Boffa Miskell

# Pest Animal Management Plan

Wharekirauponga Compensation Package
Prepared for OceanaGold

24 February 2025

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|---|---|---|
| **Bibliographic reference for citation:**<br>Boffa Miskell Limited 2025. *Draft Pest Animal Management Plan: Wharekirauponga Compensation Package*. Report prepared by Boffa Miskell Limited for OceanaGold. | | |
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| StatusFinal | Revision / version: H | Issue date: 24 February 2025 |

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Template revision: 20210624 0000

File ref:
\\bmlaklfs1\NAT_design$\2022\BM220086_HBI_Pest_management_for_southern_Coromandel_mitigation_area\Documents\WPAMP

*Cover photograph:* Archey's frog, Coromandel © E. Hotham, 2021

# Executive Summary

The Waihi North Project comprises several components to expand the Waihi operation with a new open pit (Gladstone Open Pit) and one new underground mine, Wharekirauponga (WUG). This document outlines a proposed animal pest management programme and associated habitat enhancement with a focus on Archey's and Hochstetter's frogs in the Wharekirauponga Animal Pest Management Area (WAPMA).

This programme has been developed to address any potential impacts of this project on frogs (although it is noted that these impacts, if any, are expected to be minimal). The pest control programme outlined in this report is expected to benefit the resident frog populations both by removing direct predation risk, as well as providing substantial benefits via the habitat enhancement that comes from comprehensive and adaptive pest control. Significant wider biodiversity gains on native flora and fauna will also occur.

The proposed WAPMA (632 ha) encompasses both the potential vibration impacted area (314 ha) and an adjacent area of high-quality frog habitat (318 ha), which is not subject to potential vibration impacts. Recent pest monitoring (commencing in 2024), has shown high population indices of pests within this area, including rodents, possums, mustelids, feral cats and pigs. This provides a high degree of confidence that undertaking intensive pest control will result in substantial and widespread benefits to flora and fauna.

This report outlines the proposed intensive pest control regime within the WAPMA, including:

- A description of the proposed WAPMA;
- A review of baseline pest monitoring;
- Target pest species;
- Protocols for toxic aerial baiting;
- Protocols for ongoing predator trapping;
- Protocols for ongoing ground based toxic baiting;
- Protocols for ongoing control of ungulates;
- Monitoring protocols;
- Timing and duration of control;
- Performance standards; and
- Data management and reporting.

As this pest management plan is focussed on biodiversity enhancement for offsetting purposes, it excludes pest invertebrates (with the exception of wasps), pest plant species, pathogens (i.e. kauri dieback, myrtle rust) and herpetofauna (i.e. plague skinks).

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# 1.0 Introduction

## 1.1 Project Background

The current Waihi life of mine plan (LoMP) is to complete production by the end of 2030. Study work conducted between 2016 and 2020 identified opportunities to expand the Waihi operation with one new open pit and a new underground development beneath Wharekirauponga, within Coromandel Forest Park. The WNP will integrate these new developments with OGNZL's existing mines and existing and consented mining infrastructure. The WNP comprises several elements, including:

- a new underground mine and associated facilities (Wharekirauponga Underground Mine or WUG);
- a new open pit (Gladstone Open Pit, GOP);
- a new tailings storage facility (TSF3);
- a new rock stack (the Northern Rock Stack, NRS).

## 1.2 Project impacts on ecology

The potential adverse ecological effects of the WUG are associated with exploration, construction and operational activities (Boffa Miskell Ltd, 2025). Broadly, the construction phase includes all site works at Willows Road farm and construction of the access tunnels (i.e. drilling and blasting that advances toward the resource). The operational phase includes ongoing activities associated with underground mining such as drilling and blasting to access and recover the resource (localised around the orebody) and associated sustained noise and vibration effects. The operational phase of underground mining is longer in duration (up to 10 years) and activities may be concentrated in particular areas).

Ecological management / compensation described in this report is based on compensation modelling undertaken by RMA Solutions. The RMA Ecology report (2025), which considers the overall summary of ecology matters, concludes that the package of ecological enhancements proposed by OGNZL for the WNP is centered on a net-gain ecology approach and will achieve clear net-benefits that substantially exceed the value and extent of areas modified or removed. Potential residual effects are described in detail in BML (2025), Bioresearches (2025) and RMA Solutions (2025.

However, the level of effects with mitigation and management measures ranges from Low to Very Low (Boffa Miskell Ltd, 2025). The primary effect of the Project within Coromandel Forest Park is the temporary loss of vegetation / habitat (0.09 ha) at each of the four ventilation raise sites and associated change in vegetation community when these sites are restored (at the close of mining). These effects will be offset by replanting and facilitating the natural regeneration of an approximately 4.15 ha area on the north east ridge of Willows Road Farm to connect Coromandel Forest Park with a forest fragment on Willows Road Farm. Additional ecological benefits associated with this project include replanting the forest boundary on Willows Road Farm (5.5 ha).

Additional potential ecological effects associated with WUG include disturbance to fauna from construction and helicopter noise; continuous noise emissions from the vent raises; and the potential to introduce kauri dieback disease into the forest environment during works.

There is a low (but uncertain) risk for this project to generate residual adverse effects on Archey's and Hochstetter's frogs (Bioresearchers 2025). Residual effects from the project on resident frog populations may arise from vibration, discharge of air pollutants via the vent shaft, and failure of the proposed mitigation measures. The impacts of these effects may include reduction of fecundity, movement of frogs out of the affected area, and / or lowered population viability of the Archey's frogs within the vibration footprint. The impacts of likelihood of these potential effects are summarised in Table 1. Large-scale habitat loss was ruled out given there is no earthwork or groundwater effects.

The primary compensation measure to address these potential residual effects is wide scale intensive pest control over an area of 633 ha, including 314 ha exposed to vibration levels greater than 2mm/s and 318 ha immediately adjacent. Compensation as research funding is proposed to undertake investigative work within the WUG and wider Wharekirauponga Animal Pest Management Area to assess efficacy of pest control regimes for frog recovery.

