

INTEGRATED PLANTING AND MANAGEMENT PLAN (B VERSION)

OWL FARM, 1716 CAMBRIDGE ROAD, CAMBRIDGE



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R5860B

INTEGRATED PLANTING AND MANAGEMENT PLAN (B VERSION) OWL FARM, 1716 CAMBRIDGE ROAD, CAMBRIDGE



Indigenous revegetation in Established Wetland at Owl Farm.

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1. INTRODUCTION

The St Peter's School Trust Board (the Client) requires an Integrated Planting and Management Plan to guide the management of previously planted areas, as well as additional planting areas, within Owl Farm.

Owl Farm is a demonstration dairy farm, at 1716 Cambridge Road, RD 3, Hamilton. The property encompasses c.180 hectares of rural land near Cambridge, and is located within the Hamilton Ecological District.

Owl Farm have established planted riparian areas, as well as, natural and constructed treatment wetlands, and scattered shade trees, located throughout the farm. Several other areas have been outlined in their Farm Environmental Plan that would benefit from planting and/or planting management. These include riparian margins, wetland areas and areas of inaccessible or unproductive pasture. Additional shade tree locations have also been identified.

The 'project area' covered by this report largely comprises the western portion of the farm as requested by Jo Sheridan. The eastern half of the farm is going to be developed in the near future so has been excluded from this plan. The land-use within the project area currently comprises: buildings, races, structures associated with farming operations; Te Awa Cycleway track; indigenous plantings; mānuka plantings for honey production, shade trees; orchards; wetlands; waterways; and pasture.

This document is an overarching planting plan for Owl Farm (for approximately the next five years) that incorporates recommendations from the existing Tiaki Farm Environmental Plan for Owl Farm (Farm Source 2020). It outlines the proposed additional planting areas and sets ongoing management requirements for these areas, and previously planted areas, within the project area. This plan is designed to guide planting and planting management activities on Owl Farm and can hopefully be incorporated into the "Overseer" software by Owl Farm.

2. INTEGRATED PLANTING AND MANAGEMENT PLAN OBJECTIVES

The aim of this Integrated Planting and Management Plan is to provide a reference manual to guide future plantings and planting maintenance activities at Owl Farm.

Extract from FEP:

The farm and school boosts significant biodiversity features all of which are permanently stock excluded, these include a remnant stand of kahikatea as well as many wetland and riparian areas which are planted in natives. The farm runs a bi-annual eco-blitz with support from Lincoln University which involves an ecological survey of both fauna and flora with school kids in which a number of protected species have been identified. Although minimal, pests are managed through bait stations at various points around the farm. Pests on farm include: pūkeko, pigs, rats/rodents.

The objectives of the IPMP are to:

- Prepare an integrated planting plan to guide the management of additional planting areas and previously planted areas within Owl Farm.
- The IPMP will include planting for biodiversity, aesthetic, and shade/shelter outcomes.
- Include site preparation, fencing, maintenance and monitoring requirements of planted areas.
- Include planting schedules of appropriate species for each planting area.
- Include a planting and management timeline and a calendar of activities for public events and student engagement.
- Incorporate plants grown by students through the Trees for Survival programme and other farm education objectives.
- Consider and be consistent with farm operations, the cycleway project, Waikato River restoration and any other farm or adjacent projects.

Implementation of this IPMP will protect and enhance ecological features of the farm and help guide future planting and subsequent management.

3. METHODS

A field survey was undertaken on 2 June 2021. Jo Sheridan, Owl Farm Demonstration Manager, also attended for a large portion of the site visit to assist with identifying/confirming potential planting areas, previously planted areas and provide site management context on issues and considerations. Grant Wills, one of the Farm Management Committee members also attended. The field survey involved accessing the project area by vehicle and on foot. Large open areas were viewed from key vantage points, while several selected sites had a more intensive walk-through survey.

The project area was divided into management units based on priority planting areas, locations and unique management issues. Representative photographs were taken of the site and specific management issues.

To determine ongoing management requirements of each management unit, assessments were made of: indigenous vegetation areas; shade trees; waterways and constructed treatment wetland plantings. Pest plant and pest animal control strategies and methods for the best ecological and production outcomes were considered in the field and have been included below.

