E7:9 Net Gain Delivery Plan: Pest and Weed Control

Drury Quarry – Sutton Block

By: JS Ecology Ltd

For: Stevenson Aggregates Limited

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Document Guide

As part of the Sutton Block pit expansion, a full suite of ecology assessments, reports and plans have been developed (**Error! Reference source not found.**). A summary of each document, including its objectives and key findings are provided in this section. This table is provided at the start of each ecology document with the relevant document highlighted to improve navigation. This document is 7 of a series of 9 ecology documents (E7:9).

Table 1. Documents prepared as part of this project. Current document is highlighted

Document name (abbreviated name)	Aspects covered
E1:9 Ecology Documents Guide and Summary	Summary of the whole project and guidance for navigating documents.
Ecological Impact and Management	
E2:9 Ecological Impact Assessment (EcIA)	Assessment of ecological values and impacts of the proposed Sutton Block on terrestrial and freshwater ecosystems, including regenerating and mature forest fragments, water courses and wetlands. Fauna values include common native invertebrates and birds, At Risk pipit, copper skinks, longfin eel and (potentially) threatened long-tailed bats. Recommendations are provided for avoiding, managing, offsetting and compensating for significant residual adverse effects.
E3:9 Ecological Management Plan (EMP)	Management of ecological impacts in accordance with the effects management hierarchy, prior to and during and following construction. Specific impacts and values addressed in this Plan include: a) Management of Vegetation Removal b) Avifauna Management Plan c) Long-Tailed Bats Management Plan d) Native Lizard Management Plan e) Edge Effects Management Plan f) Native Freshwater Fauna Management Plan g) Sutton Block Riparian Planting Plan
Residual Effects Analysis Reports (REAR)	
E4:9 REAR: Terrestrial Ecology (REAR-TE)	Residual effects on terrestrial ecosystems and fauna
E5:9 REAR: Stream and Wetland Loss (REAR-SW)	Residual effects on freshwater ecosystems
Net Gain Delivery Plans (NGDP)	
E6:9 NGDP: Planting Plan (NGDP:PP)	Terrestrial offset planting
E7:9 NGDP: Pest and Weed Control (NGDP:PWC)	Terrestrial offset pest and weed control
E8:9 NGDP: Wetland Planting (NGDP:WP)	Freshwater offset planting of wetlands.
E9:9 NGDP: Riparian Planting (NGDP:RP)	Freshwater offset planting of streams.

Contents

List of acronyms and abbreviations

Abbreviation/Acronym	Explanation
AEE	Assessment of Ecological Effects
AUP	Auckland Unitary Plan
BBOP	Business and Biodiversity Offsets Programme
BCM	Biodiversity Compensation Model
BOAM	Biodiversity Offset Accounting Model
ED	Ecological District
ha	Hectares
EcIA	Ecological Impact Assessment
NGDP:PP	Net Gain Delivery Plan: Planting Plan
NGDP:PWC	Net Gain Delivery Plan: Pest and Weed Control
NVS	National Vegetation Survey
NAWAC	National Animal Welfare Advisory Committee
REAR-TE	Residual Effects Analysis Report – Terrestrial Ecology
SAL	Stevenson Aggregates Limited
SEA	Significant Ecological Area
Spp	Species
SPQZ	Special Purpose Quarry Zone
VS2	Kānuka scrub/forest[1]
VS5	Broadleaved species scrub/forest
WF9	Taraire, tawa, podocarp forest
WF11	Kauri, podocarp, broadleaved forest

[1] As described in Singers et al (2017).

Executive Summary

This Plan follows on from Residual Effects Analysis Report – Terrestrial Ecology (REAR-TE).

The Sutton Pit Project will result in the loss of 16.65ha of native vegetation over the 50+ year life of the quarry pit. Native habitats to be lost include Taraire tawa podocarp forest (WF9), Rock forest (a variant of WF7 Puriri forest) and Kanuka scrub/forest (VS2). Biodiversity offset accounting modelling (BOAM) to counteract the loss of these native habitats is described in the REAR-TE and requires the enhancement of existing forest containing similar habitats.

The Net Gain Delivery Plan: Pest and Weed Control (NGDP:PWC) or "Sutton Block Forest Enhancement Plan" sets out the rationale for the enhancement of 108.35ha of existing forest at the SAL site as part of the proposed biodiversity offset for the Sutton Block.

The proposed forest enhancement actions follow the accepted principles for biodiversity offsetting in New Zealand according to the published literature. These enhancement actions are designed to account for the time lag between loss of native habitats within the Sutton Block footprint and the eventual replacement of those habitat values by restoration planting.

Forest enhancement comprises mammalian predator control, pest plant control and control of feral ungulates. Stock-proof fencing will be erected where necessary to exclude livestock from bush areas. Forest enhancement actions are proposed to commence in Year 1 of the project and to continue for 25 years.

This report describes best-practice methods for undertaking the required enhancement actions. The required record-keeping and long-term monitoring to support these actions and ensure the modelled biodiversity gains are achieved are set out and described, as are contingency actions to be implemented should biodiversity gains fall short of those predicted by the model.

Enhanced forest areas will be legally protected in perpetuity to ensure biodiversity gains are maintained.

1 Purpose and Objective of the Net Gain Delivery Plan: Pest and Weed Control (NGDP:PWC).

The purpose of this report is to set out site-specific enhancement actions to achieve the modelled ecological enhancement[2] required to offset loss of native vegetation within the Sutton Pit project area. Existing tracts of native forest that currently receive no control of pest mammalian predators or feral ungulate browsers will receive pest and weed control to reduce pest animal numbers and weeds to low levels. Control of pests and weeds will provide immediate habitat enhancement for native fauna and flora. These enhancement actions are designed to account for the time lag between loss of native habitats within the Project footprint and the eventual replacement of those habitat values by restoration planting.

The key objectives of the forest enhancement work are:

a) To ensure that sufficient quantity and quality of enhancement actions, as set out in the REAR-TE, is achieved to offset the loss of vegetation and habitats to be removed as a result of the Project.
b) To control pest animals and plants within the forest enhancement area in order to improve biodiversity values and provide safe habitat for the full range of indigenous fauna and flora that make up the natural community for each ecosystem type being enhanced.
c) To set out methods by which offset enhancement actions will achieve net gain outcomes, as modelled (REAR-TE), through a detailed maintenance and monitoring schedule.
d) To ensure the biodiversity gains that are achieved are maintained in the long term through suitable protection mechanisms.

2 Consultation with Mana Whenua

Early consultation with Mana whenua was undertaken, with the identification of Kārearea Pā as a site of key cultural significance to Ngāti Te Ata Waiohua and Ngāti Tamaoho iwi. The proposed forest enhancement aligns with iwi aspirations to see the ngahere at the SAL site returned to full ecological health.

3 Offset Enhancement modelling

Enhancement modelling is discussed in in the REAR-TE and in Section 1 of this report. Model outputs are presented in Table 1.

Table 1 Loss of ecosystem types within the Sutton Project area and enhancement required.

Ecosystem type	Loss (ha)	Timing of removal/ year	Enhancement/ ha
Rock Forest	0.65	0-5	5.35
Broadleaved Podocarp Forest 1 (WF9 1 & 5)	1.98	0-5	23

[2].As set out in the BOCP Section 2.

Broadleaved Podocarp Forest 2, 3 & 4 (WF9 2, 3 & 4)	5.46	>30	40
Kanuka Forest (VS2)	8.79	>30	40
Totals	**16.65**		**108.35**

Enhancement achieves modelled improvements to existing ecological values, thereby enabling like-for-like ecological values in the immediate landscape to be maintained and enhanced. Biodiversity benefits from enhancement can generally be achieved within a shorter timeframe than restoration planting. They include:

1. Reduction or cessation of predation on native forest fauna by exotic predators targeted in this Plan
2. Recovery of fauna populations through improved breeding success
3. Restoration of forest regeneration processes through control of browsers and seed predators
4. Restoration of ecosystem services such as pollination and seed dispersal.
5. Removal of pest plants that threaten forest ecological integrity

Current threats to forest ecosystem integrity include deer, goats, possums and pigs that are browsing forest tiers, particularly the understorey and groundcover, pest plants, and predators on native forest fauna. Less obvious are the effects on native invertebrates and seeds of forest plants which are predated by rats.