*Table 1.* Likelihood of occurrence and potential effects on frogs and frog habitat of potential adverse effects that may be associated with the WUG project. Summarised from Bioresearchers 2025.

| **Potential effect** | **Likelihood of occurrence** | **Likelihood of loss of potential frog habitat** | **Explanation** |
|---|---|---|---|
| Vibration (episodic) – at ground level leading to loss of breeding success/ frog movement away | Low | Nil | Vibrations will be intermittent and are at levels unlikely to result in biological responses that negatively impact frogs and their reproduction |
| Vent shaft – discharge of air pollutants, leading to localised pollutant effects on frogs | Very Low | Nil | Several thousands frogs may be in the vicinity of vent stacks and exposed to elevated levels of air emissions compared to the current background state (although less than levels that roadside Archey's frogs are currently exposed to). |
| Potential dewatering effects associated with mine dewatering and associated groundwater drawdown | Very Low | Very low (Hochstetters)<br>Nil (Archeys) | Reductions in flow and wetted width are unlikely to negatively impact semi-aquatic Hochstetter's frog habitat quantity or quality. Potential dewatering will have no impact on terrestrial Archey's frogs |
| Failure of proposed mitigation measures | Very low | Low (less than 1 ha; which constitutes far less than 0.3 % of the local WUG area occupied by Archey's frogs, and around 0.61 % of known occupied habitat by Archey's frogs on the Coromandel Peninsula | Some number less than the estimated population within the potential effects footprint |

## 1.3 Residual ecological effects management

The 'effects management hierarchy' was applied to address the identified impacts of the proposed WNP (EIANZ; Roper-Lindsay et al., 2018). The effects management hierarchy outlines the order of priority for ecological impact management as:

a. Avoid.

b. Remedy.
c. Mitigate.
d. Offset.
e. Compensate.
f. And any supporting actions.

The proposed mitigation for the Project has been offered as a fully integrated mitigation 'package' that includes all aspects of mitigation, offsets, and compensation for landscape and ecological enhancements so that the overall cumulative benefits are a vast improvement than each individual component. The Mitigation Plan is fully described in the 'WNP mitigation and offset plan' includes:

- Ecological and landscape connectivity across and within the Waihi North Project.
- Extensive restoration planting and open areas across the Waihi North Project.
- Extensive riparian planting along the waterways, to complement the riparian enhancements already carried out by OGNZL (and its predecessors).
- Providing recreational opportunities where safe to do so.
- Creation of new wetlands, and enhancement of existing wetland areas.
- Enhanced habitat for elements of native fauna such as frogs, birds, eels, koura, Cran's bullies, and for wetland birds.
- Greater ecological connectivity across the landscape for both resident and transient fauna.

Specially regarding frogs, a range of initiatives are being proposed to address the potential residual adverse effects, which could be defined as further mitigation, or biodiversity offsetting, or ecological compensation. These actions, which seek to provide measurable benefits for Archey's and Hochstetter frogs, include:

The approach to managing the (low) potential for residual adverse effects on frogs has four components. These include:

- Predator control around the WUG area;
- Frog distribution surveys to better assess population status;
- Fund frog-related research programmes;
- Investigate translocation and population establishment;

## 1.4 Benefits of Pest Management in New Zealand

Introduced mammalian pests have an extensive, damaging impact on New Zealand's flora and fauna. Reducing these impacts via pest control is known to result in substantial benefits for native biodiversity. For example, possum, rat and ungulate control has been proven to directly benefit native NZ vegetation by increasing foliage and fruit production, and by reducing tree mortality (Byrom et al., 2016; Wilson et al., 2003). Possums are opportunistic feeders, but particularly seek out tall canopy trees and will systematically strip individual trees of vegetation, after which the tree often cannot survive. This changes the composition of the forest over time and every level of the ecosystem is impacted.

Native bird abundance has also been proven to significantly increase following pest population suppression to low densities, both on offshore islands and on the mainland (MacLeod et al., 2015; Saunders & Norton, 2001; Spurr & Anderson, 2004). Integrated pest management regimes (similar to that recommended here), have been effective at mitigating the impacts of predation by introduced mammals at a landscape scale, including for even the most vulnerable species (O'Donnell & Hoare, 2012).

Pest control can also help to restore functionality of ecosystem services. At Maungataurari Sanctuary Mountain, Iles & Kelly (2014) demonstrated the restoration of pollination services to kotukutuku resulting from higher abundance of pollinating birds. Compared to sites with no pest mammal management, there was higher bird visitation to kotukutuku flowers, and higher pollen loads on female and hermaphrodite flowers.

There is also a growing body of evidence that some of the benefits of pest control can spill over into the surrounding landscape, sometimes referred to as a 'halo effect' (Glen, Pech, et al., 2013). For example, the abundance of tūī increased in the largely unmanaged area surrounding Maungatautari Sanctuary Mountain over a nine-year period following pest eradication (Fitzgerald et al., 2019), and forest bird species, including kākā, have recolonised many of Wellington's urban forests since the establishment of Zealandia (Recio et al., 2016). These spillover benefits have also been observed for vegetation, for example, Tanentzap & Lloyd (2017) found that saplings of bird-dispersed fleshy-fruited tree species were higher inside and up to 500 m outside of Orokonui Ecosanctuary (near Dunedin) eight years after the mammal eradication than in comparable unfenced sites. Halo effects have also been observed at unfenced sites with predator control; at Ark in the Park elevated abundances of several native taxa (including broadleaved trees and weta) were observed up to 600 m beyond the edge of control infrastructure (Nathan et al., 2013).

Furthermore, a recent report by Forest and Bird (Hackwell & Robinson, 2021) estimated that the equivalent of nearly 15% of New Zealand's 2018 net greenhouse gas emissions per year — 8.4 million tonnes of CO2 — could be locked into native ecosystem carbon sinks if feral browsing animals were controlled to the lowest possible levels, although the timeframe to achieve these benefits may be long (Allen et al., 2023).

The methods needed to suppress pests sufficiently to achieve positive biodiversity outcomes are now well understood and widely used. Effective pest control is therefore expected to have an immediate benefit on native fauna, including decreasing predation pressure on populations of birds, lizards and invertebrates, increasing reproductive success due to lower instances of nest predation, and decreasing the impact of browse on native flora, thus increasing availability of food resources and plant survival. As the success of pest control and resulting biodiversity gains are readily obtained, measurable and can be tracked over the long-term, undertaking pest control as a form of mitigation is becoming more commonplace around New Zealand.

