MANGARARA SUB-CATCHMENT PLAN DRAFT

TLC The Big Picture: Tackling the big issues sub-catchment by sub-catchment

Tukituki Land Care

A COHESIVE VOICE FOR THE LAND

Final Draft 27 March 2025

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TUKITUKI CATCHMENT: THE BIG PICTURE

1. Introduction to The Big Picture

1.1. Purpose of The Big Picture

In 2024 Tukituki Land Care (TLC) launched The Big Picture, a six-month project designed to create independent, science-based catchment plans for the 17 sub-catchments of the Tukituki River in Central Hawke's Bay. The initiative identified each sub-catchment's unique environmental challenges and developed practical, cost-effective solutions to address them. As TLC Chair Richard Hilson explained, "We tackled the big issues sub-catchment by sub-catchment, to piece together the bigger picture."

The project employed a comprehensive research approach that combined field investigations, insights from local farmers, and an in-depth analysis of existing studies and data on the Tukituki catchment. Environmental planning consultancy, Environment, Innovation and Strategy Ltd (EIS), led by Matt Highway, undertook this work.

This project reflects TLC's dedication to improving environmental health and farm productivity, paving the way for a sustainable future for the Tukituki community.

1.2. Freshwater status of the Tukituki catchment

Summary of State of the Environment reporting

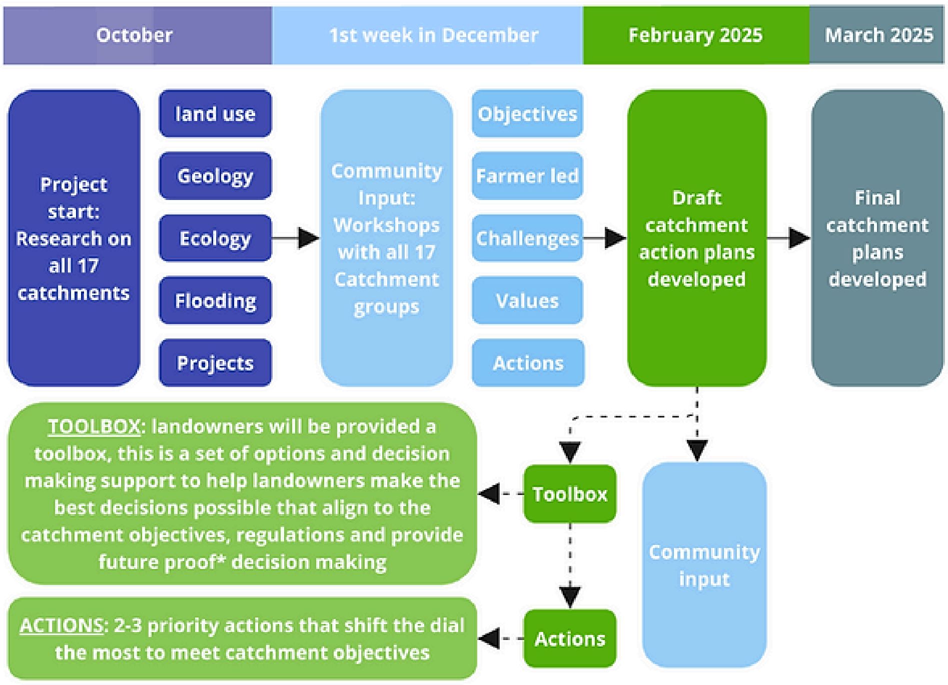
The Tukituki catchment faces water quality, land use, and climate challenges. The catchment, dominated by sheep and beef farming, has experienced significant modifications, leaving only about 10% of its land covered in indigenous vegetation. Water scarcity is a persistent issue, with decreasing river flows over the past three decades, exacerbated by droughts and climate change. Groundwater levels in the Ruataniwha Plains are under strict management to prevent further decline, but interannual variability and climate change pose ongoing risks.

Water quality is a major concern due to high levels of nitrogen, phosphorus, and sediment. The highest nitrogen concentrations in the region occur in streams draining the Ruataniwha Plains, and some areas exceed nitrogen targets by two to four times. Phosphorus and fine sediment issues, linked to erosion, contribute to poor water clarity and degraded aquatic habitats. Toxic algae, particularly Phormidium cyanobacteria, can proliferate in the river during low summer flows, posing a risk to both human and animal health. Despite these issues, the Tukituki River remains generally swimmable, except after heavy rainfall when contaminant levels rise.

1.3. Approach: creating priority actions in the Tukituki

The Big Picture project adopted a highly collaborative approach involving detailed catchment research, GIS mapping, and farmer engagement. Workshops were conducted with local farmers in each sub-catchment to better understand group dynamics, gather community values, and identify key issues and opportunities. Feedback from the workshops, survey results, and field investigations have been used to shape tailored catchment plans aligning with the local communities' specific landscape context and aspirations.

As part of the implementation phase, TLC introduced "THR3E"—three actionable steps designed for farmers in each sub-catchment to implement over three years. The TLC Farmer Toolbox was also launched, providing practical resources to help landowners make informed decisions and maximise the impact of their efforts. Additionally, monitoring strategies are to be implemented, and demonstration sites will be identified to help showcase best practices, ensuring that the plans remain relevant and actionable.



2. Tukituki's Overall Big Picture

2.1. Summary of sub-catchment challenges and priorities

The Big Picture project team has worked with farmers to identify challenges and opportunities in each of the 17 sub-catchments. While each sub-catchment has an individual plan, it is the big picture of the people, the land and the water within the Tukituki that we are trying to collectively support. The approach is reminiscent of a jigsaw puzzle where many pieces fit together and form something greater than themselves as an individual piece. Figure 1 below shows how the Tukituki sub-catchments fit together as a big picture, showing the sub-catchments that are aligned in similar top priorities. Note that the image only shows the proposed highest recommended priority area for each catchment, and all catchments will have multiple outcomes they are seeking.