4. MANAGEMENT UNITS

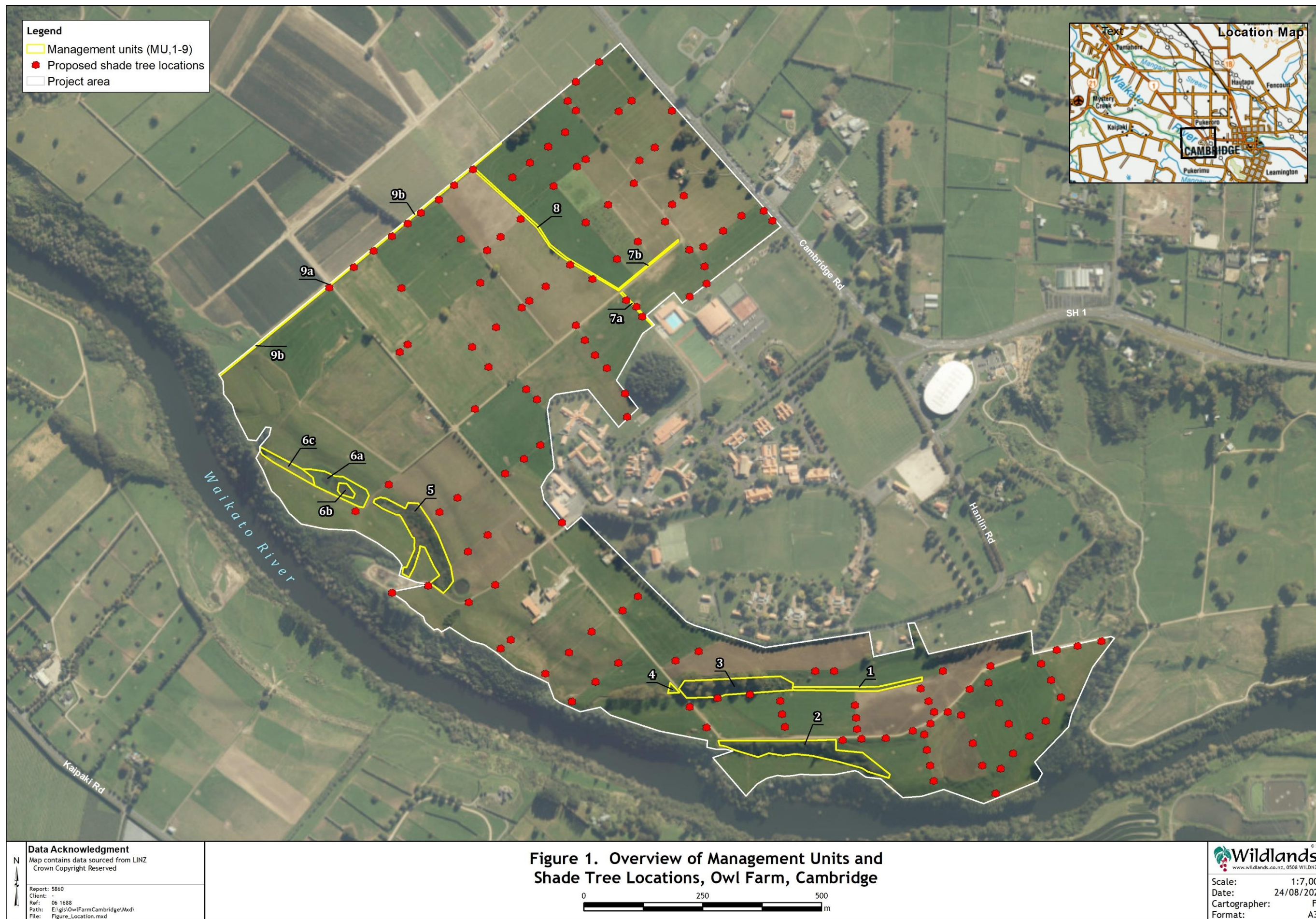
4.1 Overview

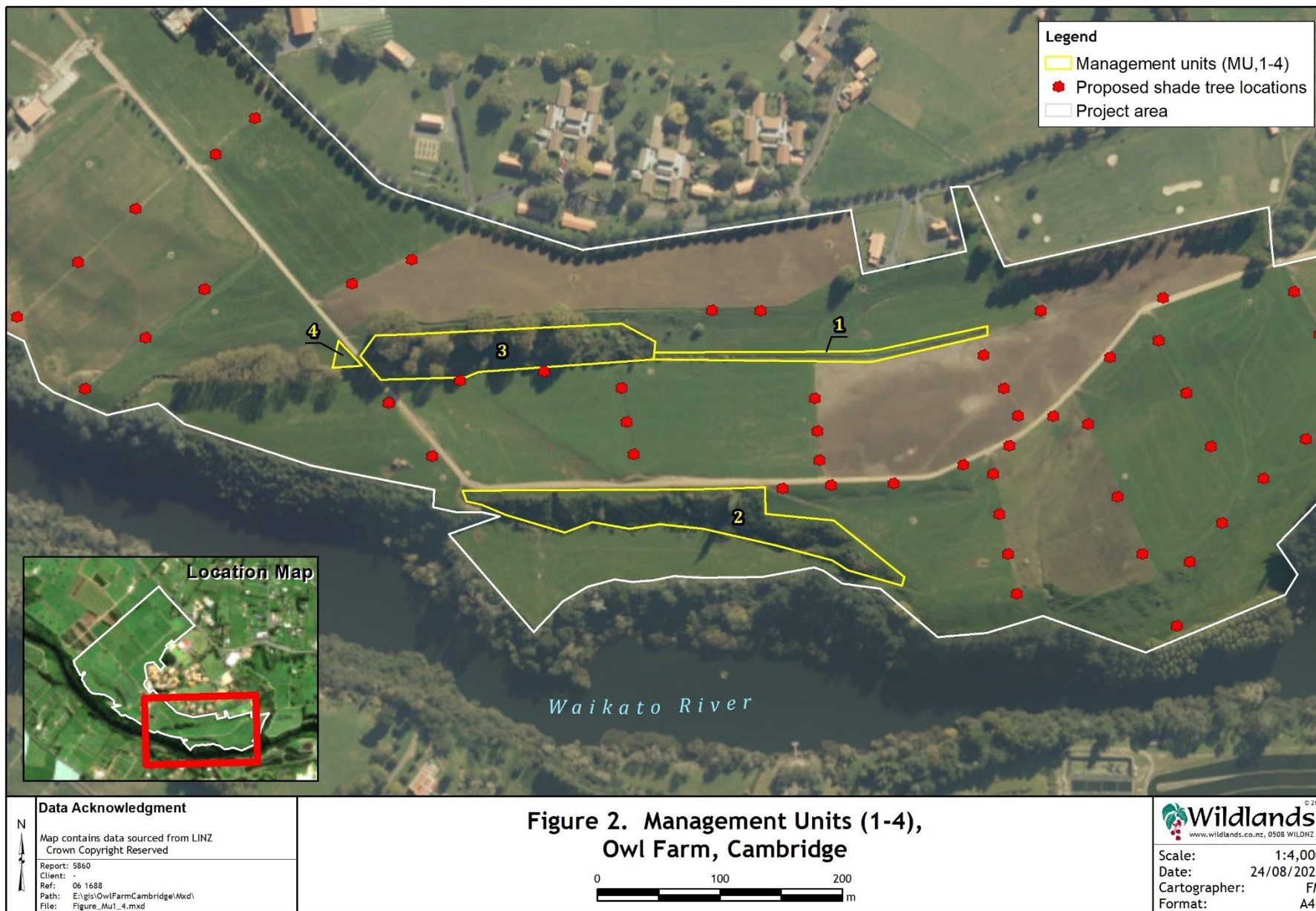
Nine broad management units (MU), with sub-units where relevant, have been mapped, based on management requirements (Figures 1-3). Potential shade tree locations have also been mapped (Figure 1).

The objectives, and immediate and ongoing requirements, for each management unit are discussed below.

Owl Farm have identified certain priority areas for management. These are MU's 1, 2, 6 and 8. A range of management actions are detailed below, including: fencing, pest plant control, site preparation, planting, and planting maintenance.

Planting schedules for proposed planting areas have been prepared. Proposed planting totals approximately 13,084 indigenous plants, planted across c. 2.5 hectares. In addition, 143 shade tree locations have been identified. All planting schedules comprise species that are ecologically appropriate and will provide habitat and/or food for indigenous fauna. All planting work should follow the proposed planting schedules and timeline (a proposed timeline for works over the next three years has been provided in Section 12). Approximate plant supply costings for each planting area have been included in Section 8.4.1.







4.1.1 Management Unit 1 (Driving Range Drain, Paddock 46)

Management Unit 1 (MU1) comprises the 'Driving Range Drain' as identified in the FEP, and during the site visit, as a possible planting area on Owl Farm (Figure 2; Plate 1).

The drain channel (average width of c.one metre) flows in a westerly direction along the southern boundary of paddock 46 and eventually drains into the Waikato River. The drain is currently fenced from stock by a single hot wire setback from the channel bank by an average of one metre on either side.

The fence set back will be widened to at least three metres on either side of the drain to allow for two rows of plants to be planted adjacent to the drain on either side (c. 1,200 m²).

Plants should be planted at an average of one metre spacing from each other, and set back at least one metre from the fence edge (leave a one metre grass strip next to the fence). Approximately 1,200¹ plants will be required to plant MU1.

During the site visit the north side of the drain was identified as an ideal planting site for students to plant in 2021 (Wildland's report 5860i). Approximately 600 plants will be required for the north side of the drain. The Client plans to plant the southern bank at a later date. The planting schedule (Table 1) is for the southern bank (as plants have already been supplied for the northern bank 2021 planting).

Current vegetation within the planting area comprises pasture grass, broadleaf species and pest plants including blackberry (*Rubus fruticosus agg.*) and pampas (*Cortaderia selloana*). All environmental pest plants, exotic grasses and broadleaf weeds require control prior to planting. See Section 7 for site preparation requirements.

Table 1: Planting schedule recommended for Driving Range Drain (southern bank, 600 m²).

Species	Common name	Preferred Grade	Spacing (m)	No. (approx.)
<i>Aristotelia serrata</i> ²	makomako, wineberry	1.5L/PB3	3-5	6
<i>Carex geminata</i> ³	rautahi, cutty grass	0.5L	1	60
<i>Carex secta</i> ³	pukio	0.5L	1	30
<i>Carex virgata</i> ³	pūrei	0.5L	1	30
<i>Coprosma propinqua</i>	mingimingi	0.5L	1	30
<i>Coprosma robusta</i>	karamū	0.5L	1	30
<i>Cordyline australis</i>	tī kōuka, cabbage tree	0.5L	1	30
<i>Cyperus ustulatus</i> ³	upoko-tangata, giant umbrella sedge	0.5L	1	30
<i>Dacrycarpus dacrydioides</i> ²	kahikatea	1.5L/PB3	3-5	6
<i>Kunzea robusta</i>	kānuka	0.5L	1	30
<i>Leptospermum scoparium</i>	mānuka	0.5L	1	90
<i>Melicytus ramiflorus</i> ²	māhoe	1.5L/PB3	3-5	6
<i>Phormium tenax</i>	harakeke	0.5L	1	90
<i>Pittosporum eugeniioides</i>	tarata, lemonwood	0.5L	1	30
<i>Pittosporum tenuifolium</i>	kōhūhū	0.5L	1	60
<i>Plagianthus regius</i> ²	mānātu, lowland ribbonwood	1.5L/PB3	3-5	6
<i>Podocarpus totara</i> ²	tōtara	1.5L/PB3	3-5	3
<i>Sophora microphylla</i> ²	kōwhai	1.5L/PB3	3-5	3

1 Please note that this number is based on a setback of three metres either side of the drain. If the Client wishes to extend the setback to 4-5 metres, then the plant numbers required will increase.

2 Plant at approximately 3-5 metre centres, while maintaining an overall coverage of one metre spacing between plants

3 Plant along the drain edge (first row).

<i>Veronica stricta</i>	koromiko	0.5L	1	30
Total				600



Plate 1: Management Unit 1 includes both riparian margins of the “Driving Range Drain”. The northern side (right hand side of photo) is scheduled to be planted in 2021. 2 June 2021.

4.1.2 Management Unit 2 (Hillslope, Paddock 49)

Management Unit 2 (MU2; c.10,000 m²) encompasses the cleared hillslope located in Paddock 49 which overlooks the Waikato River and the new cycleway (Figure 2; Plate 2). Planting MU2 is a high priority for the Client, who wishes to create a “biodiversity corridor” and use this area for educational purposes, both for the public and the school students. Ideally this site can be used to showcase planting on Owl Farm.

A small portion of MU2 will comprise an area where previously excavated soil containing artifacts of cultural significance will be placed. This archaeological area will not be planted (c. 200 m², exact location within planting area yet to be determined).

The majority of MU2 has recently been cleared, however occasional pest plants still persist (including Chinese privet (*Ligustrum sinense*), *Pinus radiata* and blackberry), along with rank grass and broadleaf weeds present along the northern section of the planting area. Some of the planting area has also been resown with grass (Plate 3). Mulch is also present in some parts (Plate 4) of the site, which may require some spreading prior to planting, i.e., if there are patches of deep mulch.

All environmental pest plants, exotic grasses and broadleaf weeds require control prior to planting. See Section 7 for site preparation requirements. The terrain of MU2 is not suitable for students or inexperienced planters and it is recommended that contractors are engaged to undertake the planting works.

The eastern section of the site is very steep, comprises bare soil, and is currently unfenced (Plate 5). The client wishes for this section to remain unfenced and will focus more on weed management and erosion control here. The best option for this site

(discussed on site) is to install mānuka brush/slash within this area. This process involves cutting fresh branches of mānuka (with seed capsules) and fixing them in place on, or at the top, of the slope. As the seed capsules dry out, they open and the fine seed is dispersed onto the bare soil. If successful, the mānuka seed germinates and establishes a mānuka vegetation cover. The recommended timing for installing mānuka brush/slash is late winter/spring, but autumn/early winter is also okay. However, the site must be bare soil, so all weeds must be controlled prior to installation.

Allowing for a one metre setback from the fence, and 1.4 metres between plants, approximately 5,102 plants will be required to plant MU2 (10,000 m²) (Table 2).

Table 2: Planting schedule recommended for Hillslope, Paddock 49.

