



# Oamaru Farm

## Biodiversity Management Plan



**This plan has been designed to meet and exceed the relevant industry assurance standards and district and regional council regulations in place at the time of preparation**

*Please note: All family and farm names in this plan have been anonymised for the purpose of this pilot project.*

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*Prepared by Becky Clements, July 2022*

## Introduction

Oamaru Farm is 397 ha of freehold land near the town of Oamaru comprising of rolling hills and some steeper slopes. The owners farm 7000 stock units of sheep, cattle and deer. Oamaru Farm lies within the takiwā (district) of Te Rūnanga o Moeraki who are mana whenua of this land and were present here for many generations prior to European settlement. The farm is within the administrative area of Otago Regional Council and Waitaki District Council. Prior to the current owners taking over ownership of the farm, their parents and grandparents farmed Oamaru Farm.

The farm owners aim is to continually improve their farm through careful, objective-driven management. They have a strong emphasis on the quality of products produced on their farm as well as reducing their environmental ‘footprint’. The farm owners have put a lot of hard work into mitigating drought on Oamaru Farm and half of their property is now irrigated by k-line sprinklers since the North Otago Irrigation Company scheme was established in 2006. They have planted in areas where flooding or erosion were issues, to reduce the impacts associated with these.

The farm owners take a holistic approach to farming their land and caring for the environment and see themselves as guardians of their land. They have shown innovation in reducing their impact on the land, they do not cultivate their paddocks but only direct drill. No run-off leaves the paddocks as management leaves buffer zones around paddocks to soak up any runoff.

## Biodiversity Vision Statement

“In 20 years’ time we will have full stock exclusion of the two wetland areas and these areas will be covered in a rich assemblage of native species that provide habitat for native wildlife, and improve the water quality. We see tūi, kereru and bellbirds frequently throughout the property. Our ponds have been enhanced through riparian planting and are also providing habitat and food resources for native birds, as well as water fowl.”

## Stocktake of Biodiversity Assets

### What is biodiversity?

The diversity of plants and animals relates directly to the health of our environment. A healthy environment means an abundance of native birds, native invertebrates, diversity of plant life across a range of different habitat types. These plants and animals in turn assist in actively sequestering carbon, healthy waterways, healthy soil and greater resilience to droughts and storms. In some parts of New Zealand our unique plants and animals are still declining in number and diversity. As pastoral farms cover 50% of New Zealand’s land, and this land includes ecosystems and climates not found in public conservation land (managed by the Department of Conservation), what happens on pastoral farms is vital to restoring the full spectrum of native biodiversity in New Zealand.



## Indigenous vegetation on Oamaru Farm:

There are several notable areas of native vegetation including two large wetlands and scattered kōwhai trees on the farm. The wetlands include raupō, harakeke (*Phormium tenax*), ti kōuka (*Cordyline australis*), purei (*Carex* species) and sparse mingimingi (*Coprosma* species) but are mostly dominated by exotic grasses. Multiple large kōwhai trees (*Sophora microphylla*) are found on the side of Rori road.

## Exotic Vegetation

The majority of the vegetation on the property is exotic grassland and cropland comprised of common pastoral species including: Ryegrass, Cocksfoot, Browntop, Clovers, Fodder beet and other winter crops. The predominant woody vegetation found on the property is exotic as there are several erosion prone sites that have been planted in pines and eucalyptus. Willows and poplars are present around the larger ponds and along creeks. Some waterways have been planted with willows to mitigate flooding risk.

## Indigenous fauna

Native birds known to be found on the property include tūi, tētē-moroiti (grey teal), pūtangitangi (paradise shelduck), and scaup. Presence of native freshwater fish is not known although it is likely there are eels in the wetlands and outflows.



*Kowhai tree beside Rori Rd*



*Raupō stand*



*Coprosma propinqua with berries*



*Tūi feeding on harakeke nectar*

## Mahinga Kai Values

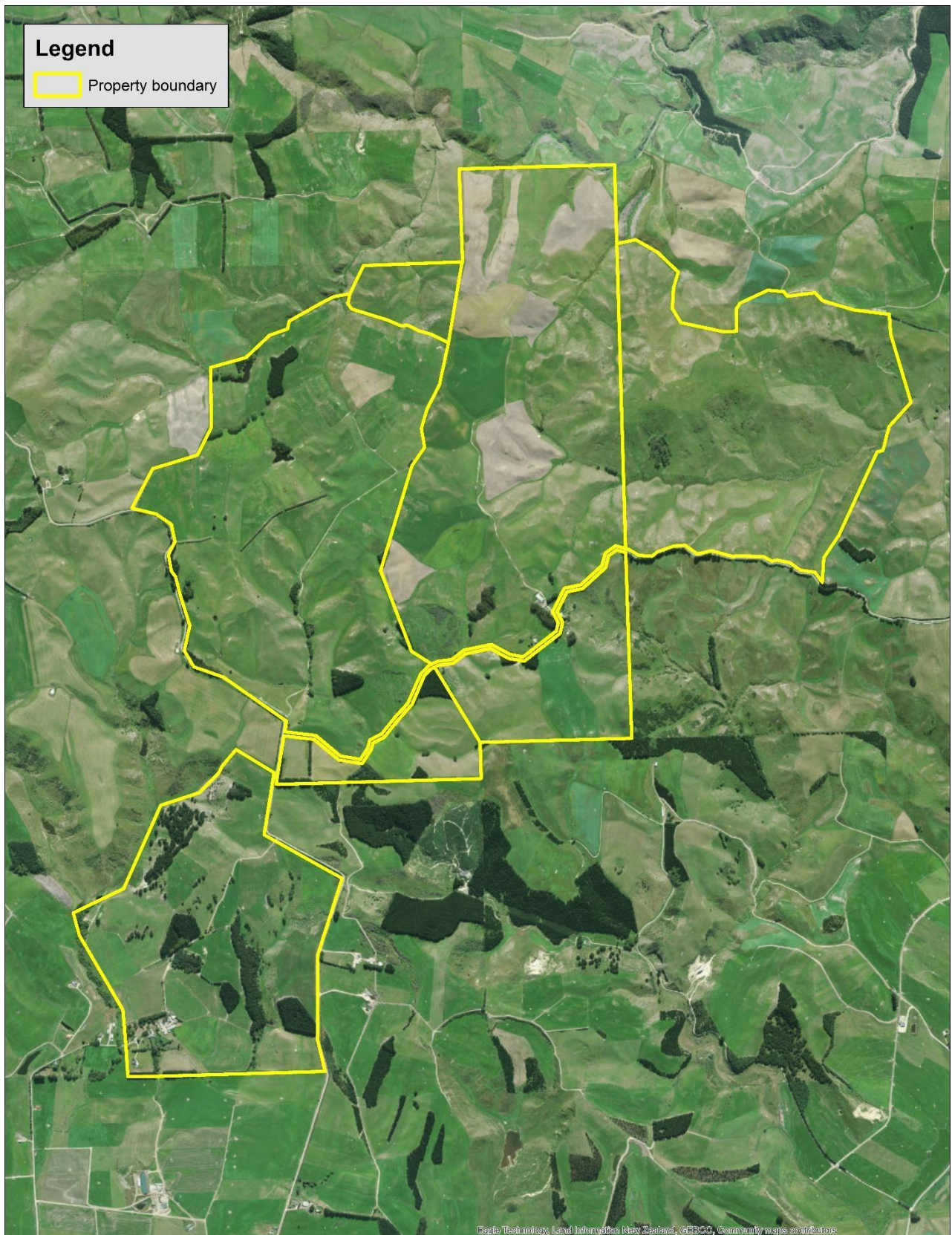
Mahinga kai is about the value of natural resources – our birds, plants, fish, and other animals and resources that sustain life, including the life of people. Mahinga kai encompasses the management and collection of natural resources important to the cultural traditions of Ngāi Tahu. It is a culturally important practice as it connects people with the land, allows for customary traditions to be passed down through generations, and provides a vital food source. Mahinga kai includes access to healthy kai, and doing this in a sustainable way, with our future generations in mind. Mahinga kai refers to numerous species and inter-relationships rather than something specific. It includes things such as species, natural habitats, materials and practices used for harvesting food, and places where food or resources are, or were, gathered.

