Appendix K

Ecological Management Plan
(NZ Ecology)

Ecological Management Plan

McPherson Quarry

Prepared for McPherson Resources Ltd
16 October 2019

Report Number 1708203.1-002.V2

ECOLOGY NEW ZEALAND

Document Sign Off

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1. INTRODUCTION

This report[1] , prepared by Ecology New Zealand Limited (ENZL) for McPherson Resources Ltd ('the client'), presents an Ecological Management Plan (EMP) for the proposed quarry expansion at 47 McPherson Road and 93 Irish Road, Pokeno ('the site'). Specifically, this report will detail management recommendations and practical methodologies for restoration planting, wetland enhancement, pest plant and animal control and native fauna management as recommended within the Ecological Impact Assessment (EcIA) prepared by ENZL (Report 1708203.1-001.V5).

2. ECOLOGICAL OUTCOME STATEMENT

The objective of this EMP is to specifically address foreseeable ecological impacts associated with the expansion of the McPherson Quarry through the implementation of commensurate mitigation, offsetting and compensation. This will be achieved through the creation of an ecological corridor linking forested areas from Mt William to Pouraureroa Stream Bush, riparian restoration of a reach of Waipunga Stream (Stream 1), and the enhancement and creation of wetland areas. The forested areas of Mt William and Pouraureroa Stream Bush are identified as Significant Natural Areas (SNA) under the Waikato District Plan.

3. TERRESTRIAL COMPENSATION PLAN

As detailed within the ecological impact assessment report prepared by ENZL[2] approximately 2.45 ha of vegetation identified as indigenous vegetation (labelled as 'kānuka-dominant forest' in the EIA by ENZL[3]) is proposed for removal. This bush block is dominated by canopy kānuka (*Kunzea robusta*), but is maturing in its regenerative state with secondary podocarp/hardwood/broadleaf species interspersed. The bush block is currently fragmented from the eastern forest areas by a metalled road.

The bush block provides moderate - high habitat potential for protected native fauna. However, subsequent to the level of survey described within the ENZL ecological impact assessment, common forest birds were the only notable species documented. In addition to this assessment, an additional lizard survey was undertaken in August 2019 using 15 artificial cover objects (ACOs) and 18 arboreal closed cell tree covers after allowing them to establish for five months. No lizards were detected during this survey.

3.1. Compensation Strategy

Compensation has been chosen as the mechanism to address the proposed 2.45 ha of indigenous vegetation clearance on-site. The proposed means of compensation has been primarily founded on a qualitative outcome-based approach. This is proposed through ecological enhancement and the re-establishment of ecological connectivity as opposed to attempting like-for-like re-creation of an ecosystem. This qualitative approach has been assessed quantitatively to further ensure suitability.

[1] This report is subject to the Report Limitations provided in Appendix A.
[2] Angove-Emery, S., Dungey, J., Whiteley, C. (2019). Ecological Impact Assessment, McPherson Quarry. Ecology New Zealand Ltd.

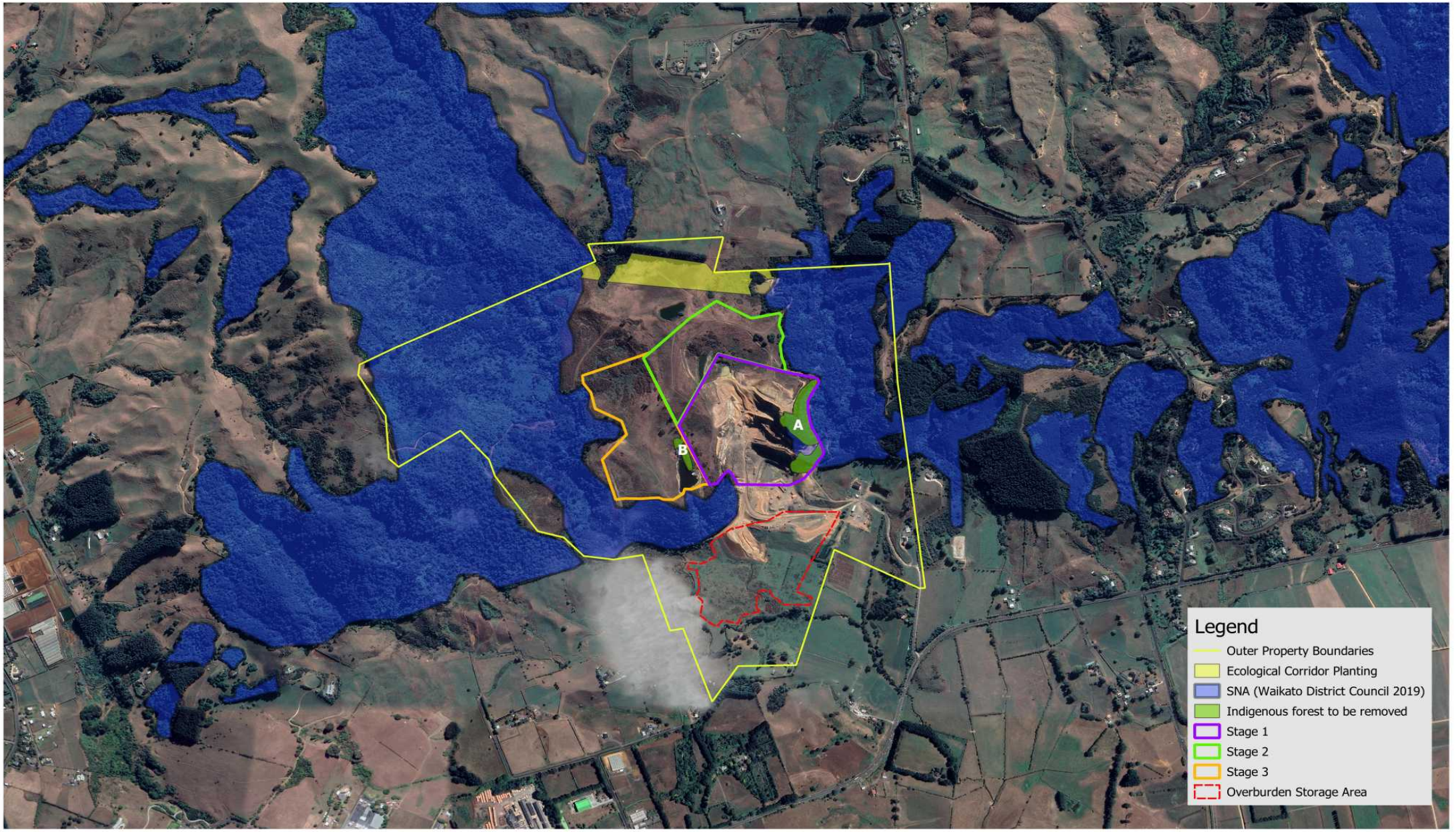
3.1.1. Qualitative Approach

The historical establishment of the McPherson Quarry has led to the severance of a forested ecological corridor stretching from Mt William to Pouraureroa Stream Bush, identified as a SNA. This severance has led to an approximately 300m gap at the southern extent of the site, and an approximately 500m gap to the north of the site, fragmenting these forested areas. This fragmentation hinders functional connectivity between these forested areas for less mobile species (e.g. lizards), with more mobile species such as birds relying on direct flights across open paddock areas currently depauperate of stepping stones.