Species	Common name	Preferred Grade	Spacing (m)	No. (approx.)
<i>Alectryon excelsus</i> ¹	tītoki	1.5L/PB3	3-5	51
<i>Aristotelia serrata</i> ¹	makomako, wineberry	1.5L/PB3	3-5	26
<i>Coprosma propinqua</i>	mingimingi	0.5L	1.4	255
<i>Coprosma robusta</i>	karamū	0.5L	1.4	255
<i>Cordyline australis</i>	tī kōuka, cabbage tree	0.5L	1.4	510
<i>Dacrycarpus dacrydioides</i> ¹	kahikatea	1.5L/PB3	3-5	26
<i>Kunzea robusta</i>	kānuka	0.5L	1.4	1275
<i>Leptospermum scoparium</i>	mānuka	0.5L	1.4	1020
<i>Melicytus ramiflorus</i> ¹	māhoe	1.5L/PB3	3-5	26
<i>Phormium tenax</i>	harakeke	0.5L	1.4	255
<i>Pittosporum eugenoides</i>	tarata, lemonwood	0.5L	1.4	510
<i>Pittosporum tenuifolium</i>	kōhūhū	0.5L	1.4	510
<i>Plagianthus regius</i> ¹	mānatu, lowland ribbonwood	1.5L/PB3	3-5	26
<i>Podocarpus totara</i> ¹	tōtara	1.5L/PB3	3-5	51
<i>Sophora microphylla</i> ¹	kōwhai	1.5L/PB3	3-5	51
<i>Veronica stricta</i>	koromiko	0.5L	1.4	255
Total				5102



Plate 2: Management Unit 2. 2 June 2021.

1 Plant at approximately 3-5 metre centres, while maintaining an overall coverage of one metre spacing between plants



Plate 3: Resown grass within Management Unit 2. 2 June 2021.



Plate 4: Mulch within Management Unit 2. 2 June 2021.



Plate 5: Unfenced eastern section of Management Unit 2. 2 June 2021.

4.1.3 Management Unit 3 (Mixed exotic-indigenous forest, Paddock 46)

Management Unit 3 (MU3, c.7,640 m²) comprises a section of fenced mixed exotic-indigenous forest located in the west of Paddock 46, along the northern side of the same drain as MU1 (Plate 6). MU3 is not a priority for the Client but has been included as an option for undertaking pest plant control and future planting.

Pest plants are abundant and include hawthorn (*Crataegus monogyna*), tree privet (*Ligustrum lucidum*), gorse (*Ulex europaeus*), Chinese privet, pampas and blackberry. These species will continue to readily invade areas where indigenous vegetation cover is absent or is in poor condition, i.e., not providing canopy closure. Pest plant control and subsequent planting is recommended within MU3 (Plate 7). See Section 7 for site preparation requirements.

An estimated plant schedule is provided below based on planting approximately 1,000 plants within a c. 1,000 m² area at one metre spacing (Table 3). Plant numbers should be reassessed following pest plant control.

The terrain of MU3 may be suitable for students or inexperienced planters but this will need to be confirmed following pest plant control works.

Table 3: Planting schedule recommended for MU3, Paddock 46.

Species	Common name	Preferred Grade	Spacing (m)	No. (approx.)
<i>Alectryon excelsus</i> ¹	tītoki	1.5L/PB3	3-5	10
<i>Aristotelia serrata</i> ¹	makomako, wineberry	1.5L/PB3	3-5	5
<i>Carex geminata</i> ²	rautahi, cutty grass	0.5L	1	50
<i>Carex secta</i> ²	pukio	0.5L	1	50
<i>Carex virgata</i> ²	pūrei	0.5L	1	25
<i>Coprosma propinqua</i>	mingimingi	0.5L	1	50
<i>Coprosma robusta</i>	karamū	0.5L	1	50
<i>Cordyline australis</i>	tī kōuka, cabbage tree	0.5L	1	100
<i>Cyperus ustulatus</i> ²	upokotangata, giant umbrella sedge	0.5L	1	50
<i>Dacrycarpus dacrydioides</i> ¹	kahikatea	1.5L/PB3	3-5	10
<i>Kunzea robusta</i>	kānuka	0.5L	1	200
<i>Leptospermum scoparium</i>	mānuka	0.5L	1	100
<i>Melicetyus ramiflorus</i> ¹	māhoe	1.5L/PB3	3-5	5
<i>Phormium tenax</i>	harakeke	0.5L	1	50
<i>Pittosporum eugeniioides</i>	tarata, lemonwood	0.5L	1	50
<i>Pittosporum tenuifolium</i>	kōhūhū	0.5L	1	125
<i>Plagianthus regius</i> ¹	mānatu, lowland ribbonwood	1.5L/PB3	3-5	5
<i>Podocarpus totara</i> ¹	tōtara	1.5L/PB3	3-5	10
<i>Sophora microphylla</i> ¹	kōwhai	1.5L/PB3	3-5	5
<i>Veronica stricta</i>	koromiko	0.5L	1	50
Total				1,000



Plate 6: Management Unit 3 (right hand side of fence). Pest plant control is recommended 2 June 2021.

1 Plant at approximately 3-5 metre centres, while maintaining an overall coverage of one metre spacing between plants
2 Plant at 1m spacing along the drain edge and wetter areas within paddock.



Plate 7: Drain margin and flood plain, MU2. 2 June 2021.

4.1.4 Management Unit 4 (triangle area near race/drain, Paddock 44).

Management Unit 4 (MU4, c.300 m²) comprises a triangle section of unfenced pasture located near the race and drain in the south eastern corner of Paddock 44 (Figure 2, Plates 8-10). The Client wishes to plant this area to assist with capturing race runoff.

Current vegetation within the planting area comprises pasture grasses and broadleaf species. Planting has previously been undertaken along the banks of the drain and the plants are now established and appear healthy. Pampas is also present along the drain bank and removal is recommended. There are occasional gaps in the adjacent drain plantings where some plants have not survived - these would benefit from infill planting (Plate 10). See Section 7 for site preparation requirements.

Allowing for a one metre setback from the fence, and one metre spacing between plants, approximately 300 plants will be required to plant MU4 (Table 4). Permanent fencing is required prior to, or immediately after, planting to exclude stock.

This site is suitable for students to plant, or for a community planting day.

Table 4: Planting schedule recommended for MU4, Paddock 44.

Species	Common name	Preferred Grade	Spacing (m)	No. (approx.)
<i>Alectryon excelsus</i> ¹	tītoki	1.5L/PB3	3-5	2
<i>Aristotelia serrata</i> ¹	makomako, wineberry	1.5L/PB3	3-5	3
<i>Carex geminata</i>	rautahi, cutty grass	0.5L	1	14
<i>Carex secta</i>	pukio	0.5L	1	14
<i>Coprosma propinqua</i>	mingimingi	0.5L	1	30
<i>Coprosma robusta</i>	karamū	0.5L	1	30
<i>Cordyline australis</i>	tī kōuka, cabbage tree	0.5L	1	30
<i>Dacrycarpus dacrydioides</i> ¹	kahikatea	1.5L/PB3	3-5	2
<i>Kunzea robusta</i>	kānuka	0.5L	1	30
<i>Leptospermum scoparium</i>	mānuka	0.5L	1	30
<i>Melicytus ramiflorus</i> ¹	māhoe	1.5L/PB3	3-5	2
<i>Phormium tenax</i>	harakeke	0.5L	1	30
<i>Pittosporum eugenoides</i>	tarata, lemonwood	0.5L	1	15
<i>Pittosporum tenuifolium</i>	kōhūhū	0.5L	1	30
<i>Plagianthus regius</i> ¹	mānatu, lowland ribbonwood	1.5L/PB3	3-5	3
<i>Podocarpus totara</i> ¹	tōtara	1.5L/PB3	3-5	2
<i>Sophora microphylla</i> ¹	kōwhai	1.5L/PB3	3-5	3
<i>Veronica stricta</i>	koromiko	0.5L	1	30
Total				300



Plate 8: Management Unit 4 (foreground). 2 June 2021.

¹ Plant at approximately 3-5 metre centres, while maintaining an overall coverage of one metre spacing between plants



Plate 9: Management Unit 4 (foreground). 2 June 2021.



Plate 10: Plantings along drain in paddocks 44 and 47. Some infill planting required. 2 June 2021.

4.1.5 Management Unit 5 (established wetland beside the old effluent pond)

Management Unit 5 (MU5, c.10,000 m²) comprises the established wetland beside the old effluent pond (Figure 3, Plate 11). The wetland largely comprises a mosaic of indigenous raupō reedland, *Carex* spp. sedgeland and harakeke flaxland, with occasional pest plants including grey willow (*Salix cinerea*), gorse and blackberry (Plates 11 & 12). These pest plants threaten the ecological value of the wetland and require control. See Section 7 for site preparation requirements.

Infill planting with indigenous wetland species should be undertaken if resources allow. Allowing for one metre spacing between plants it is estimated that following pest plant control approximately 400 plants will be required to infill plant MU5 (Table 5). The exact planting area size (and subsequent plant numbers) will need to be confirmed once pest plants have been controlled.

It is recommended that contractors are engaged to undertake the planting works within the wetland due to the challenging terrain/wetland, and associated health and safety risks.

Table 5: Planting schedule recommended for MU5; established wetland.