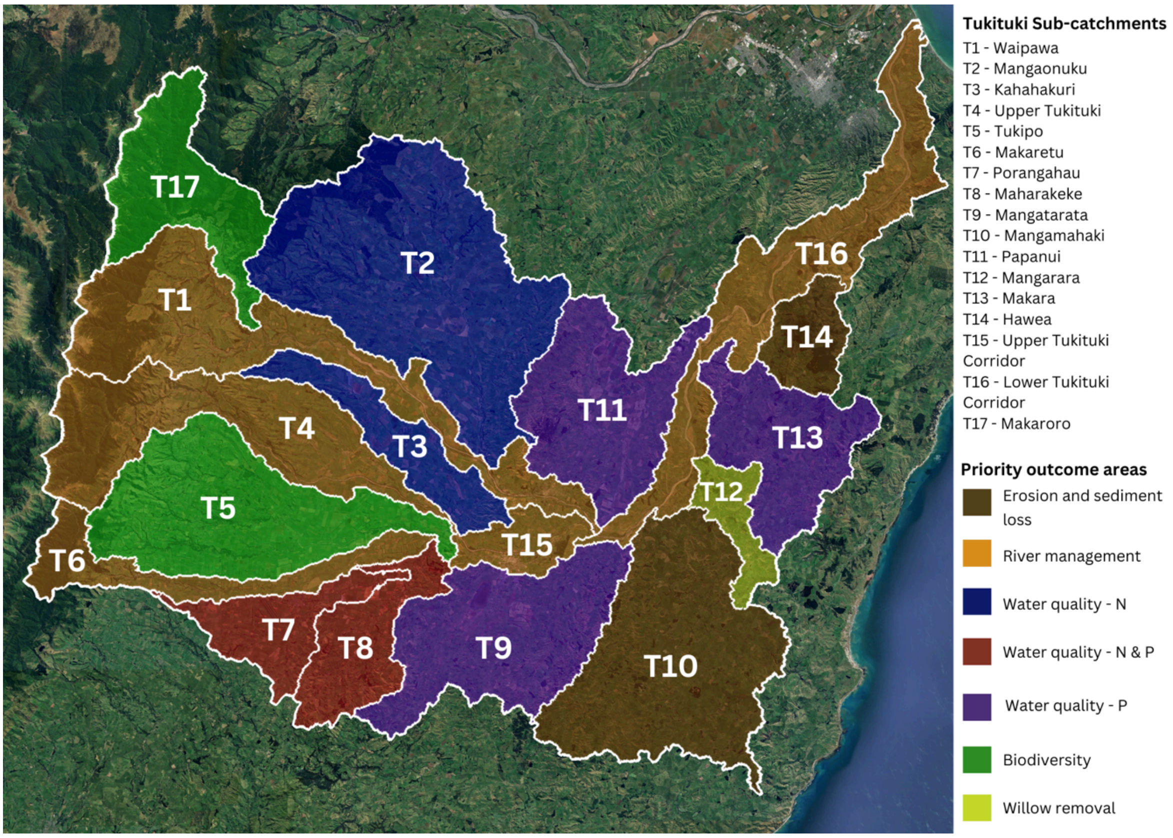


Figure 1 – Sub-catchment map for the Tukituki. Coloured areas highlight the recommended priorities for each catchment.

2.2. Outcome areas most sought by farmers (from workshops)

During workshops, farmers were asked to vote on a selection of outcome areas. Below are the top five outcomes:

- Support landowners with the knowledge to make informed decisions to improve the environment
- Improve the flood resilience of the catchment, including upstream and downstream to reduce effects on community in adverse weather events
- Protect and enhance the economic viability of the area
- Protect and enhance the quality, ecology, mauri of waterways and wetlands
- Represent farmers interests in future regional government setting of rules and regulations

MANGARARA CATCHMENT: CONTEXT AND CHALLENGES

3 The Mangarara Catchment Context

3.1 Background

The Mangarara catchment (figure 2), located east of the Patangata bridge, is the smallest sub-catchment in the Tukituki region, covering just under 4,000ha. Despite its size, it faces significant challenges from soil erosion and sedimentation. Cyclone Gabrielle exacerbated these issues, causing the stream bed to rise by up to 60cm in some areas. The catchment has one of the highest sediment yields in the Tukituki region, averaging 6.5 tonnes per hectare annually. The predominantly steep hill country, classified as Land Use Capability classes 6e and 7e, is highly erosion-prone, with landslides regularly reducing land productivity.

Figure 2 - Location of the Mangarara catchment in the wider Tukituki

A lack of woody vegetation together with invasive crack willows along waterways worsen these problems with the willows creating blockages and increasing flood risks. The community has implemented a two-phase erosion and sediment control strategy developed through Access2Experts to address these challenges. Immediate actions include crack willow removal and afforestation, with space-planted poplars suited for Class 6 land and hardy natives like kanuka for Class 7 areas.

As a result of the strategy, the catchment received $50,000 through the Cyclone Gabrielle Appeal Trust, which will be used to remove willows from priority sites, as highlighted in the strategy. Current works have been completed at the start of the confluence of the Tukituki river and the Mangarara stream.

