

Tiromoana Bush

Restoration Management Plan



July 2022 – June 2027

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INTRODUCTION

In 2004 Transwaste Canterbury Ltd., a public-private joint venture company, commenced a comprehensive restoration programme in the Kate Valley Conservation Management Area (referred to here as Tiromoana Bush; Appendix 1, Figure 1) as part of the mitigation for the establishment of the Canterbury Regional Landfill at Kate Valley which resulted in the loss of a small (<1 ha) stand of tawhai rauriki (black beech)¹. The restoration project became a legal requirement of the resource consent for the operation of the landfill and aims to result in a substantial increase in the biodiversity values of Tiromoana Bush within the 35-years of the landfill resource consent.



Figure 1. Location of Tiromoana Bush (red line) in relation to the Kate Valley (Canterbury) Regional Landfill and adjacent public conservation land (yellow line).

A key assumption underlying the approach to the restoration of Tiromoana Bush is that management works with natural successional processes, using plant and animal pest control to allow natural regeneration and recolonisation by native species together with strategically located restoration plantings to facilitate and speed up these natural processes, but letting nature dictate eventual ecosystem composition and structure appropriate to the site's environment. The restoration being undertaken is a mix of the minimum interference management approach that has been used successfully at Banks Peninsula sites such as Hinewai Reserve and the more active planting approach that is being used successfully at a range of sites throughout Aotearoa New Zealand.

This 2022-2027 restoration plan is the fourth for Tiromoana Bush and builds on the restoration management work that has been implemented over the eighteen years since the

¹ Scientific names of plants and animals mentioned in the text are listed in Appendix 2.

project started in 2004. The biodiversity outcomes from the last eighteen years have been substantial and are reviewed in Appendix 3. Unlike previous plans which have focused on a five-year period, this plan also considers a longer time frame, looking ahead to the next ten-years. While we need to continue to consolidate on what we have achieved over the last 18-years, we are now in a position where we can start setting in place more ambitious goals for the project and 10 years provides a suitable time frame for these. However, we still use five-years as the management planning framework within which annual work plans can be developed.

This management plan updates the overall vision and outcomes for the Tiromoana Bush restoration project and sets 10-year outcomes and five-year goals for management. The basic approach to restoration is similar to that outlined in earlier plans and involves the on-going exclusion of browsing pressure thus facilitating natural regeneration and recolonisation, the establishment of appropriate plant species through strategic restoration plantings, the encouragement of public access and use of the area for recreation, and on-going science and monitoring as tools to support and assess the success of these management actions. However, several new initiatives are also included including reintroduction of a locally extinct animal species and development of a much more active partnership with Ngāi Tūāhururi in project management.

This management plan is the guiding document for restoration. It provides the overview of the approach that will be taken in restoration, but is not prescriptive as it is difficult to predict in advance changing circumstances that might result as restoration develops, or changing biotic and abiotic factors that might influence restoration. Much of the detail included in earlier management plans is now included in appendices to this plan, thus allowing us to focus here on goals. The restoration management plan provides the general overview of the project while the annual restoration work plans provide the detail on the specific actions that will be undertaken to implement this plan. These work plans are produced annually in June/July, together with a review of the previous year's management work.

RESTORATION VISION AND GOALS

Introduction

Successful restoration is dependent on having clearly defined goals. Goals are important as they enable the success of restoration to be quantified and reported on, as well as allowing the restoration manager to evaluate and adapt the management approach. It is useful to set goals within a broader vision of what the site might be like at some stage in the future. However, it is not possible to use such a vision to assess the success of restoration because of the long time-frames involved and because of the uncertainties over future conditions (e.g. as a result of changing climate). For the Tiromoana Bush Restoration Management Plan, an overall vision of what the site might be like in 300 years has been developed to guide the project, with time-defined outcomes and goals identified to assess restoration success against.

While the restoration vision and 35-year outcomes were specified in the decision of the Environment Court granting resource consents for operation of the Kate Valley landfill (see Appendix 4), we have modified these slightly to better reflect the nature of the project today.

Our vision for Tiromoana Bush

Tiromoana – He Kitenga O Te Wāheke (A View To The Future)

Take a moment to imagine... standing here 300 years from now you will see before you a mosaic of forest and wetland. New Zealand's tallest tree – kahikatea - towers above wetlands, their buttressed roots holding firm. Mighty tōtara clothe the hillsides leading down to the coast, with patches of tawhai/black beech on the dry ridges. Trees echo with the voices of korimako/bellbird, tūī and the whirr of kererū wings. Wildlife flourishes and people visit to learn, recreate and enjoy.

Mō tātou, ā, mō kā uri, ā muri ake nei - For us and our children after us.

Thirty-five year outcomes

At the end of the 35-year resource consent period of the Kate Valley landfill (2039), the following outcomes will have been achieved as a result of our management within Tiromoana Bush:

1. Vigorous regeneration will be occurring within the existing areas of shrubland and forest sufficient to ensure that natural successional processes are leading towards the development of mature lowland forest appropriate to local conditions.
2. The existing korimako (bellbird) population has expanded and kereru (native pigeon) are now residing within the area. The species and abundance of native water birds have also been enhanced².
3. The tawhai rauriki (black beech) forest remnant known as “Remnant B” has been secured and enhanced in terms of the area of tawhai rauriki and at least one additional tawhai rauriki stand has been established³.

² Water birds have been added here as they are likely to respond to the wetland restoration efforts.

³ This outcome was previously separated into two outcomes but with the same wording.

4. Restoration plantings and natural regeneration will have been sufficient to ensure good connectivity of regenerating forest between Remnant “B”, Ella Bush Significant Natural Area and Tiromoana Scenic Reserve.
5. Restoration plantings have been used to re-establish locally rare vegetation types.
6. The area is being actively used for recreational, educational and scientific purposes.

Where we would like to be in ten years’ time (2033)

Based on the review of what we have achieved over the last 18-years (Appendix 3), we have identified four key outcomes that we would like to see resulting from our restorative management at Tiromoana Bush over the next ten-years. While our review of biodiversity outcomes from the past 18-years indicates that we are already well on course to realising the 35-year outcomes specified in the Kate Valley landfill resource consent (Appendix 4), these four ten-year outcomes are intended to extend on what we have already achieved and establish Tiromoana Bush as an exemplar for enhancing native biodiversity in North Canterbury. By 2033 we would like to see the following achieved:

- Restoration plantings have established a substantial area of developing kahikatea forest while enrichment plantings of tōtara and mataī have established future seed sources for natural recruitment of these species into the naturally regenerating shrublands and forests and restoration plantings on the site.
- A breeding population of kororā (little blue penguins) have been successfully established along the coastline of Tiromoana Bush and on the adjacent Glenafric Station.
- Ngāi Tūāhuriri are actively involved in the Tiromoana Bush restoration project, being engaged in management, interpretation, and future project planning.
- Tiromoana Bush forms the hub of a wider and active conservation project encompassing the area between the Waipara River, State Highway 1 and Motunau Beach Road.

Five-year goals

In order to ensure that both the 35-year resource consent outcomes and the new 10-year outcomes identified here are achieved, we have identified 14 goals to guide restoration management over the 2022-2027 period. For each goal we have identified specific management actions that are required to meet the goal. These management actions will be included in the annual restoration work plans. More detailed comments on the approach to implementing these goals, including location maps, is included in the next section.

Goal 1: Positively engage with Ngāi Tūāhuriri in a way that creates the opportunity for their active partnership in the Tiromoana Bush restoration project.

Explanation: Ngāi Tūāhuriri are mana whenua for the land on which Tiromoana Bush is located. Their active partnership in this restoration project is one small step to both recognise their being mana whenua and to allow them to connect to their land. Active partnership does not impose any obligations on Ngāi Tūāhuriri.

Actions

- 1.1 Explore with Ngāi Tūāhuriri if they see value in a partnership and if they do, how they would like to see this develop (ongoing).

Goal 2: Undertake annual reviews of management work and produce annual work plans.

Explanation: Project management requires regular review of progress and the development of annual work plans to guide day-to-day management. Provisional time frames have been given to the management actions in this plan but depending on progress, these need to be updated for the annual work plan.

Actions

- 2.1 Undertake an annual review of management activities and monitoring results (annually in April).
- 2.2 Prepare the following years workplan and its associated budget (annually in April).

Goal 3: Control introduced mammalian pests to levels that do not threaten the restoration plantings, natural regeneration, or the native fauna in Tiromoana Bush.

Explanation: Mammalian pests are the single biggest threat to the success of ecological restoration projects in Aotearoa New Zealand. Herbivores can significantly affect the growth of plantings and natural regeneration while omnivorous pigs can also affect soils and their associated biota. Mammalian predators impact native fauna, especially birds and reptiles. Domestic livestock and feral deer will continue to be excluded through fencing, while pigs and small mammal predators will be controlled to levels that do not impact restoration outcomes, especially vegetation condition and fauna.

Actions

- 3.1 Continue casual monitoring of cattle and sheep and if present, shoot (ongoing).
- 3.2 Maintain deer fence (inspect annually) to exclude deer and pigs as much as possible (annual).
- 3.3 Continue casual monitoring for deer sign and if present, shoot (ongoing).
- 3.4 Continue to suppress pigs to as a low a level as possible, focusing on regular control rather than irregular one-off culls (ongoing).
- 3.5 Continue small mammal pest control (ongoing).

Goal 4: Key plant pests are controlled to levels that do not threaten biodiversity values.

Explanation: Plant pests threaten the viability of a range of plant communities including regenerating forest, restoration plantings and wetlands, especially through competition, although this plan is pragmatic and recognises that not all exotic plants are necessarily pests. In particular, gorse and European broom are being allowed to expand naturally as they act as a nurse crop for native forest regeneration. However, as the bush recovers, various plant pests are likely to be found and surveillance and control of these species in a systematic manner is required for the key species threatening biodiversity values (e.g. wilding conifers, willows, old man's beard, hawthorn, cherry plum).

Actions

- 4.1 In conjunction with Waiora Landscapes, review weed control zones and priority weed species (2022/23).
- 4.2 Continue systematic weed control focusing on priority weed species (ongoing).

Goal 5: Restoration plantings focus on restoring kahikatea-dominated forest and associated wetland vegetation across the floor of Kate Valley.

Explanation: Kahikatea forest is a regionally and nationally rare ecosystem and there is a reasonable area of potentially suitable habitat for this forest type in Tiromoana Bush. Some initial plantings have already been undertaken and this goal sets out a management regime to meet the 10-year outcome of having the floor of Kate Valley established in regenerating kahikatea forest.

Actions

- 5.1 Restoration plantings in the floor of Kate Valley continue annually.
- 5.2 At least one 10x10 monitoring plot is established each year in these plantings (annually after plantings have been completed).

Goal 6: Continue to enrich site with tōtara and mataī.

Explanation: While there is prolific natural regeneration in the understorey of shrubland and forest areas, this is mainly dominated by a small group of angiosperm trees, especially māhoe. Tōtara and mataī would have been dominant in the pre-human forest but seed sources for these are distant from Tiromoana Bush and it will likely take many decades, if not centuries for these species to naturally re-establish. It is therefore proposed to build on existing tōtara plantings to systematically establish a substantial seed source on site to speed up the transition to a more diverse podocarp-angiosperm forest.

