DECEMBER 2023

Alliance Ecology™

Draft Ecological Management Plan

NEWCOMBE ROAD SAND QUARRY

Prepared for R S Sand Ltd

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Document Control

Note: This Draft Management Plan is a working version of the document and will be further developed in consultation with Mana Whenua, the Department of Conservation, Waipā District Council (Waipā DC) and Waikato Regional Council (WRC). This plan will be subject to updates prior to construction commencement and Council certification.

Glossary

Specific terms	
ABM	Acoustic Bat Monitor
ACO	Artificial Cover Objects
AEcE	Assessment of Ecological Effects Report
AMP	Avifauna Management Plan
BOMP	Biodiversity Outcome Monitoring Plan
BRP	Bat Roost Protocols
DOC	Department of Conservation
EIANZ	The Environment Institute of Australia and New Zealand
ESC	Erosion and Sediment Control
ESCP	Erosion and Sediment Control Plan
HREP	Habitat Restoration and Enhancement Plan
LBMP	Long-tailed Bat Management Plan
LMP	Lizard Management Plan
NITOW	Ngā Iwi Tōpū O Waipā
NZTCS	National Threat Classification System
PB	Plant bag
QMP	Quarry Management Plan
RMA	Resource Management Act
VMP	Vegetation Management Plan
WRC	Waikato Regional Council
General terms	
Biodiversity	The variety of life on Earth at all its levels, from genes to ecosystems, and can encompass the evolutionary, ecological, and cultural processes that sustain life
Ecology	The study of the relationships between living organisms, including humans, and their physical environment.
Site description	
Project area	An area of approximately 41ha of the available land at 77 Newcombe Road, comprising of a 27ha quarry area and 14ha ecological restoration area.

1. Introduction

This draft Ecological Management Plan (EMP) has been prepared for the proposed Newcombe Road Sand Quarry on behalf of RS Sands.

The EMP encompasses a suite of management plans that will come into effect, assuming that RS Sands obtains resource consents for the construction and operation of the proposed quarry at 77 Newcombe Road.

The Site is located on three records of title which have a total area of 134.67 hectares. The quarry is proposed on approximately 27.09 hectares in the western portion of the properties (Figure 1). The quarry is made up of a 23 hectare pit area towards the western boundary and a 4 hectare plant area (for processing and stockpiling) to the east of the pit. A 14ha proposed ecological restoration area is located on the northern boundary of the Site.

The quarry is proposed to extract and process up to 400,000 tonnes of sand from the pit area per year (depending on demand) for approximately 25 years, The proposed plant area includes a processing plant (approximately 6m high and 20m wide) towards the middle of the area and a water recycling pond towards the north. Graded sand will be stockpiled around the plant area. The southwestern portion of the plant area will contain an office and breakroom building, maintenance workshop, car parking, weighbridge, and wheel wash facility.

Excavations of the pit area will begin 10-15m from the Karapiro Stream and move towards Newcombe Road.

The project activities are expected to have a range of effects on ecological values, and the cultural values and interest of mana whenua, primarily being Ngaati Korokii-Kahukura and Ngaati Hauaa Iwi Trust (Ngaati Hauaa). Key terrestrial and wetland ecological values at the site include:

- Long-tailed bats (pekapeka);
- Presence or potential presence of nationally 'Threatened' or 'At Risk' bird species, including NZ falcon (kārearea), pipit (pīhoihoi), Australasian bittern (matuku hūrepo), spotless crake ((pūweto), kākā, and black shag (kawau pū);
- Likely presence of copper skink (mokomoko); and
- Gully seepage wetlands.

While permanent and intermittent streams are present onsite, direct loss of these stream habitat have been avoided and impacts are assessed as low.

Potential ecological effects on these values are described in the Assessment of Ecological Effects Report (Alliance Ecology, 2023) and the Long-Tailed Bat Report (Bluewattle Ecology, 2023). The relevant effects management protocols are described further in the individual management plans following this section.

Legal protection of all ecological restoration and habitat enhancement sites will be provided through covenants where appropriate.

1.1. Status of the EMP

This draft version of the EMP will be reviewed and updated over the course of the project following discussions with Waikato Regional Council (WRC), Waipā District Council (Waipā DC) the Department of Conservation (DOC), Ngaati Korokii-Kahukura and and Ngaati Hauaa Iwi Trust (Ngaati Hauaa) and to reflect resource consent conditions.

1.2. Purpose and objectives of the EMP

The management plans within this EMP set out procedures to address the effects of the sand quarry on terrestrial and wetland ecological values. The plans also set out the monitoring and review processes to be undertaken before, during and after construction.

The EMP sets out methods to be adopted to address adverse effects on ecological and biodiversity values, including:

- Vegetation and habitat loss
- Bats
- Avifauna
- Lizards

1.3. Responsibilities and competencies [TBC]

The roles and responsibilities for implementing this EMP are set out in the various management plans below. The site manager holds overall accountability for implementation of and compliance with this plan.

1.4. EMP structure

Following this introduction, sections 2-5 comprise a suite of stand-alone management plans that describe the measures to be implemented during and following construction to avoid, remedy and mitigate effects on ecological values. Namely:

- Section 2 – Vegetation Management Plan (VMP)
- Section 3 – Avifauna Management Plan (AMP)
- Section 4 – Lizard Management Plan (LMP)
- Appendix A – Long tailed Bat Management Plan

Section 5, the Habitat Restoration and Enhancement Plan (HREP), addresses the management of residual adverse effects on ecology values.

1.5. Wildlife Act Authority requirements

'Wildlife Act Authorisation' (WAA) permissions must be obtained from the Department of Conservation in accordance with the relevant provisions of the Wildlife Act 1953. WAA permits will be sought to allow enactment of the fauna management measures provided in this EMP including capturing, handling, interacting with and relocating wildlife. The following management plans will support the application for wildlife permits: [TBC]

- Lizard Management Plan

1.6. Mana whenua /cultural matters

The cultural values of the site are described in the Cultural Impact Assessment (Te Hira Consultant Ltd, 2023)(Appendix Q of the AEE).

[Placeholder if indicated, for iwi to include specifically the cultural context and values they would like presented in this EMP. Expect will include broader cultural context and specific reference to fauna/flora/ecosystem values of cultural importance]

1.7. Relationship with other plans

Other management plans required for the project that are directly relevant to this EMP include:

- Erosion and Sediment Control Plan (ESCP)
- Quarry Management Plan
- Dust Management Plan.

2. Vegetation Management Plan

2.1. Introduction

2.1.1. Plan purpose

This Vegetation Management Plan (VMP) set out the methods that will be used to avoid, remedy or mitigate adverse ecological effects on vegetation and associated terrestrial and wetland habitats for flora and fauna during the construction phase of the sand quarry.

Table 2.1: Purpose, specific objectives, performance measures and monitoring relevant to the VMP

[Placeholder – specifics determined based on consent conditions].

Purpose	This VMP outlines how the earthworks and associated vegetation clearance and rehabilitation methods to be used during the project will meet the requirements of resource consent conditions.
Specific Objectives	The objective of this VMP is to achieve the standard set out in consent conditions and to avoid or minimise or rehabilitate adverse ecological effects on vegetation and associated habitats for flora and fauna. [Placeholder: Additional objectives as considered relevant and appropriate by iwi in the application of mātauranga Māori and exercise of kaitiakitanga.]
Performance Outcomes	A Vegetation Management Plan (VMP) shall be submitted to Council for certification at least XX months prior to the Construction Commencement Date. Certification shall be against the conditions of this consent, the objective set out below and further detailed in the draft VMP dated XXX. The plan shall be prepared by an appropriately qualified ecologist(s) and shall address native forest and wetland protection and effects avoidance, minimisation or rehabilitation measures, including: (a) Vegetation clearance protocols to protect surrounding habitat and to avoid intrusion of construction works beyond the construction area, such as the physical delineation of areas and individual significant or high value large trees that are close to but outside the project footprint, directional felling of trees or sediment controls around wetlands; (b) Adherence to bat roost tree protocols (detailed in the LBMP); (c) Avoidance of vegetation clearance within tall stature exotic forest or pine forest during peak breeding season (September to December inclusive) (d) Proposed measures to avoid vegetation clearance within 50m of nests for Threatened and At Risk species, or within 25m for other indigenous species until chicks have fledged (detailed in the AMP);

	(e) Salvaging of lizards (detailed in the LMP); (f) Relocation of coarse wood (detailed in the HREP); and (g) Post mining rehabilitation into pasture grassland.
Monitoring	Inspection monitoring to confirm that requirements of consent conditions have been adhered to before, during and after vegetation clearance.
Reporting	Incident based reporting will be provided to Council within five working days of an unforeseen event occurring. A compliance monitoring report will be submitted to Council following completion of vegetation clearance by September).

2.1.2. Consent Condition Scope

This VMP has been developed in accordance with [placeholder consent reference].

Thes conditions of consent will be addressed through the implementation, monitoring and reporting procedures set out in this VMP and interlinking plans. The term 'vegetation clearance' in this VMP refers to all vegetation clearance proposed to enable earthworks and land disturbance associated with the project. The following plans are also relevant to the VMP [placeholder TBC]:

- The long-tailed bat, avifauna and lizard management plans (within this EMP);
- Habitat Restoration and Enhancement Plan (HREP) (Section 5), which provides detail on the location, type and magnitude of native habitat restoration and enhancement measures that are proposed to compensate for residual adverse ecological effects associated with this project; and
- The Erosion and Sediment Control Plan (ESCP), which provides detail on erosion and sediment control effects and mitigation protocols.

2.1.3. Responsibilities and competencies

[placeholder – to be updated. Intent for Mana Whenua to provide input to identify roles].

Delivery of, and compliance with, the VMP will be the responsibility of the site manager who will liaise with the lead project ecologists (lead bat ecologist and herpetologist) and vegetation clearance and earthworks contractors as required.

The responsibilities of the site manager include, but are not limited to:

- Reading and understanding the VMP;
- Facilitating a project start-up meeting with the lead bat ecologist and herpetologist, site engineers, and vegetation clearance and earthworks contractors before vegetation clearance and earthworks commence for each stage of the Project. The objective of this meeting will be to determine habitats scheduled for clearance each season, enabling forward planning and avoiding delays in the construction and extraction schedule;

- Contacting the lead bat ecologist and lead herpetologist a minimum of X weeks before any non-pasture habitat is scheduled for clearance as per Figure X;
- Maintaining clear lines of communication with the Project ecologists, site manager and vegetation and earthworks contractors regarding changes in the works schedule;
- Briefing new personnel about the contractor's responsibilities under this plan; and
- Inviting iwi to participate in and support any vegetation or habitat salvaging and relocation as deemed necessary, to ensure appropriate exercise of kaitiakitanga responsibilities and that cultural concerns are addressed.

All personnel working on site are responsible for alerting the project ecologists and the site manager to the discovery of any 'At Risk' or 'Threatened' flora and fauna not otherwise identified in this management plan.

The Project ecologist is responsible for reporting the discovery of 'At Risk' or 'Threatened' flora and fauna to the DOC Local Area Manager and for maintaining a database with an incident register and file log of actions taken for each such discovery.

2.1.4. Plan structure

This VMP is set out as follows:

- Section 2.1 - Introduction (this section);
- Section 2.2 - Summary of ecological effects and effects management;
- Section 2.3 - Protocols for managing effects of vegetation clearance, including pre-clearance, clearance, and site remediation protocols; and
- Section 2.4 – Compliance monitoring and reporting requirements.

2.2. Effects and effects management summary

2.2.1. Effects on vegetation/habitat

The project is expected to result in the permanent loss of approximately 7.89 ha of variable quality habitat for terrestrial and wetland biodiversity values. Additionally, there will be a temporary loss of 19.63 ha of pasture habitat.

The actual and potential impacts of the Project associated with vegetation clearance are described in the AEcE (Alliance Ecology 2023) and the associated Long-tail bat report (Bluewattle 2023), and in summary include:

- Vegetation and habitat loss through vegetation clearance, earthworks and land disturbance, and potential changes to wetland hydrology;
- Mortality or injury to species during vegetation clearance or earthworks;
- Creation of habitat edge effects, altering the composition and health of adjacent vegetation, which may affect habitat suitability for flora and fauna; and
- Discharge of sediment to aquatic receiving environments that may affect the quality of wetland and stream habitats.

2.2.2. Effects management

A range of measures will be undertaken during construction to avoid and minimise adverse effects on vegetation/habitats and associated 'Threatened' or 'At Risk' species. These measures include:

- Vegetation management protocols (Section 2.3);
- Bat roost tree felling protocol;
- Bird nest surveys;
- Salvaging and relocation of lizards and lizard habitat (coarse wood) (Sections 4.3.1 and 2.3.3); and
- Site remediation to rehabilitate temporary loss of pasture habitat.

Additionally, residual effects will be compensated for via habitat restoration measures as set out in the Habitat Restoration and Enhancement Plan (Section 5).

2.3. Protocols for managing effects of vegetation clearance

Set out below are the management processes and protocols to avoid, remedy and mitigate adverse effects on vegetation clearance.

In the first instance, vegetation clearance will be avoided, where possible, during [TBC] cooler months (May to September inclusive) to:

- minimise impacts on roosting bats.
- minimise impacts on lizards by salvaging when these fauna are more active (and readily detected) and more likely to survive relocation.

Table 2.3 below summarises the vegetation management measures along with consent conditions, roles and management plans that relate to each vegetation management measure. Each measure is described in the section below.

Table 2.3: Summary of vegetation clearance measures and associated consent condition(s), roles and responsibilities and management plans

[placeholder – to be linked to specific conditions of consent].

Vegetation clearance management measures	Relevant consent conditions	Primary responsibility and relevant roles	Primary management plan(s)
Before vegetation clearance (section 2.3.1)			
Engage, report to, and seek feedback from Iwi		TBC and the Lead Project ecologist	Not applicable
Physical delineation		Project ecologist(s) in consultation site manager and vegetation clearance contractors	VMP

Bat roost tree protocols		Lead bat ecologist in consultation with Project ecologist, construction engineer(s), arborist and vegetation clearance contractors	LBMP
Avifauna nest checks		Project ecologist in consultation with site manager and vegetation clearance contractors	AMP
Salvaging of lizards		Project ecologist/lead herpetologist in consultation with site manager and vegetation clearance contractors	LMP
During vegetation clearance (section 2.3.2)			
Ecological oversight of vegetation clearance and clearance management measures		Project ecologist and lead bat ecologist in consultation with site manager and vegetation clearance contractors	VMP, AMP, LBMP, LMP
Construction assisted lizard salvaging in select high value habitats		Project ecologist/lead herpetologist in consultation with site manager and vegetation clearance and earthworks contractors	VMP + LMP
Stockpiling coarse wood for relocation - TBC		Project ecologist/lead herpetologist in consultation with site manager and vegetation clearance contractors	VMP + HREP
Post vegetation clearance (section 2.3.3)			
Mitigation plantings	X	XX	
Rehabilitation of habitat back into pasture post mining		Site manager in consultation with contractor	VMP
Relocation of coarse wood - TBC		Project ecologist/lead herpetologist in consultation with site manager and earthworks contractors	VMP+HREP

The vegetation clearance management measures are provided below in order of occurrence i.e. before (section 2.3.1), during (section 2.3.2) and after clearance (section 2.3.3).

2.3.1. Pre-clearance protocol

Physical delineation

The project footprint will be physically delineated to minimise potential for incidental vegetation/habitat loss outside the footprint. Individual mature native trees or bat roost trees located near to, but outside, the project footprint will also be identified by the lead

bat ecologist and marked by flagging tape or fencing to avoid inadvertent clearance and to minimise potential damage to branches and roots.

Sediment and erosion control

Prior to vegetation clearance, sediment control measures will be undertaken to avoid or minimise effects on aquatic species due to effects on water quality. Procedures for minimising the area and duration of soil exposure from vegetation clearance will be undertaken in accordance with the ESCP.

Fauna surveys and salvaging

Procedures to avoid or minimise impacts to bats, birds and lizards prior to vegetation clearance are summarised in Table 2.3.1 below and addressed in detail in the respective plans. DOC permits allowing species-specific salvaging and relocation operations will apply.

Table 2.3.1: Fauna management surveys and salvaging required prior to vegetation clearance

Taxa	Pre- vegetation surveys and salvaging	Management plan reference
Bats	Pre-vegetation clearance bat monitoring and implementation of tree-felling protocol for potential bat roost trees.	LBMP
Birds	Nest checks outside peak breeding season (clearance avoided during this time) but during the remaining bird breeding season (January to March inclusive in exotic forest and pine habitat (see Figure X)	AMP
Lizards	Deployment of Artificial Cover Objects (ACO) in all non-pasture habitat a minimum of 3 months prior to vegetation clearance	LMP

2.3.2. Clearance protocol

Vegetation removal will commence only after all pre-clearance management measures have been implemented and have been confirmed by the project ecologist in consultation with the lead bat ecologist and lead herpetologist.

Vegetation will only be cleared immediately prior to construction works beginning in the project footprint to reduce both habitat effects and the potential for erosion and sediment generation.

During vegetation clearance activities, maintenance of physical delineation barriers and erosion and sediment control measures as described in the ESCP will be ongoing.

As described in the LMP, machinery-assisted lizard salvaging will be undertaken during vegetation clearance.

Felled trees and already fallen logs (herein coarse wood) are ecologically important to forest regeneration processes and as habitat for a wide range of species. As such, coarse wood will be salvaged and stockpiled for the purposes of relocation into restoration and habitat enhancement sites. Coarse wood will be placed into small and compact windrows within defined areas with stockpile locations determined via consultation with the lead herpetologist site manager and vegetation clearance contractors.

Priority coarse wood for stockpiling includes large (> 50 cm diameter) felled logs or trunks of native (preferably) or exotic trees. These should be cut up into manageable portions (0.5 – 3 m sections). Enough coarse wood should be stockpiled across the footprint to allow for the relocation of 100m of coarse wood into habitat restoration and enhancement areas.

2.3.3. Post-clearance protocol

Relocation of coarse wood

Coarse wood will be relocated to restoration and habitat enhancement sites via machinery where-ever this can be undertaken without adverse effects on vegetation outside the project footprint. Deployment is to be directed by the lead herpetologist in consultation with the site manager and vegetation and earthworks contractors.

Site Remediation (TBC)

Mitigation plantings

Native mitigation plantings of approximately 0.837 ha will be undertaken, that includes 10m width x 837m length of native plantings along the northern boundary of the project footprint between the eastern edge of Gully A basin wetland and the head of Gully E (See Appendix A, Figure 2).

The mitigation planting including the site preparation and maintenance regime will be identical to that proposed for restoration zones as set out in the HREP (Section 5).

2.4. Compliance monitoring and reporting

Compliance or incident reports described in this section will be submitted to Waipā DC and WRC.

2.4.1. Incident monitoring and reporting

Incident-based reporting will be provided to Council as soon as practicable but no more than five working days after an unscheduled event associated with vegetation clearance. Such events include notable compliance failure that results in adverse ecological effects, or an event that causes vegetation damage on a scale that requires an urgent remedy according to the Project ecologist to return to compliance with any section of the EMP and planting programmes.

The incident-based report will include the following information:

- The causes of the incident, the emergency response measures (if applicable) and the response proposed to avoid a recurrence of the issue;
- An assessment undertaken by a suitably qualified ecologist which details any adverse effects of the exceedance; and
- Proposed, measures to avoid, remedy or mitigate effects or to offset or compensate for significant residual effects that cannot be avoided, remedied or mitigated.

All incidents will be tracked to resolution through the site's compliance management system.