An opportunity to create an ecological corridor between forested areas to the east and west of the site lies at the site's northern boundary. It is proposed that ecological plantings are undertaken across this northern extent to create this corridor. It is envisioned that in time, this corridor will provide the foundations to facilitate dispersal and movement of biota and ecosystem services in an east - west direction between adjacent forested areas. The linkage will facilitate higher levels of connectivity for local fauna metapopulations, allowing beneficial effects to carry on to flora through the provision of services such as seed dispersal and pollination.

The ecological corridor is proposed to be planted to an approximate width of 100m. This corridor width aims to balance edge effect considerations with planting requirements considered commensurate to the proposed impacts on the SNA. With specific focus on a key driver of edge effects, being pest animal recruitment and utilisation, these potential effects are proposed to be controlled for the lifetime of the quarry. The control of pest animals is considered especially important as the corridor will provide an indiscriminate pathway of mobility between the fragmented forest blocks, thereby potentially increasing the effect of pest animals.

The proposed ecological corridor north of the site will provide additional benefits for key freshwater features within this area; namely a permanent stream reach, subterranean water flow observed within three tomos and a pond. Three tomos are located to the east of the site's northern boundary. These tomos have collapsed, and appear to be slowly eroding on their sides, likely attributed to a lack of stable soil and unfettered stock access. On inspection during August 2019, these tomos were hydrologically connected with subterranean water flows; with the third tomo having its water acting as the headwater to an onsite intermittent/permanent stream. A pond was located in close proximity to these tomos, appearing to show signs of raupo (*Typha orientalis*) winter dieoff. This area of open water with peripheral raupo could provide suitable habitat for dabchick (*Poliocephalus rufopectus*) which were noted onsite.



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McPherson Quarry, Mangatawhiri

Ecological Corridor Concept

Date: 16 October 2019| Revision : 2

Plan prepared for McPherson Resources Limited by Ecology New Zealand Limited
Author: stephanie.angove-emery@ecologynz.nz |

3.1.2. Quantitative Approach

The proposed extent of indigenous vegetation removal equates to approximately 2.45 ha of vegetation clearance. Compensation is proposed through the creation of an approximately 100m wide ecological corridor that provides vegetative contiguity across the site's northern boundary. This planting will result in an area of approximately 4.53 ha being ecologically enhanced. The level of ecological enhancement will equate to a compensation ratio of 2:1 for the bush block in the eastern side of the site that is primarily within the SNA overlay, and a 1:1 ratio for the kānuka-dominant vegetation located next to the pond (labelled as Areas 'A' and 'B' in Figure 1) to address the proposed ecological impacts.

Table 1 Compensation areas for indigenous vegetation removal.

Impacted area	Area to be removed	Compensation ratio	Compensation area
A	2.08ha	2:1	4.16ha
B	0.374ha	1:1	0.374ha
Total			**4.53ha**

4. PLAN IMPLEMENTATION

Implementation of flora and fauna management plans should be undertaken by appropriately qualified, experienced and permitted individuals. This is to ensure the most successful outcome is achieved and that legislative requirements are adhered to.

Quantities provided in this management plan are a guideline only and may be adjusted as appropriate by the planting team leader to ensure spacing is correct and plants are planted in the correct locations.

The definition of a pest plant can vary depending on the context being applied and the environment in which they are situated. For the purposes of this report, pest plant definitions will be guided by the Waikato Regional Pest Management Plan 2014-2024 (WRPMP), taking heed of the formal status of each species identified within the works footprint, whilst applying local considerations as to the actual effect the pest is having on the site. Some exotic or pest plant species may provide local ecological benefits (e.g., exotic trees and shrubs can provide nest sites for native birds) and, as such, options for the removal or retention of these species will be carefully considered.

4.1. Pest Animal Control

Management of pest animals will increase the quality of habitat for native fauna and protect new plantings from pest browsing. No significant signs of pest animals were observed during the site visit. Given the habitat and food source available on site, and in the surrounding area, it is reasonable to assume that pest animals are present in at least low abundance on-site.

4.1.1. Expected Outcome

Given the rural location of this site and its linkages with neighbouring properties, the intent of pest animal control is to restore and enhance native biodiversity by reducing the pest animal populations, specifically to decrease pest animal use of the proposed corridor. Pest animal

control will be undertaken within the northern corridor area, for the lifetime of the quarry. Pest animal control will be undertaken for a total of five years within the southern restoration sites to allow new plantings to become established. Given the near certainty of ongoing pest animal re-invasion occurring from the adjacent bush blocks, it is unreasonable to expect eradication at this site.

4.1.2. Control Methods

There is no single technique for successful pest animal control and methods can vary between and within each species. Often a combination of multiple methods can have the best effect and the recommended plan below takes into consideration the most practical methods to meet the aforementioned expected outcomes. It is recommended that an experienced pest animal control professional is hired to implement animal pest control, commencing with trap instalment.

Table 2Table 6 detail observations and control methods separately for different pest animals, though most will include one or a combination of baiting or trapping. It is recommended for this site to install a trapping network to reduce the occurrence of bait within the vegetation due to the residential setting of the immediate area.

Records will be kept detailing trap location / re-location (if moved), dates of servicing, and catch results in alignment with the below methodologies.

4.1.3. Possums

At the time of the site visit, no significant sign of browsing was observed. Given the nature of the site (habitat and food source), it is reasonable to assume that possums are present in at least low abundance on-site.

Table 2: Possum Control

Common Name	Species Name	WRPMP Category	Control Method
Possum	*Trichosurus vulpecula*	Eradication and containment	Trapping Network

Control of possums is recommended by way of a bait station and/or trap network for this site. This takes into consideration the size and topography of the site as well as the practicality of servicing such a programme on a regular basis.

Mini-philproof bait stations are to be installed as per the manufacturer's guidelines. The below network approximates station locations with stations spaced approximately 50m apart, totalling 32 bait stations across the revegetated corridor in the northern part of the site. The restoration areas within the identified riparian and wetland areas in the southern part of the site should be spaced approximately 75m apart, totalling 14 bait stations. Bait stations are to be located adjacent to or affixed to a combination of existing trees and either existing fence posts or fences. The bait station network should be filled with Brodifacoum bait (waxed type) or a suitable alternative recommended by the implementing professional.

Bait stations should be serviced as part of a pulse cycle, being checked every 3-4 weeks through February – May and again through August – November (8 months per year). Bait stations should be emptied of bait between pulses.

Supplementary control via trapping or night shooting is also acceptable, though detailed records of each event should be kept.

4.1.4. Rats, Mustelids and Hedgehogs

No signs of rats, or mustelids were observed onsite, however hedgehogs were detected during nocturnal surveys. Given the nature of the site (habitat and food source), it is reasonable to expect that rats, mustelids will be present in at least low abundance on site.