## 1.5 Impacts of predators on native frogs

Introduced mammalian predators (including rats, stoats, mice, possums, hedgehogs, feral pigs, and cats), are widely known to predate on *Leiopelma* frogs and have been implicated in the decline in distribution of *Leiopelma* in New Zealand (Bishop et al., 2013; Egeter et al., 2015; Egeter, 2014; Thurley & Bell, 1994). A recent review of native frog translocation outcomes showed that the presence of invasive predators was among factors associated with translocation failure (along with small founder numbers, homing behaviour, and poor habitat quality) (Wren et al., 2023). A number of biological features make New Zealand's native frogs vulnerable to population decline or extinction, including: restricted distribution ranges, unusually long lived, low reproductive rates, and vulnerability to introduced predators (as reviewed in Najera-Hillman, 2009).

Baber et al. (2009) suggested that introduced mammals are likely to be the most serious threat to Hochstetter's frogs (*L. hochstetteri*), with ship rats (*Rattus* spp.) in particular named as a primary factor contributing to the extinction of New Zealand's herpetofauna. Molecular diet analysis has demonstrated that both Hochstetter's and Archey's frogs (*L. archeyi*) are a food source for rats (Egeter et al., 2015, 2019), with ship rats consuming both species on mainland New Zealand. Rat bite marks have previously been discovered on the remains of Archey's frogs (Thurley & Bell, 1994).

It is likely other introduced mammalian predators such as mustelids (*Mustela* sp.) and cats (*Felis catus*) are also contributing to the decline of native anurans, with multiple observations of predation events. For example, in April 2005, a stoat was observed with a live Hochstetter's frog in its mouth in the Hunua Ranges (Baber et al., 2008), and in September 2024 Hochstetter's frog remains were found in a trapped ferret's stomach at Mahakirau Forest Sanctuary (Mahakirau Forest Sanctuary, unpublished data[1]).

Feral pigs (*Sus scrofa*) also destroy frog habitat by trampling and foraging on the edge of streams, and may also opportunistically consume native frogs (Baber et al., 2006). There have now been multiple reported events of native frogs being found in the stomach contents of hunted pigs, with anecdotal reports of live Archey's frogs being found in some (Emily Hotham, Pers comm). It is likely that the impact of feral pigs on frog predation has previously been underestimated, and feral pig control should form a key part of any population restoration attempts with a focus on frog recovery. The control of the feral ungulates also promotes an increase in ground cover vegetation (and thereby microhabitat quality), which is also key to promoting population recovery (Easton, 2021).

There is currently no direct evidence that mice (*Mus musculus*) prey on *Leiopelma* frogs in the wild (Egeter et al., 2015). However, mice consumed southern bell frogs (*Litoria raniformis*) in laboratory trials (Egeter, 2014), and some indirect field evidence is suggestive of potential mouse predation on native frogs. Germano *et al.* (2023) studied the outcomes of rat control on Archey's frogs in Whareorino Conservation Area over a 12-year period. They recorded reduced survival of juvenile and sub-adult frogs in plots where rat control was implemented (relative to plots with no rat control), and suggested mouse predation as a potential explanation, noting a concurrent increase in mouse abundance in the rat control plots attributed to the release of mice from predation and competition by rats. In that example, it is important to note that the frog population as a whole increased over time, despite the reduction in subadult and juvenile survival rates, due to strong adult survival (Germano et al., 2023). Predation by mice (and/or kiwi) was also suspected as causing an initial decline of a small population (29 individuals) of Hamilton's frogs (*Leiopelma hamiltoni*), translocated to Zealandia and released in an area where mice were present. This population survived and reproduced at lower rates than another group which were released into a mouse-proof sub-enclosure within Zealandia at the same time (Lukis, 2009). Nevertheless, with annual toxin operations to suppress mice, as well as a supplemental translocation of additional frogs, this translocated population of frogs has persisted (Karst et al., 2023). Furthermore, there are other potential explanations for the initial decline of this small translocated population, in particular, founder populations of fewer than 70 individuals are associated with translocation failure (Wren et al., 2023).

Leaving predators and other pests uncontrolled (or poorly controlled), will lead to ongoing predation events on frogs and continued population declines. Despite this, efforts to control

[1] Post on Mahakirau Forest Sanctuary Facebook page, 20 September 2024. https://www.facebook.com/Mahakirau

predators for recovery of threatened amphibian populations are few (Baber et al., 2008). Furthermore, whilst undertaking a review of other predator control programmes for frogs as part of establishing the Wharekirauponga PAMP, it became clear that previous pest control attempts have generally not been comprehensive and adaptive enough to allow for the potential maximum benefits.

## 1.6 Benefits of predator control on native frogs

Table 2 summarises three comparable case studies that have reported benefits of intensive predator control on *Leiopelma* frog populations in New Zealand. These case studies show that predator control, in particular targeting rats (either specifically for protection of frogs or other native species), have measurable benefits on both population size and juvenile recruitment of *Leiopelma* populations.

For example, there is a substantial body of evidence that intensive control of ship rats, stoats and possums aimed at protecting kōkako in the Hunua Ranges (Kōkako Management Area; KMA) also benefits Hochstetter's frog populations. Crossland et al. (2023) used occupancy modelling to show that history of predator control was the only factor that was strongly and consistently related to frog occupancy of sampling sites within the Hunua Ranges, with the probability of occupancy by juvenile, sub-adult, and adult frogs being higher at sites that were subject to intensive predator management. In earlier studies at the same site, Baber et al. (2008) found that pest control in the KMA resulted in an increased abundance of Hochstetter's frog, as well as a higher proportion of juveniles when compared to nearby areas with substantially lower levels of pest control. Further, the smaller mean size of frogs and the higher proportion of juveniles within the KMA compared to outside the KMA, indicates that introduced mammals may also influence population structure (Baber et al., 2008).