2.4.2. Post-clearance

An annual post-clearance monitoring report shall be submitted to Council within three months following vegetation clearance. The report shall include confirmation that the vegetation clearance protocols were adhered to in accordance with this VMP. This shall include:

- Maps illustrating areas of vegetation clearance undertaken during the previous clearance season.
- Photos showing stockpiled coarse wood for deployment to enhance habitat in accordance with Section 2.3.3. above, and Section 5.3.2 of the HREP.
- Post-clearance reports relating to bat roost protocol and lizard plans will be required under the LBMP and LMP respectively.

3. Avifauna Management Plan

3.1. Introduction

3.1.1. Plan purpose

This Avifauna Management Plan (AMP) sets out the methods that will be used to avoid or minimise potential adverse effects on avifauna.

Legislation affords protection to native avifauna. Most native avifauna on site are protected by the Wildlife Act 1953 and the Resource Management Act 1991 (RMA) affords protection to significant habitats of indigenous fauna. Furthermore, several species identified on site are classified as 'Threatened' or 'At Risk' under the DOC National Threat Classification System (NZTCS).[1]

Table 3.1: Purpose, specific objectives, performance measures and monitoring relevant to this AMP

[placeholder – update with references to conditions of consent]

Purpose	This AMP outlines how avifauna management during project construction and operation meets the requirements of condition XXX of the resource consent conditions dated XXXX.
Specific Objectives	The objective of this AMP is to achieve the standards set out in Condition XX and to avoid, remedy, minimise or mitigate the potential adverse effects of the project on avifauna. [Placeholder: Additional objectives as considered relevant and appropriate by iwi in the application of mātauranga Māori and exercise of kaitiakitanga.]
Performance Outcomes	This AMP includes provisions for bird breeding protection and effects minimisation including: • Avoidance of vegetation clearance (excluding pasture habitat) during peak bird breeding season (September – December inclusive) • Indigenous bird nest survey and checks within any vegetation to be cleared during late breeding season (January – March inclusive). • Proposed controls for maintaining a 50 m setback of vegetation clearance from nests of 'Threatened' and 'At Risk' bird species during bird breeding season, until chicks have fledged; and • Proposed controls for maintaining a 25 m setback of vegetation clearance from nests of other indigenous bird species during bird breeding season, until chicks have fledged.

[1] Robertson, H. A., Baird, J. E., Elliott, G. P., Hitchmough, R. A., McArthur, N. J., Makan, T. M., Miskelly, C. M., O' Donnell, C.J., Sagar, P. M., Scofield, P., Taylor, G. A. & Michel, P. (2021). Conservation status of birds in Aotearoa New Zealand, 2021. New Zealand Threat Classification Series 36. Department of Conservation, Wellington. 43 p.

Monitoring	• Compliance monitoring to ensure that relevant consent conditions have been met and protocols set out in the AMP have been adhered to.
Reporting	• Incident based reporting will be provided to Waipā DC and WRC within five working days of an unforeseen event occurring. • An annual post-clearance compliance monitoring report will be submitted to Waipā DC and WRC in XXX following completion of vegetation clearance (as specified in the VMP).

3.1.2. Consent condition scope

[placeholder – update with specific conditions of consent]

The requirements of consent conditions for the proposed sand quarry will be addressed through the implementation, monitoring and reporting procedures set out in this AMP and the following interlinking plans. The term 'vegetation clearance' in this AMP refers to all vegetation clearance proposed to enable construction earthworks associated with the sand quarry.

Further measures to address effects on birds are detailed in the following plans:

- The Vegetation Management Plan (VMP) which provides detail on how adverse effects associated with vegetation clearance (including effects on breeding birds) will be avoided or minimised through vegetation clearance protocols.
- The Erosion and Sediment Control Plan (ESCP), which provides detail on erosion and sediment control effects and mitigation protocols, which relate to the mitigation of sediment impacts on wetland bird habitat.
- Habitat Restoration and Enhancement Plan (HREP), which provides detail on the location, magnitude and type of native habitat restoration and enhancement measures that are proposed to offset or compensate for significant residual effects on terrestrial ecological values, and adverse effects on natural inland wetland values affected by the sand quarry, including for avifauna.

3.1.3. Wildlife Act Authority Requirements

Most native avifauna on site are protected by the Wildlife Act (1953). If an activity is likely to disturb or kill protected wildlife or their eggs, then a Wildlife Act Authority (WAA permit) is needed from the Department of Conservation.

Handling of wildlife (whether injured or dead) is permitted only with a WAA. The WAA permit conditions must also be followed for accidental discovery (Section 3.5 below). Protocols for collecting bird carcasses are provided in Section 3.4 below.

This AMP shall be updated to achieve consistency with any authorisation given by the Director-General of Conservation under section 53 of the Wildlife Act 1953 where any such authorisation is required.

3.1.4. Responsibilities and competencies

[placeholder – to be updated. Intent for Mana Whenua to provide input to identify roles].

The Site Manager holds overall accountability for implementation of and compliance with this plan. The technical lead role will be performed by a suitably qualified and experienced ornithologist (lead ornithologist).

The responsibilities of the environmental manager (s) include but are not limited to:

- Reading and understanding the AMP;
- Facilitating a project start-up meeting with the site engineer, lead ornithologist and the vegetation clearance contractors before vegetation clearance commences for each construction stage. The purpose of this meeting is to establish the areas scheduled for clearance to enable forward planning and avoid delays in the construction and excavation schedule;
- Contacting the lead ornithologist a minimum of X weeks before vegetation clearance (excluding clearance of pasture);
- Inviting iwi to participate in and support any survey deemed necessary so that iwi can exercise kaitiakitanga responsibilities and so that cultural concerns are addressed; and
- Maintaining clear lines of communication with the lead ornithologist and the vegetation clearance contractors regarding changes in the works schedule.

All personnel working on site are responsible for alerting the site manager and lead ornithologist to the discovery of any 'At Risk' or 'Threatened' birds not otherwise identified in this management plan.

The site manager in consultation with the lead ornithologist is responsible for reporting the discovery of 'At Risk' or 'Threatened' bird species to the Local Area Manager (DOC) and for maintaining a database with an incident register and file log of actions taken for each such discovery.

3.1.5. Plan structure

This AMP is set out as follows:

- Section 3.1 – Introduction (this section);
- Section 3.2 – Summary of effects and effects management;
- Section 3.3 – Protocols for managing vegetation clearance effects;
- Section 3.4 – Bird injury and mortality protocols;
- Section 3.5 – Accidental discovery protocol (at risk or threatened birds); and
- Section 3.6 – Compliance monitoring and reporting.

3.2. Summary of effects and effects management

3.2.1. Effects on avifauna

Detailed information on potential effects on avifauna and proposed effects management is provided in the Ecology Report (Alliance Ecology 2023) and the associated bat report (Bluewattle Ecology 2023).

Potential adverse effects associated with the construction and operation of the sand quarry primarily include harm to eggs and chicks during breeding season and loss of terrestrial habitat.

3.2.2. Proposed effects management

In summary, these effects will be avoided, remedied or mitigated through:

- Avoidance of vegetation clearance in all habitats except managed pasture during peak breeding season (September – December inclusive)
- Nest surveys prior to vegetation clearance during late breeding season (January to March inclusive)
- Protocols for managing accidental bird injury and mortality
- Initiatives determined by iwi.

These measures are summarised in Table 3.2 below.

Additionally, the HREP address significant residual adverse effects on avifauna and other terrestrial biodiversity values that cannot be avoided, remedied or mitigated. This plan provides detail on the location, type and magnitude restoration and enhancement proposed to compensate for residual adverse effects on avifauna associated with the project.

Table 3.2: Avifauna effects management summary

Avifauna	Effect to be managed	Key timeframes	Effects management	Relevant management plans
All indigenous avifauna	Vegetation clearance (all habitats except managed pasture)	Peak bird breeding season (Sept – Dec inclusive)	Effects avoidance during peak bird breeding season (Sept – December)	AMP and VMP
	Pre-vegetation clearance surveys	Late bird breeding season (Jan – Mar inclusive)		AMP and VMP
	All significant residual effects that cannot be avoided,	All year	Habitat restoration and enhancement measures including removal of livestock	HREP

	remedied or mitigated		and native revegetation of wetland and terrestrial habitats	

3.3. Protocols for managing vegetation clearance effects on avifauna

Best practice measures to avoid or minimise potential adverse effects of the project activities on indigenous bird species are set out below. These measures incorporate the use of mātauranga and tikanga Māori in collaboration with iwi TBC.

Non-pasture habitats are focal areas for managing effects on native birds.

Table 3.3 summarises the avifauna management measures along with and the relevant management plans that address each effect. Each measure is described in the section below.

Table 3.3: Summary of avifauna management associated consent condition(s), and primary management plans relevant to each section

(placeholder – to be updated to reflect conditions of consent).

Avifauna management measures	Relevant consent conditions	Primary management plan(s)
Engage, report to, and seek feedback from iwi		
Avoidance of non-pasture vegetation clearance during peak breeding season		AMP
Nest surveys during late breeding season (Jan – Mar inclusive)		AMP
Section 3.4 Bird injury and mortality protocol		AMP
Section 3.5: Accidental discovery protocol		AMP

3.3.1. Avoidance of vegetation clearance during peak breeding season

Vegetation clearance (excluding managed pasture) will be avoided during peak breeding season which includes the months of September to December inclusive.

3.3.2. Nest surveys during late breeding season

Within 48 hours prior to vegetation clearance during late bird breeding season (January to March inclusive nest surveys must be undertaken to confirm that no active nests of

indigenous avifauna (nests with eggs or chicks present) are located within the area proposed for vegetation clearance.

In the event that active nests for indigenous avifauna are present, then a 50m buffer (threatened or at risk species) or 25 m buffer (non-threatened indigenous species) must be established and delineated with no vegetation allowed within these buffers until chicks have fledged (as confirmed by the lead ornithologist).

3.4. Bird Injury and Mortality Protocols

Handling of wildlife (whether dead or injured) requires a Wildlife Act Authorisation (WAA) from the Department of Conservation.

The location of any discovered injured bird or carcass must be recorded, the bird photographed at the location and an incident mortality data sheet filled out.

If an injured native bird is found during construction or operations, the following procedures will be implemented:

- Injured native birds will be taken immediately to a vet approved by DOC for assessment;
- Birds will be placed in a cool, dark, material-lined box/bag by or under the direction of a Project ecologist to ensure the bird is handled appropriately;
- The local DOC office or DOC hotline (if after hours) will be contacted no longer than two hours after the injured or dead bird is found. The DOC hotline is 0800 DOCHOTLINE (0800 362 468); and
- Contact information for approved contact in the event of native bird injury or mortality shall be advised by DOC.

Note: It is anticipated that mana whenua involvement will be through established protocols with DOC; however, a process for notifying iwi will also be confirmed.

DOC and veterinary advice shall be sought in conjunction with a suitably trained Project ecologist when considering the rehabilitation requirements of any injured native birds (for example, legislative requirements will need to be considered). Once the vet has made an assessment, the project ornithologist will, taking into account the advice from the vet, determine any rehabilitation action required and the longer-term future for the bird/s. If the bird is euthanised by the vet, it must be taken to the local DOC office as soon as practicable.

3.5. Accidental discovery protocol (threatened species)

All personnel working on site are responsible for alerting the Project ecologist and the site manager of the discovery of any 'At Risk' or 'Threatened' avifauna not otherwise identified in this management plan on the same working day as the discovery.

Any 'At Risk' or 'Threatened' avifauna species not identified in this management plan will be reported to the DOC Local Area Manager and [Mana Whenua]. All such discoveries are to be recorded in a database with an incident register and log of actions taken for each discovery.

3.6. Compliance monitoring and reporting

Compliance or incident reports will be submitted to WRC and Waipā DC as set out below.

This report will be prepared by an appropriately qualified and experienced ecologist(s) certifying that the works have been carried out in accordance with the approved AMP and shall provide details of the outcomes of any bird nest checking, or instances of native bird mortality or injury.

In light of findings and results, all proposed changes in management approaches described in this AMP will be undertaken in consultation with Waipā DC and WRC. Specialist and expert advice will be sought as appropriate to improve the management approach as necessary.

Compliance reporting on restoration planting to address significant residual effects on indigenous avifauna is addressed in the HREP and AMP.

3.6.1. Incident monitoring and reporting during vegetation clearance

Incident-based reporting will be provided to Council, within 5 working days of an unforeseen event (e.g. notable compliance failure that results in adverse ecological effects), and will include the following information:

- The causes of the incident, the emergency response measures (if applicable) and the response proposed to prevent a recurrence of the issue;
- An assessment undertaken by a suitably qualified ecologist which details any adverse effects of the issue; and
- Proposed measures to avoid, remedy or mitigate effects or to offset or compensate for significant residual effects of the issue that cannot be avoided, remedied or mitigated.

4. Lizard Management Plan

4.1. Introduction

4.1.1. Plan purpose

All native lizards on site are protected by the Wildlife Act 1953 and the Resource Management Act 1991 (RMA) which affords protection to significant habitats of indigenous fauna.

The 'At Risk' (declining) copper skink (*Oligosoma aenea*) is expected to be present on site and the introduced plague skink is known to be present. No other species are expected to be present due to an absence of suitable habitat or habitat that is contiguous with suitable habitat.

The Lizard Management Plan (LMP) describes measures to reduce potential effects to copper skinks that will be impacted by the project if present.

Table 4.1: Purpose, specific objectives, performance measures and monitoring relevant to this LMP

(placeholder: to be updated to reflect conditions of consent)

Purpose	This LMP describes how measures to reduce potential effects to copper skink will be impacted by the project meets the requirements of conditions [XX] of the resource consent conditions dated XXX.
Specific Objectives	The objective of this LMP is to achieve the standards set out in Condition XX, and to minimise any potential effects on copper skink within suitable habitat. [Placeholder: Additional objectives as considered relevant and appropriate by iwi in the application of mātauranga Māori and exercise of kaitiakitanga.]
Performance Outcomes	This LMP has been prepared by a suitably qualified and experienced herpetologist to include: (a) Timing of the works; (b) A description of salvaging methodology; and (c) A description of relocation methodology, including transfer methods, relocation site(s) selection and relocation site habitat enhancement measures.
Monitoring	Recording the sex, age class, snout to vent length, and location of capture and release of any salvaged copper skink [Placeholder: Additional monitoring that may be identified by iwi in relation to cultural matters]
Reporting	• A compliance monitoring report will be submitted annually during construction to Waipā DC and WRC within 20 working days of

	completion of salvaging and relocation operations for each earthworks season. • Relocation site log deployment and pest monitoring compliance (browsers only) (TBC) • Reporting requirements outlined in Wildlife Act Authority (Authorisation no. XXX-FAU) will be adhered to and submitted to DOC annually (by June 30th each year).

4.1.2. Consent condition scope

[Placeholder: This LMP has been developed in accordance with consent conditions [xx].

The requirements of these consent conditions will be addressed through the implementation, monitoring and reporting procedures set out in this LMP and the following interlinking plans. The term 'vegetation clearance' in this LMP refers to all vegetation clearance and habitat loss proposed to enable construction earthworks associated with the sand quarry. Further measures to address effects on lizards are detailed in the following plans:

- The Vegetation Management Plan (VMP), which provides detail on how adverse effects associated with vegetation clearance (including effects on lizard habitat) will be avoided or minimised through vegetation clearance protocols. This includes the salvaging, felling, stockpiling and relocation of coarse wood into compensation sites to provide additional habitat for lizards (and invertebrates) in these locations.
- Habitat Restoration and Enhancement Plan (HREP), which provides detail on the location, magnitude and type of native habitat restoration and enhancement measures that are proposed to offset or compensate for significant residual effects on ecological values affected by the sand quarry, including for lizards.

4.1.3. Wildlife Act Authority Requirements

All indigenous lizards are legally protected under the Wildlife Act 1953 (Wildlife Act).

This LMP will be used to support a Wildlife Act permit application to the Department of Conservation (DOC) to authorise the following:

- Handling of lizards (including non-threatened, 'At Risk' and 'Threatened' lizard species); and
- Capture, relocation and release of lizard species from the Project footprint; Inadvertent lizard injury and death; and Accidental discovery (threatened species).

Wildlife Act Authority Permit reporting requirements will be adhered to as specified in Section 4.6.3 below.

4.1.4. Responsibilities and competencies

[placeholder – intent for Mana Whenua to provide input to identify roles].

Delivery of, and compliance with this LMP will be the responsibility of the site manager, lead herpetologist (lizard ecologist) and vegetation clearance and earthworks contractors as required.

The implementation of the LMP will be under the direct supervision of the lead herpetologist. The lead herpetologist will be suitably qualified and experienced and hold a current Wildlife Act Authority for lizard salvage and relocation operations.

The responsibilities of the site manager are to:

- Facilitate a project start-up meeting with the lead herpetologist, site manager, site engineer(s) and vegetation clearance and earthworks contractors before the earthworks season commences to determine habitats scheduled for clearance to enable forward planning and avoid delays in the construction schedule;
- Contact the lead herpetologist a minimum of X weeks before any of the areas outlined in the [x-ref constraints map] and Table X below are scheduled for clearance;
- Invite iwi to participate in and support any translocation deemed necessary, to ensure appropriate exercise of kaitiakitanga responsibilities and that cultural concerns are addressed;
- Maintain clear lines of communication with the lead herpetologist, site manager, site engineer(s) and vegetation clearance and earthworks contractors regarding changes in the works schedule; and,
- Brief new personnel about the vegetation clearance contractors responsibilities under this plan.

All personnel working on site are responsible for alerting the lead herpetologist, site engineer(s) and the site manager upon discovery of any 'At Risk' or 'Threatened' lizards not otherwise identified in this management plan.

The lead herpetologist is responsible for reporting the discovery of 'At Risk' or 'Threatened' lizards to the Local Area Manager (DOC) and for maintaining a database with an incident register and file log of actions taken for each discovery of an 'At Risk' or 'Threatened' lizard not otherwise identified in this management plan.

4.1.5. Plan Structure

This LMP is set out as follows:

- Section 4.1 – Introduction (this section);
- Section 4.2 – Summary of lizard values and effects;
- Section 4.3 – Protocols for effects avoidance, including salvaging protocols (section 4.3.1) and relocation protocols (section 4.3.3);
- Section 4.4 – Inadvertent injury or death;
- Section 4.5 – Accidental discovery protocol; and
- Section 4.6 – Monitoring and reporting requirements.

4.2. Effects and effects management summary

Detailed information on ecological values, effects and effects management is provided in the AEcE (Alliance Ecology 2023) and Assessment of Ecological Effects (Kinetic Environmental, 2023) and summarised below.

Copper skinks are expected to be directly and indirectly impacted by the loss of terrestrial vegetation within the footprint, which includes a total of 3.64 ha.

Potential adverse effects on lizards that are associated with the construction within the sand quarry project footprint will primarily occur through habitat loss associated with vegetation clearance, earthworks. These effects will be avoided, remedied or mitigated through:

- Seasonal constraints on vegetation clearance (vegetation clearance only during earthworks season – during these warmer months lizards are more active and less cryptic) as detailed in the VMP;
- Vegetation clearance protocols to minimise the potential for effects outside the required project footprint (detailed in the VMP); and
- Vegetation clearance salvage and relocation operations for copper skinks (as set out in this LMP).

To address residual adverse effects on copper skinks and other terrestrial biodiversity values that cannot be avoided, remedied or mitigated, habitat restoration and enhancement measures are set out in the HREP (Section 5). This plan provides detail on the location, type and magnitude of restoration and enhancement proposed to compensate for residual adverse effects on lizards associated with the project.

