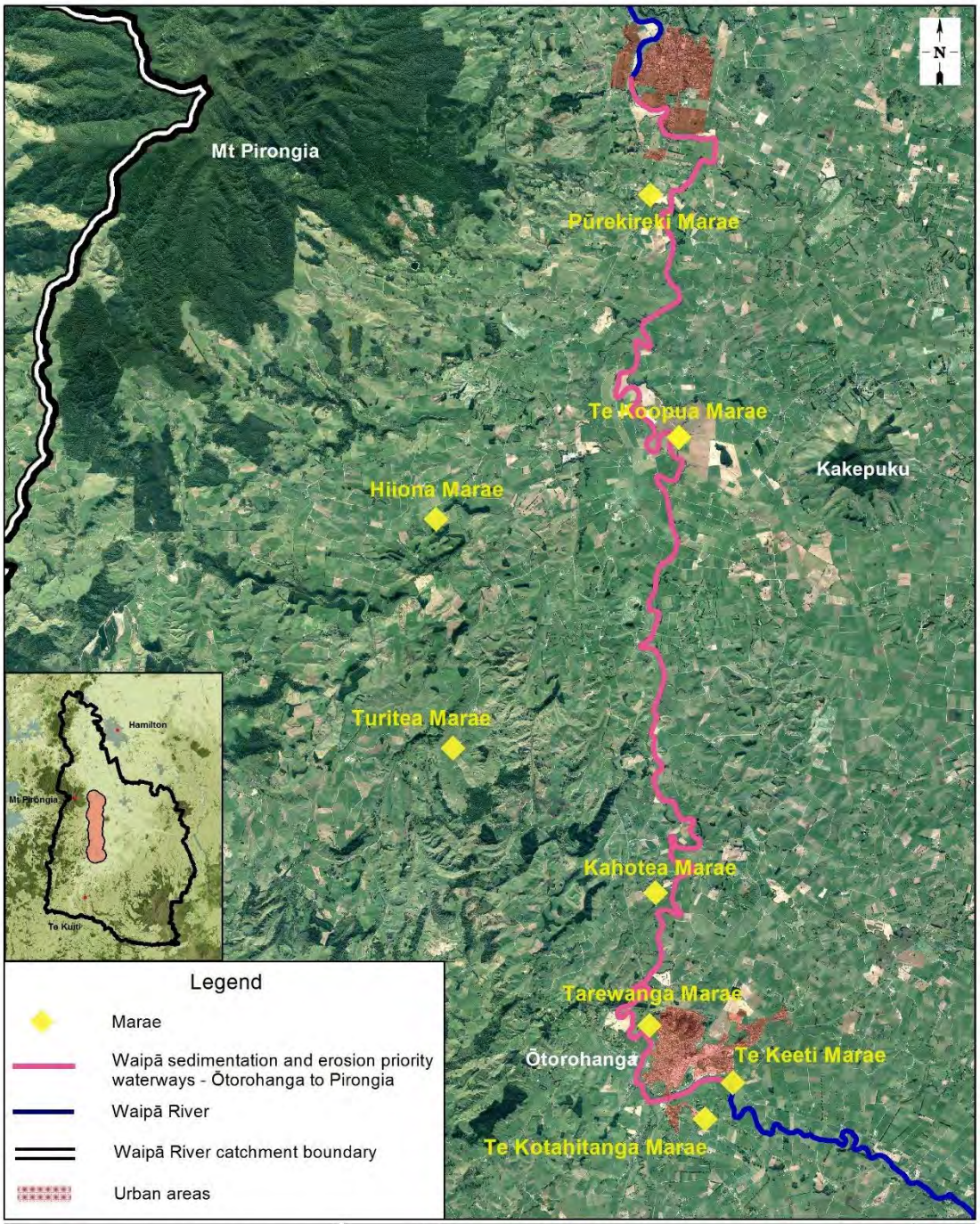
This area is historically significant to iwi with multiple historic pā sites in the vicinity and of pakanga (battles) during the “Waikato Wars”. Ōtorohanga was previously a well inhabited papakāinga for many centuries. There are currently 7 marae with significant interests in this stretch of the Waipā.

Water quality information for the Waipā River at Ōtorohanga indicates that the river here is safe for fishing and sometimes, but not always, safe for swimming. By the time it reaches Pirongia it is safe for fishing but not safe for swimming due to unsatisfactory levels of E. coli.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- A 37km stretch of river with stable, vegetated banks and where major erosion events are limited.
- A riparian margin at least 10m wide that is well vegetated with native plants and exotic plants where required to prevent erosion.
- The river is swimmable, fishable and has access for recreation.
- Iwi and community have a strong connection to the river and are active in its use protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Waipā River – Ōtorohanga to Pirongia reach – would have a very high impact on giving effect to the Vision & Strategy at a Waipā catchment level.</td><td>VS = 125</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Mass bank erosion events and ongoing bank scouring</td><td>Estimated to yield approximately 9500 tonnes of sediment per year to the Waipā River, excluding major flood events.</td></tr></table></td><td></td></tr>
</table>

Project goal/s	Within 15 years of project commencement: - The river has stable banks and a continuous vegetated (native and exotic for erosion control) 37km margin along the reach from Ōtorohanga to Pirongia. - Stock is excluded from 100% of the river. - Sediment to the Waipā River over this stretch is reduced by 15%.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **River erosion protection and remediation** - It is estimated that about a third of this reach will require vegetation management for erosion purposes. This equates to 12km of river at $40 per channel metre ($480,000). Note: this should not be undertaken all at once, but rather staged so that areas can revegetate before others are cleared. - Disposal is estimated at 20% of removal costs ($96,000). - Re-fencing will be required where vegetation has been removed. Assume a 3-wire electric for 24km of riverbank ($134,000). - Willow/poplar poles should be planted for initial stability, at 10m intervals along this length (2400 poles is $33,600). - For long term stability of the riverbank, native vegetation should also be planted in these areas with a 10m setback. This would require 24ha of planting ($901,248). - 30 woody debris structures (using vegetation on site) should be installed as habitat for fish. At a cost of $1600 per structure this equates to $48,000. - This stretch of the Waipā main stem is estimated to require 10 erosion protection structures along its length at a cost of $30,000 per structure ($300,000). Activities such as willow removal, installation of erosion protection structures, installation of woody debris and any earthworks associated with these actions may require resource consent from Waikato Regional Council. Council's Integrated Catchment Management division hold an existing consent for much of this type on work on this waterway and therefore anyone proposing to undertake river management works should discuss this with council staff during project planning. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management.	

	Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 12-13 years after project commencement.	L = 12.5
Effectiveness of works	The Waipā River (Ōtorohanga to Pirongia) varies in condition over this reach, being moderate at Ōtorohanga and poor by the time it reaches Pirongia. As this river travels through this reach it is joined by some rivers and streams with very high sediment loads including the Moakurarua and Puniū. The river is not swimmable towards Pirongia, the banks are unstable in many places and stock have access to the river at a number of locations. The riverbanks are not well vegetated with native plants. Some deterioration in the river is expected over the next 20 years in the absence of this project, with impacts of the upper catchment, and bank stability in the Waipā main stem likely to lead to further decline in water quality and habitat for fish. This decline is expected to be offset by the outcomes of this project which will improve aspects related to bank stability, stock exclusion and extent of native vegetation along the margins. Overall, however, the upper catchment impacts will still be the biggest factor in water quality through this reach and therefore this stretch of river will benefit from works being undertaken both locally and in the upper catchments that it receives water from. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy.	W = 0.05
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding and/or erosion before they are established. This would be minimised by the fencing setbacks being at least 10m, and by planting sterile willow poles to stabilise banks while native plantings establish. Erosion control structures and fish habitats should be designed and constructed by experienced practitioners to avoid exacerbating erosion and/or other negative impacts and to minimise risk of failure.	F = 0.87
Adoptability	It is estimated that almost half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks is likely to be a challenge in terms of uptake. In addition there are large sections of the river that are meandering and erosive in nature and likely to flood on a regular basis. Landowners may be reluctant to erect fences in these locations due to the potential maintenance costs. This	A = 0.45

<table>
<tr><td></td><td>risk can be reduced by the larger setbacks and use of plantings. There are also some existing projects along this reach that provide a good example of what can be achieved with larger riparian margins.</td><td></td></tr>
<tr><td>Information quality</td><td>Average – estimates are based on aerial photographs, Waipā catchment riparian surveys and input from catchment officers who are familiar with the reach and are working with landowners to help them undertake similar works.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>Unknown specifically how much fencing already exists. This would need to be established as part of the project planning.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>15 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Description</th><th>Cost ($)</th></tr>
<tr><td>Erosion protection structures (10)</td><td>300,000</td></tr>
<tr><td>Fish habitats (30)</td><td>48,000</td></tr>
<tr><td>Native planting (24ha)</td><td>901,248</td></tr>
<tr><td>Vegetation management (12km)</td><td>480,000</td></tr>
<tr><td>Vegetation disposal</td><td>96,000</td></tr>
<tr><td>Poplar/willow poles (2400)</td><td>33,600</td></tr>
<tr><td>Fencing (24km)</td><td>134,000</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>597,854</td></tr>
<tr><td>Total</td><td>$2,590,702</td></tr>
</table>
</td><td>C = 2.59</td></tr>
</table>



Waipā River bank erosion protection and remediation - Ōtorohanga to Pirongia

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.00 0.75 1.50 2.25 3.00 3.75
Kilometers

Scale 1:110,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

Waipā River – Ōtorohanga to Pirongia – showing managed areas of vegetation management and large setbacks (far side of river).

Waipā River – Ōtorohanga to Pirongia – showing areas susceptible to erosion.

Waipā River just upstream of Pirongia village. Areas of bank erosion and instability can be seen, and the impacts of high sediment loads from the upper catchment are evident.

<table>
<tr><td>WP 12
Priority: High</td><td>Tuna habitat rehabilitation within 7 Pūniu River oxbows</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>There is a programme of restoration, enhancement and protection of pā tuna, other significant fishing sites and fish habitat without compromising the natural range of species.

Where possible, the natural functioning of floodplains and other ephemeral wetland sites is restored and maintained.</td><td></td></tr>
<tr><td>Name of feature</td><td>Puniū River oxbows</td><td></td></tr>
<tr><td>Brief description of feature</td><td>A collection of old oxbows along the Puniū River. Some of these are well connected to the river while others are not. They are in various vegetated states – some with dense willow canopy and others with small remnants of native vegetation. All of the oxbows flood when the Puniū River floods and many retain water throughout most of the year.

This area is of tribal significance to Maniapoto and Waikato, known as Mangatoatoa, the same name held by the marae situated directly at the confluence of the Puniū and Waipā rivers. The restoration of these oxbows to improve tuna (eel) habitat would greatly enhance the ability of the marae to sustain its people and manuwhiri (visitors).</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- Oxbows provide valuable habitat for tuna and tuna are found there in abundance.
- All oxbows are well connected to the river and have maximum opportunity to inundate when Waipā River levels are high.
- Open water areas are excluded from stock and shaded with appropriate vegetation to assist in the prevention of dense aquatic weed growth.
- Stands of willow remain in place to provide habitat for tuna.
- Iwi and communities have a strong connection to the oxbows and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Puniū River oxbows would have a high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 2</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on the feature</th></tr><tr><td>Drainage, disconnection from the river, infilling with overburden and conversion to pasture</td><td>Loss of tuna (eel) habitat and loss of a unique feature in the landscape.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of this project commencing:
- Oxbows are fenced to exclude stock
- Increase by 25% the overall area that inundates at least three times per year and retains water for at least three weeks following flood events.</td><td></td></tr>
</table>

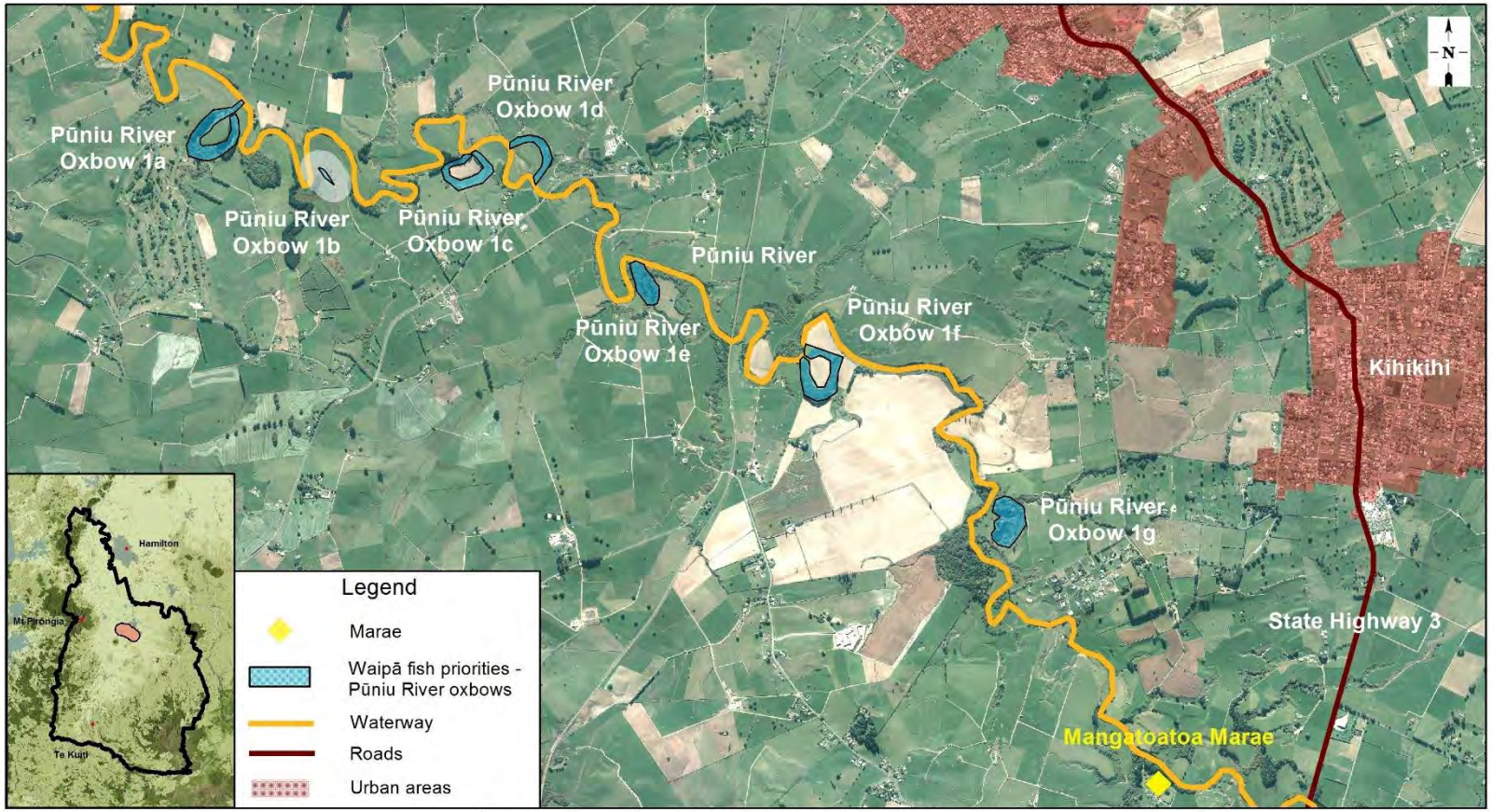
	- A 5m buffer of native and exotic (poplars) plants is created around open water areas to provide shade to assist in reducing water weeds and providing a food source for tuna.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Project plan development** Each oxbow will need to have a more detailed works plan developed which provides a detailed design showing where work will be undertaken, ground levels for excavation (if applicable), expected inundation areas, planting and fencing areas. The cost of this will vary for each site but a cost of up to $5000 has been estimated per site. **Increase habitat for tuna** Where possible, undertake earthworks work in oxbows 1a, 1b, 1c, 1d, 1f and 1g to increase the area of land that has standing water during and after flood events, and remove weeds choking existing ponding areas. If required, improve connectivity to the river in all oxbows by installation of culverts and channels. Undertake steps to improve flow within oxbow 1e – this may involve improving connectivity to the river. Avoid removing willows unless necessary to achieve desired area of open water. **Aquatic weed management** Undertake a mix of native and exotic planting (poplars) around open water areas. The purpose of planting will be to assist in shading out water weeds and provide a food source for invertebrates. **Earthworks and planting** The following estimates have been made around the work required: Oxbow 1a – 3 days long reach excavator and a 6m long culvert ($6310), 1 day crosscutter for selective pest tree removal ($700), 620m long section of fencing ($4960) and native planting (on average 5m wide), a row of exotic trees (e.g. poplar) planted every 15m to provide shade ($12,757). Oxbow 1b – 4 days earthworks with 12 tonne excavator and a 6m long culvert ($6360), 1 day crosscutter for selective pest tree removal ($700), 260m long section of fencing ($2080) and planting (on average 5m wide), a row of exotic trees planted every 15m to provide shade ($5349). Oxbow 1c – 5 days long reach excavator for a 6m long culvert ($9550), 400m long section of fencing ($3200), native planting	

	(average 5m wide), a row of exotic trees every 15m to provide fast growing shade ($8222). Oxbow 1d – up to 20 days long reach excavator and a 6m long culvert ($33850), 700m long section of fencing ($5600), native planting (on average 5m wide), a row of exotic trees planted every 15m to provide fast growing shade ($14,403). Oxbow 1e – culvert installation if required ($1050 for a 6m long culvert). Oxbow 1f – 200m willow removal ($6000), 4 days long reach excavator to excavate inundation area and install a 6m long culvert if required ($7930), 400m fencing ($1600) and native planting. A row of exotic trees planted 15m apart to provide fast growing shade ($4115). Oxbow 1g – 1 day long reach excavator and installation of culvert if required ($3070), 700m long section of fencing ($5600), natives tree planting (5m wide margin on average) and a row of exotic trees for shade planted at 15m spacing ($14,403). It is assumed that a 12 tonne excavator will move 200m^3 of soil per hour and that a long reach excavator will remove 150m^3 per hour. **Resource consent** Resource consent costs may be required for some projects. A budget of $5000 per site has been allowed for this. This assumes that consent applications may be lodged at different times for different oxbows. A budget of $5000 per project has been provided for investigation and design. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen within 1 year of project completion.	L = 5.5
Effectiveness of works	These oxbows are currently in a poor condition when compared to desired state. It is not expected that they will deteriorate significantly over the next 20 years if this project is not undertaken. However, if this project is successfully completed then it is expected that oxbow condition in 20 years will be significantly closer to the desired Vision & Strategy state than it is currently.	W = 0.4

	This project addresses the majority of aspirations for these features.	
Risk of technical failure	There is a high risk of project failure due to technical feasibility. Techniques are not well established or tested. Risks relate to providing adequate flow and supply of water to the oxbows year round, and preventing pest fish dominating the fish biomass at these sites. Expert engineering advice should be sought in the early stages of the project.	F = 0.65
Adoptability	It is estimated that almost half of landowners would adopt the works if they were fully incentivised. There may be concerns about reconnection of sites with the river and increased flooding. However, site design should ensure that this is avoided. There could also be reluctance to give up summer grazing areas to create more open water habitat. Some sites have been contoured and re-grassed to provide additional grazing. Early landowner engagement will be important as part of project planning.	A = 0.45
Information quality	Average – recommendations are based on the judgement of a fish expert with some local knowledge. Quantities of work required are predominantly based on estimates made from aerial photographs.	
Knowledge gaps and response	Further investigation is required to determine what is feasible and practical at each oxbow site. More information is required about each oxbow including current connectivity to the river, and whether there is opportunity to improve connectivity and increase the area and duration of inundation. This should be undertaken at the early stages of project planning. A detailed design needs to be carried out for each site and this should be undertaken early in project implementation.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks.	P = 0.85
Project duration (years)	5 years	

Up-front cost – total for implementation phase/project duration		C = 0.30

Task	**Total ($)**
Project plan development (up to $5,000 per site)	35,000
Oxbow 1a physical works	24,727
Oxbow 1b physical works	14,489
Oxbow 1c physical works	20,972
Oxbow 1d physical works	53,853
Oxbow 1e physical works	1,050
Oxbow 1f physical works	19,645
Oxbow 1g physical works	23,073
Resource Consent	35,000
Project management/staffing/incidentals (30%)	68,342
Total	**296,151**



Tuna habitat rehabilitation within 7 Pūniu River oxbows

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.0 0.3 0.6 0.9 1.2 1.5
Kilometers

Scale 1:30,000@A4 Landscape

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

WP 13 Priority: Medium	Ngakoaohia Stream (and selected tributaries) fish habitat rehabilitation	BCR value
Relevant unit goal(s)	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.	
Name of feature	Ngakoaohia Stream and selected tributaries (flowing from Pirongia mountain near Ngutunui)	
Brief description of feature	A 26km long stream network flowing from Mt Pirongia in the vicinity of Ngutunui to join the Waipā River approximately 7km kilometres upstream of Pirongia village. Streams within the network include Mangati Stream, Whakarautawa Stream, Mangakiekie Stream and Pekanui Stream. The land use either side of the stream is predominantly pastoral farming or native bush remnants. The Pirongia area has long been an important place for tāngata whenua. Its vast forests and waters were a significant food bowl for its people. Pirongia was named by Kuahupeka not long after the arrival of the Tainui waka in Kāwhia. Its full name is “Pirongia-te-aroaro-o-Kahu”. Kahupeka left the Kāwhia area to traverse inland. These waterways have been identified as priorities as they are known to have populations of native fish species and these are expected to respond well to further habitat enhancement work.	
Desired state to achieve the Vision & Strategy	Within 15 years of the project commencing: - Stock is excluded from all waterways within the catchment. - The stream network has a well vegetated native riparian margin along its entire length (at least 5m wide) - Potential manmade barriers to fish passage have been remedied. - Native fish are abundant and there is a wide diversity of species present including non-climbing species. There are no manmade barriers to native migratory fish. - Waterways are swimmable, fishable and have access for recreation. - Iwi and communities have a strong connection to the streams and are active in their use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition the Ngakoaohia Stream and selected tributaries flowing from Pirongia mountain would have a very high impact on giving effect to the Vision & Strategy at a local level.	VS = 8

<table>
<tr>
<td>Key threats to the feature that this project addresses</td>
<td>
<table>
<tr><th>Key threat</th><th>Impact on the asset</th></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish.</td></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
<tr><td>Vegetation clearance</td><td>Reduced cover, habitat and food (invertebrates) for native fish species.</td></tr>
<tr><td>Culverts and crossings that are a barrier for native fish</td><td>Native fish unable to access upstream areas.</td></tr>
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<tr>
<td>Project goal/s</td>
<td>
- The full 26km stream network is fenced to exclude stock and has a riparian margin of at least 5m wide on both sides which is vegetated with plant species to provide stream shade and enhance habitat for adult native fish.
- Manmade barriers to native fish migration are identified and remedied.
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<tr>
<td>Priority works for funding</td>
<td>
Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Fencing
Carry out riparian fencing with a minimum 5m setback from the top of the streambank (5 wire fence, 2 electric wires). Include adjoining wetland areas and forest remnants within the riparian fencing.