Table 3: Rat, mustelid and hedgehog control.

Common Name	Species Name	WRPMP Category	Control Method
Rat (Ship and Norway)	*Rattus* Sp.	Eradication and containment	Trap Network
Mustelids (Stoat, Weasel, Ferret)	*Mustela* sp.	Eradication and containment	Trap Network
Hedgehog	*Erinaceus europaeus occidentalis*	Eradication and containment	Trap Network

The control of rats and mustelids is recommended to occur via two methods of control. The first method is via the bait station network prescribed for possum control. Rats will also consume the bait with similar toxic effects to possums. While, mustelids can also be controlled via the baiting programme as a result of secondary poisoning after scavenging on poisoned rats, it is considered necessary to strengthen the control programme by adding 17 DoC 200 kill traps within the management areas at approximately 100m spacings. Traps should be placed along watercourses or fence lines where mustelids are likely to traverse. Traps should be baited with either a fresh egg or rabbit meat and serviced at the same frequency as the possum bait station network.

4.1.5. Deer, Goats, Pigs, Feral Cats

At the time of the site visit, no sign of deer, goat, pig or feral cat presence was observed. Given the size and vegetation type across the site, it is considered that any presence of these animals on site will be transient and if observed, control should be undertaken without delay.

Table 4 Deer, Goat, Pigs and Feral cat control.

Common Name	Species Name	WRPMP Category	Control Method
Wild deer	Various	Eradication and containment	Shoot
Feral goat	*Mustela sp.*	Eradication and containment	Shoot
Feral Pig	*Sus scrofa*	Eradication and containment	Shoot
Feral Cat	*Felis catus*	Eradication and containment	Shoot

Control should be implemented via shooting and should be undertaken by an experienced and competent operator. Records of all shooting events should be kept including date, species, location, number, sex and age class if possible.

4.1.6. Rabbits

Rabbits were observed onsite during surveys. Given the rural nature of the site, it is reasonable to expect that rabbits will be present in moderate abundances on-site. The weight of browsing damage caused per rabbit can be high against regenerating native seedlings and in particular revegetation plantings where fresh growth is abundant. Control will need to be assessed and implemented prior to any revegetation works and also as part of the plant maintenance programme. (section 4.6.3 below).

Table 5 Rabbit control.

Common Name	Species Name	WRPMP Category	Control Method
Rabbit	*Oryctolagus cuniculus*	Eradication and containment	Night Shoot

Though there are many options available for the control of rabbits including poisoning, trapping and fumigating, the method considered most appropriate for this site is night shooting. This method takes into consideration the size of the site, the abundance of the pest and the practicality of the method. Night shooting is a good "mop up" technique when rabbit numbers are not high or have been knocked down by previous control methods such as an intensive ground laid baiting programme.

Shooting for the purposes of rabbit control is to be undertaken by an experienced and competent shooter. Records of all shoot events should be kept including date, location, number and approximate age if possible.

4.1.7. Pūkeko

Pūkekos have been seen onsite but are considered to be in relatively low numbers. Also, similar to rabbits, pūkeko damage is mainly a concern at time of revegetation planting as they are prone to pulling freshly laid plants out of the ground. Plant pins can be used to help retain plants, though if the population is high enough control will be required to minimise loss of plants. The most effective control method for Pūkeko is shooting. Shooting for the purposes of Pūkeko control is to be undertaken by an experienced and competent shooter. Records of all shooting events should be kept including date, location, number and approximate age if possible.

Table 6 Pūkeko control.

Common Name	Species Name	WRPMP Category	Control Method
Pūkeko	*Porphyrio melanotus*	Not listed	Shoot

Legend

- Outer Property Boundaries
- Fencing
- DOC 200s
- Bait Stations
- Ecological Corridor Planting
- Pond
- Riparian Planting
- Overburden Storage Area
- Stream 1
- 7.5m Riparian Buffer
- Existing wetland areas
- Extended wetland areas

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McPherson Quarry

Fencing and Pest Animal Map

Date:16 October 2019 | Revision : 2

Plan prepared for McPherson Resources Limited by Ecology New Zealand Limited

Author: stephanie.angove-emery@ecologynz.nz

5. PEST PLANT CONTROL/PLANTING SITE PREPARATION

A pest plant control programme will be implemented across all restoration areas for a minimum of five years to remove established pest plants and control any re-infestations. Pest plant species observed on-site have been summarised in Table 7 with their relative categorisation under the Waikato Regional Pest Management Plan and the expected control measure.

The following sections provide instructions on how these pest plants will be managed using best-practice methodologies. It is important to note that the plant list is not intended to be exhaustive, and any additional pest plants that may be found when undertaking the works will also be controlled in alignment with the Waikato RPMP.

5.1. Control Methods and Expected Outcomes

Across the site, most pest plant infestations will require initial control, as well as multiple follow-up control visits. It is reasonable to expect that all pest plant infestations will be controlled within one year. It is expected that at this time, no fruiting or flowering pest plants will be present within the planting areas, nor will there be any dense/monoculture stands of immature pest plant species. Pest plant control will be initiated six months prior to any planting.

Control techniques will differ between species and will depend on the nature and the size of infestations. Methods that will be used will include one or more of the following as appropriate: cutting and pasting, foliar spraying and hand-pulling. The table below summarises the recommended control methods and herbicide for each species observed.

5.1.1. Agrichemical Use

Agrichemical use will be assessed for each area and species, with the intention of minimising herbicide use as much as practicable without compromising the efficacy of control. All herbicide application will be undertaken by a Registered Chemical Applicator or at a minimum by a Growsafe Approved Handler. This is particularly important for any herbicide application around or near waterways and within wetland areas. Operators must apply industry best practice methods and be in alignment with the Management of Agrichemicals (NZS 8409:2004) guidelines.

Records of herbicide application must be kept, including what has been used, where, application rates and date of application.

5.2. Pest Plants On-Site

Table 7 Pest plant species observed on-site.

Common Name	Species Name	RPMS Category[3]	Control Measure	Control Method	Photo ID
Blackberry	*Rubus fruticosus agg.*	Environmental threat	To zero density	Foliage spray using 60ml/10L Triclopyr (Knapsack sprayer)	
Darwin's Barberry	Berberis darwinii	Progressive containment	Sustained control	Grub out. Stump swab 200ml Glyphosate/L or 2.5g Metsulfuron/L. Foliage spray 5g Metsulfuron/10L (Knapsack Sprayer).	
Elaeagnus	*Elaeagnus x reflexa*	Environmental threat	Multi-levelled approach	Cut low at stump and apply 60ml/L Triclopyr to cut stump	
Gorse	*Ulex europaeus*	Sustained control	Multi-levelled approach	Foliage spray using 60ml/10L Triclopyr (Knapsack sprayer)	
Hawthorn	*Crataegus monogyna*	Environmental threat	To zero density	Drill and poison using 5g/L Metsulfuron	
Himalayan honeysuckle	*Leycesteria Formosa*	Environmental threat	Multi-levelled approach	Foliage spray using 150ml/10L Glyphosate 510 (Knapsack sprayer)	

[3] Waikato Regional Pest Management Strategy 2014-2024.