3.2 Mangarara Catchment Context

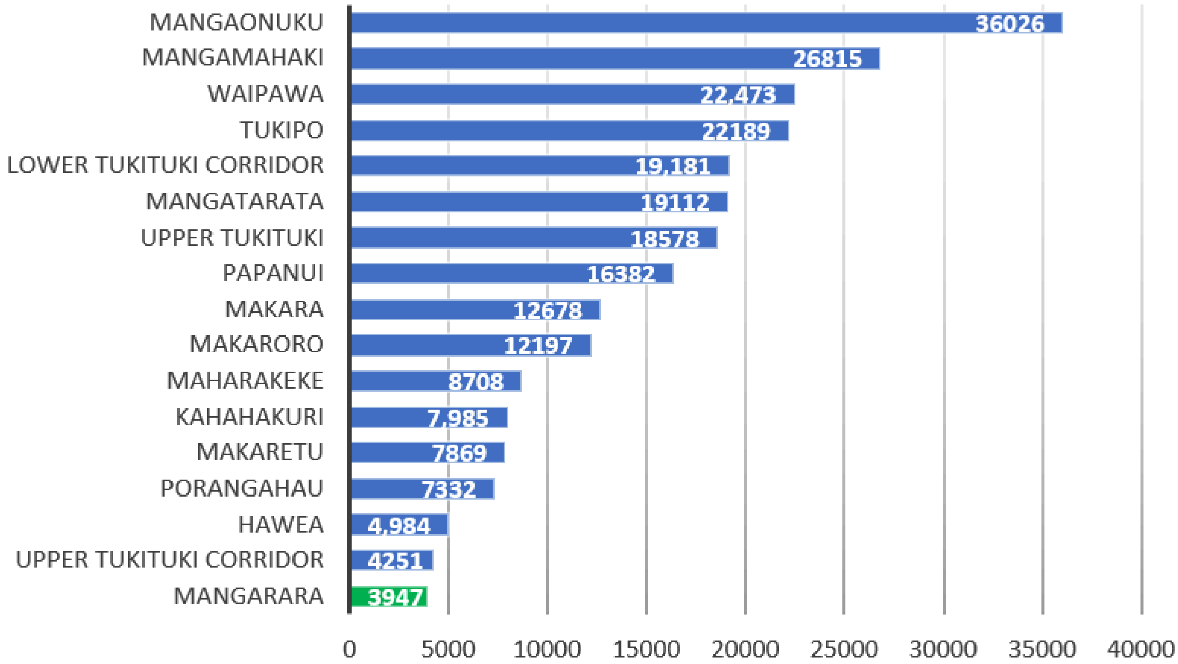


Figure 3 – Tukituki sub-catchment areas in hectares.

The Mangarara catchment is 3947ha, which amounts to 1.5 % of the wider Tukituki catchment. The Mangarara is the smallest sub-catchment of the Tukituki, which is 250,000ha in total (figure 3).

Land use in the Mangarara is typical of the wider Tukituki catchment with 92% of the catchment in pasture and 7% in exotic forest. Notably, less than 1% of land cover is in native vegetation (figure 4).

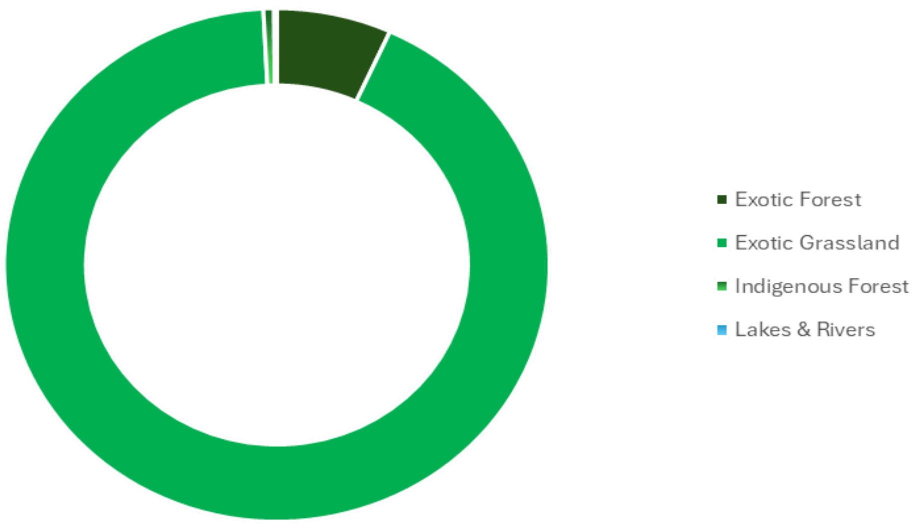


Figure 4 – Land use in the Mangarara catchment.

3.3 Catchment Challenges

The Mangarara Catchment Group workshop in December 2024 focused on progressing the community's restoration goals and addressing key challenges such as willow management, sediment control, and water quality improvement. Central to discussions was implementing the previously developed two-phase erosion and sediment control strategy, prioritising crack willow removal, afforestation, and sediment capture measures.

Attendees shared updates on the current willow removal project and proposed actions, including mapping out digger use for accessible areas and drill-and-fill methods for harder-to-reach sections. With the involvement of two key landowners, a goal of achieving a willow-free catchment within the next decade was proposed. The next step proposed was to plan the remaining willow removal along the Mangarara River, utilising the funding received from the Cyclone Gabrielle grant.