To model the effects of browsers and seed predators, the biodiversity attributes of seedling and sapling abundance and sapling species richness have been chosen. These attributes currently have low ecological values at both the impact and offset enhancement sites at Drury Quarry. Reference sites show significantly higher values. Browsing of seedlings and seed predation result in very few seedlings reaching the sapling stage where they can recruit into upper forest tiers. Any saplings that do survive are generally less palatable species, thereby skewing future forest composition. This results in a sparse understorey layer that provides fewer food and habitat resources to fauna. Native groundcover % cover provides an overall measure of browsing pressure.

Avifauna breeding success is a direct measure of predation pressure and an improvement of at least 10% has been modelled. This parameter is very difficult to measure directly and bird abundance will be used as a proxy for this biodiversity attribute since improved breeding success should be reflected in increased native bird presence.

Table 2 Modelled biodiversity attributes to be monitored

Biodiversity Component	Biodiversity attributes
Forest Enhancement (pest and weed management over existing forest)	Native bird abundance by species
	Sapling abundance
	Sapling species richness
	Seedling abundance

	Groundcover % cover

4 Principles of Biodiversity offsetting

Appendix 3 of the NPSIB[3] sets out the principles of biodiversity offsetting and Section 1.4 of the REAR-TE presents an explanation of how each of the principles are satisfied by the NGDP:PWC and the NGDP:PP.

Net gain

The model outputs provide at least a 10% gain in biodiversity values. Net present biodiversity value shows improvements of between 1.77 and 10, demonstrating a large biodiversity gain.

Additionality

Under the principles of biodiversity offsetting set out in the NPSIB, the proposed enhancement actions must be additional to any other biodiversity enhancement actions already being undertaken (or likely to occur) at the subject sites.

Proposed protection and enhancement of 108.32ha of existing forest types at Drury Quarry is additional to any other resource consent requirements or planned conservation actions.

While there are a number of restoration planting sites at the Quarry which form part of the requirements for earlier resource consents, no protection or enhancement of existing forest tracts are required by any of these earlier consents.

Time lags and duration of enhancement

Although some of the highest value ecosystem types will be lost early in the life of the project (Years 1 – 5), much of the native vegetation (84%) will not be lost until after 30 Years or more. The full quantum of forest enhancement is proposed to be implemented at the start of the project in Year 1, and continue for 25 years, thus providing biodiversity benefits decades ahead of the loss of much of the native vegetation within the Sutton Pit. Time lags between loss of biodiversity values within the Sutton Pit and achievement of benefits from biodiversity enhancement will therefore be minimised.

Long term outcomes

Enhancement actions will be maintained within enhancement areas for a period of 25 years, providing long-term biodiversity benefits.

Biodiversity offset gains for enhancement are modelled over 25 years for Taraire, tawa podocarp (WF9, loss during stage 1 and 2) and rock forest (WF7.2) biodiversity types as the biodiversity attributes being enhanced include vegetation parameters that take several decades to show measurable improvements. For kanuka forest (VS2) and Taraire, tawa podocarp (WF9, loss during stages 4 and 5) biodiversity offset gains are modelled over 20 years since the enhancement will start in advance. For the bird breeding success enhancement attribute, the gains are modelled for 1 year, as the positive effects of predator control are evident after one breeding season for bird breeding

[3] National Policy Statement for Indigenous Biodiversity.

success, however improvements that are additional to those modelled are expected after 25 years of predator control.

Landscape context

Biodiversity enhancement will occur in forest vegetation of the same types which lies immediately adjacent to the Sutton Pit within SEA_T_5323. This ensures optimal ecological outcomes and close match for landscape context characteristics.

Tangata whenua and stakeholder participation

Tangata whenua and local stakeholders have been involved in consultation from an early stage. Results of consultation have guided the location of offset planting, which connects the forest enhancement areas with offset planting.

Transparencey

The design of the biodiversity offset package is set out in the REAR-TE. This report sets out the methods and timing for implementation of the biodiversity offset package.

5 Offset Enhancement Sites

Ecological enhancement involves improving the biodiversity values of existing similar vegetation types to those being lost within the project area. In this case areas of rock forest, broadleaved podocarp forest and VS2 kanuka forest/scrub vegetation will receive ecological management to enhance their biodiversity values.

Suitable locations have been selected for the offset enhancement actions that meet the requirements for offsetting, as laid out in the NPSIB Appendix 3. This includes the requirement that any offset sites can achieve “comparable, additional, and lasting biodiversity gains”.

Significant tracts of recovering and regenerating native forest (SEA_T_5323) lie outside the Special Purpose Quarry Zone (SPQZ) to the north and east of the proposed Sutton Pit Project area and within SAL ownership. This area is currently not being managed for biodiversity conservation, although much of it is fenced to exclude livestock. It contains very similar vegetation to that within the Project area and the proposed enhancement area will be legally protected to secure its values in the long term. The area proposed for rock forest enhancement consists of four areas of gully forest to the southwest (Figure 2).

The proposed enhancement areas are:

- Most of the remaining extent of SEA_T_5323 within SAL property, excluding areas of exotic vegetation (103ha). It contains a mosaic of forest types; mostly podocarp broadleaved forest some of which has been mapped by Auckland Council as WF13 (Auckland Council Geomaps biodiversity layer. Ground investigations reveal the forest on the SAL land holdings is mostly Taraire, tawa, podocarp forest (WF9) and kanuka forest (VS2). The vegetation structure indicates historic disturbance with large mature native trees often forming a broken canopy over younger vegetation.
- Grazed rock forest fragments (5.35 ha) in the southeast of the SAL property. These have minimal ground cover and understorey cover, consisting mainly of tall canopy trees.

Vegetation data (REAR-TE Appendix A) for SEA_T_5323 within the SAL property shows a very low abundance and diversity of native saplings, although seedling numbers are higher than for the grazed impact sites. The grazed rock forest remnants have similar ecological values to the impact site, both being virtually devoid of any saplings or seedlings >15cm in height.

6 Offset Enhancement Actions

Offset enhancement actions will be implemented across 108.35ha of degraded forest areas within the SAL holdings at the Drury Quarry (Figure 1). Actions include:

1. Removal of pest predators: possums, rats, mustelids
2. Control of ungulate browsers: deer, goats, pigs
3. Pest plant removal
4. Fencing of rock forest remnant patches.