Pampas	*Cortaderia selloana*	Progressive containment	Multi-levelled approach	Foliage spray using 200ml Glyphosate/10L (Knapsack sprayer)	
Woolly nightshade	*Solanum mauritianum*	Progressive containment	To zero density	Cut low at stump and apply 60ml/L Triclopyr to cut stump; hand pull if small enough to completely remove root system.	

6. RESTORATION PLANTING

6.1. Plant Selection

Plant selection is based on a number of considerations, including the replication of native plant communities present on-site and in the surrounding area, the likelihood of establishment, the benefit to native fauna, stock availability and revegetation species that ensure quick re-establishment of canopy cover.

The planting schedules outlined below are provided as a base template for species selection and quantity. It is recommended that experienced professional ecological restoration contractors undertake this planting work and be afforded the opportunity to make appropriate changes to species selection, site preparation and timing based on site specific conditions, when deemed necessary.

6.2. Plant Sourcing

Plants to be used will be of good quality and eco-sourced from the Tamaki Ecological District. Eco-sourcing is key to ensure plants are well adapted to local conditions, increasing survivorship through to establishment. Plants purchased should also be of pure stock with no hybrids used.

Prior to any Myrtaceae species being delivered to the site (e.g. manuka and kanuka), a signed Myrtle Rust Nursery Management Declaration must be provided to the contractor by the nursery to indicate that the plant producer has implemented the New Zealand Plant Producers Incorporated Myrtle Rust Nursery Management Protocol.

Plant quality will be checked upon delivery by the nursery / supplier. The foliage and roots of the supplied plants must be in good health. Plant quality will be tested by the contractor with visual inspections, and by lifting no less than 10 supplied plants by the stem to confirm whether the planter bag / root trainer of each plant is supported (i.e. the plant doesn't pull out of bag). Plants considered by the contractor to be of poor quality will be rejected and will need to be replaced by the nursery.

6.3. Plant Layout, Density and Grade

Plant layout is important to maximise plant survival and establishment, and needs to be considered across the planting site. The following diagram has been used as a guide in terms

of zoning planting layout and this will be used to allocate planting zones as part of the planting schedule below.

Further to the above guidelines, plants will be planted in clusters of one or more species, while avoiding the creation of large areas of open ground, to replicate the natural process of seed dispersal and establishment. This is in contrast to creating larger monoculture areas or conversely intentionally separating species. General plant layout should also be random in nature as opposed to a grid or row layout.

Planting grades to be used may differ per site and per species but should generally be of 0.5 to 1.5 litre grade plants. This takes into consideration the greater success of transplanting smaller plants, the larger root mass to leaf area ratio and the economics of large-scale planting.

Planting is to be undertaken at an average density of 1m^2 (1 plant per 1 square metre); however, sedges should be planted at a higher density of 0.5m^2 (2 plants per 1 square metre). This density will enable canopy closure to be achieved quickly where required and the understorey to be re-instated as quickly as possible.

6.4. Planting Methodology

Timing of plantings will be mid to late autumn, ideally after rain but before winter frosts. Planting directly into damp soil will benefit the plants both through water availability but also through soil compressibility, getting a good packing of soil around exposed roots.

Holes will be dug approximately twice the size of the root ball. Hand dug holes are preferred, but machinery can be used (e.g., motorised auger) as long as the walls of each hole are scarfed to facilitate root penetration. Plant roots will be slightly loosened at the base of the root mass to aid roots to grown outward once plated, rather than remain in a tight root ball.

Care must be taken when removing plants from bags / pots to minimise root disturbance, and plants will need to be pressed/heeled in firmly once in the ground to minimise air pockets around the root system.

6.5. Planting Completion / Plant Maintenance

Upon completion of the initial works, all plantings will be periodically monitored for a period of five years or until an average of 75% canopy closure and 90% survival rate is achieved. This involves undertaking regular pest plant control to minimise a re-invasion impact. Plants will be inspected at least annually with any dead or dying plants replaced. Typically, this is accommodated by 10% replacement in year one and 5% replacement in years two and three.

The below plant monitoring form (Appendix B) should be used annually to inspect the health of all plantings (survival rate, canopy closure) and take records of any works undertaken to improve planting success such as pest plant control, fertilisation and replacement planting.

7. ECOLOGICAL CORRIDOR PLANTING SCHEDULES

Restoration planting of the northern ecological corridor should comprise of approximately 44,665m^2 of terrestrial planting and 675m^2 of riparian stream (Figure 3). The planting schedules

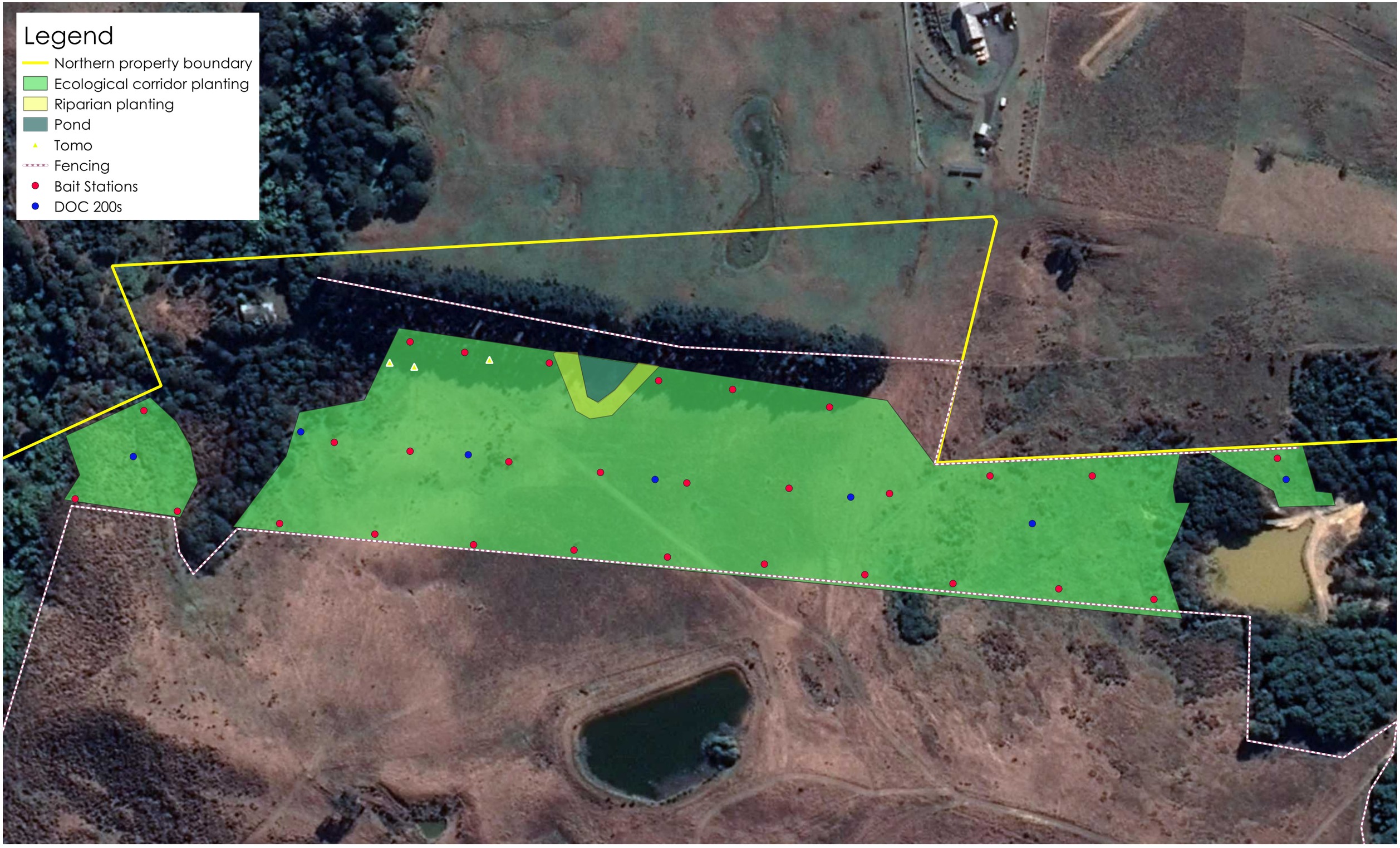
(Tables 8 and 9 below) for this area have been developed to enable a solid foundation and facilitate the introduction of natural diversity through seed dispersal from the adjacent mature bush block areas.