Species	Common name	Preferred Grade	Spacing (m)	No. (approx.)
<i>Carex geminata</i>	rautahi, cutty grass	0.5L	1	60
<i>Carex secta</i>	pukio	0.5L	1	60
<i>Coprosma propinqua</i>	mingimingi	0.5L	1	40
<i>Cordyline australis</i>	tī kōuka, cabbage tree	0.5L	1	60
<i>Cyperus ustulatus</i>	upokotangata, giant umbrella sedge	0.5L	1	60
<i>Dacrycarpus dacrydioides</i> ¹	kahikatea	1.5L/PB3	3-5	10
<i>Laurelia novae-zealandiae</i> ¹	pukatea	1.5L/PB3	3-5	10
<i>Phormium tenax</i>	harakeke	0.5L	1	60
<i>Schoenoplectus tabernaemontani</i>	kāpūngāwhā/lake club rush	0.5L	1	40
Total				400

¹ Plant at approximately 3-5 metre centres, while maintaining an overall coverage of one metre spacing between plants



Plate 11: Grey willow which requires removal, MU5. 2 June 2021.



Plate 12: Blackberry and gorse which require removal, MU5. 2 June 2021.

4.1.6 Management Unit 6 (Constructed Treatment Wetland)

Management Unit 6 (MU6, c.6,910 m²) comprises a constructed treatment wetland (Figure 3, Plate 13). The constructed treatment wetland is monitored by The National Institute of Water and Atmospheric Research (NIWA) to investigate the impact the wetland is having on extracting nitrates from the water.

The area has been split into three sub-units, based on management recommendations. Occasional pest plants were noted and overall weed control throughout the wetland is recommended. The wetland should be managed to encourage regeneration of indigenous plant cover. Therefore, pest plants should be controlled and prevented from spreading, so that the indigenous wetland vegetation that is present can be allowed to naturally regenerate over the site.

The Client would like to undertake additional planting within the middle of the wetland (MU6b; Plate 14) where some previous plantings have failed, largely due to pūkeko removing plants. The recommended approach to limit damage by pūkeko is to plant larger grades (1.5L/PB3), use well developed plant stock (good roots and foliage), and undertake control of any problem pūkeko (refer Section 7.5).

Allowing for one metre spacing between plants it is estimated that approximately 732 plants will be required to infill plant MU6b (Table 6).

Additional planting could also be undertaken within the area adjacent to the wetland MU6c (Plate 15). This should first be discussed with any research organisations involved with the constructed treatment wetland to ensure additional plantings will not impact current research being undertaken, as the rank grass that is currently present may be a key part of any research project. Allowing for one metre spacing between plants it is estimated that approximately 1,800 plants will be required to plant MU6c (Table 7). The client also discussed the option of biomass removal/harvesting to encourage new plant growth and subsequent increase of the uptake of nitrates. However, according to NIWA, harvesting of plant biomass is not recommended as an effective nutrient removal strategy as nutrient uptake and storage by the wetland plants only accounts for a small portion of the nutrient removal system within the wetland (Tanner & Kloosterman 1997; Tanner *et al.* 2021).

Table 6: Planting schedule recommended for MU6b; constructed wetland.

Species	Common name	Preferred Grade	Spacing (m)	No. (approx.)
<i>Baumea articulata</i>	jointed twig-rush	1.5L/PB3	1	110
<i>Carex geminata</i>	rautahi, cutty grass	1.5L/PB3	1	110
<i>Carex secta</i>	pukio	1.5L/PB3	1	110
<i>Cyperus ustulatus</i>	upokotangata, giant umbrella sedge	1.5L/PB3	1	110
<i>Schoenoplectus tabernaemontani</i>	kāpūngāwhā/lake club rush	1.5L/PB3	1	292
Total				732

Table 7: Planting schedule recommended for MU6c; constructed wetland.

Species	Common name	Preferred Grade	Spacing (m)	No. (approx.)
<i>Austroderia fulvida</i>	toetoe	0.5L	1	90
<i>Baumea articulata</i>	jointed twig-rush	0.5L	1	180
<i>Carex geminata</i>	rautahi, cutty grass	0.5L	1	270
<i>Carex secta</i>	pukio	0.5L	1	90
<i>Carpodetus serratus</i> ¹	putaputaweta	1.5L/PB3	3-5	18
<i>Coprosma robusta</i>	karamū	0.5L	1	90
<i>Cordyline australis</i>	tī kōuka, cabbage tree	0.5L	1	126
<i>Cyperus ustulatus</i>	upoko-tangata, giant umbrella sedge	0.5L	1	90
<i>Dacrycarpus dacrydioides</i> ¹	kahikatea	1.5L/PB3	3-5	18
<i>Kunzea robusta</i>	kānuka	0.5L	1	180
<i>Laurelia novae-zealandiae</i> ¹	pukatea	1.5L/PB3	3-5	18
<i>Leptospermum scoparium</i>	mānuka	0.5L	1	180
<i>Pittosporum eugenoides</i>	tarata, lemonwood	0.5L	1	90
<i>Pittosporum tenuifolium</i>	kōhūhū	0.5L	1	90
<i>Phormium tenax</i>	harakeke	0.5L	1	180
<i>Veronica stricta</i>	koromiko	0.5L	1	90
Total				1,800



Plate 13: Constructed treatment wetland, MU6a. 2 June 2021.

¹ Plant at approximately 3-5 metre centres, while maintaining an overall coverage of one metre spacing between plants



Plate 14: Area to replant within constructed treatment wetland, MU6b. 2 June 2021.



Plate 15: Additional area to plant within constructed treatment wetland, MU6c. 2 June 2021.

4.1.7 Management Unit 7 (pool drain and race drain)

Management Unit 7 (MU7) comprises two drains (Figure 3). These management units are a low priority for management. MU7a (Plate 16) is planted on both sides of the drain, but requires some infill planting (Table 8). MU7b (Plate 17) has recently been planted on the eastern side to capture runoff from the race.

Ongoing maintenance of these two areas is recommended. The Client does not wish to plant the western bank of the raceway drain.

Table 8: Planting schedule recommended for infill plantings, MU7a.

Species	Common name	Preferred Grade	Spacing (m)	No. (approx.)
<i>Carex geminata</i>	rautahi, cutty grass	0.5L	1	60
<i>Cyperus ustulatus</i>	upoko-tangata, giant umbrella sedge	0.5L	1	40
Total				100



Plate 16: Management Unit 7a. 2 June 2021.



Plate 17: Management Unit 7b, with plantings along eastern bank.
2 June 2021.

4.1.8 Management Unit 8 (drain, Paddocks 21-23)

Management Unit 8 (MU8) comprises the drain located along the boundary of paddocks 21-23 (Figure 3; Plate 18), and is a high priority for management.

The drain channel (average width of c.one metre) flows in a westerly direction to join the western boundary drain which eventually drains into the Waikato River. The drain is approximately 400 metres in length and is currently fenced by two hot wires on the southern side and a single hot wire on the northern side. The fences are setback from the channel bank by an average of one metre on either side (Plate 18).

Current vegetation within the planting area comprises rank grass, broadleaf species and blackberry. Some sparse planting (*Carex* spp.) has been undertaken on the southern bank. All environmental pest plants, exotic grasses and broadleaf weeds require control prior to planting. See Section 7 for site preparation requirements.

The fence set back will be widened to at least three metres on either side of the drain to allow for two rows of plants to be planted adjacent to the drain on either side. Plants should be planted at an average of one metre spacing from each other within the planting area and set back at least one metre from the fence (leave a one metre grass strip next to the fence). Allowing for a one metre setback from the fence, approximately 1,600 plants will be required to plant MU8 (Table 9).

This site is suitable for students to plant, or for a community planting day.

Table 9: Planting schedule recommended for MU8 (drain, Paddocks 21-23).

Species	Common name	Preferred Grade	Spacing (m)	No. (approx.)
<i>Alectryon excelsus</i> ¹	tītoki	1.5L/PB3	3-5	8
<i>Aristotelia serrata</i> ¹	makomako, wineberry	1.5L/PB3	3-5	16
<i>Austroderia fulvida</i>	toetoe	0.5L	1	160
<i>Carex geminata</i>	rautahi, cutty grass	0.5L	1	320
<i>Carex secta</i>	pukio	0.5L	1	160
<i>Carex virgata</i>	pūrei	0.5L	1	80
<i>Coprosma propinqua</i>	mingimingi	0.5L	1	80
<i>Coprosma robusta</i>	karamū	0.5L	1	80
<i>Cordyline australis</i>	tī kōuka, cabbage tree	0.5L	1	80
<i>Cyperus ustulatus</i>	upoko-tangata, giant umbrella sedge	0.5L	1	160
<i>Dacrycarpus dacrydioides</i> ¹	kahikatea	1.5L/PB3	3-5	8
<i>Leptospermum scoparium</i>	mānuka	0.5L	1	80
<i>Melicytus ramiflorus</i> ¹	māhoe	1.5L/PB3	3-5	8
<i>Phormium tenax</i>	harakeke	0.5L	1	160
<i>Pittosporum tenuifolium</i>	kōhūhū	0.5L	1	80
<i>Plagianthus regius</i> ¹	mānatu, lowland ribbonwood	1.5L/PB3	3-5	16
<i>Podocarpus totara</i> ¹	tōtara	1.5L/PB3	3-5	8
<i>Sophora microphylla</i> ¹	kōwhai	1.5L/PB3	3-5	16
<i>Veronica stricta</i>	koromiko	0.5L	1	80
Total				1,600



Plate 18: Management Unit 8. 2 June 2021.