3.4 Catchment Challenges

3.4.1 Pest Willow

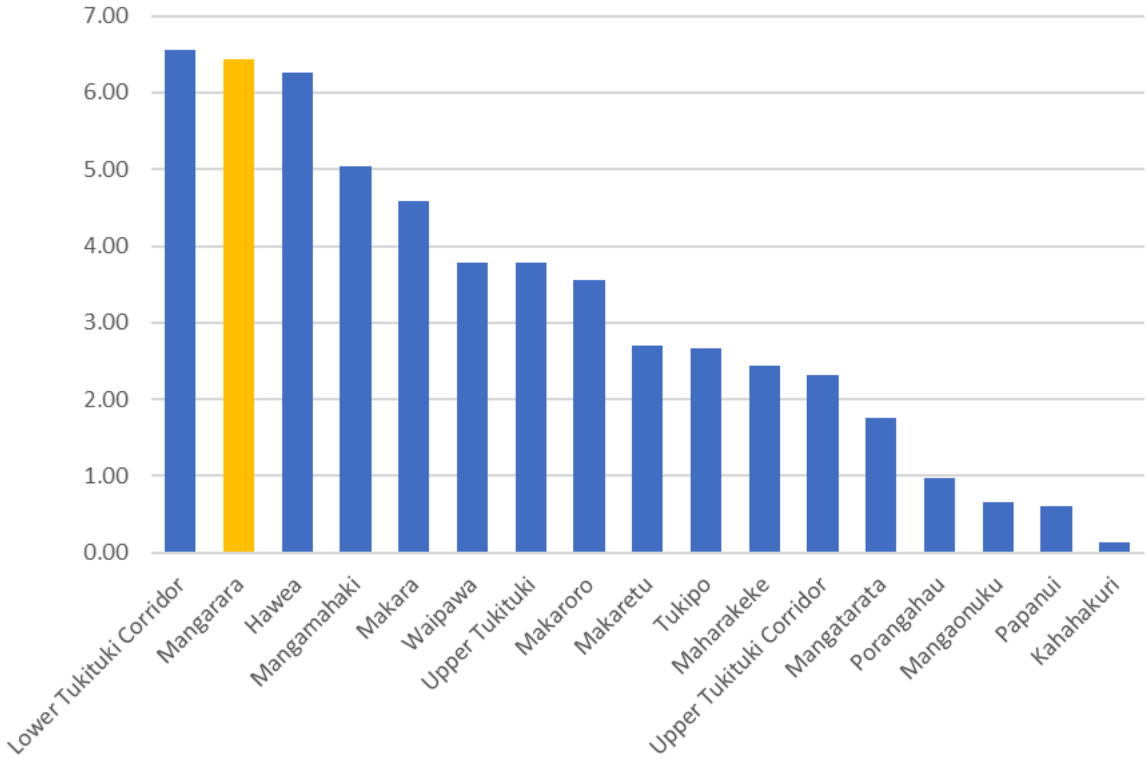
The Mangarara stream is highly impacted by crack willow. Crack willow is a highly invasive species that often obstructs streams, accelerates bank erosion, and increases the risk of flooding. Although it does not produce seed in New Zealand, its brittle branches and stems readily take root, enabling rapid colonisation of bare sites downstream.

In the Mangarara catchment, aging crack willows are breaking apart, being carried downstream, and clogging the river (figure 5). Extensive sections of the catchment appear to be dominated by large willows along riparian zones, increasing the risk of further erosion and flooding. To mitigate these risks, it is recommended that these trees be removed. Observations from the field visit indicate that past willow removal efforts have been successful, with streambanks in treated areas remaining stable over a long period of time.

Figure 5 - Large crack willow are becoming old and brittle, during storm events they wash downstream into accumulation areas which may lead to increased erosion.

3.4.2 Soil erosion

Sediment yield in the Mangarara catchment is one of the highest across the Tukituki, with nearly 6.5 t/ha/year modelled through SEDNET (figure 6). Within the wider Tukituki catchment, the sub-catchments identified as having the highest percentage area of land with high landslide risk with delivery to streams are the Hawea (5.3%), followed by Mangarara (3.1%), Tukipo (3.0%), and Upper Tukituki (2.9%). Landslides are known to produce high sediment yields, so erosion mitigation activities should focus on those areas.



The Mangarara catchment has a current erosion and sediment reduction plan, which demonstrates the challenges and opportunities around reducing soil erosion in the catchment. In addition to the Mangarara Access2Experts report, The Big Picture project has developed a surface erosion model which can be used to help prioritise action within the catchment (figure 7).

RUSLE - Revised Universal Soil Loss Equation - Mangarara

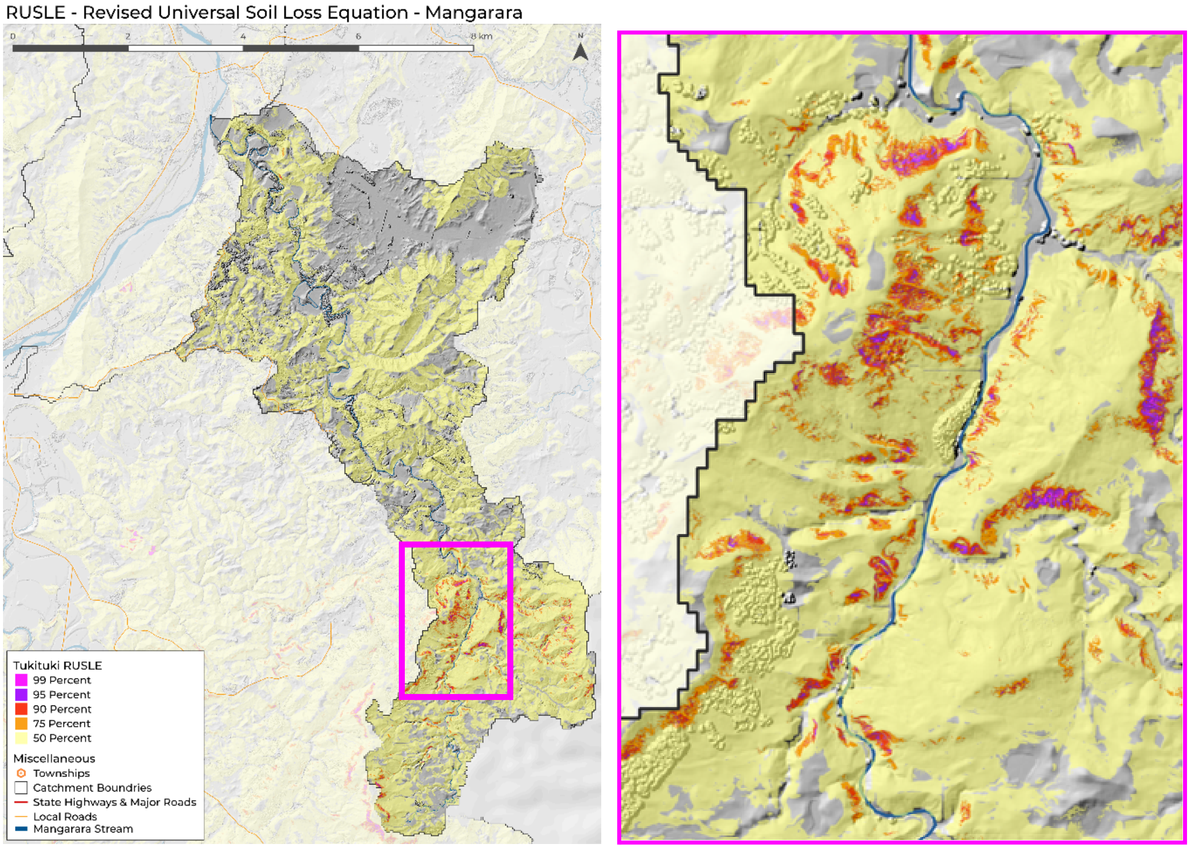


Figure 7 – Surface erosion model used across the Tukituki as part of The Big Picture project. A majority of the catchment has erosion risk areas greater than 50% of the rest of the catchment and has a significant amount of areas that have greater than 90% of the erosion risk.