Table 4.2: Summary of measures to minimise effects on copper skinks, and associated consent condition(s) and management plans

[placeholder: to be updated]

Salvaging and relocation protocols	Relevant consent conditions	Relevant management plan (s)
Engage, report to, and seek feedback from iwi		
Section 4.3.1: Salvaging protocol (ACO checks, manual day salvaging)		LMP
Section 4.3.3: Relocation protocol, including capture, handling and relocation site selection and release		LMP, HREP
Section 4.4: Accidental death or injury protocol		LMP

Section 4.5: Discovery of additional 'Threatened' or 'At Risk' species		LMP

4.3. Protocols for effects avoidance and minimisation

4.3.1. Salvaging protocol

The protocols for lizard salvaging and relocation specified below are consistent with standard methodologies from DOC's Inventory and Monitoring Toolbox: Herpetofauna[2] and are commonly used on many construction projects. The methodologies have been adapted in this LMP for local site conditions at the sand quarry.

Salvaging footprint and timing

Lizard salvaging is proposed in all instances where the project footprint includes potential lizard habitat to reduce mortality or injury during vegetation clearance and associated earthworks.

High-level assessment of lizard habitat has already been undertaken as outlined in the Ecology Report (Alliance Ecology, 2023), and habitat includes all cover objects and vegetation within the project footprint (excluding managed pasture).

Salvage methodologies will only be undertaken during the period from 1 October to 30 April inclusive. Lizard salvage will be undertaken using methodologies described below. The specific salvage methodologies will be guided by the lead herpetologist (lizard ecologist) based on their assessment of the lizard habitat. The lead herpetologist has discretion to include or exclude salvage in certain areas based on the type and quality of habitat being cleared.

Pre-clearance salvaging

Pre-clearance salvaging will be undertaken only during the warmer months (October – April inclusive) when lizard species are more active and therefore more likely to be detected during salvaging operations.

For the purpose of this management plan, suitable weather is defined as minimum temperatures of 15°C for daytime salvaging, with light winds and fine weather.

Pre-clearance salvaging will involve the deployment of Artificial Cover Objects (ACOs) to capture native lizards within suitable habitat types as well as manual searching, which includes turning over cover objects.

A total of XX ACOs (ca. 30 ACOs per ha) will be deployed at least three months prior to vegetation clearance within the approximate XX ha area. Each ACO will be deployed in suitable microhabitat spaced at least 5 m apart within potential lizard habitat. Each ACO will consist of two stacked onduline sheets measuring approximately 450 mm x 400 mm.

[2] Lettink, M. (2012). Department of Conservation Inventory and Monitoring Toolbox: Herpetofauna. Department of Conservation, Wellington

Checking of ACOs will commence four weeks prior to vegetation clearance, continuing at two-week intervals up to and immediately prior to vegetation clearance (i.e. three checks per ACO). The ACO checks will be undertaken during weather conditions and timeframes deemed by the lead herpetologist to be suitable for ACO-based lizard capture.

Clearance salvaging

If copper skink are detected during pre-clearance salvaging, then systematic manual, destructive, and/or machine-assisted salvaging will be undertaken during vegetation clearance (excluding pasture habitat).

Manual salvaging on the same day as vegetation clearance will include:

- Turning over or pulling apart of all cover objects that can be feasibly searched (e.g. coarse woody debris or rocks);
- Select habitat searches of low growing epiphytes, dense low-growing vegetation, loose tree bark, fern skirts and woody debris.

Construction (machinery) assisted salvaging during vegetation clearance activities will be undertaken in conjunction with:

- Habitat reduction of low stature non-woody vegetation using a mulching head or a scraping bucket to render habitat unsuitable and to facilitate detection/salvaging of lizards; and
- Turnover, checking and stockpiling of all large cover objects (e.g. large decomposing logs) that cannot be searched manually.

Manual salvaging immediately after vegetation clearance will be undertaken and will involve manual searching of the project footprint immediately after vegetation clearance.

4.3.2. Data collection

Each individual copper skink will be assigned a number and the following information will be recorded:

- Date and time of capture and weather conditions;
- Capture methodology;
- Capture location (GPS coordinates), capture methodology, habitat type;
- Sex (reproductive status for females), age class, Snout to Vent Length (SVL) and tail status (regenerating versus original tail), and overall health and condition; and
- A minimum of one photograph of each captured lizard, including at least one photograph showing the dorsal surface clearly.

4.3.3. Relocation protocol

This section provides detail on the methods that will be used for lizard relocation.

Handling and release protocol

The following steps will be undertaken by the project herpetologist to ensure appropriate handling of lizards occurs. The transportation of all lizards will comply with the Animal Welfare (Transport within New Zealand) Code of Welfare.[3]

Capture, handling and relocation of lizards will be undertaken in accordance with the following methodologies:

- All field equipment that indigenous lizards may come into contact with (e.g. plastic enclosures, collection bags, scales, etc.) will be sterilised;
- Hand sterilisation will be undertaken;
- Salvaged lizards will be placed in either cloth bags (only during salvage), or in suitable ventilated plastic containers (during transportation). Care will be taken so that the bags and containers will be kept at a constant ambient temperature. Vegetation/leaf litter will be added to plastic containers to shelter and protect lizards during transportation;
- Where practical, lizards will be placed into ventilated two-litre plastic containers for no longer than 8 hours for transportation and relocation to the relocation site; and
- Lizards will be released into appropriately prepared and protected habitat suitable for the species being relocated.

Upon release, the following information will be recorded for each lizard:

- Date and time of release and weather conditions;
- Release location (GPS coordinates) and habitat type; and
- Release photograph(s).

Relocation site requirements

Key aspects of the lizard relocation site(s) are that:

- It includes a diversity of adjoining habitats, namely rank grassland, regenerating exotic shrublands or forest, and is readily accessible.
- It lies immediately adjacent to the compensation area (see HREP and Map XX), which will be subject to the habitat restoration and enhancement measures that will also benefit relocated lizards, including:
    - Removal of livestock;
    - Deployment of felled coarse woody debris (decaying or felled logs) that have been salvaged from the project footprint (specifics to be determined); and
    - Native revegetation.

4.4. Inadvertent lizard injury or death

The following steps will be implemented if any injured or dead lizards are found during lizard salvage as per Wildlife Act Authority Permit (Authorisation no. XXXX-FAU):

[3] Ministry for Primary Industries (2018). Code of Welfare: Transport within New Zealand. MPI, Regulation and Assurance Branch, Wellington 6140

- The project herpetologist will notify DOC at the earliest opportunity within 24 hours after an injured or dead lizard is found;
- Any dead lizard of a Threatened, At Risk, or Data Deficient species shall be sent to XXX Wildlife Post Mortem Service for necropsy:
    - The body is to be chilled if it can be delivered within 24 hours, or frozen if longer than 24 hours to deliver.
- Appropriate measures shall be undertaken to minimise further lizard deaths;
- Injured lizards found during salvage will be taken to a suitably qualified vet as soon as possible for assessment and treatment. Injured lizards will be kept in an appropriate portable enclosure (i.e., a clean, well-ventilated plastic container) under the direction of the project lizard ecologist to ensure the animal is handled appropriately until the lizard(s) can be assessed and treated;
- Lizards assessed by the vet or alternative specialist as uninjured, or otherwise in suitable condition for release, will be transported to the lizard relocation site in the portable enclosure and released into habitat suitable for the species being relocated; and
- Euthanasia of an injured lizard shall only be undertaken under direction from DOC.

4.5. Accidental discovery protocol (threatened species)

As part of site inductions, all contractors and staff will be made aware of the possibility of the 'Threatened' and 'At Risk' lizard species being present, and will be supplied with photographs so they know what they look like.

Contractors and staff will also be briefed regarding the accidental discovery protocol and all personnel will be made familiar with the lizard recovery and translocation protocols set out below.

Personnel are responsible for alerting the site manager in the discovery of any 'At Risk' or 'Threatened' herpetofauna on the same working day as the discovery who will in turn inform the lead herpetologist, who will inform the site manager.

Any 'At Risk' or 'Threatened' species will be reported to the DOC Local Area Manager and iwi by the lead Herpetologist. All discoveries are to be recorded in a database with an incident register and log of actions taken for each discovery.

If additional 'At Risk' or 'Threatened' species not addressed by this EMP are discovered at any stage in the lifetime of the project, these species will be incorporated into this EMP.

Should any novel lizard species be recorded, an experienced herpetologist will be engaged to submit the record to the DOC Amphibian and Reptile Distribution Scheme (ARDS), to undertake a follow up survey and make recommendations (if any), and to review relevant aspects of this EMP accordingly.

4.6. Compliance reporting

4.6.1. Compliance monitoring report

A compliance monitoring report will be submitted annually during construction to Waipā DC and WRC. The compliance monitoring report will be submitted within 20 working days of completion of salvaging and relocation operations for each earthworks season. The annual report will also be provided concurrently to iwi.

This report shall include:

- Confirmation that lizard salvaging and relocation operations were undertaken in accordance with the LMP and associated consent conditions;
- Salvage and relocation results;
- Relocation site pest monitoring results to verify that pest reduction targets have been met and that pest control protocols have been adhered to for management of browsers; and
- Recommendations for potential changes to improve the effectiveness of lizard management in relation to the LMP scope.

Notable changes to salvage and relocation protocol will be undertaken in consultation with WRC, Waipā DC, DOC, iwi project partners, and/or stakeholders (as required). Resulting changes and updates to the LMP, following consultations, will be effective upon confirmation with all respective groups.

The compliance monitoring report shall also include representative photos showing:

- The salvaging methodologies; and
- Captured lizards, including both salvage and relocation site photos.

Annual reporting will cease once lizard salvage has been completed and all captured lizards have been relocated to the release site. A final report summarising the outcomes of LMP implementation will then be prepared and submitted to Waipā DC and WRC within three months following final lizard release.

No post-monitoring of lizards is proposed within the relocation site to determine if relocation has been successful unless the triggers set out in Section 5.6.2 below are realised. This is due to the inherent difficulties associated with marking individuals and with obtaining and interpreting meaningful data on the expectation that the number of lizards salvaged will be low, the lizards are difficult to detect and absence of detection does not constitute confirmation of relocation failure (e.g. lizards may all survive but may disperse away from the relocation site and outside of the monitoring footprint). [Placeholder – specifics dependent on conditions of consent].

4.6.2. Triggers for post-translocation monitoring (TBC)

Monitoring at the release area will be required 50 or more individuals are relocated.

If this requirement for monitoring is triggered, a five-year monitoring plan will be developed with guidance from DOC, and designed in accordance with numbers and species moved or known to be naturally present at the release site.

If a monitoring requirement is triggered, a brief annual report on the monitoring will be submitted to Waipā DC and WRC, the Department of Conservation and iwi.

4.6.3. Wildlife Act Authority Monitoring

Reporting requirements outlined in Wildlife Act Authority Permit (Authorisation no. XXX-FAU) will be adhered to. Lizard capture and relocation data will also be compiled, summarised and submitted to DOC's national data repository for lizard records (the Bioweb Herpetofauna database) annually (by 30 June each year). As a minimum, the report will include the following information:

- DOC Wildlife Act Authority number and Project name and location;
- A summary of the species, numbers and age/sex classes of lizards captured;
- Locations of lizards captured; and
- Summary of salvage methodologies, effort and success.

5. Habitat restoration and enhancement plan

5.1.Introduction

5.1.1. Plan Purpose

Collectively this HREP sets out procedures for how the sand quarry will compensate for residual adverse effects on terrestrial and wetland values and associated species.

5.1.2. Consent condition scope

This HREP has been developed in accordance with resource consent conditions for the sand quarry (Consent number XXX).

Table 5.1: Summary of habitat restoration and enhancement measures, associated consent conditions and inter-linking management plans

[placeholder: to be updated to reflect consent conditions]

Ecological enhancement and restoration plan protocols		Relevant consent conditions	Interlinking plans
Section 5.3: Ecological enhancement and restoration		x	Not applicable
Section 5.3.2: Site preparation	Weed plant control	x	Not applicable
	Pest animal (browser) control	x	Not applicable
	Stock proof fencing	x	Not applicable
	Felled log deployment	x	VMP, LMP
Section 5.3.3: Planting method, guidelines, and specifications		x	Not applicable
Section 5.3.4: Post-planting maintenance		x	Not applicable
Section 5.3.5: Artificial roost boxes		x	LBMP
Section 5.3.6: Programme		x	Not applicable
Section 5.4: Monitoring and compliance reporting		x	Not applicable

[TBC whether all compensation sites will be protected in the form of covenants on the titles].

These consent conditions will be addressed through the implementation, monitoring and reporting procedures set out in this HREP and the interlinking plans including:

- The Vegetation Management Plan, Long-tailed Bat Management Plan, Avifauna Management Plan (AMP); and Lizard Management Plan (LMP) and
- The ESCP which provides detail on how erosion and sediment effects will be managed.

Table 5.2: Purpose, specific objectives, performance measures and monitoring relevant to this HREP

Purpose	The HREP outlines how residual effects on ecological values associated with the Project are managed in accordance with conditions.
Specific Objectives	The objective of the HREP is to achieve the standards set out in consent conditions to compensate for residual effects on terrestrial and wetland ecological values to achieve a net positive ecological outcome.
Performance Outcomes	This HREP has been prepared by a suitably qualified and experienced ecologist and includes: Timing of habitat restoration and enhancement works. Methods for restoring and enhancing ecological values. [Placeholder: Additional objectives as considered relevant and appropriate by iwi in the application of mātauranga Māori and exercise of kaitiakitanga.]
Monitoring	Compliance monitoring to verify that stated restoration and enhancement activities have been undertaken. [Placeholder: Additional monitoring that may be identified by iwi in relation to cultural matters]
Reporting	A compliance monitoring report will be submitted annually during construction to Waipā DC and WRC within 20 working days of completion of habitat restoration and enhancement measures for each earthworks season.

5.1.3. Responsibilities and competencies

[placeholder – to be updated. Intent for iwi to have input to identify roles].

Delivery of, and compliance with this HREP will be the responsibility of the site manager who will liaise with the lead bat ecologist, lead herpetologist, lead restoration ecologist, and nursery, planting and pest management contractors as required.

The implementation of the HREP will be under the direct supervision of the lead restoration ecologist who will be suitably qualified and experienced. All lead ecology experts and contractors that will contribute to the implementation of the HREP shall be suitably qualified in the development and implementation of restoration and habitat enhancement activities. This includes but is not limited to lead bat, bird, lizard ecologists and contractors with expertise in fencing, plant nursery operations, planting and plant maintenance and weed and animal pest management (browsers only).

The site manager and lead restoration ecologist must read and understand the HREP so that the protocols are adhered to correctly during restoration and enhancement works.

The responsibilities of the site manager include but are not limited to:

- Reading and understanding the HREP;
- Advance communications with seed collectors and nursery contractors;
- Facilitating a project start-up meeting with the lead restoration ecologist and relevant contractors prior to commencement of the respective habitat restoration and enhancement activities;
- Inviting iwi to participate in and support any relocation deemed necessary, to ensure appropriate exercise of kaitiakitanga responsibilities and that cultural concerns are addressed;
- Maintaining clear lines of communication with the lead ecologists and relevant contractors (eg, nursery, planting and weed management contractors) regarding changes in the works schedule; and,
- Briefing new personnel about their responsibilities under this plan.

5.1.4. Plan structure

The HREP is set out as follows:

- Section 5.1 – Introduction (this section);
- Section 5.2 – Residual effects and effects management summary;
- Section 5.3 – Habitat restoration and enhancement measures
- Section 5.4 – Compliance monitoring and reporting

5.2. Residual effects and effects management summary

Detailed information on ecological values, effects and effects management associated with the Project is provided in the AEcE (Alliance Ecology 2023), the Assessment of Ecological Effects Report (Kinetic Environmental 2023) and the Long-Tailed Bat Report (Bluewattle Ecology, 2023).

As set out in these reports, the type and quantum of restoration and habitat enhancement activities for addressing significant residual adverse effects was determined in accordance with offsetting and compensation principles set out in the Waikato Regional Policy Statement (RPS). To this end, the habitat restoration and enhancement activities set out in this plan primarily address the following residual effects:

- The permanent loss of approximately 3.64 ha of terrestrial vegetation/habitat and 0.17 ha of wetland habitat (gully seepages);
- The permanent loss of 7.87 ha of pekapeka/long-tailed bat habitat (which includes 4.09 ha of pasture as well as the loss of terrestrial vegetation and wetland habitat);
- Potential loss of up to 3.64 ha of habitat and/or harm to copper skink (if present).

The habitat restoration and enhancement actions undertaken to address the above residual effects will have broader benefits and are also expected to address those residual effects assessed as moderate or lower under the Ecological Impact Assessment Guidelines (EIANZ 2018).

5.3. Habitat restoration and enhancement measures

The overarching objective of the proposed restoration and enhancement actions is to address significant residual effects on terrestrial and wetland biodiversity values in accordance with consent condition requirements. This centres on the requirement to achieve 'Net Positive' outcomes (compensation) in which ecological gains associated with restoration and habitat enhancement are expected to outweigh project impacts.

5.3.1. Approach

To optimise ecological benefits associated with the proposed compensation activities, we have focused on the following ecological outcomes:

- Replacement or enhancement of all habitats, vegetation communities, plant species and native fauna habitat that have been affected by the project;
- A substantial increase in the areal extent of native habitat types in the landscape (above and beyond what is currently present);
- Improved landscape/ecological connectivity through linking smaller habitat fragments to create larger contiguous habitat and through linking high value Significant Natural Areas (SNAs) and different habitat types (i.e. terrestrial, wetland, and freshwater streams);
- Providing ecological buffers to protect and enhance existing high value native habitat types;
- Improving the ecological integrity of existing habitats through the above measures coupled with livestock exclusion, weed management, deployment of coarse wood and artificial bat roost boxes;
- Long-term protection of sites proposed for habitat restoration and enhancement through covenants; and
- Providing opportunities to work collaboratively with iwi; to enhance cultural aspirations and outcomes, e.g. utilisation of vegetation and habitat types that support cultural values and practices.

Vegetation successional progress and trajectory is complex and determined by a wide range of interconnecting environmental factors such as soil types, microclimates, interspecies interactions, soil seedbanks, aerial seed sources, and mammalian browsing or seed predation. Correspondingly, the focus of restoration plantings is to include plant species that:

- Are representative of ecosystems types that would have been historically present prior to land use change; and
- Have a high chance of survival and establishment within planted areas.

The following sections describe restoration and enhancement activities that will compensate for residual effects. These activities will occur in existing pasture, exotic weed dominated habitats and degraded wetland habitats within the site that are currently located between existing SNAs.

5.3.2. Site preparation

Overview

Site preparation inspections will be undertaken between December and February to inform the types of site preparation management actions required in preparation for restoration planting in the areas defined in Table XX. Site inspections will include a site visit to confirm and record the following:

- Locations for felled-log deployment;
- Planting locations of specific tree species suitable for bats;
- Locations for fencing alignments;
- The types and location of weed species to inform the necessary controls;
- The pest species (browsers) on site to inform the necessary controls; and
- Canopy gaps to inform necessary infill planting for wetlands and riparian margins along Karapiro Stream.

Prior to planting, sites will be subjected to deployment of logs (all sites excluding wetlands), stock exclusion fencing, weed control and animal pest control. Animal pest control will centre on the control of browsers such as rabbits, pukekos and possums as required to increase the likelihood of plant survival.

The addition of topsoil is not considered necessary as plantings will be planted into pasture and wetlands. Furthermore, mulching will not be used (despite reducing weed establishment) because mulching also suppresses the natural colonisation of native seedlings and reduces habitat suitability for ground-dwelling lizards and invertebrates.

Weed management

Pest and weed plants can smother and inhibit the growth of native species, typically by outcompeting for space and resources until the native planting is established and dominant. Pest and weed plants recorded on site have been identified as posing a threat to the health of the proposed enhancement and restoration plantings. A list of pest and weed plant controls is detailed in Table 5.3 below.