In another case study involving Hochstetter's frogs, in 2004, a very small population of this frog species was discovered in a single catchment within the 3363 ha Maungatautari Sanctuary Mountain during the construction of the predator-exclusion fence. Pest eradication within the Sanctuary was subsequently completed in 2007, with the exception of mice. Frog surveys were carried out in 2009 and 2012, i.e. approximately 2 and 5 years after the eradication of most mammal pests. A fourfold increase in frog abundance was recorded between the two surveys, as well as a wider spatial distribution, suggesting a population that was growing and spreading out within a short timeframe despite the persistence of mice in the Sanctuary (Longson et al., 2017).

Archey's frog populations have also been shown to benefit from ship rat control in several studies at Whareorino forest (Ramirez Saavedra, 2017 and references within) (Table 2). Recent reports by DOC (including Easton 2021), monitoring Archey's frogs at Whareorino, conclude that "*it does seem that rat control has been generally effective in suppressing rat numbers and is likely benefiting the frogs*". However, habitat protection for frogs remains challenging at Whareorino (particularly with ongoing ungulate impacts), and rat numbers in frog protection areas have frequently been well over the 5% tracking tunnel index (TTI) targets (sometimes up to 60% TTI; Easton, 2021), meaning these frogs have still been subject to predation impacts.

In 2023, Germano et al., published results from a 12-year study in Whareorino Conservation Area, which investigated the effects of sustained rat control on Archey's frog survival. A key conclusion of this study was that:

> *"Population modelling showed ongoing rat suppression has a positive effect on the rate of independent juveniles produced per adult frog and on adult abundance over time, revealing a significant increase in frog abundance in treatment (annual rate of increase,*

*adult frogs: 10.75, 95%; CI [4.62, 17.24]) compared to nontreatment areas where frogs declined".*

In summary, evidence from multiple studies indicates that native frog populations can be expected to respond positively to intensive animal pest management and as such they may also be a useful bio-indicator to measure the general success of mammalian pest control initiatives. Control of rodents, mustelids, possums, pigs and feral cats will therefore have a direct and measurable positive impact on the frog population at Wharekirauponga. Based on evidence from other pest control programmes around New Zealand, with effective pest control in place over the wider area, the population of Archey's frogs could be expected to increase between 2.3 and 4 x the current population over a period of 3-4 years (and possibly greater in subsequent years) (Table 2).

Table 2. Summary of case studies of predator control impacts on frog populations. Note areas are approximations only, and some boundaries are not well-defined.

| **Area** | **Size** | **Control programme** | **Pest control targets** | **Success rates for frogs** | **References** |
|---|---|---|---|---|---|
| Kokako Management Area (KMA; Hunua Ranges) | 850 ha | Intensive bait stations and traps; aerial 1080 | 1% residual trap catch (RTC) for possums and 1% rat tracking index (RTI) for rats by 1 Nov each year | Hochstetter's frog abundance / person hour searched was significantly higher within the KMA, with a higher the proportion of juveniles in the KMA (21% inside c.f. 9% outside).<br>Predator control consistently associated with higher probability of site occupancy by Hochstetter's frogs. | • Baber et al., (2008)<br>• Baber et al., (2009)<br>• Crossland et al., (2023) |
| Maungatau-tari | 3,363 ha | Pest eradications and pest-proof fence (except mice) | 0% (pest-free) except for mice) | Fourfold increase in Hochstetter's frog numbers between 2009 and 2012 from low initial density | • Longson et al., (2017) |
| Whareorino | Initially 300ha, later in 2017 increased to 600ha | Intensive ground-based rodent control programme using with anticoagulant rodenticides and five yearly aerial 1080 operations | <3% for possums<br><5% TTI for rats | 2.3 x increase in *L. archeyi* population numbers (Ramirez Saavedra 2017), despite rodent densities sometimes reaching high levels.<br>Significant increase in frog abundance in treatment area. | • Haigh et al., (2007)<br>• Ramirez Saavedra (2017)<br>• Pledger (2011); Pledger (2013), Bridgman (2015) (unpub DOC reports, cited in Ramirez Saavedra (2017).<br>• Germano et al., (2023) |

## 1.7 Confidence in success of achieving WAPMP control

### 1.7.1 Advances in technologies

Pest control tools in New Zealand have been advancing at a rapid rate, which is allowing for substantial improvements in managing pests in a cost-effective and efficient manner. As well as continuing to improve the use of existing tools, new technologies are now available with increased efficiency and humanness (such as self-resetting traps, species recognition devices, species-specific toxicants and novel toxin and lure delivery systems). Investment driving these advances has been greatly enhanced through the instigation of the Predator Free 2050 government initiative.

An example of one of these new tools is norbormide, a uniquely selective rat toxicant, with rats being 100- to 150-fold more sensitive to norbormide toxicity than most other mammals and birds. After 10 years of focused development in New Zealand, recent field results showed 100% reductions in ship rat abundance at two large test sites (Shapiro et al. 2022).

Automatic resetting traps or poison delivery devices which can continually operate for extended periods allowing for ongoing effective operation are greatly reducing labour costs while increasing control efficiency (such as the AT220 from NZ Auto Traps and the CSL AI trap from Critter Solutions). These new tools have greater cross-species effectiveness, are safer for non-target species and include remote connection technologies. When compared to conventional single set DOC traps, the number of kills per trap type versus the days of operation in the field differ greatly. In a 2022 comparison by Swann, manual DOC traps were estimated to have a kill per trap per year rate of 1.23 (when manually rebaited 26 times per year), whereas the NZ Autotraps was 31.08 and recently the CSL AI trap was recorded as having a kill rate of 86.46 target pest kills per year per trap.

Trapping projects have been able to achieve and maintain very low densities of pests purely based on using these newer resetting trap designs.  For example, Bay Bush Action Conservation Trust in Opua Forest, Bay of Islands used a 75 x 75 m grid network of AT220 traps over 263 ha, reducing possums and rats to near zero density (Bay Bush Action Group 2022).  This was a notable result given highly productive warm Northland podocarp/broadleaf forest can support densities of pests. Rat tracking was reduced from 46.6% to 0% within six months (with 0% still recorded at 12 months). Similarly, possums were reduced from 93.3% tracking to 5.7%.

### 1.7.2 Predator Free 2050 landscape initiatives

The Predator Free 2050 ‘landscape’ projects aim to achieve areas of widespread pest elimination or suppression on mainland New Zealand. As of 2023, the cumulative areas under these initiatives were 1,472,683 ha, which included work undertaken both by DOC and ‘on-the ground’ work undertaken by Predator Free 2050 Limited landscape projects.

