MAHARAKEKE & PORANGAHAU STREAM 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

CONTENTS

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

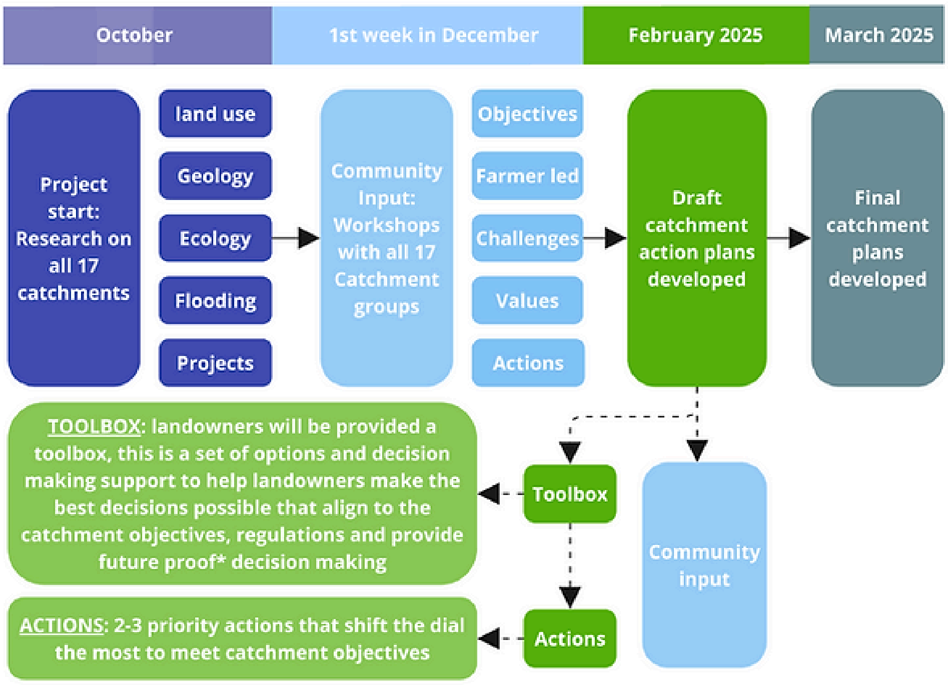
The Tukituki catchment faces water quality, land use, and climate challenges. The catchment, dominated by sheep and beef farming, has experienced significant modifications, leaving only about 10% of its land covered in indigenous vegetation. Water scarcity is a persistent issue, with decreasing river 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 sub-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.

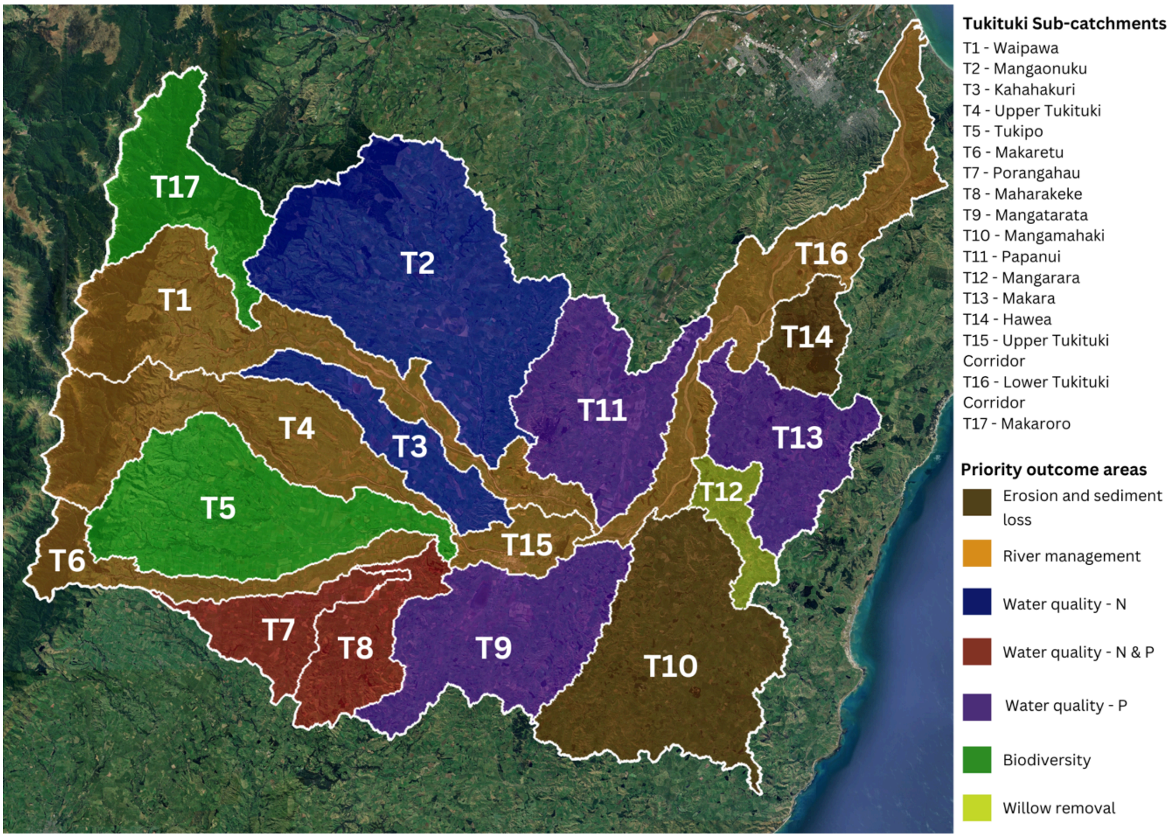


Figure 1 – Sub-catchment map for the Tukituki. Coloured areas highlight the recommended priorities for each sub-catchment.

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

MAHARAKEKE & PŌRANGAHAU STREAM (WOWMAP) SUB-CATCHMENTS: CONTEXT AND CHALLENGES

3. Sub-Catchment Context

3.1. Background

The Pōrangahau and Maharakeke sub-catchments, covering 15,219ha, play a crucial role in the wider Tukituki River system. Water quality challenges, particularly high levels of dissolved inorganic nitrogen and phosphorus, have made this area a priority for the Hawke's Bay Regional Council (HBRC).

Figure 2 - Location of the WOWMAP sub-catchment in the wider Tukituki catchment.

In response, local farmers and the community have come together to form the 'Watch Our Water – Maharakeke and Pōrangahau' (WOWMAP) Catchment Group, working under the farmer-led 'Tukituki Land Care' (TLC) network. The group is making practical changes to improve water quality and farm resilience thanks to expert advice and funding support through a TLC demonstration grant.

A key focus has been education and awareness, with signage and riparian planting projects involving Silver Fern Farms and Takapau School to engage the next generation in land and water stewardship. Alongside community engagement, on-the-ground interventions are being trialled to tackle nutrient and sediment loss.

Massey University has played a role in these efforts, conducting research and leading field trials to identify effective mitigation strategies. One of the key interventions has been the installation of a woodchip bioreactor, an edge-of-field practice designed to reduce nitrate leaching from farmland. The early results from the Maharakeke-Pōrangahau site are promising, showing reduced nitrate concentrations in drainage water.

Another significant project is the detainment bund (P120), a specialised sediment trap. This approach effectively reduces nutrient runoff during heavy rain events while ensuring that pasture productivity isn't compromised.