Further investigation is required to determine the length of stream requiring treatment. However, based on aerial photographs and known information about the catchment it is estimated that 50% (13km) of the stream remains to be fenced (or fence upgraded). This equates to a total fence length of 26km (both sides) at an estimated $8 per metre ($208,000).

Native planting
Undertake native riparian planting along the waterway and carry out associated weed control and maintenance for native plant establishment.
- Assume 50% (26km) of streambanks require native planting. This equates to a planting area of 13ha at an estimated cost of $37,552/ha ($488,176). Includes site preparation, plant purchase, planting labour and five releasing events.

Remediation of fish barriers
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	Investigate the locations of barriers to fish passage and undertake the required work to remedy these barriers. Remediation options should follow the recommendations of a freshwater fish ecologist. The following culverts/crossings are thought to provide a barrier or partial barrier to fish passage: - Culvert where Pekanui Road crosses Pekanui Stream. - Culvert where Mangiti Road crosses Mangakiekie Stream. - Two culverts (in two locations) where Mangati Road crosses Mangati Stream. - Culvert where Kiwi Road crosses Ngakoaohia Stream. It is also estimated that there are a large number of fish barriers on private land, particularly along raceways and farm tracks (possibly as many as 12). The estimated cost for remediation of fish barriers is up to $5000 per barrier. Resource consent may be required for remediation of fish barriers and the cost of this should be covered by the cost estimate provided for remediation of fish barriers. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately one year following project completion.	L = 11
Effectiveness of works	The Ngakoaohia Stream and selected tributaries are currently in moderate to good condition with some of the Vision & Strategy desired state aspects already being met, including being swimmable and fishable. Condition is expected to decline over the next 20 years in the absence of this project. However, if this project is successfully completed then these sites are expected to improve and be closer to desired state with aspects related to fish habitat and passage and stock exclusion all being addressed.	W = 0.15
Risk of technical failure	Low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding.	F = 0.87
Adoptability	It is estimated that almost half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may be a challenge in terms of uptake. If there is already fencing close to the streambank in places (i.e.	A = 0.45

<table>
<tr><td></td><td>with a narrow riparian margin) landowners may be unwilling to move fences back to allow room for native planting.</td><td></td></tr>
<tr><td>Information quality</td><td>Poor – riparian management requirements are based predominantly on review of aerial photography. Fish passage management requirements are based on some limited local knowledge but predominantly on aerial photography and GIS layers for fish barriers and fish species predictability.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>It is unknown how much fencing already exists and how close it is to the stream edge. Detailed fencing requirements would need to be determined in the early stages of the project.
It is also unknown exactly how many barriers to fish passage there are along the stream and whether landowners would be willing to remedy such barriers. This will need to be determined during the project planning phase.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table><tr><th>Task</th><th>Cost ($)</th></tr><tr><td>Fencing (26km)</td><td>208,000</td></tr><tr><td>Native planting (13ha)</td><td>488,176</td></tr><tr><td>Remediation of fish barriers</td><td>85,000</td></tr><tr><td>Project management/staffing/incidentals (30%)</td><td>234,352</td></tr><tr><td>Total</td><td>1,015,528</td></tr></table></td><td>C = 1.02</td></tr>
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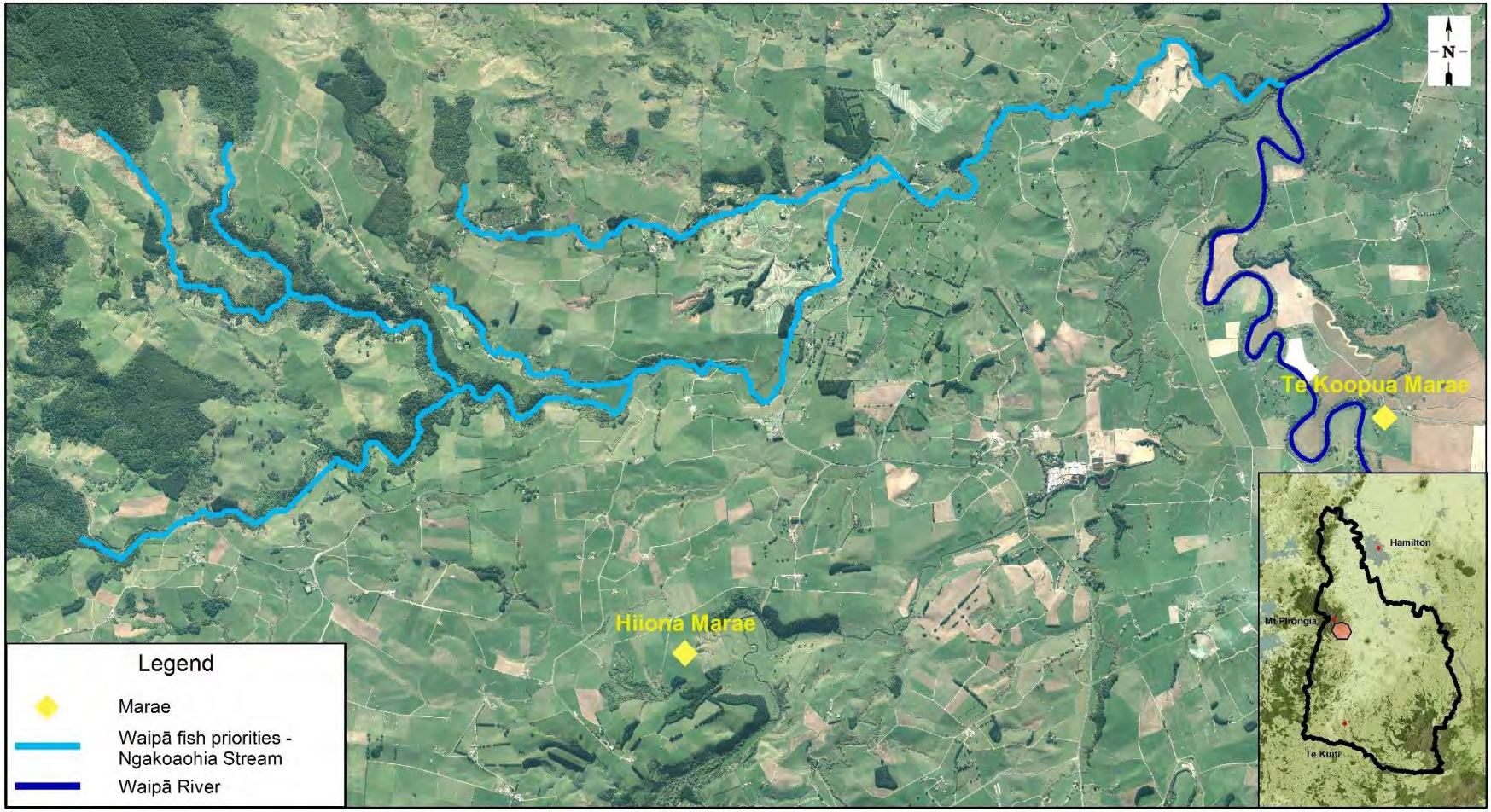


Ngakoaohia Stream (and selected tributaries) fish habitat rehabilitation

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.0 0.4 0.8 1.2 1.6 2.0
Kilometers

Scale 1:40,000@A4 Landscape

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

WP 14 Priority: Very high	Moakurarua integrated catchment programme	BCR value
Relevant unit goal(s)	The appropriate management of steep and erosion prone land is promoted and incentivised. River margins prone to significant erosion are managed to minimise erosion risk, whilst enhancing aquatic habitat and retaining the natural character of river systems. Riparian planting of preferably indigenous species is undertaken to stabilise riverbanks, reduce erosion and enhance terrestrial and aquatic biodiversity. Water quality is such that waters within the catchment are swimmable and safe to take food from in all places. Land uses are being adapted to match the capability of the land. 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. 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.	
Name of feature	Moakurarua subcatchment	
Brief description of feature	A 14,974ha catchment in the upper Waipā with a total stream network of 277km. 34% of the catchment is in indigenous forest. Moakurarua Stream starts in the hill country south of Honikiwi and flows north to join the Waipā River approximately 7km upstream of Pirongia. The predominant land use within the catchment is pastoral farming (58% of the total area). Approximately 6000ha of land is LUC 6e or 7 in pasture and the catchment has been identified as a priority sediment catchment in the Waipā Catchment Plan and through the Healthy Rivers Plan Change. A 62km long stream network consisting of Moakurarua Stream and selected tributaries flowing from hill country to the west has been identified as a priority for native fish. Within this, a 27km stretch of the main stem of the Moakurarua Stream upstream of the Waratah piggery and an 8km stretch of the Oamaru Stream have been identified as priorities for river management through bank stabilisation. The top 6km of the Moakurarua stretch is a	

<table>
<tr><td></td><td>small gravel bottomed stream with very low banks. It is not fully fenced and lacks continuous vegetation. Erosion here is caused by stock access, lack of vegetation and flood events. The next 21km of stream has a silt/gravel bottom and highly erodible banks ranging from shallow to 4m high. Lateral bank erosion is extensive in places along this stretch of the stream.

The Oamaru Stream has extensive erosion in places. It is estimated that there is 5km of extensive bank stability works required along this stream.

Upper Moakurarua forest fragments have been identified within the top 30% of biodiversity priorities in the Waikato River catchment (based on representativeness). There are 9 marae with significant cultural and historical interests in this area.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>A subcatchment where land use matches capability and with a stable stream network that has a well vegetated riparian margin along its entire length (at least 5m wide) to assist in providing erosion protection and shade, shelter.
- Native and taonga species are abundant and there is a wide diversity of species present
- The river is swimmable, fishable, safe for gathering kai, and has access for recreation.
- Iwi and communities have a strong connection to the river and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Moakurarua subcatchment would have a very high impact on giving effect to the Vision & Strategy at a Waipā catchment level.</td><td>VS = 275</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Hill country erosion</td><td>Estimated to yield more than 10,000 tonnes of sediment per year to the Waipā River</td></tr><tr><td>Riverbank erosion</td><td>Estimated to yield approximately 2300 tonnes of sediment per year to the Waipā River, excluding major flood events.</td></tr><tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr><tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 15 years of project commencement:
- The main channel of the Moakurarua Stream is stable, fenced to exclude stock and vegetated along its entire length.</td><td></td></tr>
</table>

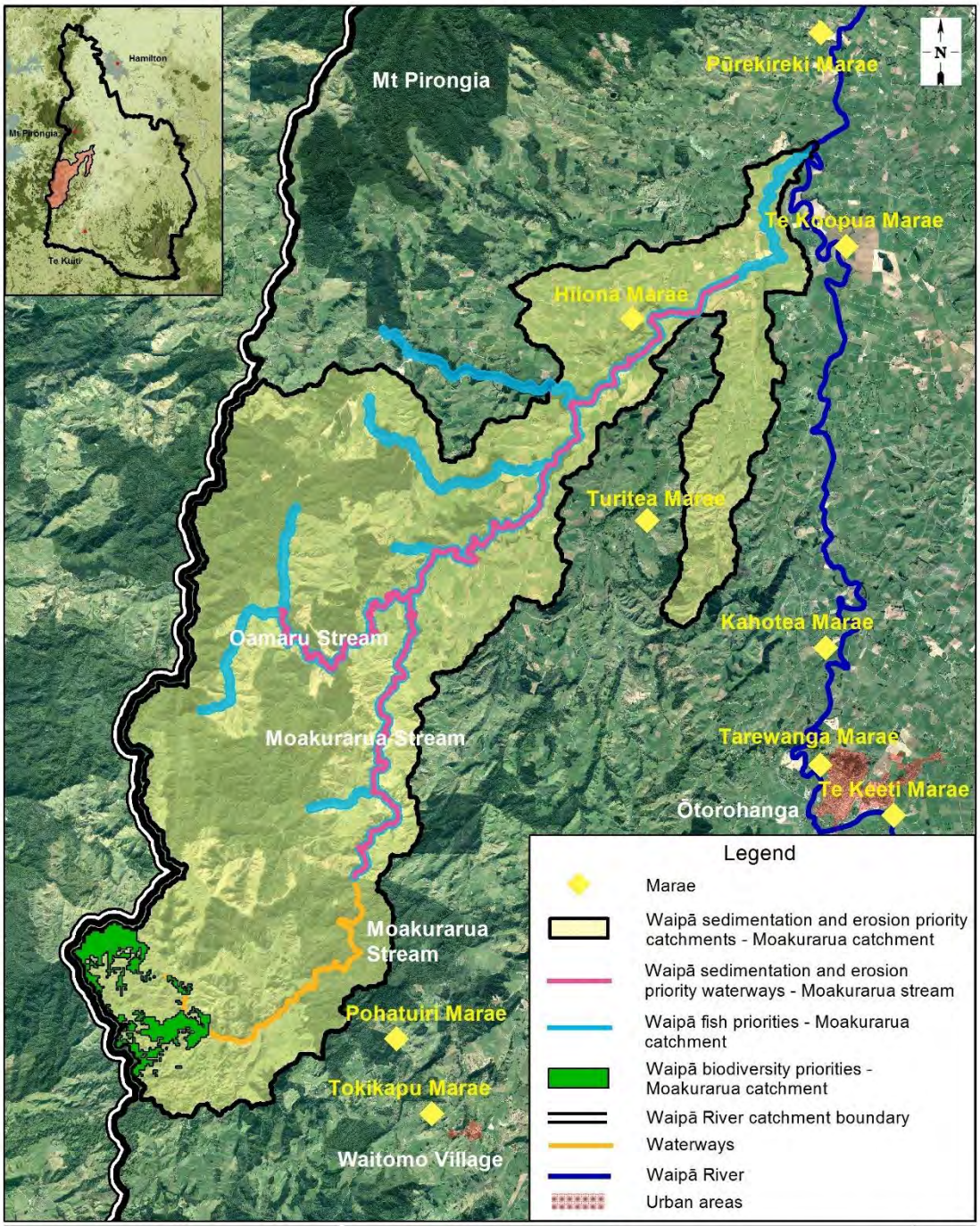
	- There is a 25% reduction in suspended sediment in the Moakurarua Stream - A 62km stream network is established that is stable, excluded to stock and has a vegetated riparian margin of predominantly native plant species (at least 5m wide) to enhance habitat for native fish species, especially tuna, piharau, kōura and kōkopu. - Native forest remnants and wetlands identified are fully fenced to exclude stock and native regeneration occurs naturally within these areas.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Hill country soil conservation** - 665ha LUC 6e managed with open space pole planting at $3000 per hectare ($1,995,000). - 665ha LUC 6e managed with plantation species (e.g. pine or mānuka) at $3000 per hectare ($1,995,000). - 131km of fencing the managed LUC 6e land at $20 per metre (8-wire and batten) ($2,620,000). - 647ha LUC 7 managed with plantation species (e.g. pine or mānuka) at $3000 per hectare ($1,941,000). - 91km of fencing managed LUC 7 land at $20 per metre (8-wire and batten) ($1,820,000). - 22ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $5000 per ha (e.g. dewatering, retiring seepages, etc) ($110,000). - 60 hunter days per year for 3 years of goat control while plantings on 6e and 7 establish. Control carried out over a 6000ha area. - 38km fencing existing indigenous forest cover at $25m (8-wire and batten) ($950,000). **Riparian Management of rivers/streams for fish habitat and soil conservation purposes** - Carry out riparian fencing along 72km of streambank (31km of stream length) with a minimum 5m setback from the top of the streambank (at least 5 wire with 2 electric wires) at an estimated cost of $8 per metre ($576,000). Include adjoining wetland areas within the riparian fencing. - Undertake a mix of native and exotic soil conservation riparian planting within the fenced area (where it doesn't exist naturally), estimated to be 36ha of planting, and associated weed control and maintenance ($1,351,872) **River management for large scale erosion** 21km stretch in the mid-section of the Moakurarua and 5km of the Oamaru Stream requires hard and soft engineering	

	structures to protect banks from mass erosion. Estimated at $20,000 per km. This cost includes fencing and planting post completion of works ($420,000). Activities such as willow removal, installation of erosion protection structures, installation of woody debris and any earthworks associated with these actions may require resource consent from Waikato Regional Council. Council's Integrated Catchment Management division hold an existing consent for much of this type on work on this waterway and therefore anyone proposing to undertake river management works should discuss this with council staff during project planning. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 13 years after project commencement.	L = 12.5
Effectiveness of works	The Moakurarua subcatchment is in very poor to poor condition compared with the desired state with few of the Vision & Strategy aspirations currently being met. It is expected that over the next 20 years there will be a deterioration in the condition of the catchment in the absence of this project. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy. However, works included in this project address many of the threats to the feature and it is anticipated that if the project is fully completed it would offset anticipated decline and make significant progress with respect to achieving the Vision & Strategy state in 20 years' time.	W = 0.4
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. It is important that appropriately experienced practitioners are undertaking/advising on the more technical aspects of the project such as river erosion control structures. There are risks related to establishment of plantings or loss of works due to flooding, however techniques are well established and have been used previously on this and other local streams. River erosion structures should be designed by an appropriately qualified practitioner.	F = 0.82

Adoptability	It is estimated that about a third of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may be a challenge in terms of uptake. If there is already fencing close to the streambank in places (i.e. with a narrow riparian margin) landowners may be unwilling to move fences back to allow room for native planting. There are large sections of stream that are meandering and erosive in nature and likely to flood on a regular basis. Landowners may be unwilling to erect fences in these location due to the high maintenance costs. Fencing is also difficult in places due to the steepness of the land. Uptake of management of LUC class 6e and 7 land may be low however there are some existing projects along this reach that provide a good example of what can be achieved through farm planning. Early community engagement and identifying key farmers will be very important for the success of this project.	A = 0.36
Information quality	Good – estimates are based on modelled information and input from catchment officers who have experience working in the subcatchment, know the river well and are working with landowners to help them undertake similar works.	
Knowledge gaps and response	It is unknown exactly how much fencing already exists and estimates are based on Waipā catchment riparian surveys. It is also unknown how close existing fences are to the stream edge. Estimates of LUC classes 6e, 7 and 8 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.	
Socio-political risks	Low risk that the project will fail to meet its goals over the long term due to socio-political risks. Opportunities to have this work incentivised should be greeted positively.	P = 0.85
Project duration (years)	15 years	

Up-front cost – total for implementation phase/project duration		C = 18.16

Task	**Cost ($)**
26km river erosion control	520,000
Pole planting erosion prone LUC class 6e land (665ha)	1,995,591
Plantation species on erosion prone LUC class 6e land (665ha)	1,995,591
Fencing managed LUC class 6e land (131km)	2,645,023
Plantation species on LUC class 7 land (647ha)	1,939,516
Fencing managed LUC class 7 land (91km)	1,813,778
Treating erosion outside LUC class 6e, 7 and 8 land (22ha)	110,000
Streambank fencing (72km)	576,000
Riparian planting river/streams (36ha)	1,351,872
Fencing existing indigenous vegetation (38km)	950,000
Goat control on 6e and 7	73,440
Project management/staffing/incidentals (30%)	4,191,243
Total	**$18,162,054**



Moakurarua integrated catchment programme

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name: WWRRS.gws

0 1 2 3 4 5
Kilometers

Scale 1:125,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

Examples of mass earth movement in the Moakurarua catchment.

A mixture of high erosion class land and some remnant vegetation in the Moakurarua catchment.

Large scale riverbank erosion on the Moakurarua Stream.

Resulting downstream sedimentation following a large weather event in the Moakurarua catchment.

<table>
<tr><td>WP 15

Priority: High</td><td>Tuna habitat rehabilitation within 10 Waipā River oxbows</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>There is a programme of restoration, enhancement and protection of pā tuna, other significant fishing sites and fish habitat without compromising the natural range of species.

Where possible, the natural functioning of floodplains and other ephemeral wetland sites is restored and maintained.</td><td></td></tr>
<tr><td>Name of feature</td><td>Waipā River oxbows</td><td></td></tr>
<tr><td>Brief description of feature</td><td>This project focuses on a collection of historic oxbows along the Waipā River between Pirongia and Ōtorohanga. Some of these are well connected to the river while some are not. They are in various vegetated states – some with dense willow canopy and others with small remnants of native vegetation. All of the oxbows flood when the Waipā River floods and many retain water throughout most of the year.

These have been identified by fish experts as important habitat for tuna and there are opportunities to further enhance these areas for tuna habitat. The enhancement of this habitat would also support the historical relationship between the tāngata whenua and its natural resources.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- Oxbows provide valuable habitat for tuna and tuna are found there in abundance.
- All oxbows are well connected to the river and have maximum opportunity to inundate when Waipā River levels are high.
- Open water areas are excluded from stock and shaded with appropriate vegetation to assist in the prevention of dense aquatic weed growth.
- Stands of willow remain in place to provide habitat for tuna.
- Iwi and communities have a strong connection to the oxbows and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Waipā River oxbows would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 3</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on the feature</th></tr><tr><td>Drainage, vegetation clearance and the filling of old oxbows with overburden and conversion to pasture.</td><td>Loss of tuna habitat and loss of a unique feature in the landscape.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of this project commencing:
- Oxbows are fenced to exclude stock.</td><td></td></tr>
</table>

	- Increase by 25% the overall area that inundates at least three times per year and retains water for at least three weeks following flood events. - A 5m buffer of native and exotic (poplars) plants is created around open water areas to provide shade to assist in reducing water weeds and providing a food source for tuna.	
Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Project plan development** Each oxbow will need to have a more detailed works plan developed which provides a detailed design showing where work will be undertaken, ground levels for excavation (if applicable), expected inundation areas, planting and fencing areas. The cost of this will vary for each site but a cost of up to $5000 has been estimated per site. **Increase habitat for tuna** Ensure there is good connectivity between the Waipā River and the oxbows. If required improve connectivity to the river through installation of culverts and channels. Where possible, undertake earthworks in oxbows 2a to 2h to increase the area of land that has standing water during and after flood events, remove any dense areas of aquatic vegetation encroaching on existing ponding areas. Undertake steps to improve flow within oxbows 2i and 2j (see map) – this may involve improving connectivity to the river. Limit willow removal as this provides habitat for tuna. Any willow removal should only be undertaken above water to enable machinery access to increase the size of inundation areas. **Aquatic weed management** Undertake a mix of native and exotic planting (poplars) at oxbows 2a and 2h to provide shade over the pond area. **Earthworks and planting** The following estimates have been made around the amount of earthworks and planting required but further investigation and planning is required. Oxbow 2a – costings include earthworks and installation of up to four 450mm diameter, 6m long culverts or similar to improve connectivity (and some additional excavator time) ($5130), 1ha of selective willow herbicide control to increase the area of open water ($3800), and 1130m fencing to exclude stock ($9040).	