Table 8 Terrestrial Planting Schedule (44,665m^2).

Common Name	Botanical Name	Grade	Spacing	Quantity	Notes
Kānuka	*Kunzea robusta*	1Litre	1m^2	28,000	
Māhoe	*Melicytus ramiflorus*	1Litre	1m^2	4,500	
Karamū	*Coprosma robusta*	1Litre	1m2	4,500	
Māpou	*Myrsine australis*	1Litre	1m^2	3,165	
Koromiko	*Veronica stricta var. stricta*	1Litre	1m^2	2,500	
Toetoe	*Austroderia fulvida*	1Litre	1m^2	1,000	Plant densely within 5m of edges to minimise pest plant infestations.
Flax	*Phormium tenax*	1Litre	1m^2	1,000	Plant densely within 5m of edges to minimise pest plant infestations.

Table 9 Riparian Planting Schedule (675m^2).

Common Name	Botanical Name	Grade	Spacing	Quantity	Location
Ti kōuka	*Cordyline australis*	1Litre	1m^2	150	Stream edge/Flood area/Bank wetland/Slope
Harakeke	*Phormium tenax*	1Litre	1m^2	175	Bank wetland/Slope
Māhoe	*Melicytus ramiflorus*	1Litre	1m^2	75	Slope
Māpou	*Myrsine australis*	1Litre	1m^2	75	Slope
Purei	*Carex secta*	1Litre	0.5m^2	300	Stream edge/Flood area/Bank wetland
Kiokio	*Blechnum novae-zelandiae*	1Litre	0.5m^2	100	Stream edge/Flood area/Bank wetland



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McPherson Quarry

Figure 3: Ecological Corridor

Date: 16 October2019 | Revision : 2

Plan prepared for McPherson Resources Limited
Author: Stephanie Angove-Emery

8. STREAM COMPENSATION PLAN

In order to compensate for the loss of a reach of Tributary 1, restoration works will be carried out on 930m of Stream 1 as shown in Figure 4. Restoration will include revegetation of a 7.5m riparian margin on both the true right and true left banks of Stream 1 and pest plant control will be undertaken over the entire 930m reach (as per Section 5 above). The restoration area will begin shortly above the current ford crossing which is just downstream of where the current native bush area ends. The restoration area will finish at the eastern boundary of the site where Stream 1 exits the property, giving a total of 16,800m^2 of riparian margin to be revegetated with pest plant and animal control. Revegetation will be accomplished using appropriate, eco-sourced native plant species as outlined in the planting schedule in Table 10.

Planting preparation, layout and methodology will be carried out as per Section 6, but taking into account the zoning specified in Table 10. The only exception to this will be for the area of substantial bank collapse on the true left bank close to the site's eastern boundary. The riparian planting in this area should be set back by 1m from the current bank edge to allow the plants to establish a root system whilst allowing for further expected bank erosion in the meantime. Any native species already in situ along the length of Stream 1 will be left in place. All plantings shall be maintained for a period of five years or until 75% canopy closure and 90% survival rate has been achieved.

Table 10: Planting schedule for Stream 1 riparian restoration

Common Name	Botanical Name	Grade	Spacing	Quantity	Location
Pūrei	*Carex secta*	1 Litre	0.5m^2	1410	Floodplain/lower banks
Rautahi	*Carex lessoniana*	1 Litre	0.5m^2	1410	Floodplain/lower banks
Broadleaf	*Griselinia littoralis*	1 Litre	1m^2	1445	Slope
Mānuka	*Leptospermum scoparium*	1 Litre	1m^2	1660	Slope
Māhoe	*Melicytus ramiflorus*	1 Litre	1m^2	2075	Slope
Mapou	*Myrsine australis*	1 Litre	1m^2	2075	Slope
Koromiko	*Veronica stricta* var. *stricta*	1 Litre	1m^2	750	Slope/upper banks
Karamū	*Coprosma robusta*	1 Litre	1m^2	2075	Slope/upper banks
Ti kōuka	*Cordyline australis*	1 Litre	1m^2	2075	Slope/upper banks
Kahikatea*	*Dacrycarpus dacrydioides*	3 Litre	5m^2	85	Slope/upper banks
Kānuka	*Kunzea robusta*	1 Litre	1m^2	415	Upper banks

**Kahikatea should be planted 2-3 years after initial plantings have established*

Legend

- Property Boundary
- Stream 1
- 7.5m Riparian Buffer
- Existing wetland areas
- Extended wetland areas
- Fencing
- Bait Stations
- DOC 200s

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Projection: NZGD2000/NZM2000
Sources: Map data ©2019 Google;Property boundaries taking from LINZ

McPherson Quarry

Freshwater Restoration Plan

Date: 16 October2019 | Revision : 2

Plan prepared for McPherson Resources Limited
Author: Stephanie Angove-Emery

9. WETLAND ENHANCEMENT/CREATION PLAN

9.1. Wetland Creation

Two wetlands are proposed to be extended, enhanced and restored (Wetland 1 and Wetland 2, see Figures 5 and 6), covering a total area of 5,195m^2 – consisting of 3,165m^2 in Wetland 1 and 2,030m^2 in Wetland 2. These are to be constructed to create a variety of habitats including deep pools, shallow water and wetland margins to ensure maximum potential for biodiversity. The finalised design will require input from hydrologists and engineers to ensure the wetlands are created appropriately and to be self-sustaining. For the purposes of this report, it has been assumed that Wetland 1 will consist of approximately 790m^2 each of deep pool areas, shallow water, boggy wetland margin and drier perimeter. Similarly, Wetland 2 will consist of approximately 505m^2 each of deep pool areas, shallow water, wetland margin and drier perimeter.