3.2. Sub-Catchment Context

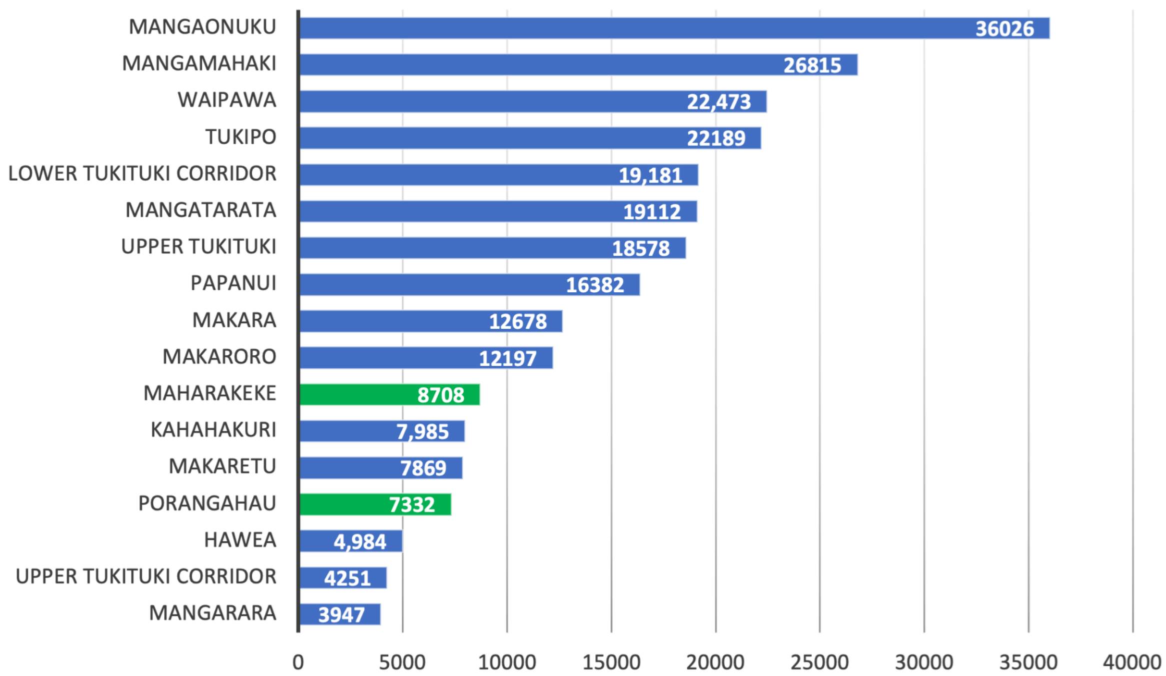


Figure 3 – Tukituki sub-catchment areas in hectares.

The Maharakeke sub-catchment is 8,708ha, which amounts to 3.55% of the wider Tukituki catchment. Meanwhile, the Pōrangahau sub-catchment is 7,332ha, approximately 2.9% of the wider Tukituki catchment. These sub-catchments combined make up 15,219ha of the Tukituki catchment (figure 3).

The land use across both sub-catchments is similar, with a large portion of both sub-catchments in pasture (92%), arable (Pōrangahau – 5% and Maharakeke - 4%), and exotic forest covering less than 4% across both sub-catchments (figure 4 and 5).

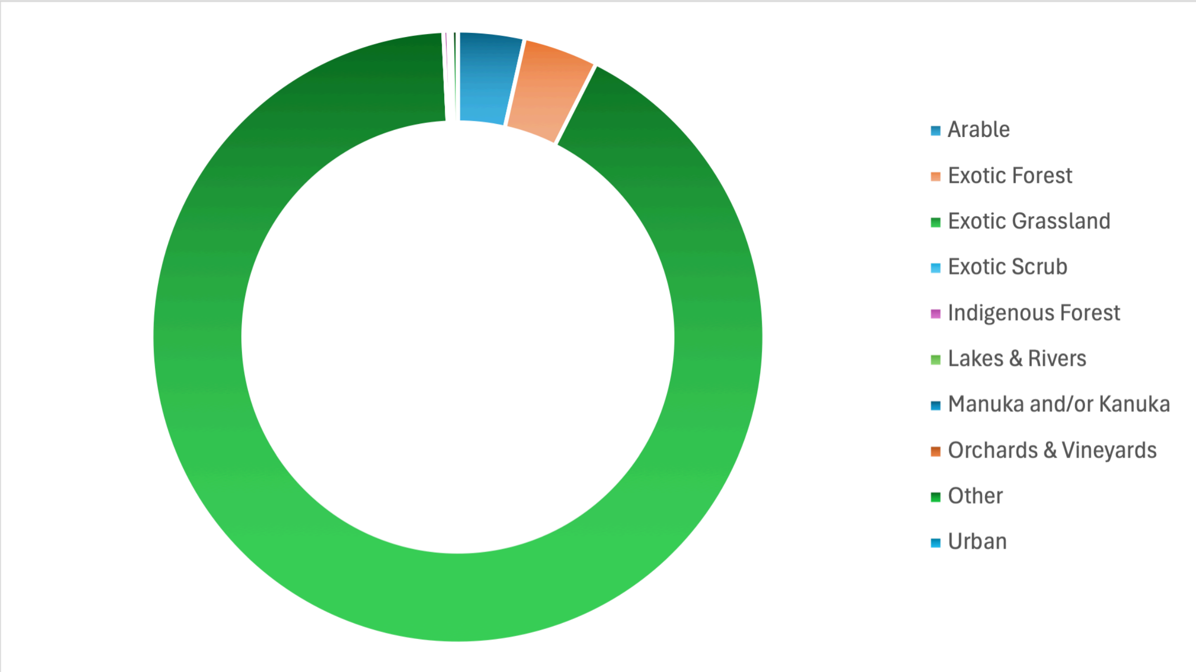


Figure 4: Land use in the Maharakeke sub-catchment.