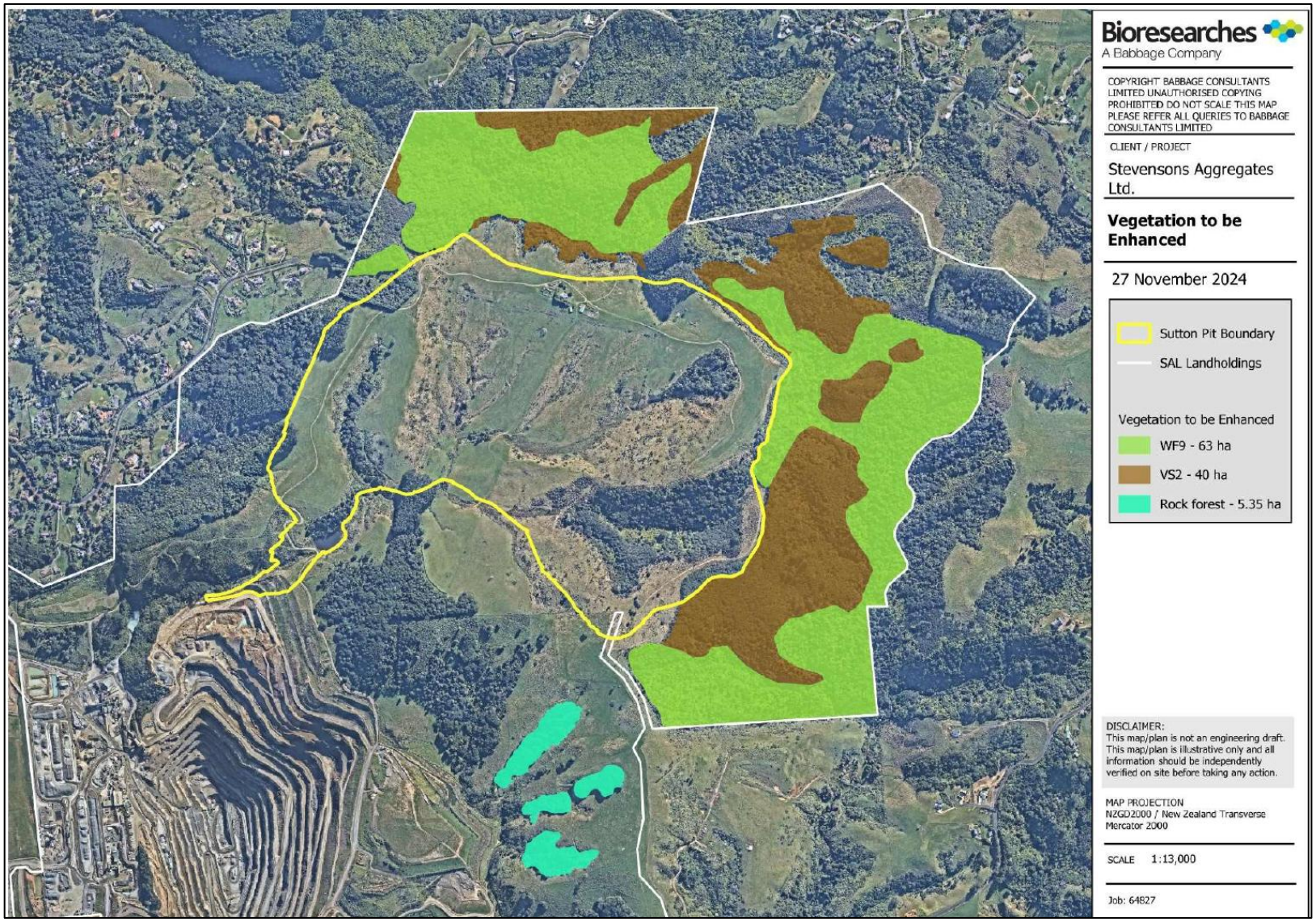

Figure 1 Vegetation types and areas to be enhanced at the SAL site

7 Enhancement methods

7.1 Pest animals requiring control

A programme for control of predators such as possums, rats, and mustelids should be implemented to protect native fauna. Feral cats are also important predators of native fauna and hedgehogs will also take native lizards and invertebrates.

Feral ungulate browsers such as deer, goats and pigs browse the lower tiers of the forest. Pigs will also damage forests by uprooting trees and saplings and eating native invertebrates. Deer are known to be present at Drury Quarry. It is not known whether goats and pigs are present.

Table 3 Pest animals requiring control at Drury Quarry

Pest	Scientific name	Prey
Possum	*Trichosurus vulpecula*	Native birds: adults, chicks, eggs. Native fruits, flowers and foliage.
Rat	*Rattus rattus* *Rattus norvegicus*	Native birds: adults, chicks, eggs. Native invertebrates. Native fruits, flowers and seeds.
Mustelids: • Stoats, • weasels, • ferrets	*Mustela erminea* *Mustela furo*	Native birds: adults, chicks, eggs.
Feral cats	*Felis catus*	Native birds: adults, chicks, eggs Native invertebrates, lizards.
Hedgehogs	*Erinaceous europaeus*	Native birds: adults, chicks, eggs. Native invertebrates, lizards.
Feral deer, Feral goats	*Cervus elaphus scoticus* *Capra hircus*	Browse native groundcover and understorey plants.
Feral pigs	*Sus scrofula*	Uproot and browse native plants. Predate native invertebrates.

7.2 Predator control

7.2.1 Options for control of rats and possums

Control of rats and possums will be undertaken using:

- Toxic baits in bait stations or
- Kill traps such as the Tipping Timmy™ or Trapinator™ for possums or
- Self-resetting traps such as the AT220, produced by NZ Autotraps (https://nzautotraps.com/).

7.2.2 Bait stations

- All toxins will be contained in bait stations. Commonly used stations for possums include Philproof, Kilmore and Sentry. Common bait stations for rodents include Run-through, Pestoff and Philproof.
- For rats use bait stations that secure the bait – this is to prevent animals stealing and storing the bait, to prevent ground spillage, and to protect other non-target species.
- Bait stations must be placed out of reach of livestock, pets and other non-target species, and clearly signposted. Place 20 – 30cm above the ground on trees if pigs are not present, 1m if pigs are present.
- Bait stations will be no more than 100m apart for possums, with at least 1-2 stations per hectare and no more than 50m apart or 2 stations per hectare for rats.
- Keep a record of the location of bait stations as well as the type of baits used and when. (Trap.nz is a free website and app where trap or bait station locations can be recorded on GIS and bait uptake, or kills can be recorded)

Recommended toxins for rats and possums

Predator Free 2050 provides a good summary of the advantages and disadvantages of the different toxic baits available for use in New Zealand (Tables 4 and 5). The summary sets out the options for poisoning possums and rats.

Bait stations will be loaded with Cholecalciferol (Feracol), and alternated with Double Tap initially to reduce possum and rat numbers to low levels. Other toxins, such as Broadificoum (e.g. Pestoff) may be used when the pest numbers have been reduced to low levels if necessary. Alternate Pestoff with Feracol and Double Tap.

Pest numbers should initially be assessed using tracking tunnels, chew cards and wax tags. If high (>10% 10% incidence) numbers of possums are present an initial knock down of numbers can be achieved using Feratox. This is an encapsulated cyanide and requires a CSL (Controlled Substance Licence). It is useful for controlling medium-to-high possum density and an effective knockdown tool before using other toxins to maintain low possum numbers. It is generally a low risk to non-target species when used appropriately. It is not designed for controlling rats, however it is useful for reducing possum numbers so that possums do not consume large amounts of bait from bait stations.

Table 4 Toxin options for targeting possums

Toxin	Single or multi feed?	Advantages	Disadvantages	CSL required?	Antidote
Brodifacoum	Single	Useful for controlling low numbers of possums.	High risk of secondary poisoning. Builds up in the environment. Can build up in feral game meat and livestock with inappropriate use.	No	Yes
Cholecalciferol	Multi	Low risk of secondary poisoning. Can be used on all densities.	Acute toxin, requires multiple feeds. Can be more expensive than other options.	No	No
Feratox (encapsulated cyanide)	Single depending on possum numbers	Effective knockdown tool.	Acute, fast acting toxin. Builds up in the environment.	Yes	Yes
Pindone	Multi	Can also be effective on rats.	First generation. Possums have to eat a significant amount to consume a lethal dose. Medium risk of secondary poisoning.	No	Yes
Double Tap (diphacinone + cholecalciferol)	Single	Can be used on all densities of possums, and can be used to target rats. No pre-feeding required.	Relatively untested as new to market.	No	

Table 5 Toxin options for targeting rats

Toxin	Single or multi feed?	Advantages	Disadvantages	CSL required?	Antidote
Brodifacoum	Single	Useful for controlling low numbers.	Builds up in the environment. High risk of secondary poisoning.	No	Yes
Bromadiolone	Single	Useful for controlling low numbers. Rats do not become bait shy.	Builds up in the environment. Medium-to-high risk of secondary poisoning.	No	Yes
Diphacinone	Multi	Useful for controlling low numbers. No prefeeding required.	Not a knockdown tool. First generation, requires multiple feeds. Medium risk of secondary poisoning.	No	Yes
Pindone	Multi	Useful for controlling low numbers.	Not a knockdown tool. First generation, requires multiple feeds. Medium risk of secondary poisoning.	No	Yes
Cholecalciferol	Multi	Low risk of secondary poisoning. Can be used on all densities of rats.	Acute toxin and can be more expensive than other options.	No	No
Double Tap (diphacinone + cholecalciferol)	Single	Can be used on all densities of rats. No pre-feeding required.	Relatively untested as new to market.	No	

Toxic bait pulsing

Toxic baits will be pulsed four times per year, generally February, April, August and November to provide optimum protection for the bird breeding season (see Figure 5). Bait pulsing occurs over a four-week period as follows

- Fill the bait station on day one, and refill as necessary on day 8 and again on day 14, if necessary.
- Remove any uneaten bait at the end of week four to end the pulse.
- When ending the pulse remove all bait in stations and dispose of it correctly. Degraded bait can make animals bait shy as it is not as effective and may only make the animal feel sick without killing it.

Different toxins may have different recommendations for when to refill bait stations and how long each pulse should be. Follow the manufacturer's instructions for each bait type.

Pre-feeding

If using feracol, pre-feed for 1-2 weeks with Ferafeed. Pre-feeding offers non-toxic baits which attracts pests to the bait station and encourages regular re-visits. Replace it with toxic bait at the end of the pre-feeding period. Replace eaten toxic baits only once or twice before again pre-feeding if ongoing control is required. Pre-feed prior to each pulse.

Double Tap and Pestoff do not require pre-feeding.

If using Feratox for initial possum knockdown, pre-feed with Ferafeed for one week before each toxin application to avoid bait shyness. Place 2-5 pellets with 5-20 g of toxic pellets or paste in each bait station. Revisit bait stations after 4-5 days and where baits are taken, replenish with more toxic bait. After a further 5 days remove all baits and pre-feed to prevent any surviving possums becoming bait shy. Dispose of bait as per manufacturer's label. Warning signs should be erected in control areas and remain in place until at least 2 months after baits have been removed.