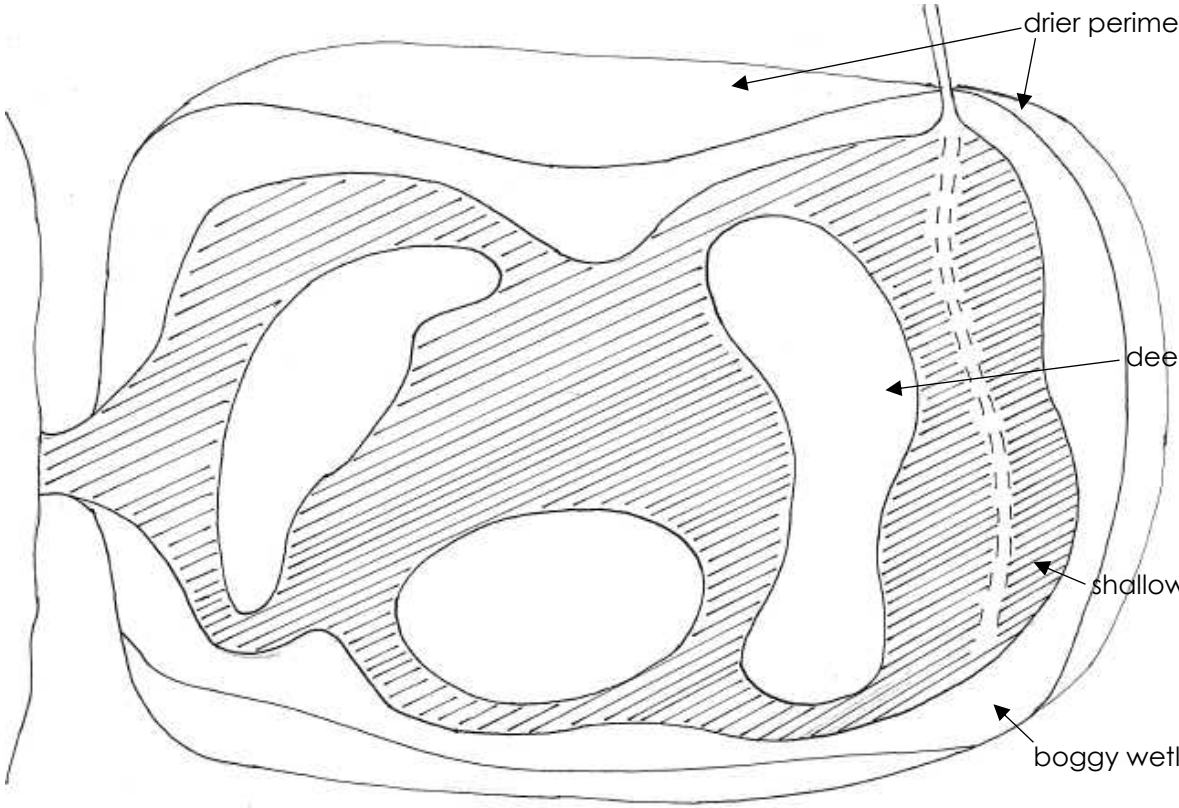

Figure 6 Concept design of zones of wetland 1

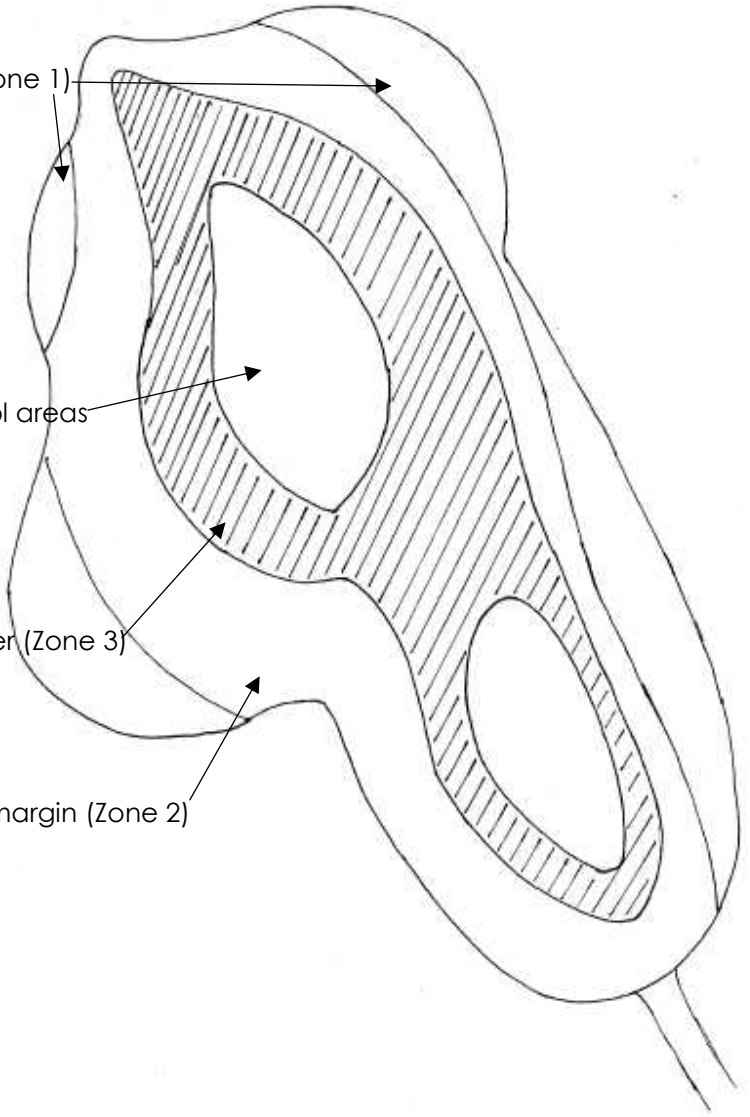

Figure 5 Concept design of zones of wetland 2

The basic construction process will include excavation of the current area to varying degrees to ensure water is consistently present and such that pools will be maintained (and therefore habitat maintained). In the case of Wetland 1, the construction will need to incorporate the inflow from streams and runoff from the adjacent hillside and to direct that water into and through the wetland and eventually into Stream 1 as defined in ENZL's Ecological Impact Assessment. For Wetland 2, consideration will need to be given to the proposed inflow from the adjacent new sediment pond. Once the areas have been correctly contoured, they will be lined with coir fibre matting which will reduce erosion potential while vegetation establishes.

Both wetlands will be fenced off as per Section 12 to prevent stock access and to delineate the protected area.

9.2. Wetland Planting Plan

Both wetland areas shall be planted with appropriate, eco-sourced native species throughout. Planting schedules for each area of each wetland are outlined below (Table 11) and are based on standard wetland planting schedules as well as Waikato Regional Council guidelines (such as their Wetland Planting Guide – Factsheet 3, July 2018; and Native Planting Programme, February 2017). Estimated quantities for both wetlands have been listed in the table and should be divided as appropriate across the two areas.