3.4.3 Catchment Focus Area

Mangarara farmers were asked to come up with objectives for their catchment. They came up with a single unifying vision:

Achieve a willow-free catchment within the next decade

This vision has directed the workstream and toolboxes outlined below for the Mangarara catchment.

MANGARARA CATCHMENT: OPTIONS ACTIONS AND RECOMMENDATIONS

4 Summary of Challenges, Impacts and Priority Actions

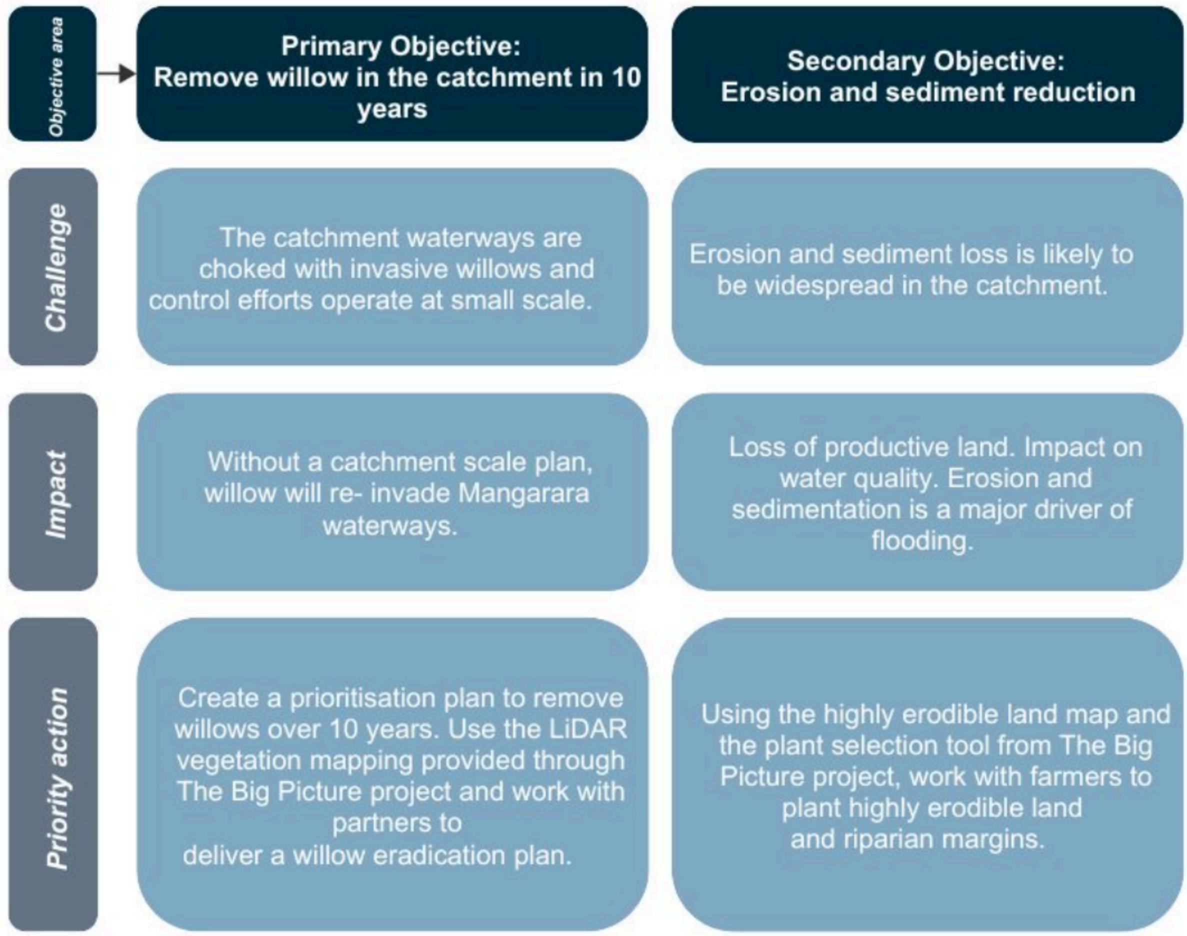


Figure 8 – Summary of the challenges, impacts and recommended priority actions for the Mangarara catchment, framed against the two major objective areas

5 Mangarara Implementation

5.1 Implementation to meet priority objectives

The primary outcome for the group is to eradicate invasive willow in the catchment within 10 years. To do this they will need to prioritise areas, understand control techniques and work with partners to support this objective through funding and expertise. Additionally, the catchment will benefit from soil conservation measures which will protect productive land, improve water quality and enable landowners to increase land eligible for the emissions trading scheme (ETS). Both options will require the support of HBRC through funding and advice.

5.2 Willow control

The Big Picture project has developed a willow control guide for the Tukituki catchment. It is highly recommended that the Mangarara catchment group uses this guidance to support wide scale control of willow in the catchment.

5.3 Erosion control and Afforestation

The below section on general approaches to soil conservation notes the options that could be explored through the catchment group or with individuals to achieve better soil management. Additionally, using the high-risk erosion mapping provided to TLC (appendix 2) and the list of erosion control and sediment reduction actions alongside their application and effectiveness (appendix 4), will help prioritise both the key areas and the key actions to take within the catchment to reduce erosion.

5.3.1 General approaches to soil conservation

Fencing and native afforestation: Significant reduction in erosion, up to 74% less slips occur in native forest compared to pasture. Native species are a great long-term approach but can be very costly and hard to establish in dry exposed hill country. Hardy species like manuka and kanuka have been used in the past as an initial coloniser species to increase canopy cover and reduce costs. This has been used for decades in New Zealand and more recently described as the Tīmata method in an Our Land and Water project.