Actions

- 6.1 Plant approximately 100 each of tōtara and mataī annually in suitable sites (edges and gaps of existing regenerating forest and shrubland, and into restoration plantings) (annual).

Goal 7: Consolidate tawhai rauriki (black beech) plantings.

Explanation: Securing and enhancing the remnant stand of mature tawhai rauriki (black beech) (Remnant “B”) and establishing at least one additional tawhai rauriki population is one of the 35-year outcomes (Outcome 3) for Tiromoana Bush. Tawhai rauriki has now been planted in three additional locations at Tiromoana Bush, with plantings showing good growth rates, although no plants have been established adjacent to Remnant “B”. It is proposed to plant tawhai rauriki adjacent to Remnant “B” and to enhance two of the existing planted sites so that they are of sufficient size to form viable long-term tawhai rauriki forest stands.

Actions

- 7.1 Source tawhai rauriki seed from a range of coastal North Canterbury sites (2022/23).
- 7.2 Plant tawhai rauriki adjacent to Remnant B and expand two existing tawhai rauriki plantings so that both contain a minimum of 200 plants in each planting (adjacent to remnant B and the two new plantings) (2023/24 onwards).
- 7.3 Tag and monitor all new plantings, and existing planted tawhai rauriki trees as well (2023/24 onwards).

Goal 8: Undertake gap creation to facilitate natural regeneration through all existing seral kānuka low forest stands.

Explanation: Seral kānuka stands occur widely across Tiromoana Bush with most stands establishing on eroded sites within pasture in the last 50-70 years. While removal of livestock grazing has seen a rapid response in the understorey of these stands, māhoe is by far the most dominant species with other potential future canopy tree species (tarata (lemonwood), whauwhaupaku (five finger), putaputaweta (marbleleaf) etc) rare. Research trials have shown that the creation of small canopy openings can increase the diversity of regenerating tree species and it is proposed to start using this as an active management tool.

Actions

- 8.1 Engage contractors to cut up to two gaps/ha across kānuka stands (2023/24).

Goal 9: Undertake due diligence work necessary for introduction of kororā (little blue penguins) in Tiromoana Bush and at Glenafric Station.

Explanation: Tiromoana Bush provides the potential for reintroduction of kororā (little blue penguins) which while present and actively breeding on Motunau Island ca. 20 km northeast up the coast, are largely absent from the mainland coast. However, before this can be

undertaken, factors that would threaten the success of such a reintroduction need to be addressed (especially predation) and a partnership formed with Ngāi Tūāhuriri to make the case for the necessary Wildlife Act permit from the Department of Conservation for reintroduction.

Actions

- 9.1 Visit Helps' property at Flea Bay to gain their ideas before commencing project (2022/23).
- 9.2 Start dialogue with Ngāi Tūāhuriri to gain their partnership (2022/23).
- 9.3 Have initial discussions with DOC about Wildlife Act requirements (2022/23).
- 9.4 Develop cooperation agreement to work with Glenafric for a joint proposal (2022/23).
- 9.5 Assess penguin presence, habitat quality and pest predation pressure at both sites (2023/24).
- 9.6 Support Glenafric to obtain funding for pest control (perhaps from ECan) (2023/24).
- 9.7 Implement Glenafric pest control. (2023/24)
- 9.8 Prepare Wildlife Act permit application to transfer adult females to both sites (2024/25).

Goal 10: Continue and expand biodiversity monitoring.

Explanation: A comprehensive monitoring system for vascular plants and birds within existing areas of shrubland and forest, and general land cover monitoring across the whole of Tiromoana Bush has been established. It would, however, be informative for future management if the monitoring network was expanded to include vascular plants in other land cover types (e.g. gorse and broom shrubland) and other animal groups (e.g. invertebrates and reptiles) to enable the success of restoration management to be assessed more widely. This goal seeks to address this issue, while recognising that monitoring does require resources and needs to be undertaken in an efficient manner. In particular there are a wide range of approaches to invertebrate monitoring, many of which involve considerable technical expertise. However, some monitoring of key invertebrate groups (e.g. wetas and snails) and reptiles can provide information on habitat quality. An initial survey of some of these taxa (especially the snail Wainuia, weta and reptiles) would provide a useful baseline for developing monitoring.

Actions

- 10.1 Continue annual photo-monitoring (annual).
- 10.2 Repeat 5-min bird monitoring for one year only (2022/23).
- 10.3 Install cacophony bird recorders at five sites and run continuously (2022/23).
- 10.4 Establish two weta motels at bird monitoring sites and check annually (2022/23).
- 10.5 Establish lizard monitoring at five sites (sites to be determined), with three artificial retreats at each following standard DOC protocols (2023/24).
- 10.6 Repeat forest Recee plots and re-photograph (2022/23 & 2026/27).
- 10.7 Repeat forest BA survey (2026/27)
- 10.8 Repeat small mammal pest monitoring using tracking tunnels and chew cards (2022/23 & 2026/27).

Goal 11: Make local schools aware of the opportunities Tiromoana Bush offers and facilitate them in utilising this resource.

Explanation: A dedicated effort is required to make local schools aware of the opportunities Tiromoana Bush offers and to facilitate them utilising this. Today's children will be tomorrow's decision makers and taxpayers, and having the local community fully engaged with this project will be a massive boost for insuring both its long-term success and the success of conservation more generally in Aotearoa. This requires developing a dialogue with local primary and high schools in Rangiora, Kaiapoi, Amberley and Hawarden.

Actions

- 11.1 Identify schools and teachers to contact (2022/23).
- 11.2 Run a half-day field tour at Tiromoana Bush for teaching staff highlighting what the restoration project involves and what opportunities might be present for class activities (summer 2022/23)

Goal 12: Promote the potential of Tiromoana Bush for teaching and research to academic staff at Canterbury tertiary institutions.

Explanation: While Tiromoana Bush has been used extensively for teaching and Research by Professor David Norton (University of Canterbury), we are only aware of one other use by a tertiary institute. With the retirement of Professor Norton it is important that the momentum for the use of the area is not lost and relevant academic staff are actively encouraged to use the area.

Actions

- 12.1 Contact relevant academic staff with copies of this management plan encouraging them to visit and use the bush (2022/23).

Goal 13: Better interpret the Tiromoana Bush project to the wider public.

Explanation: There are still opportunities to better interpret both the restoration project itself and the importance of the area to Ngāi Tūāhuriri along the Tiromoana Bush Walkway through installation of further interpretative material.

Actions

- 13.1 Work with Ngāi Tūāhuriri to develop interpretative material for the Pou Ika (2022/23, 2023/24).
- 13.2 Develop two additional interpretative panels focusing on the restoration work – perhaps plantings and natural regeneration within the existing forest areas (2024/25).

Goal 14: Tiromoana Bush forms the hub of a wider and active conservation project encompassing the area between the Waipara River, State Highway 1 and Motunau Beach Road.

Explanation: The Hurunui Biodiversity Trust (www.hurunuibiodiversity.org) was established in late 2018 with the mission to inspire and enable Hurunui's landowners / kaitiaki / custodians and the wider community to understand, value and enhance our district's varied biodiversity, with particular focus on indigenous biodiversity. There has, to date, been no direct input from the Tiromoana Bush restoration project but there is ample opportunity for greater interaction in the future with opportunities for open days focusing on the types of management being implemented providing an opportunity to assist the wider community implement active conservation management with a particular focus on the area between the Waipara River, State Highway 1 and Motunau Beach Road.

Actions

- 14.1 Run field days for adjacent landowners and others within the Hurunui Biodiversity Trust area showcasing the management being undertaken at Tiromoana Bush (2023/24, 2025/26).

IMPLEMENTING RESTORATION

A number of factors have the potential to constrain or limit the success of management in achieving the 35-year restoration outcomes, and ultimately the long-term vision for the site. Constraints to restoration include those associated with the abiotic, biotic, and socio-economic environment and are discussed further in Appendix 5.

Restoration management involves a range of actions including establishing restoration plantings, plant and animal pest control, monitoring and provision of public access around the site. The specific methods used for these meet current best practice guidelines and are continually reviewed in consultation with the individuals and organisations contracted to implement them. People undertaking specific activities such as plant and animal pest control must have appropriate certification for the use of herbicides and pesticides.

In this section, the management actions that will need to be implemented to achieve the five-year goals outlined earlier are briefly reviewed.

Animal pest control

A number of introduced animal pests including brushtail possums, stoats, ferrets, weasels, feral cats, rats, mice, red and fallow deer, goats, rabbits, hares, pigs, hedgehogs and vespid wasps are likely to be present in or border on Tiromoana Bush. Domestic livestock may also come onto the site from time to time. The presence of both wild and domestic animals within the restoration area will impact upon the restoration work proposed at Tiromoana Bush.

Animal pest control methods need to meet accepted best practice standards and the methods used will be kept under regular review. All animal pest control programmes will meet the legislative conditions and requirements set by the relevant Acts and Regulations of Parliament. All pest control operators will be required to have appropriate pesticide licences where required. Details of the methods to be used for animal pest control will be developed with the contractors undertaking the work based on current best practice guidelines.

For the period of this management plan the main animal pest control actions will be focused on removing any domestic livestock, feral deer and pigs that are found within Tiromoana Bush deer fence. Occasional control of hares/rabbits and Canadian geese is also undertaken on an “as required” basis. Deer and pig control is undertaken by qualified hunters under the control of Canterbury Waste Services (CWS) division of Waste Management NZ Ltd. No other hunting is allowed. All dead deer and pigs are to be removed from the property and disposed of in a suitable manner where practicable. The Tiromoana Bush Walkway will be closed during any hunting operations. Any domestic livestock encountered will also be shot during these operations. Rabbit, hare and Canadian geese control are undertaken by contract shooting on an ‘as required’ basis in Tiromoana Bush as organised by CWS and again the walkway is closed. Small mammal pests (brushtail possums, stoats, ferrets, weasels, feral cats, hedgehogs, rats and mice) are controlled using a trap station network involving DOC200 and Timms traps and follows currently accepted best practice. The trap network is checked monthly.

Plant pest control

All plant pest control will meet national and regional legislative requirements, especially any obligations imposed through the Regional Pest Management Strategy, and will follow best-practice guidelines. All staff involved in weed control work will be required to have appropriate licences for handling any chemicals involved. Details of the methods to be used for plant pest control will be developed with the contractors undertaking the work and will be based on current best practice guidelines.

Weed species, especially woody ones, can limit the success of the restoration programme as they out-compete planted species and natural regeneration resulting in reduced growth rates and mortality. Key woody weeds that are of concern include wilding conifers, willows (crack and grey), cherry plum, hawthorn, willow, and old man's beard, which are all present at Tiromoana Bush, and barberry and blackberry which although not yet recorded at Tiromoana Bush are present in the wider area. To ensure a coordinated approach to woody weed control, Tiromoana Bush has been split into five zones, with systematic surveillance and weed control undertaken in one zone each year (Figure 2). It is, however, proposed to review both the priority weeds and the weed control zones to ensure that they are fit for purpose.