¹ Plant at approximately 3-5 metre centres, while maintaining an overall coverage of one metre spacing between plants

4.1.9 Management Unit 9 (culvert and drain, western boundary)

Management Unit 9 (MU9) comprises the western boundary drain (Figure 3; Plate 19 & 20). The site has been split into MU9a (culvert; Plate 19) and MU9b (rest of drain, Plate 20) based on priority areas and management requirements.

The drain channel (average width of c.one metre) flows in a southerly direction along the western boundary of Owl Farm, and eventually drains into the Waikato River. The drain is approximately 800 metres in length and is currently fenced by the boundary fence on the western side, and a single hot wire on the eastern side, which is setback from the channel bank by 1-2 metres. There is a mown running track, regularly used by the school, on the eastern side of this management unit. Any planting undertaken within MU9 must not impede on the running track

Current vegetation within the planting area comprises rank grass and broadleaf species. All exotic grasses and broadleaf weeds require control prior to planting. See Section 7 for site preparation requirements.

The fence set back will not be altered and at this stage the client is only interested in planting the eastern side of the drain, except around the culvert where both sides can be planted. There is only sufficient space for one row of plants to be planted adjacent to the drain on the eastern side.

Plants should be planted at an average of one metre spacing from each other within the planting area and planted mid-way between the drain and the hotwire fence. Approximately 50 plants will be required to plant MU9a (Table 10) and 800 plants to plant MU9b (Table 11). MU9a (culvert) is a higher priority area to plant than MU9b. The client also wishes to only plant lower growing species around the culvert such as *Carex* spp.

Table 10: Planting schedule recommended for MU9a (culvert, western boundary).

Species	Common name	Preferred Grade	Spacing (m)	No. (approx.)
<i>Carex geminata</i>	rautahi, cutty grass	0.5L	1	50
Total				50

Table 11: Planting schedule recommended for MU9b (drain, western boundary).

Species	Common name	Preferred Grade	Spacing (m)	No. (approx.)
<i>Alectryon excelsus</i> ¹	tītoki	1.5L/PB3	3-5	4
<i>Aristotelia serrata</i> ¹	makomako, wineberry	1.5L/PB3	3-5	8
<i>Austroderia fulvida</i>	toetoe	0.5L	1	80
<i>Carex geminata</i>	rautahi, cutty grass	0.5L	1	160
<i>Carex secta</i>	pukio	0.5L	1	80
<i>Carex virgata</i>	pūrei	0.5L	1	40
<i>Coprosma propinqua</i>	mingimingi	0.5L	1	40
<i>Coprosma robusta</i>	karamū	0.5L	1	40
<i>Cordyline australis</i>	tī kōuka, cabbage tree	0.5L	1	80
<i>Cyperus ustulatus</i>	upoko-tangata, giant umbrella sedge	0.5L	1	80
<i>Dacrycarpus dacrydioides</i> ¹	kahikatea	1.5L/PB3	3-5	4
<i>Leptospermum scoparium</i>	mānuka	0.5L	1	80
<i>Melicytus ramiflorus</i>	māhoe	1.5L/PB3	1	4
<i>Pittosporum tenuifolium</i>	kōhūhū	0.5L	1	40
<i>Plagianthus regius</i> ¹	mānatu, lowland ribbonwood	1.5L/PB3	3-5	8
<i>Podocarpus totara</i> ¹	tōtara	1.5L/PB3	3-5	4
<i>Sophora microphylla</i> ¹	kōwhai	1.5L/PB3	3-5	8
<i>Veronica stricta</i>	koromiko	0.5L	1	40
Total				800



Plate 19: Management Unit 9a, culvert. 2 June 2021.

¹ Plant at approximately 3-5 metre centres, while maintaining an overall coverage of one metre spacing between plants



Plate 20: Management Unit 9b. 2 June 2021.

Table 12: Management Unit Summary

MU	Owl Farm Priority Ranking	Suitable for students/ bioblitz etc	Landform	Current vegetation	Fencing	Site preparation requirements	Indicative planting year (within next 3 years)	Estimated no. of plants required	Maintenance requirements
1 (driving range drain)	HIGH	YES - easy access, simple site	Drain - riparian margin	Pasture grass, broadleaf weeds, blackberry, pampas.	Set back to be widened to 3 m either side of drain	Hard graze/blanket spray	North side 2021; South side 2023.	1,200 (600 either side)	Spot spray/hand release
2 (hillslope, paddock 49)	HIGH	NO - H&S risk	Hillslope/ sideling	Mostly bare soil, occasional pasture grass and pest plants	Fenced, except for eastern portion which will remain unfenced.	Blanket spray areas where grass present. Some pest plant control required (see Section 13).	Planting 2022	5,102	Spot spray
3 (mixed forest, paddock 46)	LOW	Possibly - for planting	Drain + forest	Mixed exotic/indigenous forest, dense swards of broadleaved weeds and pasture grass.	Fenced	Pest plant control - various techniques (see Section 13), blanket spray areas of rank grass and broadleaf weeds	Lower priority – not within next 3 years	1,000	Spot spray/hand release
4 (triangle area, paddock 44)	LOW	YES - easy access, simple site	Riparian + paddock	Pasture grass and broadleaf weeds, some existing indigenous plantings near drain.	Requires fencing	Hard graze/blanket spray	Planting 2021 (if excess leftover plants from MU1 planting) otherwise plant 2023	302	Spot spray/hand release
5 (established wetland)	LOW	Possibly - for planting	Wetland	Existing indigenous plantings, pest plants	Fenced	Pest plant control - various techniques (see Section 13).	Lower priority – not within next 3 years	400	Spot spray/hand release additional plantings. Ongoing pest plant control - various techniques (see Section 13).
6a (constructed treatment wetland)	LOW	NO - H&S risk	Wetland	Existing indigenous plantings, pest plants	Fenced	Pest plant control - various techniques (see Section 13).	N/A	n/a	Ongoing pest plant control - various techniques (see Section 13).
6b (planting area within CTW)	HIGH	YES – (older students)	Wetland	Broadleaf weeds, scattered existing plantings	Fenced	Not required.	Planting 2022	732	Spot spray/hand release additional plantings.
6c (additional planting area extending CTW)	LOW	YES - easy access, simple site	Wetland	Rank pasture grass, broadleaf weeds, blackberry	Fenced	Careful blanket spraying of areas of rank grass and broadleaf weeds. Some pest plant control required (see Section 13).	TBD (first confirm if it's OK to be planted with any research partners e.g., NIWA). Lower priority – not within next 3 years.	1,800	Spot spray/hand release
7a (pool drain)	LOW	Possibly - for planting	Drain - riparian margin	Existing indigenous plantings, pasture grass and broadleaf weeds	Fenced	Spot spray where infill planting to occur.	Lower priority – not within next 3 years	100	Spot spray/hand release
7b (planted raceway drain)	LOW	Possibly – for any future planting	Drain - riparian margin	Existing indigenous plantings, pasture grass and broadleaf weeds	Fenced	N/A	N/A (possible infill in future if any plantings don't establish).	n/a	Spot spray/hand release
8 (drain, paddocks 21-23)	HIGH	YES - easy access, simple site	Drain - riparian margin	Pasture grass and broadleaf weeds	Set back to be widened to 3 m either side of drain	Hard graze/blanket spray	Planting 2022/2023	1,600	Spot spray/hand release
9a (culvert)	LOW	Yes - easy access, simple site	Culvert - drain	Pasture grass and broadleaf weeds	Fenced	Blanket spray	Low priority – not within next 3 years	50	Spot spray/hand release
9b (western boundary drain)	LOW	Yes - easy access, simple site	Drain - riparian margin	Pasture grass and broadleaf weeds	Fenced	Blanket spray	Low priority – not within next 3 years	800	Spot spray/hand release

5. SHADE AND SHELTER TREES

A range of specimen/shade trees are already present on Owl Farm. Species include, but are not limited to:

- Cedar (*Cedrus* spp.)
- Chestnut (*Castanea* spp.)
- Cypress (*Cupressus* spp.)
- Elm (*Ulmus* spp.)
- Empress tree/princess tree (*Paulownia Tomentosa*)
- Fagus (*Fagus sylvatica*)
- Liquidambar (*Liquidamber styraciflua*)
- London plane (*Platanus x acerifolia*)
- Magnolia (*Magnolia* spp.)
- Oak (*Quercus* spp.)
- Poplar (*Populus* spp.)
- Willow (*Salix* spp.)

One hundred and forty-three additional shade tree locations have been identified across the western portion of Owl Farm (Figure 1). Tree are proposed to be planted along fence lines, to eventually have 2-3 trees per paddock (some paddocks already have established shade trees). The Client requested that shade trees are not planted in the middle of paddocks, or planted close to raceways (to avoid excess shading of the raceways and to discourage cows from congregating on the races). Paddocks which are currently leased, or are soon to be leased have been excluded. The total number and final location of shade trees are to be confirmed with the Client, however suggested locations are presented in Figures 1-3.

Species recommended for planting include:

Deciduous:

- Elm (*Ulmus* spp.)
- Honey locust (*Gleditsia triacanthos*)
- Liquidambar (*Liquidamber styraciflua*)
- London plane (*Platanus x acerifolia*)
- Magnolia (*Magnolia* spp.)
- Oak (*Quercus* spp.)¹
- Poplar (*Populus* spp.)
- Willow (*Salix* spp.)