As of June 2023 (according to the Predator Free 2050 biennial progress report), there was 1,775,513 hectares (ha) of public conservation land with ongoing control of mustelids, rats and possums under the DOC’s National Predator Control Programme. This will increase slightly over the next 4 years to 1,800,000 ha. In 2022, most NPCP operations achieved a post-operation rat monitoring result of 0%.

In June 2023, Predator Free South Westland had eliminated predators from around 43,500 ha across two distinct sites, in the Whataroa Perth catchment and South Ōkārito rowi/kiwi sanctuary, with re-invasion being managed around the boundaries of each site. The project aims to have eliminated predators across nearly 107,000 ha by 2025. Other smaller projects (each less than 20,000 ha) have achieved elimination of one or more of the target predator species. Some areas have been free of resident predators for over 3 years. Predator Free Wellington is defending 1,200 ha of mustelid (weasel and stoat) and Norway rat elimination. Predator Free Hawke's Bay (Whakatipu Māhia) is defending 5,500 ha of possum elimination. Towards Predator Free Taranaki – Taranaki Taku Tūranga is defending 2,000 ha and Predator Free Whangārei is defending 1,882 ha of possum freedom.

### 1.7.3 Case study example: Mahakirau Forest Estate

In regard to projects within a similar habitat type and with similar pest targets as proposed here, the work achieved by the nearby Mahakirau Forest Estate (also on the Coromandel) is an excellent comparison. This site comprises 580 hectares of native forest (a similar size to the 632 ha proposed here), and is also bounded by DOC managed land - with the Manaia Kauri Sanctuary to the south and the Coromandel State Forest to the east and west.

The Mahakirau Forest Estate also aims to protect native species (including native frogs), through targeted control of mammalian pests and predators, with work undertaken to suppress possums, rats and stoats through a network of traps and bait stations.

The following pest targets have been maintained since 2008:

- Rats <10% at beginning of summer,
- Possum <5% at beginning of summer,
- Stoats <0.15 average.

In 2024, the average annual rodent monitoring was 0% for mice and 3% for rats (with 190 tracking tunnels monitored). This demonstrates the very low levels of pest suppression possible with dedicated resources.

# 2.0 Purpose and scope of this Plan

This Wharekirauponga Animal Pest Management Plan (WAPMP) sets out the methods that will be used to control mammalian pests (i.e. rats, mice, mustelids, possums, feral cats, and ungulates) at a specified site and as part of the package to address the residual ecological effects associated with the Project, in particular relating to Archey and Hochstetter frogs.

This plan includes:

- A description of the proposed Wharekirauponga Animal Pest Management, including current ecological values (Map 1);
- Animal pest management areas (Map 2), namely (1) within the area potentially impacted by vibrations, and (2) within an adjacent area of high-quality frog habitat
- A review of baseline pest monitoring undertaken and the results from those surveys;
- Target pest species information (rats, mice, possums, mustelids, hedgehogs, feral cats, pigs, and goats);
- Protocols for toxic aerial baiting;
- Protocols for ongoing predator trapping, including trap types, locations, lures, and servicing frequencies;
- Protocols for ongoing ground based toxic baiting, including bait type and control frequencies, primarily for targeting rats and possums as well as suggestions for toxic feral cat and stoat control
- Protocols for ongoing control of ungulates;
- Pest animal monitoring protocols;
- Timing and duration of control;
- Performance standards of pest animal control, with targets and thresholds for additional control based on monitoring results; and
- Data management and reporting protocols tied to long-term frog population monitoring, to determine success of the predator control programme as adequate offset for the WNP Project (i.e. the programme successfully counterbalances residual adverse impacts).

# 3.0 Wharekirauponga Animal Pest Management Area

The proposed WAPMA (Map 1 and 2) covers 632 ha, which includes the 314 ha area that may be subject to vibration impacts, as well as an adjacent area of 318 ha that is of high habitat quality for frogs based on modelling (Map 3). This combined 632 ha area will undergo an intensive pest control regime as described in this WAPMP.