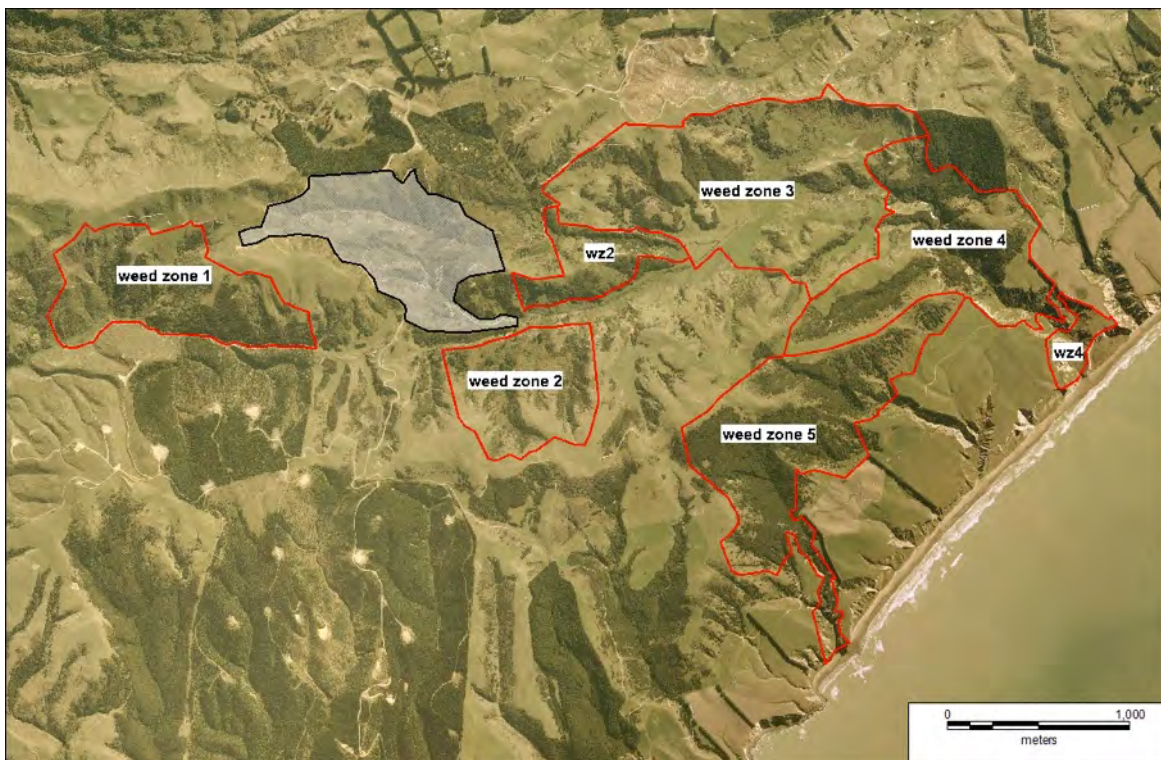


Figure 2. Woody weed control zones at Tiromoana Bush.

Gorse and European broom are being allowed to regenerate across Tiromoana Bush so that they can act as nurse plants for forest regeneration because of (1) the high costs associated with controlling them, (2) the potential of by-kill of native regeneration when controlling these species, and (3) the known ability of gorse and broom to invade rank grassland and provide a suitable environment for indigenous forest regeneration. However, both species also present a considerable fire risk and a key component of restoration management is to maintain

a total-fire ban within Tiromoana Bush and to limit public access during periods of high fire risk.

The operative Regional Pest Management Strategy for Canterbury outlines rules relating to the control of European broom (7.5.5) and gorse (7.6.5). [The two rules are identical in wording and only that for gorse is included here.]

7.6.5 Strategy rules for gorse

- (a) *Land occupiers shall eliminate gorse infestations that cover up to 50 square metres in area and are greater than five metres from other gorse infestations exceeding 50 square metres in area on the land that they occupy.*

For the purpose of this rule eliminate means the permanent preclusion of the gorse plant's ability to set viable seed.

- (b) *Land occupiers shall eliminate gorse infestations on the land that they occupy within 10 metres of any adjoining property occupied by another land occupier where that adjoining property is clear of, or being cleared of, gorse infestations within 10 metres of the boundary between the properties.*

For the purpose of this rule eliminate means the permanent preclusion of the gorse plant's ability to set viable seed.

Landowners are, however, allowed to apply for an exemption from this rule as outlined in Chapter 12 of the Regional Pest Management Strategy for Canterbury. In particular it notes that: “*Exemptions [may be] sought in situations where gorse and broom provide natural cover and a nursery for regenerating native bush and where exotic forestry is used as a control method. Any such exemptions would need to take account of possible spill-over effects on neighbouring properties.*” An exemption for Tiromoana Bush from clause (a) of these rules has been obtained.

The one herbaceous plant species present at Tiromoana Bush for which there is a specific regulatory requirement for control is nassella tussock. Under the Canterbury Regional Pest Management Strategy there is a requirement for annual control of nassella tussock.

6.2.5 Strategy rules for nassella tussock

- (a) *Land occupiers shall, on all the land they occupy, complete a control programme to prevent nassella tussock plants from seeding by:*
- (i) *31 October every year within the area delineated on Map 1 Appendix 3.*

Restoration plantings

This section outlines the broad approach to establishing restoration plantings in Tiromoana Bush. The main focus of restoration plantings in this planning period is on valley bottom kahikatea forests. As well as re-establishing representative vegetation types, restoration plantings provide habitat for native birds. The assumption is that these birds will in turn play a key role in dispersing planted species more widely through Tiromoana Bush. Among indigenous birds, kereru are frugivores and herbivores, while korimako, tui and tauhou (silvereve) are frugivores and nectarivores. Piwakawaka (fantail) and riorio (grey warbler) are

insectivores and it is assumed that a diversity of planted species is also required to support them as some of the invertebrates that are their prey are likely to be plant host-specific.

The general approach to planting encompasses five steps:

- Plant ecologically appropriate locally sourced species adapted to local conditions.
- Plant in late winter/early spring to avoid winter frosts but provide the longest possible time for root systems to develop before summer droughts occur.
- Use an herbicide application to kill pasture grasses and forbs prior to planting.
- Include fertiliser tab as required at planting.
- Undertake post-planting weed control as required.

Collection and propagation of plant material: Species choice for restoration is based on current species distribution patterns at Tiromoana Bush and in comparable sites, coupled with experience from existing restoration plantings at Tiromoana Bush. In addition, species choice is influenced by known growth rates (rapid growth species are preferred because they shade out the grass quicker) and the ability of particular species to provide suitable conditions for subsequent indigenous regeneration. Overall species choice represents a balance between those species that will grow best under the prevailing environmental conditions, are likely to contribute most to meeting the restoration goals for the site, and be most attractive to seed dispersing birds. The success of different plantings also provides strong guidance on suitable species.

Sources of plant stock for propagation to be grown at Tiromoana Bush are seeds from wild plants growing in the southern part of the Motunau Ecological District (except for kahikatea where plants may need to be sourced more widely – e.g. from Pūtaringamotu/Riccarton Bush). All collection of material for propagation will follow the appropriate guidelines with regard to *Threatened* and *At Risk* species, and all necessary permits and permissions will be obtained prior to collecting.

Site preparation, planting and post-planting maintenance: Primary site preparation involves using herbicides to kill pasture grasses prior to planting. Planting is undertaken manually with spacing appropriate to the species, but typically being 1.5 m. Fertiliser tabs are placed in planting holes. Plant guards are used to limit the impact of hares on plantings. Post-planting maintenance involves herbicide application or hand weeding where required. However, the basic approach to restoration taken here is that through appropriate site preparation and use of good quality plants, post-planting maintenance should be kept to a minimum. The intention is that once established, the restored areas should require minimal direct human intervention unless something unexpected occurs.

The timing of restoration activities during the year is largely dictated by climatic conditions and the plant growth patterns. The annual work cycle is focussed on late-winter/spring planting with the aim of gaining full benefit from the period when soil moisture is likely to be at a peak. However, plants must also be suitably hardened off prior to planting in order to withstand conditions at the time of planting. Sites protected from severe frost may be planted in late July, but in more frost-sensitive sites planting should be delayed until August or September. The following is a summary of the main restoration activities and their timing.

Autumn – planning for next years requirements.

Winter – site preparation, planting (late-winter).

Spring – finish planting, post planting maintenance.

Summer – seed collection, further post planting maintenance.

Planting focus: Restoration planting during the 2022-2027 period will focus on two main areas:

- The primary restoration focus is on restoring valley floor kahikatea forest. The floor of Kate Valley was drained at some stage during its farming history, with Kate Stream constrained within a linear drain. However, the formation of Kate Pond is gradually re-wetting the valley and creating conditions suitable for a wet kahikatea forest. While kahikatea is an open-site regenerating species, it appears to do best with some shelter and it is therefore proposed to plant the bulk of the valley bottom with a mixture of mānuka, mingimingi, harakeke (flax), ti kouka (cabbage tree), kōwhai and other species, with species choice reflecting local wetness. Kahikatea will be planted as part of this mixture aiming for at least one kahikatea every 3-6 m. The approximate location of this planting is indicated in Figure 3.
- Expansion of black beech adjacent to remnant B and of two existing black beech plantings (Figure 4) and establishing further mataī and tōtara both along the edges and in gaps in the existing naturally regenerating forests and shrub lands, and in restoration plantings.

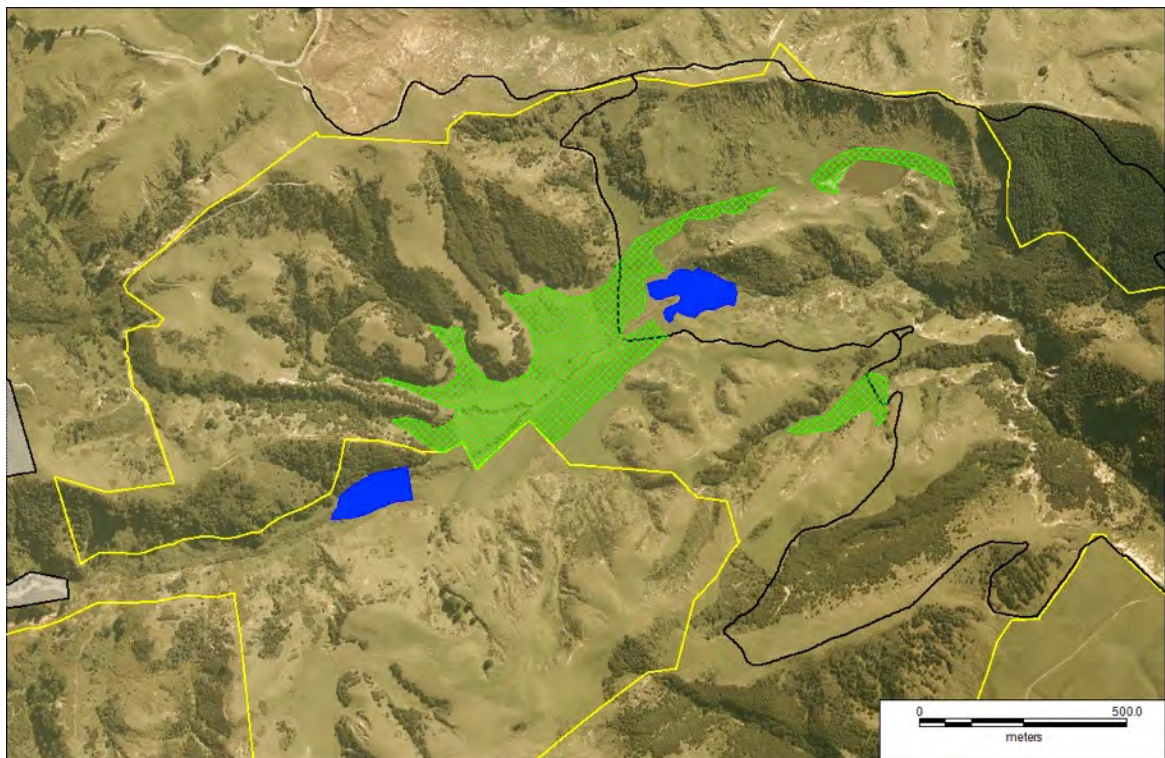


Figure 3. Approximate location of mixed kahikatea forest – wetland plantings (green crosshatch) for the 2022-2027 period.