Evergreen:

- Cedar (*Cedrus* spp.)
- Eucalypt (*Eucalyptus* spp.)
- Kahikatea (*Dacrycarpus dacrydioides*)²
- Titoki (*Alectryon excelsus*)²
- Totara (*Podocarpus totara*)²

¹ Caution when planting oak as can be toxic to cattle (when green acorns are consumed in large quantities). Oaks must be well fenced so cattle can't access the acorns and should be planted in an area with plenty of grass to deter stock from seeking out acorns.

² Indigenous species - relatively much slower growing than the exotic species.

An extract from the Dairy NZ “Trees for Shade” guide is shown below in Figure 4. The guide discusses how much shade is needed per cow and provides data on the length of shadow created by various species.

(ii) How much shade?

Providing shade for as many animals as possible will help prevent large groups gathering under too few trees, which leads to high nutrient loading, soil compaction and pasture loss. A guideline, based on cattle housing standards, is 4-9m² of shade per cow (or 1m² per 100kg liveweight).

The table below shows the length of shadow created by a selection of mature trees when the sun is at 70° – an angle that represents a mid-New Zealand location in mid-summer, in the middle of the day, and so is an estimate of the minimum length of shade created.

For any given day and time, the actual area of shade available to livestock will vary according to the diameter of the tree as well as its height, and whether the tree is in the middle of a paddock or on a fence line, in which case stock may not have access to all the shade created.

Trees	Height after 5 years (m)	Growth rate	Mature height (m)	Mature width (crown diameter m)	Length of shadow (metres) of mature tree with sun at 70° (midday sun in summer)	Total area of shade if sun was at 90° i.e. directly overhead (m ²) and all shade available to livestock
Poplars	7	Fast	30	5	~ 11	19.6
Ground-durable eucalypts	6	Medium-fast	20	8	~ 7	50
English oak	4	Medium	25	15	~ 9	176
Cabbage tree	4	Medium	10	2	~ 4	3
Lemonwood (Pittosporum eugenoides)	3	Medium	12	3	~ 4	7
Totara	2	Slow	25	8	~ 9	50

Figure 4: Dairy NZ guide – “Trees for shade – How much shade?”. Accessed from www.dairynz.co.nz on 06/07/21.

Prices will range, depending on the species and grade. The speed of growth is also highly variable between these species. Larger trees (PB18-28 or larger) will provide faster results, but are more expensive to buy and plant. Poplar/willow poles are the most cost-effective option, are fast growing, and can also provide stock fodder.

Fencing around each shade tree will be required to prevent stock access. Shade trees will also require staking at planting to ensure they establish well.

6. CYCLEWAY

The native planting and archaeology concept plan for the new Hamilton to Cambridge ‘Te Awa Cycleway’ portion which is located on St Peter’s School property has been mapped. The planting areas outlined in the concept plan have been excluded from this IPMP as they will be managed by the Waipā District Council (not Owl Farm). The draft plant list that was provided to Owl Farm for these planting areas has been reviewed and the species recommended for planting are all ecologically appropriate for the site and mostly suitable for revegetation planting.

7. SITE PREPARATION

Site preparation is a key factor in the successful implementation of ecological restoration projects. This involves removing or controlling exotic grasses and broadleaf weeds to ground level to facilitate ease of planting and reduce competition to indigenous plants.

In some instances, it is appropriate and suitable for the area to be grazed hard prior to planting. Grazing can be a good option that can be done close to planting time, reduces the use of herbicides, and has a lower cost. Care must be taken to ensure stock are kept out of any waterways. Areas that can't be grazed hard should be blanket-sprayed to create a clear area free of exotic vegetation, approximately 4-6 weeks prior to planting. Areas that have been grazed hard prior to planting, may also require spot spraying with a selective, grass specific, herbicide post-planting.

All environmental pest plants should also be controlled within the management units. Pest plant control should be undertaken using appropriate control methods for the pest plants and site characteristics, and undertaken by a suitably skilled and trained Contractors. Pest plant control should be undertaken well before planting time to allow for follow up control visits, if required, to ensure effective pest plant control has been achieved.

7.1 Fencing

Some additional, or alterations to existing, fencing is required (as detailed above). The Client should arrange such fencing prior to, or immediately following planting.

In some cases it is recommended that posts are installed prior to planting to demarcate the new fence lines, but wires put up after planting has been undertaken, to allow for possible hard grazing by stock prior to planting (as site preparation), and/or for ease of access to the planting area, particularly if the area is being planted by students.

All fences should then be maintained in a stock proof condition post-planting to ensure stock do not have access to the planting areas.

7.2 Pest plant and general weed control

A variety of control techniques will be required to control pest plant infestations. Some species (e.g. grey willow and pampas) will require persistent effort to reduce to low density. Relative timing of activities and approach will be critical to ensure potential impacts on existing indigenous species are minimised, while at the same time ensuring effective weed control. Care will also need to be taken in the selection and application of herbicides to ensure there is no inappropriate discharge of chemicals into wetlands and waterways. For these reasons, and to be compliant with relevant legislation, all personnel applying herbicide treatments will need to have Growsafe qualifications or be under the immediate supervision of an operator who has such.

It is recommended that pest plants adjacent to, or within the general vicinity of, any identified management units, are controlled to reduce the seed source and minimise pest plants from establishing within the planting areas.

A table of recommended control methods for pest plants present within listed Management Units on Owl Farm is presented in Section 13.

7.3 Herbicide application

Herbicides are generally most effective when applied to plants that are undergoing active growth, usually in spring/summer, and in full leaf. Some species, however, can be treated all year round with the appropriate chemical (see Appendix 3). Very few weed infestations can be removed completely with a single application of herbicide, and two or more applications will be required in most instances. It should be noted that some herbicides take longer to kill target plants than others, and this needs to be taken into account when planning monitoring and follow up treatments.

7.4 Tree removal and control

Pest plant trees (Chinese privet, willows) can either be felled and stumps poisoned, or can be poisoned standing by the drill and fill method, and left *in situ* to die. The latter is the preferred option for willow species when growing in 'natural areas'. If trees are to be felled, they can then be chipped on site and/or cut logs stockpiled where it can be readily accessed and removed for firewood. Felling and breaking down of the trees at this site is a technical operation that will require the services of an appropriately qualified and experienced arborist.

7.5 Pest animal control

Rabbits and hares were seen during the site visit. The FEP also mentions feral pigs are present on the farm. Newly-planted trees and shrubs can be damaged, or killed, if browsing pest species are present. Control of these species, or protection against browsing, is required as this will minimise plant loss due to browsing and rooting up of new plants.

An effective method for controlling rabbits and hares is night shooting, utilising thermal imaging scopes where possible to enhance the control of any light shy animals, and increase the safety factor. The use of thermal imaging equipment will also likely detect the presence of feral pigs, and assist in determining if any control is required. Pigs can be captured in cage traps and humanely disposed of, or controlled by night shooting methods.

Pūkeko were also noted on site during the site visit. Pūkeko control should be considered if they are abundant in and around any planting area. Shooting is the most effective control method for pūkeko. If shooting is to be undertaken during the game bird season, it can be carried out under a game bird hunting licence from Fish and Game NZ, as long as the permit conditions are followed. Any pūkeko control that takes place outside of the game bird season requires a Permit to Disturb, which can be sought from, and issued by Fish and Game NZ, if they approve the reasoning for the control. The Permit to Disturb details the approved control methods and number of birds that can be culled.

Individual plant guards may also be used to protect each plant from browsing. Plant guards also provide shelter, increased humidity, reduction of moisture loss, and help to prevent unintended herbicide damage during maintenance work. However, this can add significant costs to any planting operation.

8. RESTORATION GUIDELINES

The following subsections contain information and considerations that are important to achieve a good quality revegetation and restoration outcomes to achieve the project vision.

8.1 Tree for Survival Programme

St Peters School is part of the Trees for Survival Program. One thousand ecosourced indigenous seedlings are provided by the Trees for Survival programme to St Peters School yearly and the students raise these native seedlings at school and then plant them on Owl Farm.

There is potential for the school to increase the scale of its nursery to grow more plants for the Owl Farm plantings. Alternatively, any shortfall in plants required can be purchased from suitable local suppliers.

8.2 Suitable species for planting

8.2.1 Principles of species selection

Restoration plantings will need to comprise a range of appropriate, indigenous species that ideally are “eco-sourced” from the Hamilton Ecological District. Eco-sourced plants are those grown from seeds, propagules, or cuttings collected from naturally occurring populations in Hamilton Ecological District. Eco-sourcing maintains local biodiversity values and ensures that the specimens that are planted are suited to the climate, soils, and other characteristics of the habitat. Many plant nurseries will supply eco-sourced plants on request but often require at least six months’ notice prior to plants being required.

8.3 Plant stock and grades

To ensure availability, the plant stock should be ordered as far in advance as possible, especially for slower-growing species required in larger grades (e.g., kahikatea).

Appropriate plant grades have been identified in the planting schedules. Slower growing species are generally supplied in larger grades (1.5L/PB3). Faster growing species, that make up the bulk of the plantings are generally supplied in smaller grades (0.5L/1L). The larger the grade, the higher the cost of the plants. For areas where pūkeko are present (and not controlled), larger grades (1.5L/PB3) should be used for all plants to minimise damage.