	Oxbow 2b - Costings allow for earthworks to increase area and/or depth of standing water and improve connectivity (2 culverts and 2 digger days $5440). Selective herbicide control of willow to increase the area of open water ($1900). 850m fencing ($6800), 200m of native planting with a 5m wide riparian margin ($3995). Oxbow 2c – costings allow for earthworks to increase area and/or depth of standing water and improve connectivity. Up to four culverts and 2 digger days ($7,240). Selective herbicide control of willow to increase the area of open water ($1900), 441m fencing ($3528), and 200m of native planting with a 5m wide riparian margin ($3995). Oxbow 2d – create permanent ponding area approximately 130m x 30m (4 days digger time using a long reach digger $6880), 320m fencing ($2560), 320m native planting around perimeter, a row of exotic trees on northern side every 15m to provide fast growing shade ($6448), and culverts to connect to the river ($1800). Oxbow 2e – create permanent ponding area approximately 6000m^2 x 2m deep (200m long x 30m wide)(10 days with long reach digger $16,600) and connect to river (with culverts if required, $1800), 750m fencing ($6000) and native/exotic planting with an average riparian margin of 5m wide ($10,008). Oxbow 2f – increase the size of the permanent ponding area by 30m x 50m (3 days with a 12 tonne excavator $4050) and connect to river with culverts if required ($1800). Undertake 500m fencing ($4000) and native planting ($3200) and additional willow/weed control if required ($2600). Oxbow 2g – improve connectivity to river with two culverts (1 day earthworks $3330). Selective willow control (x-tree basal) to increase the area of open water ($3800). Oxbow fencing 1.6km ($13,000). Some native planting along inlet/outlet (two rows 320m at $3796). Oxbow 2h – improve connectivity to the Waipā River (two culverts $1800), increase area of open water (4 long reach digger days $6880). Selective ground based willow removal ($2600), 880m of fencing ($7040) and a small amount of native planting in open areas ($3796). Oxbow 2i – investigate connecting this old oxbow to the river at the upstream end. Allow earthworks two days and two 6m long culverts ($5440). Assume mostly fenced ($1600 allocated for fencing), and selected ground based willow control if required ($2790).	

	Oxbow 2j – investigate connecting to river at upstream end. Allow earthworks two days and two 6m long culverts ($5440). Assume mostly fenced ($1600 allocated for fencing), and selected ground based willow control if required ($2790). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen within 1 year of project completion.	L = 5.5
Effectiveness of works	These oxbows are currently in a poor-moderate condition when compared to desired state. It is expected that they will deteriorate slowly over the next 20 years if this project is not undertaken. However, if this project is successfully completed then it is expected that oxbow condition in 20 years will be significantly closer to the desired Vision & Strategy state than it is currently. This project addresses the majority of aspirations for these features.	W = 0.25
Risk of technical failure	There is a high risk of project failure due to technical feasibility. Techniques are not well established or tested. Risks relate to providing adequate flow and supply of water to the oxbows year round, and preventing pest fish dominating the fish biomass at these sites. Expert engineering advice should be sought in the early stages of the project.	F =0.7
Adoptability	It is estimated that about half of landowners would adopt the works if they were fully incentivised. There may be concerns about reconnection of sites with the river and increased flooding. However, site design should ensure that this is avoided.	A = 0.54
Information quality	Average – recommendations are based on the judgement of a fish expert with some local knowledge. Quantities of work required are predominantly based on estimates made from aerial photographs.	
Knowledge gaps and response	Further investigation is required to determine what is feasible and practical at each oxbow site. More information is required about each oxbow including current connectivity to the river, and whether there is opportunity to improve connectivity and increase the area and duration of inundation. This should be undertaken at the early stages of project planning. A detailed design needs to be carried out for each site and this should be undertaken early in project implementation.	

<table>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Total ($)</th></tr>
<tr><td>Design plan development (up to $5,000 per site)</td><td>50,000</td></tr>
<tr><td>Resource consent ($5,000 per site)</td><td>50,000</td></tr>
<tr><td>Oxbow 2a physical works</td><td>17,970</td></tr>
<tr><td>Oxbow 2b physical works</td><td>18,135</td></tr>
<tr><td>Oxbow 2c physical works</td><td>16,663</td></tr>
<tr><td>Oxbow 2d physical works</td><td>17,688</td></tr>
<tr><td>Oxbow 2e physical works</td><td>34,488</td></tr>
<tr><td>Oxbow 2f physical works</td><td>15,650</td></tr>
<tr><td>Oxbow 2g physical works</td><td>23,926</td></tr>
<tr><td>Oxbow 2h physical works</td><td>22,116</td></tr>
<tr><td>Oxbow 2i physical works</td><td>9,830</td></tr>
<tr><td>Oxbow 2j physical works</td><td>9,830</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>85,888</td></tr>
<tr><td>Total</td><td>372,184</td></tr>
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</td><td>C = 0.37</td></tr>
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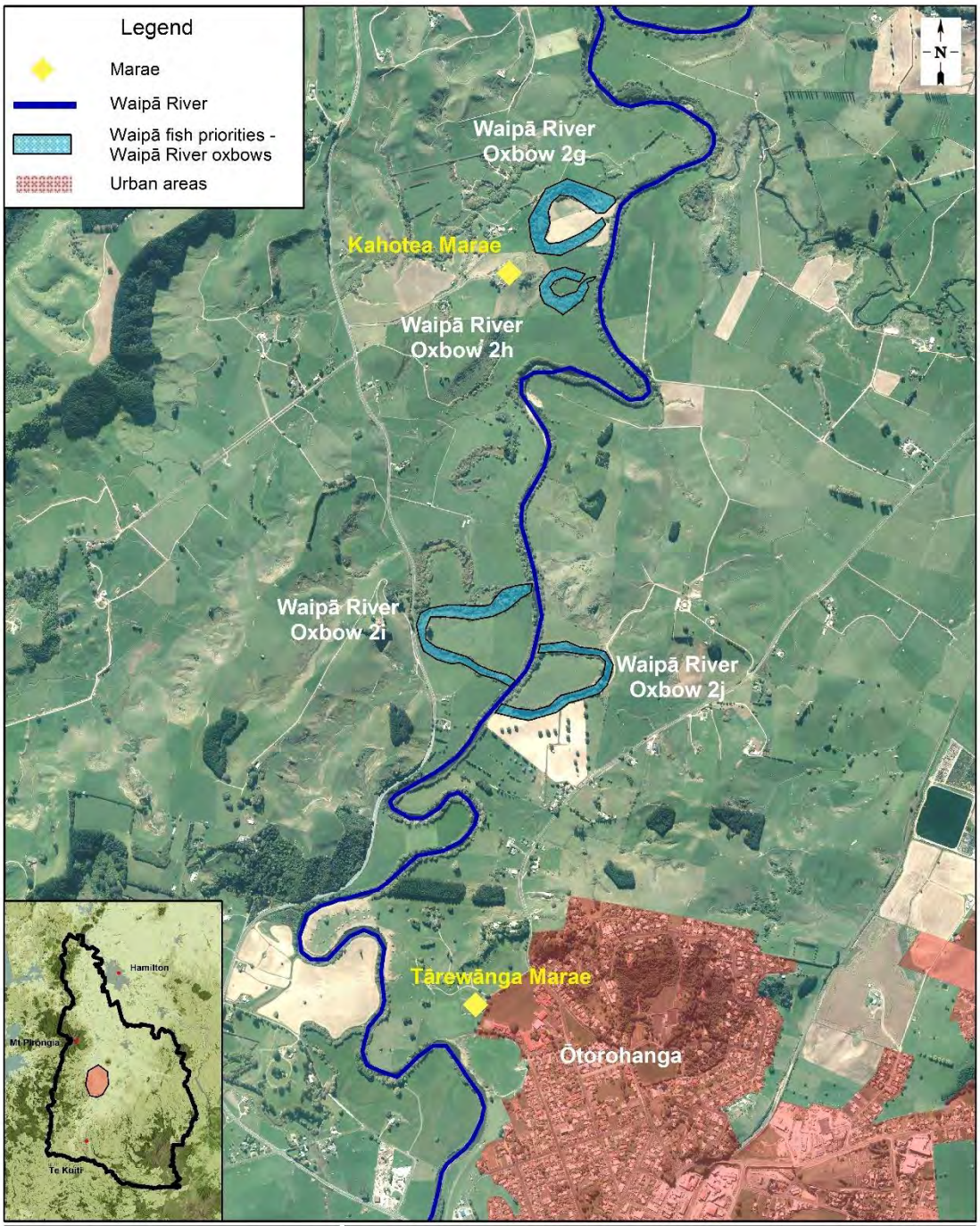


Tuna habitat rehabilitation within 10 Waipā River oxbows Map 1/2

WWRRS Project Map

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

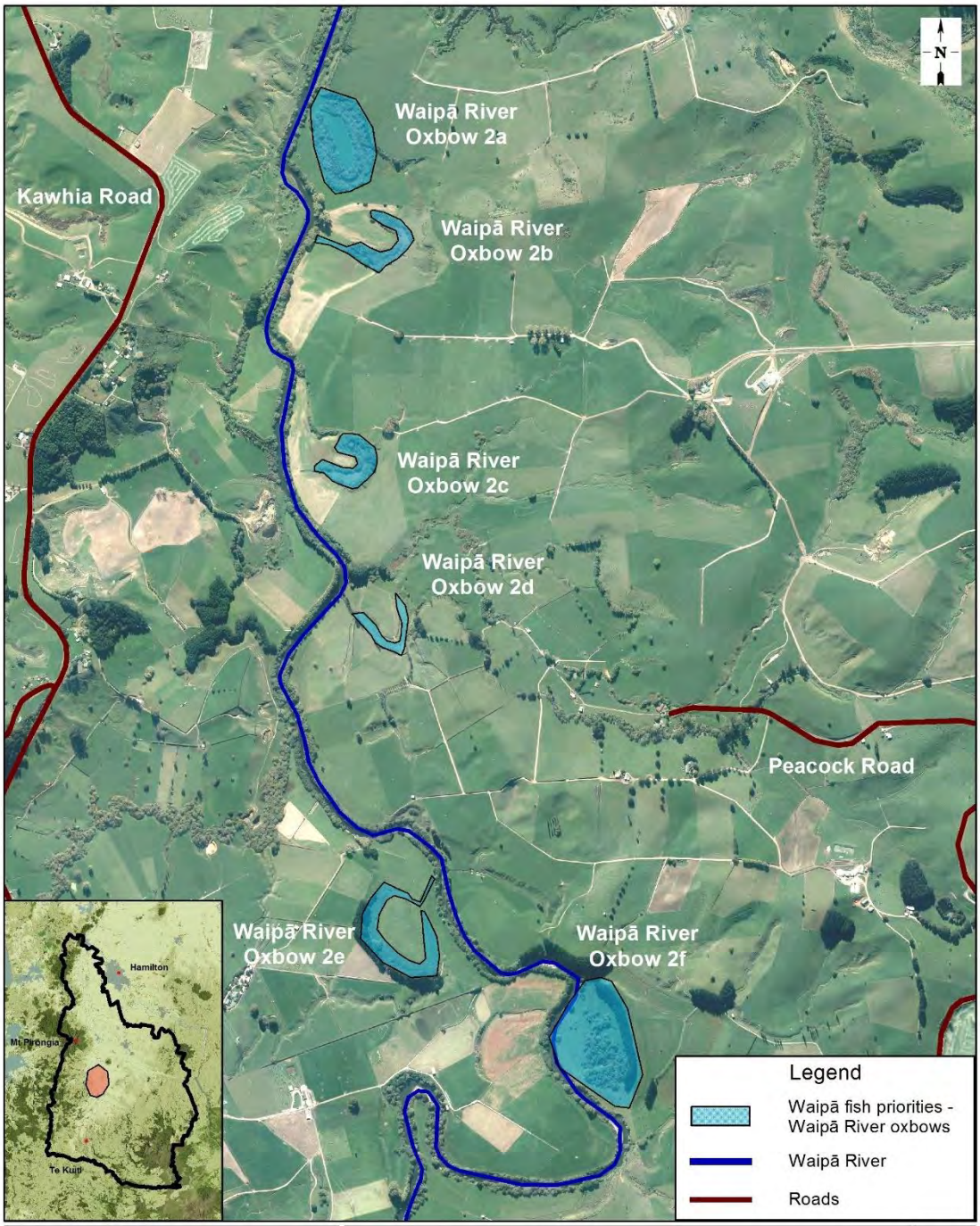
Status: Final
Request No.: N/A
File name: WWRRS.gws

0.00 0.15 0.30 0.45 0.60 0.75
Kilometers

Scale 1:20,000@A4 Portrait

A4

Waikato Regional Council
Te Kaunihera ā Rohe o Waikato



Tuna habitat rehabilitation within 10 Waipā River oxbows Map 2/2

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name: WWRRS.gws

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Kilometers

Scale 1:15,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

Photo of Waipā River oxbows 2a and 2b.

Photo of oxbows 2g and 2h.

Oxbows 2i and 2j.

WP 16 Priority: Very high	Mangatutu River erosion protection, remediation and management and fish habitat rehabilitation	BCR value
Relevant unit goal(s)	River margins prone to significant erosion are managed to minimise erosion risk, whilst enhancing aquatic habitat and retaining the natural character of river systems. Riparian planting of preferably indigenous species is undertaken to stabilise riverbanks, reduce erosion and enhance terrestrial and aquatic biodiversity. Water quality is such that waters within the catchment are swimmable and safe to take food from in all places. 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.	
Name of feature	Mangatutu River	
Brief description of feature	A 20km reach of the Mangatutu River from Puniū to Wharepuhanga Road. About 25% of this reach has had some work undertaken involving erosion control and native and exotic plantings. The river has a moderate gradient with a gravel and stony bed. Banks range from 1m to 3m high across the reach. Riverbank erosion along this reach generally occurs during high flow events and is prevalent where there is no stabilising vegetation – occurring mainly on outside bends. There is lateral bank erosion in the upper reach and bank slumping in the lower reach. According to Waikato Regional Council monitoring results the Mangatutu River at Walker Road bridge is safe for swimming some but not all of the time.	
Desired state to achieve the Vision & Strategy	- A 20km reach of river with stable, vegetated banks and where major erosion events are limited. - A riparian margin that is well vegetated with native plants (at least 5m wide) and exotic plants where required to prevent erosion. - There is increased in-stream structure (at least 10 woody structures per kilometre) to provide habitat for fish, particularly tuna and piharau. - The river is swimmable, fishable and has access for recreation. - Iwi and communities have a strong connection to the river and are active in its use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition the Mangatutu River would have a high impact on giving effect to the Vision & Strategy at a Waipā catchment level.	VS = 80

<table>
<tr>
<td>Key threats to the feature that this project addresses</td>
<td>
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Riverbank erosion</td><td>Estimated to yield approximately 1300 tonnes per year of sediment to the Waipā River, excluding major flood events.</td></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish.</td></tr>
<tr><td>Lack of woody debris and structures within the stream channel</td><td>Reduced habitat for adult native fish and trout.</td></tr>
</table>
</td>
<td></td>
</tr>
<tr>
<td>Project goal/s</td>
<td>Within 10 years of project commencement:
- A 20km reach of the Mangatutu River is stable, fenced and vegetated (at least 5m setback) along its entire length providing increased shade, shelter and food for native fish.
- There are 10-15 structures per kilometre that provide protection against erosion and enhance habitat for native fish, particularly tuna.
- Stock is 100% excluded from the Mangatutu River</td>
<td></td>
</tr>
<tr>
<td>Priority works for funding</td>
<td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

River erosion protection and remediation
- It is estimated from aerial photographs and on-the-ground knowledge that one third of this reach would require willow control. This equates to 7km of willow control at $20 per metre ($140,000).
- As 4km of the river is already being managed for erosion/habitat enhancement as part of a WRA/WRC funded project, there is 16km of river remaining that requires erosion management. This is likely to require hard (rock) and soft (vegetation) structures throughout at a cost of $20,000 per km (16km = $320,000). This would also provide approximately 10-15 fish habitat structures per km of stream.

Activities such as willow removal, installation of erosion protection structures, installation of woody debris and any earthworks associated with these actions may require resource consent from Waikato Regional Council. Council's Integrated Catchment Management division hold an existing consent for much of this type on work on this waterway and therefore anyone proposing to undertake river management</td>
<td></td>
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</table>

	works should discuss this with council staff during project planning. **Riparian fencing and planting** Carry out riparian management along approximately 16km of the unmanaged section of stream (32km of streambank) with a minimum 5m setback from the top of the streambank. - It is estimated that 46% of the unmanaged bank requires fencing. This equates to 14.7km of new fencing (5 wire, 2 electric) ($117,760). - It is estimated that approximately two thirds of the unmanaged stretch of 16km would require willow pole planting at 15m intervals. This would require 1422 poles ($19,908). Native planting – 5m planted margin on both sides of the stream for 16km would require 16ha of native planting ($600,832). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 7-year period, it is estimated that the majority of the project benefits would be seen within 1 year of project completion.	L = 7.5
Effectiveness of works	The Mangatutu Stream is in relatively good condition with some of the Vision & Strategy desired state aspects already being met, including being swimmable at times and fishable. It is expected that over the next 20 years there may be a slow deterioration in the stream in the absence of this project. Works included here address most of the threats to the feature and it is anticipated that if the project is fully completed then the stream will be in excellent condition and close to the Vision & Strategy state being achieved. The project does not address catchment land use, however the proposed fencing and planting works will assist in protecting and restoring water quality at this site.	W = 0.2
Risk of technical failure	There is a low to moderate risk of project failure due to technical feasibility if appropriately experienced practitioners are undertaking/advising on the more technical aspects of the project. Risks are mostly related to establishment of plantings or loss of works due to flooding. Techniques are well established and have been used	F = 0.9

<table>
<tr><td></td><td>previously on the Mangatutu Stream. River erosion structures should be designed by an appropriately experienced practitioner.</td><td></td></tr>
<tr><td>Adoptability</td><td>It is estimated that currently about a third of landowners would adopt the works if they were fully incentivised. There are large sections of stream that are meandering and erosive in nature and likely to flood on a regular basis. Landowners may be unwilling to erect fences in these locations due to the potential maintenance costs. The extent of the fencing setbacks may be a challenge in terms of uptake, however there are some existing projects along this reach that provide a good example of what can be achieved with larger riparian margins.</td><td>A = 0.32</td></tr>
<tr><td>Information quality</td><td>Good – advice of local expert/s with a history of association to the stream and experience in undertaking similar works.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>It is unknown specifically how much fencing already exists and estimates are based on Waipā catchment riparian surveys. This information would need to be collected in the early stages of the project. Specific locations for erosion control structures would need to be determined during preliminary site visits.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Moderate risk that the project will fail to meet its goals over the long term due to socio-political risks. Early stakeholder engagement will be very important for the successful delivery of this project.</td><td>P = 0.62</td></tr>
<tr><td>Project duration (years)</td><td>7 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>River erosion protection/remediation (16km)</td><td>320,000</td></tr>
<tr><td>Willow management (7km)</td><td>140,000</td></tr>
<tr><td>Streambank fencing (14.7km)</td><td>117,760</td></tr>
<tr><td>Willow/poplar pole planting (1422 poles)</td><td>19,908</td></tr>
<tr><td>Native planting (16ha)</td><td>600,832</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>359,550</td></tr>
<tr><td>Total</td><td>$1,558,050</td></tr>
</table></td><td>C = 1.56</td></tr>
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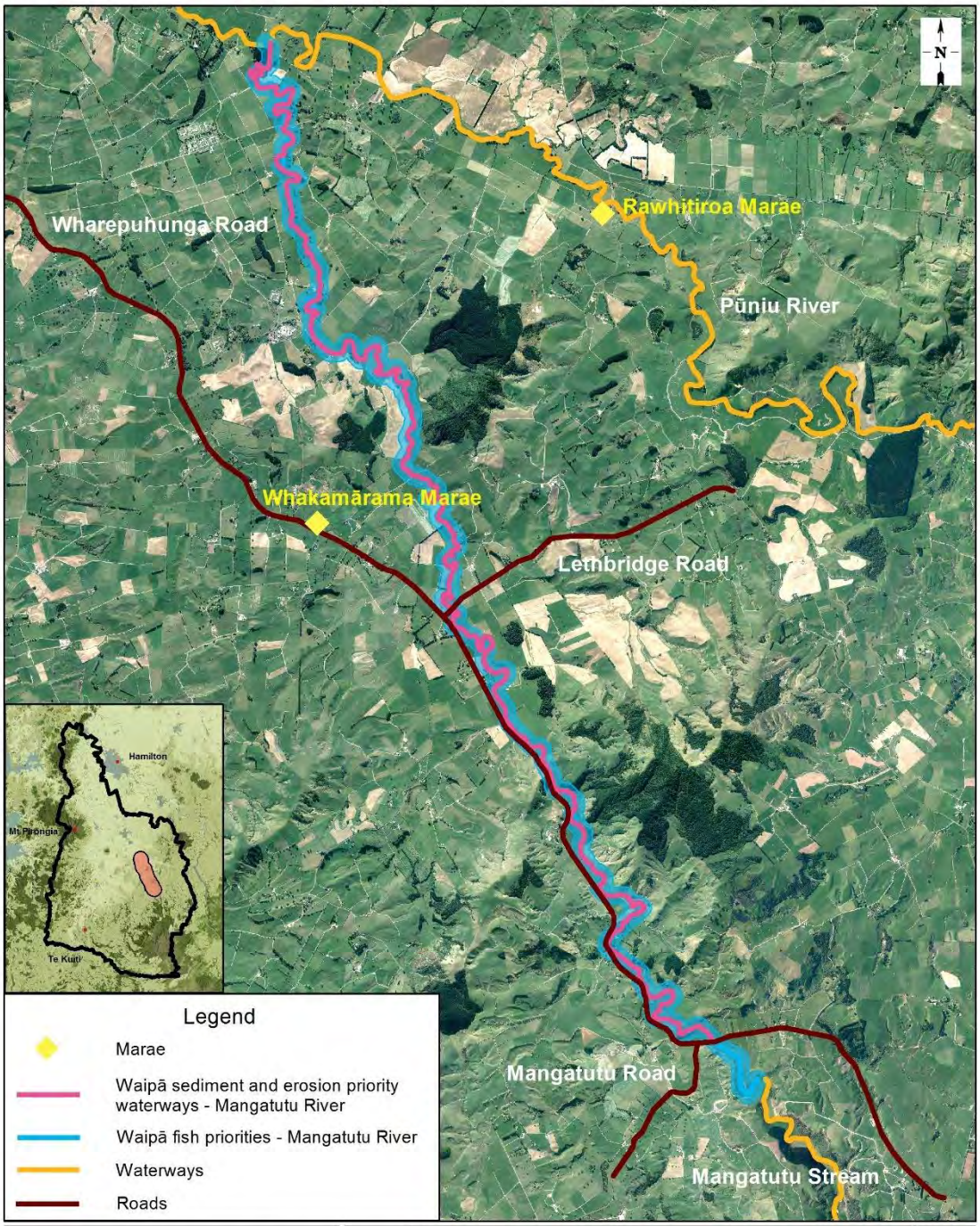

Mangatutu River erosion protection, remediation and management and fish habitat rehabilitation

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.5 1.0 1.5 2.0 2.5
Kilometers

Scale 1:60,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

Examples of large scale bank erosion along the Mangatutu River.