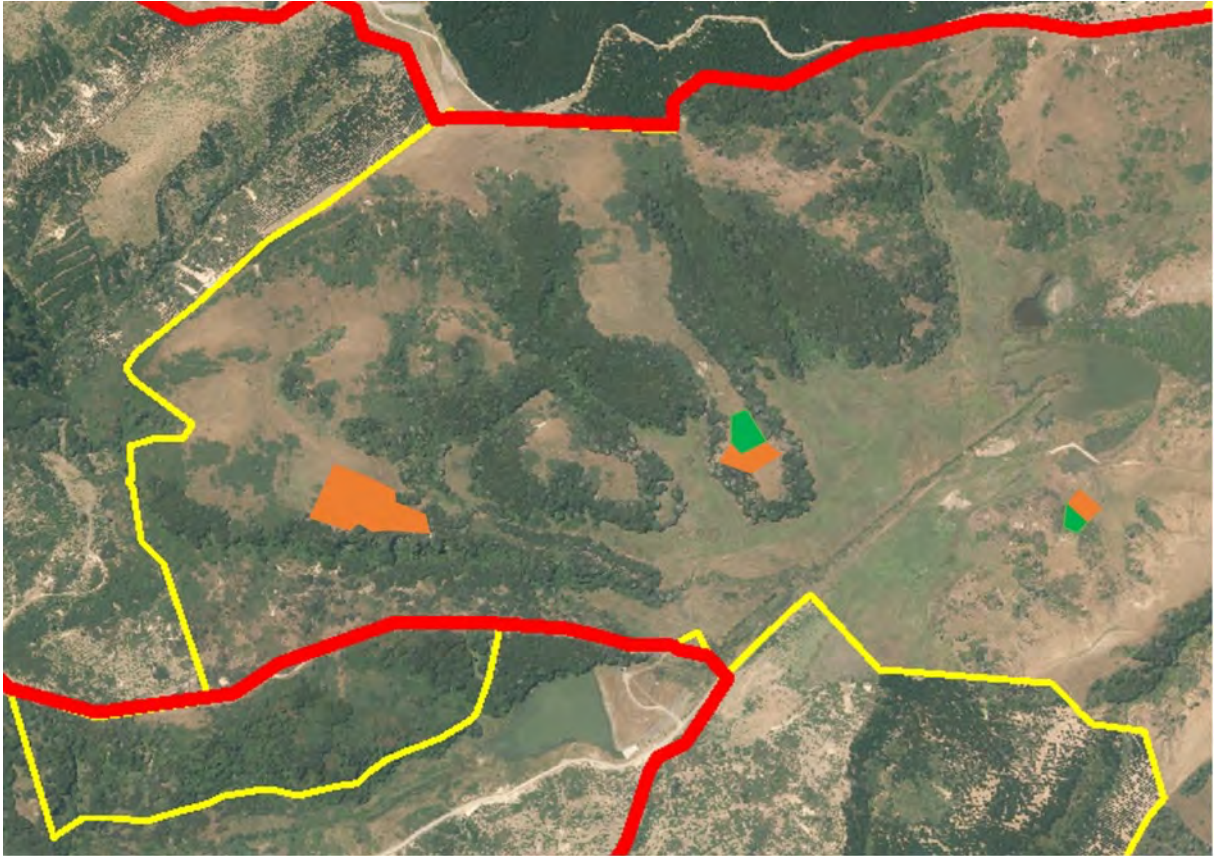


Figure 4. Approximate location of additional tawhai rauriki (black beech) plantings (brown) for the 2022-2027 period (existing plantings are marked in green).

In addition, it is proposed to cut gaps in established kānuka forest remnants to facilitate a greater diversity of understorey regeneration. Research by University of Canterbury PhD student Adrian Tulod⁴ showed that gap creation resulted in a significant increase in the number of species and density of woody regeneration including a wider range of woody species. Survival and growth of woody regeneration was also significantly greater in canopy gaps than beneath the intact kānuka canopy. It is therefore proposed to employ professional tree-fellers to create gaps of approximately 16 m² in the canopy which will involve felling 4-6 kānuka trees at each site, with 1-2 gaps created per ha. Locations of kānuka stands to be treated are indicated in Figure 5.

Fire management

Fire is one of the biggest threats to the Tiromoana Bush restoration project. Prevention of fire involves a total fire ban within Tiromoana Bush, liaison with adjacent landowners about the risks that fire poses to the project, maintenance of water supplies on site through the landfill water storage pond and Kate Pond, and restricting public access during periods of high fire risk. In addition, all management access to Tiromoana Bush will be restricted to foot access only during times of high fire risk and no track mowing will be undertaken at this time.

⁴ Tulod AM & Norton DA 2020. Regeneration of native woody species following artificial gap formation in an early-successional forest in New Zealand. *Ecological Management and Restoration* 21, 229-236.

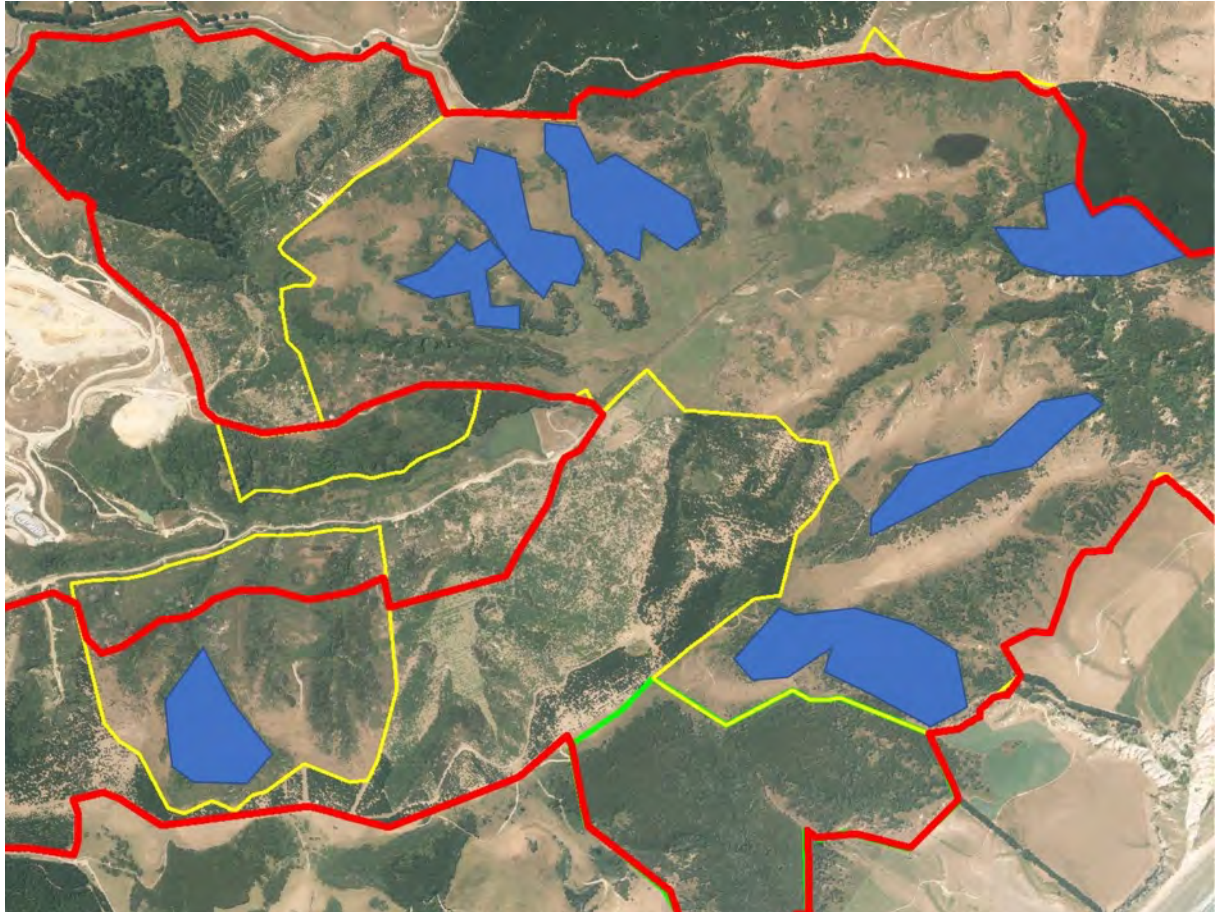


Figure 5. Kānuka stands suitable for gap creation (blue) over the 2022-2027 period.

Public access

The Tiromoana Bush walkway has been substantially upgraded with new signs and new tracks. This provides an approximately 2.5 – 3.5 hour round trip, as well as shorter options. The track is open all year except during periods when the fire risk is high (usually January-March). Dogs and mountain bikes are prohibited on the track. The track is maintained by mowing regularly through the summer, toilets are available, and signs are in place showing the different routes.

Interpretative panels have been located in two locations along the walkway and further interpretation is proposed relating to the importance of this area to Ngāi Tūāhuriri, the iwi with mana whenua over this part of Canterbury (at the Pou Ika) and on the restoration activities. Development of these new interpretative signs will complement the design approach of the existing signs.

Tiromoana Bush has had some use by schools, but this needs to be strengthened. It is proposed that during the life of this management plan that schools will be approached on a more proactive manner with the aim being to ensure that there are regular school visits.

Monitoring

Current monitoring within Tiromoana Bush comprises a network of panoramic photo-points that have been rephotographed annually (in December), permanent vegetation plots and bird monitoring sites. In addition, restoration monitoring plots have been established. It is proposed to continue the established monitoring and establish new monitoring as follows:

- Continue annual photo-monitoring (December each year).
- Repeat 5-min bird monitoring in October 2022 and install cacophony bird recorders at five sites (Figure 6) and run continuously.
- Establish two weta motels at bird monitoring sites and check annually.
- Establish lizard monitoring at five sites (to be determined), with three artificial retreats at each following standard DOC protocols.
- Repeat forest Recee plots and re-photograph in 2022/23), and repeat together with BA measurements in 2026/27.