Mahinga kai values include the protection of indigenous habitat like the forested gullies, scrubland, and tussock lands that are found on South Farm. Below are some examples of mahinga kai species that are found on South Farm:

- Harakeke/flax
- Tī kōuka/cabbage trees
- Waterfowl
- Potentially tuna/eels in streams.

The recognition of Mahinga Kai values does not imply any obligation on the landowner, but this concept is used within the Freshwater Management National Policy Statement as one of the indicators on freshwater quality.





## Oamaru Farm Property Boundary

0 250 500 1,000 1,500 2,000 Meters





# Assessment of Biodiversity Assets

## Asset 1: First wetland area

This wetland is found to the east of the homestead approximately 2.6 ha in size (including the stream below it) and is bordered by two small exotic forestry blocks, with a gully above that feeds into the wetland area. Stock are already excluded from the wetland, including the gully and the surrounding hillside that is not in pines. The total area of the asset including the gully and the hillside to the east of the wetland is 11.4 ha (see map on following page).

The wetland comprises dense stands of raupō and purei with scattered tī kōuka and harakeke but the main vegetation is rank grass and floating sweet grass (*Glyceria maxima*). There are fern species in the creek below the wetland and willow trees along the creek. There are also several wilding pines in the wetland area.

Wetlands often support many native fish species such as eels, galaxiids and bullies, and it is possible that they are present in this wetland along with introduced species of frogs (Southern bell frog and Green bell frog). Wetlands also provide habitat and food resources for native bird species such as the matuku (Australasian bittern), mātātā (fernbird), pateke (brown teal) karakahia (grey duck), taihoropī (NZ dabchick), kōkōreke (marsh crake). A tūī was recorded in the wetland during the ecological assessment.



*The first wetland, with the pond in the foreground*





**Asset 1: Wetland and Gully**

0 50 100 200 300 400 Meters





## Asset 2: Second wetland area

This wetland area is on the boundary with the neighbouring property which is a dairy runoff block and is approximately 4.4 ha. The tributary gully is not on Oamaru Farm. Currently, this wetland is dominated by exotic plant species, mainly rank grass. Floating sweet grass and wilding pines are found in this wetland. However, raupō and tī kōuka are scattered throughout the wetland. Sparse matagouri and coprosma species, along with purei are also present in the wetland.

The pond at the bottom of the wetland is covered in a red native fern-ally Azolla which forms floating mats over slow moving or still bodies of water and are an important food source for the tadpole stage of introduced frog species. This wetland has a higher native biodiversity value than the first wetland as the area dominated by native vegetation is approximately 5 times that of wetland 1.

Like wetland 1, it is likely that with further monitoring, native fish and bird species may be inhabiting this area.



*Tī kōuka, raupō, and coprosma shrubs  
pictured in the wetland*



*Wilding pine and cabbage trees in the  
wetland with weed species in the  
foreground*







### Asset 3: Ponds

There are two large ponds (both approximately 1 ha) that host a range of waterfowl species and are bordered by willows. The native floating fern *Azolla* is present and it is likely that there are eels in these ponds. Grey teal ducks have been sighted in flocks of hundreds and are likely breeding at these ponds. Ponds planted with native species help to increase biodiversity in your area. They provide habitat and food for a large range of insects and birds. Birds such as waterfowl, herons, stilts, kōtare (sacred kingfishers) and even mātātā (fernbirds) can be attracted to a created pond. Perching spots over ponds help to attract birds to the pond. Together with other areas of native planting, ponds help to recreate natural habitats.



*Paradise shelducks*



*Mātātā (Fern bird)*



*Kōtare (Sacred kingfisher)*



*Azolla rubra*





## Asset 3: Ponds

0 37.5 75 150 225 300 Meters





## Risks to Biodiversity

The main risks to native biodiversity identified on Oamaru Farm are from pest animals such as:

- Wild red deer
- Mammalian predators (Possums, cats, stoats, ferrets, rats).

Deer will destroy the forest understory as well as causing mortality in young seedlings by herbivory and older saplings by rubbing their antlers and stripping the bark. Feral cats pose a large threat to native biodiversity as they predate upon lizards, insects and bird species. Stoats often catch large numbers of animals and cache them in their burrows. Possums can strip a tree of foliage within one night. They also predate upon bird eggs and young chicks.

## Biodiversity Action Plan

The biodiversity management goals have been developed keeping in mind your vision for Oamaru Farm. The biodiversity management goals listed below are ranked in order of priority to be undertaken within a 10-year period. Undertaking these tasks will ensure that you achieve high quality biodiversity management outcomes for Oamaru Farm.

The biodiversity management actions undertaken to achieve the goals will need to be recorded and reviewed annually alongside your usual farm management planning so that you can make informed biodiversity management decisions for the coming year. This allows you flexibility to carry out the work when you have the capacity and make changes in the face of unexpected events.

### **Biodiversity goals shortlist:**

1. Plantings by homestead.
2. Restoration Planting at Wetland 2
3. Restoration Planting at Wetland 1
4. Continue regular pest control
5. Biodiversity Monitoring
6. Review of Biodiversity Plan

## **Goal 1 – Plantings by homestead**

There are two small areas in the paddock north of the homestead that present opportunities for biodiversity enhancement by providing habitat and food resources for native fauna. The cumulative area is 0.63 ha. A planting plan is attached on page 33.

### **Actions**

- Source planting material from local nursery or by eco-sourcing and producing own seedlings. 1,980 seedlings will be needed to plant both of the areas (0.63 ha) if using 1.8 m spacings. 2,862 seedlings will be required if using 1.5 m spacings.
- Plant following best practice methods (Appendix 4).
- Maintain plantings following best practice methods (Appendix 4).