Examples of fish habitat enhancement.

WP 17 Priority: Very high	Waitomo River – headwaters to caves catchment erosion protection and remediation	BCR value
Relevant unit goal(s)	The appropriate management of steep and erosion prone land is promoted and incentivised. Water quality is such that waters within the catchment are swimmable and safe to take food from in all places. Land uses are being adapted to match the capability of the land.	
Name of feature	Waitomo subcatchment and caves	
Brief description of feature	This 4434ha catchment is situated southwest of Ōtorohanga, upstream of Waitomo village, and contains the Waitomo Glowworm Caves. Approximately 1394ha of land is LUC 6e or 7 in pasture and the catchment has been identified as a priority sediment catchment in the Waipā Catchment Plan. The pastoral land use is predominantly dairy support and dry stock with 10% of the catchment in plantation species, primarily pine. 36% of the catchment is in indigenous cover. The main waterway in this catchment is the Waitomo River. This catchment has been the site of historic catchment management works, with the focus on protecting the Waitomo Glowworm Caves which were under significant threat from sedimentation. Issues, concerns and criticism peaked during the 1970s when sedimentation was at its worst and the future of the caves, ecologically and economically, was seriously threatened. Eventually through the work of the Waitomo Catchment Trust Board (who raised 65% of the cost of works) and Waikato Regional Council (who funded 35% of the cost of works) in the 1990s and 2000s, 118km of fencing was completed and 1223ha of erosion prone land retired in this catchment. Sediment monitoring in the river indicated that this led to a 40% reduction in sediment loads by the early 2000s. Recent monitoring indicates that loads may be starting to increase again. Further work is required in the catchment to prevent this. Waikato Regional Council monitoring of water quality in the Waitomo Stream near the caves (Tumutumu Road) indicates that the stream is not safe for swimming due to high E. coli levels.	
Desired state to achieve the Vision & Strategy	- A subcatchment where land use matches capability. - A stable stream network that has a fenced and well vegetated riparian margin along its entire length (at least	

<table>
<tr><td></td><td>5m wide) to assist in providing erosion protection and shade, shelter, food and habitat for native fish species.
- River is swimmable, fishable, safe for gathering kai, and has access for recreation purposes.
- The Waitomo Glowworm Caves are protected from further sedimentation.
- Native fish are abundant and there is a wide diversity of species present
- Iwi and communities have a strong connection to the river and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Waitomo subcatchment would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 200</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Hill country erosion</td><td>Estimated to yield more than 2600 tonnes per year of sediment to the Waipā River.</td></tr><tr><td>E. coli to waterways</td><td>Impacts the swimmability of the site.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>There is a 20% reduction in suspended sediment in the upper Waitomo Stream within 10 years of project commencement.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Hill country soil conservation
- 60ha LUC 6e managed with open space pole planting at $3000 per hectare.
- 60ha LUC 6e managed with plantation species (pine or mānuka) at $3000 per hectare.
- 10km of fencing the managed LUC 6e land at $20 per metre (8-wire and batten).

(Note: Estimates of management for LUC Class 6e are based on 10% of the land area requiring management to reduce erosion risk. This differs from other Waipā subcatchments due to the significant works already undertaken in the upper Waitomo as part of the Waitomo Catchment Scheme. A flexible approach should be taken to addressing remaining erosion risk and resources may be more usefully targeted to sediment traps, wetland/seep retirement etc.)

- 92ha LUC 7 managed with plantation species (pine or mānuka) at $3000 per hectare.
- 19km of fencing managed LUC 7 land at $20 per metre (8-wire and batten).</td><td></td></tr>
</table>

	- 3.6ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $5000 per hectare (e.g. dewatering, retiring seepages etc). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period it is estimated that the majority of the project benefits would be seen approximately one year after project completion.	L = 11
Effectiveness of works	The Waitomo headwaters to caves subcatchment is generally in very good condition with many of the Vision & Strategy desired state aspects being met. It is expected that over the next 20 years there will be a slight deterioration in the condition of the catchment in the absence of this project. Works included here address some of the threats to the feature and it is anticipated that if the project is fully completed it would offset declines and make some progress towards achieving the Vision & Strategy state for water quality in 20 years' time. E. coli levels affecting swimmability of the stream should have some improvement as a result of this project, however will also need to be addressed through other mechanisms. The project does not directly address fish habitat and biodiversity threats however the proposed fencing and planting works provide secondary benefits to these values.	W = 0.10
Risk of technical failure	There is a low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings.	F = 0.87
Adoptability	It is estimated that about two thirds of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 7 land may be more challenging however there is a well-established and successful catchment scheme already in place. This has provided an outstanding example of what can be achieved through this type of work.	A = 0.63
Information quality	Average – estimates are based on modelled information and input from catchment officers who are familiar with the subcatchment and are working with landowners to help them undertake similar works.	

<table>
<tr><td>Knowledge gaps and response</td><td>Estimates of LUC classes 6e and 7 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Pole planting erosion prone LUC class 6e land (60ha)</td><td>180,000</td></tr>
<tr><td>Plantation species on erosion prone LUC class 6e land (60ha)</td><td>180,000</td></tr>
<tr><td>Fencing managed LUC class 6e land (10km)</td><td>200,000</td></tr>
<tr><td>Plantation species on LUC class 7 land (92ha)</td><td>276,000</td></tr>
<tr><td>Fencing managed LUC class 7 land (19km))</td><td>380,000</td></tr>
<tr><td>Treating erosion outside LUC class 6e, 7 and 8 land (3.6ha)</td><td>18,000</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>308,500</td></tr>
<tr><td>Total</td><td>1,542,500</td></tr>
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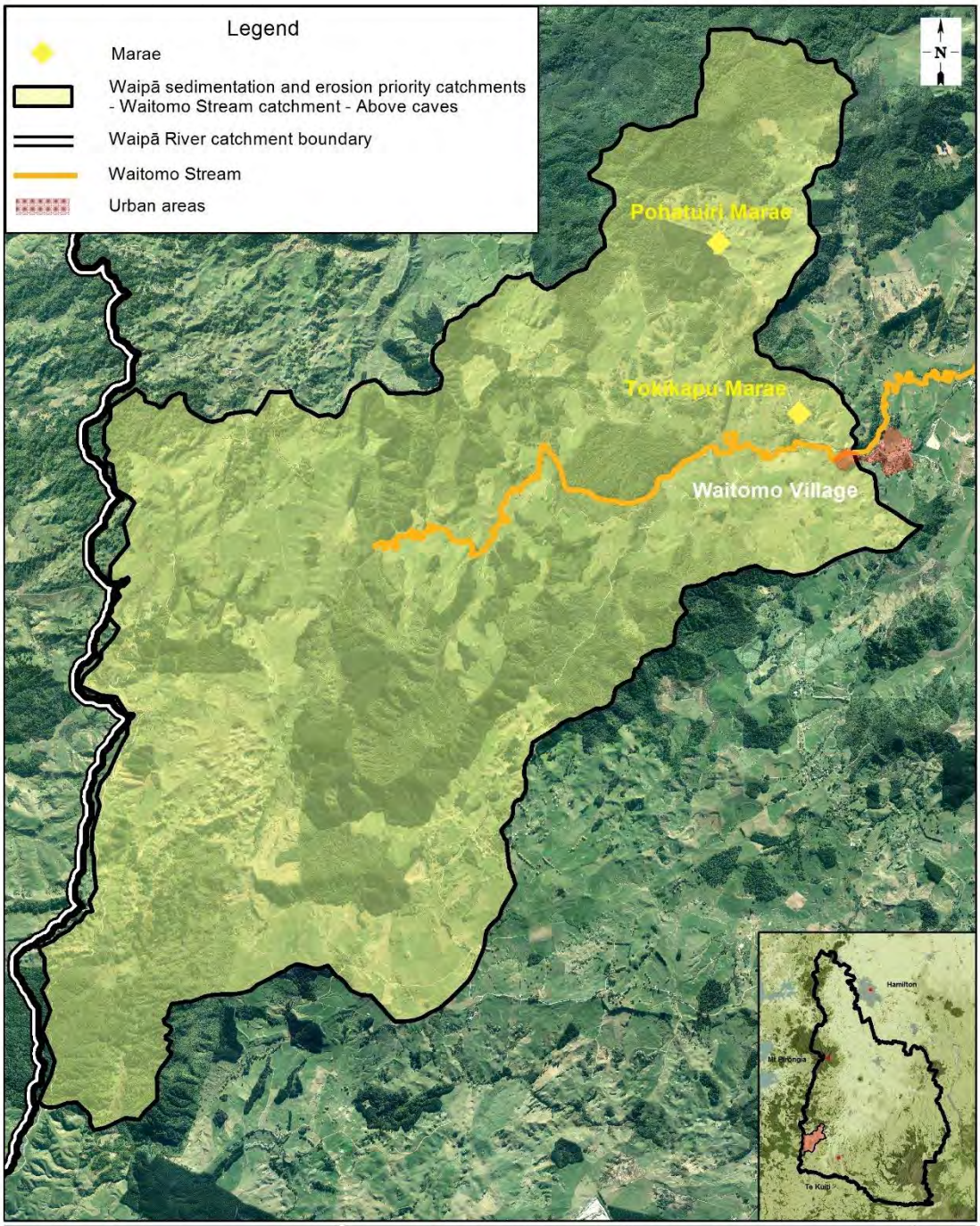

Waitomo River- Headwaters to caves catchment erosion protection and remediation

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.4 0.8 1.2 1.6 2.0
Kilometers

Scale 1:55,000@A4 Portrait

A4

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A land slip above a Waitomo stream with soil conservation afforestation in the background.

Examples of landslips in the upper Waitomo catchment.

Sedimentation in the upper Waitomo catchment following heavy rain events

Example of fencing and retirement of erosion prone land in the upper Waitomo catchment.

Example of gully retirement and planting in the upper Waitomo catchment.

<table>
<tr><td>WP 18
Priority: High</td><td>Rehabilitation of fish habitat at Ōtorohanga (Waipā River)</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>There is a programme of restoration, enhancement and protection of pā tuna, other significant fishing sites and fish habitat without compromising the natural range of species.

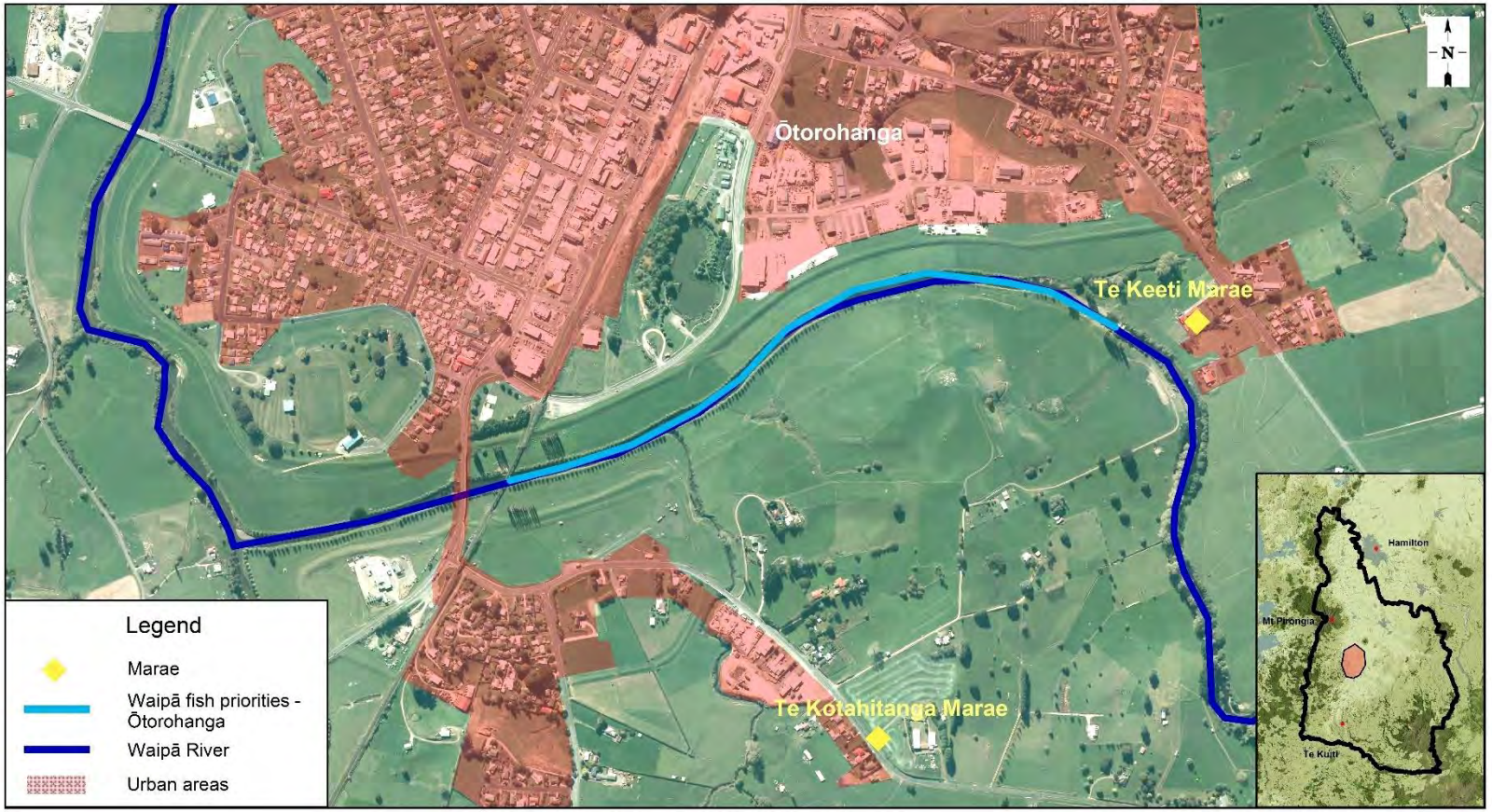
Indigenous fish have access throughout the river catchments (except where natural barriers exist) and the catchment has an abundance of taonga species such as kōkopu, piharau, tuna, kōura and kāeo.</td><td></td></tr>
<tr><td>Name of feature</td><td>The 1.3km section of Waipā River between Ōtorohanga rail bridge and the weir</td><td></td></tr>
<tr><td>Brief description of feature</td><td>This section of Waipā River between Ōtorohanga rail bridge and the weir is approximately 1.3km long. It is part of the Ōtorohanga flood protection scheme and has flood levees on either side. The river channel has been cleared as part of the flood protection scheme and matsudana willow trees established along the banks for stabilisation purposes.

This area is historically significant to iwi with multiple historic pā and pakanga (battle) sites in the area. Ōtorohanga was previously a well inhabited papakāinga for many centuries.

This section of river has been identified by fish experts as having very little in-stream structure for fish habitat but with potential to provide a large area of habitat (particularly for tuna) if habitat rehabilitation work was undertaken.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- The identified section of Waipā River has a healthy tuna population that utilise a network of in-stream structures for habitat.
- The identified section of river is swimmable, fishable and has access for recreation.
- Iwi and communities have a strong connection to the river and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition this section of the Waipā River at Ōtorohanga would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 3</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on the asset</th></tr><tr><td>Lack of in-stream woody debris and below water structures</td><td>Reduction in cover and habitat for fish.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within two years of the project commencing the identified section of Waipā River has adequate in-stream structure (at least 5 additional structures installed per 500m) to provide habitat for tuna.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>It is not envisaged that this project be undertaken by private citizens but should be instead be undertaken by an organisation with expertise in river engineering and hydrology.</td><td></td></tr>
</table>

	This work would need to be undertaken in consultation with Waikato Regional Council and Ōtorohanga District Council who manage the flood control scheme. Works must also consider risks to navigation safety as this stretch of the river is widely used for recreational boating and swimming. **Fish habitat structures** This project involves the investigation, design and installation of 5 rock or wood structures per 500m (at least 13 structures in total) for the purpose of fish habitat rehabilitation. Design would need to account for the channel being a core component of the Ōtorohanga Flood Control Scheme. A cost estimate of $3700 per rock/woody habitat structure has been made. This includes investigation, design and installation of structures. **Resource consent** Resource consent would be required and a cost estimate of $7000 has been made. It is assumed that one consent would be applied for to authorise all of the structures. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 2-year period, it is estimated that the majority of the project benefits would be seen upon project completion.	L = 2
Effectiveness of works	The Waipā River at Ōtorohanga is currently in moderate condition with some of the Vision & Strategy desired state aspects already being met, including being fishable and, at times, swimmable. There is not expected to be significant deterioration in the river over the next 20 years in the absence of this project. Works included here address only the threats to the feature's tuna fishery and it is anticipated that if the project is fully completed, the tuna habitat in this reach of the river will be in an improved condition. However, the project does not address catchment land use, water quality, biodiversity or other threats to the river.	W = 0.025
Technical feasibility	Risks are mostly related to loss of works due to flooding. There is a moderate risk of project failure due to technical feasibility. This can be minimised by works being undertaken in consultation with experiences practitioners.	F = 0.87

<table>
<tr><td>Adoptability</td><td>The land is owned by Ōtorohanga District Council and the channel is managed by Waikato Regional Council. There should be high support for adoptability so long as these organisations agree that there will be no impact on the stability of the channel and the integrity of the flood control scheme. This needs to be established in the early stages of project planning.</td><td>A = 1</td></tr>
<tr><td>Information quality</td><td>Good information – judgement of fish and river management experts with relevant local knowledge.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>The specific location and design of structures to be installed needs to be determined during the early stages of the project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>2 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table><tr><th>Task</th><th>Cost ($)</th></tr><tr><td>Installation of structures for fish habitat (13)</td><td>48,100</td></tr><tr><td>Resource consent</td><td>7000</td></tr><tr><td>Project management/staffing/incidentals (20%)</td><td>11,020</td></tr><tr><td>Total</td><td>66,120</td></tr></table></td><td>C = 0.07</td></tr>
</table>



Rehabilitation of fish habitat at Ōtorohanga (Waipā River)

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.0 0.1 0.2 0.3 0.4 0.5
Kilometers

Scale 1:10,000@A4 Landscape

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

The reach of the Waipā River where work is proposed.

WP 19 Priority: High	Waipā River bank erosion protection and remediation – Toa Bridge to Ōtorohanga	BCR value
Relevant unit goal(s)	River margins prone to significant erosion are managed to minimise erosion risk, whilst enhancing aquatic habitat and retaining the natural character of river systems. Riparian planting of preferably indigenous species is undertaken to stabilise riverbanks, reduce erosion and enhance terrestrial and aquatic biodiversity. Water quality is such that waters within the catchment are swimmable and safe to take food from in all places.	
Name of feature	Waipā River – Toa bridge to Ōtorohanga	
Brief description of feature	This reach consists of 21km of Waipā main stem from Toa bridge to Ōtorohanga. The river is steep through this stretch with a fall of 53m over 20km. This gradient is a contributing factor to the high risk of riverbank erosion through the reach. There is also a high incidence of flood driven erosion causing bank scouring. The river has a gravel bed and banks 3-4m high. Some erosion features in this stretch have been several hundred metres in length and 50m back into the bank. The river is fringed with crack willow and hybrid willow in places (the latter for erosion control). The river bed has been subject to extensive gravel extraction for commercial purposes. The river margin is fenced for a majority of the length but fences are periodically lost due to flooding. This area is historically significant to iwi with multiple historic pā and pakanga (battle) sites in the area. Ōtorohanga was previously a well inhabited papakāinga for many centuries. There are three marae with significant interests in this stretch of the Waipā. Waikato Regional Council water quality monitoring indicates that the Waipā River at Ōtorohanga is sometimes safe for swimming, however E. coli levels make it regularly unsuitable.	
Desired state to achieve the Vision & Strategy	- A 21km stretch of river with stable, vegetated banks and where major erosion events are limited. - A riparian margin that is well vegetated with native plants and exotic plants where required to prevent erosion. - The river is swimmable, fishable and has access for recreation. - Iwi and communities have a strong connection to the river and are active in its use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition the Waipā River – Toa bridge to Ōtorohanga – would have a high impact on giving effect to the Vision & Strategy at a Waipā catchment level.	VS = 80

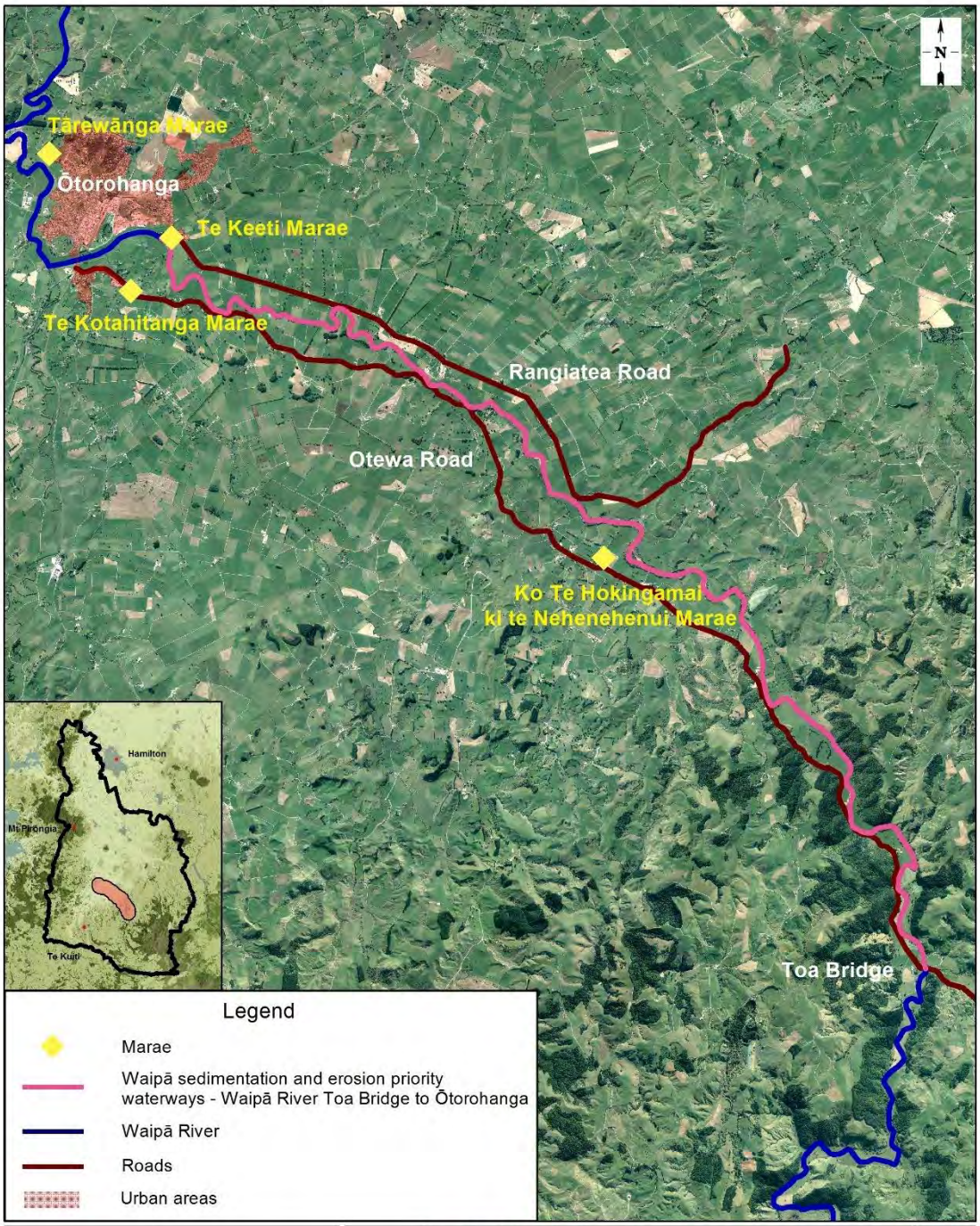
<table>
<tr>
<td>Key threats to the feature that this project addresses</td>
<td>
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Mass bank erosion events and ongoing bank scouring</td><td>Estimated to yield approximately 2293 tonnes of sediment per year to the Waipā River, excluding major flood events.</td></tr>
</table>
</td>
<td></td>
</tr>
<tr>
<td>Project goal/s</td>
<td>Within 10 years of project commencement:
- The river has stable banks and a continuous vegetated (native and exotic for erosion control) 21km margin from Toa's bridge to Ōtorohanga.
- There is 100% stock exclusion with at least 10m riparian setbacks.
- Sediment to the Waipā River over this stretch is reduced by 15%.</td>
<td></td>
</tr>
<tr>
<td>Priority works for funding</td>
<td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

River erosion protection and remediation
- It is estimated that 20 sites along this stretch would need erosion control structures/treatment. On average these structures would be 150m long and with an estimated cost of $22,500 each. Structures should be a mix of rock and vegetation and costs include materials (rock, vegetation, poles) and contracted services (including for willow removal where required). Total cost $450,000. Note: Waikato Regional Council holds resource consent for this type of work along this stretch of the river and should be consulted prior to any works being planned.
- It is estimated that 4km of native planting would be required in total behind these structures with 10m setbacks. This is equates to 4ha of native planting ($150,208).
- A further 8km of vegetation management (aged poplar and willow removal/management) for the purposes of erosion control is estimated to be required at a cost of $40 per metre of river. ($320,000). This vegetation should be replaced with hybrid willow at 10 m intervals (for 16km of bank length). This equates to 1600 poles ($22,400).