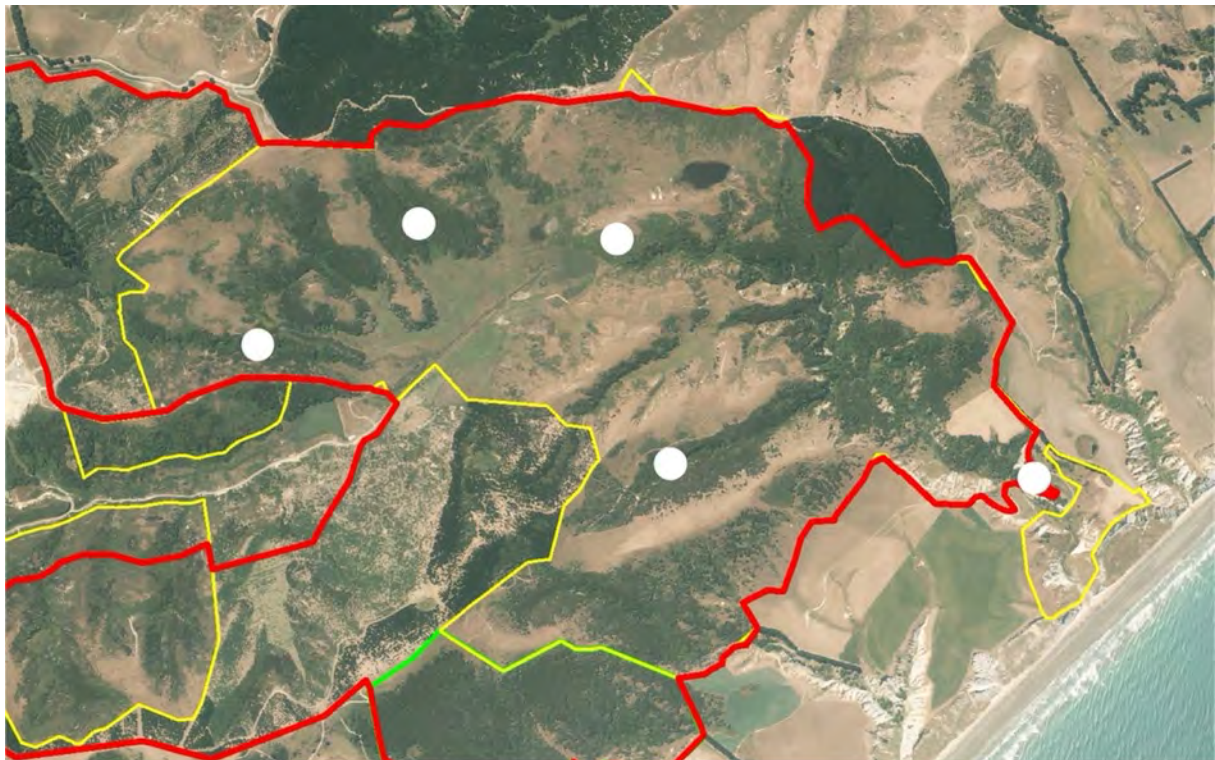


Figure 6. Proposed sites for establishing acoustic bird recorders.

Project management

The day-to-day management of the restoration project is the responsibility of CWS who receive an annual budget for this work from Transwaste Canterbury Ltd. However, the majority of the actual restoration work is undertaken by external contractors (plant propagation, weed control etc.) and has been coordinated by Professor David Norton for CWS and Transwaste Canterbury Ltd. As Professor Norton has now retired from the University of Canterbury and moved out of Canterbury, this work is now being coordinated by Fraser Maddigan, with support from Professor Norton. The current Tiromoana Bush Restoration Management Plan runs for five years from July 2022 and will be reviewed in April 2027.

APPENDIX 1: SUMMARY OF TIROMOANA BUSH ENVIRONMENT

Tiromoana Bush (407 ha) includes most of the catchment of Kate Valley below the landfill, as well as a small area adjacent to Selby Road and the coastal faces connecting lower Kate Stream and Tiromoana Scenic Reserve (Figure 1). The site lies close to the southern limit of North Canterbury coastal hill country in the Motunau Ecological District (43° 06' S, 172° 51' E). Aside from the main valley floor of Kate Stream, the site is hilly and extends from sea level to 346 m a.s.l. at the summit of Ella Peak. The underlying geology comprises Tertiary seabed strata dominated by fine-grained compacted sedimentary deposits including limestones and mudstones. Annual rainfall is around 920 mm but with considerable variation both within and between years. The area typically experiences warm dry summers and cool wet winters. Snow is rare although frost can occur in winter, especially in valley bottoms away from the coast. Storm events, perhaps exacerbated by sea level rise, are affecting the coastal faces with erosion a regular event.

Historically the area would have been forest (mainly mixed podocarp–angiosperm, but with smaller areas of coastal angiosperm and tawhai rauriki forest), which was likely cleared 500–700 years ago as a result of fires associated with early Māori settlement. Ngāi Tūāhuriri is the iwi who hold mana whenua over this area. While there is no evidence for permanent settlement at Tiromoana Bush (the main Pā was at Kaiapoi), there is a long history of association with the area and the coastal zone was a key mahinga kai which is recognised by the Pou Ika at the coastal lookout on the Tiromoana Bush Walkway.

Since European settlement, the property had a long farming history prior to the start of the restoration project and was typically farmed as an extensive sheep and beef property although farm productivity was apparently limited to some extent by bad infestations of nassella tussock. While pasture was dominant at the start of the project, the current vegetation is a mix of kānuka and mixed-species shrubland and low forest, gorse and European broom shrubland, restoration plantings, wetlands and rank pasture. Two ponds are present (Kate Pond and Ella Pond) with a large area of wetland vegetation adjacent to Kate Pond. Kate Pond was constructed by Transwaste Canterbury Ltd. as part of the Tiromoana Bush project to enhance the natural wetlands in the area.

APPENDIX 2: COMMON AND SCIENTIFIC NAMES

Plant names

*naturalised (exotic) species

barberry*	<i>Berberis</i> spp (incl <i>B. glaucocarpa</i> & <i>B. darwinii</i>)
tawhai rauriki (black beech)	<i>Fuscospora solandri</i>
blackberry*	<i>Rubus fruticosus</i> agg.
cabbage tree (ti kouka)	<i>Cordyline australis</i>
cherry plum*	<i>Prunus cerasifera</i>
cocksfoot*	<i>Dactylis glomerata</i>
crack willow*	<i>Salix fragilis</i>
elderberry*	<i>Sambucus nigra</i>
European broom*	<i>Cytisus scoparius</i>
five-finger	<i>Pseudopanax arboreus</i>
golden akeake	<i>Olearia paniculata</i>
gorse*	<i>Ulex europaeus</i>
grey willow*	<i>Salix cinerea</i>
harakeke (flax)	<i>Phormium tenax</i>
hawthorn*	<i>Crateagus monogyna</i>
kaihikatea	<i>Dacrycarpus dacrydioides</i>
kānuka	<i>Kunzea robusta</i>
mahoe	<i>Melicytus ramiflorus</i>
matai	<i>Prumnopitys taxifolia</i>
nassella tussock*	<i>Nassella trichotoma</i>
ngaio	<i>Myporum laetum</i>
old man's beard*	<i>Clematis vitalba</i>
podocarp	Native conifer in family Podocarpaceae (e.g. tōtara)
purei	<i>Carex secta</i> and <i>Carex virgata</i>
tōtara	<i>Podocarpus totara</i>
wilding conifers*	Mainly <i>Pinus</i> species
willow*	<i>Salix</i> species

Animal names

*naturalised (exotic) species

cat*	<i>Felis catus</i>
deer*	Family Cervidae (e.g. red deer)
dog*	<i>Canis familiaris</i>
fallow deer*	<i>Dama dama</i>
ferret*	<i>Mustela furo</i>
goat*	<i>Capra hircus</i>
hare*	<i>Lepus europaeus occidentalis</i>
hedghegog*	<i>Erinaceus europaeus occidentalis</i>
kereru (NZ pigeon)	<i>Hemiphaga novaeseelandiae novaeseelandiae</i>
korimako (bellbird)	<i>Anthornis melanura melanura</i>
lagomorphs*	Hare and rabbit
mice*	<i>Mus musculus</i>
mustelid*	Stoat, ferret and weasel
pig*	<i>Sus scrofa</i>

piwakawaka (fantail)	<i>Rhipidura fuliginosa</i>
possum (brush-tail)*	<i>Trichosurus vulpecula</i>
rabbit*	<i>Oryctolagus cuniculus cuniculus</i>
rat*	<i>Rattus rattus</i>
red deer*	<i>Cervus elaphus</i>
riario (grey-warbler)	<i>Gerygone igata</i>
rodent*	Mice and rats
stoat*	<i>Mustela erminea</i>
ungulates*	Deer and goats
vespuid wasps*	<i>Vespula germanica</i> & <i>V. vulgaris</i>
weasel*	<i>Mustela nivalis vulgaris</i>
weka	<i>Gallirallus australis</i>

APPENDIX 3: 2004-2022 MANAGEMENT REVIEW

See next page.

Tiromoana Bush Restoration Project 2004-2022 Review



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11 May 2022

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INTRODUCTION

In 2004 Transwaste Canterbury Ltd., a public-private joint venture company, commenced a comprehensive restoration programme in the Kate Valley Conservation Management Area (henceforth referred to as Tiromoana Bush; Figure 1) as part of the mitigation offered for the establishment of the Canterbury Regional Landfill at Kate Valley. The restoration project became a legal requirement of the resource consent for the operation of the landfill and aims to substantially increase native biodiversity values in Tiromoana Bush over the 35-years of the consent.



Figure 1. Location of Tiromoana Bush (red line) in relation to the Kate Valley (Canterbury) Regional Landfill and adjacent public conservation land (yellow line).

This report reviews progress with this restoration project over the 18 years through to May 2022 as a basis for planning management through until 2032 (when the project will have been running for 28 years). A summary of some of the earlier progress with the project is provided in Norton (2019). The current report provides a comprehensive review of the project against the 2017-2022 five-year management goals and then against the 35-year outcomes that underpin the overall vision for the project.

2017-2022 MANAGEMENT GOALS

To progress the project towards meeting the 35-year outcomes for Tiromoana Bush, 11 goals were developed for the 2017-2022 management period and progress against these goals is now reviewed.

Goal 1: Herbivorous mammal pests are controlled to levels that do not threaten the restoration plantings or natural regeneration in Tiromoana Bush.

Performance indicator: Key mammalian herbivores have not adversely affected restoration plantings or natural regeneration and any domestic livestock, deer or pigs found within the deer fence are promptly eliminated.

Progress against goal: The deer fence was completed in 2017 (Figure 2) which represents a major milestone for the project. Subsequently, four deer have been shot during pig culling operations and while recent sightings suggest that 2-3 deer may still be remain, a lack of widespread deer damage suggests that they are having a limited impact on the restoration plantings. Ongoing pig control will hopefully result in these remaining deer being eliminated and the deer fence is considered to be secure in terms of future deer invasion.