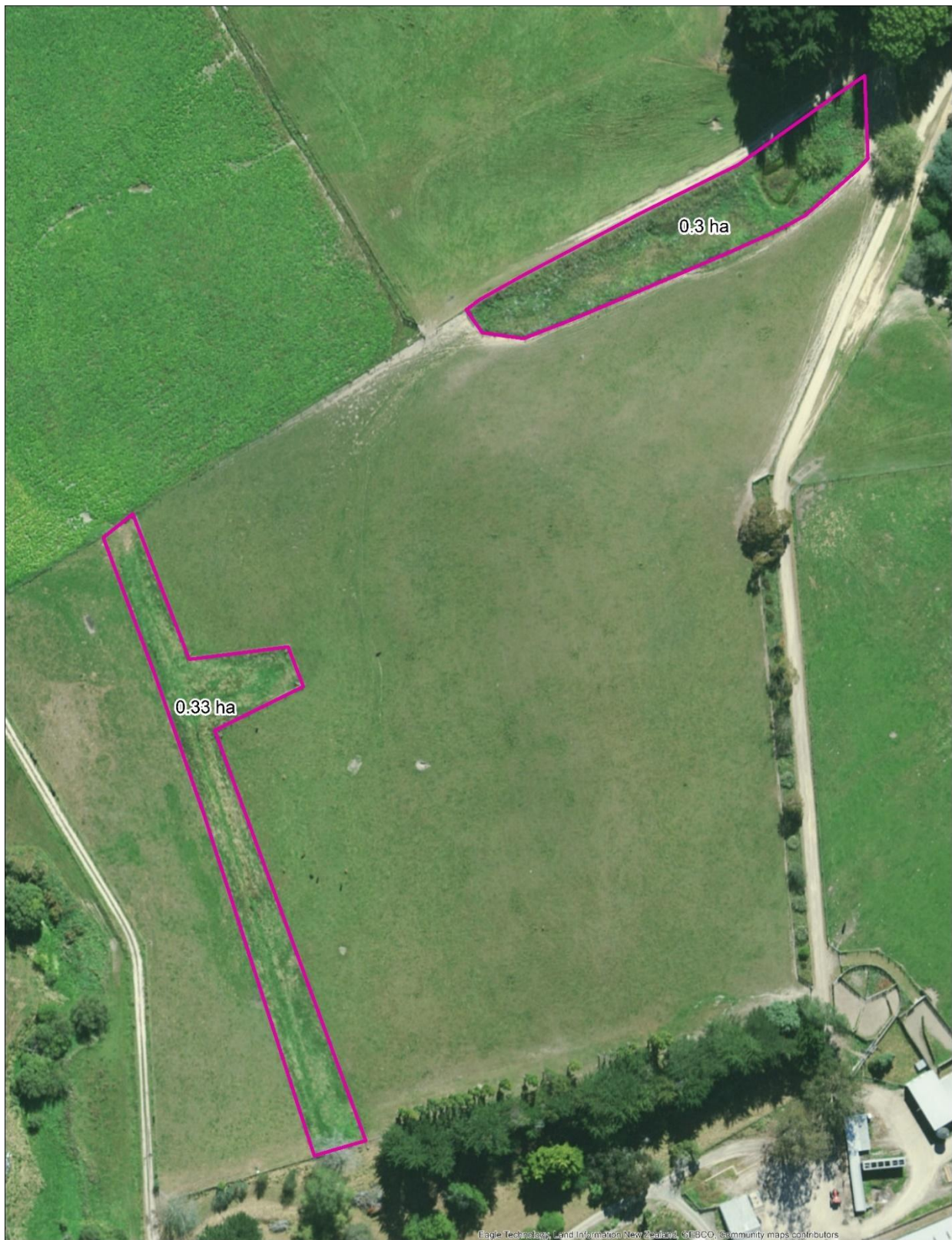
## **Benefits to biodiversity**

These areas will provide habitat and food sources for a variety of native bird and invertebrate species, as well as providing shelter for livestock. These plantings will also provide connectivity between other native habitat areas across the farm.

## **Effect on farm business**

Native biodiversity on farm provides ecosystem services such as pollination, increased soil and pasture health from beneficial insects and microorganisms. These two plantings will also offer shelter for stock and provide aesthetic value to the farm as they can be seen from the homestead.





## Plantings by Homestead

0 12.5 25 50 75 100 Meters



## **Goal 2 – Restoration Planting at Wetland 2**

This goal aims to enhance and expand the area of wetland 2 in order to increase its biodiversity values and the ecosystem benefits the wetland provides the farm such as nutrient filtration and sediment trapping.

Wetland 2, measuring from below the farm track, is around 3.58 ha. To ecologically restore this wetland, aim to plant 1,000 seedlings in the wetland every year, follow the planting guide attached with this plan (page 34). If using an average plant spacing of 1.5 m, 1,000 plants for the next 10 years will eventually cover 2.3 ha.

### **Actions**

- Source seedlings from local nursery or by eco-sourcing and producing own seedlings. Aim to plant 1,000 seedlings each year. See planting plan on page 34.
- Fence restoration site below to farm track as indicated on the following map. The fenced area will be 4.4 ha and the length of fencing required around 655 m, see map below.
- Undertake plantings following best practice methods (Appendix 4).
- Maintain plantings following best practice methods (Appendix 4).

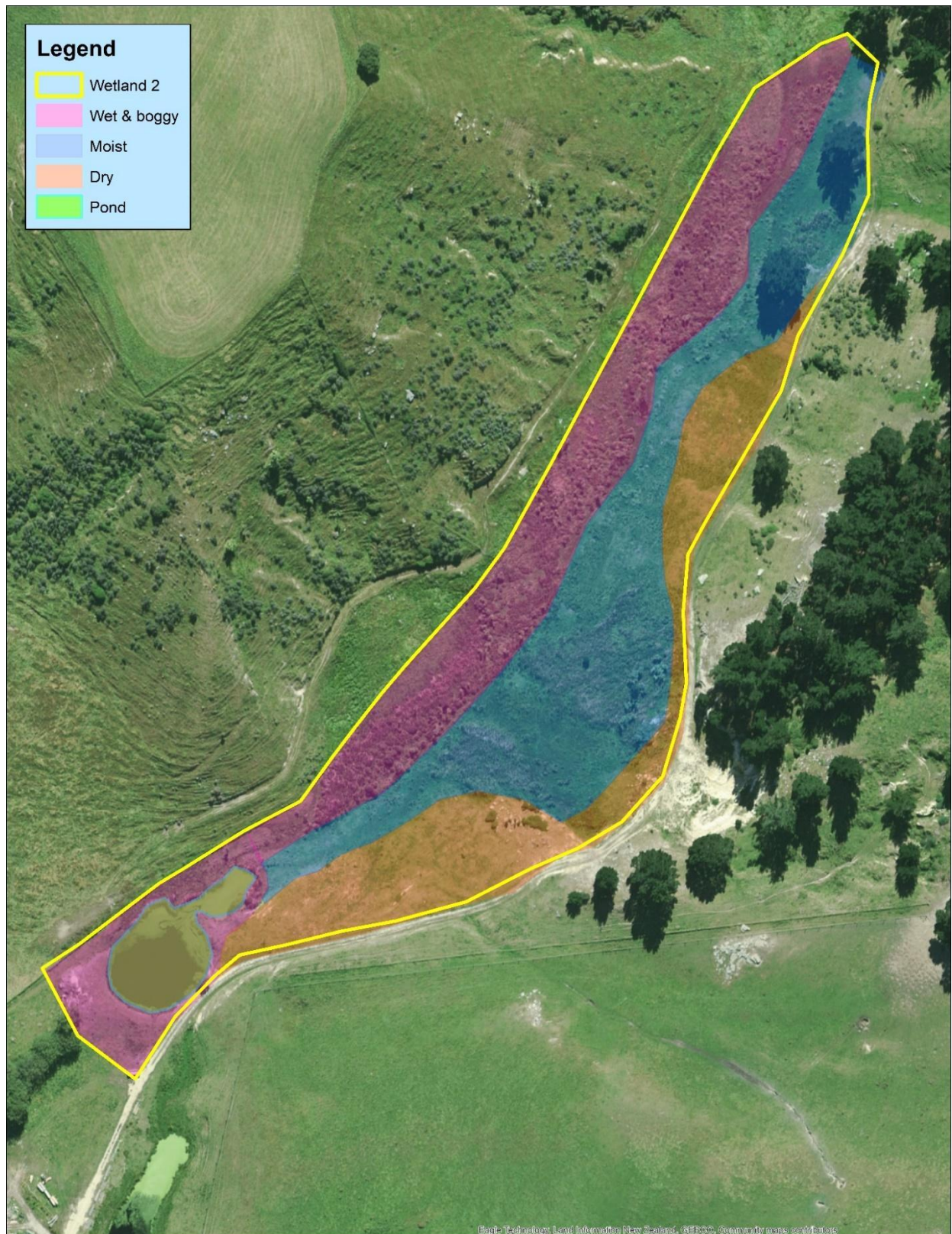
## **Benefits to biodiversity**

Wetlands are some of the most biologically diverse ecosystems, providing a valuable home for a range of native plants and animals. Wetlands also provide mahinga kai values as many taonga species are found in wetland habitats.

## **Effect on farm business**

Wetlands act as a filter for the environment, and can remove significant amounts of nitrate from runoff through sequestration and uptake by plants, improving the quality of water leaving the wetland. They also trap sediment and phosphorus and reduce faecal bacteria. Birds & insects that live in wetlands provide ecosystem services such as pollination, seed dispersal, and improved soil health.





**Wetland 2 Planting Zones**

0 25 50 100 150 200 Meters



## **Goal 3 – Restoration Planting at Wetland 1**

This goal aims to enhance and expand the area of Wetland 1 in order to increase its biodiversity values and the ecosystem benefits the wetland provides the farm.

To further expand the ecological value of the wetland, the adjacent dry face and gully should be planted in native trees, this area can then be entered into a carbon credits scheme. The dry face and gully together equal ~ 8.8 ha. This sized area would be eligible under the He waka eke noa scheme, if it comes to fruition. You would likely see a profit in about 10-15 years' time after the cost of planting. However, native forests continue to sequester carbon for much longer than exotic pine trees.

### **Actions**

Wetland 1, including the dry face, is approximately 3.5 ha. As restoring this wetland is second priority to restoring wetland 2, begin planting at Wetland 1 either after 5 years of restoration work at Wetland 2 or after a satisfactory number of seedlings have been planted at Wetland 2.