Activities such as willow removal, installation of erosion protection structures, installation of woody debris and any earthworks associated with these actions may require resource consent from Waikato Regional Council. Council's Integrated Catchment Management division hold an existing consent for much of this type on work on this waterway and therefore anyone proposing to undertake river management works should discuss this with council staff during project planning.</td>
<td></td>
</tr>
</table>

	Riparian Fencing & Planting - 6.5km of the 21km stretch is currently being managed as part of the WRA/WRC funded Waipā Rerenoa project. This leaves 14.5km of river (29km of bank) unmanaged. Based on surveys of Waipā catchment waterways, it is estimated that 46% of the remaining unmanaged riverbank will still require fencing. This equates to 13.3km of fencing. Fence should be set back 10m from the river and be minimum 3 wire electric ($74,480). - It is estimated that 13ha of native planting will be required along newly fenced margins ($488,176). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately 7 years after project commencement.	L = 7
Effectiveness of works	The Waipā River – Toa bridge to Ōtorohanga – is currently in moderate condition with some of the Vision & Strategy desired state aspects already being met, including being fishable and on occasion swimmable. It is expected that over the next 20 years there will be some deterioration in the river along this stretch in the absence of this project. Works included here focus on the threats to the feature's banks but would have secondary benefits on nutrient attenuation and fish habitat. It is anticipated that if the project is fully completed, the stability of the riverbanks in this reach will be in significantly improved condition and close to the Vision & Strategy state being achieved in 20 years' time. However the project does not fully address catchment land use, water quality or biodiversity threats and it is acknowledged that achieving the overall Vision & Strategy at this site will take longer than the 20-year time frame of the Restoration Strategy.	W = 0.05
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are related to establishment of plantings or loss of works due to flooding and/or erosion before they are established; and vegetation removal exacerbating erosion along this stretch. Exotic vegetation in and along waterways reduces flow velocities. Therefore it will be very important that willow removal is staged over the 10 years of the	F = 0.87

<table>
<tr><td></td><td>project and followed by replanting with native species to reduce the rate of channel modification resulting from increased flows. Risks would be further minimised by the fencing setbacks being at least 10m and by planting sterile willow poles to stabilise banks while native plantings establish. River erosion structures should be designed by an appropriately qualified practitioner.</td><td></td></tr>
<tr><td>Adoptability</td><td>It is estimated that about half of landowners would adopt the works if they were fully incentivised. There are large sections of river that are meandering and erosive in nature and likely to flood on a regular basis. Landowners may be unwilling to erect fences in these locations due to the potential maintenance costs. Fencing setbacks of at least 10m from the riverbank should help to minimise this, however this loss of grazing land may also be a challenge with uptake, as has been the case with similar river margin projects. It would be beneficial to establish that sites that demonstrate the benefits of stable, vegetated river margins.</td><td>A = 0.54</td></tr>
<tr><td>Information quality</td><td>Good information – advice of local expert/s with a history of association with this reach of the river and experience in undertaking similar work locally.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>It is unknown exactly how much fencing already exists and estimates are based on Waipā catchment riparian surveys and local knowledge. This would need to be establish during project planning.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Moderate risk that the project will fail to meet its goals over the long term due to socio-political risks. Early stakeholder engagement will be very important for the successful delivery of this project.</td><td>P = 0.62</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Erosion protection structures (21km)</td><td>450,000</td></tr>
<tr><td>Native planting behind structures (4ha)</td><td>150,208</td></tr>
<tr><td>Willow management (8km)</td><td>320,000</td></tr>
<tr><td>Poplar/willow pole planting (1600)</td><td>22,400</td></tr>
<tr><td>Fencing (13.3km)</td><td>74,480</td></tr>
<tr><td>Native planting behind new fences (13ha)</td><td>488,176</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>451,579</td></tr>
<tr><td>Total</td><td>$1,956,843</td></tr>
</table></td><td>C = 1.96</td></tr>
</table>



Waipā River bank erosion protection and remediation - Toa Bridge to Ōtorohanga

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.6 1.2 1.8 2.4 3.0
Kilometers

Scale 1:75,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

Examples of major bank erosion and instability along the Waipā River – Toa's bridge to Ōtorohanga.

A stretch of Waipā River – Toa's bridge to Ōtorohanga – where there was significant bank erosion (above) that has been remedied and stabilised (bottom photo).

Before and after river erosion remediation and stabilisation works along the Waipā River – Toa's bridge to Ōtorohanga

Examples of rock and vegetation erosion protection structures (as proposed as part of this project).

<table>
<tr><td>WP 20
Priority: Medium</td><td>Upper Pūniu catchment erosion protection and remediation</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>The appropriate management of steep and erosion prone land is promoted and incentivised.

Water quality is such that waters within the catchment are swimmable and safe to take food from in all places.

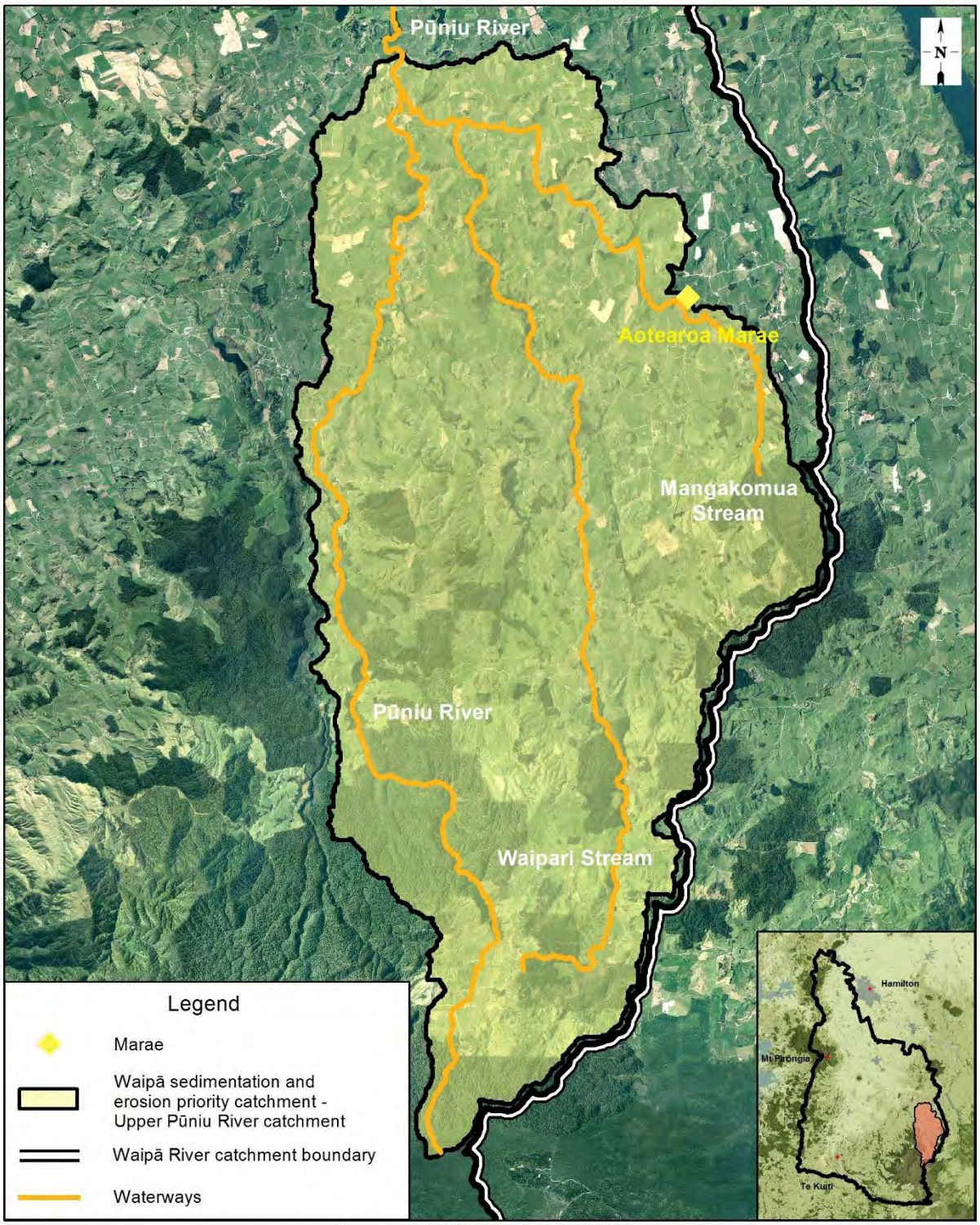
Land uses are being adapted to match the capability of the land.</td><td></td></tr>
<tr><td>Name of feature</td><td>The Upper Puniū subcatchment</td><td></td></tr>
<tr><td>Brief description of feature</td><td>The Upper Puniū is a 16,857ha catchment situated southeast of Te Awamutu and bordering the eastern edge of the Waipā catchment. Approximately 7357ha of land is LUC 6e or 7 in pasture and the catchment has been identified as a priority sediment catchment in the Waipā Catchment Plan. The land use is a mixture of dairy, dairy support and dry stock with small areas of woodlot forestry, primarily pine (2% of the catchment). 24% of the catchment is in indigenous cover.

The area is of tribal significance to Maniapoto and Waikato, known as Mangatoatoa, the same name held by the marae situated directly at the confluence of the Puniū and Waipā rivers. Better management of the upper catchment would improve the historic and cultural relationship of the marae and its people with the natural resources. It would also enhance the ability of the marae to sustain its people and manuwhiri (visitors) with local kai (food).

The main waterways in this catchment are the Puniū River, Waipāri Stream and Mangakomua Stream.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- A subcatchment where land use matches capability and where the waterways have a riparian margin that is well vegetated with native plants and at least 5m wide.
- Waterways are swimmable, fishable and have access where appropriate for recreation.
- Iwi and community have a strong connection to the catchment and its waterways and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Upper Puniū catchment would have a very high impact on giving effect to the Vision & Strategy at a Waipā catchment level.</td><td>VS = 200</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Hill country erosion</td><td>Estimated to yield more than 3400 tonnes of sediment per year to the Waipā River.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>There is a 25% reduction in suspended sediment in the Puniū River within 15 years of project commencement.</td><td></td></tr>
</table>

Priority works for funding	Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components. **Hill country soil conservation** - 688ha LUC 6e managed with open space pole planting at $3000 per hectare ($2,064,000). - 688ha LUC 6e managed with plantation species (pine or mānuka) at $3000 per hectare ($2,064,000). - 116km of fencing the managed LUC 6e land at $20 per metre (8-wire and batten) ($2,320,000). - 1857ha LUC 7 managed with plantation species (pine or mānuka) at $3000 per hectare ($5,571,000). - 172km of fencing the managed LUC 7 land at $20 per metre ($3,440,000). - 52ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $5000 per ha (e.g. dewatering, retiring seepages etc.) ($260,000). - 74 hunter days per year for 3 years of goat control while plantings on 6e and 7 establish. Control carried out over a 7400ha area. - 34km fencing existing indigenous vegetation at $25 per metre ($850,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 30% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 20-year period, it is estimated that the majority of the project benefits would be seen approximately 16 years after project commencement.	L = 16
Effectiveness of works	The upper Puniū subcatchment is in moderate to poor condition when compared to desired state, with few of the Vision & Strategy aspirations being met. It is expected that over the next 20 years there may be a deterioration in the condition of the catchment in the absence of this project. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20-year horizon used for the purposes of the Restoration Strategy. However, works included in this project address some of the key threats to the feature and it is anticipated that if the project is fully completed the upper Puniū subcatchment will be significantly closer to the Vision & Strategy desired state in 20 years' time, particularly	W = 0.25

<table>
<tr><td></td><td>when it comes to land use matching capability and waterways being swimmable. The project does not directly address E. coli, fish habitat and biodiversity, however improvements are expected as secondary benefits.</td><td></td></tr>
<tr><td>Risk of technical failure</td><td>Risks are mostly related to establishment of plantings or loss of works due to severe erosion before they are established. There is a high risk of project failure due to technical feasibility.</td><td>F = 0.82</td></tr>
<tr><td>Adoptability</td><td>It is estimated that about 20% of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low and we are not aware of significant similar works being undertaken in this catchment to date. Early community engagement, flexibility in approach and identifying key farmers will be very important for the success of this project.</td><td>A = 0.2</td></tr>
<tr><td>Information quality</td><td>Average – estimates are based on modelled information and input from catchment officers who are familiar with the subcatchment.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>Estimates of LUC classes 6e, 7 and 8 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>20 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Pole planting erosion prone LUC class 6e land (688ha)</td><td>2,064,000</td></tr>
<tr><td>Plantation species on erosion prone LUC class 6e land (688ha)</td><td>2,064,000</td></tr>
<tr><td>Fencing managed LUC class 6e land (116km)</td><td>2,320,000</td></tr>
<tr><td>Plantation species on erosion prone LUC class 7 land (1857ha)</td><td>5,571,000</td></tr>
<tr><td>Fencing managed LUC class 7 land (172km)</td><td>3,440,000</td></tr>
<tr><td>Treating erosion outside LUC class 6e, 7 and 8 (52ha)</td><td>260,000</td></tr>
<tr><td>Fencing indigenous forest remnants (34km)</td><td>850,000</td></tr>
<tr><td>Goat control on treated 6e and 7</td><td>90,576</td></tr>
<tr><td>Project management/staffing/incidentals (30%)</td><td>4,997,872</td></tr>
<tr><td>Total</td><td>$21,657,448</td></tr>
</table>
</td><td>C = 21.66</td></tr>
</table>



Upper Pūniu catchment erosion protection and remediation

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name: WWRRS.gws

Scale 1:110,000@A4 Portrait

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

WP 21 Priority: High	Mangapū River erosion protection and riparian enhancement	BCR value
Relevant unit goal(s)	River margins prone to significant erosion are managed to minimise erosion risk, whilst enhancing aquatic habitat and retaining the natural character of river systems. Riparian planting of preferably indigenous species is undertaken to stabilise riverbanks, reduce erosion and enhance terrestrial and aquatic biodiversity. Water quality is such that waters within the catchment are swimmable and safe to take food from in all places.	
Name of feature	Mangapū River	
Brief description of feature	This is a 35km stretch of river broken up into two reaches. The top reach (Waitomo Valley Road to Trooper Road) is 21km long. Approximately 8km of this has already been managed and fenced/planted. This leaves 13km unmanaged in this reach. This reach is part of an alluvial river flat. Banks have a relatively small amount of stabilising vegetation and are subject to slumping following high flow flood events. The lower reach (downstream of Waitomo Valley Road) is 14km of stream. This portion is largely unmanaged (from a riparian perspective) and requires bank stabilisation as the river is incising through this reach. The Mangapū River is historically and culturally significant to Ngāti Maniapoto. There are historic forts along the Mangapū established during intertribal wars including Pukehōkio, Pānikau and Te Tuhi-o-te-ao-mārama. This was a commonly traversed area. There are 14 marae with interests in the Mangapū River. According the water quality monitoring undertaken regularly by Waikato Regional Council, the Mangapū River at Ōtorohanga is not safe for swimming due to unsatisfactory levels of E. coli, and the river's water clarity is unsatisfactory.	
Desired state to achieve the Vision & Strategy	- A 35km reach of river with stable, vegetated banks and where major erosion events are limited. - A riparian margin that is fenced to exclude stock with a minimum 5m setback, and that is well vegetated with native plants and exotic plants where required to prevent erosion. - Native fish are abundant and there is a wide diversity of species present - The river is swimmable, fishable, safe for gathering kai, and has access for recreation. - Iwi and communities have a strong connection to the river and are active in its use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition the Mangapū River would have a high impact on giving effect to the Vision & Strategy at a Waipā catchment level.	VS = 80

<table>
<tr>
<td>Key threats to the feature that this project addresses</td>
<td>
<table>
<tr><th>Key threat</th><th>Impact on feature</th></tr>
<tr><td>Riverbank erosion</td><td>Estimated to yield approximately 2600 tonnes of sediment per year to the Waipā River, excluding major flood events.</td></tr>
<tr><td>Stock access to the stream</td><td>Reduced water quality and destruction of riparian vegetation.</td></tr>
<tr><td>Lack of riparian cover and associated fish habitat</td><td>Reduced habitat for adult fish.</td></tr>
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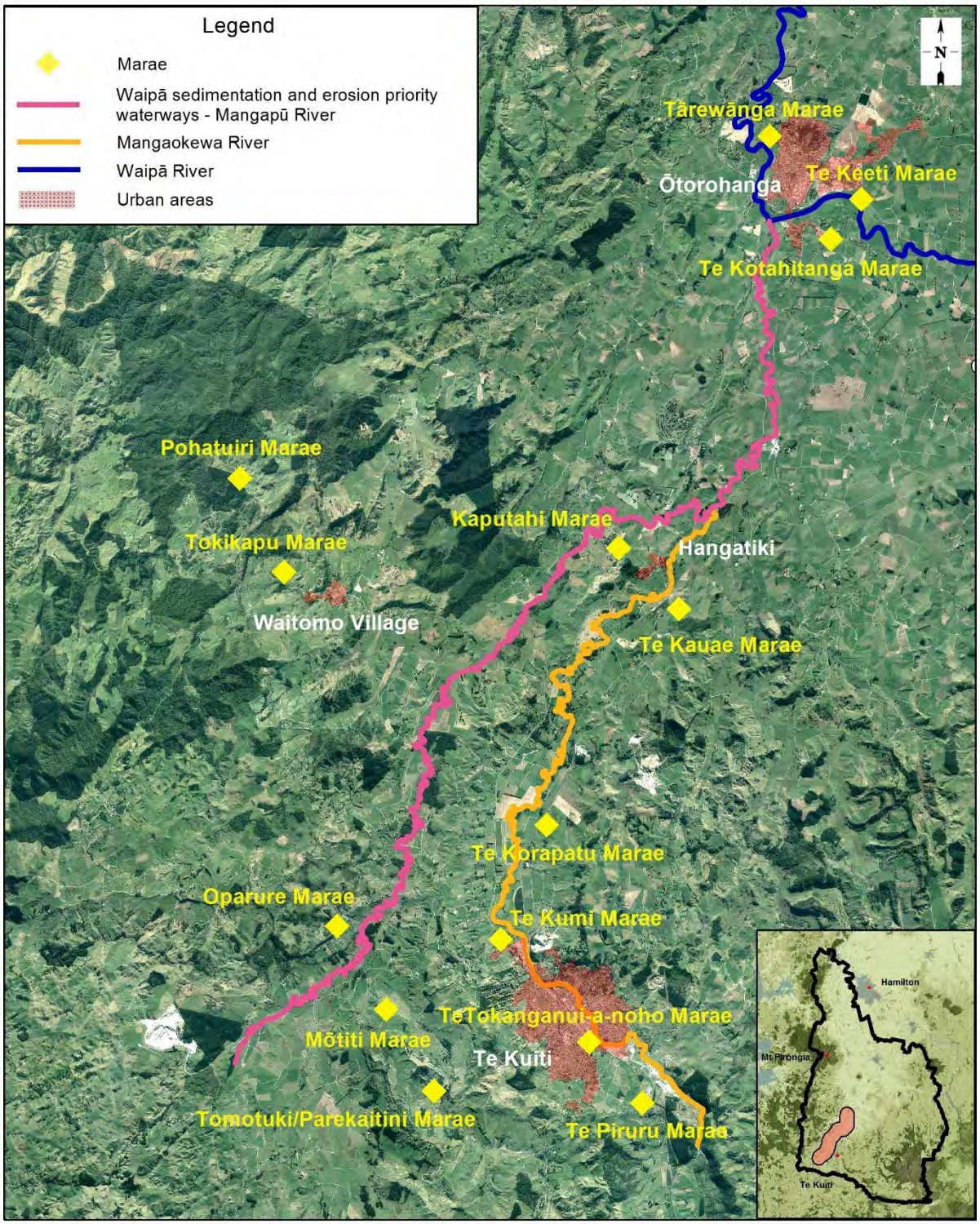
</tr>
<tr>
<td>Project goal/s</td>
<td>Within 8 years of project commencement:
- A 35km reach of the Mangapū River is stable, fenced and vegetated with a minimum 5m margin along its entire length providing increased shade, shelter and food for native fish.
- Stock is 100% excluded from the Mangapū River.</td>
<td></td>
</tr>
<tr>
<td>Priority works for funding</td>
<td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

River erosion protection and remediation
- It is estimated that approximately 15% of the lower reach requires willow removal. This equates to 5.25km of willow control at $20 per metre ($105,000).
- As 8km of the top reach of the river is already being managed as part of an existing project, there is 13km of river (26km bank) remaining in the top reach that requires management. This is likely to require soft (vegetation) structures throughout at approximately 1 structure per km (a cost of $2500 per km) (13km is $32,500). The lower 14km stretch of the river would require a mix of soft and small hard engineering structures. Estimated 2 structures per km ($5000 per km) (14km is $70,000).
- The top reach is estimated to require pole planting along half of the riverbank length (13km of riverbank). Poles at 15m spacing equates to 866 poles ($12,124). The lower stretch is estimated to require pole planting along two thirds of the riverbank (14km of riverbank). Poles at 15m spacing equates to 933 poles ($13,062).