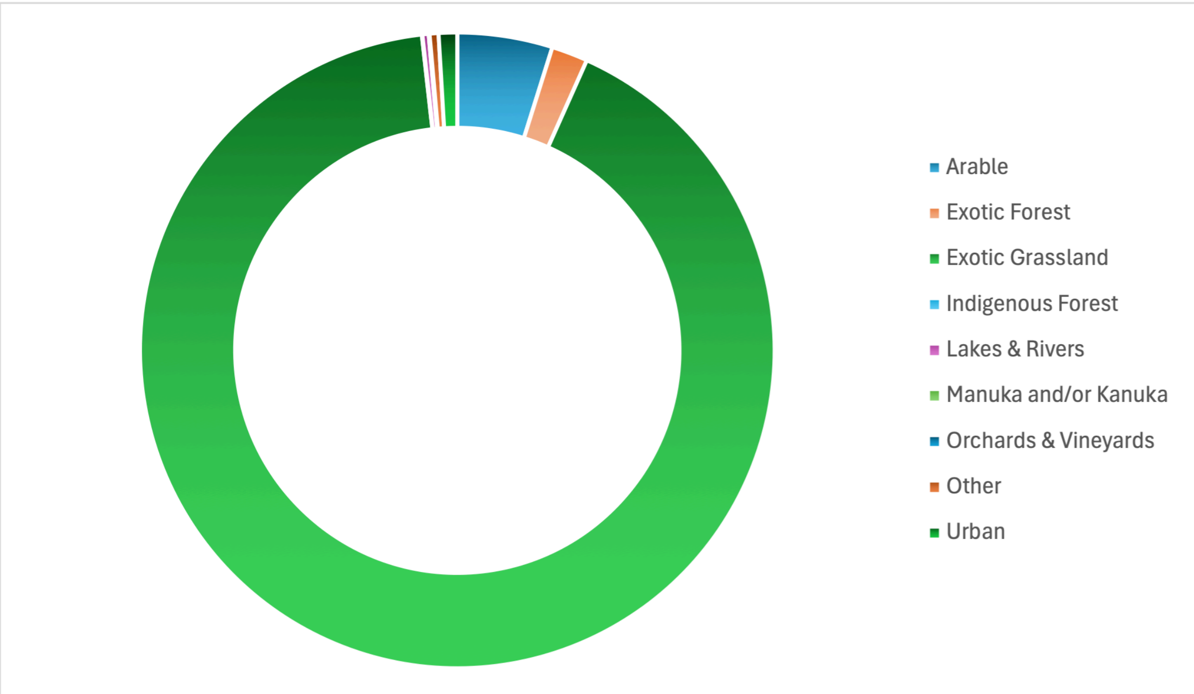


Figure 5 – Land use in the Pōrangahau sub-catchment.

3.3. Sub-Catchment Challenges and Key Focus Areas

At the WOWMAP sub-catchment workshop in December 2024, participants discussed ongoing initiatives, identified challenges, and explored priority areas for improving water quality and farm sustainability. Key topics included the progress of Massey University's trial sites and the need for practical tools and better communication of results.

A key concern discussed was the lack of tangible results from Massey University's trial sites. While the bioreactor has (only) been in place for a few months and positioned near a high-nitrogen spring, farmers are yet to see meaningful data on its effectiveness. Similarly, the detention bund has been built but not tested due to lack of rain. Participants also noted that Massey has already mapped the area using Lidar, but this information hasn't been widely shared or built upon.

Another major challenge was clarifying water quality limits and their feasibility. Farmers questioned where specific targets (e.g., the 0.8 mg/L nitrogen limit) come from and whether improving Macroinvertebrate Community Index (MCI) scores is realistic, given the natural stream types within the sub-catchments (see table 1 for 5 year rolling average of water quality in the Pōrangahau and Maharakeke sub-catchments).

*Table 1 - Pōrangahau and Maharakeke sub-catchment water quality indicators over a five-year rolling average. * The standard represents water quality levels based on the Tukituki plan or national standards. See Link to the Pōrangahau and Maharakeke dashboard for more information.*

Water Quality Parameter	Pōrangahau[1]	Maharakeke[2]	Standard*
Nitrogen (DIN)	2.255 mg/ L	1.386 mg/ L	0.8
Phosphorus (DRP)	0.025 mg/ L	0.049 mg/ L	0.015
Bacteria (E.coli)	145 (count)	100 (count)	260
Freshwater invertebrates (MCI)	86.7 (index)	84.5 (index)	100
Sediment (Turbidity)	0.74 mg/ L	0.97 mg/ L	4.1 FNU (light)

Additionally, cow cress was identified as an issue at the bottom end of the sub-catchment, requiring further management.

A strong theme from the discussion was the need for better education and engagement. Farmers were enthusiastic about short, practical videos explaining mitigation measures backed by real-world data and cost comparisons. They also supported the idea of sharing farmer stories to make the information more relatable.

There was also interest in carbon dating local springs to understand groundwater movement and nitrogen flow better. A recent finding by a landowner showed that two springs just 20 metres apart had drastically different water ages, raising questions about how high-nitrogen springs function.

1 https://www.hbrc.govt.nz/environment/farmers-hub/in-the-tukituki-catchment/tukituki-dashboard/porangahau-dashboard

2 https://www.hbrc.govt.nz/environment/farmers-hub/in-the-tukituki-catchment/tukituki-dashboard/maharakeke-dashboard

Lastly, attendees saw value in simplifying information about nitrogen and phosphorus cycles—specifically, how different mitigations (e.g., wetlands, detention bunds) impact nutrient losses and which are the most effective (e.g. figure 6). Providing clear, farmer-friendly guidance would help landowners make practical, informed decisions about improving water quality while maintaining farm productivity.

Figure 6 – Existing denitrification bioreactor in the sub-catchment.

3.4. Landscape Constraints

The WOWMAP sub-catchment areas that are dominated by flat country are in the centre of the sub-catchment with rolling to steep country in the south, centre and east. The topography and soils have a particular way that they interact with nitrogen and phosphorus. The soils left behind by wetlands will have a low nitrogen loss profile (figure 7) and will often denitrify nitrogen rich water. However, some soils (like the pallic soils) are highly erodible, and have a reduced ability to bind phosphorus to the soil, meaning phosphorus will easily leave the soil once in contact with water.

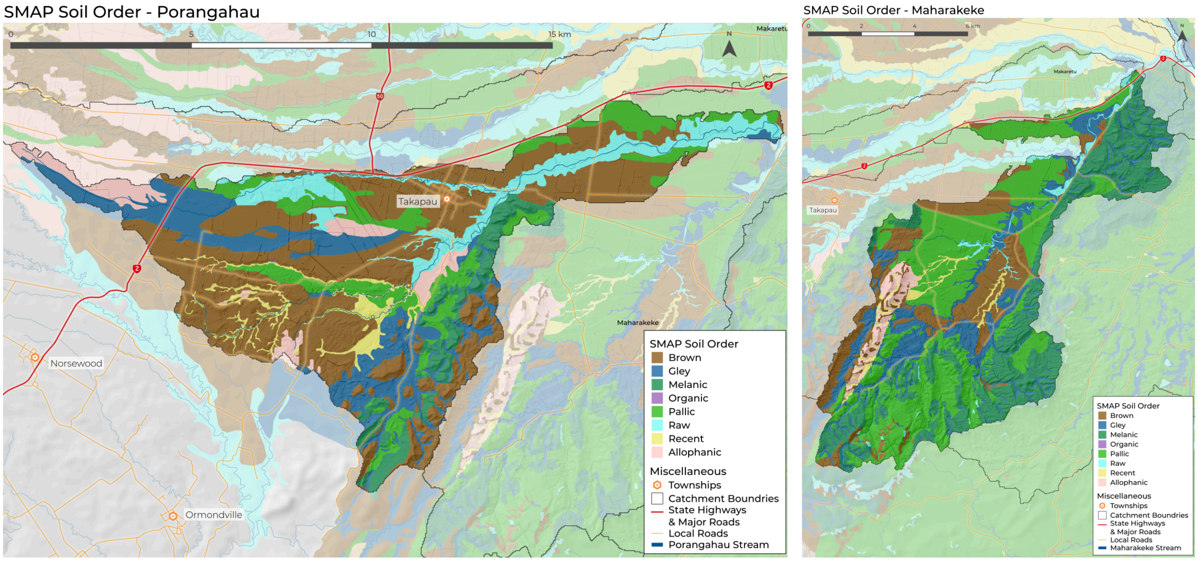
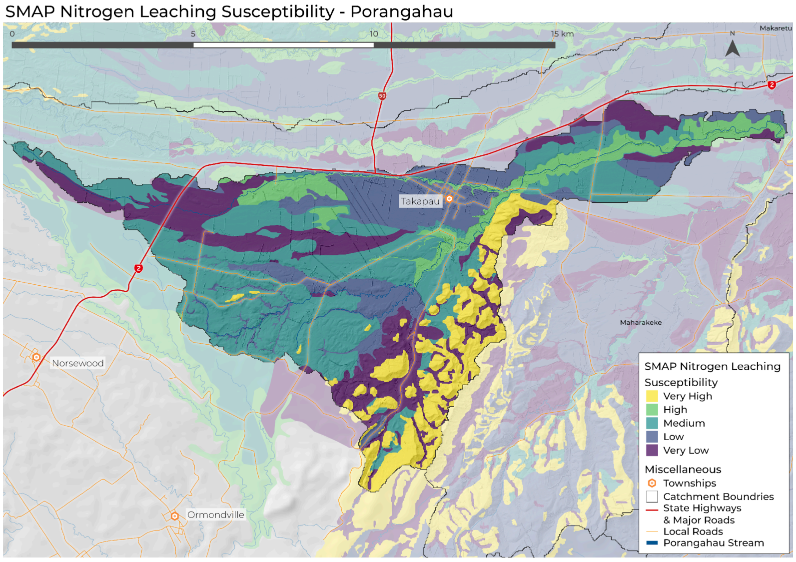