The following actions will need to be taken in the wetland:

- Source seedlings for restoration planting, either from a local nursery or through eco-sourcing seeds from the property and surrounding areas. A detailed planting plan is attached on page 34.
- Fence off main wetland area as indicated on the following map. Estimated length of fencing required is 83 m.
- Remove willows in the creek below the wetland through drill and fill technique to avoid damaging existing native ferns in the creek. Methods for this are in Appendix 2.
- Plant seedlings following best practice methods (Appendix 3).
- Maintain plantings using best practice methods (Appendix 3).

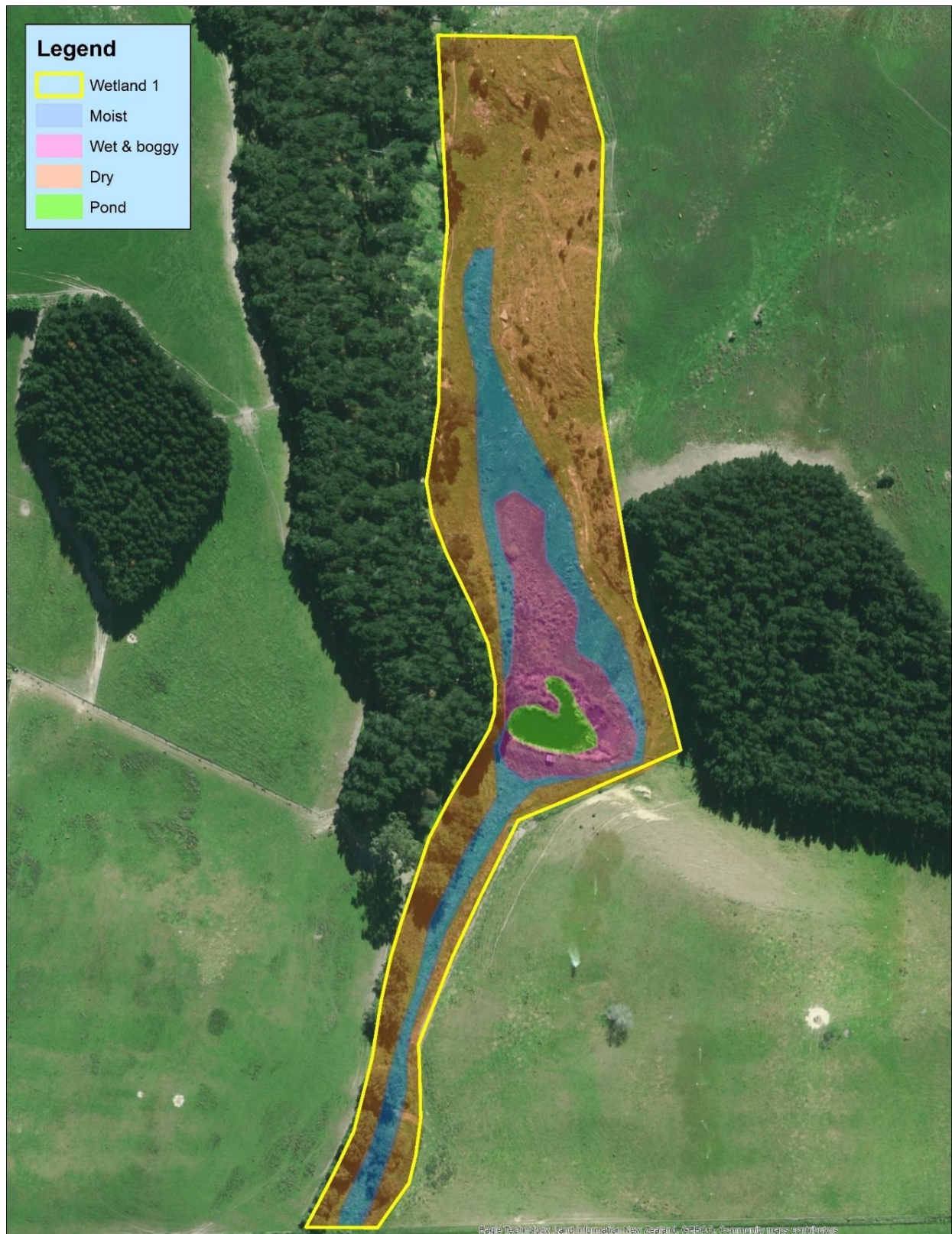
### **Benefits to biodiversity**

The restoration of this wetland will have the same biodiversity outcomes as Wetland 2 and it will increase the amount of biodiversity on Oamaru Farm greatly by having two fully restored wetlands on the property.

### **Effect on farm business**

These are the same as for Wetland 2, but again will greatly increase the effects by having twice the area restored.





**Wetland 1 Planting Zones**

0 25 50 100 150 200 Meters



## **Goal 4 - Continue regular pest control**

This goal aims to continue suppressing mammalian predators which will in turn increase native biodiversity on the property. The farm owners themselves already control rabbits, possums and cats through shooting with some 130 cats being caught annually. Mustelids are controlled through a trapping line maintained by a neighbor.

Continue shooting and trapping for:

- Possums
- Cats
- Rabbits
- Mustelids
- Wild deer - need to be controlled as they will damage native plantings, either by shooting or constructing deer fencing around native plantings.
- Record trapping and hunting tallies.

## **Benefits to biodiversity**

Possums, rabbits and deer all damage palatable native plants and will need to be controlled for restoration plantings to thrive. Cats and mustelids (stoats, weasels and ferrets) all predate upon native bird and lizard fauna and can be extremely damaging to biodiversity.

## **Effect on farm business**

Controlling pests on farm will not only help increase native biodiversity, but will also benefit the farm business as a proportion of winter crops is lost to wild deer every year and possums are TB vectors.



## Goal 5 – Implement Biodiversity Monitoring

This goal aims to establish a biodiversity management plan for Oamaru Farm. All records collected through the below monitoring actions must be kept for at least 5 years although it is recommended that you keep them in perpetuity as their value will be in the long term (including for future generations).

### Actions:

#### Establish photo point monitoring

The simplest way to monitor change in your native vegetation (as a proxy for biodiversity generally) over time is to install a photo-point monitoring network. This entails taking photos from the exact same location, in the exact same direction at the same time every year. The photos should show an area of land where you expect to see a change in vegetation over time.

At Oamaru Farm, your initial photo-points should show a view of areas where management actions such as planting, weed control and stock fencing are planned to occur. Further detail on these methods is found in Appendix 4.

#### Establish automated acoustic bird monitoring.

One acoustic bird recorder should be purchased from the Cacophony Project (<https://www.2040.co.nz/collections/cacophonometer-bird-monitoring>). This should be set to run for a full year and rotated between the plantings by the homestead, Wetland 1 after restoration planting and Wetland 2 after restoration planting. If there is cellphone coverage where the recorders are located, data will be automatically uploaded to the cloud. If there is not coverage, recorders will need to be checked regularly to back up data, this will need to be done every 3-12 months depending on the storage capacity option chosen. At this stage the data can only be analysed for overall bird counts and ruru/morepork. However, it is expected that within the next 3-5 years the AI will be advanced far enough to identify all common bird species in Aotearoa and at that stage all records stored on the Cloud will be analysed and you will receive a much more detailed record of the birds that you have been recording.

#### Freshwater monitoring

**Take an environmental DNA (eDNA) test of waterways:** Water samples should be taken annually from the outflows of both wetlands in years 1 and 5. eDNA gives a snapshot of what species are present in your waterways, both native and invasive, and is an important step in identifying what exists within the catchment.

The equipment is simple to use, further information and directions can be found at: <https://www.wilderlab.co.nz/directions>.

Although eDNA will give you an indication of native species present in the waterway it can't be used to show how well the population of a species is doing and how many individuals there are. There are other methods to assess these but require specialists' gear and knowledge to produce robust data.

**Predator control monitoring:** Records should be kept of all trapping data along with hunting and incidental sightings of predators and feral ungulates.

#### Benefits to biodiversity

Understanding which species are on the property and how their presence is changing as a result of management actions will influence future decisions on how to manage these species to further increase biodiversity on your property.

## **Effect on farm business**

Monitoring changes in biodiversity on farm is expected to become more important as local and international customers are increasingly looking to source products from farms that operate to environmentally high standards and this is likely to be reinforced as new regulations come into effect. It is important to have a record of any biodiversity enhancement conducted on your property.