Health and safety

To ensure the safety of humans and non-target animals, care should be taken to follow all safety instructions found on the labelling of the poison bait products.

Recommended approach to use of toxic baits to target both rats and possums

Baits such as cholecalciferol or Double tap™ will be used in bait stations. Broadificoum (Pestoff) is a commonly used bait that can alternated with other bait types to prevent the pests becoming bait-shy (avoiding the bait). Pestoff can persist in the environment and should not be used as the sole bait type.

Any neighbouring properties should be notified that toxic baits are in use, and baits should be kept well away from livestock, children and dogs. Approved signage should be erected warning that pest control is in progress.

7.2.3 Trapping possums and rats

A range of kill traps are available for rats and possums. Examples are the Tipping Timmy™ or Trapinator™ for possums and Victor Professional rat trap in a tunnel for rats. These traps need frequent checking and manual resetting to remain effective. Peanut butter, mayonnaise, Nutella and dried meat are all good lures for possums and rats. Possums are also attracted to pieces of apple dusted with cinnamon. The Tipping Timmy™, Trapinator™ and Victor Professional rat trap all meet NAWAC humane standards.

Automatic self-resetting traps are a more expensive option but are easier to use and require fewer checks, resulting in lower labour costs.

The AT220 automatic trap is a self- resetting and self-re-baiting kill trap that runs on a rechargeable battery that lasts up to 6 months. The mayonnaise-based lure, which attracts both rats and possums lasts at least 3 months and up to 6months, so the number of visits required to service the trap is about 4 times per year. It is a smart trap with an app that collects data on the number of times the trap has been triggered, number of times it has reset and number of large animals (possums caught). The trap has a sensor which switches it off during daylight hours to conserve the battery. It has a no-touch eye beam trigger and dead animals fall away from the trap to the ground below. The trap is very effective for possums and can also catch rats. The manufacturers claim that the trap will also kill mustelids and feral cats.

The A24 automatic trap from Goodnature targets rats. It comes with an automatic lure pump which, once activated, will release the lure itself slowly and consistently over a 6-month period. The A24 is powered by carbon dioxide canister which has pressure for 24 humane kills and will need to be replaced at least 6-monthly. It is recommended that the trap is checked more frequently at first to make sure it is working correctly. Plan on replacing CO_2 cylinders and lure every about every 3–4 months at first until rat numbers decline.

Both of the automatic traps are NAWAC approved and provide an app for recording the number of times the trap has been fired.

Targeting possums and rats

Possums don't like wet weather, so target them during fine weather (particularly in the colder months). The best time of the year for possum control is winter, when natural food supplies are at their lowest and possums are hungry and more likely to take alternate foods. Late winter/early spring is also a key time to protect nesting birds in the area.

For signs of possums, check for scratches on trees, damaged fruit, foot tracks and faeces. Possums respond to visual cues and a lure such as white flour mixed with scented spices, e.g. cinnamon helps to attract them. Place the lure outside the bait station/trap or on the tree trunk and scuff up the surrounding area to create interest.

According to DOC (NZ Department of Conservation), the Norway rat's home range is generally 0.8 – 21 hectares and the ship rat's home range is just 0.3 – 11.4 hectares. The distances can vary depending on habitat and food availability. Rat numbers tend to increase rapidly in autumn when seed is abundant, so good control is required over the winter to ensure numbers are low by the time bird breeding season comes in early spring.

7.2.4 Mustelid control

Mustelids are targeted with kill traps, either Doc 200 traps or self-resetting traps may be used if appropriate. Stoats, in particular are very wary and hard to catch.

Traps for mustelids are deployed along main tracks, ridgelines, and streams at an average coverage of one trap per 6ha.

- Use DOC 200 wooden box traps with enlarged openings (4×4 mesh squares) to target weasels, stoats and ferrets. File off any sharp edges around the entrance hole.
- Place away from stock access at 100–150m intervals along the inside of bush block fences, on game trails, and along stream edges within bush areas.
- Ensure that stoats will never be more than 200m from a trap.
- Re-bait about every 2 weeks with eggs, fresh rabbit meat (in winter), dried rabbit meat or Erayz rabbit blocks/paste (a long-life product) in warmer climates. Rebait less in winter and more in spring/summer.
- DOC 200 traps also catch rats and hedgehogs.

DOC 200 traps are baited with a hens egg or dried rabbit meat which is replaced at the same time as bait pulses occur or automatic traps are checked. DOC 200 traps may also catch rats and therefore between December and March they should be checked more frequently (fortnightly) to ensure their continued effectiveness over the main bird breeding season. Additional lures such as mayonnaise, blood lure or salmon lure should be used to attract pests to the traps. Mustelids are also attracted to the scent of previous kills from the trap.

DOC 200 traps can also be modified to catch hedgehogs by making the entrance larger and using a protein- base bait.

Targeting mustelids

Mustelids are cautious and very cunning, therefore challenging to trap. Using a “run-through” trap with an entrance at each end greatly increases the chance that a pest will enter it because the animal can see its way out. DOC 200 traps can be modified for this.

Correct placement and monitoring is crucial to trapping success with mustelids. Mustelids use track edges and waterways as conduits, as well as bush edges.

Place twigs and stones around the trap to guide the animal to it. Egg-based mayonnaise has been shown to attract mustelids and can be strategically placed around the trap to improve trapping success. Place the bait on or behind the trap in such a way that the animal must walk over the trap to reach it. Check the traps at least monthly using gloves to handle them.

7.2.5 Feral cats and hedgehogs

The Tawhiti cage trap is a live trap that captures mustelids, feral cats, hedgehogs and sometimes non-target animals which are unharmed. If the application is supported by a local “gateway”, a “smart” version is available which sends a notification to one or more cell phones. You are legally required to check the trap within 24 hours of setting it or within 24 hours of notification if using the “smart” version. Please see: https://predatorfreefranklin.nz/product/cage-trap/ for detailed information on this trap.

The trap is open at both ends and has a trip plate in the middle. It has an automatic lure pump which lasts about 5 months. These traps are demonstrating good success, particularly with ferrets, hedgehogs and feral cats. Consult Predator Free Franklin for further advice on these traps.

The captured pest will need to be humanely killed, so ensure there is a plan for doing this. Live capture allows determination of whether the captured animal is a feral cat or a domestic cat. Feral cats are usually quite obvious by their "wild' response to being captured, but neighbours should also be alerted and photos of any neighbouring domestic cats obtained if possible.

To enquire whether a local "gateway" for the Tawhiti "smart" version is available contact WheroNet Ltd (Ph 09 232 8282) or go to https://www.wheronet.co.nz/ .

Six Tawhiti traps are sufficient to begin with since feral cats have large home ranges. Add more traps if catch rates are high. Place the traps along forest edges, tracks and in other places where cat sign is seen (scats, scratching, kills). They can be easily moved around to target different areas or features.

7.2.6 General guidelines for all traps and bait stations

- Recommended methods for mammalian predator control are summarized in Appendix 1.
- Make sure groundcover vegetation is controlled at trap or bait station entrances and at least one metre from the entrances. This reduces moisture which causes the bait to go mouldy and makes access easier for predators.
- Scuff the ground around traps during each check to create 'interest' for predators.
- Lure the area around each trap or bait station site with scented (peach, vanilla, cinnamon) flour laced with icing sugar, again to increase interest. Use this as a "blaze" on adjacent tree trunks and bare ground but do not put flour on the devices themselves. For mustelids a mayonnaise-based lure or salmon spray works well (available online from trap & bait station retailers).
- A combination of bait types and trapping over time is best practice to avoid predators adapting to control methods.
- Use gloves when handling bait, traps, bait stations and any kills. Feral animals carry a range of diseases.
- Maintain trap mechanisms in good working order.

New traps, trap boxes or bait stations may not catch immediately after placement. Predators have a natural suspicion towards unfamiliar objects and may take a few days to venture near them

7.2.7 Trap and bait station placement.

Traps or bait stations for rats and possums (targeted together) will be positioned on a network of 100 meter by 50–100-meter intervals. Place trap or bait lines in a grid pattern, with spacing between lines no more than 100m apart. Place traps 50m apart if targeting rats and possums together (or 25m apart in high-density areas), and 25m apart along perimeters. This equates to an average **two traps/bait stations per hectare** of forest habitat. A combination of traps and bait stations can be used to obtain full coverage of the enhancement area.

DOC 200 mustelid traps should be placed 200m apart along traplines or one per 3ha. Tawhiti traps should be placed in places where cat sign is seen or moved around until they are showing good catch rates.