Figure 7 – Soil orders in the WOWMAP sub-catchments. Left: Porangahau; Right: Maharakeke. Sourced from SMAP (Manaaki Whenua).

The topography and soils lead to a marked difference in nutrient loss throughout the sub-catchment. The nitrogen loss profile (figure 8) for example is very high in some parts of the sub-catchments and very low in other parts. This highlights that the sub-catchments are not created equally and should be managed appropriately.

SMAP Nitrogen Leaching Susceptibility - Porangahau



SMAP Nitrogen Leaching Susceptibility - Maharakeke

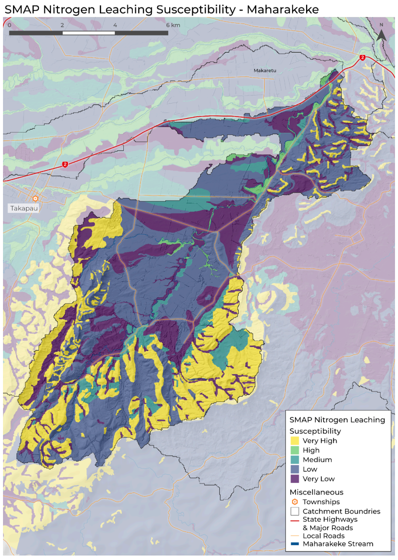
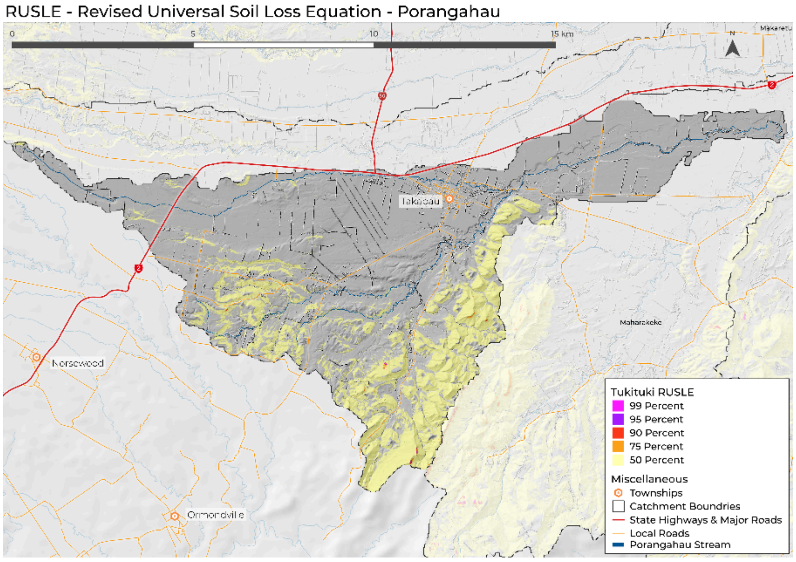


Figure 8 – Nitrogen loss in the WOWMAP sub-catchments. Left: Porangahau; Right: Maharakeke. Sourced from SMAP (Manaaki Whenua).

Erosion in the sub-catchment is also likely to be high in some parts of the sub-catchment and very low in others. The erosion mapping completed for the Tukituki highlights where hill country erosion is most likely to occur (figure 9). Some parts of the sub-catchment are in the top 1% of likely to erode sites and prioritisation in these areas should occur.

RUSLE - Revised Universal Soil Loss Equation - Porangahau



RUSLE - Revised Universal Soil Loss Equation - Maharakeke

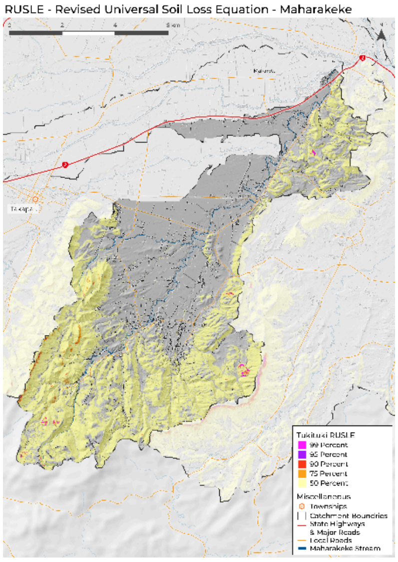


Figure 9 – High risk erosion areas in WOWMAP sub-catchments as modelled by RULSE. Left: Porangahau; Right: Maharakeke. Sourced from SMAP (Manaaki Whenua).

3.5. Waterway Management Status

In a survey in 2014 by HBRC, it was found that WOWMAP sub-catchments had some of the poorest riparian stock exclusion and vegetation condition in the Tukituki catchment. Given the challenges of phosphorus and nitrogen in streams, improving the riparian condition is likely to be important.

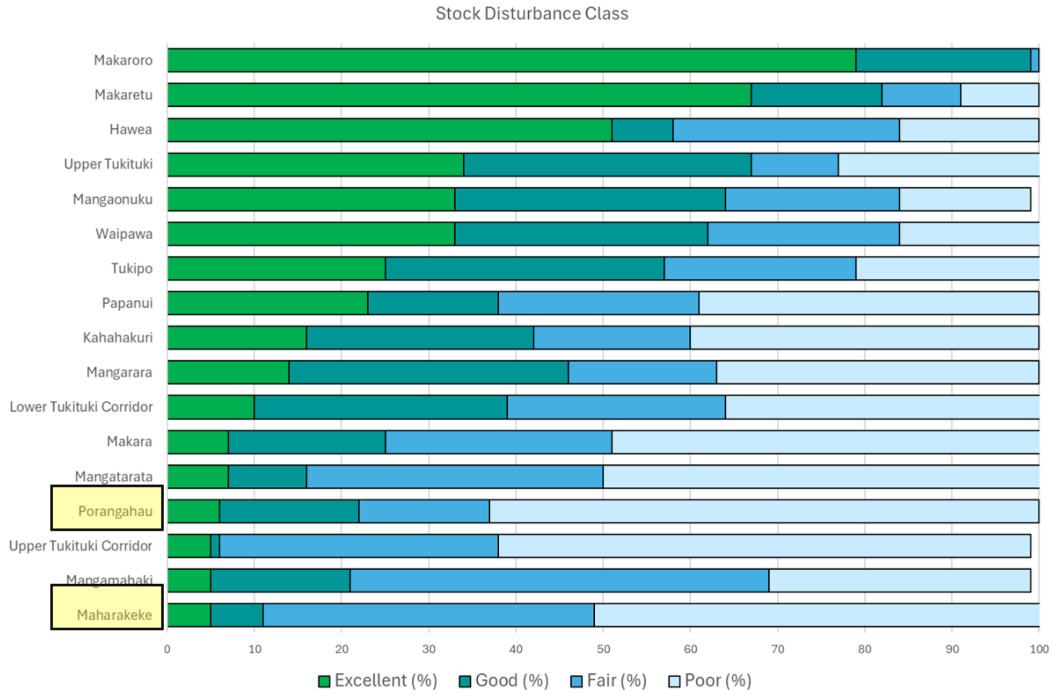


Figure 10 – Stock disturbance class from a 2014 survey. Undertaken as a desktop analysis by HBRC.