## **Estimated costs**

- Automatic bird recorder = \$419 + annual cloud storage @ \$79.
- Basic freshwater eDNA package = \$160 per sample.
- Photo-points – cost of metal standards to mark location.

## **Goal 6 - Review of Biodiversity Plan**

It is important that this biodiversity plan isn't just a one-off exercise and that it is reviewed regularly and the results from monitoring are used to guide future management. While the whole biodiversity plan will have a substantial review every 5 years, annual reviews and updates to the 10-year operational plan are considered essential and should be undertaken. An annual review is also important because this plan is designed to be able to meet the needs of regulators and market auditors.

## **Actions**

Review this biodiversity plan at the same time as setting the overall farm work programme and budget for the next year. This review will include:

- Summarising the results of monitoring information from the past year.
- Undertaking a review of biodiversity management achievements against what we have proposed and assess why the management actions did or did not work.
- Undertake forward planning for both the next year and the next five-year period, which will include updating the operational plan.

## **Benefits to biodiversity**

Having a structured approach to planning biodiversity restoration work will increase the likelihood of biodiversity management actions being undertaken.

## **Effect on farm business**

Having records of biodiversity work undertaken and results of monitoring may become important to comply with future regulations.



**The following goals are not a priority for the next 10 years as the above 6 goals already provide a full 10-year work plan. The next three goals should therefore be re-visited when revising the plan after 10 years and added into the workplan.**

### **Goal 7 - Riparian plant ponds**

This goal aims to improve the biodiversity values of the two large ponds on Oamaru Farm by replacing willows with a rich assemblage of native vegetation in the riparian zone of the two ponds, providing habitat and food resources for native birds as well as waterfowl. Riparian planting will also improve the water quality in the ponds by filtering nutrients and trapping sediment. Remove willows from around the ponds using drill and fill technique. Fence riparian areas surrounding the ponds, at least 10 m wide. Riparian area around the ponds should be as wide as possible to provide ecological viability long-term. Plant appropriate native species that provide habitat and food resources for native fauna.

### **Goal 8 – Expand wetland plantings**

As time and funding become available, continue to expand the plantings using the species list provided and following best practice methods described in Appendix 2 and 3.

### **Goal 9 – Establish native forest in gully above wetland 1.**

The gully above Wetland 1 present an opportunity to establish a native forest there to provide continual income through a carbon scheme. The gully and dry face area is approximately 8.8 ha and as this area is beginning to erode it is not of high value for grazing. Converting the gully into native forest would greatly increase the biodiversity values of the area as well as income for the farm through the ETS or He Waka Eke Noa.

## **Appendix 1: Eco-sourcing**

Eco-sourcing benefits native biodiversity by using seeds from plants that naturally occur in the area. They therefore will be genetically adapted to the conditions and more likely to survive. Getting seedlings that have been grown from seed is much better than plants that have been propagated from cuttings as cuttings will mean each plant is genetically identical and the population will therefore not be robust against the risk of disease and adverse weather. Genetic diversity within a population is needed for survival. When eco-sourcing seeds, you should collect them from a variety of different plants as well as slightly different times in the season.

Resources on propagation of natives and a calendar for seed collection can be found on DOC's website: <https://www.doc.govt.nz/get-involved/run-a-project/restoration-advice/native-plant-restoration/ecosource-seeds/>

Basic guide to setting up a native nursery: [https://www.whitebaitconnection.co.nz/images/wbc/resources/HK\\_Resources/He\\_Kkano\\_\\_How\\_to\\_set\\_up\\_a\\_native\\_plant\\_nursery.pdf](https://www.whitebaitconnection.co.nz/images/wbc/resources/HK_Resources/He_Kkano__How_to_set_up_a_native_plant_nursery.pdf)

#### **Manuka<sup>1</sup>:**

They have seed capsules from September to May but you can often find capsules most of the year. When the flower petal falls off and a brown capsule remains, collect the capsules before they split open and

place them in a paper bag to open and release the seeds. Leave in a dry/warm place for two days, then look at the very bottom of the bag to find the seeds. They look like red eyelashes.

### **Harakeke<sup>1</sup>:**

Harakeke have flowers from September to November and have seeds from November to March. You may notice old empty stalks from past years. Pick the whole 'pod' off the harakeke stalk and it put straight into a bag or container. Gently open the pod and let the shiny black seeds fall out.

### **Māhoe<sup>1</sup>:**

Māhoe have really sweet smelling, tiny green/white flowers, sometimes coming straight from the trunk. From December to April you might find dark purple berries. Collect the purple berries (some think they look like 'mini-microphones'). Squash them between your fingers, wash in a sieve to get rid of the excess flesh and find the seeds inside.

### **Ti kōuka<sup>1</sup>:**

Ti kōuka have berries from December to March. The berries are white with blue speckles. Often you will only find one bunch of berries per 'head' of leaves. Each berry may contain 1-10 seeds inside. Get in quick! Kererū love to eat these berries. Gently squash them between your fingers, wash in a sieve to get rid of flesh and find the little black seeds inside.

### **Kōwhai<sup>1</sup>:**

Kōwhai have very small leaves, actually called 'leaflets'. Sometimes you can find kererū eating the new leaves. Kōwhai have seeds from October to May. Seed pods can be picked when the long strands of cases are dry and brown. There is one seed inside each 'bubble'. Kōwhai seeds have a hard yellow shell that needs to be broken in order for germination to start. Ask an adult to cut an end off with scissors or rub the seed on sandpaper until you can see the pale inside. Caution! Kōwhai seeds can be toxic so keep them away from young children.

### **Karamū<sup>1</sup>:**

You can collect the berries from March to July. The plant will often have berries of all colours, from green to orange, in each bunch. If the flowers are pollinated they will turn into a berry. You can pick the berries when they are bright orange. Wash and sieve the berries to expose two white, hard seeds.

### **Pureri (*Carex secta* and *C. virgata*)<sup>2</sup>:**

These two species of sedge are commonly found in wetlands, both growing in open sunlight or light shade in wet soil, tolerating water to a depth of 300 to 400 mm. The roots of *Carex secta* can form a trunk-like structure, making the individual plant up to 2 metres tall. The seeds are borne on long spikes – upright in *Carex virgata* and more pendulous in *C. secta*. Seeds ripen in late summer and are dispersed by floating on water. Be careful when stripping seeds from the seed head as leaf margins can be sharp. Sow on firm seed raising mix and cover lightly with mix. Germination can be a few weeks in warmer temperatures but slower in winter.

1: Retrieved on 17/06/22 from:

[https://www.whitebaitconnection.co.nz/images/wbc/resources/HK\\_Resources/He\\_K%C4%81kano\\_Seed\\_Collecting\\_Guide\\_1.pdf](https://www.whitebaitconnection.co.nz/images/wbc/resources/HK_Resources/He_K%C4%81kano_Seed_Collecting_Guide_1.pdf)

2: Retrieved on 17/06/22 from:

<https://www.doc.govt.nz/get-involved/run-a-project/restoration-advice/native-plant-restoration/ecosource-seeds/collection-and-propagation-guide-grasses/>



## Appendix 2: Planting site preparation

### Prepare sites for planting by:

- Removing exotic tree species
- Spot spraying prior to planting
- Marking locations for seedlings to be planted.

Use herbicides that have been especially formulated for use near waterways.

- Roundup Biactive, this is a specially formulated herbicide that was created to be used in environmentally sensitive areas such as around waterways and wetlands.
- Diquat® can be used in water for the control of some submerged species.
- Gallant® is specifically targeted to control grasses but should not be used where contamination of water can occur.
- Triclopyr triethylamine (e.g. Garlon 360) – kills mainly broadleaf trees (willows and alders, but also native shrubs and trees), best for scattered willows or alders where most of the natives are monocots (strappy-leaved plants like flax, cabbage tree, sedges and native grasses), ideal if spraying from the air on young invading grey willow.
- People applying the herbicides should have “Growsafe” ([www.growsafe.co.nz](http://www.growsafe.co.nz)) certification for safe handling and chemical application.
- Glyphosate can be used for the dry sites where contamination of water is not an issue.

### Removing willows from creek

Exotic trees such as eucalyptus, willows and poplars need to be removed for a native forest to successfully establish. Exotic conifer species soak up moisture in the soil and deplete nutrients, making it difficult for native tree species to establish. Removal of trees can be either by mechanical means or through poisoning.