A trap grid and system of tracks will be developed in consultation with the pest control contractors. Traps or bait stations will be placed in appropriate places along ridges and spurs in rough terrain and along conduits that pests are likely to be using. An outline plan of the indicative proposed network is shown in Figure 2. Table 6 sets out an annual plan for use of different traps and bait stations, and monitoring methods.

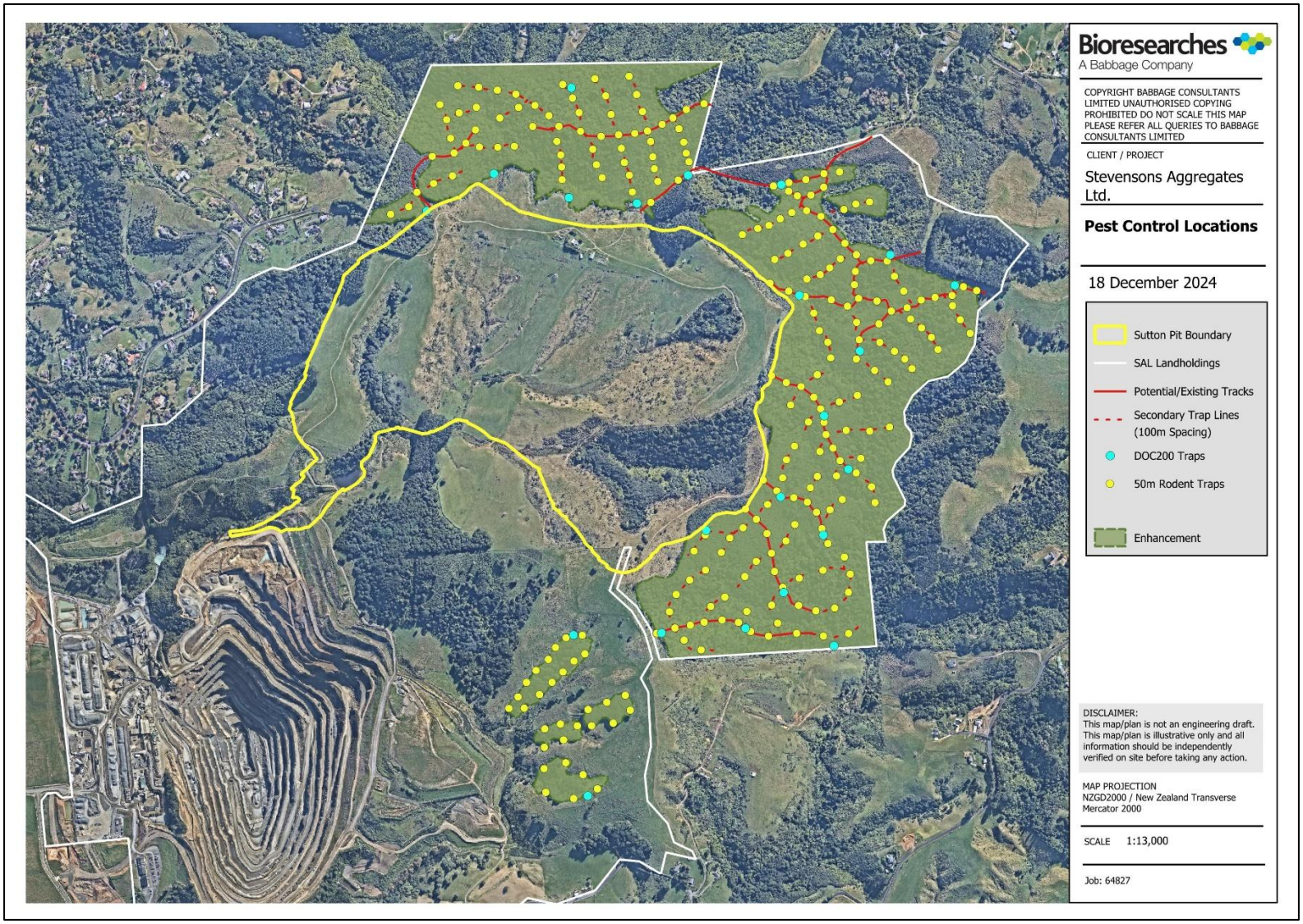

Figure 2 Proposed pest control network. Note: possums and rats to be targeted together (2 bait stations/traps per hectare)

Table 6 Annual programme for pest control and monitoring

Tool	Target species	Action	January				February				March				April				May				June				July				August				September				October				November				December			
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Bait stations	Rodents possums	Fill/refresh baits																																															
		Remove all baits																																															
Automatic AT220	Possums, rats, mustelids	Replace battery and lure																																														
Humane kill traps DOC 200	Mustelids Hedgehogs	Check & reset																																														
		Deactivate & service trap																																														
Tawhiti cage live trap (smart trap)	Feral cats, mustelids Hedgehogs.	Bait & set. Automatic notification – check within 24 hours																																														
		Replace battery and lure																																														
Tracking tunnels, chew cards	Rodents Possums Mustelids Hedgehogs	Place fresh card & replace after 3 days																																													

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8 Control of feral ungulate browsers

Control of ungulate browsers such as deer, goats and pigs will occur as necessary to prevent damage to lower forest tiers and browsing of seedlings and saplings. Some control of deer is currently undertaken by the Auckland Council as part of their region-wide deer eradication programme. Deer have been observed to still be present within the enhancement area at the Drury Quarry site however, and more intensive control of these pests will be necessary until numbers have been reduced to low across the Auckland Region. Drury Quarry will liaise with Auckland Council with regard to ungulate control.

A survey will need to be undertaken to assess numbers of all feral ungulates. Appropriate measures such as the engagement of contract shooters will need to be taken to control these pest animals to low levels within the enhancement area. Control of these pests will be most efficient if SAL can liaise with surrounding neighbours to coordinate a pest control programme at the local landscape scale.

Deer: Deer need to be hunted and shot. Trials using thermal imaging technology mounted on drones are showing promise for locating deer in the bush.

Goats: Two methods for goat removal are possible:

- Rounding up and trucking to an abattoir.
- Shooting

Goats are highly social animals and sometimes a “Judas” goat can be captured from a feral flock and collared with a radio tracker. The animal then returns to the flock, leading the hunters to the flock. The animals can the either be shot or herded to a suitable yarding facility where they can be loaded into a stock truck and taken to the abattoir. The Judas goat method has been successfully used in the Hunua Ranges Regional Park and is now being extended to properties neighbouring the Ranges (van Heughten 2023). Stock yards that may be suitable are currently available near the farm managers house on the northern side of the Sutton Pit footprint on the edge of Stage 3.

Pigs: Need to be shot. Sometimes a suitable area can be “baited” to attract the pigs where they can then be shot or trapped using a large cage trap. Thermal imaging technology mounted on drones may also be a useful tool to locate pigs in the bush.

9 Pest plant control methods

The location and extent of any weed infestations within the forest enhancement area will be mapped in the first year of the Sutton Project. This will involve consulting high resolution aerial images of the area to identify potential infestations, using a drone to locate infestations or walking through the forest areas and recording GPS locations and photo points. An aerial plan of the enhancement areas will be marked up with weed information. This map will be updated as part of annual monitoring. The removal and monitoring of pest plant infestations is part of the annual monitoring and long-term monitoring set out in Section 11.

Pest plant control methods are listed in Appendix 2. All pest plant management methods have been sourced from Tiaki Tamaki Makaurau Ngā kīrearea ki Tāmaki Makaurau pest control guidelines: https://www.tiakitamakimakaurau.nz/protect-and-restore-our-environment/pests-in-auckland/.

10 Fencing

The portion of SEA_T_5323 proposed for forest enhancement within the SAL site currently has some stock-proof fencing, and this will be upgraded to ensure livestock cannot access the forest from the Drury Quarry site.

The rock forest fragments proposed for enhancement are only partially fenced and will require some additional fencing to render them fully stock proof.

All stock-proof fencing must be of the 7-wire post and batten type or equivalent. Electric fencing should not be relied upon for permanent fencing, due to the risk of it being accidently switched off or a power cut.

11 Record keeping

Detailed records must be kept of the following by weed and pest control contractors:

11.1 Weed control programme:

- A copy of the weed map for the site as described in Section 9

- Species controlled and dates undertaken
- Location map
- Methods of control & herbicides used
- Effectiveness of control methods
- Follow-up control required.