Activities such as willow removal, installation of erosion protection structures, installation of woody debris and any earthworks associated with these actions may require resource consent from Waikato Regional Council. Council’s Integrated Catchment Management division hold an existing consent for much of this type on work on this waterway and therefore anyone proposing to undertake river management works should discuss this with council staff during project planning.</td>
<td></td>
</tr>
</table>

	Riparian fencing and planting - The top 13km of the river (26km of bank) unmanaged is estimated to require 46% of riverbank to be fenced with a 5-wire, 2-electric (12km of fencing) ($96,000). - The lower 14km of the river (28km of bank) is estimated to require 46% of riverbank to be fenced (13km of fencing ($104,000). Fence should be set 5m back from the top of the bank and adjoining wetland areas included in the fencing. - A 5-metre planted margin on both sides of the river for 25km would require 27ha of native planting ($938,800) **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over an eight year period, it is estimated that the majority of the project benefits would be seen approximately two years after project completion.	L = 10
Effectiveness of works	The Mangapū is currently in poor to moderate condition when compared to desired state, with few of the Vision & Strategy aspirations being met. The river is not swimmable year-round or 100% excluded from stock access. However, it still retains important values and the river is of high cultural significance for iwi. It is expected that over the next 20 years there may be some deterioration in the river in the absence of this project. Works included here focus on the threats to the feature's banks but would have secondary benefits of nutrient attenuation, reducing E. coli to waterways and improving fish habitat. It is anticipated that if the project is fully completed, the stability of the riverbanks in this reach will be in significantly improved condition and progress will be made towards the Vision & Strategy desired state. However, the project does not fully address catchment land use, water quality or biodiversity elements, and additional work outside the scope of this project would be required for the river to be swimmable.	W = 0.05
Risk of technical failure	Low risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding.	F = 0.9
Adoptability	It is estimated that approximately half of the landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may provide some challenge in terms of uptake, and some landowners may be concerned about maintenance of fences following floods. However, this should be minimised once plantings mature and there are significant existing works along	A = 0.54

<table>
<tr><td></td><td>the Mangapū that provide a good example of what can be achieved with larger riparian margins.</td><td></td></tr>
<tr><td>Information quality</td><td>Average – estimates are based on aerial photographs, Waipā catchment riparian surveys and input from catchment officers who are familiar with the reach and are working with landowners to help them undertake similar works.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>It is unknown specifically how much fencing already exists and how close it is to the stream edge. Detailed fencing requirements would need to be determined in the early stages of the project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>8 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table><tr><th>Task</th><th>Cost ($)</th></tr><tr><td>River erosion management and protection (27km)</td><td>102,500</td></tr><tr><td>Willow management (5.25ha)</td><td>105,000</td></tr><tr><td>Fencing (25km)</td><td>200,000</td></tr><tr><td>Willow/poplar pole planting (1799 poles)</td><td>25,186</td></tr><tr><td>Native planting (25ha)</td><td>938,800</td></tr><tr><td>Project management/staffing/incidentals (25%)</td><td>342,871</td></tr><tr><td>Total</td><td>$1,714,357</td></tr></table></td><td>C = 1.7</td></tr>
</table>



Mangapū River erosion protection and riparian enhancement

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.00 0.75 1.50 2.25 3.00 3.75
Kilometers

Scale 1:100,000@A4 Portrait

A4

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Te Kaunihera ā Rohe o Waikato

Mangapū River showing devegetated banks and lack of adequate setback.

WP 22 Priority: Very high	Biodiversity restoration within lowland kahikatea fragments in the Mangapū catchment	BCR value
Relevant unit goal(s)	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.	
Name of feature	Lowland kahikatea remnants in Waipā catchment and their associated wetlands	
Brief description of feature	Within the Waipā catchment only 2.07% of the conifer-dominated forests (kahikatea) remain (approximately 170ha). Fifty hectares of these are within the Mangapū River catchment and the rest spread throughout the remainder of the Waipā River catchment. Of the 50ha within the Mangapū catchment there is an 18.5ha area known as the Pehitawa Kahikatea Forest Reserve. This site currently has a management plan in place and has almost virgin condition forest with mature pole-stand kahikatea, some around 120 years old. Most other stands are small (less than 10ha), fragmented and impacted by stock, land drainage and plant and animal pests. They require further management to ensure their existence long term. There is also potential to extend existing stands by undertaking further planting. The Mangapū River is historically and culturally significant to Ngāti Maniapoto. There are historic forts along the Mangapū established during intertribal wars including Pukehōkio, Paanikau and Te Tuhi-o-te-ao-mārama. This was a commonly traversed area. There are 14 marae with interests in the Mangapū River.	
Desired state to achieve the Vision & Strategy	- Lowland kahikatea remnants and associated wetlands are fenced to exclude stock, densely vegetated with native vegetation and connected to riparian corridors when they are located nearby. - Native plant regeneration occurs naturally within the native bush remnants and any existing black mudfish populations within their associated wetland areas are retained.	
Impact on Vision & Strategy	In a restored condition the kahikatea forest remnants in the Mangapū catchment would have a very high impact on giving effect to the Vision & Strategy at a local level.	VS = 18

<table>
<tr><td>Key threats to the feature that this project addresses</td><td><table>
<tr><th>Key threat</th><th>Impact on the feature</th></tr>
<tr><td>Further fragmentation of forest fragments</td><td>Affects the viability of the forest fragment through increasing edge effects, increasing potential for weed and animal pest invasion. Also reduces the habitat available for native species.</td></tr>
<tr><td>Stock access to native forest fragments</td><td>Stock prevent native regeneration and open up areas to plant pests.</td></tr>
<tr><td>Lack of riparian vegetation and stock access to riparian areas</td><td>Reduction in in-stream biodiversity.</td></tr>
</table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 5 years of the project commencing:
- Lowland kahikatea forest remnants identified within the Mangapū catchment are fenced to exclude stock and connected to the other forest remnants, associated wetlands and riparian areas as identified.
- Native planting is undertaken (along with weed control) to fill gaps within fenced areas where there is no native vegetation.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

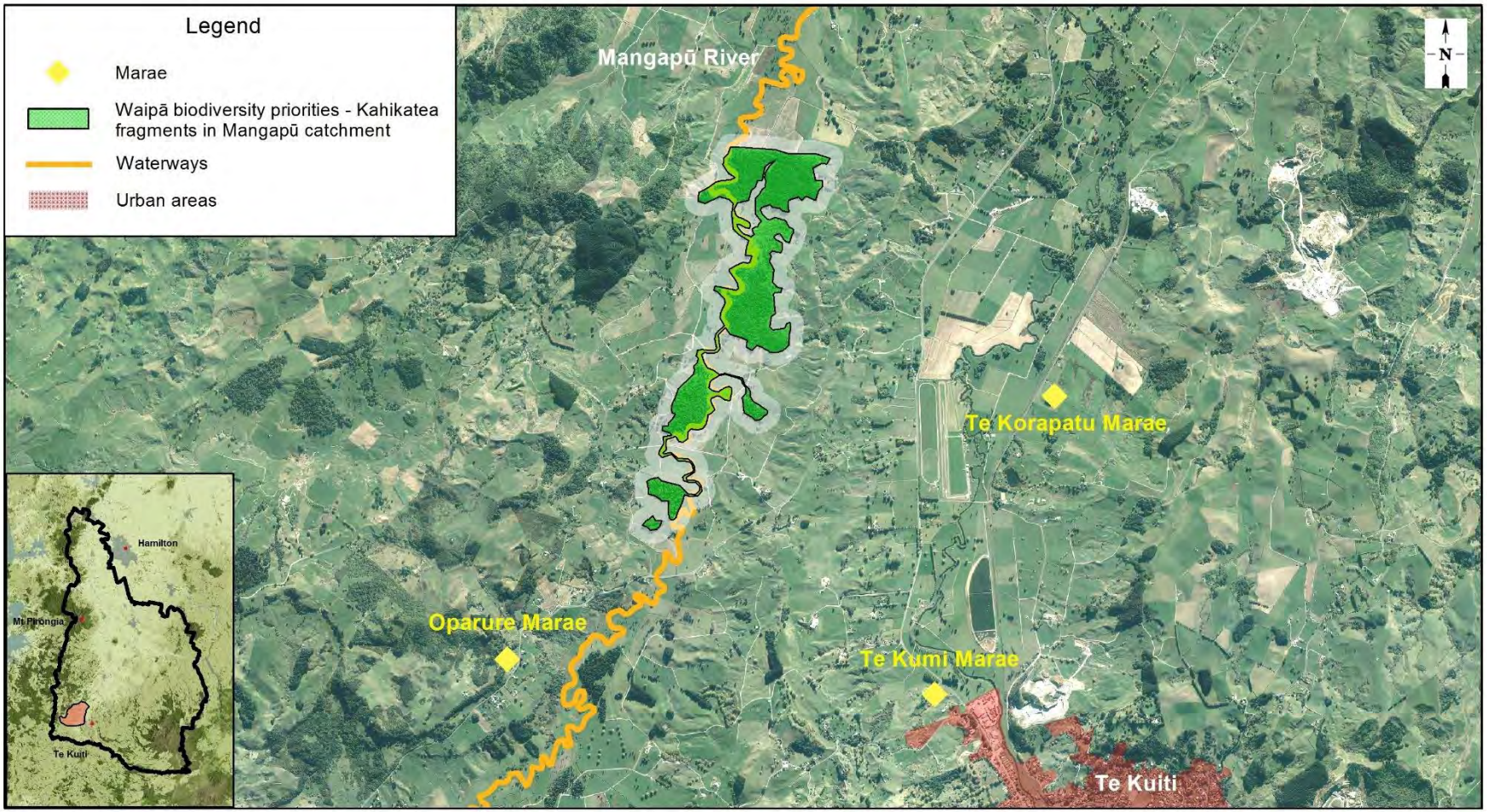
The site identified for restoration work consists of 50ha of lowland kahikatea remnants (including 18.5ha Pehitawa Forest Reserve) and 35ha of adjoining riparian margins and wetland areas. The total area of the site is 85ha. Recommended work and costings take into account management already being undertaken at Pehitawa Forest Reserve.

Management plan
A management plan should be developed for the areas outside of Pehitawa Forest Reserve. This should involve a site survey of vegetation types, detailed recommended management actions and costs. The estimated cost for a management plan is $10,000. Further investigation is required to determine the amount of fencing, planting and weed control required. However, based on aerial photographs the following estimates and assumptions have been made:

Fencing, planting, weed and possum control
- Assume that 50% of the 15.6km perimeter of the site requires fencing/fence upgrade with a 5 wire (2 electric) fence at an estimated cost of $8 per metre ($64,400)
- Four hectares of native planting required (and associated weed control) at a cost of $39,552 per hectare ($158,208).</td><td></td></tr>
</table>

	- General weed control using a knapsack sprayer required over another 10% (7ha) of the site for a period of 3 years at an estimated cost of $2800 per hectare per year ($58,800). - Possum control across the full 85ha area for a period of 3 years until native plantings are established, at $600 per hectare x 85ha ($51,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 20% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a five year period, it is estimated that the majority of the project benefit would be seen soon after project completion.	L = 5.5
Effectiveness of works	The lowland kahikatea remnants in Waipā catchment and their associated wetlands are currently in moderate to good condition with some of the Vision & Strategy desired state aspects already being partially met. Condition is expected to slightly decline over the next 20 years in the absence of this project. However, if this project is successfully completed then these features are expected to improve and be closer to desired state in 20 years' time, with aspects related to stock exclusion and native revegetation being addressed.	W = 0.1
Risk of technical failure	Low risk of project failure due to technical feasibility. Risk is mostly related to the potential for invasive weeds to overtake native planting at the site and potential for flooding to damage nearby fencing and planting.	F = 0.87
Adoptability	It is conservatively estimated that approximately 60% of landowners would adopt the works if they were fully incentivised. Land tenure is a mix of iwi owned, private and charitable trust.	A = 0.6
Information quality	Poor – management requirements based solely on aerial photography.	
Knowledge gaps and response	Detailed fencing, planting and pest control requirements would need to be determined during project planning.	
Socio-political risks	Very low risk that the project will fail to meet its goals due to socio-political risks	P = 0.97
Project duration (years)	5 years	

<table>
<tr>
<td>Up-front cost – total for implementation phase/project duration</td>
<td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Management plan</td><td>10,000</td></tr>
<tr><td>Fencing (15.6km)</td><td>64,400</td></tr>
<tr><td>Native planting (4ha)</td><td>158,208</td></tr>
<tr><td>Weed control</td><td>58,800</td></tr>
<tr><td>Possum control</td><td>51,000</td></tr>
<tr><td>Project Management/staffing/incidentals (20%)</td><td>68,482</td></tr>
<tr><td>Total</td><td>410,890</td></tr>
</table>
</td>
<td>C = 0.41</td>
</tr>
</table>



Biodiversity restoration within lowland kahikatea fragments in the Mangapū catchment

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.0 0.4 0.8 1.2 1.6 2.0
Kilometers

Scale 1:40,000@A4 Landscape

A4

Waikato REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

Kahikatea forest fragments in the Mangapū River catchment.

WP 23 Priority: High	Mangaokewa Stream erosion protection and remediation	BCR value
Relevant unit goal(s)	River margins prone to significant erosion are managed to minimise erosion risk, whilst enhancing aquatic habitat and retaining the natural character of river systems. Riparian planting of preferably indigenous species is undertaken to stabilise riverbanks, reduce erosion and enhance terrestrial and aquatic biodiversity. Water quality is such that waters within the catchment are swimmable and safe to take food from in all places.	
Name of feature	Mangaokewa Stream	
Brief description of feature	A 23km reach of stream which flows from the Viaduct Reserve through the Te Kūiti township to the confluence with the Mangapū River at Hangatiki. The stream is relatively incised in places with steep banks that are susceptible to slumping. Approximately 6.6km of the stream lies within the township. Te Araroa walkway follows alongside the upper Mangaokewa from the viaduct reserve to the Te Kūiti township. There is native planting and erosion control associated with this pathway. There has been flood control works undertaken on the river through the urban area of Te Kūiti to reduce the risk of the township flooding. This included the creation of a larger floodway. Any works within this reach would need an assessment undertaken on the impact on flood levels and flood control infrastructure. There has been isolated catchment and river management works undertaken to address streambank erosion at ad hoc sites throughout the reach. There has been some privately funded fencing and native planting along this reach of stream. This extends for about 1km of bank. Waikato Regional Council monitoring of the Mangaokewa Stream at Te Kūiti indicates that the stream is not swimmable due to unsatisfactory levels of E. coli, and has unsatisfactory water clarity. The Maniapoto Maori Trust Board has recently developed a Cultural Health Index (CHI) for this river.	
Desired state to achieve the Vision & Strategy	- A 23km stretch of river with stable, vegetated banks and where major erosion events are limited. - A riparian margin that is fenced to exclude stock with a minimum 5m setback, and is well vegetated with native plants and exotic plants where required to prevent erosion. - Native fish are abundant and there is a wide diversity of species present - The river is swimmable, fishable, safe for gathering kai, and has access for recreation.	

<table>
<tr><td></td><td>- Iwi and communities have a strong connection to the river and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Mangaokewa Stream would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 12</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Riverbank erosion</td><td>Estimated to yield approximately 2700 tonnes of sediment per year to the Waipā River, excluding major flood events.</td></tr><tr><td>Stock access to the river</td><td>Reduced water quality and trampling of banks and destruction of riparian vegetation.</td></tr><tr><td>De-vegetated banks</td><td>Bank slumping and increased sediment to water.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 10 years of project commencement:
- A 23km reach of the Mangaokewa River is stable, fenced (5m setback) and vegetated along its entire length providing increased shade, shelter and food for native fish.
- Stock is 100% excluded from the Mangaokewa River.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

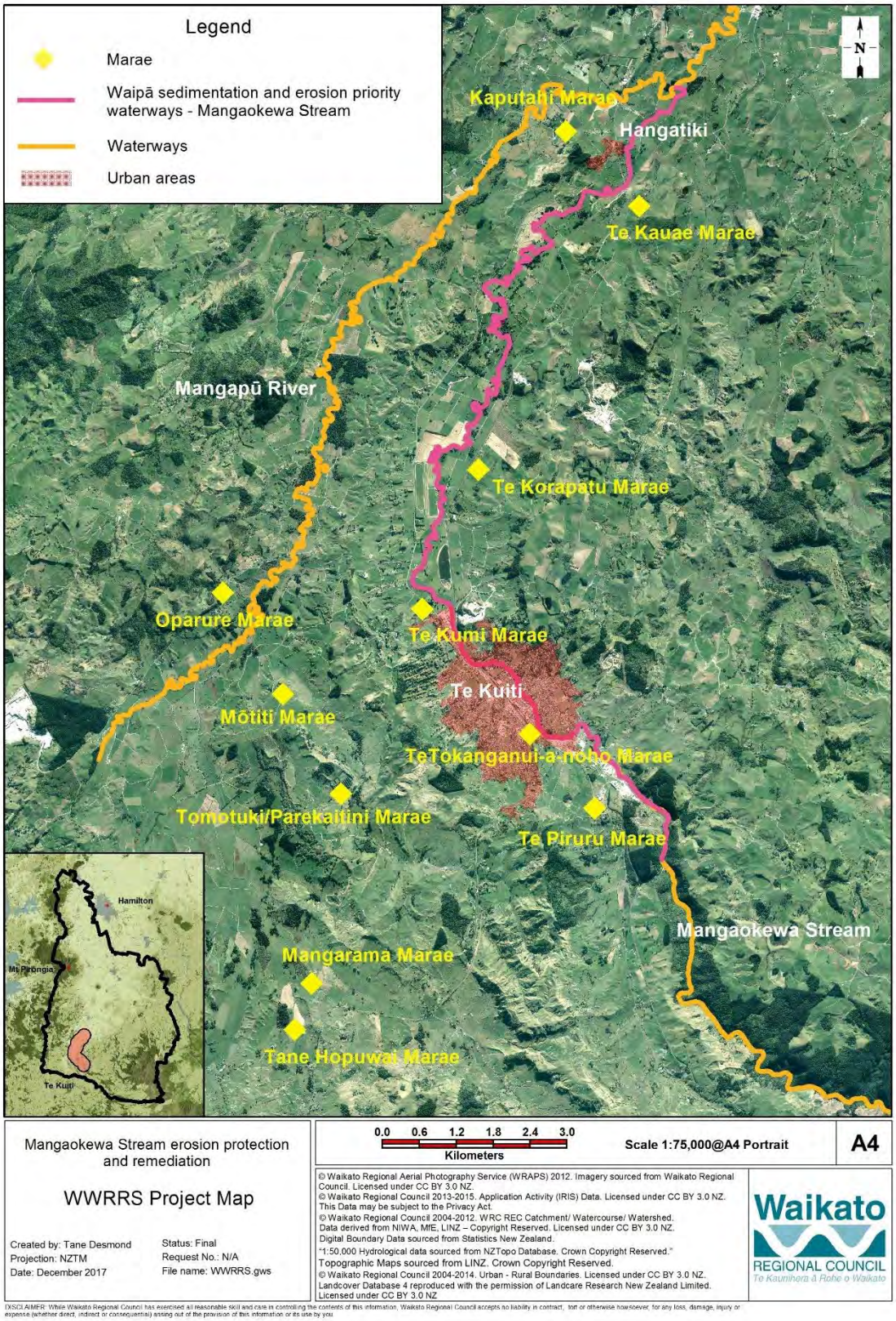
River erosion protection and remediation
- It is estimated that 23km of stream is likely to require soft (vegetation) structures throughout at a frequency of 2 per km ($5000 per km) ($115,000).
- Based on aerial photographs and on-the-ground knowledge of the reach it is estimated that approximately 15% (or 3.5km) of the lower reach would require willow/poplar management at a rate of $20 per metre ($70,000).
- Willow disposal is estimated to cost $14,000.

Activities such as willow removal, installation of erosion protection structures, installation of woody debris and any earthworks associated with these actions may require resource consent from Waikato Regional Council. Council’s Integrated Catchment Management division hold an existing consent for much of this type on work on this waterway and therefore anyone proposing to undertake river management works should discuss this with council staff during project planning.