Table 5.3: Ecological pest and weed plant species to be controlled before and after enhancement and restoration planting efforts

Species name	Common name	Control (until native plantings dominate)
Cenchrus clandestinus	Kikuyu grass	Spot spray around planting holes.
Cortaderia selloana	Pampas	Grub out small plants or excavate large plants with digger. Spray during summer-autumn in dense sites where non-target damage is unlikely with glyphosate and penetrant.
Delairea odorata	German ivy	Hand pull or dig out scattered plants and seedlings. Cut and paint stems with glyphosate.
Leycesteria formosa	Himalayan honeysuckle	Dig out small plants. Cut and stump paint with glyphosate. Spray during summer with penetrant.
Ligustrum lucidum	Tree privet	Pull and dig seedlings. Cut and stump paint. Drill and poison with melsulfuron.
Passiflora 'Tasconia' subgroup	Banana passionfruit	Pull roots up. Cut off above ground or tie stems in air to prevent layering. Spray large masses on ground where roots cannot be pulled with glyphosate between spring- autumn.
Rubus	Blackberry	Dig out (small patches only). Dispose of root crowns and rhizomes. Spray metsulfuron-methyl or triclopyr at label application rates, in late summer to autumn. If spraying regrowth, ensure the stems are at least one metre long and have fully grown leaves to maximise chemical absorption.
Salix fragilis	Crack willow	Hand pull small plants, taking care to remove all parts and dispose appropriately. Cut or drill every 100 mm around truck diameter and fill each cut/hole with glyphosate in summer-autumn.
Selaginella kraussiana	African clubmoss	Rake and hand pull small infestations areas. Spray larger infestations with glyphosate.

Tradescantia fluminensis	Tradescantia	Rake and hand pull small infestation areas from edge towards the centre of the infestation. Caution when disposing and transporting as dropped fragments spread. Spray larger areas with glyphosate to achieve over 90%.
Ulex europaeus	Gorse	Hand pull seedlings and small plants. Cut and stump paint with glyphosate or 2,4D. Spray with herbicide penetrant between spring-autumn.

Pest plants and weeds shall be controlled to a low level prior to planting. Spot spraying should be carried out in planting spots to remove kikuyu grass in planting areas and riparian margins to limit the use of chemicals around waterways. Manual release of plantings or weed trimming is recommended where appropriate, particularly in wetland planting areas.

All chemical control will be carried out by qualified contractors trained in chemical application for weed control and adhere to NZS 8409:2004 "Management of Agrichemicals" and rules in chapter 6.2 of the Waikato Regional Plan.

Removal of pest and exotic vegetation as part of weed and pest control along the riparian margin, wetland margin, within a wetland or stream may require a resource consent in accordance with the Waikato Regional Plan.

Animal pest management (browsers)

The site preparation inspection will inform which target species to control for each enhancement area. Hares (*Lepus europaeus*), rabbits (*Oryctolagus cuniculus*), possum (*Trichosurus vulpecula*), and pukeko (*Porphyrio melanotus*) are known or expected to be present on site and are likely to damage enhancement plantings. Pest animal control could include bait stations, kill traps, and/or pulse shootings. All pest animal control will be carried out by suitably qualified and certified contractors trained in pest control (e.g. use of poison).

Stock-proof fencing

Livestock will be excluded from all revegetation enhancement and restoration sites, by constructing stock exclusion fencing that is fit for purpose. Setbacks of ≥ 1 m from plantings will be exercised to prevent livestock from grazing the planted edges and also enabling rank grassland to establish, which provides habitat for copper skink.

Fencing locations will be determined during site preparation inspections. In locations where fencing may interrupt and inhibit temporary access requirements, temporary fencing may be used.

Temporary fences will be replaced with permanent, fit for purpose exclusion fences when initial planting efforts are completed.

Felled log deployment

Felled trees and fallen logs, in various states of decomposition, are ecologically important to forest regeneration processes and as habitat for a wide range of species. Felled and fallen logs provide critical habitat for decomposers, including invertebrates (e.g. peripatus), fungi and bacteria, and lizards (e.g. skinks) and are key sites for plant regeneration.

Felled native (preferably) or exotic log deployment into offset and compensation sites will be undertaken as detailed in the VMP. A minimum of 10 m / ha of cut up, stockpiled logs will be deployed into terrestrial compensation sites. Log material will be placed in locations where they are unable to be dislodged into streams.

5.3.3. Planting specifications (native revegetation and/or enrichment planting)

Planting detailed in this section has been developed in accordance with Council guidance,[4,5] to promote successful establishment and long-term persistence of plantings.

To encourage planting success and survival, plant species will be eco-sourced from the Hamilton Ecological District, preferably from a nearby source to the site. Species will be selected in consultation with local hapu and iwi.

Terrestrial, wetland, and riparian margin planting will predominantly be carried out in the standard planting season between the months of April to October due to higher soil moisture.

Wetland infill planting of wetland species that grow in standing water and boggy ground are proposed to be planted at the end of summer (i.e. when water levels are low).

- Optimal plant stock will be used in the planting which have the following attributes:
- Healthy, vigorous, and free from obvious signs of disease and pests;
- Of at least average size for the specified pot/plastic bag size (i.e. PB);
- Well-developed root system with a high amount of new root growth;
- Not root bound; and
- Well-branched and symmetrically shaped.

Appropriate plants will be placed in specific areas based on the locality of the planting and the immediate in-situ conditions to ensure the success of the revegetation.

Site specific factors that will be considered include:

- Slope topography (i.e. steepness affects establishment success);
- Soil characteristics (i.e. species grow in specific types of soil conditions);
- Wind (i.e. certain species have tolerance to wind);

[4] https://www.waikatoregion.govt.nz/environment/biodiversity/planting-guides/what-to-plant-in-maungatautari-ecological-district/

[5] Waikato Region Wetland Planting Guide, Waikato Regional Council wetland factsheet series Updated July 2018 (5804).

- Aspect (i.e. direction of slope may affect the duration of sunlight and dryness of soil);
- Shading (i.e. certain species are adapted to grow in full sunlight, while other species are shade-tolerant and require establishment under a canopy);
- Moisture (i.e. certain species are adapted to grow in regularly wet soils, while other species require wet soils to survive); and
- Frost (i.e. tolerance to frost).

Plant holes shall be dug according to spacing requirements and each plant hole is to be dug deep and wide enough so the plant collar is approximately 1 cm below ground level. Grass will be cleared away from each planting hole to ensure the new plants get enough light and nutrients.

Fertiliser tablets are to be placed in a planting hole before planting if not already included in the nursery root ball. The soil will be loosened at the bottom of the hole, to allow the roots to penetrate the soil more freely. The plant is to be secured in the ground by filling the space surrounding the roots with soil and then lightly compressing to fill any voids that might be present around the roots to avoid waterlogging.

Marking plants with bamboo stakes is recommended for ease of monitoring and maintenance purposes. Mulch or any other ground conditioning is not considered necessary for these sites.

Plant species specifications

The native enhancement and restoration planting mix selected for each enhancement area and type are guided by species:

- Within ecosystem types that have been impacted by the project footprint;
- That would naturally occur historically;
- That have been recorded in the surrounding SNA and/or non-SNA fragments/remnants;
- Within the Hamilton Ecological District;
- That offer food resources and refuge/shelter for a range of native fauna to help address fauna habitat that have been impacted by the Project; and
- That are selected after considering the views of cultural advisers.

Planting will be carried out in two phases. The first phase is aimed at allowing colonisation of pioneer plant species that are adapted to high sunlight, lower soil moisture content, and exposure to wind. Pioneer plant species will help to increase the diversity of a habitat, create more stable and fertile soils for other secondary successional species to establish. The second phase is aimed at enrichment planting and guiding succession by planting species that are adapted to secondary succession, such as shade tolerant and greater soil moisture.

Therefore, the starting crop species matrix for each enhancement site has been selected based on their tolerance of site specific environmental stresses (e.g. shade intolerant species), location (e.g. riparian margin) and associated characteristics of ecosystem types. Enrichment planting species matrix has been selected based on secondary

successional species associated with each of the ecosystem types that were historically present.

Additional considerations have been incorporated into the species selection for riparian margin planting. Riparian margins are being planted to improve aquatic ecosystem health and therefore species have been selected to provide shade, organic matter input, bank stability and overland flow filtering capability. Opportunities for mana whenua participation in species selection will be provided where possible.

Starting crop and enrichment species matrix for each category (i.e. riparian, terrestrial, and wetland) are described in Tables 5.4 - 5.6 below.

Table 5.4: Floodplain forest (non-wetland)

NB: ALL PLANTING SPECIFICATION TABLES ARE INCOMPLETE

Common name	Scientific name	Abundance	Planting phase
Cabbage tree	*Cordyline australis*	Common	Starting crop
Harakeke	*Phormium tenax*	Most	Starting crop
Kahikatea	*Dacrycarpus dacrydioides*	Most	Starting crop
Kaikomako	*Pennantia corymbosa*	Common	Starting crop
Kānuka	*Kunzea robusta*	Few	Starting crop
Karamu	*Coprosma robusta*	Few	Starting crop
Kowhai	*Sophora microphylla*	Few	Starting crop
Mahoe (small leaved)	*Melicytus micranthus*	Common	Year 5
Mahoe	*Melicytus ramiflorus*	Common	Year 5
Mānuka	*Leptospermum scoparium*	Most	Starting crop
Māpou	*Myrsine australis*	Common	Starting crop
Matai	*Prumnopitys taxifolia*	Least	Starting crop
Mikimiki	*Coprosma propinqua*	Few	Starting crop
Pate	*Schefflera digitata*	Few	Year 5
Poataniwha	*Melicope simplex*	Common	Year 5
Pigeonwood / Porokaiwhiri	*Hedycarya arborea*	Few	Year 5
Pokaka	*Elaeocarpus hookerianus*	Least	Year 5
Pukatea	*Laurelia novae-zelandia*	Few	Year 5
Ramarama	*Lophomyrtus bullata*	Least	Year 5
Rewarewa	*Knightia excelsa*	Few	Year 5
Ribbonwood (lowland)	*Plagianthus regius*	Few	Starting crop
Rimu	*Dacrydium cupressinum*	Few	Year 5
Swamp coprosma	*Coprosma tenuicaulis*	Common	Starting crop
Titoki	*Alectryon excelsus*	Few	Year 5
Totara (lowland)	*Podocarpus totara*	Common	Starting crop
Tree fuchsia/ kotukutuku	*Fuchsia excorticata*	Least	Year 5
Turepo / milk tree	*Streblus heterophyllus*	Few	Year 5
Wineberry / makomako	*Aristotelia serrata*	Least	Starting crop

Table 5.5: Podocarp/broadleaf forest revegetation

NB: ALL PLANTING SPECIFICATION TABLES ARE INCOMPLETE

Common name	Scientific name	Abundance	Planting phase
Cabbage tree	*Cordyline australis*	Common	Starting crop
Fivefinger	*Psuedopanax laetus*	Few	Year 5
Kahikatea	*Dacrycarpus dacrydioides*	Few	Starting crop
Kaikomako	*Pennantia corymbosa*	Common	Starting crop
Kamahi	*Weinmannia racemosa*	Few	Year 5
Kānuka	*Kunzea robusta*	Most	Starting crop
Karamu	*Coprosma lucida*	Few	Year 5
Karamu	*Coprosma robusta*	Most	Starting crop
Kawakawa/pepper tree	*Macropiper excelsum*	Most	Year 5
Kohuhu	*Pittosporum tenufolium*	Few	Year 5
Kowhai	*Sophora microphylla*	Common	Starting crop
Lacebark (houhere)	*Hoheria sexstylosa*	Few	Starting crop
Lancewood/horeaka	*Psuedopanax crassifolius*	Few	Starting crop
Mahoe	*Melicytus ramiflorus*	Common	Year 5
Mamangi / tree coprosma	*Coprosma arborea*	Least	Starting crop
Mangeao	*Litsea calicaris*	Common	Year 5
Mānuka	*Leptospermum scoparium*	Common	Starting crop
Māpou	*Myrsine australis*	Most	Starting crop
Matai	*Prumnopitys taxifolia*	Few	Starting crop
Mingimingi	*Leucopogon fasciculatus*	Common	Starting crop
Miro	*Prumnopiys ferruginea*	Few	Year 5
Pate	*Schefflera digitata*	Common	Year 5
Pigeonwood / porokaiwhiri	*Hedycarya arborea*	Few	Year 5
Pokaka	*Elaeocarpus hookerianus*	Least	Year 5
Pukatea	*Laurelia novae-zelandia*	Common	Year 5
Ramarama	*Lophomyrtus bullata*	Least	Year 5
Rangiora	*Brachyglottis repanda*	Common	
Rewarewa	*Knightia excelsa*	Common	Year 5
Ribbonwood (lowland)	*Plagianthus regius*	Few	Starting crop

Common name	Scientific name	Abundance	Planting phase
Rimu	*Dacrydium cupressinum*	Few	Year 5
Swamp coprosma	*Coprosma tenuicaulis*	Common	Starting crop
Tanekaha / celery pine	*Phyllocladus trichomanoides*	Few	Year 5
Tawa	*Beilschmiedia tawa*	Few	Year 5
Titoki	*Alectryon excelsus*	Few	Year 5
Totara (lowland)	*Podocarpus totara*	Few	Starting crop
Tree fuchsia/ kotukutuku	*Fuchsia excorticata*	Few	Year 5
Turepo / milk tree	*Streblus heterophyllus*	Few	Year 5
Wineberry / makomako	*Aristotelia serrata*	Common	Starting crop
White maire	*Nestegis lanceolata*	Least	Year 5

Table 5.6: Wetland native enrichment planting

NB: ALL PLANTING SPECIFICATION TABLES ARE INCOMPLETE

Common name	Scientific name	Abundance
Purei	*Carex secta*	Most
Purei	*Carex virgata*	Most
Harakeke	*Phormium tenax*	Few
Toetoe	*Austroderia fulvida*	Few
Umbrella sedge	*Cyperus ustalatus*	Few
Maire tawake	*Syzgium maire*	Few

5.3.4. Post-planting maintenance

Replacement planting

To ensure plantings are healthy and thriving, enhancement plantings will be inspected twice a year, once in spring and once in autumn, for the first three years.

Plants that do not survive are to be replaced with either the same species or an alternative appropriate species from the planting species matrix in the following planting season.

Replacement of plants which do not survive is important to ensure gaps are not created which could allow weeds to enter the planting area.

Weed plant control

Post-planting weed plant control is required to suppress the growth of weeds to ensure long-term persistence of plantings. Control actions will be carried out as detailed in section X.

In the first three years after the initial planting has been carried out, chemical and/or manual weed control in the enhancement and restoration areas will be carried out twice a year, once in spring a once in autumn. This is aimed at reducing weed and pest plant pressure on the plantings and to deplete pest plant seedbank stores.

In subsequent years as required, pest and weed plants will be controlled annually during summer.

5.3.5. Artificial bat roosts

As described in the LBMP, artificial bat roosts will be utilised to supplement available roosting habitat following vegetation clearance. Artificial bat roosts will be provided in the form of bat roost boxes in suitable existing habitats within the compensation sites.

Artificial bat roosts will be installed in habitat suitable for bat roosting within the compensation sites, outside of the project footprint at the density or spacing defined in the LBMP.

Locations, placement, and types of artificial bat roosts to be utilised are detailed in the LBMP.

5.3.6. Programme

The implementation of enhancement and restoration planting activities will be driven by specific timing restrictions. A calendar for seasonal staging for all activities is summarised in Table 5.7.

This HERP is based on the expectation that all habitat restoration and enhancement planting described in this HERP will be completed within [X] years of the initial construction and enabling works being completed.

Riparian margin restoration as specified within Table 5.7 will be completed within five years following commencement of consent.

Table 5.7: Seasonal staging for the implementation of enhancement and restoration activities detailed in this HEP (placeholder)

[table to include reference to Mātauranga Māori linkages to be identified in consultation with Ngaati Korokii-Kahukura and Ngaati Hauaa]

Enhancement and restoration activities	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Phase One (Years One to Three) – Initial planting of starting crop												
Site preparation inspection	✓	✓										✓
Weed plant control	✓	✓	✓									
Pest animal control	✓	✓	✓									
Stock-proof fencing	✓	✓	✓									
Felled log deployment			✓	✓								
Wetland reveg (starting crop)		✓	✓									
Terrestrial reveg (starting crop)				✓	✓	✓	✓	✓	✓			
Phase 2 (Year Five) – Enrichment planting												
Terrestrial enrichment planting				✓	✓	✓	✓	✓	✓			
Phase 3– Maintenance												
Replacement planting (year 1-3)			✓	✓	✓				✓			
Weed plant control (year 1-20)			✓	✓	✓				✓	✓	✓	

5.4. Compliance reporting

5.4.1. Compliance confirmation report

A compliance confirmation report will be submitted to Waipā DC and WRC within 30 days of completion of the restoration and enhancement activities to confirm that all enhancement and restoration planting activities have been completed in accordance with this HREP. The report shall include, but not be limited to, confirmation of:

- Planting species matrix and number of plants planted;
- Areal extent and location of plantings;

- Felled log deployment locations in compensation sites; and
- Proof of covenant/encumbrance and terms therein.

5.4.2. Incident reporting

Incident-based reporting will be provided to Waipā DC and WRC within 30 working days of an unscheduled event that causes ecological harm (e.g. flood, fire, and disease) or event that sets back an element of the restoration and habitat enhancement programme by a season or more.

Reporting will include the following information:

- The causes of the incident, the emergency response measures (if applicable) and the response proposed to avoid a recurrence of the issue;
- An assessment undertaken by a suitably qualified ecologist which details any adverse effects of the exceedance;
- Proposed, measures to compensate for residual effects; and
- Incident resolution will be tracked through the site's compliance management system.

5.4.3. Compliance monitoring report

Annual inspection surveys shall be undertaken during normal conditions (i.e. not during flooding events) to monitor the following:

- Identify weeds;
- Identify pest animal damage;
- Estimate planting survival and densities of facultative wetland species in wetlands and all terrestrial plants within compensation sites; and
- Estimate canopy coverage.

Findings will inform the types of weed and pest animal management requirements for the subsequent year.

Compliance monitoring reports will be submitted to Waipā DC and WRC every second year from the initial planting establishment until closure, i.e. once all plantings are 10 years in age and native canopy closure targets have been met. The monitoring report shall include:

- Representative photos showing progress of terrestrial, riparian and wetland revegetation, including photos of sites where plantings are 10 years in age and 90% canopy closure has been achieved (where applicable);
- Information/data on plant survival, infill planting, and progress towards 90% canopy closure;
- Reduction targets and requirements for weed management (Section 5.3.4) and control of browsers (e.g. rabbits, possums and pukeko). (Section 5.3.2); and
- Information on incidents and adaptive management responses.