Larger grade plants are easier to locate and manage in terms of releasing and monitoring when this is to be undertaken by students or volunteers. Therefore the smallest grade plants to use in these areas should be 1L grade, with the option of using the cheaper 0.5L grade plants in areas to be planted and managed by contractors.

8.4 Planting Guidance

8.4.1 Schedule, timeline and costings

Plant schedules have been provided for all Management Units (above). A timeline for planting over the next three years is presented in Section 12.

Table 14 presents a ball park estimation of plant supply costs to help guide budget decisions. Approximate plant supply prices (including delivery) for 0.5L grade plants is \$3.00 per unit and 1.5L/PB3 grade plants is \$4.50 per unit. All prices are exclusive of GST.

Table 14: Estimated plant supply costs per Management Unit

MU	No. of plants			Costs (Excl. GST)
	0.5L	1.5L/PB3	Total	
1	570	30	600	\$ 1,845.00
2	4845	257	5102	\$ 15,691.50
3	950	50	1000	\$ 3,075.00
4	283	17	300	\$ 925.50
5	380	20	400	\$ 1,230.00
6a	0	0	0	-
6b	0	732	732	\$ 3,294.00
6c	1746	54	1800	\$ 5,481.00
7a	100	0	100	\$ 300.00
7b	0	0	0	-
8	1520	80	1600	\$ 4,920.00
9a	50	0	50	\$ 150.00
9b	760	40	800	\$ 2,460.00

8.4.2 Plant spacing and layout

Plantings need to be undertaken at spacings appropriate to the circumstances (landform, objectives, timeframe, and budget) and species being used. Ideally the plants should be planted between one plant per square metre (10,000 plants/hectare) and one plant per 1.4 metres (5,400 plants/hectare). Plants should also be set back at least one metre from any fence edge (leaving a one metre grass strip next to the fence).

Planting at one metre spacings will ensure that the restoration plantings will, within several years, suppress the growth of the surrounding introduced vegetation, which increases the likelihood that the restoration project will be successful. However, spacings between plants is recommended to be widened to 1.4 metres on appropriate sites. Larger growing species (i.e., kahikatea and kōwhai) should be planted further apart at approximately 3-5 metre centres, while maintaining an overall coverage of one metre spacing between all plants.

It is recommended that sedges and grasses are generally planted along waterway edges (first row), with other revegetation species laid out in a mix along the remainder of the planting area. Remaining species should be laid out in a random mix. Laying the plants out as a random mix in the relative proportions available will create a more “natural” look and ensure each species are spread throughout the planting area.

See individual plant schedules and descriptions for each management unit for recommended plant spacings for each species, and any other layout information.

Figure 7 overleaf is from the Dairy NZ website and offers guidance on what to plant and where.

What to plant and where

The next step is to decide what to plant, where and at what spacing.

There can be up to three zones of plant types on a healthy riparian zone, as illustrated in the picture below. Planting your upper and lower banks will improve your water quality more than using grass strips alone.

Use the Table of Riparian Plants in this guide to find out which plants are recommended for each zone in the Waikato region and the correct plant spacings to ensure plants outcompete weeds.

Drains: Maintaining access to drains is important so plant up one side only, preferably the north bank to provide the stream with shade in summer. Avoid planting deep-rooted species (upper bank plants) over tile drains.

Grass strip: A one metre wide grass strip should be left around all fences. This will help to filter out sediment, phosphorus and faecal bacteria from runoff and prevent plantings from tripping electric wires or being grazed.

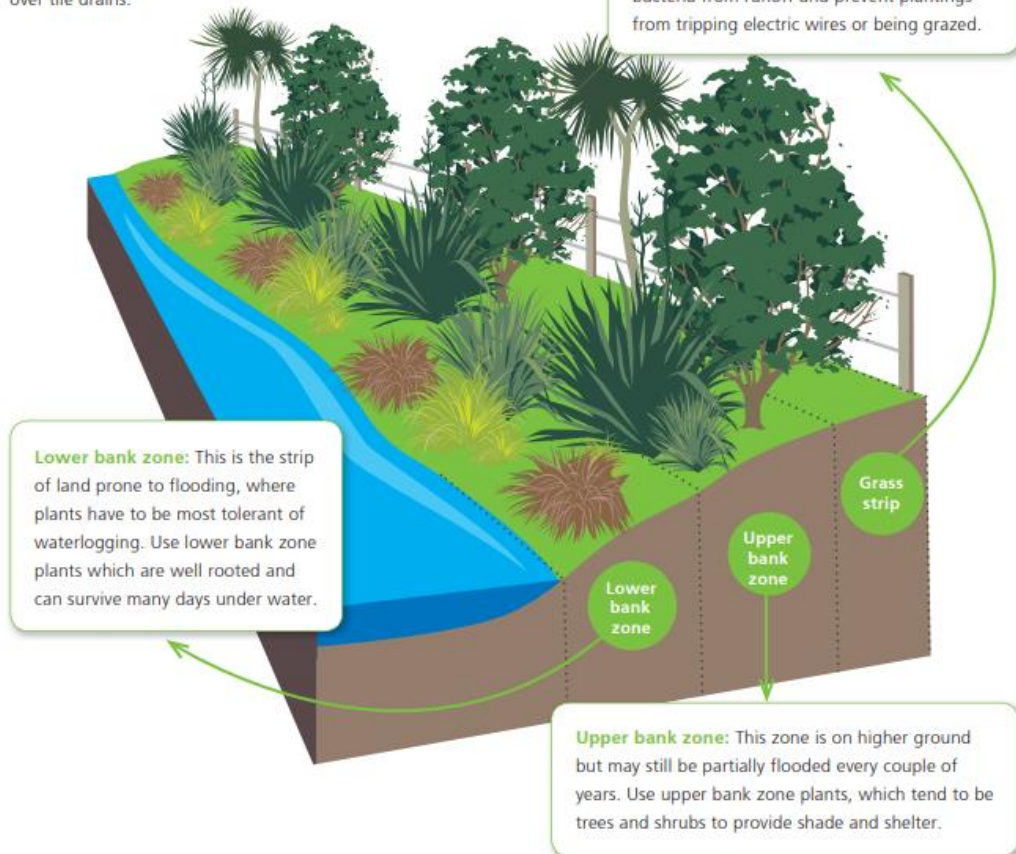


Figure 7: Dairy NZ guide – “Getting riparian planting right in the Waikato”. Accessed from www.dairynz.co.nz on 24/06/21.

8.4.3 Timing of planting

Planting of non-wetland sites is best carried out in winter (July/August) and planting of wetland sites should be carried out in late spring (October/November). See Section 12 for proposed timeline of works.

8.4.4 Fertiliser

The addition of fertiliser to planting holes at the time of planting indigenous species is not recommended for most situations, because indigenous revegetation species are generally adapted to lower fertility soils. Revegetation sites on previously grazed pasture for example, will usually have sufficient fertility levels for the successful establishment of the revegetation species. Plants supplied from commercial nurseries

often already have slow-release fertiliser included within potting mix and the additional nutrients from fertiliser added at the time of planting are not required for plant establishment.

8.4.5 Infill planting

Replacement of dead plants should be undertaken as required, approximately 2-3 months after initial planting, to replace any plants that have died. Other plants that die in the first and second years should also be replaced to reduce the risk of invasion by aggressive weeds. Infill planting requirements can be identified in February/March preceding the next planting season.

8.5 Maintenance of plantings – weed control and ‘releasing’

Maintenance is critical to the long-term success of all planting operations. Planted areas should be receive maintenance three times during the first two years following planting, and 1-2 times a year in the following years until the plants are established. Ongoing long-term weed control and monitoring will likely be required for problematic environmental weed species (e.g. pampas, grey willow, crack willow, tree privet, gorse, hawthorn, Chinese privet, and blackberry) to control, and maintain absence, or very low levels of infestation.

Maintenance involves the ‘releasing’ of revegetation plants from weeds and grasses that have the potential to smother them. This can be undertaken by hand (suitable for students and other volunteers), or by the use of selective herbicides. Hand releasing involves pulling, or carefully cutting, any competing grasses and herbs away from each planted plant. Pulled/cut vegetation can then be placed around any planted plants as a mulch.

Post-planting animal pest control will need to be implemented if animal damage is detected during inspections.

As the plants becomes established, they will begin to out compete other exotic species and the frequency and extent of maintenance will decrease. Most plantings will be relatively self-sufficient after three to five years, depending on plant growth, and then require no, or minimal, maintenance.

9. MONITORING FOR EDUCATIONAL PURPOSES

9.1 Photo/video points

A simple monitoring system of photopoints could be established at appropriate locations to record visual changes in vegetation composition over time. These should be installed prior to weed control/planting, and re-photographed at least annually for the first five years of the programme. These could include the management units in this plan, as well as the cycle way project plantings undertaken by Council.

More frequent photographs may be useful from an educational view to see changes on a more frequent basis, such as before/after planting, before/after maintenance visits, spring growth, summer/winter seasonal changes. Time-lapse video and/or photograph sequences could also be utilised during the planting and maintenance phases to show quick changes on the sites. This monitoring could also be used around any pest plant

control operations – to show the differences between quick result methods such as felling trees, compared with foliar spraying blackberry or stem poisoning willows, that could be used in learning around how herbicides and different pest plant control methods work.