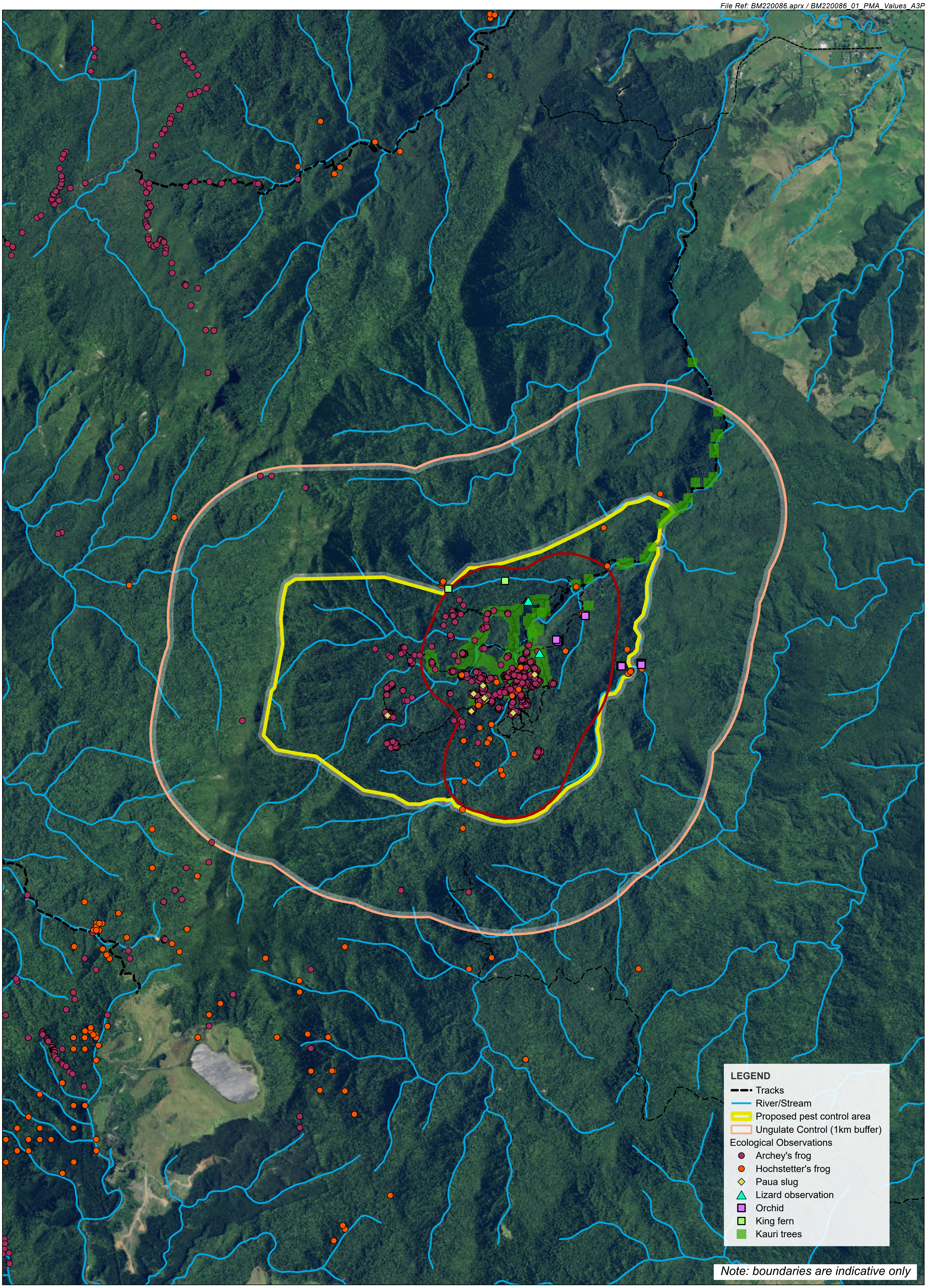
Whareorino reported significant increases in Archey's frog populations with only 300 ha under active rat management (with a 2.3 fold increase reported in Ramirez 2017). In 2017, the size of the area under management was increased to 600 ha and the rat control continues to result in population increases (Easton, 2021). We can therefore be confident that the size of the proposed area of pest control will be more than sufficient to achieve biodiversity outcomes for frogs (as well as other native species). Pest management will also be implemented at a release site for native animals salvaged from drill, pump and vent sites when they are cleared. This release site/s will be within the proposed 632 ha pest management area, but is described separately in the WUG Ecological Management Plan (Boffa Miskell 2024a).

## 3.1 Biodiversity Values of Pest Management Area

Biodiversity values within the proposed WAPMA are outlined in detail in previous Boffa Miskell reports (Boffa Miskell Ltd, 2024a, 2024b), drawing on ecological data from Wharekirauponga exploration drill surveys and baseline ecological surveys (Boffa Miskell Ltd, 2018c, 2018b, 2019a, 2019b, 2021b).

A summary of relevant values is provided below to provide an overview of the biodiversity values present (all of which will benefit from the proposed pest control).

File Ref: BM220086.aprx / BM220086_01_PMA_Values_A3P

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*Data Sources:* Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors, Boffa Miskell, OceanaGold, Bioresearchers, DOC