Appendix A: Site maps

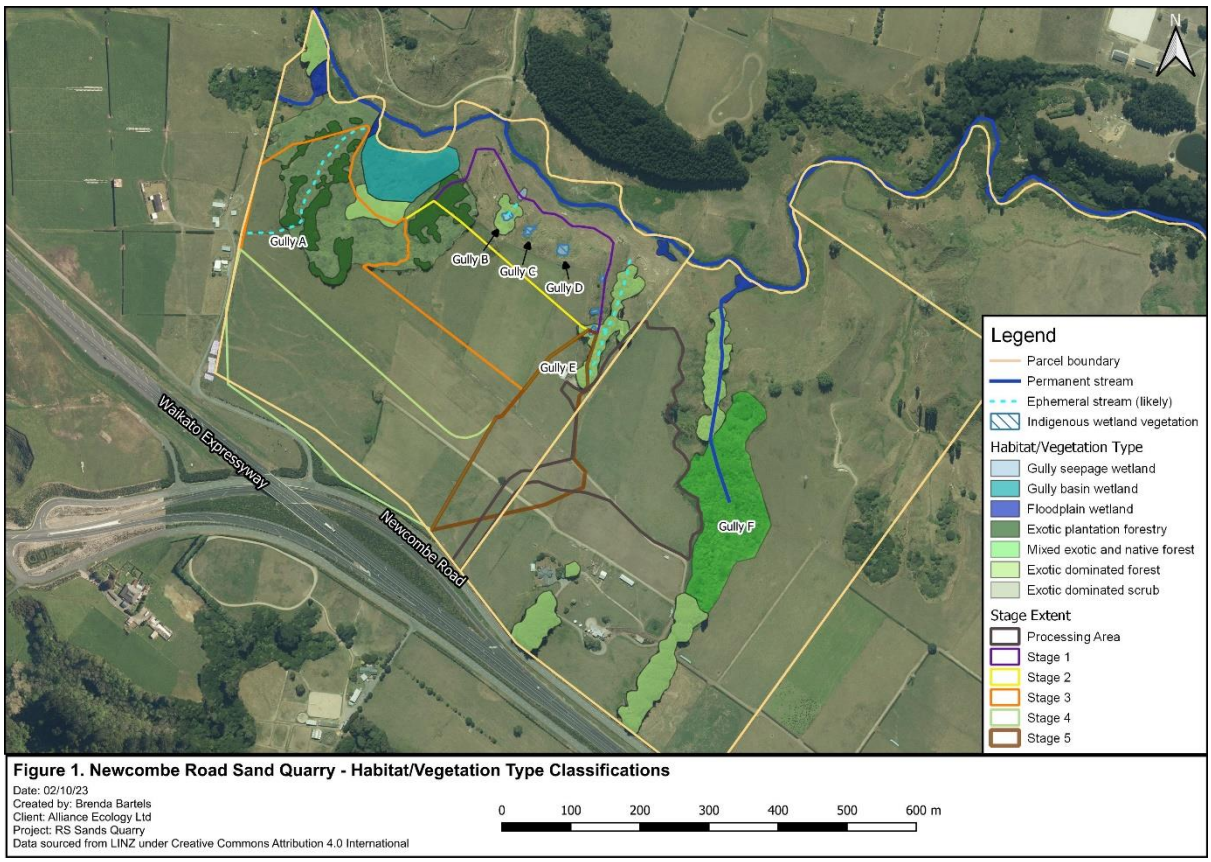

Figure 1. Newcombe Road Sand Quarry - Habitat/Vegetation Type Classifications

Date: 02/10/23
Created by: Brenda Bartels
Client: Alliance Ecology Ltd
Project: RS Sands Quarry
Data sourced from LINZ under Creative Commons Attribution 4.0 International

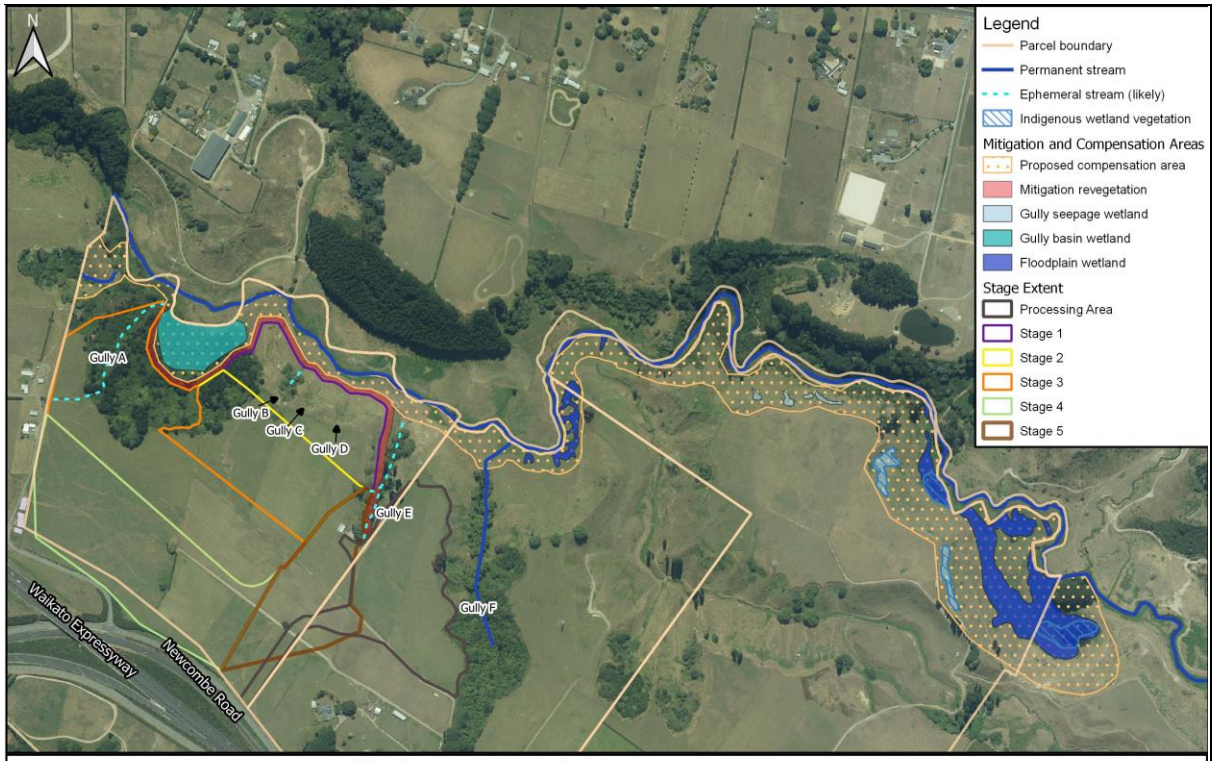

Figure 2. Newcombe Road Sand Quarry - Mitigation and Compensation Areas

Date: 02/10/23
Client: Alliance Ecology Ltd
Project: RS Sands Quarry
Created by Brenda Bartels
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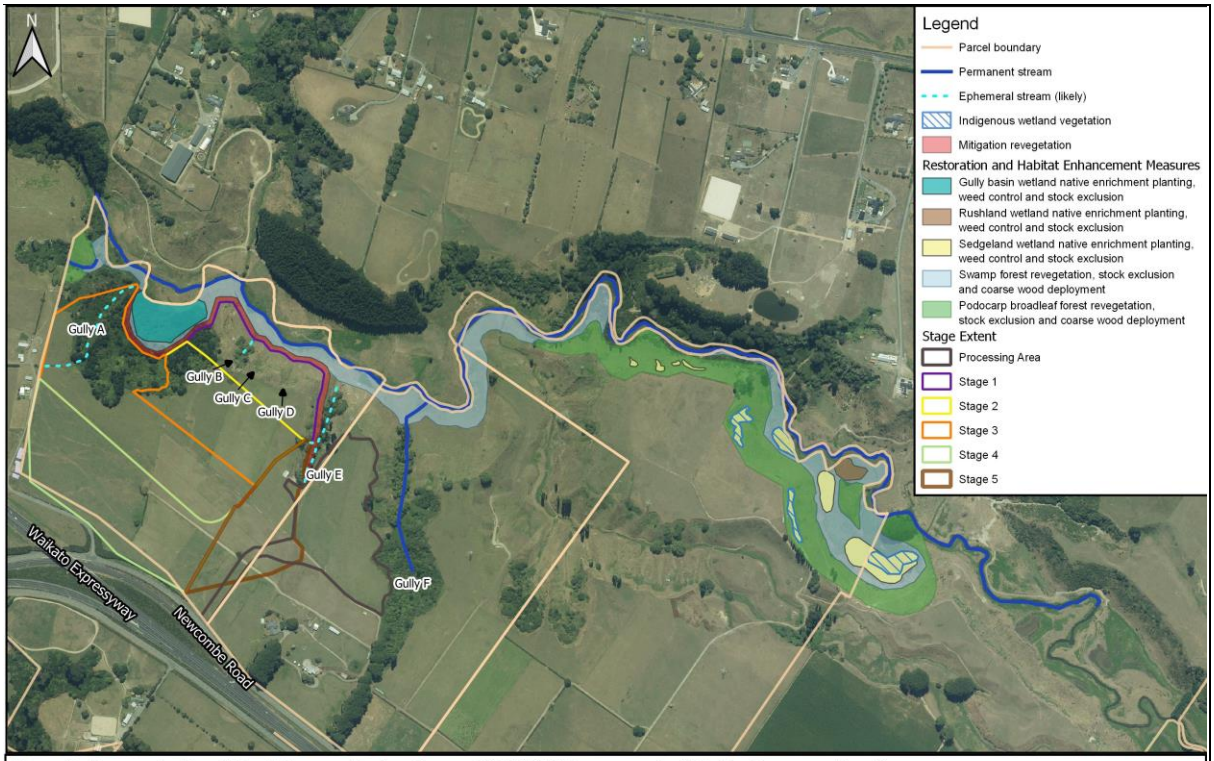

Figure 3. Newcombe Road Sand Quarry - Restoration and Habitat Enhancement within the Compensation Area

Date: 02/10/23
Client: Alliance Ecology Ltd
Project: RS Sands Quarry
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Appendix B: Long-tailed bat management plan

RS Sands

Bat Management Plant
Newcombe Road Sand Mine

Bluewattle Ecology

TABLE OF CONTENTS

Prepared by: Titia Schamhart & Gerry Kessels

Version: Draft 3 – 04/12/2023

PWF Ref: FUL.00601

Front photo courtesy of Department of Conservation Waikato

1 INTRODUCTION

1.1 PURPOSE

This draft Bat Management Plan (BMP) has been prepared to support the draft Ecological Management Plan (EMP) prepared to support the resource consent application for the proposed Newcombe Road Sand Quarry on behalf of RS Sands. It supports and links to the draft Ecological Management Plan (EMP).

The objective of this BMP is to achieve the standards set out in Conditions XX, and to avoid, remedy, minimise or mitigate the potential adverse effects of the project on long-tail bats from the removal of any vegetation and/or trees that are potential bat roost habitat.

1.2 OUTLINE OF THE SITE AND THE PROPOSED ACTIVITIES

It also sets out the required compliance monitoring to ensure effects management has been undertaken in accordance with consent conditions and this BMP

RS Sands plans to establish a sand mine quarry at 77 Newcombe Road, located on the eastern side of Cambridge ('the site' – see Figure 1). The site encompasses a varied terrain, including pastureland, exotic trees, remnants of indigenous forests, scrub, wetlands, gullies, and a stream running along its northern boundary.

The site is located on three records of title which have a total area of 134.67 hectares. The quarry is proposed on approximately 27 hectares in the western portion of the properties. The quarry is made up of a 23 hectare pit area towards the western boundary and a 4 hectare plant area (for processing and stockpiling) to the east of the pit. A 14 ha proposed ecological restoration area is located on the northern boundary of the Site.

The quarry is proposed to extract and process up to 400,000 tonnes of sand from the pit area per year (depending on demand) for approximately 25 years, The proposed plant area includes a processing plant (approximately 6 m high and 20 m wide) towards the middle of the area and a water recycling pond towards the north. Graded sand will be stockpiled around the plant area. The southwestern portion of the plant area will contain an office and breakroom building, maintenance workshop, car parking, weighbridge, and wheel wash facility.

Excavations of the pit area will begin 10-15 m from the Karapiro Stream and move towards Newcombe Road.

The BMP encompasses all construction and operational activities that could potentially have adverse effects on bats and their habitat throughout the construction and operation of the quarry, regardless of the time of year. Specifically, it will be applied to the areas out lined in Figure 1.

Coordination between the quarrying activities, the EMP and the BMP is imperative to minimize the depletion of valuable bat habitat and to prevent any inadvertent harm or mortality of bats. The effectiveness of this BMP relies on safeguarding high value bat habitat and the restoration of ecological corridors. Furthermore, it entails the implementation of specific avoidance design measures during construction, meticulous assessment of locations earmarked for potential bat habitat removal by certified bat ecologists, adaptive management procedures to address unforeseen discoveries like occupied bat roosts, and continuous monitoring of bat activity on the site.

1.3 STRUCTURE OF THIS BMP

The structure of this plan is as follows:

- Habitat requirements and on-site habitat features for bats - section 2
- Bat Roost tree felling protocols – section 3
- Measures required to minimise adverse effect on bats and their habitats from the construction and operation of the quarry - sections 4 & 5
- Residual effects management requirements – section 6
- Monitoring requirements – section 7

1.4 KEY PERFORMANCE STANDARDS

1.4.1 CONSENT CONDITIONS

The consent conditions pertaining to the safeguarding of long-tailed bats and their habitat, as mandated by Section 6(c) of the Resource Management Act 1991, establish the foundation for the requirements of this BMP.

It is expected that this draft BMP will, once finalised, become a requirement of the consent conditions required for the construction and operation of the Newcombe Sand Quarry.

1.4.2 ACCREDITED PROFICIENT BAT ECOLOGIST

Only an accredited proficient bat ecologist (BE - a bat ecologist who has met the essential ethical criteria to be officially recognized as a competent, authorised bat worker by the New Zealand Bat Recovery Group, Department of Conservation for their specific tasks) shall oversee and assist in the implementation of this BMP.

The BE shall be readily available and possess expertise in bat behaviour to oversee quarrying and infrastructure construction activities, offer guidance, and ensure adherence to this BMP.

1.4.3 DEPARTMENT OF CONSERVATION PROTOCOLS

This BMP outlines the procedures to be adopted to minimize, to the greatest extent possible, the risk of harm or fatality to bats throughout the construction and operation phases of the Newcombe Road Quarry Project Site. It also aims to prevent the removal of potential and occupied bat roost trees and safeguard bat habitat.

The protocols for evaluating the potential removal or limbing of bat roost trees follow the most recent edition of the New Zealand Department of Conservation's Bat Recovery Group Protocols, designed to mitigate the risk of unintentionally felling occupied bat roosts (refer to Bat Roost Protocols - Version 2: October 2021, attached as **Appendix I**).

Supervision of potential bat roost trees removal is solely entrusted to an 'Authorised competent bat worker'—a bat worker who has met the necessary ethical standards for registration as a competent, authorised bat worker by the New Zealand Bat Recovery Group, specifically for the tasks they are undertaking (refer to section 1.4.1).

2 LONG-TAILED BATS AND THEIR HABITAT REQUIREMENTS

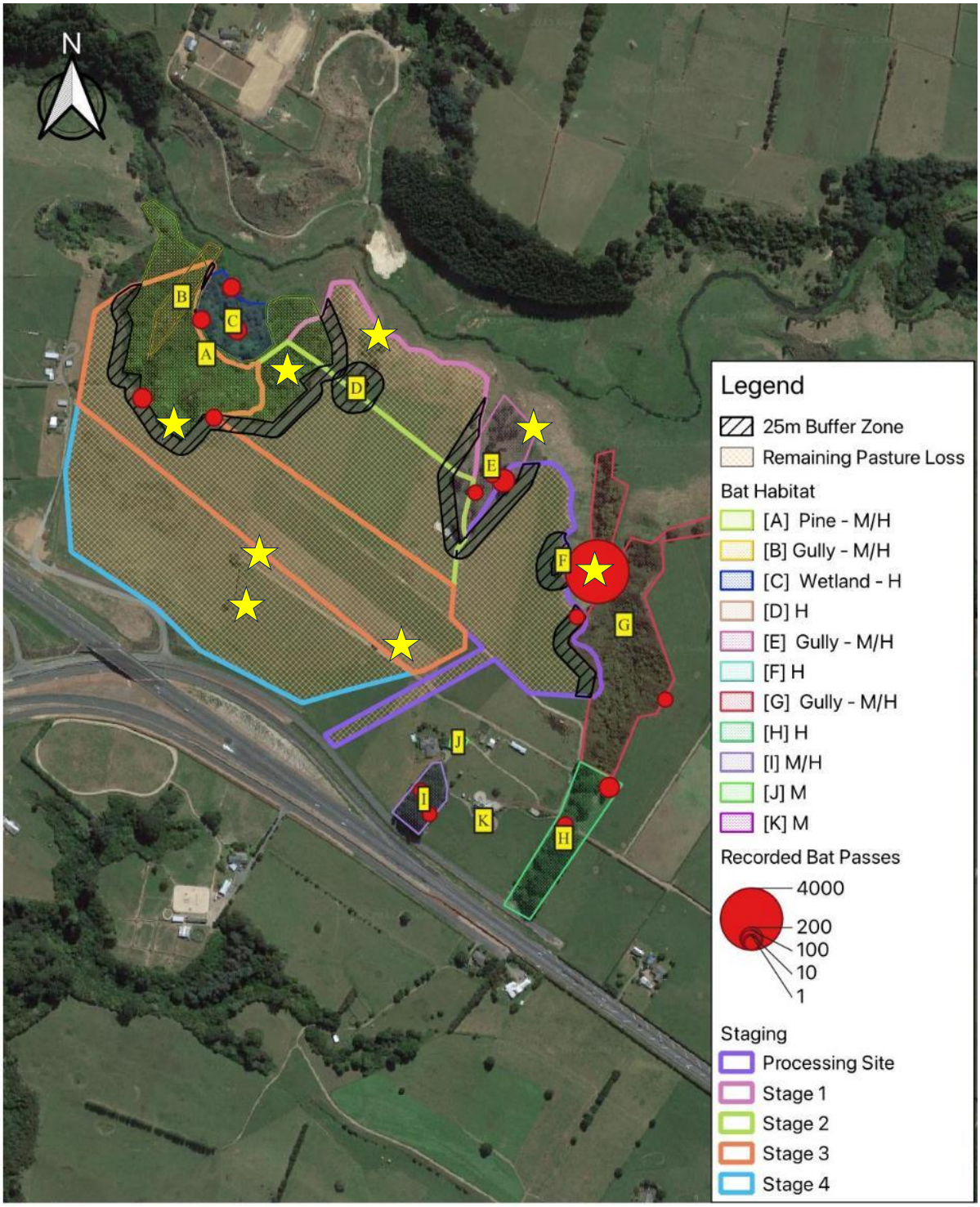
2.1 HABITAT USAGE PROFILE

The long-tailed bat (*Chalinolobus Tuberculatus*), is categorized as Endangered - Nationally Critical[1], and it's threat status is primarily related to the effects of habitat loss and predation by introduced mammalian predators such as rats, possums, cats and mustelids.

Monitoring of potential bat habitat within the quarry site has demonstrated regular and high activity levels, with some areas showing more frequent use by long-tailed bats based on nightly bioacoustic detection rates (Kessels & Kessels, 2020). These bats are aerial insectivores with a specialization in foraging along the edges of woodlands, over water bodies, and above the canopies of vegetation to capture small airborne insects. They have a habit of roosting in both native and exotic trees with knots, loose bark, and other cavities. Long-tailed bats exhibit remarkable mobility, often covering substantial distances between their roost sites and foraging areas. Studies on bat monitoring have highlighted the significance of streams as essential corridors regularly utilized by long-tailed bats for movement within the landscape. The network of incised gully systems, which contains mature native forests, scrublands, treelands, and wetlands within and around the property, acts as vegetated corridors that facilitate bats in navigating their altered environment. These corridors grant access to crucial habitat features such as water bodies and forest remnants. Additionally, these areas are home to several large mature trees with cavity-bearing attributes, which may potentially serve as roosts for bats.

Solitary native and exotic trees, shelterbelts, and groups of exotic trees in this altered environment likely serve as potential bat habitat and could include trees suitable for roosting by bats. It is well-documented that both exotic and native trees are utilized as roosting sites by bats.

[1] O'Donnell, C.F.J.; Borkin, K.M.; Christie, J.; Davidson-Watts, I.; Dennis, G.; Pryde, M.; Michel, P. 2023: Conservation status of bats in Aotearoa New Zealand, 2022. New Zealand Threat Classification Series 41. Department of Conservation, Wellington. 18 p.