Riparian fencing and planting
- It is assumed that 46% of the streambank will require fencing with a 5-wire (2 electric) fence. This equates to 21.2km of streambank ($169,000). This should have a minimum of a 5m</td><td></td></tr>
</table>

	setback from the top of the bank and include adjoining wetland areas. - Riparian planting should be a mix of native species with exotics where required for stability. It is estimated that willow/poplar poles would be required at 15m intervals over 23km of streambank length (1533 poles is $21,462). - Native planting should be a 5m margin on both sides of the stream for 21.2km of bank length, so 10.6ha ($398,051). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately one year after project completion.	L = 11
Effectiveness of works	The Mangaokewa Stream is currently in poor to moderate condition with few of the Vision & Strategy desired state aspects being met. The stream is not swimmable and stock still have access in places. However, the Mangaokewa still retains important values and is of high cultural significance for iwi. It is expected that over the next 20 years there may be some deterioration in the river in the absence of this project. Works included here focus on the threats to the feature's banks but would have secondary benefits of reducing E. coli to water, nutrient attenuation and improving fish habitat. It is anticipated that if the project is fully completed, the stability of the riverbanks in this reach will be in significantly improved condition and progress will be made towards the Vision & Strategy state being achieved in 20 years' time. The project does not fully address catchment land use, water quality or biodiversity threats.	W = 0.15
Risk of technical failure	There is a low risk of project failure due to technical feasibility if appropriately experienced practitioners are undertaking/advising on the more technical aspects of the project. Risks are mostly related to establishment of plantings or loss of works due to flooding. Techniques are well established and have been used previously on other local streams. River erosion structures should be designed by an appropriately qualified practitioner.	F = 0.9
Adoptability	It is estimated that at least half of landowners would adopt the works if they were fully incentivised. The extent of the fencing setbacks may provide some challenge in terms of uptake, and some landowners may be concerned about maintenance of fences following floods. However, this should be minimised once plantings mature. There are limited examples of this type of	A = 0.54

<table>
<tr><td></td><td>work along the Mangaokewa and adoptability may be increased by working with key landowners to establish example sites.</td><td></td></tr>
<tr><td>Information quality</td><td>Good – advice of local expert/s with a history of association to the stream and experience in undertaking similar works.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>It is unknown specifically how much fencing already exists and estimates are based on Waipā catchment riparian surveys. This information would need to be collected in the early stages of the project. Specific locations for erosion control structures would need to be determined during preliminary site visits.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>River erosion management and protection</td><td>115,000</td></tr>
<tr><td>Willow/poplar management (3.5km)</td><td>70,000</td></tr>
<tr><td>Willow/poplar disposal</td><td>14,000</td></tr>
<tr><td>Fencing (21.2km)</td><td>169,000</td></tr>
<tr><td>Willow/poplar pole planting (1533 poles)</td><td>21,462</td></tr>
<tr><td>Native planting (10.6ha)</td><td>398,051</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>196,878</td></tr>
<tr><td>Total</td><td>$984,391</td></tr>
</table>
</td><td>C = 0.98</td></tr>
</table>


Legend
Marae
Waipā sedimentation and erosion priority waterways - Mangaokewa Stream
Waterways
Urban areas
N
Kaputahi Marae
Hangatiki
Te Kauae Marae
Mangapū River
Te Korapatu Marae
Oparure Marae
Te Kumi Marae
Te Kuiti
Motiti Marae
TeTokanganui-a-noho Marae
Tomotuki/Parekaitini Marae
Te Piruru Marae
Mangaokewa Stream
Mangarama Marae
Tane Hopuwai Marae
Hamilton
Mt Pirongia
Te Kuiti
Mangaokewa Stream erosion protection and remediation
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
0.0 0.6 1.2 1.8 2.4 3.0
Kilometers
Scale 1:75,000@A4 Portrait
A4
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Mangaokewa Stream during a small flood showing unstable banks and limited riparian margins.

<table>
<tr><td>WP 24

Priority: Medium</td><td>Mangarapa catchment erosion protection and remediation</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>The appropriate management of steep and erosion prone land is promoted and incentivised.

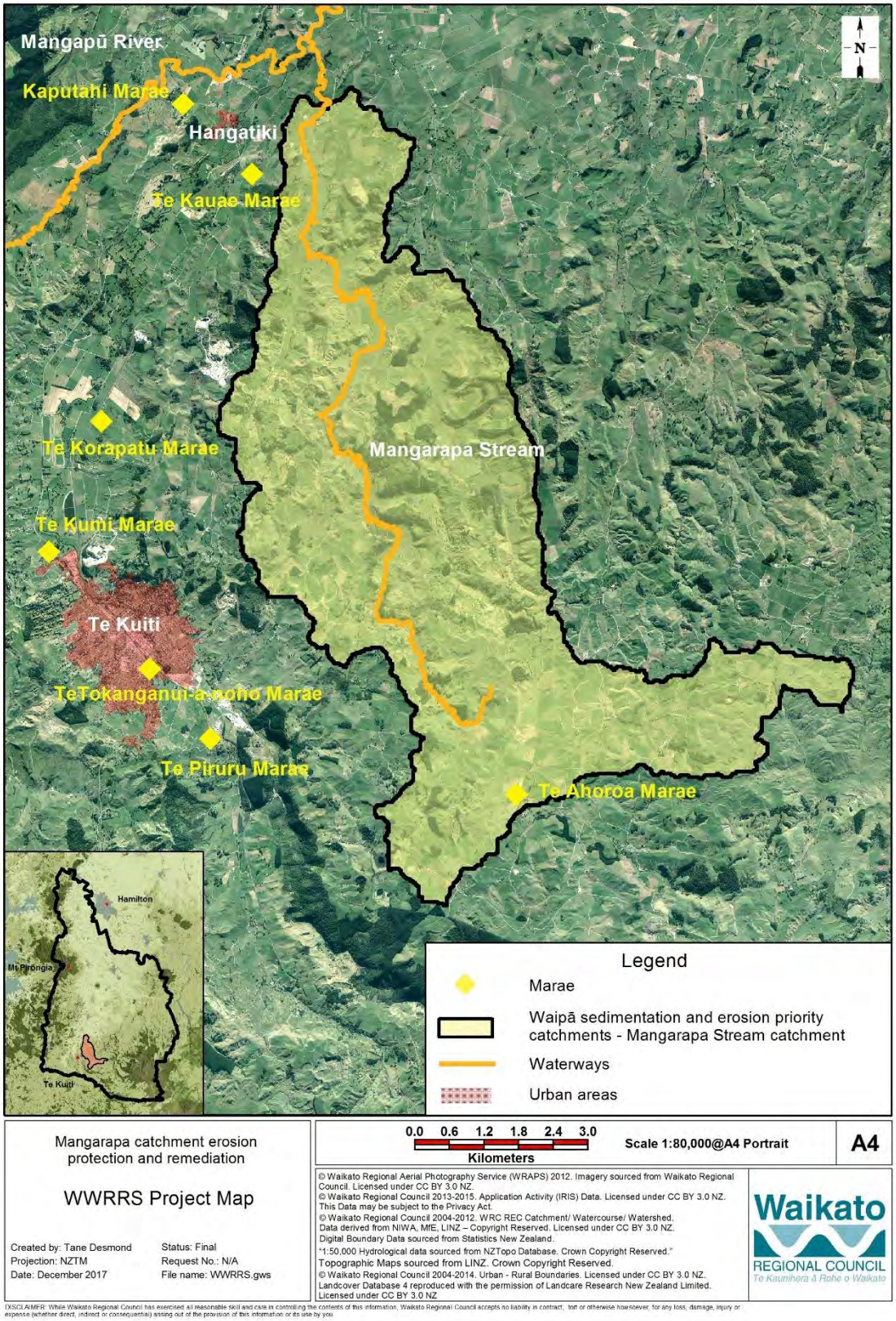
Water quality is such that waters within the catchment are swimmable and safe to take food from in all places.

Land uses are being adapted to match the capability of the land.</td><td></td></tr>
<tr><td>Name of feature</td><td>Mangarapa subcatchment</td><td></td></tr>
<tr><td>Brief description of feature</td><td>A 5306ha catchment situated to the south of Ōtorohanga and east of Te Kūiti. Approximately 2678ha of land is LUC 6e or 7 in pasture and the catchment has been identified as a priority sediment catchment in the Waipā Catchment Plan. The land use is a mixture of dairy, dairy support and dry stock with small areas of woodlot forestry (2% of the catchment), primarily pine. Approximately 8% of the catchment is in indigenous cover. The main waterway in this catchment is the Mangarapa Stream.

The catchment area provided natural resources to tāngata whenua for many purposes including rongoā (medicine), kākahu (clothing) and kai (food). An historic village, named Te Tarata, sat at the confluence of the Mangarapa and Mangaokewa.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- A subcatchment where land use matches capability and where the stream has a riparian margin that is well vegetated with native plants and at least 5m wide.
- The stream is swimmable, fishable and has access where appropriate for recreation.
- Iwi and communities have a strong connection to the catchment and its waterways, and are active in their use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Mangarapa subcatchment would have a high impact on giving effect to the Vision & Strategy at a Waipā catchment level.</td><td>VS = 100</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Hill country erosion</td><td>Estimated to yield more than 3400 tonnes of sediment per year to the Waipā River</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>There is a 25% reduction in suspended sediment in the Mangarapa Stream within 15 years of project commencement.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their</td><td></td></tr>
</table>

	own labour). This project could be undertaken as a whole, or in multiple smaller components. **Hill country soil conservation** - 325ha LUC 6e managed with open space pole planting at $3000 per hectare ($975,000). - 325ha LUC 6e managed with plantation species (pine or mānuka) at $3000 per hectare ($975,000). - 54km of fencing the managed LUC 6e land at $20 per metre (8-wire and batten) ($1,080,000). - 78ha LUC 7 managed with plantation species (pine or mānuka) at $3000 per hectare ($234,000). - 14km of fencing managed LUC 7 land at $20 per metre (8-wire and batten) ($280,000). - 18.5ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $5000 per ha (e.g. dewatering, retiring seepages etc) ($92,500). - 14.5km fencing existing indigenous vegetation at $25 per metre (8-wire and batten) ($362,500). - 27 hunter days per year for 3 years of goat control while plantings on 6e and 7 establish. Control carried out over a 2700ha area. **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 13-14 years after project commencement.	L = 18
Effectiveness of works	The Mangarapa subcatchment is in moderate to poor condition when compared to desired state, with few of the Vision & Strategy aspirations being met. It is expected that over the next 20 years there may be a deterioration in the condition of the catchment in the absence of this project. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy. However, works included in this project address some of the key threats to the feature and it is anticipated that if the project is fully completed it would offset anticipated decline and make some headway with respect to achieving the Vision & Strategy state in 20 years' time. The project does not directly address all threats to the Mangarapa, however the proposed fencing and	W = 0.2

<table>
<tr><td></td><td>planting works would provide secondary benefits of reducing E. coli to waterways and improving fish habitat and biodiversity.</td><td></td></tr>
<tr><td>Risk of technical failure</td><td>Risks are mostly related to establishment of plantings or loss of works due to severe erosion before they are established. However, proposed management actions are widely used and accepted for managing hill country erosion. There is a moderate risk of project failure due to technical feasibility.</td><td>F = 0.87</td></tr>
<tr><td>Adoptability</td><td>It is estimated that about 20% of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low and we are not aware of significant similar works being undertaken in this catchment to date. Early community engagement and identifying key farmers will be very important for the success of this project.</td><td>A = 0.2</td></tr>
<tr><td>Information quality</td><td>Average – estimates are based on modelled information and input from catchment officers who are familiar with the subcatchment.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>Estimates of LUC classes 6e, 7 and 8 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>15 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td>
<table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Pole planting erosion prone LUC class 6e land (325ha)</td><td>975,000</td></tr>
<tr><td>Plantation species on erosion prone LUC class 6e land (325ha)</td><td>975,000</td></tr>
<tr><td>Fencing managed LUC class 6e land (54km)</td><td>1,080,000</td></tr>
<tr><td>Plantation species on erosion prone LUC class 7 land (78ha)</td><td>234,000</td></tr>
<tr><td>Fencing managed LUC class 7 land (14km)</td><td>280,000</td></tr>
<tr><td>Erosion outside LUC class 6e, 7 and 8 land (18.5ha)</td><td>53,600</td></tr>
<tr><td>Fencing indigenous forest bordering LUC class 6e land (14.5km)</td><td>362,500</td></tr>
<tr><td>Goat control on treated LUC class 6e and 7 land</td><td>33,048</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>998,287</td></tr>
<tr><td>Total</td><td>$4,991,435</td></tr>
</table>
</td><td>C = 5.19</td></tr>
</table>


Mangapū River
Kaputahi Marae
Hangatiki
Te Kauae Marae
Te Korapatu Marae
Mangarapa Stream
Te Kumi Marae
Te Kuiti
TeTokanganui-a-noho Marae
Te Piruru Marae
Te Ahoroa Marae
N
Hamilton
Mt Pirongia
Te Kuiti
Legend
Marae
Waipā sedimentation and erosion priority catchments - Mangarapa Stream catchment
Waterways
Urban areas
0.0 0.6 1.2 1.8 2.4 3.0
Kilometers
Scale 1:80,000@A4 Portrait
A4
Mangarapa catchment erosion protection and remediation
WWRRS Project Map
Created by: Tane Desmond
Projection: NZTM
Date: December 2017
Status: Final
Request No.: N/A
File name: WWRRS.gws
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Examples of general topography of the Mangarapa catchment.

Mass movement and slips.

Examples of erosion protection pole planting, above, and areas of plantation species, below (from the Mangapū/Mangaokewa catchments).

<table>
<tr><td>WP 25

Priority: Medium</td><td>Mangatea catchment erosion protection and remediation</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>The appropriate management of steep and erosion prone land is promoted and incentivised.

Water quality is such that waters within the catchment are swimmable and safe to take food from in all places.

Land uses are being adapted to match the capability of the land.</td><td></td></tr>
<tr><td>Name of feature</td><td>Mangatea subcatchment</td><td></td></tr>
<tr><td>Brief description of feature</td><td>A 1326ha catchment situated in the upper Mangapū subcatchment southwest of Te Kūiti. Approximately 615ha of land is LUC 6e or 7 in pasture and the catchment has been identified as a priority sediment catchment in the Waipā Catchment Plan. The land use is a mixture of dairy, dairy support and dry stock with small areas of woodlot forestry, primarily pine (1% of catchment). 7% of the catchment is in indigenous cover. The main waterway in this catchment is the Mangatea Stream.

There are two marae situated alongside the Mangatea stream.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- A subcatchment where land use matches capability.
- Waterways with a riparian margin that is fenced to exclude stock with a minimum 5m setback, and is well vegetated with native plants and exotic plants where required to prevent erosion.
- Native fish are abundant and there is a wide diversity of species present.
- The river is swimmable, fishable, safe for gathering kai, and has access for recreation.
- Iwi and communities have a strong connection to the river and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Mangatea Stream would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 15</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Hill country erosion</td><td>Estimated to yield more than 2600 tonnes per year of sediment to the Waipā River.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>There is a 25% reduction in suspended sediment in the Mangatea Stream within 15 years of project commencement.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.</td><td></td></tr>
</table>

	Hill country soil conservation - 76ha LUC 6e managed with open space pole planting at $3000 per hectare ($228,000). - 76ha LUC 6e managed with plantation species (pine or mānuka) at $3000 per hectare ($228,000). - 14km of fencing the managed LUC 6e land at $20 per metre (8-wire and batten) ($280,000). - 5ha LUC 7 managed with plantation species (pine or mānuka) at $3000 per hectare ($15,000). - 2km of fencing the managed LUC 7 land at $20 per metre (8-wire and batten) ($40,000). - 12.4ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $5000 per hectare (e.g. dewatering, retiring seepages etc.) ($62,000). - 6 hunter days per year for 3 years of goat control while plantings on LUC 6e and 7 land establish. Control carried out over a 600ha area. - 3.4km fencing existing indigenous vegetation at $25 per metre (8-wire and batten) ($85,000). **Project management/staffing/incidentals** Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 10-year period, it is estimated that the majority of the project benefits would be seen approximately one year after project completion.	L = 11
Effectiveness of works	The Mangatea subcatchment is in poor to moderate condition with some of the Vision & Strategy desired state aspects being met. It is expected that over the next 20 years there may be a deterioration in the condition of the catchment in the absence of this project. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy. However, works included in this project address some of the key threats to the feature and it is anticipated that if the project is fully completed it would offset anticipated decline and make some headway with respect to achieving the Vision & Strategy state in 20 years' time. The project does not directly address all threats to the Mangatea, however the proposed fencing and planting works would provide secondary benefits to reducing E. coli to waterways and improving fish habitat and biodiversity.	W = 0.275
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding.	F = 0.82

<table>
<tr><td>Adoptability</td><td>It is estimated that about a quarter of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low and we are not aware of significant similar works being undertaken in this catchment to date. Early community engagement and identifying key farmers will be very important for the success of this project.</td><td>A = 0.225</td></tr>
<tr><td>Information quality</td><td>Average – based on modelled information and local expert knowledge.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>Estimates of LUC classes 6e, 7 and 8 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>10 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Pole planting erosion prone LUC class 6e land (76ha)</td><td>228,000</td></tr>
<tr><td>Plantation species on erosion prone LUC class 6e land (76ha)</td><td>228,000</td></tr>
<tr><td>Fencing managed LUC class 6e land (14km)</td><td>280,000</td></tr>
<tr><td>Plantation species on erosion prone LUC class 7 land (5ha)</td><td>15,000</td></tr>
<tr><td>Fencing managed LUC class 7 land (2km)</td><td>40,000</td></tr>
<tr><td>Erosion outside LUC class 6e, 7 and 8 land (12.4ha)</td><td>62,000</td></tr>
<tr><td>Fencing indigenous forest remnants 3.4km)</td><td>85,000</td></tr>
<tr><td>Goat control on treated LUC class 6e and 7 land</td><td>7344</td></tr>
<tr><td>Project management/staffing/incidentals (25%)</td><td>236,336</td></tr>
<tr><td>Total</td><td>$1,181,680</td></tr>
</table></td><td>C = 1.18</td></tr>
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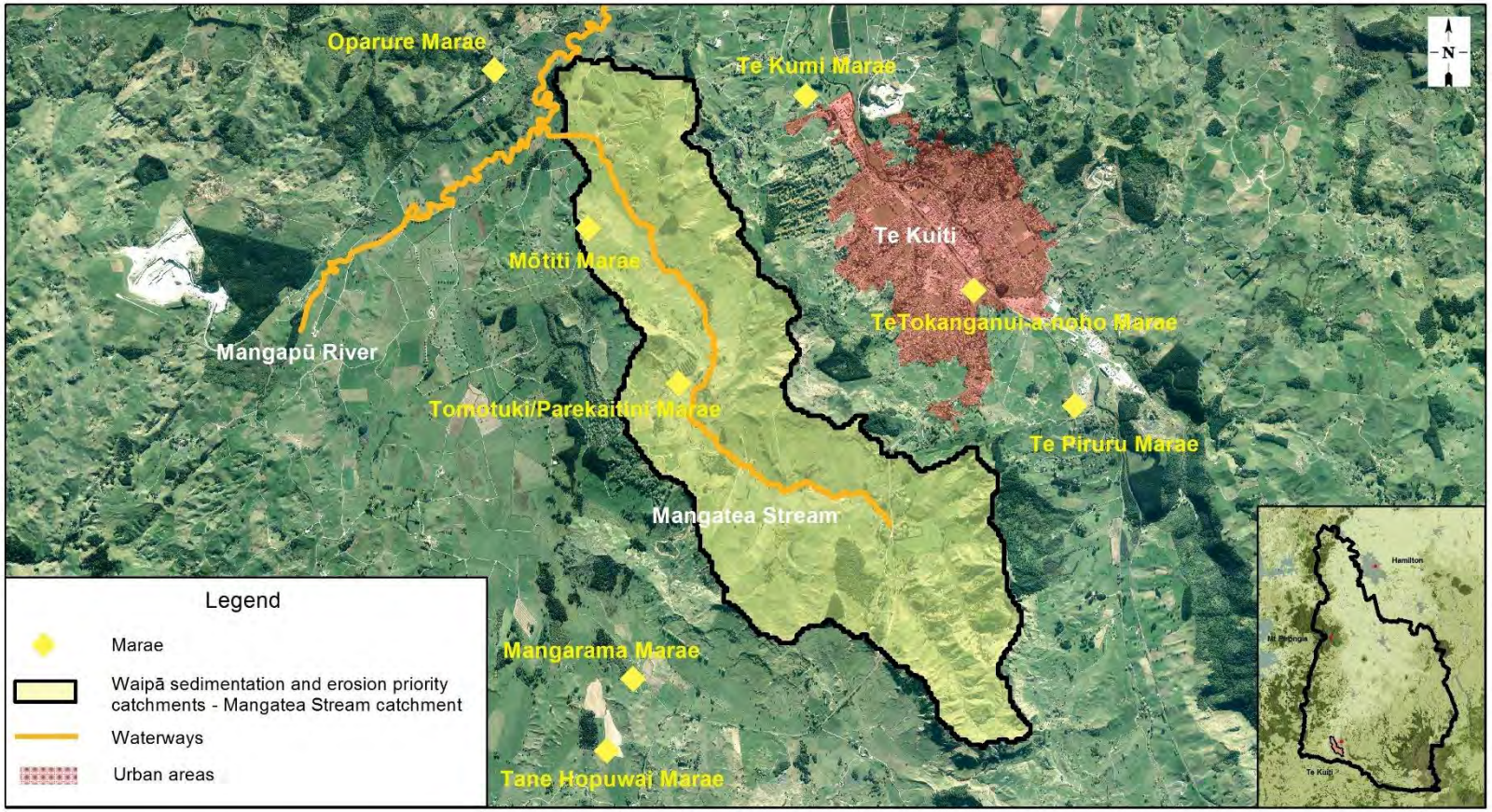

Mangatea catchment erosion protection and remediation

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.0 0.6 1.2 1.8 2.4 3.0
Kilometers

Scale 1:55,000@A4 Landscape

A4

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Shallow soil slip (rear), mass land movement (middle) and stabilisation poplar planting (foreground),

<table>
<tr><td>WP 26

Priority: Medium</td><td>Mangarama catchment erosion protection and remediation</td><td>BCR value</td></tr>
<tr><td>Relevant unit goal(s)</td><td>The appropriate management of steep and erosion prone land is promoted and incentivised.