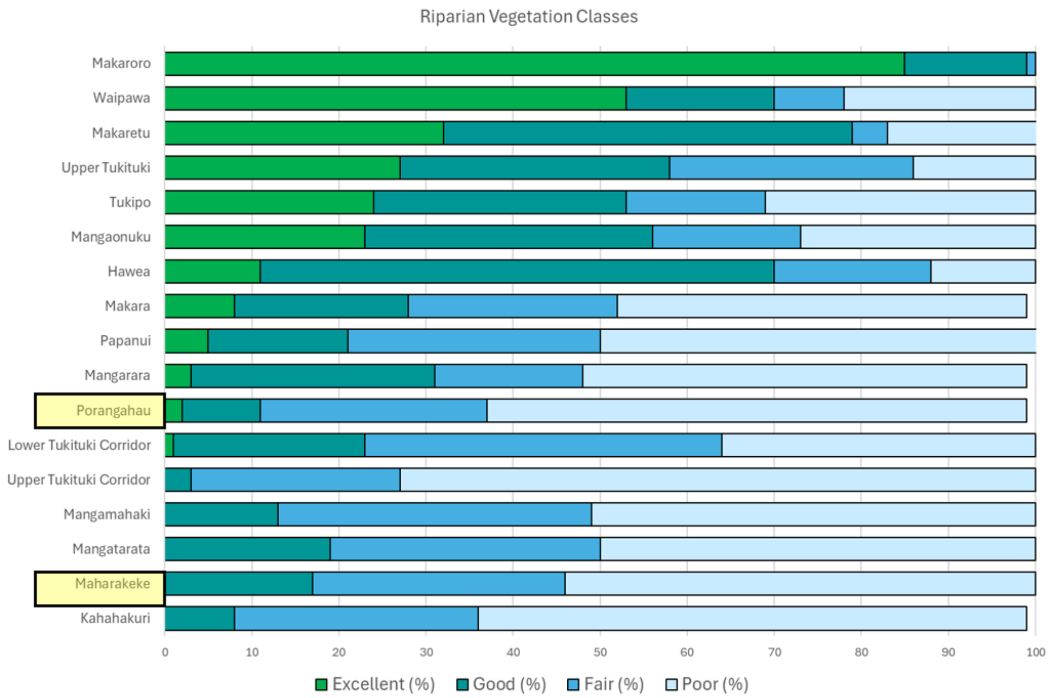


Figure 11 – Riparian vegetation class from a 2014 survey. Undertaken as a desktop analysis by HBRC.

4. Summary of Challenges, Impacts and Priority Actions

Objective area	**Water Quality**	**Land use and appropriate planting**	**Informed decision making to implement good practice on and maintain economic viability**
Challenge	High DIN and DRP levels, but little information about where it is coming from or how to manage it.	Planting is a key activity to reduce soil loss, build alternative revenue through the ETS and increase flood resilience. However information is lacking to help decision making	The major challenge is to support landowners make the best decions possible to reach outcomes
Impact	Waterway health reduced. Decline in aquatic biodiversity. Regulation risks.	Investment in afforestation that doesn't meet catchment or landowners objectives.	Studies indicate farm planning can make an marked difference for water quality and increase efficiency.
Priority action	1.Focus sediment management practices on highly eroded land 2. Map, implement and measure effectiveness of edge of field mitigations 3. Implement high priority good practice on farms.	Build and communicate a decision support tool for planting to meet multiple outcomes. Support farmers to make appropriate decisions through effective communication and training	Promote the use of the good practice decision support tool and expert advice where needed.

Figure 12 – Summary of the challenges, impacts and recommended priority actions for the WOWMAP sub-catchment, farmed against the three major objective areas.

5. Implementing Actions

5.1. Catchment Overview

In these sub-catchments, nitrogen loss varies across the landscape, with some areas being more susceptible than others. While well-drained soils in certain locations allow nitrogen to move more freely through the soil profile, flatter areas with gley soils tend to denitrify. These flatter zones are also well-suited for constructed wetlands due to their low slope, denitrifying soil properties, and the likelihood of high-nitrate springs emerging from areas in the upper sub-catchments where nitrogen loss through the soil is greatest.

5.2. Farm Management and Mitigation Strategies

Farmers across the sub-catchments could focus on implementing good farm management practices suited to their land characteristics. The WOWMAP Catchment Group may wish to support this by facilitating farmer-to-farmer learning opportunities or engaging specialist advice to enhance sustainable land management.

Additionally, guidance materials, such as TLC's On-Farm Action Planning Tool, provide practical recommendations for prioritising farm management actions (see appendix 1).

Focussing initially on soil loss in the upper sub-catchments (reducing P and sediment), good practice nitrogen mitigation in high loss areas (figure 8) and good practice P management in the lowland areas.

While there is no single solution to reduce P and N, studies in New Zealand have shown that adopting good farm planning practices and planting erosion prone areas can significantly reduce nutrient loss to water.

5.3. Constructed Wetlands and Edge-of-Field Mitigations

Given the landscape characteristics of this sub-catchment, constructed wetlands, detention bunds and perhaps even bioreactors present a valuable opportunity to intercept and treat high-nitrate water before it reaches waterways. Flatter areas with gley soils are particularly well suited for these edge-of-field mitigations due to their low slope, natural denitrification potential, and the presence of springs carrying nutrient-rich water from upslope areas. Sub-catchment groups in the Tukituki can use the maps developed in The Big Picture project to select where these edge-of-field mitigations could be established, figure 14.

The WOWMAP Catchment Group could identify and test spring-fed water sources to determine the highest nitrogen loads, prioritising mitigation efforts accordingly. Constructing wetlands or bunds at these strategic locations can significantly reduce nitrate levels in water, with typical nitrate reduction rates ranging from 50–70%, and in some cases, up to 95% (e.g. Pekapeka Figure 13). For detailed guidance on the design and construction of effective wetlands, the Constructed Wetland Practitioner Guide provides useful information (Figure 13) (NIWA Guide).