11.2 Pest control programme:

- Target species and dates undertaken
- Location map of traps/bait stations (e.g. TrapNZ app) and areas of shooting,
- Kill tallies for shooting and traps
- Bait uptake for bait stations

11.3 Annual report

An annual report is to be submitted to the Drury Quarry Environmental Manager in November each year setting out all weed and pest control actions undertaken and results for that year.

12 Monitoring

12.1 Baseline monitoring

Baseline monitoring will need to be undertaken at the enhancement site prior to the implementation of enhancement actions. This will include:

- Assessment of predator numbers and density using approved methods such as tracking tunnels and chew cards/wax tags
- Assessment of ungulate browser numbers and their effects on the forests using approved methods such as presence of visual sighting, faecal pellets, hoof prints and evidence of browse.

- Weed mapping to identify pest plant infestations (see Section 9): High-res aerials, drone, walk through.
- Assessment of forest condition using representative Recce plots and long term photo points.
- 5-minute bird counts or other accepted bird abundance measure.

12.2 Long term monitoring and contingencies

12.2.1 Pest control monitoring

Predator monitoring

Routine monitoring using approved methods needs to be undertaken every year to track predator numbers and provide appropriate adaptive management. Monitoring should take place at the beginning of the bird breeding season (October- November) and again at the end (March - April).

Feral ungulate monitoring

Deer can be monitored using Faecal Pellet Index (FPI), a method used by DOC (Forsythe 2005, Forsythe et al 2007). Other species can be detected by their faeces and the obvious browsing of forest lower tiers or ground disturbance.

Bird monitoring

Five-minute bird counts twice per year at the same time as predator monitoring. Bird monitoring should follow guidance from Department of Conservation protocol[4]. Bird counts should be spaced a minimum of 200 metres apart, with the permanent points established from the initial monitoring year. Within the extent of the enhancement areas, a minimum of 16 bird count stations should be established.

Monitoring data will be collected from within the enhancement area and each ecosystem type on an annual basis. Monitoring must be done by a suitably qualified ecologist.

Pest and weed control outcomes across the total enhancement area (108.32) will be monitored as part of the overall enhancement programme for the area. Standard monitoring parameters will be used including but not limited to:

- trap catch data (manual or automatic)
- bait uptake rates (kg per pulse)
- Tracking tunnel and chew card/waxtag results,
- Technical innovations in pest monitoring as these become available.
- Camera traps
- Pest plant mapping
- Browse indexes/faecal pellet counts (see Forsythe 2005 for methods).
- Bird abundance

[4] https://www.doc.govt.nz/globalassets/documents/science-and-technical/inventory-monitoring/im-toolbox-birds-incomplete-five-min-counts.pdf

12.3 Vegetation condition monitoring

Monitoring data for vegetation condition will be collected at Years 1 (baseline) 5, 10, 15, 20, and 25 from:

- 7 representative 20 x 20 m permanent Recce plots within WF9
- 3 representative 20 x 20 m permanent Recce plots within VS2 forest
- Four 10 x10 permanent Recce plots within RF enhancement areas at Years 1 (baseline) 5, 10, 15, 20, and 25.

Parameters to be measured are a subset of standard Recce data including:

- Seedling counts >15cm
- Sapling counts (>135cm & <2.5cm dbh[5])
- Sapling species diversity
- Groundcover % cover

Recce plot methods should be standardized:

- Plot locations should be representative of the average condition of the total area of each vegetation type at each location and should aim to provide wide spatial coverage where offset monitoring requires multiple plots.
- Plots should be permanently marked, and data collection repeated at the same locations in every monitoring year.
- Four 10 x 10 m Recce plot may be used in place of one 20 x 20 Recce plot if better representation is achieved e.g. for small rock forest fragments

Photo points should also be established at each plot location and at other suitable locations within the forest enhancement areas to visually record changes in forest condition over time.

12.3 Monitoring targets and contingencies

Monitoring targets and contingencies for predator control are presented in Tables 7 and 8.

Monitoring of faecal pellets, browse and camera traps should be able to demonstrate control of pigs, deer and goats to undetectable levels by Year 5 and maintenance of this level of control for the next 20 years. If this goal is not met, more intensive control is required to ensure it is met by Year 10. This may require more technical solutions such as use of thermal imaging cameras on drones or other innovative approaches as these are developed for general use.

Bird abundance is a proxy for bird breeding success which is very difficult and time-consuming to measure in the field. Ideally bird abundance should increase year on year, indicating population increases due to breeding success. However external factors such as weather patterns and dispersal of young birds can cause fluctuations. Effects of the forest enhancement actions on birds are also indirectly measured via predator control monitoring data.

Vegetation condition monitoring targets and contingencies are presented in Tables 9-14.

[5] Diameter at breast height

Table 7 Monitoring targets for for predator control

Enhancement attribute	2 years	5years	10 years	15 years	20 years	25 years
Tracking Tunnel Indices (%)	5%	5%	5%	5%	5%	5%
Residual Trap Catch (%)	5%	5%	5%	5%	5%	5%

Pest control attributes are considered feasible, based on previous published studies looking at the level of pest control required to have a 10% gain in bird breeding success (Innes et al, 2015 etc). Note that year 1 is not recorded, as the first year will be required for establishing pest control (i.e. installing bait stations, traplines etc). Pest control in forest enhancement areas will align with that being carried out in offset planting areas at the SAL site.

Table 8 Contingency table for pest abundance at offset

Biodiversity attribute	Required biodiversity value by 25 years	Contingency if not met at 20 years	Rationale for Contingency
Tracking Tunnel Indices (%)	5%	Adaptively manage. If expected 5-year target is not met investigate causes of high pest abundance and seek to remedy through increasing levels of rat control, such as increased density of bait stations or implementation of a buffer zone to reduce reinvasion from surrounding habitats.	Targets have been conservatively set. Previous studies have achieved this level of rat abundance on mainland forest fragments following a single bout of pest control. The risk of reinvasion at the enhancement sites is high, so more time has been allowed to achieve final targets. Risk of not achieving the target is low
Residual Trap Catch (%)	5%	Adaptively manage. If expected 5-year target is not met investigate causes of high pest abundance and seek to remedy through increasing levels of possum control, such as increased density of traps or implementation of a buffer zone to reduce reinvasion from surrounding habitats.	Targets have been conservatively set. Previous studies have achieved this level of possum abundance on mainland forest fragments following a single bout of pest control. The risk of reinvasion at the enhancement site is high, so more time has been allowed to achieve final targets. Risk of not achieving the target is low

Table 9 . Monitoring targets for 0.65 ha Rock Forest enhancement offset –Targets prior to offset outcome are indicative only and should prompt management response.

Biodiversity attribute	5 years	10 years	15 years	20 years	25 years
Total seedling count /20x20m plot	500	1000	1500	1900	2100
Sapling count/20x20m plot	5	20	50	100	280
Sapling diversity/20x20m plot	1	2	3	4	6
Groundcover (%)	0.1	1	3	6	8

Table 10 . Contingency table for Rock Forest values at offset site

Biodiversity attribute	Required biodiversity value by 25 years	Contingency if not met at 15 years	Rationale for Contingency
Total seedling count /20x20m plot	2100	Manage through enhancement of existing rock forest. Examine possible reasons for lack of sufficient seedlings e.g. insufficient control of browsing ungulates possums or rats. Intensify control of browsers if this is the reason. Consider whether there is sufficient local seed source and disperser presence (birds). If the monitoring targets are not being met, undertake more plots to ascertain whether it is a widespread problem or the result of an atypical plot	Lack of seedlings is most often the result of browsing pressure or lack of seed and avian dispersers. Forest lower tiers are often patchy. If monitoring targets are consistently falling short over multiple plots and vegetation enhancement parameters, additional enhancement area may be required.
Saplings count/20x20m plot	280	Examine possible reasons for lack of sufficient seedlings e.g. insufficient control of browsing ungulates possums or rats. Intensify control of browsers if this is the reason. Consider whether there is sufficient local seed source and disperser presence (birds). If the monitoring targets are not being met, undertake more plots to ascertain whether it is a widespread problem or the result of an atypical plot	Lack of saplings is most often the result of browsing pressure or lack of seed and avian dispersers. Forest lower tiers are often patchy. If monitoring targets are consistently falling short over multiple plots and vegetation enhancement parameters, additional enhancement area may be required.