Figure 2. Deer fence being installed along the Tiromoana Bush boundary.

Sheep are occasionally observed within the deer fenced area, primarily accessing it through the farm fencing that separates the plantation forest on the Ella Peak side of Tiromoana Bush from the conservation management area – both areas are included within the deer fence. Sheep are not, however, a major issue as they appear mainly restricted to the walking track and no evidence of their having an impact on either the regenerating forest or restoration plantings has been noticed. When sheep are seen within Tiromoana Bush, the Mt Cass Organic Farms manager has been informed and asked to remove them, although more

recently it has been agreed that any sheep present within Tiromoana Bush can be shot during pig control operations. Cattle have not been seen inside the deer fence.

Pigs are, however, another matter, and have been consistently present within the deer fenced area throughout this management period despite two major culls: July 2018 (29 pigs killed) and June 2021 (39 pigs killed). The ongoing presence of pigs is likely due to several factors including the inability to exclude them with deer fencing, a failure to fully remove all animals during cull operations, their high intrinsic breeding rate, and high pig numbers in surrounding areas (especially within the pine forests management by Rayonier) thus putting pressure on the fence. Pigs are causing severe damage locally, both within forest remnants and grassland areas, and have also damaged restoration plantings (with all planting in 2021 postponed because of high pig impacts). Their impact requires ongoing targeted management.

Goal 2: A detailed assessment of predatory mammals is undertaken as a basis for assessing the need for future predator control.

Performance indicator: An assessment of mammalian predators has been undertaken.

Progress against goal: This assessment was completed in November 2018 using tracking tunnels and chew cards. The results showed the presence, in moderate to high numbers, of a suite of small mammals that are known to prey on native fauna (Maddigan 2018). Species identified were mice, rats, mustelids (weasels, stoats and ferrets) cats, hedgehogs and possums.



Figure 3. *Small mammal trap network comprising paired DOC200 and Timms traps.*

As a result of this monitoring, the decision was made to commence an active predator control programme in October 2019 focusing on these species. This control is based on a network of 200 paired DOC200 and Timms traps spread through the bush (Figure 3). The traps are serviced monthly, and all animals killed are recorded. Over the last 2 ½ years this has resulted in the killing of 226 mice, 394 ship rats, 282 weasels, 68 stoats, 17 ferrets, 96 cats, 312 hedgehogs and 183 possums. While mustelid, possum, hedgehog and cat kills have declined with time, indicating that we are starting to suppress these species, rodent numbers have been less impacted, perhaps because their predators (cats and mustelids) have been suppressed and also because of the abundance of grass seed in the area. Feral cats are increasingly being seen as the single biggest threat to native fauna nationally. Small mammal predator control will continue to be a major priority for management at Tiromoana Bush as reinvasion is constantly occurring from surrounding areas and numbers can increase rapidly if control stops

Goal 3: A systematic approach to plant pest control occurs and key plant pests are controlled to levels that do not threaten restoration or other values.

Performance indicator: A systematic approach to plant pest control has been undertaken that enables key plant pests to be controlled to a level that does not threaten the biodiversity values at Tiromoana Bush.

Progress against goal: Waiora Landscapes are contracted annually to undertake control of woody weeds. The focus has been primarily on willows in the Kate Stream catchment and wilding conifers, although any other woody weeds encountered (e.g. hawthorn and old man's beard) are also removed. Control is based on a division of the area into five weed control zones, with control rotating around these zones annually. While we should eventually be able to eliminate willows, wilding conifers are an ongoing issue as seed sources are present in the wider landscape and will require ongoing control until closed-canopy native forest dominates the site.

Goal 4: Restoration plantings focus on restoring kahikatea-dominated forest and associated wetland vegetation across the floor of Kate Valley, and angiosperm forest and associated shrubland and herbaceous vegetation in the coastal zone of lower Kate Stream.

Performance indicator: Restoration plantings have been established primarily on the floor of Kate Valley and in the coastal zone, and a review of the restoration plantings undertaken to-date has been completed.

Progress against goal: Except for 2021, when no plantings were undertaken because of high pig numbers, restoration plantings have continued to be undertaken annually, primarily on the floor of Kate Valley (Figure 4) and in the coastal zone of lower Kate Stream. Some infill panting at other sites has also been undertaken.



Figure 4. Kahikatea forest restoration plantings, Kate Valley.

To assess the overall success of restoration plantings to date, University of Canterbury masters student Alistair Kernahan assessed all of the restoration monitoring plots that have been established since 2006, as well as kahikatea planted in 2006 and the three areas where black beech has been planted (see Goal 5). Monitoring sites include plantings established in 2006 (1 plot), 2008 (3 plots), 2011 (3 plots) and 2012 (2 plots). While there is variation from site to site reflecting differences in species composition and site attributes, the overall conclusion is that restoration plantings have done well with good survival of most species (Kernahan 2021).

The three monitoring plots in the 2008 planting (13 years growth) are perhaps the best indication of what is being achieved through restoration. The plots are spread between two different planting areas and are variable in terms of species composition and aspect. Despite this they show strong similarities, especially in height growth. Plant survival was generally good, 83% in two plots and 66% in the third, as was canopy cover (85, 83 and 53%). The 53% canopy cover was due to that plot having a high proportion of tī kōuka (cabbage trees) which do not form large spreading canopies as other species do (e.g. kōhūhū/black matipo, ngaio and tarata/lemonwood). However, for the dominant species across all three plots, tree height exceeded 5 m and was greater than 8 m in some cases. One of the plots also had a reasonable amount of natural regeneration occurring under the planted canopy. These three plots were also estimated as having sequestered 222 tonnes CO₂/ha after 13 years.

Ten kahikatea were planted along the shores of Kate Pond (Figure 5) at the outset of our restoration efforts. These trees were tagged and have been monitored since. By 2021 (15 years later) all were still alive, with their heights ranging from 3 m to just over 6 m tall, and with an average diameter at breast height of 8 cm.



Figure 5. Vigorously growing 11-year old kahikatea, Kate Pond.

Goal 5: Consolidate restoration of black beech.

Performance indicator: Black beech has been planted adjacent to Remnant “B” and, where appropriate, the three new black beech stands have been enriched through further plantings.

Progress against goal: Mainly because of a lack of seed, no new black beech plantings have been established. However, the progress of the existing three stands were assessed as part of the 2021 restoration assessment by Alistair Kernahan. The three black beech stands comprised 16, 21 and 93 live black beech, plus five dead plants. This suggests high survival (96%), although some black beech may have died soon after planting and are no longer visible. All stands are of a similar age (11-12 years old in 2021). The plants have grown well with average plant heights now 6–7.5 m, with the tallest nearly 10m, and an average diameter at breast height of 10 cm (Figure 6).



Figure 6. Vigorously growing black beech.

Goal 6: Commence a programme of enriching the existing seral kānuka low forest stands.

Performance indicator: A programme of enrichment through canopy gap creation has commenced, including strategic tōtara planting.

Progress against goal: This work was not commenced during this period, although the two scientific papers, based on research at Tiromoana Bush, providing the rationale for this approach have now been published in scientific journals (Tulod et al. 2019, Tulod & Norton 2020).

Goal 7: Undertake due diligence work necessary for a possible introduction of a native animal species that is currently absent from Tiromoana Bush.

Performance indicator: Due diligence has been undertaken to assess the potential of introducing a native animal species that is currently extinct from Tiromoana Bush, including the development of a reintroduction plan if it is deemed that this is appropriate.

Progress against goal: While no formal work was undertaken on this, a number of informal discussions were held and it was established that reintroduction of mudfish into Kate Pond would not be possible because of the presence of eels. Given we only started predator control at the end of 2019, it has probably been too soon to start progressing this issue.

Goal 8: Establish additional biodiversity monitoring.

Performance indicator: At least five vegetation monitoring plots have been established in areas of gorse/broom shrubland to monitor the development of these areas towards native forest. Baseline surveys of the snail Wainuia, weta and reptiles have been undertaken.

Progress against goal: These activities were not undertaken during this management period. However, our regular monitoring of permanent vegetation plots (forest and restoration plantings), photo-points and birds (2017-2019) has continued and reports on the monitoring of forest plots (Tulod & Norton in submission), restoration plantings (Kernahan 2020), bird monitoring (Luring & Lloyd 2020) and photo-point monitoring (Norton 2022) have been produced.

Goal 9: Better interpret the Tiromoana Bush project to the wider public.

Performance indicator: Interpretative material has been installed along the walkway and more information on the Tiromoana Bush restoration project has been made available through the Transwaste Canterbury web site.

Progress against goal: This work started in the last management plan period with the walkway upgrade and has continued into the current management period. Two new interpretation panels have now been installed, at Barbara's Lookout and Kate Pond, and the Pou Ika was installed at the coastal lookout, all in November 2018 (Figure 7). In addition, a general pamphlet on the walkway was produced (2019) which complements the main information sign at the car park, while a brochure specifically on the Tiromoana Bush restoration project was also produced (2020). The Transwaste Canterbury website has also been upgraded and includes information on both the walkway and the restoration project.



Figure 7. *Installing the interpretation panel at Kate Pond and the Pou Ika at the coastal lookout platform looking northeast up the coastline.*

In addition, Transwaste Canterbury commissioned Grant Mangin to produce a series of press releases on different issues relating to the Kate Valley Landfill, including the Tiromoana Bush restoration project. Over the last three years, seven press releases have been produced and

published in one or both of Northern Outlook and North Canterbury News (and some have also appeared on stuff.co.nz) focusing on the restoration work being undertaken in Tiromoana Bush. The topics covered in these articles have included restoring rare ecosystems, pest management, restoring kahikatea forest, photo-monitoring, bird conservation, mistletoes and considering Tiromoana Bush in the context of the wider Hurunui area.

Goal 10: Tiromoana Bush is used as part of local school and LEARNZ learning programmes.
Performance indicator: At least four visits by local schools to Tiromoana Bush occur each year.

Progress against goal: While LEARNZ did run a field trip that included a strong restoration focus in 2018, no formal school visits to the restoration project occurred.

Goal 11: Provide support to the development of a wider Motunau Ecological District conservation initiative.

Performance indicator: Support is provided towards the development of a wider Motunau Ecological District conservation initiative as appropriate.

Progress against goal: Transwaste Canterbury has supported the establishment and running of the Hurunui Biodiversity Trust which started in late 2018. Their mission is to inspire and enable Hurunui's landowners/kaitiaki/custodians and the wider community to understand, value and enhance our district's varied biodiversity, with particular focus on indigenous biodiversity. There has, to date, been no direct input from the Tiromoana Bush restoration project but there is ample opportunity for greater interaction in the future.

Overall assessment of progress against 5-year goals

We have made strong progress in several areas over the last five years, notably with Goals 1, 2, 3, 4 and 9. In fact with Goal 2, we have exceeded what was planned. We have also made some progress with four other goals (5, 6, 8 and 11), but have only made limited progress with Goals 7 and 10. The reasons for lack of progress with some goals are varied but include a stronger emphasis on other areas and a need for further resources to support them.