Newcombe Road Sand Quarry - Bat Roost & Habitat Mapping

0 100 200 300 400 500 m

Date: 10 November 2023
PWF: FUL00601
Created by: Titia Schamhart
Data sourced from LINZ under Creative Commons Attribution 4.0 International

Bluewattle Ecology

Figure 1: **Staging Plan RS Sands with bat habitat values; M= Medium, H=High; pasture is assessed as having low habitat value; yellow stars denote potential roost tree locations which require pre-felling surveys, and recorded bat passes from the Kessels & Kessels 2020 survey.**

2.2 SUMMARY OF BASELINE SURVEY RESULTS

Baseline bat monitoring data collected between December 2019 to January 2020 and May to June 2020, has been utilized to inform the development of the BMP (see Kessels & Kessels, 2020 for details).

During this period, acoustic bat surveys were conducted using Acoustic Bat Monitors (ABMs), specifically omni-directional 'FC' recorders known as "AR4," provided by the Department of Conservation. A total of twenty ABMs were strategically deployed in suitable habitat across the site (refer to Figure 1 for precise locations) during suitable weather conditions.

A total of **4,868** bat passes were recorded over 61 nights of surveying spread over 2 survey periods.

The results showed that riparian margins of the gully, the plantation forest edges, the lower wetland and riparian margins of the Karapiro Stream, appear to be critical habitat, as bats depend on access to key resources associated with these environments and use the areas as commuting corridors or microclimates to feed where flying insects are in abundance (see Figure 1). These **High & Medium Value Bat Habitat** (HMVH) areas provide:

- Mature exotic and indigenous vegetation within sheltered forest remanets, glades and treeland for roosting purposes (individual trees isolated in open pastureland tend not to be used as roosting even if they exhibit cavity bearing properties);
- Emergent aquatic insect prey (e.g., mosquitoes) for foraging (which can include foraging over areas of open pasture);
- Freshwater for drinking; and
- Linear landscape corridors for movement and navigation.

In addition, open pasture habitat has values where pasture is located 25 m from the edge of HMVBH areas. This 25 m buffer zone has the same value as the adjoining bat habitats because these edges are likely important for commuting and foraging habitats. Open pasture outside of these buffer areas is of low value habitat for bats, primarily because, while used occasionally, in the context of the amount of this habitat type found through the Waikato Basin not near urbanised areas (such as southern hamilton), and because bats being primarily edge habitat users, it is not as valuable.

3 BAT ROOST TREE FELLING PROTOCOLS

3.1 QUALITY ASSURANCE CHECK LIST FOR VEGETATION REMOVAL IN RELATION TO BATS

Quality Assurance and Seasonal Restrictions Check List:

a. **The felling of potential bat roost trees can only be undertaken between 1 October and 31 April.**

b. **The DOC bat roost tree-felling protocols shall apply to all trees ≥15 cm diameter at breast height (DBH), tree ferns and other vegetation that meet the criteria for a potential bat roost defined as a tree which provides features that are able to be used for bat roosting – see Appendix I.**

c. **No trees or associated vegetation identified as potential roosts can be felled or cleared without the prior written approval of the BE.**

d. **Prior to the commencement of surveys, all automated bat monitoring units (ABMs) shall be tested to ensure they are not faulty. If DOC AR4s are used his can be achieved using DOC**

Bat recorder tester v0.1 application or at a site where bat activity is known to be high. Faulty or suspect ABMs are not to be deployed;

e. **Roost habitat assessments can be undertaken at any time of year; and**

f. **Once the results of the visual surveys and ABM data have been reviewed by the BE the following communication procedures shall be implemented:**

   i. **If no bats are sighted or detected, the BE shall call the vegetation clearance supervisor to give permission for the affected tree(s) and/or vegetation to be removed under direct supervision of the BE in accordance with relevant protocols set out in Appendix I.**

   ii. **If bats are sighted or detected, the BE shall call the vegetation clearance supervisor to inform them that the affected vegetation cannot or can be cleared in accordance with the relevant protocols set out in Appendix I.**

3.2 VEGETATION REMOVAL WORK PLAN

The site BE, in coordination with the site engineer and quarry manager, shall be responsible for devising a vegetation removal work plan for each area of vegetation slated for removal or disturbance before quarry activity occurs at each of the four stages.

For any individual tree exceeding 15 cm DBH, whether within or outside of high and moderate bat value areas, an individual tree or tree stand felling plan will be required. This plan should also be integrated into a specific work plan for each corresponding quarrying phase.

The work plan will delineate the monitoring procedures to be executed for the removal of vegetation or trees identified as potential bat roosts. It will also address particular measures and adjustments to infrastructure footprint that aim to avoid or minimize the direct removal of mature trees and High-Value bat habitat to the greatest extent possible.

At a minimum, the work plan shall encompass the following provisions:

- Conducting bioacoustic surveys two weeks before the scheduled removal of potential bat roost trees or High-Value bat habitat to detect bat activity.
- Managing the timing of vegetation removal to fall outside the months when bats go into torpor, thereby reducing potential risks to bats – surveys only permitted between 1 October and 31 April.
- In each work plan, any tree deemed to be a potential bat roost tree shall follow the DOC tree felling protocols detailed in Appendix I
- Potential bat roost trees, as identified during the assessment, shall then undergo pre-felling monitoring in accordance with tree felling protocols. **Figure 2** shows the Decision Tool for Tree Removal. Follow each step of the DOC pre-felling protocols in Appendix I to work through the process.

No trees or vegetation identified as potential roosts can be felled or cleared without obtaining prior written approval from the project bat ecologist.

Potential bat roost trees can only be felled using these protocols between the 1st of October 1 to the 30th of April 30 in any one calendar year.

3.3 IDENTIFICATION OF ROOST TREES

For **all** trees on the site intended for removal or limbing as part of the quarry's construction and operation, having a DBH exceeding 15 cm, an assessment conducted by the BE is mandatory. This assessment aims to determine whether these trees are classified as either High or Low risk potential bat roost trees.

3.3.1.1 HIGH-RISK TREES

In accordance with this protocol, The BE shall determine trees deemed to pose a high risk as potential bat roosts are those with a DBH greater than 15 cm and exhibiting one or more of the following features:

- Cracks, crevices, cavities, or fractured limbs of sufficient size to accommodate roosting bats;
- Sections of loose flaking bark large enough to provide roosting space for bats;
- A hollow trunk, stem, or branches;
- Deadwood within the canopy or stem that is of suitable size to support roost cavities or hollows; and
- Presence of bat droppings, grease marks, or urine staining around cavities or ground.

3.3.1.2 LOW-RISK TREES

Trees with a DBH less than 15 cm, along with trees exceeding 15 cm DBH that do not exhibit the typical features of a bat roost, fall into the low-risk category. These low-risk trees can be felled without the requirement for additional assessment or monitoring.

However, any vegetation displaying signs of roosting bats, such as roost features, droppings, grease marks, or urine staining, must be treated as a potential roost tree. Such trees should undergo a thorough investigation by the BE.

3.4 REPORTING

The outcomes of the bat roost protocol implementation will be documented and reported to the Waipa District Council in the form of a letter or memorandum, demonstrating compliance with the established guidelines. This report will be submitted within 20 working days after the conclusion of vegetation clearance. It will encompass comprehensive information regarding the monitored potential bat roost trees, including their size, location, type, and weather data recorded during the bat roost protocol implementation.

Furthermore, the results of all pre- and post-clearance survey activities will be supplied to DOC for integration into the national bat distribution database, within 20 working days of the data being analysed.

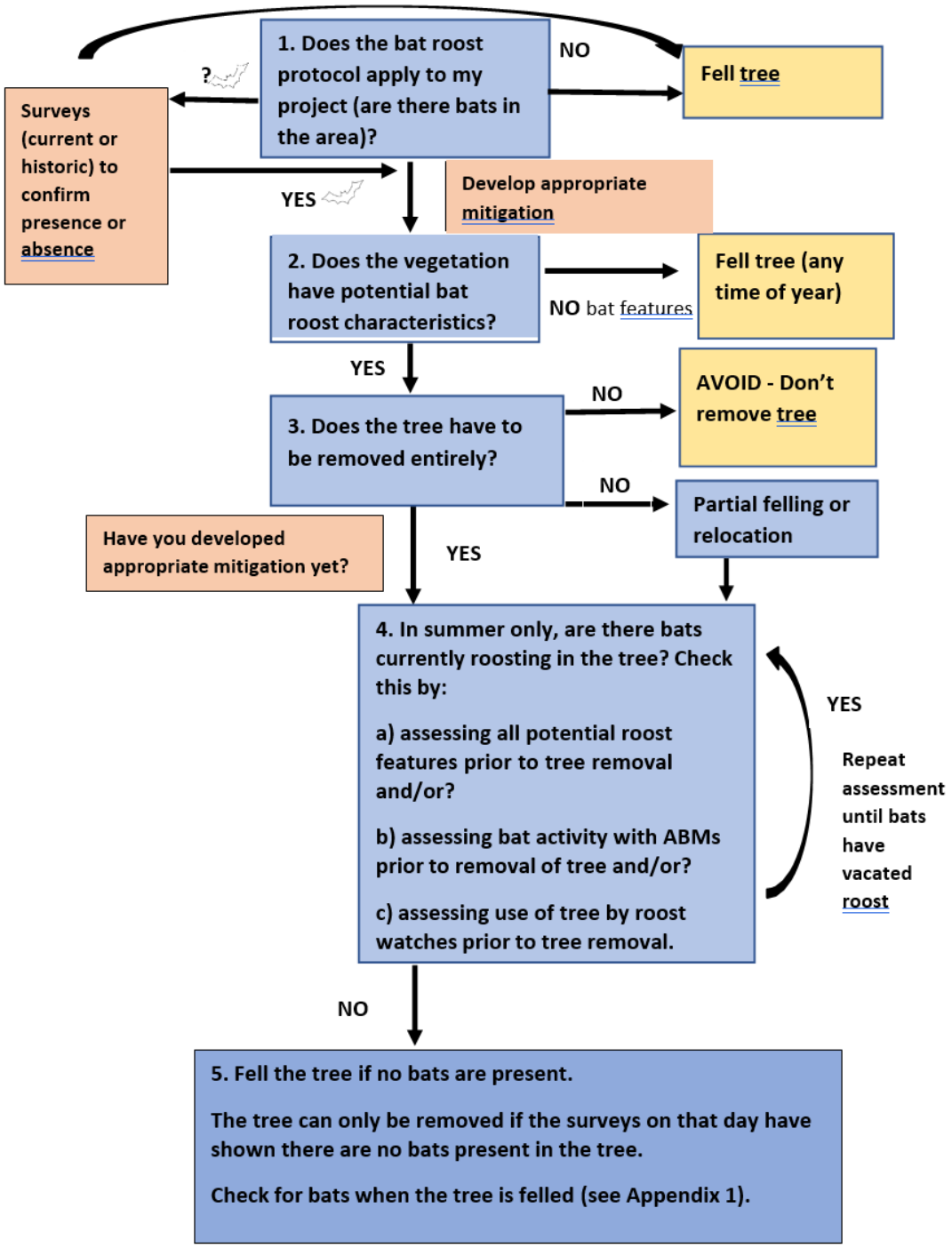


Figure 2 – Decision Tool for Tree Removal

4 MINIMISING DISTURBANCE FROM CONSTRUCTION ACTIVITIES

4.1.1 PRE-CONSTRUCTION SURVEYS

Further bioacoustic monitoring during construction and once the quarry is operational is recommended as well (refer to section 7 for details).

4.1.2 EXCLUSION ZONES

Exclusion zones around identified bat roosts and areas of high sensitivity will be established. Limit construction operations within these zones to reduce disturbances to the bat population. Ensure that these zones are clearly demarcated and communicate their boundaries to construction staff.

4.1.3 TIMING

In the event of a roost site being identified on-site, it will be necessary to plan construction activities to steer clear of critical bat activity periods, including breeding seasons when pups are non-volant (November-December) and during torpor periods (March-October). Alternatively, an exclusion buffer zone of 25 metres can be established.

4.1.4 ALTERNATIVE ROOSTING OPPORTUNITIES

Prior to commencing construction, the establishment of alternative roosting options in close proximity will offer long-tailed bats the chance to roost in alternative areas of the property, away from the construction zones.

A total of twenty artificial roost boxes or similar structures will be installed under the guidance of an experienced bat ecologist in suitable locations to offset any potential loss of roosting sites. For further elaboration, please refer to section 6 for detailed information.

4.1.5 NOISE AND VIBRATION CONTROL MEASURES

Construction operations often produce loud noises and vibrations, which can disturb bats inhabiting roosts unaccustomed to such disturbances.

If an occupied bat roost is discovered on-site, a bat noise minimisation plan will be developed in consultation with an experienced bat ecologist. This plan will outline strategies to mitigate noise effects, which may involve establishing work exclusion zones around occupied bat roosts until they are vacated, installing noise barriers, acoustic curtains, or implementing vibration dampening techniques to minimize the impact on bats near known roost sites.

4.1.6 LIGHTING DURING CONSTRUCTION

Bats are extremely sensitive to artificial light, particularly in the vicinity of their roosting areas. Therefore, it is imperative to reduce artificial lighting near HMVH areas and any active bat roosts encountered during construction. This is to prevent bats from becoming disoriented during their commutes, foraging, or disturbed within occupied roosts.

If construction or security lighting is necessary within 25 metres of a HMVH area or a tree occupied bat roost, a tailored bat lighting control plan will be developed in collaboration with an experienced bat ecologist. This lighting plan will encompass various measures, including defining lighting lux and kelvin level limits within 25 metres of HMVH areas, light source shielding, restricting lighting during periods

of high bat activity, and minimizing the duration of artificial lighting to the greatest extent possible. For additional details and management actions aimed at minimizing bat disturbance from temporary or permanent artificial lighting, please refer to section 5.1.

4.1.6.1 GROUND DISTURBANCE MINIMIZATION

The consent holder shall make deliberate efforts to the greatest extent possible, prevent the trimming or removal of any trees or shrubs within HMVH areas.

If it becomes necessary to remove trees exceeding 15 cm DBH within the construction area the consent holder shall adhere to the protocols detailed in section 3 to minimise the risk of harming bats.

5 MINIMISING EFFECTS OF THE OPERATIONAL QUARRY

5.1 OPERATIONAL LIGHTING

Recent research from New Zealand suggests that artificial light at night (ALAN) may negatively impact the behaviour of long-tailed bats, potentially delaying their use of certain areas and excluding them from foraging habitat (Schamhart et al. 2023). Therefore, a precautionary approach is advisable, drawing on the findings of the New Zealand study and supported by research from Australia and Europe. In areas where ALAN is necessary, it is essential to implement lighting practices that minimize adverse effects on bats. To achieve this, the following standards should be met for artificial lighting emissions measured at the outer edge of a 25-metre lighting buffer around all HMVH areas:

- Utilisation of amber-coloured lighting (2700K, 590 nm).
- A luminosity level of less than 0.3 lux with downward-pointing fixtures.

In the context of the lighting plan, the proposed lighting for the quarry is designed with characteristics such as low intensity, downward-directed illumination, and a low height (typically under 4 metres).

5.2 OPERATIONAL NOISE

Observations have revealed that long-tailed bats have been roosting near both bustling suburban and rural roads as well as within densely populated urban areas for more than a decade. Considering their adaptability to such environments, it is anticipated that any potential increased noise impacts on long-tailed bats resulting from quarry development operations will be minimal. As a result, there is no need for specialized noise management to safeguard HMVH areas in the operational quarry phase.

However, it's important to note that construction-related noises and vibrations may be more pronounced and closer to the HMVH areas. Thus, specific noise control measures may be necessary during the construction period (see section 4.1.5).

6 RESIDUAL EFFECTS MANAGEMENT

6.1 HABITAT RESTORATION & PLANTING

The details for the residual effects management quantum in relation to bats is contained in the Biodiversity Compensation Modelling report and its implementation detailed in the EMP. In summary, residual effects management relates to the loss of 7.74 ha of HMVH areas for long-tailed bats. This includes the permanent loss of approximately 4 ha of pasture buffering the HMVH areas, 3.64 ha of exotic terrestrial vegetation and 0.107 ha of wetland habitat.

Proposed compensation for loss of native and exotic habitat for long-tailed bat includes 14.38 ha of native revegetation of pasture habitat along the Karapiro Stream, with habitat enhancement (artificial roost boxes for bats and bespoke bat roost tree plantings) to account for the temporary loss of the low value pasture habitat areas.

6.2 ANIMAL PEST CONTROL

Research has emphasised the crucial role of managing mammalian predators to enhance the long-term survival of long-tailed bats. The primary focus at this site will be on implementing a targeted method to reduce the risk of animal predators from entering potential artificial and natural roost trees using bands strapped around these trees to reduce mammalian predators from climbing them.

6.3 RESTORATION PLANTING

To enhance roosting conditions for bats within the revegetated areas, the EMP shall incorporate the planting of canopy species known for their cavity-bearing properties, ideally suited for creating roosting opportunities for bats as they mature. These specific tree species have been carefully chosen due to their capacity to offer desirable roosting features, including cavities, crevices, and appropriate microclimates.

By deliberately introducing these species during the revegetation process, the objective is to establish an environment that accommodates bat populations by providing them with suitable locations for resting, breeding, and nurturing their young. The selection of these tree species considers their compatibility with the local ecosystem and their recognized suitability for bat roosting.

Through the integration of these preferred tree species, the restoration efforts aim to attract bats to utilize the newly restored areas, contributing to the long-term conservation of bat populations.

When the trees reach a cavity bearing age, they will require banding to restrict access by mammalian predators.

6.4 REPLACEMENT OF POTENTIAL BAT ROOSTS

This section outlines the procedures for their replacement bat roost trees are either removed or trimmed during the construction and operation of the quarry. This entails the establishment of appropriate alternative roosting habitats within the Site or in adjacent areas, following the recommendations provided by the BE.

6.4.1 CREATING NATURAL BAT ROOSTS

To mitigate the impact on potential bat roost trees resulting from vegetation clearance, mitigation measures may involve relocating and recreating natural bat roosting habitat to compensate for the removal or trimming of high-risk potential bat roost trees. The selection of trees for relocation will consider factors such as the quality of roost features, the tree's condition, and the likelihood of a successful relocation. Examples of these trees and structures are provided in **Appendix II**.

Trees chosen for relocation will undergo careful trimming and cutting to preserve existing bat roost features before being transplanted to areas designated for indigenous vegetation restoration. These trees will be strategically dispersed, vertically secured, and stabilized using steel rods to ensure long-term stability and potential roost habitat. It is acknowledged that artificially "re-planting" wildlife trees may impact the rate of decomposition and roost feature degradation. However, relocated roost trees are expected to serve as temporary "bridge habitat" between vegetation removal and the gradual development of newly planted specimen trees, which will ultimately replace the current stock of high-risk potential bat roost trees.

In cases where entire trees cannot be relocated, roost features will be carefully removed and affixed to suitably sized trees within the riparian margin. The relocation or re-planting of potential roost trees will adhere to DOC's Protocols for minimizing the risk of felling bat roosts.

An experienced team comprising a bat ecologist and an arborist will be responsible for executing the relocation and creation of natural roosting habitat as required.

6.4.2 ARTIFICIAL ROOSTS

To address the loss of roosting habitat resulting from vegetation clearance in areas with high-risk bat trees, a plan is in place to deploy temporary artificial bat roost boxes as an interim solution. These roost boxes will serve as short-term replacements until the newly planted approved trees have matured sufficiently to provide suitable roosting sites.

Strategic placement of these artificial bat roost boxes will be prioritized, with a focus on locations within 150 metres of waterways or wetlands. A survey will be conducted to determine the specific number of artificial bat boxes required, tailored for long-tail bats. Installation of these artificial bat roosts will be carried out before the removal of any high-risk bat trees. They will be mounted on suitable trees at a minimum height of 10 metres, ensuring a clear space of 2 metres around the roost opening. Additionally, predator bandings will be wrapped around the trunk of each tree hosting an artificial bat roost, both above and below the roost, to deter mammalian predators.