### Drill and fill technique:

- Great for large trees and some hard to kill species, as plants continue translocating herbicide to roots for longer period resulting in more herbicide uptake.
- This method uses less herbicide than most other methods and minimal amounts of water.
- Can generally be used all year round.

- Aim is to access the cambium layer (under bark) so deep holes are not necessary.
- Only suitable for use in areas where eventual tree fall will not pose a risk to people or property

Methods:

1. Using a large drill bit (10 – 14mm), drill downward sloping holes at the recommended interval around the base of the trunk (often 10 -20cm intervals). Holes can be angled slightly across the trunk, rather than straight into the middle as most of the vascular tissues are concentrated below the bark. On multi stemmed trunks, if you can't get below the branch point, drill around each trunk.
2. Fill each hole (usually about 10-15ml in each) with the recommended herbicide using a trigger sprayer (on jet not spray) or drench gun and pack. It is usually advisable to wait till the first amount of herbicide is absorbed and then fill again.

Information obtained from: <https://weedaction.org.nz/pest-plant-control-methods/>

## Appendix 3: Planting Instructions

Spot spray 2-6 weeks prior to planting to ensure that weed competition is effectively reduced and any herbicide residue has dissipated. Ensure the areas sprayed are at least 1 m in diameter. Spraying in a snaking motion, rather than circling, reduces spray overlap. Plant seedlings in the ground during spring time when the frost risk is less. Alternatively, plant under shelter or after earlier plantings have established sufficient cover. Wetland plants should also be planted in late spring to early summer, after the water table has fallen. Exact timing of planting will depend on weather conditions and the result of initial spot spraying.

It is important to source locally appropriate plants and these may already be available commercially or a nursery will need to be contracted to collect seed and propagate them. Nurseries often need a year in advance to prepare large quantities of plants.

If purchasing hardened seedlings from a nursery, be sure to ask whether they treat their native seedlings with a mycorrhizal inoculation. It will be important to ensure that seedlings are able to develop healthy populations of mycorrhizal fungi in their roots prior to planting out. These symbiotic fungi help plants to take up nutrients and water more effectively and can make a significant difference in seedling survival rate when planted into a stressful environment.

To plant the two areas by the homestead, 1,980 seedlings will be required for the cumulative area of 0.63 ha using 1.8 m spacings.

There are three different zones in a wetland. The planting plan attached with this report details which species to plant in which zones. Be sure to order correct proportions of the different zoned plants. The persons carrying out the planting will need to understand microhabitat selection. Refer to the maps of the wetland zones attached within this plan for a guide on where to plant the different species.

- Zone A: Wet and boggy – immediately surrounding the pond and where the main flow of water passes through the wetland. Plant 0.3 ha.



- Zone B: Moist/occasionally wet – This is the largest zone type in these two wetlands. Plant 1 ha.
- Zone C: Dry – The outermost areas of the wetlands and the surround slopes. Plant 0.7 ha.

Trees and shrubs in Zones B and C should be planted at 1.8 m spacing, about 3000 trees per ha. Sedges, rushes and harakeke planted on Zone A should be planted at 1 m spacing to ensure adequate ground cover for shade, shelter and habitat for freshwater fish and invertebrates. Native plants that provide habitat for invertebrate and native bird species should be planted according to the species list provided in this plan (page 34).

Using plant guards helps to suppress weeds around the seedlings and make it easier to find and maintain the seedlings afterwards. They help protect against frosts and drying out in exposed sites. Guards can also help to protect against rabbit and hare browse. Guards should be used in combination with matting, as the weeds that grow up inside the plant guard can compete with the native seedling and are difficult to remove. Plant guards and mats are, however, optional as they do add a significant cost to the restoration project. Maintenance of plantings will need to be carried out every year, this includes release spraying and control of regrowth of woody weeds. Plant guards and stakes range between \$1.20 - \$2.80 each.

See planting techniques for Natives technical guide by Tanes Tree Trust:

[https://www.tanestrees.org.nz/site/assets/files/1069/8\\_1\\_planting\\_techniques\\_for\\_natives-1.pdf](https://www.tanestrees.org.nz/site/assets/files/1069/8_1_planting_techniques_for_natives-1.pdf)

Find options for weed mats and plant guards at Advance Landscape Ltd:

<https://www.advancelandscape.co.nz/shop/Plant+Establishment.html>

## **Appendix 4: Photo point monitoring technique.**

Regular repetition of photographs under the same seasonal conditions will be the best way to monitor the actual effect that these management actions are having on vegetation regeneration in the wetlands. Early summer (November-December) is the best time to photograph native vegetation after the flush of growth in spring but before vegetation starts to die back in mid-summer. Installing a waratah is a good way to mark the location of where to take the photos from.

Aligning the frame of repeated photos is key. It is recommended that you take copies of the original photos out with you when taking follow-up photos to ensure that you are pointing the camera in the same direction (consider using a compass bearing) and showing the same trees year on year. Relying on your memory to aim and frame the picture correctly usually produces poor results.

I recommend installing three photo points at both wetlands to be able to capture the revegetation of the three different wetland zones. At least one of these photo points should be a wider shot of the entire wetland, from a high vantage point. Suggested locations for photo points are shown on the following map.

Before conducting riparian planting and willow removal around the ponds, install two photo points at different angles at each location too.

Although photo points are useful for showing growth of larger wetland plant species, a more in-depth ecological survey using transects would be needed to fully understand species composition of the wetlands.

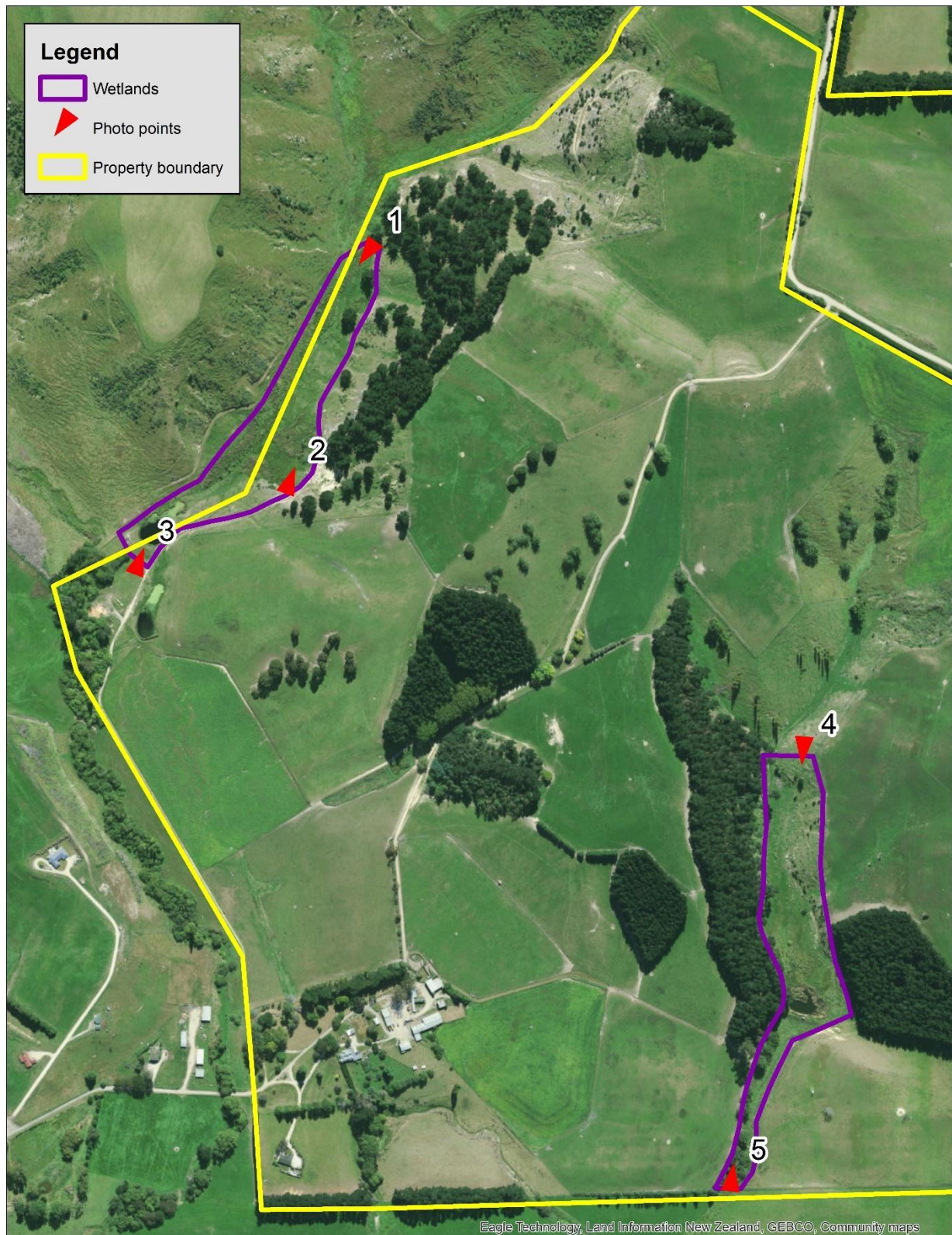
*Landscape photo-point showing change in vegetation cover on a retired sheep and beef farm over 13-years (2005 left, 2018 right). Note the increase in shrub cover on the hill side in the top right and restoration plantings below this, and the changes to the two ponds and especially expansion of raupō on the left-hand pond.*