*Projection:* NZGD 2000 New Zealand Transverse Mercator

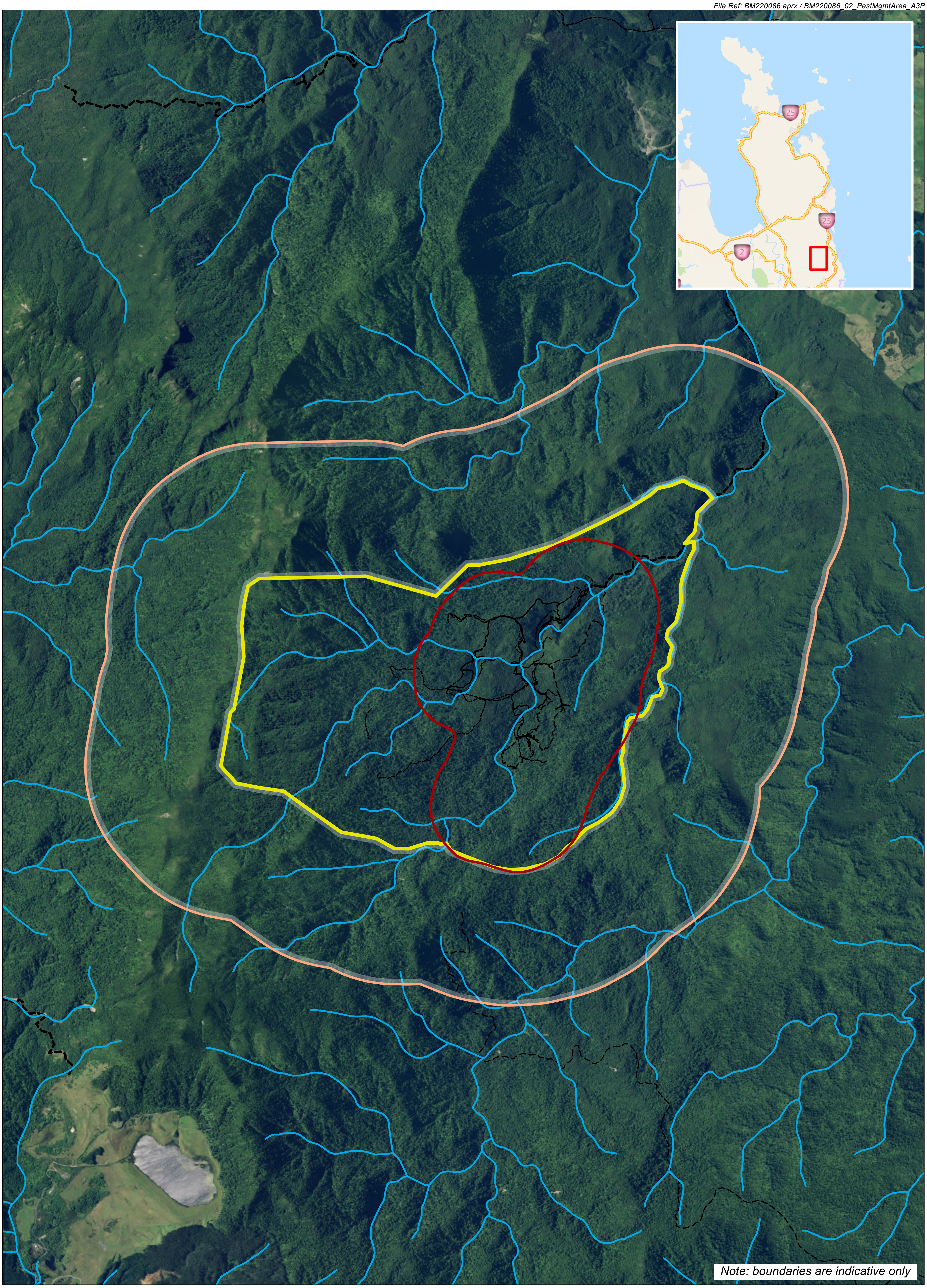
**PEST MANAGEMENT**

## Map 1. Proposed Pest Management Area and Ecological Values

**Date: 18 February 2025 | Revision: 3**

Plan prepared by Boffa Miskell Limited

Project Manager: Helen.Blackie@boffamiskell.co.nz | Drawn: HCo | Checked: HBI

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0 500 m

1:25,000 @ A3

*Data Sources:* Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors., Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

*Projection:* NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Tracks
- River/Stream
- Proposed pest control area
- Ungulate Control (1km buffer)
- Area potentially subject to vibrations

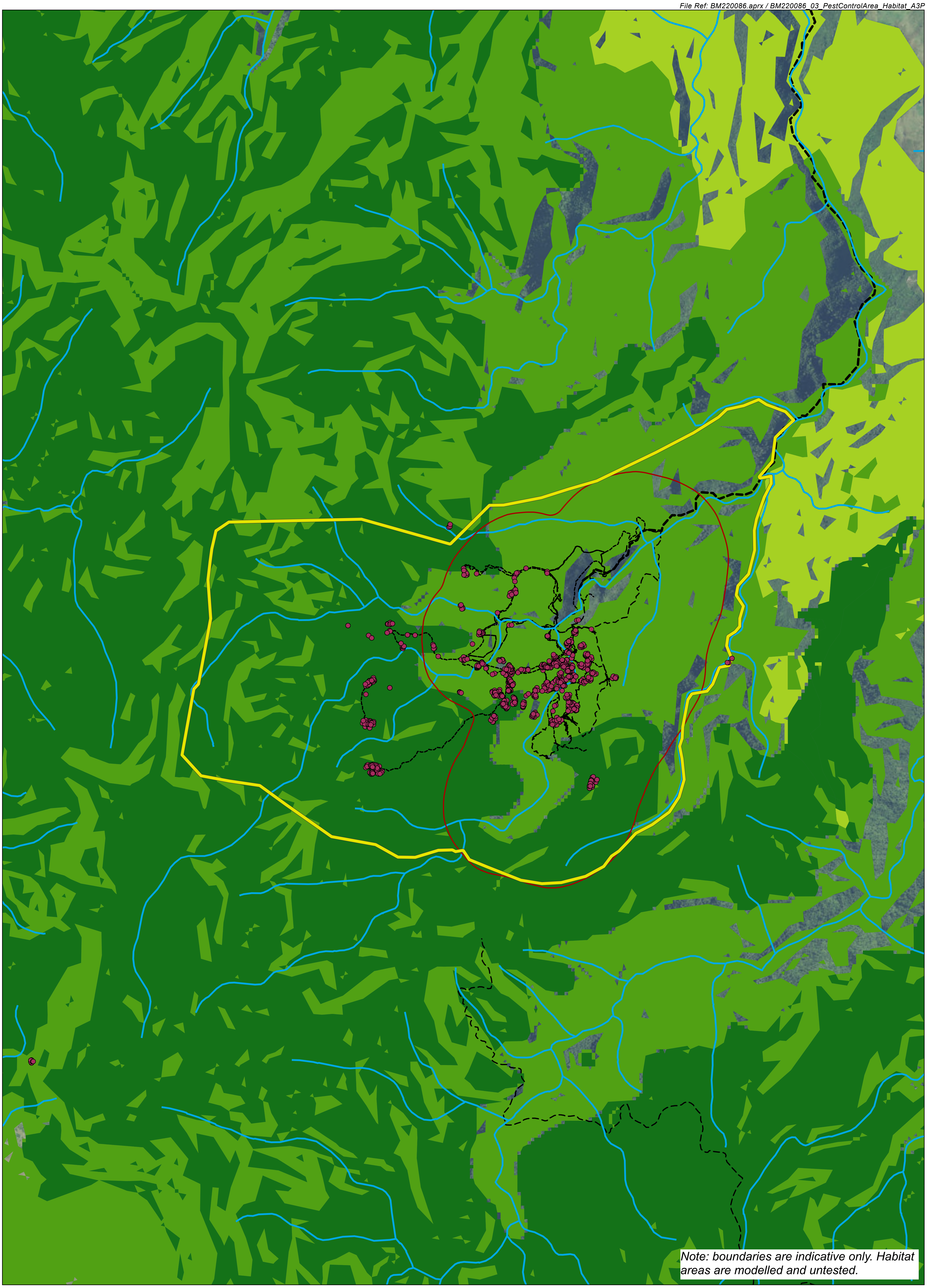
**PEST MANAGEMENT**

Map 2. Wharekirauponga Pest Management Area

**Date: 04 October 2024 | Revision: 3**

Plan prepared by Boffa Miskell Limited

Project Manager: Helen.Blackie@boffamiskell.co.nz | Drawn: HCo | Checked: HBl

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*Data Sources:* Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

*Projection:* NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Frog Record (Archey)
- River/Stream
- Tracks
- Proposed pest control area
- Area potentially subject to vibrations