Space planted poplars: Space planted poplars are one of the most common forms of slope stabilisation in New Zealand and are readily accessible through regional council soil conservation programmes. During cyclone Bola land planted with space planted trees had 22% less erosion than pasture areas without trees.

Afforestation with pines: Established pine forest had 87% less erosion scars than pasture alone in the Manawatu events in 2004. However, pine trees have limited benefit in gully erosion and for stabilising stream banks.

Space planted kanuka: A study on a Hawke's Bay farm found 108% more pasture growth under kanuka trees on sloping summer dry hill country pastures compared to open pasture. The study found: 49% more organic matter, 116% more Olsen-P, 9% greater porosity under the trees. Perennial ryegrass and cocksfoot dominated the pasture under the trees and browntop dominated the pasture away from the trees. The researchers surmised that these differences are mainly due to livestock preferentially spending more time under the trees grazing, and the trees adding organic matter to the soil.

Mānuka only planting: Mānuka planted for erosion control were found to be unlikely to provide effective erosion mitigation on steep land until significant root mass develops below the depth of the shear plane at which most landslides occur. Increasing the planting density, reducing early seedling mortality by better management of weed competition, and/or their replacement (blanking) would probably improve the erosion mitigation effectiveness of low-density manuka plantings. The time (years after planting) to attain canopy closure and root occupancy, if stands of mānuka were to remain fully stocked, varies between landforms and would likely occur between 6.5 and 9 years after planting. However, variable rates in planting density, and of plant mortality, resulting in under-stocking would significantly delay this, particularly on landslide-affected slopes.

Grazing under exotic trees: Several studies have found that pasture production can be between 17% and 53% higher under Holm oaks in dry areas of Spain and Portugal. The studies suggested that the reasons for this improvement were either increased availability of nutrients under the tree, or microclimate modifications for conserving water[1].

Another study found that pasture production was 45% higher in southern beech silvopastures compared to open pasture in Argentina. The researchers suggested that the reason for these effects was that there was 80% less wind in areas with the trees compared to areas without trees, resulting in less evapotranspiration under the trees[2].

Tīmata method: The Tīmata method refers to afforestation using low-cost techniques. This technique significantly reduces challenges associated with affordability, supply of trees and labour, while retaining the ecological and economic benefits of establishing native forest. The principles are: A) 2m spacing (2,500 stems/ ha), B) 70% manuka or kanuka, C) Small forestry grade trees, D) Careful land preparation including weed and animal pest control.

Fencing and sowing legumes: Rapid establishment of productive pastures on erosion scars in Wairarapa and similar hill country can be achieved by retiring areas from grazing for 2-3 years, and oversowing with white clover and lotus.

Over sowing legumes only: Where spelling from grazing is not an option, significant (but reduced) improvements in rate of slip revegetation and subsequent productivity can be made through oversowing white clover seed.

6 Implementation steps and costs

6.1 Proposed Implementation Steps and Estimated Costs

1. Use mapping provided to identify and plan willow removal
    a. Work from the top of the catchment down.
    b. Section the catchment based on control methods that suit each site. Identify methods, costs and maintenance to ensure willow reinvasion is controlled.
    c. This will enable costing of overall willow removal in the catchment over 10 years.
    d. Estimated cost: Unknown total cost without a removal plan. Planning by an external adviser should cost approximately $5,000, but TLC and the catchment group should be able to do this in-kind.

1 https://verdantiaresearch.co.nz/
2 https://verdantiaresearch.co.nz/

2. Reduce erosion and increase profitability. Support farmers to implement good practice and afforestation actions that are most suited to their farm.
    a. This could be implemented through land management staff at HBRC and in-kind through TLC coordinators.
    b. Estimated cost: Variable due to unknown implementation methods.

APPENDICES -

1. Appendix 1 - TLC On-Farm Action Planning Tool

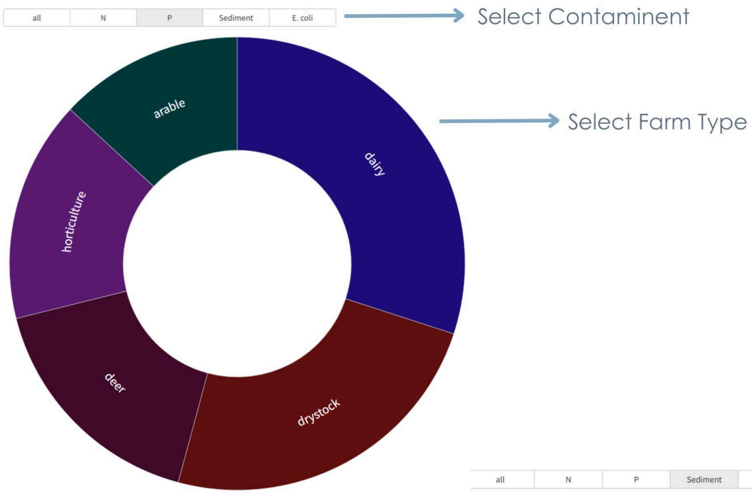
This decision-support tool is designed to help farmers identify and prioritise cost-effective environmental actions on their farms. Use the filters to explore mitigation options by contaminant and farm type.