*Close-up photo-point showing rapid re-growth of mahoe under a kānuka canopy over three years with grazing animal retirement. Note background trees for reference.*







## Photo Point Locations



## Appendix 5: Opportunities & Constraints

### Intrinsic opportunities and constraints to protect and enhance indigenous biodiversity on Oamaru Farm.

#### Opportunities:

The intrinsic opportunities for native biodiversity on Oamaru Farm are that there is existing native vegetation in two wetlands that have the potential to provide multiple benefits to biodiversity as well as water quality. Seeds can be eco-sourced from the existing vegetation on the property to increase native plants.

#### Constraints:

Wild deer are present on the property and pose a threat to any future native plantings as well as causing damage to crops. Although there are small numbers of possums found on the property, their presence here and in the wider habitat threaten biodiversity values as they are capable of stripping native trees of foliage and predate on bird eggs and chicks.

Feral cats pose a huge threat to native wildlife, including birds and lizards. The large number of cats that were shot on the property in one year is concerning as there is either a large population in the wider habitat, or the public are dumping pet cats nearby.

There is never enough time when running a busy farm business to do everything. This is something that all farms face with the many demands on people's time, not only for day-to-day farm work, but also in meeting the ever-increasing regulatory demands being imposed by Councils.

### Extrinsic opportunities & constraints to protect & enhance indigenous biodiversity

#### Opportunities:

The opportunity to collaborate with neighbouring properties and catchment group members on management actions such as pest control. Catchment groups and NOSLaM may be an information source for funding opportunities.

Market demand: There is a growing demand from markets, both domestic and international, for farm products sourced from properties that undertake proactive environmental management, including for native biodiversity conservation.

Carbon sequestration: Plantings of woody vegetation suited to margins of wetlands, a minimum of 1 m wide from the edge of the bank of the wetland may qualify for on-farm rewards for carbon sequestration through the He Waka Eke Noa emissions scheme. This can be a mix of indigenous and non/indigenous used for environmental purposes. Non-woody vegetation, such as flaxes and toetoe can be included but they must not be the predominant species. This has not been guaranteed yet as the policy is still being finalized. There are going to be opportunities for farmers in the Voluntary Carbon Market.

#### Constraints:

Conducting pest control on your property will only protect your land so far if the neighbouring properties do not control predators such as possums, mustelids, rats and pigs. Incursions to your property will continue to occur if predators are not controlled at landscape scale. This therefore ties in with the opportunities as there is a need to collaborate with neighbouring properties to control animal pests.



## Plantings lists

	Oamaru Planting List			
	Pioneer species (1)	Secondary colonisers (2)		
	Wetlands 1 & 2	Total area: 2 ha	Approximate stem spacing 0.5 m x 0.5 m for Zone A (40,000 stems per ha), 1.8 m x 1.8 m for Zones B and C (3,000 stems per ha)	
	Species	Scientific name	Number of seedlings	Specifics
	Zone A - Wet and boggy	0.3 ha		
1	Harakeke (Flax)	<i>Phormium tenax</i>	2000	Tolerant of permanently wet soil. Shelter for tree seedlings.
1	Purei	<i>Carex secta</i>	1700	Bank stabilising, sediment filtering, habitat forming. All purpose wetland plant excellent shelter for tree seedlings. Can grow to 5 m tall.
1	Pukio	<i>Carex virgata</i>	1700	Fast growing, prefers permanently wet soil. Stream banks.
1	Buchanan's sedge	<i>Carex buechananii</i>	1700	Will tolerate most conditions, but does best in full sun in a permanently damp soil. Stream banks.
1	Swamp kiokio	<i>Parablechnum minus</i>	1700	Although it does best in full sun planted within a permanently damp soil, it also can be grown in shade and also on dry soils.
1	Baumea	<i>Machaerina rubiginosa</i>	1620	Prefers an acidic, permanently damp soil but plants can be grown in free draining soils and once established will tolerate dry spells.
1	Toetoe	<i>Austroderia richardii</i>	1500	Tolerant of permanently wet soil. Shelter for tree seedlings. Use instead of exotic pampas.
1	Raupō/bullrush	<i>Typha orientalis</i>	300	Inhabits shallow fertile waters, up to about 1.5 m deep, or water-logged soils. Has the tendency to dominate habitats.
		Total:	12220	
	Zone B - Moist/Occasionally wet	1 ha		

Homes

Species

Kōwhai

Tīkōka

Broadle

Five Fin

Mānatu

Karamu

Māhoe

Harakek

Pōkākā

Tōtara

Koromil

Mingim

Rōhutu

Narrow

Winebe

Kahikat

Matai

1	Mānatu (Lowland Ribbonwood)	<i>Plagianthus regius</i>	250	Fast growing main canopy species. Tolerates wet and some shade and dry. Shelter for tree seedlings.
1	Ti kōuka (Cabbage tree)	<i>Cordyline australis</i>	250	All sites. Important habitat for birds and invertebrates. Shelter for tree seedlings.
2	Kahikatea	<i>Dacrycarpus dacrydioides</i>	250	The tallest tree native to NZ. Requires shelter plants around seedlings to protect from harsh temperatures and wind. Requires damp soil year round.
2	Pōkākā	<i>Elaeocarpus hookerianus</i>	250	Canopy species. Plant among shelter species where the soil is always damp.
2	Mataī	<i>Prumnopitys taxifolia</i>	250	Emergent and main canopy component. Requires shelter plants around seedlings. Suitable for slightly dryer sites than Kahikatea but not as dry tolerant as totara
1	Karamū	<i>Coprosma robusta</i>	135	Fast growing early successional species. Versatile but not suited for the driest sites.
1	Koromiko	<i>Hebe salicifolia</i>	200	Hardy shrub. Intolerant of dry soil. Will provide early shelter for slower growing species.
1	Five Finger	<i>Pseudopanax arboreus</i>	200	Fast growing canopy cover. Versatile. Tolerant of shade. Intolerant of dry soil.
1	Rōhutu	<i>Lophomyrtus obcordata</i>	200	Avoid planting in the wettest areas, suitable for most other planting sites.
1	Narrow-leaved lacebark	<i>Hoheria angustifolia</i>	200	Wetland edges and dryer sites. Fast growing main canopy species. Similar to lowland ribbonwood but more dry tolerant.
1	Makomako (wineberry)	<i>Aristotelia serrata</i>	200	Fast growing canopy cover. Versatile. Tolerant of shade. Intolerant of dry soil.
1	Broadleaf	<i>Griselinia littoralis</i>	150	Canopy species. Relatively tolerant of harsh temperatures. Very palatable to stock
1	Kōtukutuku (Tree Fuchsia)	<i>Fuchsia excorticata</i>	150	Requires damp soil year round when establishing. Shade and cold tolerant.
1	Mingimingi	<i>Coprosma propinqua</i>	150	Very hardy shelter shrub suitable for most sites.
1	Tarata (Lemonwood)	<i>Pittosporum eugenioides</i>	100	Fast growing main canopy species. Tolerant of some shade and dry
1	Māhoe	<i>Melicytus ramiflorus</i>	100	Fast growing main canopy species suitable for all sites on this property
1	Harakeke (Flax)	<i>Phormium tenax</i>	100	