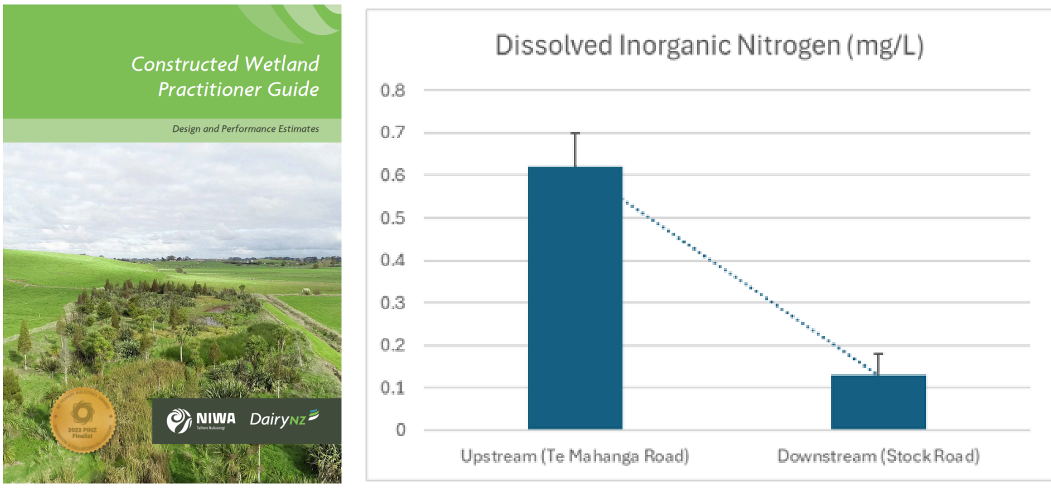


Figure 13 – Left - Constructed wetland practitioner guide. found at: https://niwa.co.nz/sites/default/files/Constructed%20wetland%20practitioner%20guide-web%20-Final%20Rev1.1.pdf. Right - Monitoring from the Pekapeka wetland demonstrating the potential effectiveness of DIN reduction of a wetlands.

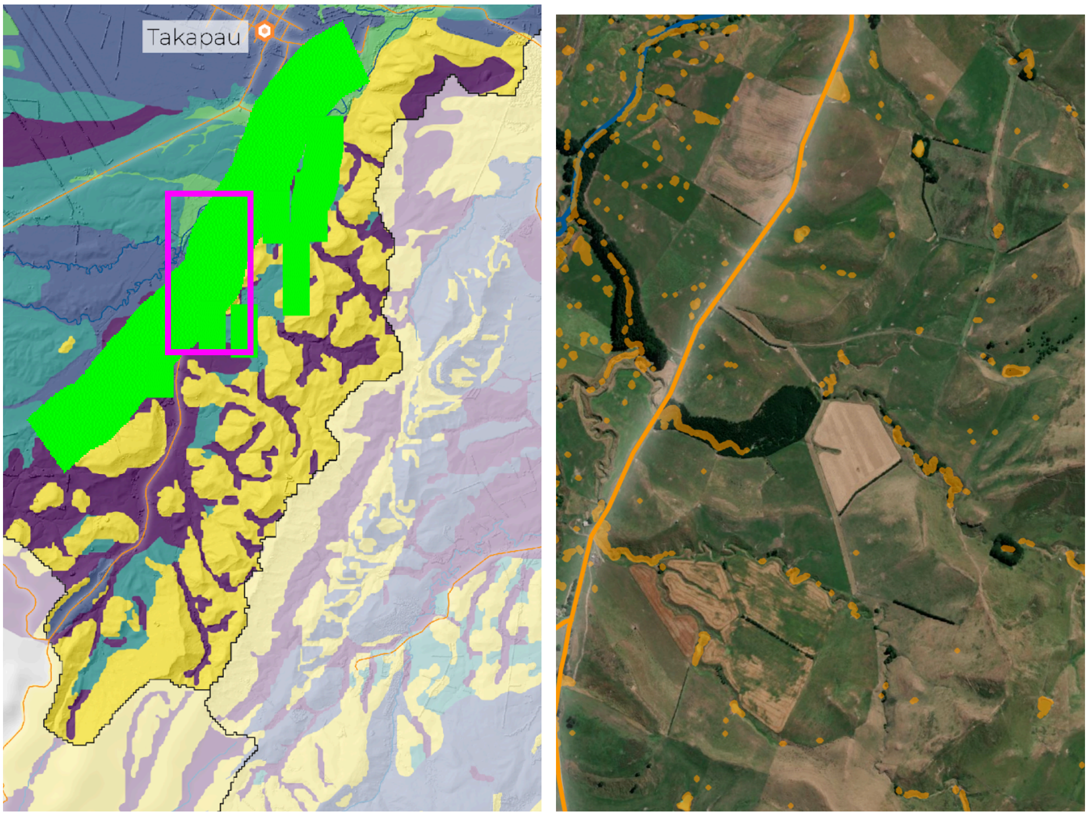


Figure 14 – Left - High loss nitrogen areas in the Porangahau sub-catchment. Right – Possible areas for edge of field mitigations to be installed in this area inset. Highlighted green left.

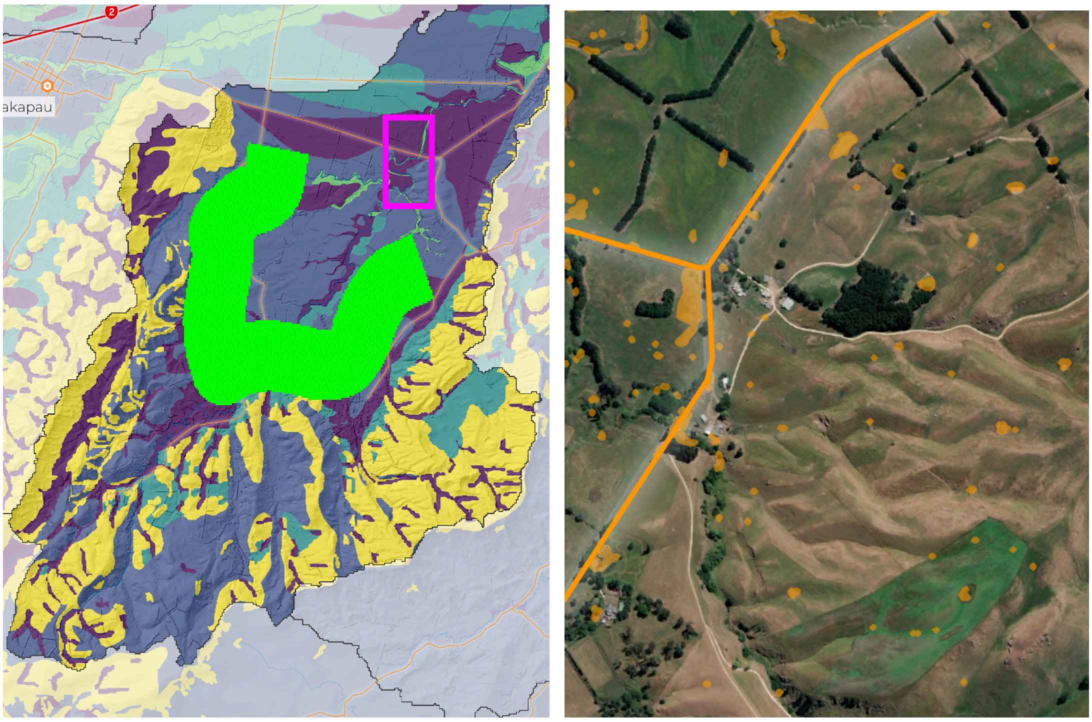


Figure 15 - Left - High loss nitrogen areas in the Maharakeke sub-catchment. Right – Possible areas for edge of field mitigations to be installed in this area inset. Highlighted green left.