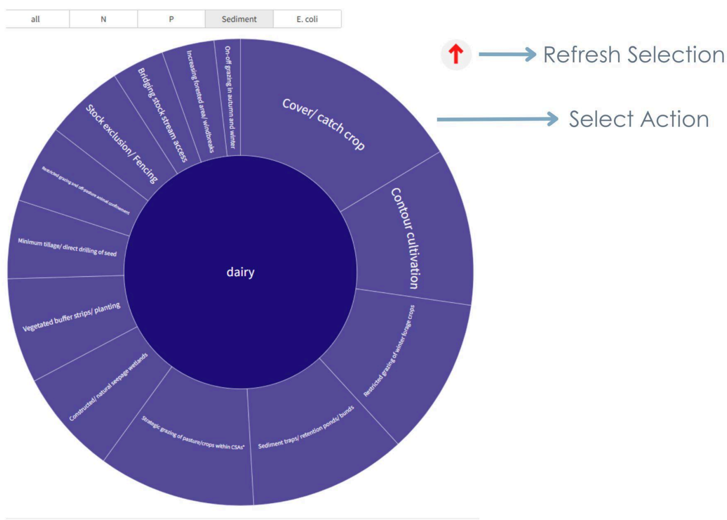
The larger the section, the greater the impact and cost-effectiveness of the mitigation. Recommended actions are displayed in descending order, starting from the top and progressing clockwise around the circle.

How to use the tool:

Visit the TLC Farmer Toolbox at www.tukitukilandcare.org/toolbox, select the On-Farm Action Planning Tool and follow these steps:

1. Select a contaminant.
2. Choose your farm type.
3. Select an action to view more details.
4. Click the red arrow to reset your selections.





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2. Appendix 2 - Understanding Highly Erodible Areas

2.1. Highly erodible areas using mapping

Each catchment in the Tukituki has been mapped using LiDAR and the revised universal soil loss equation (RUSLE) has been applied. The equation, described in IECA as having the following form: $A = R \cdot K \cdot LS \cdot C \cdot P$ where A is the annual soil loss due to erosion (t/ha year); R the rainfall erosivity factor; K the soil erodibility factor; LS the topographic factor derived from slope length and slope gradient; C the cover and management factor; and P the erosion control practice factor. The limitations of RUSLE are that it only accounts for soil loss through surface erosion (sheet and rill erosion) and ignores the effects of gully erosion.

This model enables understanding of the highest risk areas within the catchment, where soil loss is mostly likely and where to prioritise soil conservation measures

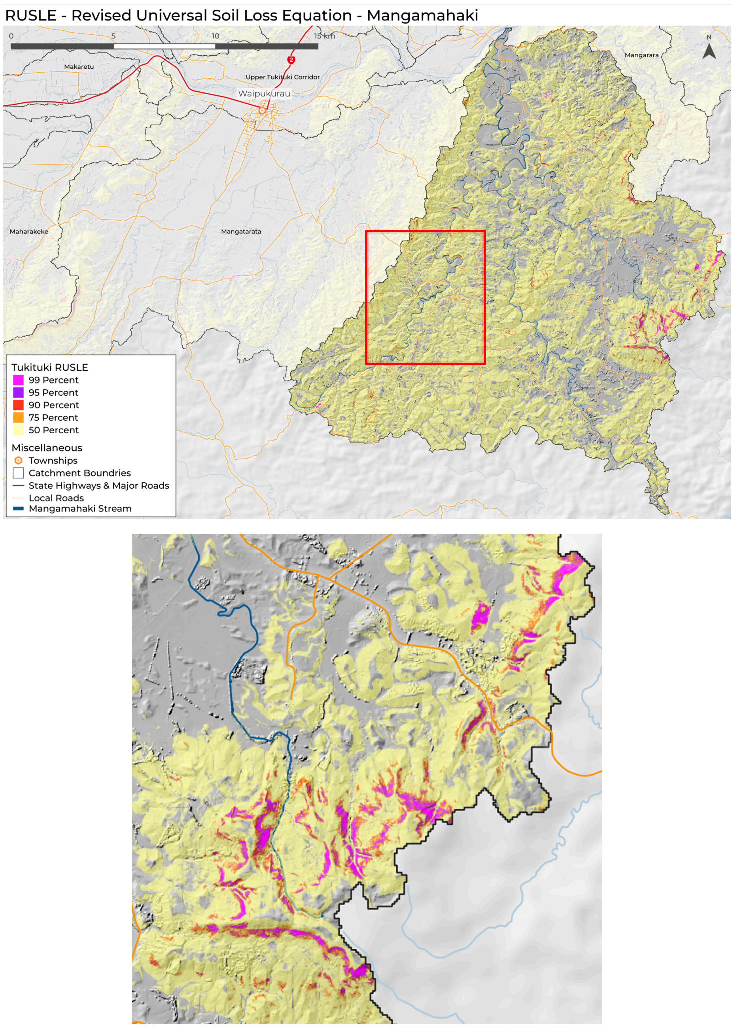

Figure 9 – RUSLE model at sub-catchment scale. High risk erosion is mapped at 99%, 95%, 90%, 75% and 50%, throughout the Tukituki catchment.

2.2. Farm planning using RUSLE

As HBRC's high resolution LiDAR data set enables high resolution mapping and prioritisation of action at Tukituki, sub-catchment and farm scale. If erosion, sediment or phosphorus is a priority for the sub- catchment, using this model will help find the areas to prioritise.

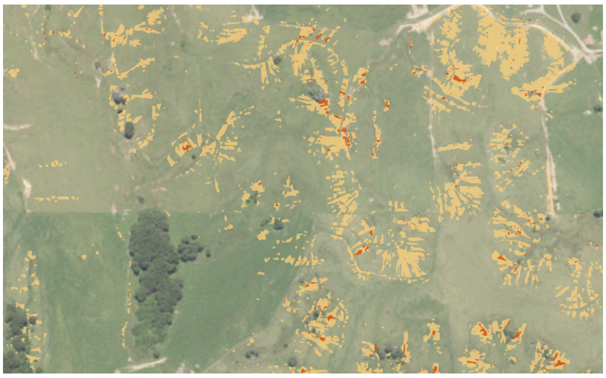

Figure 10 – From a farm planning point of view the RULSE can be used to prioritise areas to implement soil conservation measures.

3. Appendix 3 - Flow mapping to understand sites for sediment trapping

3.1. Identification of sites for edge of field mitigations (wetlands, bunds, dams)

Topographic Wetness Index (TWI) is a measure of how likely an area is to accumulate and retain water based on its slope and contributing upslope area. TWI identifies wet or poorly drained areas in a landscape, making it useful for understanding placement of edge of field[3] mitigations like bunds and wetlands.