35-YEAR MANAGEMENT OUTCOMES

Successful restoration is dependent on having clearly defined goals. Goals are important as they enable the success of restoration to be quantified and reported on, as well as allowing the restoration manager to critically evaluate the methods that are being used. It is useful to set goals within a broader vision of what the site might be like at some stage in the future.

However, it is not possible to use such a vision to assess the success of restoration because of the long time-frames involved and because of the uncertainties over future conditions (e.g. as a result of changing climate). For the Tiromoana Bush restoration project, an overall vision of what the site might be like in 300 years was developed at the outset of the project as a general guide, with more specific 35-year and five-year goals identified to assess restoration success against. The five-year goals are the most specific, while the 35-year outcomes are more indicative and were thought likely to require modification depending on progress.

The vision and 35-year outcomes were specified in the 2004 decision of the Environment Court granting resource consents for operation of the Kate Valley (Canterbury) regional landfill.

This vision saw Tiromoana Bush in 300 years restored to a:

“Predominantly forest ecosystem (including coastal broadleaved, mixed podocarp-broadleaved and black beech forests) where dynamic natural processes occur with minimal human intervention, where the plants and animals typical of the Motunau Ecological District persist without threat of extinction, and where people visit for recreation and to appreciate the restored natural environment.”

This vision statement has been adapted for the interpretation panel at Barbara’s Lookout as follows:

Tiromoana – He Kitenga O Te Wāheke (A View To The Future)

Take a moment to imagine... standing here 300 years from now you will see before you a mosaic of forest and wetland. New Zealand’s tallest tree – kahikatea - towers above wetlands, their buttressed roots holding firm. Mighty tōtara clothe the hillsides leading down to the coast, with patches of tawhai/black beech on the dry ridges. Trees echo with the voices of korimako/bellbird, tūī and the whirr of kererū wings. Wildlife flourishes and people visit to learn, recreate and enjoy.

Mō tātou, ā, mō kā uri, ā muri ake nei (For us and our children after us)

This adapted vision better articulates what we are trying to achieve with the Tiromoana Bush Restoration Project.

To meet this vision, a series of outcomes need to be achieved after 35 years of running this project. These outcomes can be seen as stepping-stones along the journey to achieving the vision. 35 years was chosen initially because it is the period of the resource consent for the Kate Valley (Canterbury) regional landfill, but it is also a good time-period over which we will be able to obtain a strong indication of how well the project is progressing. As 2022 is

approximately halfway through this 35-year period (18 years to be precise), it is timely to review progress against these outcomes.

Outcome 1: Vigorous regeneration will be occurring within the existing areas of shrubland and forest sufficient to ensure that natural successional processes are leading towards the development of mature lowland forest appropriate to local conditions.

Progress against outcome after 18 years: Both vegetation plot and photo-point monitoring is showing that there has been a strong response in terms of understorey regeneration, although the evidence to date suggests that this is primarily dominated by mahoe (Figures 8 & 9, Tulod et al. in submission) and we still have some way to go to obtain regeneration of other species, especially podocarps like tōtara and matai which would have been the dominant trees in the pre-human forests. It will require more active management interventions to introduce these species into the successions. Management interventions including gap creation and enrichment are likely to be the most successful and research by University of Canterbury PhD student Adrian Tulod has provided the basis for these interventions (see Tulod et al. 2019, Tulod & Norton 2020).



Figure 8. Dense māhoe and mingimingi regeneration in the understorey of a kānuka forest after 12 years of livestock exclusion. The two people are measuring one of the permanent vegetation monitoring plots that are located through these forests.

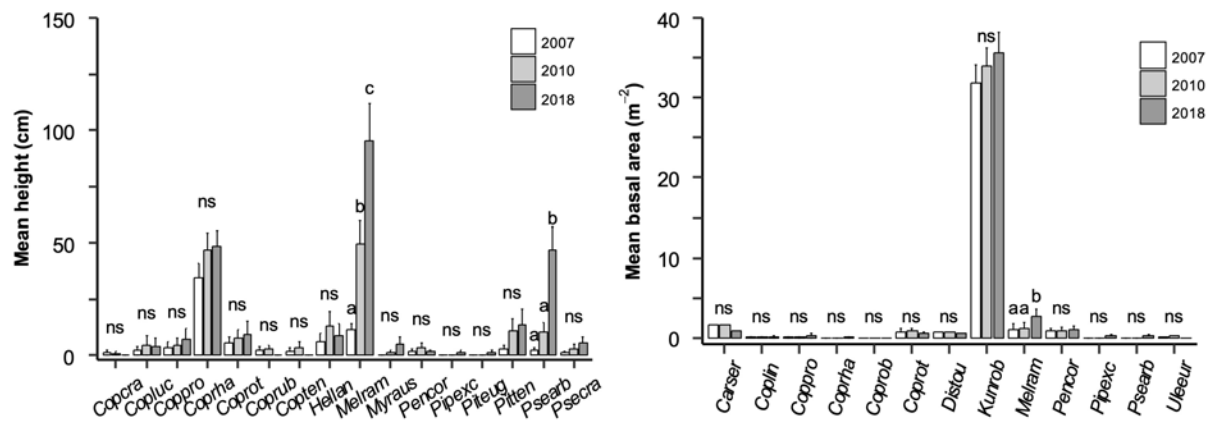


Figure 9. Change in seedling height (left) and tree basal area (right) in forest monitoring plots from 2007-2018. Both māhoe (Melram) and five-finger/whauwhaupaku (Psearb) have increased significantly in height, while māhoe is the only species to show a significant increase in tree basal area, joining kānuka (Kunrobo) as a small tree in these forests.

Outcome 2: The existing korimako (bellbird) population has expanded, and kereru (native pigeon) are now residing within the area. The species and abundance of native water birds have also been enhanced.

Progress against outcome after 18 years: Water birds were added to this outcome in the 2017-2022 management plan as they are likely to respond to the wetland restoration efforts.

Results from monitoring showed that overall native forest bird counts changed little between 2005-2009 and 2017-2019. There was, however, a significant 24% decline for korimako/bellbirds, although tauhou/silvereye and piwakawaka/fantail mean counts increased by 104% and 52% respectively. The increase in kereru counts from zero at the start of monitoring to four in 2019, is not statistically significant, but implies it may be becoming a regular visitor or resident. The 1014% increase in ngirungiru/tomtit counts and 72% increase in pīpīwharauoa/shining cuckoo counts are significant. Both monitoring periods were undertaken prior to predator control being implemented and the decline in korimako may reflect predation, although anecdotal observations since we commenced active small mammal predator control suggests that korimako numbers are increasing, with groups of up to 20 korimako seen/heard together at times. Tui have also been heard and seen several times in lower Kate Stream in the last couple of years, having not previously been recorded in Tiromoana Bush.

The slight but steady increase in native forest bird diversity at Tiromoana Bush is a positive sign for the restoration. This increase appears to be driven largely by colonization of new species such as tomtit and kereru and increases in rare species such as pīpīwharauoa. These changes may reflect an increase in habitat diversity as the kānuka forest understory regenerates in the absence of grazing. Further increases in diversity as well as abundance are expected with ongoing predator control.

Waterfowl and wetland bird counts from 2017-2019 establish a baseline to compare future trends against, particularly with predator control now implemented. Few significant changes were detected over the three years, due to high variability in counts and the flocking habit of many waterfowl. Matuku-hūrepo/bittern and mātātā/fernbird were not recorded confirming their absence from the site. However, four pūweto/spotless crane (Figure 10), one

koitareke/marsh crane and one unknown crane were heard. These ongoing observations of pūweto confirm the presence of a resident population of this Nationally Declining bird in Tiromoana Bush.



Figure 10. Pūweto/spotless crane (photo by Paul Le Roy and taken from <https://nzbirdsonline.org.nz/species/spotless-crake>).

Based on these results it seems likely that the site is moving in the right direction in terms of this outcome, but until we have a sustained period of predator control, we are unlikely to see a more substantial recovery of the avifauna. In the 2020 bird monitoring report (Luring & Lloyd 2020), the authors note that species diversity may provide an additional measure of success for Tiromoana Bush as well as the abundance of the initial species present. They note that other forest restoration projects have shown that many of the original species decline as new species establish and compete after predator control.

Outcome 3: The beech forest remnant known as “Remnant B” has been secured and enhanced in terms of the area of black beech and at least one additional black beech site has been established.

Progress against outcome after 18 years: This outcome was previously separated into two outcomes and were merged in the 2017-2022 management plan retaining the same wording. “Remnant B” is secured in that it is with the QEII covenant area and within the deer fence. Understory regeneration is good within this black beech remnant and we have also established three additional beech populations comprising 130 individual black beech plants in total that are on average 6–7.5 m tall, with the tallest nearly 10 m (Figure 6). All were sourced either from seed or seedlings collected from “Remnant A” (which has now gone) and “Remnant B” (seeds only). There is however a need to establish black beech around “Remnant B” to enhance it, and to do further plantings to expand the three planted beech forest patches.

Outcome 4: Restoration plantings and natural regeneration will have been sufficient to ensure good connectivity of regenerating forest between Remnant “B”, Ella Bush Significant Natural Area (SNA) and Tiromoana (Ella Peak) Scenic Reserve.

Progress against outcome after 18 years: Both restoration plantings and natural regeneration are enhancing connectivity between different areas of remnant native vegetation (Figure 11a). This is an ongoing process and will likely accelerate with time. The photo-monitoring (Norton 2020), coupled with aerial photography provides a good record of progress against this outcome.



Figure 11. 2004 (top) – 2021 (bottom) photo-point comparisons. 11a (left) shows both natural regeneration and restoration plantings reconnecting remnant forest areas while 11b (right) shows restoration plantings expanding coastal shrubland and forest.

Outcome 5: Restoration plantings have been used to re-establish locally rare vegetation types.

Progress against outcome after 18 years: All lowland forest types are rare in North Canterbury because of the impacts of human settlement, so all of our forest restoration work is addressing this outcome. The establishment of lowland kahikatea forest (Figures 4 & 5) and of coastal forest (Figure 11b) are good examples of this. The creation of Kate Pond and restoration of the wetland vegetation that now surrounds it is also addressing this outcome as wetlands are one of the rarest ecosystems locally, regionally and nationally. Some locally rare plant species have also been included in plantings, including tītoki and fierce lancewood.

Outcome 6: The area is being actively used for recreational, educational and scientific purposes.

Progress against outcome after 18 years: The redevelopment of the Tiromoana Bush Walkway has led to sustained use of this facility for recreation. A track counter was operating close to the main entrance to the walkway from early 2018 to mid 2020. Over this time and allowing for walkway closures due to fire risk and Covid lockdowns, an average of 50-60 people were recorded using the walkway each week. However, the counter was moved in late 2021 and positioned above the entrance gate. Over the period December 2021 – April 2022, the number of visitors to Tiromoana Bush has averaged 145 people per week. It is rare, even during weekdays, to not encounter someone on the walkway and the carpark can contain multiple cars in weekends.

Tiromoana Bush has been well used for university education and research over the last 18 years, primarily through Te Kura Ngahere/School of Forestry visits. Several students have used the bush as part of their postgraduate research, while numerous undergraduate and postgraduate classes have visited using the bush to better understand the principles and application of ecological restoration (Figure 12).