Planting preparation requirements are expected to be minimal but will be as per the planting preparation guidelines in Section 6. Planting will be carried out during late winter/early spring, after construction of the new sections of wetland (and prior to livening for Wetland 1). The timing of this planting is later than would be recommended for other types of planting (amenity, riparian etc) – this is due to the different conditions in which these plants will be growing, as well as the need for Wetland 1 to be livened at the same time as the fish management plan is enacted for Tributary 1 (see Section 10).

Planting zones have been divided into three (see Figure 7) based on varying soil moisture levels.

- Zone 1 = Outer perimeter, soils may be moist or dry depending on the time of year
- Zone 2 = Boggy margin, may be inundated after rain
- Zone 3 = Shallow standing water (up to approximately 0.5m)

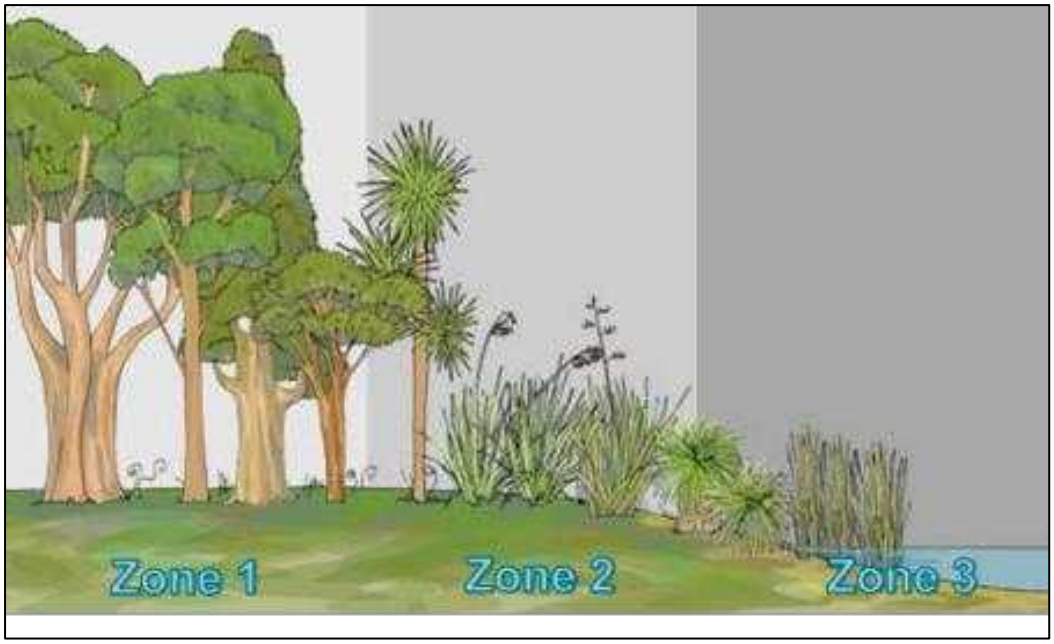

Figure 7: Indicative planting zones for wetlands - from Greater Wellington Regional Council

Table 11: Wetland planting schedule for both Wetland 1 and 2

Common Name	Botanical Name	Grade	Spacing	Quantity	Location
Pūrei	*Carex secta*	1 Litre	0.5m^2	865	Zone 3
Raupō	*Typha orientalis*	1 Litre	0.5m^2	865	Zone 3
Kāpūngāwhā	*Schoenoplectus tabernaemontani*	1 Litre	0.5m^2	865	Zone 3
Ti kōuka	*Cordyline australis*	1 Litre	1m^2	340	Zone 2
Giant umbrella sedge	*Cyperus ustulatus*	1 Litre	1m^2	340	Zone 2
Harakeke	*Phormium tenax*	1 Litre	1m^2	340	Zone 2
Mānuka	*Leptospermum scoparium*	1 Litre	1m^2	250	Zone 2
Kahikatea*	*Dacrycarpus dacrydioides*	3 Litre	5m^2	50	Zone 2
Karamū	*Coprosma robusta*	1 Litre	1m^2	325	Zone 1
Māhoe	*Melicytus ramiflorus*	1 Litre	1m^2	325	Zone 1
Patē*	*Schefflera digitata*	1 Litre	1m^2	325	Zone 1
Mamaku*	*Cyathea medullaris*	1 Litre	1m^2	325	Zone 1

*Kahikatea, patē and mamaku should be planted 2-3 years after initial plantings have established.

10. FISH MANAGEMENT PLAN

To avoid injury to or death of native fish species during reclamation of water bodies on site (Tributary 1, Pond 1 and Pond 2), a fish salvage should be undertaken with all fish being relocated to a suitable release site. Methodologies for the stream and ponds will differ and as such will be addressed separately below.

The management plan for Tributary 1 and the wetland areas should be enacted at the beginning of the earthworks season so as to be as close as possible (chronologically) to the planting of Wetland 1. This is to ensure the best chance of survival of the wetland plants by livening the wetland in close succession to the time of planting.

The release site for all native fish captured will be the main stream (Stream 1) at or around the confluence of Tributary 1. All fish will be temporarily stored in a cool, aerated chill bin during the salvage and released within one hour of capture – if this is not possible, the water shall be changed after one hour to prevent stress or mortality. All fish will be held for a maximum of two hours before release.

Any exotic or pest fish species found during salvage will be separated from native fish and humanely euthanised using clove oil in water, before being disposed of appropriately.

10.1. Tributary 1

Immediately prior to the dewatering and infilling of Tributary 1, the length of reach to be reclaimed should be isolated through the use of fish barriers at both the upstream and downstream ends (including the upstream extent of the drain from sediment pond E). The barriers shall be constructed using fine mesh plastic netting and waratahs and should be dug into the substrate to prevent fish moving under the net. Barriers will extend 2m either side of the channel to prevent overland migration by Anguilliformes (Figure 8).

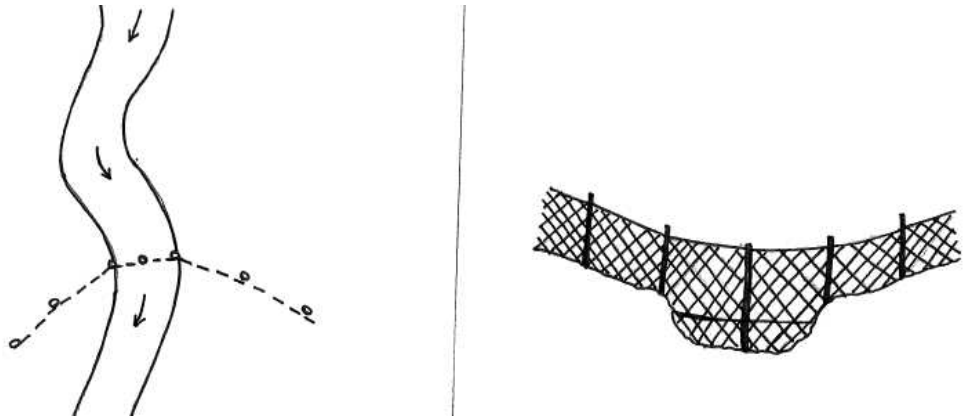

Figure 8: Sketch of fish barrier installed to prevent up and down stream migration.