5.4. Planting decision support

Many of the good practice actions in the sub-catchment will require planting. This includes managing critical source areas, constructed wetlands, planting eroded sites and managing waterways.

To support farmers in making good decisions, TLC have developed a Plant Selection Tool. This tool will help meet objectives for planting and ideally reduce costs by planting the right trees in the right places for each project. See Appendix 3 for the Plant Selection Tool. Note that this tool is updatable and can be further refined to support landowners in the Tukituki catchment.

Figure 16 – Farmers in the Tukituki are planting a wide range of landscapes from wetlands to hill country erosion areas.

6. Proposed Implementation Steps and Estimated Costs

1. Gain an improved understanding of water quality in the sub-catchment. Start by measuring flow and water quality of smaller tributary areas. Undertake a snapshot survey.
    a. This will help support operational decision making around action but will jot be useful beyond that unless a long-term monitoring programme is implemented.
    b. Estimated cost: $3,000
2. In identified high nutrient loss catchments from step 1. Identify spring areas and waterways that could support nutrient management actions like constructed wetlands to be implemented.
    a. Use existing mapping tools provided by The Big Picture to identify these sites
    b. Undertake a prioritisation of remediation of these sites to ensure the most cost-effective sites are implemented first.
    c. Create a demonstration site. Include cost effective monitoring design
    d. Estimated cost: Prioritisation: $2,000; demonstration: $35,000; monitoring $5,000
3. Support farmers to implement good practice actions that are most suited to their conditions
    a. This could be in-kind through TLC Catchment Coordinators or local farmers or through consultants
    b. Estimated cost: $0 (recommend using existing communication channels)

APPENDICES

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

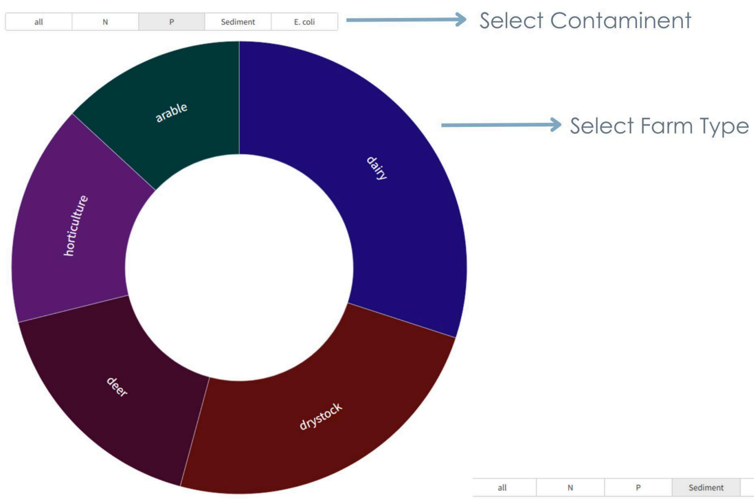
This decision-support tool is designed to help farmers identify and prioritise cost-effective environmental actions on their farms. Use the filters to explore mitigation options by contaminant and farm type.

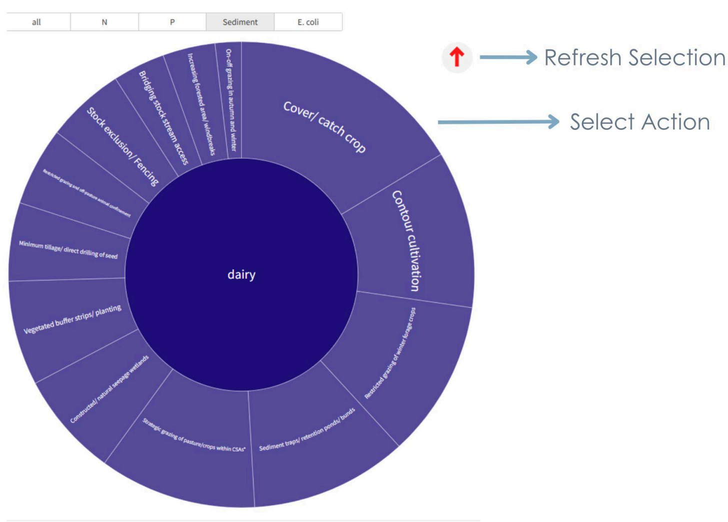
The larger the section, the greater the impact and cost-effectiveness of the mitigation. Recommended actions are displayed in descending order, starting from the top and progressing clockwise around the circle.

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.





8. Appendix 2: TLC Plant Selection Tool

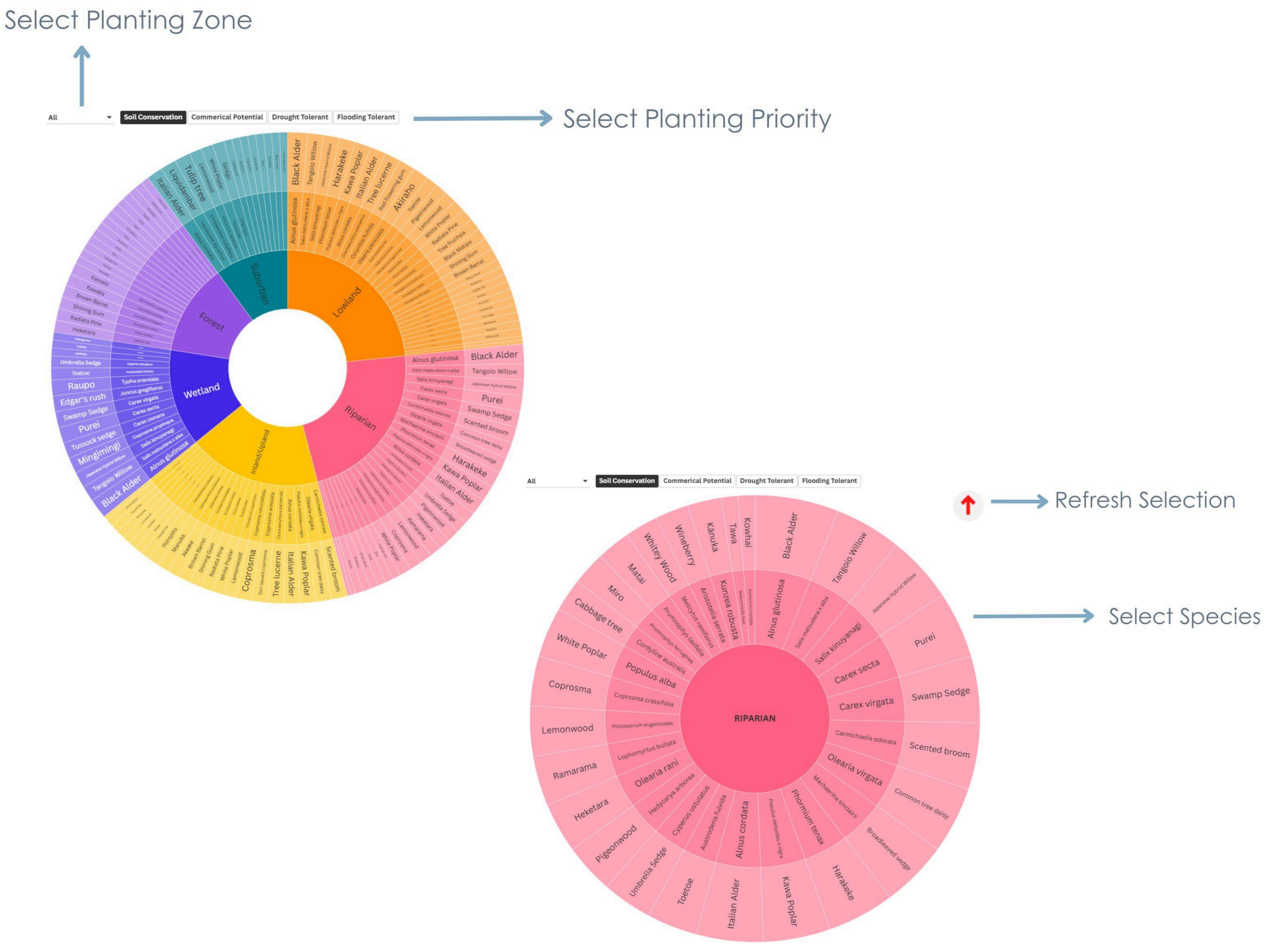
This decision-support tool is designed to help farmers choose the right plants for on-farm environmental projects by matching the planting zone and soil type with suitable species.