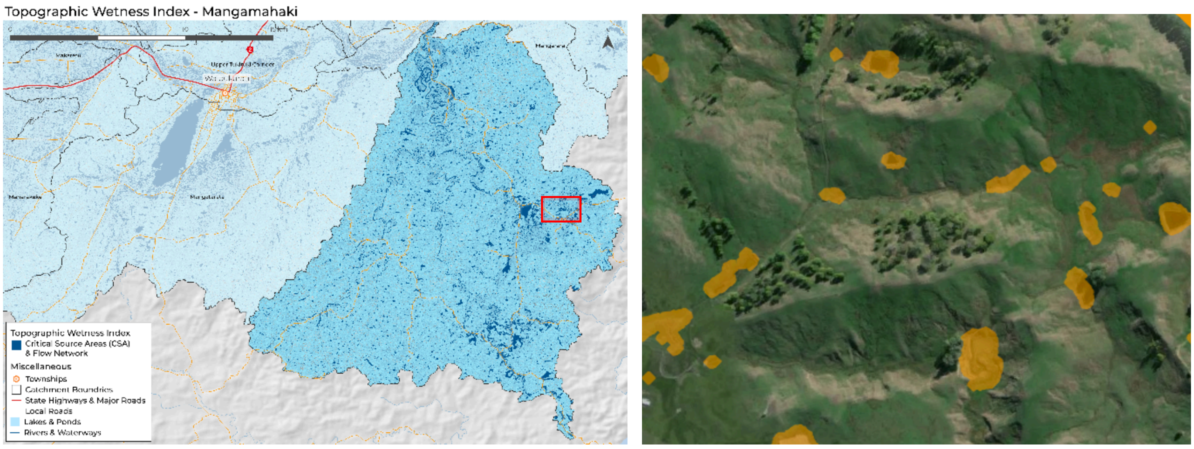

Figure 11- TWI example in a sub-catchment. Using the data layers supplied by EIS will enable exploration of the data using GIS or Google Earth.

TWI can be a very useful tool in catchment and farm planning for those wanting to implement over and above farm actions. It does need ground truthing but can be useful in finding appropriate sites, with an estimate of water accumulation areas and volumes.

It is important to note that the edge of field mitigation needs to suit the outcome each catchment is seeking. TLC will have to be aware of single focus edge of field, which has become a common narrative in New Zealand. For example, promotion of single solutions like installing only constructed wetlands or detention bunds (detainments bunds) was common in freshwater management during the 2010s.

[3] Edge of field tactics are a group of mitigations that operate downstream of a contaminant source, and capture water to treat it. They are normally placed in overland flow path channels before water enters main waterbodies.

Figure 12 – Examples of edge of field mitigations, from large detention bunds, large wetlands through to in-line or off-line sediment traps.

4. Appendix 4 - Erosion control and sediment capture actions and effectiveness

4.1. Erosion control

There is a wide range of tactics that can be used in hill country landscapes. Table 2 below outlines the typical soil conservation tactics available for deployment in rural landscapes. The table outlines each tactic's application, and the probable sediment loss reduction based on relevant literature.

Table 2 – Summary of the effectiveness and application of soil conservation treatments. In general, reduction percentage described below outlines the improvements possible from deploying that tactic compared to undertaking no actions at a site.

SOIL CONSERVATION TACTICS	Mass wasting (deep e.g. earth flows)	Mass wasting (shallow e.g. soil slips)	Sheet and Rill	Waterway Erosion	Gully	Tunnel gully	Erosion reduction
Space planted trees (poplars & eucalypts)	✓	✓	✓	□	✓	✓	14-70%;
Afforestation -Exotics (pines)	✓	✓	✓	□	✓	✓	87% vs pasture 19-66% in gullies 50% catchment wide
Afforestation - Manuka	✓	✓	✓	□	✓	✓	90% fewer landslides vs pasture
Afforestation - Kanuka	✓	✓	✓	□	✓	✓	65% vs pasture
Afforestation -Natives	✓	✓	✓	□	✓	✓	74% less landslides 87% less volumetric

4.2. Sediment capture

Sediment reduction and edge of field approaches to reduce the impact of soil loss have been researched less in New Zealand than afforestation and soil conservation. The below list outlines the known major interventions that can be applied in the rural landscape. The interventions exclude good management practices like stock exclusion of waterways, pasture and grazing management.

Table 3 below outlines the typical sediment attenuation tactics available for deployment in rural landscapes. The table outlines each tactic's application and the probable sediment loss reduction based on relevant literature.

Table 3 – Summary of the effectiveness and application of sediment reduction treatments that are typically applied. In general, reduction percentage described below outlines the improvements possible from deploying that tactic compared to undertaking no actions at a site.

SEDIMENT REDUCTION TACTICS	Mass wasting (deep e.g. earth flows)	Mass wasting (shallow e.g. soil slips)	Sheet and Rill	Waterway	Gully	Tunnel gully	Sediment attenuation
Grass buffers (see filter strips also) pastoral farming	☐	☐	✓	☐	☐	☐	20-30% (channelised flow) 40-80% (non channelised)
Critical Source Area management	☐	✓	✓	☐	☐	☐	20-30% (pastoral farming - channelised flow)
Grass filter strips (see buffers also)	☐	☐	✓	✓	☐	☐	90% (Tss reduced). Grass 90% better than bare soil (AC)
Detention bunds	☐	✓	✓	☐	☐	☐	70% 23-79% (Decanting earth bund)
Sediment traps (land based)	☐	☐	✓	☐	☐	☐	50-60%
Wetlands	✓	✓	✓	✓	☐	☐	60-80%
Sediment trap and wetland	☐	✓	✓	✓	☐	☐	70%
Sediment Traps (Inline waterway)	☐	☐	☐	✓	☐	☐	50%
Sediment retention pond	☐	✓	✓	☐	☐	☐	33%
Debris dams	☐	☐	☐	☐	✓	☐	80%