Once the reach has been isolated, the salvage process shall proceed as follows:

- A total of 30 Gee Minnow traps shall be installed, baited and left in place for a minimum of three nights. The total number of traps may be reduced if insufficient water depth is present at the time of salvage. Traps will be set partly submerged so that atmospheric

air is available for fish to breathe in the case of poorly oxygenated water (especially at night).

- Traps shall be checked daily and any fish captured will be identified, measured and relocated to the release site.
- If high numbers of fish are still being caught on the third day, trapping shall continue until such time as the catch is reduced to 15% of the catch rate of the first night of trapping.
- Immediately prior to infilling of the stream (i.e. the morning of, or at most the day before), a suitably qualified ecologist will electric-fish the isolated reach to try and capture any fish which have avoided trapping. These fish will also be relocated to the release site.
- Once electric fishing has been completed, the reach shall be hydrologically isolated through the placement of earth bunds both upstream and downstream.
- Once hydrologically isolated, the reach shall be divided into manageable sections through the use of earth bunds and each section dewatered as much as possible using a pump. A suitably qualified ecologist will supervise the dewatering process and remove any residual fish seen.
- Subsequent to dewatering of each section, a digger shall be used to scrape approximately 150mm of the substrate from the bottom of the channel. This sediment will be carefully placed on the stream bank and searched by the supervising ecologist to look for any fish (e.g. *Anguilla* spp.) that may be concealed in the mud.
- Once the reach has been entirely dewatered and scraped, the channel shall be infilled immediately (within a maximum of one week) to prevent any chance of recolonisation by fish species (e.g. subsequent to rainfall).

10.2. Ponds

Both Pond 1 and Pond 2 will be salvaged in a similar way and as such will be considered together below. Prior to the salvage commencing, the outflow of the pond should be blocked to prevent re-entry to the pond by any fish species. The salvage shall then proceed as follows:

- Immediately prior to infilling works, trapping shall be carried out for a minimum of three nights. Fyke nets shall be spaced at 10m intervals around the pond margins (wherever safe access is possible). Gee minnow traps shall be placed 5m either side of the fyke nets where possible.
- All traps will be baited and checked daily. Any fish captured will be identified, measured and relocated to the release site.
- If high numbers of fish are still being caught on the third day, trapping shall continue until such time as the catch is reduced to 15% of the first night of trapping.
- Seine netting may also be attempted, however should the benthic substrate prove problematic then fyke netting and gee minnow trapping will be considered sufficient.
- Once trapping is completed, dewatering will commence and be supervised by a suitably qualified ecologist. Any fish seen will be captured using a hand net.
- Once dewatering is completed, a digger will be used to scrape any loose sediment from the bed of the pond, which will be placed gently on the banks of the pond to be searched for concealed fish. Any fish located within the mud will be relocated as above.

- Subsequent to dewatering and sediment scraping, the pond shall be filled in immediately (within a maximum of one week) to prevent recolonisation by fish species (e.g. after rainfall).

10.3. Reporting

Once all fish salvage works have been completed, a completion memo detailing methodology used and fish caught will be submitted to the client within two weeks for Waikato Regional Council sign-off purposes.

Details of all fish caught will be entered into the New Zealand Freshwater Fish Database within one month of completion.

11. TIMELINE OF FRESHWATER WORKS

Because of the nature of the proposed works (i.e. a staged expansion of the McPherson Quarry), fish management works and wetland creation will not be completed all at once. A recommended schedule of works is outlined below (Table 12) in order to ensure the highest chance of success of both the wetland restoration/development and the fish salvages.

Table 12: Timeline and person responsible for freshwater works

Timing	Activity	Person Responsible
Prior to new overburden area being utilised	1. Create Wetland 1 offline and plant.	1. Contractor, engineers, ecologists & planting team
	2. Begin salvage of Tributary 1 when Wetland 1 ready to liven.	2. Contractor & ecologists
	3. Bund and salvage Tributary 1, liven Wetland 1	3. Contractor & ecologists
	4. Infill Tributary 1	4. Contractor
	5. Create Wetland 2	5. Contractor & engineers
	6. Plant Wetland 2	6. Planting team
As required – depending on timing of quarry expansion	Salvage, dewater and infill Ponds 1 and 2	Contractor and ecologists

12. FENCING

All freshwater restoration areas and the ecological corridor should be excluded from stock. This is will be best achieved through fencing the entirety of these areas with continuous, ungated, stock-proof fencing outside the projected dripline of edge plantings. It should be noted that some of these areas are already fenced, providing stock exclusion. Stock-proof fencing should follow requirements in the Fencing Act 1978 and include seven-wire post and batten fencing, or eight-nine wire with or without battens.

13. CONCLUSION

A series of mitigation and compensation measures have been provided by ENZL that are considerate to the values found on site. These measures include details on the creation of wetlands and ecological corridors, pest control, and the enhancement of riparian corridors. It is considered that the full implementation of these measures will commensurately address the level of proposed impacts associated with the expansion and operation of the Macpherson quarry.

APPENDIX A

Report Limitations

This Report/Document has been provided by Ecology New Zealand Limited (ENZL) subject to the following limitations:

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ii) The scope and the period of ENZL's services are as described in ENZL's proposal and are subject to restrictions and limitations. ENZL did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Report/Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by ENZL in regards to it.

iii) Conditions may exist which were undetectable given the limited nature of the enquiry ENZL was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Report/Document. Accordingly, if information in addition to that contained in this report is sought, additional studies and actions may be required.

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v) Any assessments, designs and advice made in this Report/Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Report/Document.

vi) Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by ENZL for incomplete or inaccurate data supplied by others.

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ix) Where lengths or other measurements have not been provided by a surveyor, ENZL has used basic GIS mapping and measurement systems to estimate these numbers. These should not be taken as surveyor-level accuracy for the purposes of decision making.

APPENDIX B

Annual Revegetation Monitoring Report

Name _____ **Date**_____

_____

Address_____

Property Owner_____

Applicable Resource Consent and Stage _____

Planting area / covenant being assessed_____

Plant survival

Canopy closure (%)_____

Percentage survival (%) _____

Approximate Growth (cm/yr)_____

Thriving species _____

Failing species_____

Fertilisation

Date applied _____

Fertiliser used _____

Quantity used _____

Replacement planting

Date completed _____

Species replaced _____

Quantities replaced_____

Location of Replacement_____

Pest plant control

Date completed _____

Species controlled _____

Location of control _____

Nature of re-infestation _____

_____

_____

Herbicide used _____

Application rates used _____

Quantity used (Concentrate) _____

Pest animal control (for purpose of planting success)

Date completed _____

Species controlled _____

Impact of pest on plantings _____

_____

_____

Control method used _____

Toxin used (if any) _____

Quantity used _____