For a minimum duration of 5 years following the installation of these artificial bat roosts, an annual inspection will be conducted. The purpose of this inspection is to assess signs of occupancy, perform necessary cleaning, and make any required repairs to ensure the artificial roosts and predator bands remain in optimal working condition. Subsequently, an annual report will be compiled and submitted to the council, offering detailed information regarding the rate of utilization of the roosts.

7 MONITORING REQUIRMENTS

7.1 FREQUENCY OF ANNUAL BIOACOUSTIC MONITORING

Bioacoustic monitoring events will be conducted across the entire site at specific intervals at the same locations undertaken during the baseline surveys (see Figure 1). They shall be in addition to any bioacoustic required for tree felling (as required by the tree felling protocol – see section 3). These events shall be as follows:

- At the onset of the construction phase
- Once during the construction phase, and
- Annually, for a period of five years once the quarry is fully operational.

The surveys will be conducted between January and march of each calendar year the surveys are scheduled.

7.2 BIOACOUSTIC SURVEY PERFORMANCE STANDARDS & METHODOLOGY

The bat surveys shall, as a preference, utilise type 'AR4 'automatic bat monitors (ABMs) manufactured by DOC. Other brands and types, with prior written approval of the BE, can be used, as long as the same type of bat detector is used consistently throughout the operation of the sand quarry.

Long-tailed bat activity is influenced by nightly weather conditions, including temperature, rainfall, wind speed, and moonlight. To ensure standardized data collection, unfavourable weather conditions will be excluded from the analysis. For this survey, suitable conditions are defined as follows:

- The air temperature must not drop below 7°C from sunset until four hours after sunset (O'Donnell 2000, O'Donnell and Sedgeley 2012).
- Rainfall should not exceed 2.5 mm/h during the first four hours after sunset .
- The wind speed should not exceed 5.6 m/s (Smith et al. 2017).
- Surveys should avoid full moon nights and those within one night of a full moon.

Hourly weather data for the survey period will be obtained from the nearest available weather station in New Zealand's National Climate database. All ABMs will be synchronized with the same date and time settings and programmed to monitor from one hour before sunset to one hour after sunrise. Data from all ABMs will be downloaded, and acoustic data from all survey nights will be analysed using BatSearch 3.12 or a similar tool.

The detectors will be hung on trees, preferably at a height of at least 2m above the ground (greater in areas with public access) to prevent interference from foliage or branches. Minor foliage clearance around the detector is acceptable.

Surveys will be conducted annually during the same period every year, within an eight-week window to accommodate varying weather conditions, moon phases, and equipment performance. This survey period needs to be similar for several reasons, including alignment with the bat life cycle, peak bat activity due to young bats leaving the roost, consistent weather conditions, high insect activity, and alignment with previous on-site surveys.

Detectors will be deployed for a minimum of 14 nights, with a goal of achieving at least 12 clear-weather nights for all detectors, which is in line with best practice (Mueller et al. 2021). In cases where

a detector fails to record or encounters issues resulting in less than 12 fine-weather nights, that specific location will be resurveyed within the eight-week survey period to ensure a total of 12 fine-weather nights.

Data collected during the surveys will be summarised to provide the mean (± SE) of bat activity per night, the temporal distribution of bat activity throughout the night (with mean ± SE), the total number and percentage of identified feeding calls, and the total number and percentage of identified social calls.

7.3 ADDITIONAL MONITORING OF OCCUPIED BAT ROOSTS

If an occupied roost site is identified during the pre-felling surveys, the particular roost site will necessitate continuous monitoring, as outlined in section 3 and detailed in the DOC protocols attached as **Appendix I**. This monitoring may include the use of bioacoustics and/or thermal imaging techniques, along with the involvement of a certified bat dog and its handler.

7.4 ARTIFICIAL ROOST BOX OCCUPANCY INSPECTIONS & MAINTENANCE

Artificial roost boxes are scheduled for annual occupancy inspections in December, which coincides with the time when non-volant young bats are most likely to be present. These inspections shall be conducted by the BE.

Maintenance tasks are planned to occur between May and October, with at least one maintenance inspection to be carried out during this period. This additional inspection is separate from the annual occupancy checks. This maintenance schedule is designed to avoid times of the year when female long-tailed bats are potentially heavily pregnant or when dependent, non-volant young bats may be present.

In cases where urgent maintenance requirements are identified during the December occupancy survey, the BE will need to verify whether bats are present before proceeding with the maintenance.

7.5 ANNUAL BIOACOUSTIC MONITORING REPORTING

Reports summarising the results of bat monitoring and artificial roost inspections will be prepared by suitably qualified ecologists, who must demonstrate competence in both bat ecology and habitat restoration. These reports will be submitted annually to the Council within two months of survey completion, which typically means they will be provided in May or June each year.

The report should encompass the following information:

a. Bat monitoring data, analysis, and observation findings.
b. Any on-site observations made in response to potential avoidance behaviour identified, along with any issues that have been resolved or are planned for resolution if they are detectable.
c. The outcomes of the artificial roost box inspections carried out during the preceding December and the maintenance inspections from the previous year.
d. Information regarding any injured or deceased bats discovered since the last bat monitoring report.

In addition to the above data, the report should include an assessment of:

e. Whether bats are actively moving across the site and any potential barriers to this movement that have been identified.
f. The trends in bat activity compared to previous years.
g. Patterns of artificial roost box occupancy, with a focus on emerging trends in preferred locations and aspects.
h. Any recommended changes to the BMP or other related management plans, including:
i. Adjustments to the monitoring methods and/or frequency.
    I. Modifications to artificial lighting.
    II. Modifications or additions to vegetated plantings.
    III. The installation of temporary physical barriers (e.g., brush hedging or similar) to enhance vegetated buffers.
    IV. Intactness and any maintenance of the predator control bands ion artificial and natural roost trees.

8 REVIEW AND REPORTING

The BMP will undergo an annual review and will be adjusted as needed to accommodate any changes in the construction schedule, design, or the operational status of the quarry.

Any necessary amendments or reporting requirements will be conducted in compliance with the relevant consent conditions for reporting to Waipa District Council as specified section 3.4 and 7.5 of this BMP.

Furthermore, in addition to the reporting requirements for Waipa District Council, the results of each annual bioacoustic survey will also be submitted to DOC for inclusion in the national bat distribution database.

As outlined in Section 3.4, the outcomes of the bat roost protocol implementation will be reported to both Waipa District Council in the form of a completion/compliance report, typically delivered as a letter or memorandum. This report will be submitted within 20 working days following the conclusion of vegetation clearance and will encompass specific details regarding the potential bat roost trees that were monitored. It will include information about the size, location, and type of these potential roost trees or vegetation, as well as weather data recorded during the implementation of the bat roost protocol.

APPENDIX I TREE FELLING PROTOCOLS

Protocols for minimising the risk of felling bat roosts

(Bat Roost Protocols (BRP))

Version 2: October 2021 approved by the New Zealand Department of Conservation's Bat Recovery Group

The use of these protocols should be a final step in the avoid/remedy/mitigate hierarchy. Avoidance of felling bat roost trees should be the first step in any project.

Purposes of this document:

1. To outline why protection of roosts is important for the persistence of New Zealand bats and why removal of known and potential roosts should be avoided.
2. Where roost removal cannot be avoided, to set out the minimum requirements and protocols for removing trees in areas where bats are present, to minimise the risk of killing bats.

This protocol does not eliminate the risk to bats of death or injury because bats or active bat roosts can be missed. The best way to eliminate risk of felling an active roost is to avoid felling any known or potential roosts.

Context

The status of New Zealand bats

New Zealand's two extant bat species (pekapeka) are classified as threatened.

Long-tailed bats are classified as 'Nationally Critical' because the species is likely to have a 70% decline in numbers within three generations.

Lesser short-tailed bats comprise three subspecies. The northern subspecies is classified as 'Nationally Vulnerable' because there are 1000-5000 mature individuals and the predicted decline in numbers is 10-50% within three generations. The central subspecies is 'Declining' because there are 20 000-100 000 mature individuals, and the predicted decline is 10-50% within three generations. The southern subspecies is 'Recovering' because there are 1000-5000 individuals, and the predicted increase is >10% within three generations.

Threats to bats

This document deals specifically with roost protection; however, roost protection is only part of the wider issue of habitat loss. Habitat loss through land clearance, habitat degradation, fragmentation and disturbance and loss of roosts reduces roosting, foraging and socialising areas. Individual bats and colonies are also threatened by the local felling of individual trees.

Bats have large home ranges which can include unprotected peri-urban habitat. Protecting habitat and maintaining connectivity of vegetation are crucial for bats being able to persist and flourish in the environment.

Predation and competition by introduced predators: mustelids, rats, cats, and possums have all been implicated in the decline of bats[1].

Roosts are critical to the survival of bats

Roosts are where bats gather to shelter during the day and at night. They are used to socialise, mate, give birth, and raise young. Bats have very specific requirements when they are choosing roosts and are not just choosing any

[1] O'Donnell CFJ; Christie JE; Hitchmough RA; Lloyd B; Parsons S 2010. The conservation status of New Zealand bats, 2009. New Zealand Journal of Zoology 37: 297– 311.

tree[2]. The specialised features of roosts make them rare and almost irreplaceable in any landscape or habitat type except over very long-time frames. People sometimes falsely suggest that "bats can just move to another tree". This is not the case, particularly where trees suitable as roosts are limited[3].

Bats demonstrate high site fidelity to existing roosts and their specific roosting areas, and they move on a rotation among these. Because roost trees are likely to be rare, and are occupied to fulfil specialised requirements, felling breeding roost trees even when bats are absent will have a significant negative effect. If the number of suitable roosts and their surrounding habitat is reduced in the landscape, bats are forced to use roosts that are less thermally efficient. This means they will use more energy to survive, resulting in reductions in survival and lower reproductive success. In this way, roost removal is likely to result in higher risk of local extinction.

Bats can roost in native or exotic vegetation – therefore it should not be presumed that exotic species such as pine trees will not support bats. Roosts, including maternity roosts, have been found in many exotic species including, but not limited to, pine, poplar, oak, and acacia species, black locust, willow, eucalyptus and Tasmanian blackwoods.

Bats are at risk of being injured or killed when trees are felled

If a tree is felled with a bat in it, it is highly likely that the bat will be injured or killed, although this may not be apparent at the time because injuries, such as bruises and fractures, which would hinder bats' ability to fly well, may take time to be obvious.

The highest risk of injuring or killing bats or trapping them within their roosts is when they are heavily pregnant, when young are still dependent on the roost (late November – February) and when bats are more likely to be in torpor (May – September). Heavily pregnant bats are slower and less agile, and young bats cannot fly, so their chances to escape are reduced when roost trees are felled. Also, it is possible that if the larger female-dominated maternity roosts are cut down when females are raising their young to independence (October-March), a whole colony of bats could be destroyed at one time.

During winter bats use torpor (a type of hibernation) more often than during other times of year, so if trees are cut down in winter, bats may be unable to rouse from torpor and to fly away in time to escape. Additionally, it is significantly harder, sometimes impossible, to detect bats roosting in trees during torpor. For these reasons, trees with potential bat roost features must not be cut down in winter. Bats also use torpor for short periods during summer, for example, if the weather gets cold, so the risk of killing or injuring bats that cannot escape falling trees exists at any time of the year.

Bat roost protocols and the RMA

The occurrence of bats and bat habitat is a matter of 'significance' under Section 6(c) of the Resource Management Act (RMA). Bat roost protocols have become a standard part of bat management plans that may be required under RMA consents. Where developments require consents, and bats (a threatened species) are present, the developments should 'Avoid' impacting bats and bat habitat. Bat roost protocols only attempt to minimise the number of bats killed by tree felling, therefore implementing bat roost protocols where bats are present should be considered a last resort after following the RMA hierarchy of "avoid, remedy, mitigate, offset, compensate".

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[2] Whilst we use the word tree frequently in this document, we acknowledge that bats also use non-tree vegetation as roosts and the terms tree and vegetation should be considered as interchangeable in the context of this document. We acknowledge that there are also non-vegetation roosts that are used and require protection. These include rocky bluffs, caves and occasionally buildings.

[3] Many references available, for example, Borkin KM; Parsons S. 2011. Sex-specific roost selection by bats in clearfell harvested plantation forest: improved knowledge advises management. Acta Chiropterologica 13(2): 373-383; Borkin KM; O'Donnell CFJ; Parsons S. 2011. Bat colony size reduction coincides with clear-fell harvest operations and high rates of roost loss in plantation forest. Biodiversity and Conservation 30; Sedgeley JA; O'Donnell CFJ 1999b. Roost selection by the long-tailed bat, *Chalinolobus tuberculatus*, in temperate New Zealand rainforest and its implications for the conservation of bats in managed forests. Biological Conservation 88:261–276; Sedgeley JA; O'Donnell CFJ 2004. Roost use by long-tailed bats in South Canterbury: Testing predictions of roost site selection in a highly fragmented landscape. New Zealand Journal of Ecology 28:1-18.

This protocol has therefore been framed following the RMA hierarchy by first focusing on the avoidance of effects, helping to identify and avoid the removal of roost trees, and to minimise the risk to bats of death or injury if avoidance is not possible. This approach is usually informed by gathering data on bats in the local areas and seeking advice from a competent bat ecologist.

Identifying and protecting *both active and inactive (i.e., trees used by bats at other times of year) roosts* by avoiding their removal is an important step in supporting the survival and persistence of bats.

Bat roost protocols and the Wildlife Act 1953

NZ bats are absolutely protected species under the Wildlife Act 1953. It is an offence to catch alive or kill, hunt, possess, molest, or disturb bats under the Act. Any projects where tree or vegetation removal overlaps with the occurrence of bats, there is a risk of killing or injuring any bats that may be present. Following the bat roost protocols minimises the chance of killing or injuring bats.

Bat roost protocol

When and how to use the protocol

Whenever vegetation removal is proposed in areas where bats are potentially present and where their habitat may be impacted, follow the decision tree (Figure 1) below as a guide to what sort of action should be undertaken. The decision tree is designed firstly to avoid felling bat roost trees, secondarily aimed at moving roost trees, and only if unavoidable, felling roost trees (but only once vacated).

None of the methods of inspecting roosts described below eliminates the risk of failing to identify bats when they are present. Therefore, techniques such as filling in cavities with expandable foam are not supported as a tool. This is because there is a risk of trapping bats that have not been detected within cavities. In addition, this method removes roosts from the landscape that bats are dependent on.

Definitions

Competencies: a set of competencies developed by the NZ Bat Recovery Group[4] to ensure that anyone working with bats is competent to do so. Contact bathandler@doc.govt.nz for a list of competencies and requirements to become an authorised competent bat worker.

Competencies referred to in this document:

2.1 Bagging storage, handling, measuring, weighing, sexing, aging, temporary marking and releasing appropriately:
For long-tailed bats: 50 individuals
For short-tailed bats: 50 individuals

3. High risk activities – Roost felling (all of these competencies include the understanding of what to do when bats are found during tree felling as per Appendix 6 of 'Initial veterinary care for New Zealand Bats' https://cdn.ymaws.com/www.nzva.org.nz/resource/resmgr/docs/other_resources/Initial_Vet_Care_NZ_Bats.pdf)

3.1 Assessing roost tree use using Automatic Bat Monitors - Demonstrate correct timing, placement, and interpretation of data for 10+ times according to DOC's Tree Felling Protocols.

3.2 Undertake roost watches/emergence counts at 10+ occupied roosts where the entrance is visible.

3.3 In at least two different forest/habitat types, including the forest/habitat type where trees are going to be assessed: evaluate 10+ potential roost features in trees (e.g., cavities, peeling bark, epiphytes).

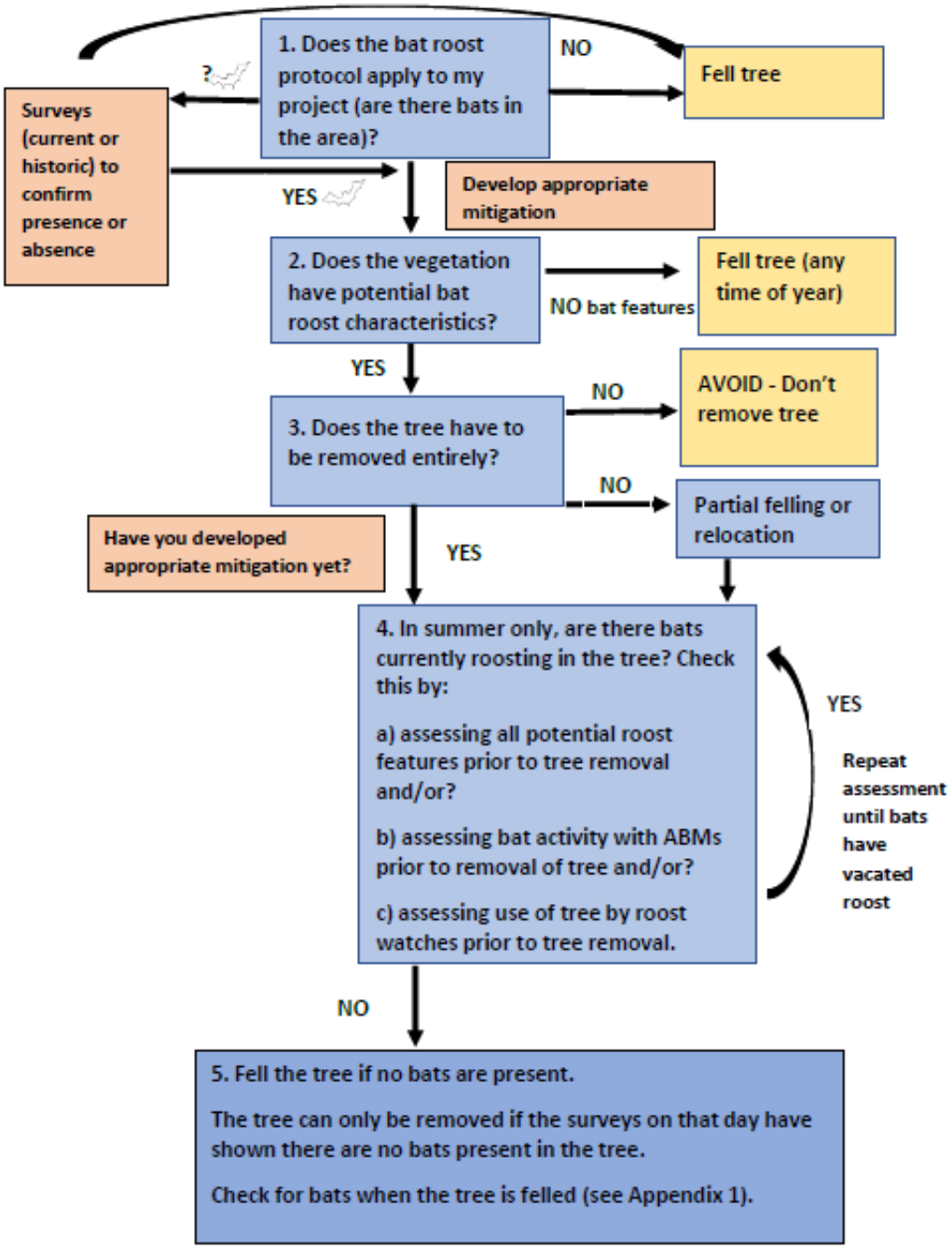
Authorised competent bat worker: A bat worker who has met the required ethical standards to be registered as a competent, authorised bat worker by the New Zealand Bat Recovery Group for the work which they are undertaking.