Sapling diversity/20x20m plot	6	Examine possible reasons for lack of sufficient seedlings e.g. insufficient control of browsing ungulates possums or rats. Intensify control of browsers if this is the reason. Consider whether there is sufficient local seed source and disperser presence (birds). If the monitoring targets are not being met, undertake more plots to ascertain whether it is a widespread problem or the result of an atypical plot	Lack of sapling diversity is most often the result of selective browsing or lack of seed and avian dispersers. Forest lower tiers are often patchy. If monitoring targets are consistently falling short over multiple plots and vegetation enhancement parameters, additional enhancement area may be required.
Ground cover (%)	8	If the monitoring targets are not being met, undertake more plots to ascertain whether it is a widespread problem or the result of an atypical plot. Intensify control of browsers if this seems to be the likely cause of insufficient groundcover development.	Forest lower tiers are often patchy. If monitoring targets are consistently falling short over multiple plots and vegetation enhancement parameters, additional enhancement area may be required.

Table 11 Monitoring targets for Taraire, tawa podocarp Forest- Area. Targets prior to offset outcome are indicative only and may require management response.

Biodiversity attribute	5 years	10 years	15 years	20 years	25 years
Total Seedling count/20x20m plot	2700	3100	3400	3600	4000
Sapling count/20x20m plot	5	10	20	30	40
Sapling diversity/20x20m plot	4	5	6	7	8
Groundcover (%)	5	6	7	9	11

Table 12 Contingency table for Taraire, tawa podocarp Forest values at offset.

Biodiversity attribute	Required biodiversity value by 25 years	Contingency if not met at 15 years	Rationale for Contingency
Total Seedling count	**4000**	Managed through enhancement of existing WF9 forest. Examine possible reasons for lack of sufficient seedlings e.g. insufficient control of browsing ungulates possums or rats. Intensify control of browsers if this is the reason.	Lack of seedlings is most often the result of browsing pressure or lack of seed and avian dispersers. Forest lower tiers are often patchy.

		Consider whether there is sufficient local seed source and disperser presence (birds). If the monitoring targets are not being met, undertake more plots to ascertain whether it is a widespread problem or the result of an atypical plot	If monitoring targets are consistently falling short over multiple plots and vegetation enhancement parameters, additional enhancement area may be required.
Saplings count	**40**	Managed through enhancement of existing WF9 forest. Examine possible reasons for lack of sufficient seedlings e.g. insufficient control of browsing ungulates possums or rats. Intensify control of browsers if this is the reason. Consider whether there is sufficient local seed source and disperser presence (birds). If the monitoring targets are not being met, undertake more plots to ascertain whether it is a widespread problem or the result of an atypical plot	Lack of saplings is most often the result of browsing pressure or lack of seed and avian dispersers. Forest lower tiers are often patchy. If monitoring targets are consistently falling short over multiple plots and vegetation enhancement parameters, additional enhancement area may be required.
Sapling diversity	**8**	Examine possible reasons for lack of sufficient seedlings e.g. insufficient control of browsing ungulates possums or rats. Intensify control of browsers if this is the reason. Consider whether there is sufficient local seed source and disperser presence (birds). If the monitoring targets are not being met, undertake more plots to ascertain whether it is a widespread problem or the result of an atypical plot	Lack of sapling diversity is most often the result of selective browsing or lack of seed and avian dispersers. Forest lower tiers are often patchy. If monitoring targets are consistently falling short over multiple plots and vegetation enhancement parameters, additional enhancement area may be required.
Ground cover (%)	**11**	If the monitoring targets are not being met, undertake more plots to ascertain whether this is a widespread problem or the result of an atypical plot. Intensify control of browsers if this seems to be the likely cause of insufficient groundcover. Consider whether there is sufficient local seed source and disperser presence (birds).	Forest lower tiers are often patchy. If monitoring targets are consistently falling short over multiple plots and vegetation enhancement parameters, additional enhancement area may be required

Table 13 Monitoring targets for kanuka forest offset– Offset success measured at 20 years.

Biodiversity attribute	5 years	10 years	15 years	20 years
Total Seedling count/20x20m plot	1800	2000	2100	2250
Saplings count/20x20m plot	2	20	50	100
Sapling diversity/20x20m plot	2	4	6	8
Ground cover (%)	<1	3	6	10

Table 14. Contingency table for Kanuka Forest values at offset.

Biodiversity attribute	Required biodiversity value by 20 years	Contingency if not met at 15 years	Rationale for Contingency
Total Seedling count	2250	Examine possible reasons for lack of sufficient seedlings e.g. insufficient control of browsing ungulates possums or rats. Intensify control of browsers if this is the reason. Consider whether there is sufficient local seed source and disperser presence (birds). If the monitoring targets are not being met, undertake more plots to ascertain whether it is a widespread problem or the result of an atypical plot	Lack of seedlings is most often the result of browsing pressure or lack of seed and avian dispersers. Forest lower tiers are often patchy. If monitoring targets are consistently falling short over multiple plots and vegetation enhancement parameters, additional enhancement area may be required.
Saplings count	100	Examine possible reasons for lack of sufficient seedlings e.g. insufficient control of browsing ungulates possums or rats. Intensify control of browsers if this is the reason. Consider whether there is sufficient local seed source and disperser presence (birds). If the monitoring targets are not being met, undertake more plots to ascertain whether it is a widespread problem or the result of an atypical plot	Lack of saplings is most often the result of browsing pressure or lack of seed and avian dispersers. Forest lower tiers are often patchy. If monitoring targets are consistently falling short over multiple plots and vegetation enhancement parameters, additional enhancement area may be required.
Sapling diversity	8	Examine possible reasons for lack of sufficient seedlings e.g. insufficient control of browsing ungulates possums or rats. Intensify control of browsers if this is the reason. Consider whether there is sufficient local seed source and disperser presence (birds). If the monitoring targets are not being met, undertake more plots to ascertain whether it is a widespread problem or the result of an atypical plot	Lack of sapling diversity is most often the result of selective browsing or lack of seed and avian dispersers. Forest lower tiers are often patchy. If monitoring targets are consistently falling short over multiple plots and vegetation enhancement parameters, additional enhancement area may be required.
Ground cover (%)	10	If the monitoring targets are not being met, undertake more plots to ascertain whether it is a widespread problem or the result of an atypical plot. Intensify control of browsers if this seems to be the likely cause of insufficient groundcover development. Consider whether there is sufficient local seed source and disperser presence (birds).	Lack of seedlings is most often the result of browsing pressure or lack of seed and avian dispersers. Forest lower tiers are often patchy. If monitoring targets are consistently falling short over multiple plots and vegetation enhancement parameters, additional enhancement area may be required.

13 Summary of Biodiversity Outcomes

Forest enhancement of 108.35 ha will also occur simultaneously with enhancement actions beginning in Year 1. These biodiversity offset actions have been modelled to account for the loss of 16.65 ha of native vegetation over 50 years. The biodiversity outcomes expected for the forest enhancement areas are the restoration of the physical structure of the forest, forest flora and fauna diversity and abundance, and forest biomass.

These biodiversity outcomes will address short term biodiversity loss due to vegetation removal within the Sutton Pit until offset planting areas begin to provide replacement habitat for these lost areas of vegetation.

The forest enhancement areas are connected to the offset planting areas so that the Sutton Pit will be completely surrounded by protected vegetation and native offset planting, with pest and weed control across the whole. This will be a net biodiversity gain compared to the current situation.

At quarry end-of-life the quarry closure plan can be expected to result in further remediation planting that will also contribute to landscape connectivity of native habitats.

Two thirds (66%) of enhancement actions will occur at least 10 years in advance of the loss of vegetation, providing very important biodiversity gains ahead of vegetation loss and addressing time lags inherent in loss of vegetation. Forest enhancement actions at Drury Quarry will protect important habitats for native fauna and combined with the proposed restoration planting, represents a significant improvement in the extent, quality and connectivity of local indigenous biodiversity and habitats.

14 Legal Protection

Areas of existing forest that are proposed to be enhanced all occur on land owned by SAL at Drury Quarry and will be legally protected in perpetuity via a suitable conservation covenant. The covenant will include obligations to maintain weed and pest control in perpetuity.

15 References

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Disclaimer and restrictions of intended purpose

This report has been prepared solely for the benefit of [Comments] as our client with respect to the brief. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such party's sole risk.

JS Ecology has performed the services for this project in accordance with the standard agreement for consulting services and current professional standards for environmental site assessment. No guarantees are either expressed or implied.

Recommendations and opinions in this report are based on discrete sampling data. The nature and continuity of matrix sampled away from the sampling points are inferred and it must be appreciated that actual conditions could vary from the assumed model.