		<b>Total:</b>	<b>3135</b>	
	<b>Zone C - Dry</b>	<b>0.7 ha</b>		
1 & 2	Kōwhai	<i>Sophora microphylla</i>	300	Suitable for dry areas. Needs full sun.
2	Tōtara	<i>Podocarpus totara</i>	205	Emergent and main canopy component for dryer areas. Requires shelter plants around seedlings. Somewhat browse resistant, plant on paddock boundaries or where stock incursion risk is high
1	Tarata (Lemonwood)	<i>Pittosporum eugenioides</i>	200	Fast growing main canopy species. Tolerant of some shade and dry
1	Mānuka	<i>Leptospermum scoparium</i>	200	Fast growing early successional canopy species. Intolerant of shade. Tolerates damp soil.
1	Red matipo/mapou	<i>Myrsine australis</i>	200	Hardy species that will do well in exposed sites. Do not plant in waterlogged sites.
2	Putaputāwētā (Marbleleaf)	<i>Carpodetus serratus</i>	200	Sub-canopy species that requires shelter trees to grow well.
1	Broadleaf	<i>Griselinia littoralis</i>	200	Canopy species. Relatively tolerant of harsh temperatures. Very palatable to stock
1	Kōhūhū	<i>Pittosporum tenuifolium</i>	150	Early successional species. Hardy. Will grown in any site.
1	Kānuka	<i>Kunzea robusta</i>	150	Dryer areas only. Fast growing main canopy species. Plant on slopes to avoid frost damage.
1	Mingimingi	<i>Coprosma propinqua</i>	150	Very hardy shelter shrub suitable for most sites.
1	Rōhutu	<i>Lophomyrtus obcordata</i>	150	Avoid planting in the wettest areas, suitable for most other planting sites.
1	Māhoe	<i>Melicytus ramiflorus</i>	100	Fast growing main canopy species suitable for all sites on this property
		<b>Total:</b>	<b>2205</b>	
	<b>Total number of seedlings</b>		<b>17560</b>	

Oamaru Homestead Planting List			
Homestead plantings	Total area 0.63 ha	Approximate stem spacing 1.8m x 1.8m - 3,000 stems per ha.	
Species	Scientific name	Number of seedlings	Specifics
Kahikatea	<i>Dacrycarpus dacrydioides</i>	70	The tallest tree native to NZ. Requires shelter plants around seedlings to protect from harsh temperatures and wind. Requires damp soil year round.
Harakeke (Flax)	<i>Phormium tenax</i>	90	Tolerant of permanently wet soil. Stream edges. Shelter for tree seedlings.
Mataī	<i>Prumnopitys taxifolia</i>	60	Emergent and main canopy component. Requires shelter plants around seedlings. Suitable for slightly dryer sites than Kahikatea but not as dry tolerant as totara
Pōkākā	<i>Elaeocarpus hookerianus</i>	80	Canopy species. Plant among shelter species where the soil is always damp.
Mahoe	<i>Melicytus ramiflorus</i>	90	Fast growing main canopy species suitable for all sites on this property
Broadleaf	<i>Griselinia littoralis</i>	100	Canopy species. Relatively tolerant of harsh temperatures. Very palatable to stock
Ti kōuka (Cabbage tree)	<i>Cordyline australis</i>	100	All sites. Important habitat for birds and invertebrates. Shelter for tree seedlings.
Mānatu (Lowland Ribbonwood)	<i>Plagianthus regius</i>	95	Fast growing main canopy species. Tolerates wet and some shade and dry. Shelter for tree seedlings.
Karamu	<i>Coprosma robusta</i>	95	Fast growing early successional species. Versatile but not suited for the driest sites.
Koromiko	<i>Hebe salicifolia</i>	76	Hardy shrub. Intolerant of dry soil. Will provide early shelter for slower growing species.
Mingimingi	<i>Coprosma propinqua</i>	76	Very hardy shelter shrub suitable for most sites.
Rōhutu	<i>Lophomyrtus obcordata</i>	76	Avoid planting in the wettest areas, suitable for most other planting sites.
Narrow-leaved lacebark	<i>Hoheria angustifolia</i>	76	Wetland edges and dryer sites. Fast growing main canopy species. Similar to lowland ribbonwood but more dry tolerant.
Wineberry	<i>Aristotelia serrata</i>	76	Fast growing canopy cover. Versatile. Tolerant of shade. Intolerant of dry soil.
Five Finger	<i>Pseudopanax</i>	95	Fast growing canopy cover. Versatile. Tolerant of shade. Intolerant of dry soil.

	<i>arboreus</i>		
Tōtara	<i>Podocarpus totara</i>	90	Emergent and main canopy component for dryer areas. Requires shelter plants around seedlings. Somewhat browse resistant, plant on paddock boundaries or where stock incursion risk is high
Tarata (Lemonwood)	<i>Pittosporum eugenioides</i>	20	Fast growing main canopy species. Tolerant of some shade and dry
Mahoe	<i>Melicytus ramiflorus</i>	95	Fast growing main canopy species suitable for all sites on this property
Mānuka	<i>Leptospermum scoparium</i>	20	Fast growing early successional canopy species. Intolerant of shade. Tolerates damp soil.
Kōwhai	<i>Sophora microphylla</i>	120	Suitable for dry areas. Needs full sun.
Red matipo/mapou	<i>Myrsine australis</i>	60	Hardy species that will do well in exposed sites. Do not plant in waterlogged sites.
Kōhūhū	<i>Pittosporum tenuifolium</i>	40	Early successional species. Hardy. Will grown in any site.
Kānuka	<i>Kunzea robusta</i>	40	Dryer areas only. Fast growing main canopy species. Plant on slopes to avoid frost damage.
Putaputāwētā (Marbleleaf)	<i>Carpodetus serratus</i>	60	Sub-canopy species that requires shelter trees to grow well.
	<b>Total number of seedlings:</b>	<b>1800</b>	



**Oamaru Farm planting list:**

<b>Oamaru Species List</b>	
<b>Species</b>	<b>Scientific name</b>
Toetoe	<i>Austroderia richardii</i>
Purei	<i>Carex secta</i>
Pukio	<i>Carex virgata</i>
Buchanan's sedge	<i>Carex buchananii</i>
Baumea	<i>Machaerina rubiginosa</i>
Swamp kiokio	<i>Parablechnum minus</i>
Raupō/bullrush	<i>Typha orientalis</i>
Kahikatea	<i>Dacrycarpus dacrydioides</i>
Harakeke (Flax)	<i>Phormium tenax</i>
Pōkākā	<i>Elaeocarpus hookerianus</i>
Mataī	<i>Prumnopitys taxifolia</i>
Tarata (Lemonwood)	<i>Pittosporum eugenioides</i>
Broadleaf	<i>Griselinia littoralis</i>
Kōtukutuku (Tree Fuchsia)	<i>Fuchsia excorticata</i>
Ti kōuka (Cabbage tree)	<i>Cordyline australis</i>
Mānatu (Lowland Ribbonwood)	<i>Plagianthus regius</i>
Karamū	<i>Coprosma robusta</i>
Koromiko	<i>Hebe salicifolia</i>
Mingimingi	<i>Coprosma propinqua</i>
Rōhutu	<i>Lophomyrtus obcordata</i>
Narrow-leaved lacebark	<i>Hoheria angustifolia</i>
Wineberry	<i>Aristotelia serrata</i>
Five Finger	<i>Pseudopanax arboreus</i>
Tōtara	<i>Podocarpus totara</i>
Tarata (Lemonwood)	<i>Pittosporum eugenioides</i>
Māhoe	<i>Melicytus ramiflorus</i>
Mānuka	<i>Leptospermum scoparium</i>
Kōwhai	<i>Sophora microphylla</i>
Red matipo/mapou	<i>Myrsine australis</i>
Kōhūhū	<i>Pittosporum tenuifolium</i>
Kānuka	<i>Kunzea robusta</i>
Putaputāwētā (Marbleleaf)	<i>Carpodetus serratus</i>