ABM: automated bat monitoring unit/detector

[4] A group of bat specialists that advise on bat issues and assess bat competencies

Figure 1. Tree removal in bat areas flow chart

Each numbered step relates to a step in the Decision Tool for Tree Removal. Follow each step fully in the text to work through the process.



Mitigation/compensation

If trees are felled and habitat lost, then compensation measures should be considered to address the adverse effects. What these measures should be is beyond the scope of this document. Provision of artificial roosts in the short-term and planting for the long-term are some of the methods commonly used in development projects, but their effectiveness is untested and a future research need.

Step 3. Does the tree have to be removed entirely?	Response	Who can make this assessment?	When?
a) Is the only option to remove the tree entirely?	If yes, continue to step 4 If no, consider leaving the tree in place, cutting off specific limbs only or relocating the tree. If any felling, partial felling (where the part to be felled has potential bat roost features) or tree relocation takes place you **MUST** proceed to step 4. If a roost (active/inactive) is confirmed, then advice should be obtained at a project level in writing from DOC before proceeding.	Project leader	Any time

Notes for Step 3

Trees must only be relocated when bats are absent and when standard automated bat monitoring unit (ABM) weather conditions are met (see notes section 4b for appropriate weather conditions), and in consultation with an authorised bat ecologist with all competencies of level 3: 'High risk activities – Roost felling'.

Step 4. Are there bats currently roosting in the tree? (Follow a or b or c or a combination)	Response	Who can make this assessment?	When
a) Are potential features being used by roosting bats? A tree climber may be required to check all features (see notes for 4a below). If roost is occupied repeat 4a another day until roost is vacated.	If yes, **THE TREE MUST NOT BE FELLED UNTIL BATS HAVE VACATED IT.** If no, the tree can be removed on the day of the tree inspection following step 5. If bats continue to use the roost, then the tree must not be cut down until the bats leave the roost. At this point re-consider again whether this tree must be felled. Advice must be obtained at a project level in writing from DOC prior to felling the tree.	An approved person at Competency Level 3.3 or an experienced tree-climber (e.g., an arborist) working with an approved person at Competency Level 3.3. If the latter, the tree climber must provide information along with photographs or video footage, to the approved person at Competency Level 3.3 who assesses and decides whether the tree can be removed. If roosts are known or confirmed through this process, then this information must be communicated to the nominated DOC bat ecologist for this project.	October 1st to April 30th when the temperature is 7°C or greater at official sunset in the South Island or 10 °C or greater in the North Island.
b) Is bat activity recorded at any time during two consecutive, valid survey nights preceding tree felling[13]? At least two nights are required as it is possible for bats to enter or leave a roost without echolocating, or to not leave the roost for a night.	If yes (bats are detected), survey must continue on subsequent nights[14] until no bat activity is recorded for two consecutive nights (to indicate bats have left the area) prior to felling. **OR** roost features of each tree must be visually assessed via climbing as in 3. If bat activity is consistent in the area and 2 nights with zero bat passes cannot be obtained, Go to 4c or 4a. If no bats are detected for two consecutive nights, the vegetation can be removed on the day immediately following the survey nights using the method in 5.	An approved person at Competency Level 3.1	October 1st to April 30th and when conditions meet the requirements for standard ABM weather conditions (see 4b notes).
c) Are bats observed entering the vegetation? This involves watching vegetation to identify bats returning to or exiting roosts. It should only be used in combination with previous ABM monitoring (4b) (see notes 4c for method). At	If yes (bats are seen at either watch), it is a confirmed roost. Removal of a roost should be avoided to minimise effects	An approved person at Competency Level 3.2[15].	Between October 1st and April 30th only **AND** when weather parameters meet

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[13] Le Roux et al (2013) found that in and around Hamilton "The longest consecutive monitoring period without bat detections at each site was three nights during winter." Le Roux et al 2013. New Zealand Journal of Zoology (2013): Spatial and temporal variation in long-tailed bat echolocation activity in a New Zealand city, New Zealand Journal of Zoology, DOI: 10.1080/03014223.2013.827125.

[14] Subsequent nights may be those immediately following bat detection or later dates.

[15] If more than one person is required for a roost watch at a tree, a minimum of one approved person at Competency Level 3.2 must be present on site for the duration of the roost watch to supervise.

least two nights are required as it is possible for bats to enter or leave a roost without being detected, or to not leave the roost for a night.	of vegetation removal on bats. Techniques used previously to ensure previously active roosts are no longer active have included the following: Watches must continue on subsequent nights until no bats are observed entering or exiting the roost for two consecutive nights (to indicate the roost is no longer active) prior to felling. If no bats are observed entering or exiting for two consecutive nights, the vegetation can be removed on the day immediately following the survey nights using the method in 5.		the roost watch requirements.

Notes for Step 4.

4a) Tree climbing and inspection

Care must be taken while climbing trees to avoid disturbing, removing or destroying tree features with bat roost potential such as sections of loose bark or cavities in dead wood. Using mobile elevated platforms can be a good option. Bats are less likely to be active over colder periods, so climbing to check whether bats are present in potential roost features must take place between October 1st to April 30th when the temperature is 7 °C [16] (South Is) or 10 °C (North Is) or greater at official sunset on the night previous to inspection.

A tree climber may be required to check all potential bat roost features:

- Can bats be seen? An endoscopic camera should be available for this step and every possible corner of each potential roosting feature inspected, i.e., cavity/crack etc. Cracks, holes, and splits may lead to cavities or may be superficial. A cavity may be wet indicating no/low potential as a bat roost.

[16] O'Donnell CFJ 2000. Influence of season, habitat, temperature and invertebrate availability on nocturnal activity of the New Zealand long-tailed bat (*Chalinolobus tuberculatus*). New Zealand Journal of Ecology 207-221.

- Can bats be heard? Search of tree features should be accompanied by use of a hand-held bat detector. If bats are present and not in torpor, then detection of presence listening at 25 kHz (for social calls) and 40 kHz (for echolocation calls) may help to determine if long-tailed bats are present. Short-tailed bat social calls are often audible or detected at 25-27 kHz.
- Is guano present or urine staining?

4b) ABM survey work

Bat activity is to be recorded using ABMs. Location of ABMs must provide sufficient coverage to be able to determine if bat roosts are present in one or more of the trees[17]. 'Valid' survey nights must have the following features:

- Begin one hour before official sunset and end one hour after official sunrise.
- Temperature 10°C or greater for the first four hours after official sunset time for the North Island and 7°C for the South Island[18].
- Precipitation < 2.5 mm in the first 2 hours after official sunset, and < 5 mm in the first 4 hours after official sunset.

Prior to the commencement of surveys, ABMs must be checked for correct operation at a site where bat activity is known to be regular, or by using the DOC – Bat Recorder Tester (Tussock Innovation Ltd) phone app made for this and available from Google Play Store. Faulty or suspect ABMs must not be deployed, and ABMs must be redeployed if faults occur.

4c) Roost watches

The following weather conditions define a valid night for roost watches:

- Temperature greater than 10°C all night between official sunset and sunrise for the North Island and 7 °C for the South Island.
- Precipitation < 2.5 mm for each two-hour period between official sunset and sunrise

Roost watches should include the deployment of ABMs and analysis of data for the night of the roost watch.

Emergence watches

- Each tree must be watched initially from sunset until it becomes too dark to see by sufficient people to observe all potential exit points. This must be supported by the use of handheld detectors. The aim of emergence watches is to identify potential roost locations within the vegetation. Infra-red and thermal imaging cameras may be useful in this process.

[17] Department of Conservation-manufactured AR4 bat detectors are considered likely to detect long-tailed bats only over short distances i.e., up to 30-60 m distant from the detector (S. Cockburn, Department of Conservation, pers. Comm.). This is similar to detection distances of other detector types.

[18] South Island temperatures are based upon O'Donnell (2000) as above. North Island temperatures are based on data collected in Kinleith plantation forest, centred around Tokoroa, Central North Island; Smith D, Borkin K. 2017. Appendix B: Influence of climate variables on long-tailed bat activity in an exotic conifer plantation forest in the central North Island. P 136-145. In: Smith, D, K Borkin, C Jones, S Lindberg, F Davies and G Eccles (2017). Effects of land transport activities on New Zealand's endemic bat populations: reviews of ecological and regulatory literature. NZ Transport Agency research report 623. 249pp.

Roost re-entry watches

The time when bats return to roosts can vary based on temperature and time of year.[19,20]

- Observers must then return the next morning and watch the tree to determine whether bats return to the vegetation.
- Roost re-entry watch timing should be based on patterns of activity recorded onsite with ABMs, i.e., as a guide watches should begin two hours prior to when the last passes were recorded on the ABMs on previous nights and finish one hour after official sunrise time. Where this information is not available and at minimum, watches shall begin two hours prior to official sunrise until one hour after sunrise. Infra-red and/or thermal imaging cameras may be useful as a supplementary tool in this process.

The methods above (Climbing and inspecting; ABM use and roost watches) can be implemented as in steps 4.

If bats are sighted, or sign detected, or a roost (active/inactive) is confirmed, the approved bat ecologist, as soon as possible, shall:

- Call the tree felling supervisor to inform them which affected tree(s) cannot be felled due to detection of bat sign.
- Send an email to the site manager, and a bat ecologist representing the council and DOC detailing the results of the survey and outlining the measures for protection or relocating the roost tree.
- A record (including photos) of any vegetation containing bat roosts shall be kept detailing the date; size, location and species of tree or other vegetation; roost type, e.g., cavity, peeling bark, broken branch; detail outlining how presence of bats was confirmed; the number of bats present; and species present, if known.

Step 5. Fell the tree if no bats present	**Response**	**Who can make this assessment?**	**When**
NB: Vegetation removal must take place on the day of tree inspection or the day immediately following night surveys that confirm that there are no bats present.			
a) If you have undertaken a visual inspection of the vegetation (following step 4a, then the vegetation can be removed **ONLY ON THE DAY OF INSPECTION** and meets the valid weather conditions (defined in notes 4c) at official sunset the day prior to inspection. If you have undertaken ABM surveys or roost watches 4b or 4c the vegetation can be removed **ONLY ON THE DAY IMMEDIATELY FOLLOWING SURVEY COMPLETION** (i.e., if the survey ends in morning the tree can be felled the same day only).		People who are familiar with the document shown in footnote[21], and physically able to check/inspect tree for signs of bats once felled.	When the inspection method chosen allows.
Trees must be inspected for signs of bats once felled and before removing from the site, if safe to do so. Follow Appendix 1 if bats are detected during vegetation removal.			

[19] Dekrout AS 2009. Unpublished PhD thesis. University of Auckland, New Zealand Pp 168.
[20] Griffiths R. 2007. Activity patterns of long-tailed bats (Chalinolobus tuberculatus) in a rural landscape, South Canterbury, New Zealand. New Zealand Journal of Zoology, 34:3, 247-258, DOI: 10.1080/03014220709510083.
[21] https://cdn.ymaws.com/www.nzva.org.nz/resource/resmgr/docs/other_resources/Bat_Care_Advice.pdf

Appendix 1. If bats are detected during tree relocation or removal

NB: Vegetation removal must take place on the day of tree inspection or the day roost watches or two consecutive nights of ABM data have confirmed that there are no bats present. If practical, trees are to be inspected for signs of bats once felled and before removing from site. People inspecting trees should be familiar with the Bat Care Advice document shown in footnote[22] and able to check/inspect tree for signs of bats once felled.

If during the felling of a tree bats are detected, felling of that tree must stop immediately if safe to do so, and DOC and an approved bat ecologist at Competency Level 2.1 must be consulted.

If bats do not fly away or are potentially injured/found on the ground, felling can only re-start once permission has been obtained from DOC after consultation with an approved bat ecologist at Competency Level 2.1.

If bats are detected once the tree has been felled, all further work must stop, and DOC and an approved bat ecologist at Competency Level 2.1 must be contacted. The felled tree must be thoroughly inspected by the approved bat ecologist for further bats.

If any bats are found on the ground or in the tree once felled, place the bat in a cloth bag in a dark, quiet place at ambient (or slightly warmer) temperature and take to a veterinarian for assessment as soon as possible. A maximum of two bats should be kept in one bag. After delivering the bat to the vet, contact an approved bat ecologist at Competency Level 2.1 in consultation with the vet and DOC (0800 DOC HOT, 0800 362 468).

Bats must be kept for three days under observation and must be kept out of torpor for this time. Additional detail is found at the links provided in this footnote[23]. Vets must euthanise bats whose injuries are causing suffering and are not likely to heal sufficiently to allow rehabilitation and return to the wild. The approved bat ecologist at Competency Level 2.1 and vet must consult with DOC to consider appropriate rehabilitation options where suffering is minimal and chances of return to the wild are high.

Euthanised bats or any dead bats (or bat parts) found must be handed to DOC.

[22] https://cdn.vmaws.com/www.nzva.org.nz/resource/resmgr/docs/other_resources/Bat_Care_Advice.pdf
[23] https://cdn.vmaws.com/www.nzva.org.nz/resource/resmgr/docs/other_resources/Initial_Vet_Care_NZ_Bats.pdf

APPENDIX II EXAMPLES OF NATURAL AND ARTIFICAL BAT ROOSTS

TREES FOR HABITATS

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Habitat creation in trees for the New Zealand environment.

Hollows occur naturally in the old grove forests, mature exotics and native trees around New Zealand, and provide an opportunity to encourage biodiversity in our environments.

Natural hollows are a direct result of physiological stress to the tree, when the heartwood is exposed to the environment. This can be caused by environmental factors, fungi, bacteria, insects, natural canopy reduction and age.

Pruning for Biodiversity

Hollows for habitat creation can also be encouraged by human intervention. Pruning for biodiversity is commonly done in Europe, America and Australia and is called habitat pruning, eco-pruning or fracture pruning.

These types of pruning involve simulating natural break-outs in the tree to leave natural-looking stumps and branch tear-outs.

The Oak below has been left in Auckland Domain and is a great example of how declining trees can be an asset in speeding up the senescence in a tree and encouraging decaying wood to harbour a bigger biodiversity.

Auckland Domain, Oak.

Natural hollow in a Kauri

FACTORS TO CONSIDER WHEN CREATING HABITATS:

- **Various entrance hole and cavity sizes which will determine the different types of wildlife that might use them**
- **Protection from predators and pests**
- **Light minimisation for nocturnal wildlife**
- **Drainage**
- **Association with food crops**
- **Introduction of guano to encourage roosting sites**
- **Use of a vegetable oil as lubrication for your chainsaw bar**
- **Protection against prevailing wind and weather**

TREES FOR HABITATS

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Habitat Creation in Trunk Wood

By chainsawing into the heartwood, habitats can be customised for numerous wildlife species. Here is an example of habitats we created for the long-tailed bat in standing trunks. (This requires good chainsaw knowledge as many of the cuts use the tip of the bar and can promote dangerous kickback.)

LONG-TAILED BAT HABITAT:

1. Cut into the trunk horizontally with two cuts at the desired height. Bore cut the face plate out.

2. Bore into the wood and make the chosen number of chambers. Cut the chambers into a fork-shaped pattern with the horizontal cut meeting the entrance hole (as shown in the picture). The entrance needs to be on a slope so it works as drainage. The size of the sloping entrance should be 17–21mm for long-tailed bats. Make sure the chambers are smaller than the face plate so that the hollow will be sealed.

3. Drill into the face plate and then screw the face plate back on to the wood.

Pest Proofing

Pest proofing the tree is important. On the trunk of the tree, below where the habitat is to be created, it is a good idea to mound around the tree's circumference a metal, aluminium or plastic sheath that predators cannot climb above. We tend to use polycarbonate joined with aluminium as it does not visually degrade the integrity of the tree as much. Make sure to prune neighbouring trees well clear of the host tree as possums can easily jump from one tree to another. For living trees, the pest guard needs to be revisited and checked to allow the expansion of the trunk.


Pest Guard

PEST GUARD EXAMPLE

1. Measure the tree and cut out the polycarbonate (60mm wide) with a 20mm overlap for joining with the aluminium bracket.

2. Drill into the aluminium and make three holes. Match up the middle hole with the plastic and drill into the plastic.

3. Tape the plastic tight to the tree and insert the aluminium bracket underneath the plastic.

4. Pop rivet the middle hole through the aluminium bracket and plastic.

5. Pull the plastic together and match up the top and bottom drill holes in the plastic and the aluminium bracket. A piece of wood could come handy to make sure there is no drilling into the tree.

6. If the tree has a natural taper, the guard can be moved downwards to get it as tight as possible.

Human-made constructions

Human-made constructions are also an alternative. Here is a bat house made for long-tailed bats; there are endless ways to make them and numerous materials that might be used. These constructions could harbour any type of wildlife depending on construction type.

TREES FOR HABITATS

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Relocation of Habitats

Relocation of habitats is sometimes required. For example, relocation would be needed in tree failures or trees that are condemned for removal. The tree wood containing the habitat can be safely lowered to the ground by rigging and can be re-erected onto living trees. With the help of familiar pheromones, the wildlife could have a better chance of finding their way to the new roosting site. This has been shown to be successful for bats in the UK and we are now making trials in New Zealand and are excitedly awaiting results.

Many trees are being removed to ground level in urban environments due to factors such as:

- Changes in RMA
- Urban development
- Diseases and pests, such as Kauri Dieback, Dutch Elm and Cypress canker
- Declining and dying trees for public and structural safety
- Landscaping trends and poor knowledge.

By using some of the techniques discussed in this text, we could enhance biodiversity by leaving trunks as new habitats and still ensure safety for the public.

"We should always remember that the description 'dead wood' implies a static state, without consideration for the process of decay and the diversity of lifeforms involved." *(Andrew Cowan)*.

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ENVIRONMENTAL, CLIMBING AND TREE CARE SERVICES

REFERENCES

Bat Conservation Trust. (n.d.) Retrieved from http://www.bats.org.uk/
Cowan, Andrew. (n.d.) Decaying wood recycling within arboreal ecosystems. EssentialARB, Issue 8, Spring 2003.
Fay, Neville. (April 2003.) Natural Fracture Pruning Techniques. Retrieved from http://www.treeworks.co.uk/downloads/8%20-%20Coronet%20cuts%20&%20retrenchment%20pruning%2017%20April%202003.pdf
Gibbons, Phillip & Lindenmayer, David. (2002). Tree Hollows and Wildlife Conservation in Australia. Vic, Australia: CSIRO Publishing. ISBN 0-643-06705-1.
VTIO Victorian Tree Industry Organisation Habitat Creation Paper-13/09/2010. Retrieved October 15, 2014 from http://vtio.org.au/downloads/

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Revegetation

For revegetation we could also apply some of these techniques to use in existing exotic trees. We might also use fast-growing exotic trees that could be transformed into desirable nesting spots to harbour many species essential to our ecosystem before the native trees reach their maturity.
As one tree species might be a problematic weed in Auckland but considered a specimen tree in the Waikato, it pays to talk to local Arborists, council, DOC or environmental organisations.

Some Factors to consider are:

- Will these trees become a weed infestation?
- What would you like to attract – invertebrates, birds or bats?
- Could the temporary exotic tree be easily be killed off after a desired period of time?
- Heavy fruiting and flowering could work as a food crop for birds but also pests.
- Will they naturally be good species to create hollows?
- What has been used in other projects around your area?

ABOUT THE LIVING TREE COMPANY

The Living Tree Company is an Auckland-based environmental arborist company with a passion for maintaining and improving New Zealand's unique natural environment. We are currently taking part in various trials for habitat creation and other ecological and arboreal projects. We believe the more work we do together the bigger and stronger the impact we can have. Please contact us with any enquiries or to share information.

This is an introduction to habitat creation in trees for the New Zealand environment. The text is prepared from an arboricultural standpoint and is to be used as an introductory discussion for ecologists.

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