APPENDIX 1 Pest Control methods

Common name	Scientific name	Recommended control method/s	Timing/ density of traps or bait stations	Comments
Possum	*Trichosurus vulpecula*	(i) Trapping: Timms or Trapinator trap or similar OR (ii) Automatic trap e.g. AT220 (iii) Broadificoum or Double Tap pellets in bait stations. One bait station/hectare	(i) & (ii)1 trap per hectare (ii) Place Philproof bait stations 100m apart	(i) Check all traps frequently at first to ensure they are catching pests. Continue to check Timms/Trapinator traps frequently to re-bait and reset (ii)Replace lures and batteries/CO_2 cylinders as necessary (ii) Check baits frequently at first and replenish as required. Pulse four times annually
Rat: ship rat Norwegian rat	*Rattus rattus* *Rattus norvegicus*	(i) Automatic trap e.g. Goodnature A24 or AT220 (ii)Broadificoum or Double Tap pellets as for possums in bait stations (2/ha).	(i)2 traps/ha Bait stations can be placed up to 50m apart.	(i) Check all traps frequently at first to ensure they are catching pests. Replace lures and batteries/CO_2 cylinders as necessary. Check baits frequently at first and replenish as required. Pulse four times annually
Mustelids: ferret Stoat weasel	*Mustela furo,* *Mustela erminea* *Mustela nivalis vulgar*	DOC 200 kill trap baited with a hen's egg, fresh rabbit meat or a long-life bait block. .	1 trap per 3 hectares or every 200m along a riparian corridor.	Check bi-monthly, re-baiting and resetting as necessary. Keep the mechanism in good order using vegetable oil to lubricate..
Feral cats	*Felis catus*	Tawhiti "smart" cage trap with automatic lure	Place where cat sign is seen or along forest edges and tracks.	Check trap within 24 hours of notification. Ensure the "smart" notification is working before setting

APPENDIX 2 Control methods for pest plants found within offset enhancement areas for Sutton Pit Project

Common name	Scientific name	Control method(s)	Herbicides and application rate	Time of application	comments
Barberry	*Berberis glaucocarpa*	(i) Hand pull seedlings & small plants (ii) Cut and paint stump with herbicide	 (ii)metsulfuron-methyl 600g/kg (5g/L).	(i)All year round: (ii) All year round	Cut stumps resprout quickly, can be hard to kill. Follow up 6-monthly
Blackberry	*Rubus fruticosus*	(i)Dig out or cut and paint stumps. (ii)Foliar spray with Metsulfuron	(i) metsulfuron gel. (ii) 5 g Metsulfuron + 10 ml Penetrant/10 litres water	(i) November to April (ii)Apply Metsulfuron November to April	Plant material should be burned or disposed of at a refuse centre. Only mulch dead plant material.
Eleagnus	*Eleagnus* x *reflexa*	(i)Dig out with machinery if possible. (ii). Cut at ground level & stump paint. Follow up likewise on suckers. (iii). Bore & fill large stems at ground level (iv) Spray small plants and regrowth.	 (ii) Glyphosate (250ml/L) or a product containing 100g picloram+300g triclopyr/L (undiluted) or picloram gel. (iii) 20 ml undiluted Tordon BK per hole.	 (iii) Best done in autumn.	(i) & (ii) Do not mulch. Remove cut material from site (iii) Inferior to stump painting but eliminates need to dispose of stems, which can be cut & removed once dead.

			(iv) (5g metsulfuron /10L)		
Gorse	*Ulex europaeus*	(i)Dig out or rotary slash. (ii) cut and paint stumps with herbicide (iii) Foliar spray	 (ii) Paint stumps with with 2g metsulfuron per 1 L of water. (iii). Foliar spray with 5g metsulfuron-methyl per 10L of water and 20ml penetrant or foliar spray with 60ml triclopyr per 10 Litres of water and 20ml penetrant.	(i)All year round (ii) All year round (i)November - February	(i) Do not burn as this triggers seed germination (ii)Ensure stumps are painted with herbicide within 5 minutes of felling.
Hawthorn	*Crataegus monogyna*	(i) Hand pull seedlings & small plants (ii) Cut and paint stump with herbicide	 (ii)metsulfuron-methyl 600g/kg (5g/L)).	(i)All year round: (ii) All year round	Cut stumps resprout quickly, can be hard to kill. Follow up 6-monthly.
Kikuyu	*Cenchrus clandestinus*	(i)Spray with herbicide	(i) Foliar spray with 100ml glyphosate green per 10L of water and 20ml penetrant or 150ml haloxyfop-P-	(i) October-April	2-3 treatments required. Spray during drought or other stress if using near watercourses.

			methyl per 10L of water.		
Moth plant	*Araujia sericifera*	(i) Destroy ripe pods (ii) Pull/dig out seedlings where feasible. (iii) Foliar spray where host plants will not be affected (iv) Cut stems low down and paint stumps where growing on desirable host plants. Paint 20cm of the stem below the cut as well.	(iii)5 g Metsulfuron /10 litres water and 20ml penetran (iv) 1g metsulfuron-methyl per 1 L of water or metsulfuron gel.	(i) March - May (ii) Year round (iii) October - March (iv) October - March	(i) pick pods off plants and dispose of to deep landfill (ii) & (iii) leave uprooted or sprayed plants to compost (iv) Leave cut vegetation to die on host plant.
Pampas (common and purple)	*Cortaderia selloana, C. jubata*	(i)Hand dig small plants or use a digger to remove large clumps **or** (ii) Foliar spray larger plants & clumps	(ii) Foliar spray with 200ml glyphosate green per 10L of water and 20ml penetrant or 150ml haloxyfop-P-methyl per 10L of water.	(i) All year round (ii)October-March for best results	Burn or mulch cut vegetation or send to landfill. (ii)Thoroughly cover all foliage with spray. 2-3 treatments required.
Poplars	*Populus deltoides*	(i)Cut and squirt large plants make 1 cut every 100mm around the trunk and fill or saturate each cut with herbicide (ii)Cut trunk and paint stump with herbicide	(i) 10g metsulfuron-methyl per 1L of water (ii) metsulfuron gel.	(i)all year round: (ii)all year round	(ii)Cut trunk near to the ground, and swab freshly cut stump

Privet (Chinese & tree)	*Ligustrum sinense* *Ligustrum lucidum*	(i)Pull/ dig out seedlings where feasible **or** (ii) foliar spray (iii) cut and treat stump for larger plants **or** (iv) Drill trunk and inject. Drill 18mm holes every 150 mm around the trunk and saturate each hole with herbicide	 (ii) 5 g Metsulfuron /10 litres water (iii) 10g metsulfuron-methyl per 1L of water (iv) 10g metsulfuron-methyl per 1L of water.	(i)All year round (ii) October-April (iii) October-April	(i), (ii) & (iii) Compost, burn or mulch cut vegetation. (iii)Ensure stumps are painted with herbicide within 5 minutes of felling. (iv) leave to die standing
Wild ginger		(i) Cut stems and dig out rhizomes of small plants (ii)Cut down and paint stump: cut above pink 'collar' at base and apply herbicide.	 (ii) 1g metsulfuron-methyl per 1 L of water	(i)All year round (ii) All year round	(i)Do not leave tubers on site – dispose of to landfill. (ii)Leave stems and leaves on site to rot down. Reduce rates to 0.5g metsulfuron-methyl per 1 L of water if working under natve forest.
willow	*Salix fragilis* *Salix cinerea*	(i)Cut and squirt: Make 1 cut every 150mm around the trunk and saturate with herbicide. (ii) Bore and fill (summer-autumn): Drill 18mm holes every 150 mm around the trunk and saturate each hole with herbicide (iii) Frilling: use a sharp chisel to make a continuous series of cuts around the trunk near ground level. Fill each cut with herbicide.	(i) 500ml glyphosate per 1L of water (ii) 500ml glyphosate per 1L of water (iii500ml glyphosate per 1L of water	(i) October-April (ii) October-April (iii) October-April	Begin control at top of catchment, treat every stem. (i). (ii) & (iii) Apply herbicide within 5 minutes of making cuts or holes in the trunk. Under planting with natives can follow as soon as the trees defoliate. Remove any cut material from site.
Woolly nightshade	*Solanum mauritianum*	(i)Seedlings – hand pull (ii)Cut and paint stumps of larger trees		(i)All year round (ii) All year round	(i) leave plant material on site to rot or mulch

		(iii)Frill stem and paste fresh cuts (iii) Trees – drill and inject	(ii) Double strength glyphosate or picloram gel (iii) Double strength glyphosate or picloram gel (iii) Metsulfuron 20g/litre water, plus 2ml surfactant	(iii) All year round	(ii) Ensure stumps are painted with herbicide within 5 minutes of felling. (iii) Leave to die standing Avoid using picloram near streams and wetlands.