9.2 Vegetation transects/plots

Permanent transects or vegetation plots could be set up within management units, and/or the adjacent cycle way project planting. Such transects or plots should be set up prior to implementing any management so they data can capture any change due to management actions, such as pest plant control or planting. Data captured, and analysed, could cover a range of skills and learnings. This could include:

- Hypothesising – what do the students expect to happen with the sites if the proposed management methods are implemented?
- Diversity – record the number of species present, split between indigenous and exotic (which will incorporate plant identification skills/learning)
- Abundance/relative abundance – counting the number of each species present, or estimating the area they cover (% or m²).
- Changes in the above data over time – presenting in a useful format (graphs/charts), analysing (statistically), and discussing why these changes may have occurred, and what may have influenced them. How do these relate to what the students hypothesised?

9.3 Fauna monitoring

9.3.1 Avifauna

Avifauna (birds) can be monitored by regular formal 5-minute birds counts. Permanent bird count locations can be set up at suitable locations, and these can be surveyed regularly. Students can study bird identification, and study what species are present, and why. Suitable questions to pose could be:

- Does the habitats influence the species present?
- Are some species always present, others occasionally, or seasonally? Why might this be?
- Do changes in management on the farm influence bird species present or abundance?
- Does the planting of indigenous species, or shade trees, influence bird species present or abundance?

9.3.2 Pest animals

Pest animal monitoring can be very interesting for students to undertake and study. There is a wealth of information on monitoring (including the required equipment, how to use it, and how to assess the data) on the Predator Free NZ (www.predatorfreenz.org) website. The most commonly used monitoring tools are:

- Tracking tunnels – baited tunnels are set up with ink tracking cards. These are left out for several nights, animals visit the tunnels and their foot prints get recorded. The tracking cards can then be analysed for what species have visited. Useful for

detecting pest animals such as hedgehogs, rats, mice, mustelids, and also indigenous species such as lizards (geckos and skinks), and wētā.

- Chew cards and wax tags – these get eaten by pest animals and the bite marks can be analysed to assess the presence of possums and rats

9.4 Recording and communicating data

There are several useful web applications for recording monitoring data, and assisting with plant or animal identification. These include:

- iNaturalist – A worldwide application. Users can upload photographs of plants and animals with location and species. Other users can provide technical advice and identification.
- E-Bird – A worldwide application. Users can upload bird surveys/data.
- Trap.NZ and similar applications, can be used to record and manage pest animal control/tracking data.

10. HEALTH AND SAFETY CONSIDERATIONS

The health and safety of staff and students undertaking restoration activities within Owl Farm is a key determining factor for which activities can be undertaken by the school, or where contractors are required. Contractors will be required to undertake pest plant control and planting activities on steep hillslopes present on the site (i.e., within MU2) as these are deemed unsuitable for students to access.

Control of the pest plants present will involve the use of hand tools (e.g. pruning saws, secateurs). Appropriate training and supervision is required, and should only be undertaken by students that are competent in their safe use.

Herbicide gels might be able to be applied by students for applying to cut stems. Any use of herbicides requires careful management, and students and staff should only be able to use with correct instruction, PPE, and supervision. The spraying of agrichemicals should only be undertaken by trained personnel with a Growsafe qualification.

It is important that a thorough risk assessment is undertaken for all restoration activities so that adequate controls are implemented to reduce the risks to staff, students and public.

11. TIMELINE FOR IMPLEMENTATION

A provisional timeline for planting and management activities, with an overview of the tasks to be carried out in each year is provided below. The timeframe for implementation given is based on the Clients wish to undertake restoration and revegetation works regularly, and be incorporated into the St Peters School curriculum. The suggested works programme is tailored for the next three years and is based off priorities as indicated by the Client.

12. WORK PROGRAMME

A proposed three-year work programme is provided below. Timing is based on a financial year of 1 July to 30 June. Proposed timing of activities is indicative of initial priorities as indicated by the Client, and the season best suited for the work to be undertaken.

The following key applies to the work programme tasks:

	Shade tree planting		Plant supply – order plants (Trees for survival + external)
	Pest plant control		Fencing
	Monitoring		Planting
	Site preparation prior to planting		Maintenance (weed control)

Year 1: 2021/2022

Task	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Establish monitoring points (photopoints, tracking tunnels, bird count locations, etc)												
Site preparation northern side of MU1 (including pest animal control, if required) – possibly MU3 if excess plants available												
Plant northern side of MU1 (possibly MU3)												
Fence northern side of MU1 (possibly MU3)												
Order plants for 2022 indigenous planting and some shade tree plantings												
Ongoing monitoring												
Maintenance northern side of MU1 (possibly MU3)												
Pest Plant Control – all MUs												

Year 2: 2022/2023

Task	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Site preparation (including pest animal control, if required): MU2, MU6b and northern side of MU8												
Plant MU2, MU6b and northern side of MU8												
Plant shade trees												
Fence northern side of MU8												
Order plants for 2023 indigenous planting and additional shade tree plantings												
Ongoing monitoring												
Maintenance: All planted MUs 2021-2022+ shade trees												
Pest Plant Control – all MUs												

Year 3: 2023/2024

Task	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Site preparation (including pest animal control, if required): MU3 (if not planted in 2021) and southern sides of MU1 and MU8												
Plant MU3 and southern sides of MU1 and MU8												
Plant shade trees												
Fence MU3 and southern sides of MU1 and MU8												
Order plants for 2024 indigenous planting and any final shade tree plantings												
Ongoing monitoring												
Maintenance: All planted MUs 2021-2023 + shade trees												
Pest Plant Control – all MUs												

13. RECOMMENDED HERBICIDE TREATMENTS FOR PEST PLANTS ON OWL FARM

Pest Plant	Control Method(s)	Chemical(s)	Application Rate	Timing	Remarks
Blackberry (<i>Rubus fruticosus</i>)	Cut and treat stumps	Glyphosate gel 120g/kg	Paste with glyphosate gel	December-April	Preferred choice close to water.
	Knapsack - foliar spray	Triclopyr 600g/L	60ml triclopyr/10L water	December-April	
Chinese privet (<i>Ligustrum sinense</i>)	Hand pull seedlings/small plants	-	-	Year round	Seedlings and sapling plants <50cm. Full coverage required.
	Cut and treat stumps Drill and inject	Glyphosate gel 120g/kg	Paste with glyphosate gel	October-April	
		Glyphosate 510g/L	70ml glyphosate + 2ml organosilicone/1L water	October-April	
	Knapsack - foliar spray	Glyphosate 510g/L	70ml glyphosate + 10ml organosilicone/10L water	October-April	
		Triclopyr 600g/L	60ml triclopyr + 10ml organosilicone/10L water		
		Metsulfuron 600g/kg	5g metsulfuron + 10ml organosilicone/10L water		
Crack willow (<i>Salix fragilis</i>), Grey willow (<i>Salix cinerea</i>),	Cut and treat stumps	Metsulfuron 600g/kg	5g metsulfuron + 2ml organosilicone/1L water	October-April	Preferred option as leaving the tree standing avoids broken twigs/branches resprouting on ground. ONLY on trees with base diameter <30cm
	Drill and inject/Bore and spray	Metsulfuron 600g/kg	5g metsulfuron + 2ml organosilicone/1L water	October-April	
		Glyphosate 510g/L	250ml glyphosate/1L water (25% glyphosate)	October-April	
	Basal bark application	Triclopyr 600g/L	2L triclopyr + 8L Syntol oil	October-April	
	Knapsack - foliar spray	Metsulfuron 600g/kg	2.5g metsulfuron/10L water	Year round	
Gorse (<i>Ulex europaeus</i>)	Cut and treat stumps	Glyphosate gel 120g/kg	Paste with glyphosate gel	October-March	
	Knapsack – foliar spray	Triclopyr 600g/L	60ml triclopyr + 10ml organosilicone/10L water	October-March	
		Metsulfuron 600g/kg	5g metsulfuron + 10ml organosilicone/10L water	October-March	
		Clopyralid 300g/L	125ml Clopyralid/10L water	October-January	
	Hawthorn (<i>Crataegus monogyna</i>)	Hand pull seedlings/small plants	-	-	
Cut and treat stumps		Glyphosate gel 120g/kg	Paste with glyphosate gel	October-April	
Drill and inject		Metsulfuron 600g/kg	5g metsulfuron + 2ml organosilicone/1L water	October-April	
Pampas (<i>Cortaderia selloana</i> , <i>C. jubata</i>)	Knapsack - foliar spray	Glyphosate 510g/L	140ml glyphosate + 10ml organosilicone/10L water	October-March	Thoroughly cover all foliage.
	Slash and spray regrowth	Haloxypop 100g/L	150ml haloxypop + 50ml crop oil/10L water	October-March	Or use on smaller plants
Pine (<i>Pinus radiata</i> , <i>P. pinaster</i> & <i>P. patula</i>)	Hand pull seedlings/small plants	-	-	Year round	50% or undiluted glyphosate will be more effective in Autumn/Winter.
	Ring bark or fell larger trees	-	-	Year round	
	Drill and inject/bore and spray	Glyphosate 510g/L	250ml glyphosate/1L water (25% glyphosate)	Year round	
Tree privet (<i>Ligustrum lucidum</i>)	Cut and treat stumps	Glyphosate gel 120g/kg	Paste with glyphosate gel	November-March	
	Drill and inject	Glyphosate 510g/L	140ml glyphosate + 2ml organosilicone/1L water	November-March	

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