Figure 12. Environmental forestry class at the Pou Ika in September 2021.

Use of Tiromoana Bush by local schools appears limited, although the LEARNZ programme has visited the area on a few occasions. However, use of the area by schools is something that requires more attention.

CONCLUSIONS

We have made considerable progress towards meeting the 35-year outcomes for the Tiromoana Bush restoration project which even now at only 18 years into the project gives considerable confidence that the project is tracking in the right direction.

- From an ecological perspective this can be seen in the strong biodiversity outcomes that have been achieved – restoration of rare ecosystems, healthy forest understories, abundant natural regeneration in pasture areas, presence of native birds including some species that were rare or absent at the start of the project.
- From a recreational perspective, the walkway is well used, especially following the substantial upgrade that occurred in 2016-2019.
- Since the start of the project, Tiromoana Bush has been regularly used for university education although this has been primarily by Professor David Norton who has now retired. Attention needs to be given to how the area might continue to be used for university education, and how this might be expanded in the future.
- A process of engagement with Ngāi Tūāhuriri has started, especially with the commissioning of the Pou Ika. There is, however, considerable room to build on this relationship.

But there is much we still need to do to both consolidate what we have achieved to date and to make sure that the project continues to move forwards and eventually fulfills the vision. Key areas where more focus is required over the next ten years include:

- Continuation of animal pest control, especially keeping small mammal predators including feral cats at low levels, eradicating the final few deer and if possible, exterminating pigs from the site.
- As well as the current focus on kahikatea forest restoration, more emphasis needs to be given in restorative management to expanding black beech and to facilitating succession within the existing restoration plantings and in naturally regenerated shrubland and forest areas towards a more diverse forest state. This should involve planting mature canopy trees like tōtara and matai around forest edges and in gaps to enhance their dispersal into these areas.
- While some locally rare or absent native bird species appear to be returning to the site (e.g. tomtit and tui), and some species are becoming more abundant, several bird species are unlikely to return without a formal re-introduction programme. Possible candidates for this are the South Island robin/toutouwai and the little blue penguin/kororā. With kororā there is a real opportunity to do this in collaboration with Glenafric Station who have a similar area of coastal habitat that is suitable for this species.
- A dedicated effort is required to make local schools aware of the opportunities Tiromoana Bush offers and to facilitate them utilising this. Today's children will be tomorrow's tax payers and decision makers, and having the local community fully engaged with this project will be a massive boost for insuring its long-term success.
- There is also a need to further promote Tiromoana Bush to tertiary institutions (Canterbury and Lincoln Universities and Ara Institute)

- While the walkway is well used, there is still ample opportunity to boost its popularity with local and regional communities in Canterbury.
- Further engagement with Ngāi Tūāhuriri must be positive for the long-term future of the Tiromoana Bush project.
- Developing the role of Tiromoana Bush as a hub for conservation in the wider area and especially across Mt Cass, Dovedale and Glenafric Stations and on the land along the Mt Cass ridge owned by MainPower.

And to do all of the above, it is important that the current biodiversity monitoring is continued and where appropriate expanded (e.g. reptiles) and takes advantage of new technologies (e.g. acoustic bird recorders), and that the project continues to receive adequate financial support.

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APPENDIX 4: VISION AND OUTCOMES FROM RESOURCE CONSENT CONDITIONS

Vision

In 300 years time the Kate Valley Conservation Area will be restored to a predominantly forest ecosystem, including coastal broadleaved, mixed podocarp-broadleaved and black beech forests, where dynamic natural processes occur with minimal human intervention, where the plants and animals typical of the Motunau Ecological District persist without threat of extinction, and where people visit for recreation and to appreciate the restored natural environment.

Outcomes

At the end of the 35 year consent period, the following outcomes will have been achieved within the Kate Valley conservation area:

- Vigorous regeneration will be occurring within the existing areas of shrubland and forest sufficient to ensure that natural successional processes are leading towards the development of mature forest appropriate to local conditions.
- The existing korimako (bellbird) population has expanded and kereru (native pigeon) are now residing within the area.
- The beech forest remnant known as “Remnant B” has been secured and enhanced.
- Restoration plantings and natural regeneration will have been sufficient to ensure good connectivity of regenerating forest between Remnant “B”, Ella Bush SNA and Ella Peak Scenic Reserve.
- At least one additional black beech site has been established.
- The area is being actively used for recreational, educational and scientific purposes.

APPENDIX 5: CONSTRAINTS TO RESTORATION

This section outlines those factors that are likely to limit the success of management in achieving the 35-year restoration outcomes, and ultimately the long-term vision for the site. Constraints to restoration include those associated with the abiotic, biotic, and socio-economic environment.

Abiotic constraints

Constraint: Climate is likely to limit natural regeneration and restoration through low soil moisture availability and frost. The annual rainfall for Kate Valley is about 920 mm, but with considerable inter- and intra-annual variation. Soil moisture deficits are common during summer and restoration plantings and natural regeneration are particularly vulnerable to soil moisture deficits, especially during the initial stages of establishment. Soil moisture levels are strongly affected by the existing vegetation. In particular, soils under grass swards are very dry because the dense grass root mat quickly takes up any water that reaches the ground. In addition, winter frost can be a major source of mortality for some species in restoration plantings (e.g. ngaio).

Response: The primary response to dealing with soil moisture deficits and frost is to only use plants adapted to conditions at Tiromoana Bush, including sourcing all plant material locally. Additionally, all plants are hardened off before planting, planting is timed to occur so that plants are well established before summer droughts but are not planted until after the worst of winter frosts, herbicide is used to kill the grass sward before planting, and post-planting herbicide application is used reduce competition with exotic plants.

Constraint: Because of the frequent occurrence of long dry periods during summer, and the presence of gorse shrubland which burns readily, a wildfire could rapidly sweep through Tiromoana Bush destroying restoration plantings and natural regeneration.

Response: Ensuring that no burn-offs occur elsewhere on Transwaste Canterbury Ltd. land, liaising with adjacent landowners about the threat of burn-offs to restoration, informing the public of the fire danger through appropriate signs and other means including restricting public access during high fire risk periods, enforcing a total open fire ban in Tiromoana Bush, and maintaining water reservoirs for fire-fighting purposes.

Constraint: Because adjacent land uses include pastoral farming and forestry, weed spraying in adjacent areas has the potential to damage natural regeneration and restoration plantings if drift occurs. The adjacent farm is an organic farm so there are also issues associated with spray drift from any spraying for restoration affecting their land.

Response: Liaising with adjacent landowners about the threat of spray-drift to restoration, and ensuring that any spraying undertaken on Transwaste Canterbury Ltd. land (e.g. associated with plantation forestry or the landfill) does not impact on the restoration area. Liaising with the adjacent farming when any spraying is undertaken on Tiromoana Bush.

Biotic constraints

Constraint: One of the major factors that limits restoration success is browsing and predation by introduced animals, including domestic livestock, possums, ungulates (deer and goats), lagomorphs (rabbits and hares), mustelids (stoats, ferrets and weasels) and rodents (rats and

mice). Browsing reduces viability and growth rates of plants, especially young ones, while the impact of predation on invertebrate, reptile and bird species influences restoration success as these species play key roles in ecosystem processes such as pollination, seed dispersal and nutrient cycling.

Response: Animal pest control is currently being undertaken through exclusion of large herbivores by the deer fence around the perimeter of the core area of Tiromoana Bush, targeted control of pigs and an intensive small mammal predator trapping programme. In addition, extensive animal pest control is undertaken in association with management of the landfill.

Constraint: Introduced plant species have the potential to severely limit the restoration success. A number of grass species are highly invasive and competitive (e.g. cocksfoot) and can lead to the loss and poor health of plantings. There is considerable potential for invasive woody species already present, or present in adjacent areas (e.g. hawthorn, elderberry, wilding conifers, willow, cherry plum, blackberry, barberry old man's beard) to expand their range and displace native vegetation in Tiromoana Bush.

Response: Grasses are sprayed prior to establishment of restoration plantings to reduce competition, while post-planting weed control is also undertaken. Regular surveys and control operations are undertaken for other identified problem weeds, especially woody weeds, with the aim of eradicating those species identified as a management priority.

Constraint: Several studies have commented on the importance of using planting stock of local genetic origin in restoration projects because of concerns about local adaptation and maintenance of genetic integrity of existing plant populations. Planting of non-local material may result in loss of local adaptations (e.g. to particular environmental conditions) and eventually could lead to a loss of overall genetic variation within particular species. Non-local plants may also be less suitable for local native fauna, especially invertebrates. However, there is also evidence that inclusion of some non-local genetic material might buffer restoration plantings against future climate change. For all of these reasons it is therefore prudent to use plant material of local origin as local plants will be better adapted to local conditions than non-local plants (e.g. resistance to salt spray), but including a small proportion of non-local material to ensure a genetic diversity.

Response: To ensure that plants are adapted to local environmental conditions and to minimise the loss of genetic variability only locally sourced planting material will be used for the restoration plantings (preferably from within the Motunau Ecological District), but also including a small component of genetic diversity from sites further afield (e.g. elsewhere within Canterbury).

Constraint: In using seed for propagation a key constraint for some species is year-to-year variation in seed production (called masting). Beech in particular is mast seeding, with years of heavy seed production separated by one or more years with little or no seed production.

Response: Consideration of mast years will be undertaken as part of propagation planning – this applies especially to black beech.

Constraint: The development of associations between planted species and mycorrhizal fungi is important for restoration success. Mycorrhizal fungi are associated with plant roots and play

a key role in nutrient uptake for many native plants. The absence of mycorrhiza may be a limiting factor for some restoration plantings.

Response: Problems associated with mycorrhizal infections do not usually occur with natural regeneration, but can be an issue for plantings. Nursery propagation of seedlings for restoration will include appropriate inoculation for mycorrhiza.

Constraint: A key premise of restoration is that management will speed up the natural processes of succession by establishing a cover of woody plants that will encourage the development of mature shrubland and forest. While some of the species that occur in these forests are wind pollinated and dispersed, others require birds for either pollination and/or dispersal. The importance of birds for dispersing seeds into restoration plantings has been highlighted in several studies. However, severe predation pressure appears to have reduced bird numbers to levels that may be limiting these processes and hence have the potential to limit restoration success. Furthermore, a diversity of plants is required to support viable bird populations at Tiromoana Bush, especially in order to provide seasonally scarce food resources (e.g. at times when flowers or fruit are naturally scarce).

Response: Undertake predator control to reduce direct impacts on indigenous birds and use strategic planting of key food resources for these birds where food resources are considered to be insufficient.

Constraint: Introduction of a new animal species could fail.

Response: Before any reintroduction is undertaken, and resources committed, a detailed due diligence assessment will be undertaken that assess biotic and socio-economic risks to ensure that actions can be implemented to reduce these as much as possible.

Socio-economic constraints

Constraint: The success of the Tiromoana Bush Restoration Project is dependent on the availability of sufficient funding to cover the cost of management activities.

Response: Transwaste Canterbury Ltd. fund the on-going conservation management work and every effort will be made to ensure that this funding is increased in line with the consumer price index so that sufficient funding is available to continue the restoration management work required to meet the goals in this management plan.