Use the filters to explore options based on your specific conditions and requirements. The larger the section, the better suited the plant is to the selected environment. Recommended plants 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 Plant Selection Tool and follow these steps:

1. Select the planting zone from the drop down list.
2. Select your planting priority.
3. Select a species for more information.
4. Click the red arrow to reset your selections.



9. Appendix 3: Highly Erodible Areas

9.1. Highly erodible areas using mapping

Each sub-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 ·K ·LS ·C ·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 sub-catchment, where soil loss is mostly likely and where to prioritise soil conservation measures

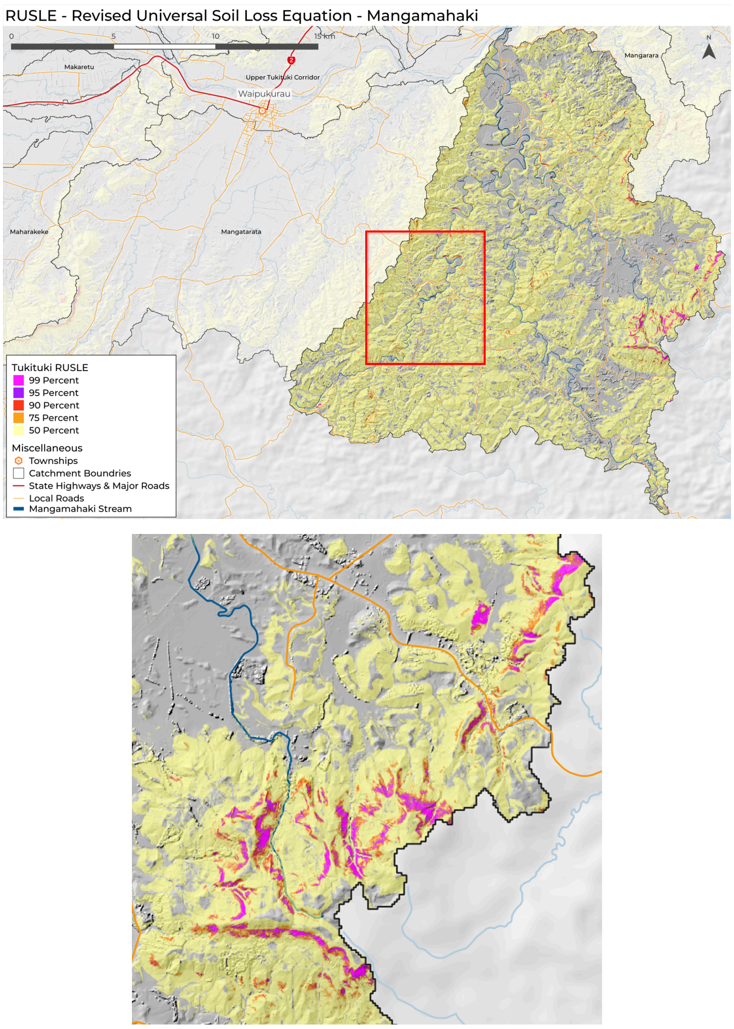


Figure 14 – RUSLE model at sub-catchment scale. High risk erosion is mapped at 99%, 95%, 90%, 75% and 50%, throughout the Tukituki catchment.

9.2. 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.

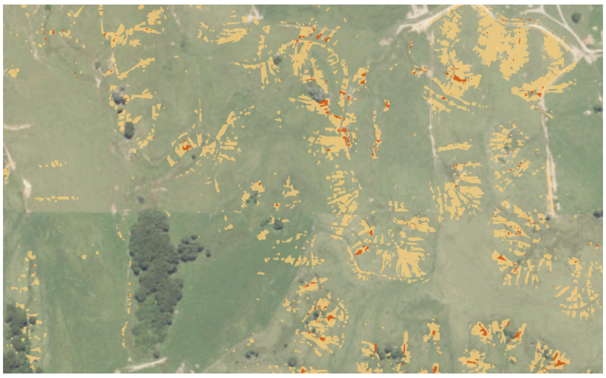


Figure 15 – From a farm planning point of view the RULSE can be used to prioritise areas to implement soil conservation measures.

10. Appendix 4: Flow mapping to understand sites for sediment trapping

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

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.

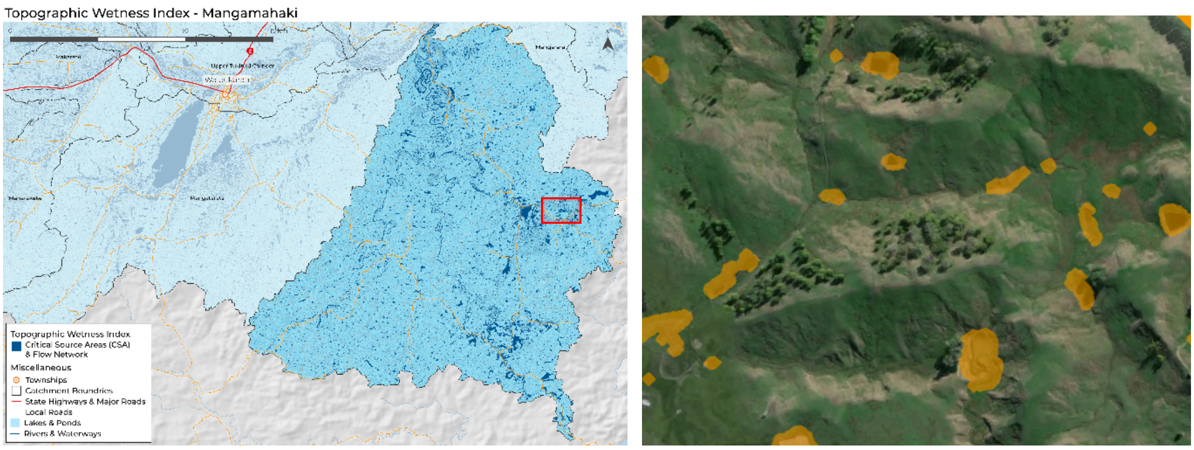


Figure 16 - TWI example in a sub-catchment. Using the data layers supplied by EIS will enable exploration of the data using GIS or Google Earth.

[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.

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 sub-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.

Figure 17 – Examples of edge of field mitigations, from large detention bunds, large wetlands through to in-line or off-line sediment traps.