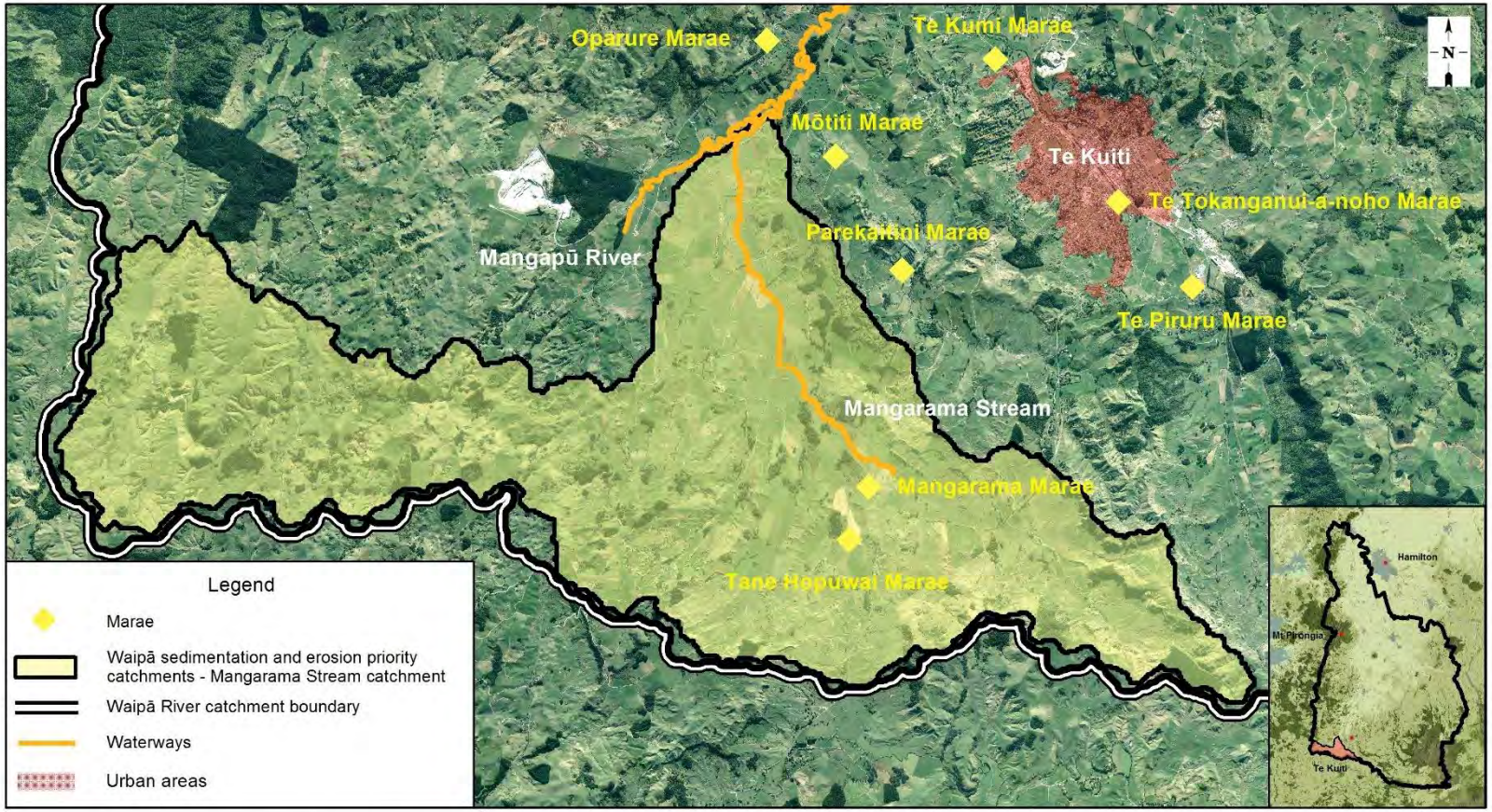
Water quality is such that waters within the catchment are swimmable and safe to take food from in all places.

Land uses are being adapted to match the capability of the land.</td><td></td></tr>
<tr><td>Name of feature</td><td>Mangarama Catchment</td><td></td></tr>
<tr><td>Brief description of feature</td><td>A 5439ha catchment situated southwest of Te Kūiti. This is adjacent to the Mangatea catchment in the southwest corner of the Waipā catchment. Approximately 2428ha of land is LUC 6e or 7 in pasture and the catchment has been identified as a priority sediment catchment in the Waipā Catchment Plan. The land use is a mixture of dairy, dairy support and dry stock with small areas of woodlot forestry, primarily pine (1.5% of the catchment). Approximately 6% of the catchment is in indigenous cover.

The main waterway in this catchment is the Mangarama Stream.</td><td></td></tr>
<tr><td>Desired state to achieve the Vision & Strategy</td><td>- A subcatchment where land use matches capability and waterways have a riparian margin that is fenced with a minimum 5m setback to exclude stock, and is vegetated with native plants and exotic plants where required to prevent erosion.
- Native fish are abundant and there is a wide diversity of species present
- The river is swimmable, fishable, safe for gathering kai, and has access for recreation.
- Iwi and communities have a strong connection to the river and are active in its use, protection and restoration.</td><td></td></tr>
<tr><td>Impact on Vision & Strategy</td><td>In a restored condition the Mangarama subcatchment would have a very high impact on giving effect to the Vision & Strategy at a local level.</td><td>VS = 25</td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td><table><tr><th>Key threat</th><th>Impact on feature</th></tr><tr><td>Hill country erosion</td><td>Estimated to yield approximately 3200 tonnes of sediment per year to the Waipā River.</td></tr></table></td><td></td></tr>
<tr><td>Project goal/s</td><td>There is a 25% reduction in suspended sediment in the Mangarama Stream within 15 years of project commencement.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.</td><td></td></tr>
</table>

	Hill country soil conservation - 264ha LUC 6e managed with open space pole planting at $3000 per hectare ($792,000) - 264ha LUC 6e managed with plantation species (pine or mānuka) at $3000 per hectare ($792,000) - 42km of fencing managed LUC 6e land at $20 per metre (8-wire and batten) ($840,000) - 315ha LUC 7 managed with plantation species (pine or mānuka) at $3000 per hectare ($945,000) - 31km of fencing managed LUC 7 land at $20 per metre (8-wire and batten) ($620,000) - 3.1ha reducing sediment to waterways outside LUC class 6e, 7 and 8 land at $5000 per hectare (e.g. dewatering, retiring seepages etc) ($15,500) - 25 hunter days per year for 3 years of goat control while plantings on LUC class 6e and 7 land establish. Control carried out over a 2500ha area. - 6.2km fencing existing indigenous vegetation at $25 per metre (8-wire and batten) ($155,000) Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees. This is estimated to be 25% of the direct project costs.	
Time lag for benefits to be realised	If works were implemented at an even pace over a 15-year period, it is estimated that the majority of the project benefits would be seen approximately 14 years after the project began.	L = 13.5
Effectiveness of works	The Mangarama subcatchment is in poor to moderate condition with some of the Vision & Strategy desired state aspects being met. It is expected that over the next 20 years there may be a deterioration in the condition of the catchment in the absence of this project. It is acknowledged that achieving the Vision & Strategy desired state will take longer than the 20 year horizon used for the purposes of the Restoration Strategy. However, works included in this project address some of the key threats to the feature and it is anticipated that if the project is fully completed it would offset anticipated decline and make some headway with respect to achieving the Vision & Strategy state in 20 years' time. The project does not directly address all threats to the Mangarama, however the proposed fencing and planting works would provide secondary benefits of reducing E. coli to waterways and improving fish habitat and biodiversity.	W = 0.3
Risk of technical failure	There is a moderate risk of project failure due to technical feasibility. Risks are mostly related to establishment of plantings or loss of works due to flooding or erosion.	F = 0.82

<table>
<tr><td>Adoptability</td><td>It is estimated that about a quarter of landowners would adopt the works if they were fully incentivised. Uptake of management of LUC class 6e and 7 land may be low and we are not aware of significant similar works being undertaken recently in this catchment. Early community engagement, flexibility of approach and identifying key farmers will be very important for the success of this project.</td><td>A = 0.225</td></tr>
<tr><td>Information quality</td><td>Average – based on modelled information and local expert knowledge.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>Estimates of LUC classes 6e, 7 and 8 come from a desktop exercise. Farm scale information will need to be gathered as part of this project.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>There is a low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.85</td></tr>
<tr><td>Project duration (years)</td><td>15 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table>
<tr><th>Task</th><th>Cost ($)</th></tr>
<tr><td>Pole planting erosion prone LUC class 6e land (264ha)</td><td>792,000</td></tr>
<tr><td>Plantation species on erosion prone LUC class 6e land (264ha)</td><td>792,000</td></tr>
<tr><td>Fencing managed LUC class 6e land (42km)</td><td>840,000</td></tr>
<tr><td>Plantation species on erosion prone LUC class 7 land (315ha)</td><td>945,000</td></tr>
<tr><td>Fencing managed LUC class 7 land (31km)</td><td>620,000</td></tr>
<tr><td>Erosion outside LUC class 6e, 7 and 8 land (3.1ha)</td><td>15,500</td></tr>
<tr><td>Fencing indigenous forest remnants (6.2km)</td><td>155,000</td></tr>
<tr><td>Goat control on treated LUC class 6e and 7 land</td><td>30,600</td></tr>
<tr><td>Project management, staffing/incidentals (25%)</td><td>1,047,525</td></tr>
<tr><td>Total</td><td>5,237,625</td></tr>
</table></td><td>C = 5.45</td></tr>
</table>



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An example of the type of erosion common in the Mangarama catchment.

An example of the type of works proposed for this project – afforestation and pole planting for soil stabilisation.

WP 27 Priority: High	Biodiversity restoration of priority sites in the upper Waipā catchment	BCR value
Relevant unit goal(s)	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. Where possible, the natural functioning of floodplains and other ephemeral wetland sites is restored and maintained. Wetlands are created or protected and actively managed to enhance multiple functions.	
Name of feature	Upper Waipā River forest remnants, wetlands and associated tributary streams.	
Brief description of feature	A range of biodiversity sites in the upper Waipā River catchment in the vicinity of the Rangitoto Range. Sites include 1054ha of forest remnants, 380ha wetland/riparian site and a 1.7km long tributary waterway. Land ownership is predominantly private with the exception of the 247ha size Otoru Scenic Reserve and Pekepeke Wetland (Waipā Myers) area, both of which are owned by Department of Conservation. The upper Waipā is of high significance to iwi and its marae as it holds water of the highest quality, generally used for the most important ceremonies. The puna (springs) of the upper Waipā flow to the main stem, forming and shaping the rest of the catchment area and sustaining the many marae along its banks. Sites included here have been identified as being within the top 30% of terrestrial biodiversity sites within the Waikato catchment because of their terrestrial biodiversity values and representativeness of this ecosystem type. One exception to this is the Waipā tributary stream which has been identified as within the top 40% of waterway sites for biodiversity.	
Desired state to achieve the Vision & Strategy	- Forest remnants and wetlands adjacent to the upper Waipā River are densely vegetated with native plant species, connected to riparian corridors and protected from stock grazing. - Native plant regeneration occurs naturally within the forest remnants. - Iwi and communities have a strong connection to the sites and are active in their use, protection and restoration.	
Impact on Vision & Strategy	In a restored condition, the upper Waipā River adjacent forest remnants, wetlands and associated tributary streams would	VS = 30

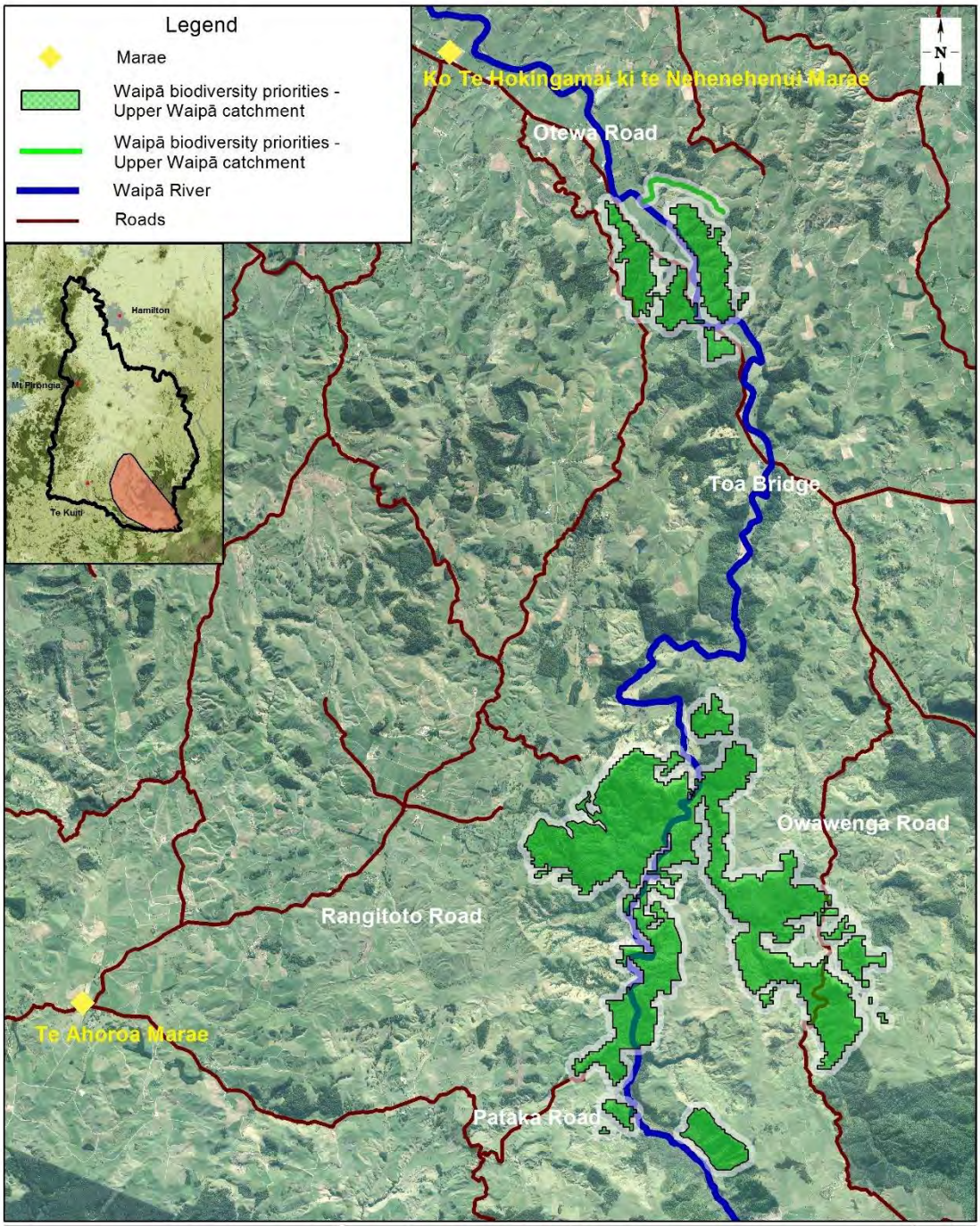
<table>
<tr><td></td><td>have a high impact on giving effect to the Vision & Strategy at a Waipā catchment level.</td><td></td></tr>
<tr><td>Key threats to the feature that this project addresses</td><td>
<table>
<tr><th>Key threat</th><th>Impact on the feature</th></tr>
<tr><td>Further fragmentation of forest fragments</td><td>Affects the viability of the forest fragment through increasing edge effects, increasing potential for weed and animal pest invasion. Also reduces the habitat available for native species.</td></tr>
<tr><td>Stock access to native forest fragments</td><td>Stock prevent native regeneration and open up areas to plant pests.</td></tr>
<tr><td>Lack of riparian vegetation and stock access to riparian areas</td><td>Water quality impacts and reduction in in-stream biodiversity.</td></tr>
<tr><td>Pest willow trees</td><td>Shade out native vegetation.</td></tr>
</table>
</td><td></td></tr>
<tr><td>Project goal/s</td><td>Within 6 years of the project commencing:
- Forest remnants and wetlands identified are fully fenced to exclude stock.
- The Waipā River tributary waterway identified is fenced to exclude stock with a minimum 5 wire (2 electric) fence and a riparian margin at least 5m wide. Native planting (and associated weed control) is carried out within the riparian margin at 1.5m spacing.
- The waterway flowing from Waipā Myers wetland is free from willow pests and has a naturally regenerating native riparian margin.</td><td></td></tr>
<tr><td>Priority works for funding</td><td>Suggested works could be implemented either by an organisation or private citizens (using contractors or their own labour). This project could be undertaken as a whole, or in multiple smaller components.

Further investigation is required to determine the exact amount of fencing and planting and weed control required. However, based on aerial photographs and local knowledge the following estimates and assumptions have been made:
- Otoru Scenic Reserve and adjoining forest fragment – 2km of post and batten fencing required at $20 per metre ($40,000).
- Other forest remnants – 18km of post and batten fencing required at $20 per metre ($360,000).
- Waipā River tributary stream (1.6km long) – 1.2km (75%) of 5 wire fencing (2 wire electric) required at a cost of $8 per metre ($9,600); 0.75ha of native riparian planting required at a cost of $37,552 per hectare including site preparation, plant purchase, planting labour and five releasing events ($28,164).
- The waterway flowing downstream from Pekepeke (Waipā Myers) Wetland requires approximately 1.5ha of ground</td><td></td></tr>
</table>

<table>
<tr><td></td><td>based willow control along its margins ($4000 per hectare is $6000) plus a further two to three years of followup treatment at $2000 per hectare ($6000).

Project management/staffing/incidentals
Staff to carry out landowner liaison, iwi engagement, Health and Safety requirements, negotiate agreements, inspect works, manage parts of the work as required (e.g. fencing or planting), project reporting and financial management. Incidentals include transport, office overheads, consumables and miscellaneous professional fees.

This is estimated to be 20% of the direct project costs.</td><td></td></tr>
<tr><td>Time lag for benefits to be realised</td><td>If works were implemented at an even pace over a 5-year period, it is estimated that the majority of the project benefits would be seen within 1 year of project completion.</td><td>L = 5.5</td></tr>
<tr><td>Effectiveness of works</td><td>The upper Waipā River adjacent forest remnants, wetlands and associated tributary streams are currently in very good condition with some of the Vision & Strategy desired state aspects already being met, including being accessible in some circumstances and the streams and wetlands swimmable and fishable. Condition is not expected to significantly decline or improve over the next 20 years in the absence of this project. However, if this project is successfully completed then these sites are expected to be in very good condition and closer to desired state in 20 years' time, with aspects related to stock exclusion and native revegetation being addressed.</td><td>W = 0.025</td></tr>
<tr><td>Risk of technical failure</td><td>Risks are mostly related to establishment of plantings. There is a low risk of project failure due to technical feasibility.</td><td>F = 0.92</td></tr>
<tr><td>Adoptability</td><td>It is estimated that about two thirds of landowners would adopt the works if they were fully incentivised.</td><td>A = 0.65</td></tr>
<tr><td>Information quality</td><td>Good information – advice of local expert/s with a history of association to selected sites.</td><td></td></tr>
<tr><td>Knowledge gaps and response</td><td>Further investigation is required to determine the specific quantities of fencing and planting required. This should be undertaken during the early stages of project planning.</td><td></td></tr>
<tr><td>Socio-political risks</td><td>Very low risk that the project will fail to meet its goals over the long term due to socio-political risks.</td><td>P = 0.97</td></tr>
<tr><td>Project duration (years)</td><td>5 years</td><td></td></tr>
<tr><td>Up-front cost – total for implementation phase/project duration</td><td><table><tr><th>Task</th><th>Cost ($)</th></tr><tr><td>Fencing (21.2km)</td><td>409,600</td></tr><tr><td>Native planting (0.75ha)</td><td>28,164</td></tr><tr><td>Ground based willow control</td><td>12,000</td></tr><tr><td>Project Management/staffing/incidentals (20%)</td><td>89,953</td></tr><tr><td>Total</td><td>539,717</td></tr></table></td><td>C = 0.54</td></tr>
</table>



Biodiversity restoration of priority sites in the Upper Waipā catchment Map 1/2

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name: WWRRS.gws

0.0 0.6 1.2 1.8 2.4 3.0
Kilometers

Scale 1:75,000@A4 Portrait

A4

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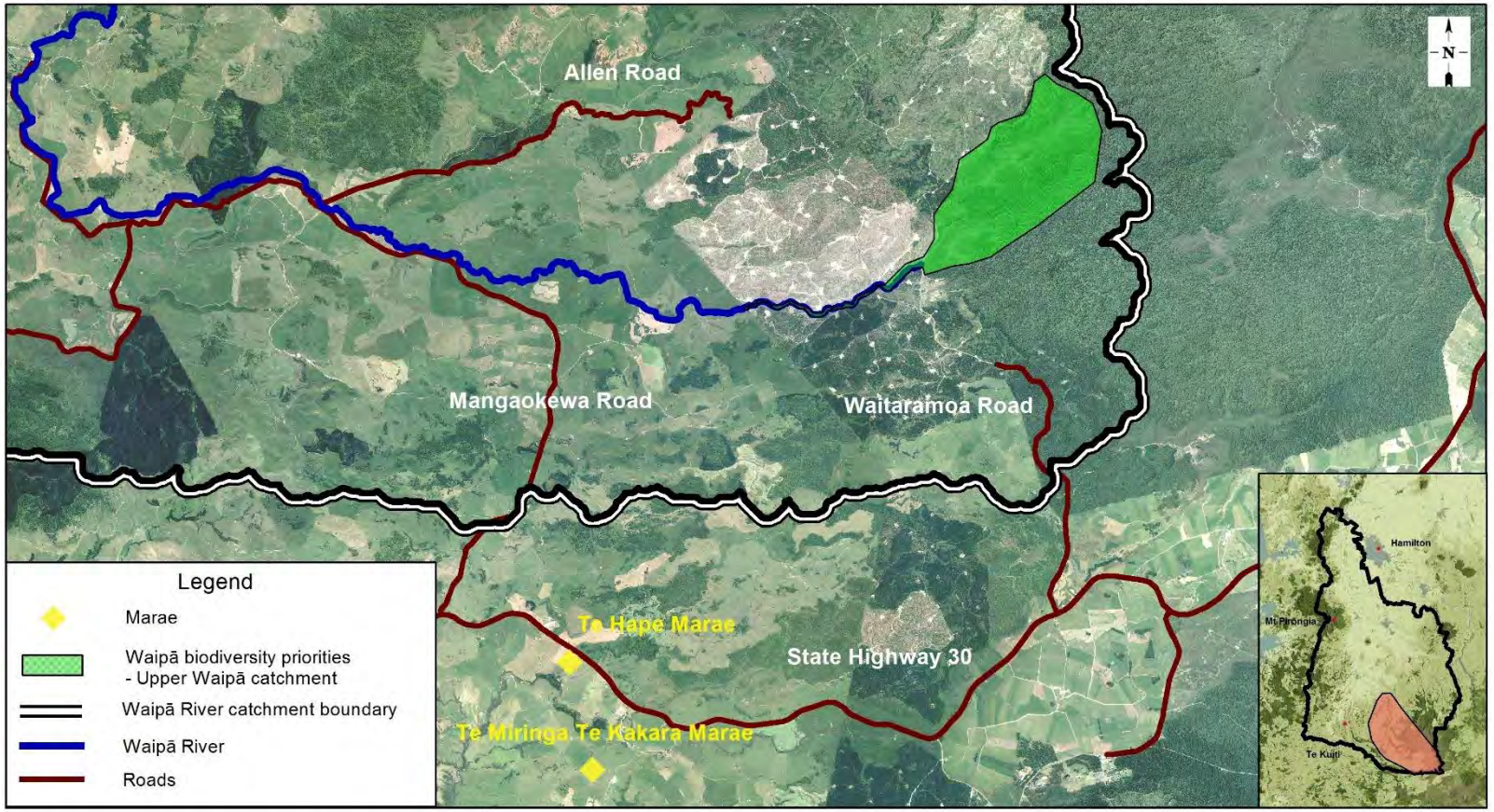

Biodiversity restoration of priority sites in the Upper Waipā Catchment Map 2/2

WWRRS Project Map

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

Status: Final
Request No.: N/A
File name:WWRRS.gws

0.00 0.75 1.50 2.25 3.00 3.75
Kilometers

Scale 1:75,000@A4 Landscape

A4

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An example of forest remnants in the upper Waipā.