Modelled Habitat

- Good
- Great
- Best

**PEST MANAGEMENT**

Map 3. Modelled Archey's Frog Habitat and Proposed Pest Control Area

**Date: 04 October 2024 | Revision: 2**

Plan prepared by Boffa Miskell Limited

Project Manager: Helen.Blackie@boffamiskell.co.nz | Drawn: HCo | Checked: HBl

### 3.1.1 Vegetation

The forest ecosystem within the proposed pest management area is characteristic of mid-elevation native forests in the Coromandel. Vegetation present includes Kauri Forest mainly on ridgelines and knolls on the sides of valleys. Tanekaha, and to a lesser extent toatoa, are interspersed sporadically throughout canopy and subcanopy tiers. Rimu and rewarewa are also present in moderate densities along with towai and *Pseudopanax discolor*. Toro and tāwari are occasionally present. Kauri grass, *Gahnia xanthocarpa* and towai are the most abundant sub-canopy species. Seedlings and saplings of canopy species are represented in the sub-canopy along with abundant broadleaved species such as kanono, pigeonwood, rewarewa, mapou, *Pseudopanax discolor*, toro and mingimingi. Miro was present in the sub-canopy as seedlings and juvenile plants. Kiokio was the most abundant fern, and silver fern was also common.

Mixed Secondary Broadleaved Forest Broadleaved secondary forest is the principal vegetation type in the Wharekirauponga catchment. The canopy structure is patchy, with numerous tall emergent trees interspersed throughout a relatively low stature.

Kānuka scrub typically has a top canopy layer approximately 5 m tall, comprising kanuka and pole-sized rewarewa, tanekaha and towai, in varying proportions. Rimu and mahoe occur frequently in the scrub canopy but are not abundant. Mapou, kauri, ponga, rimu, pigeonwood, mingimingi, mahoe, *Pseudopanax discolor*, supplejack, towai and karamu, hangehange, kiokio are also common, while miro, nikau, kauri grass, toro, lancewood, kumeraho, morelotia, bushy clubmoss, makamaka, *Gahnia xanthocarpa*, kiekie, wheki, akapuka, kānuka, kamu and toropapa are often present. Tree ferns are more common on the lower slopes and hillsides.

During surveys in 2020, thirty-four species of orchid were found across seven different orchid types (gnat, perching, finger, bird, sun, spider and greenhood orchids). All orchid types listed above were found within the kauri forest vegetation classification. Two *Pittosporum virgatum* (Threatened – Nationally Vulnerable) were observed within the RECCE plots in Wharekirauponga. King fern (Ptisana salicina, At Risk- Declining) was incidentally observed within the wider Wharekirauponga catchment.

### 3.1.2 Avifauna

An assemblage of native and introduced birds characteristic of North Island forest is present within the WAPMA.

As recorded in recent surveys, native bird species that are locally abundant include common forest birds such as miromiro / tomtit, riroriro /grey warbler, ruru / morepork, kererū, tui and korimako. Pōpokatea / whitehead, Kākā (At Risk – Recovering), and yellow-crowned kākāriki (At Risk – Declining) have also been recorded in smaller numbers. Other native species that have not been recorded in recent surveys, but which are regarded as potentially present within the wider Coromandel Forest Park, include North Island brown kiwi and koekoeā / long-tailed cuckoo, a migratory species that breeds in New Zealand forests over spring and summer.

Native bird populations are at threat from mammalian predators, particularly hole-nesting species such as kākā and kākāriki (Dilks et al., 2003; Innes et al., 2010).

### 3.1.3 Bats

New Zealand has two endemic species of bat (pekapeka), the long-tailed (*Chalinolobus tuberculatus*) classified as Threatened – Nationally Critical and short-tailed (*Mystacina tuberculata*) classified as Threatened – Nationally Vulnerable.

Bat surveys have previously been carried out at specific sites as part of the Wharekirauponga exploration drill surveys and baseline ecological surveys. A total of 15 sites throughout the Wharekirauponga area have been surveyed for 220 nights. No bats have been detected in the Wharekirauponga catchment during any of these surveys. However, long-tailed bats are commonly recorded around the northern extent of the Kaimai Ranges (c 25 km from the Project Area), and given that they can range over large areas of 657–1589 ha (O'Donnell, 2001) and move long distances between roost sites, it is possible that long-tailed bats may be utilising the proposed pest management site for foraging and/or roosting.

Bats are susceptible to the full suite of mammalian and avian predators, but are particularly sensitive to high densities of rats and mustelids (Pryde et al., 2005). Controlling rats in the proposed management area will likely benefit any local populations of long-tailed bats by decreasing predation risk when the bats are roosting during the day, when in torpor over the winter months and over the summer breeding season.

### 3.1.4 Invertebrates

Kessels & Associates (2010) notes two invertebrate taxa of conservation interest within the Waihi ED, these being paua slug (*Schizoglossa worthyae*, *S. novoseelandica novoseelandica*) and a flightless stag beetle (possibly Te Aroha stag beetle - *Geodorcus auriculatus* sp.). In surveys of the Wharekirauponga area, paua slugs were confirmed to be present, but no large stag beetles were observed (although the survey method used, nocturnal searching, is not optimal for finding beetles) (Boffa Miskell Ltd, 2024a).

The presence of paua slugs is indicative of high value forest invertebrate habitat within the WAPMA, as this is a relatively immobile species that is sensitive to drought and vulnerable to predation in the absence of suitable refuges such as dense vegetation or litter microsites.

Other species recorded in ecological surveys of the Wharekirauponga area include *Peripatus* sp./ Ngaokeoke, Auckland tree wētā (*Hemideina thoracica*), and cave wētā (*Pachyrhamma* sp.).

Large, flightless invertebrates, such as those noted above, are vulnerable habitat destruction and predation by invasive mammals such as rats and pigs (Leschen et al., 2012).

### 3.1.5 Herpetofauna

Hochstetter's frogs (*Leiopelma hochstetteri*) and Archey's frogs (*L. archeyi*) have been recorded throughout the wider Coromandel Forest Park and in the Wharekirauponga catchment. Both Hochstetter's and Archey's frogs are classified as At Risk – Declining.

Hochstetter's frogs were observed during targeted surveys in the Wharekirauponga catchment, and numerous small, stony-bottomed tributaries in the catchment provide high quality habitat for Hochstetter's frog.

Archey's frogs have been surveyed more intensively within the Wharekirauponga catchment than anywhere else throughout their range (Lloyd, 2023). Relative to other well-studied populations, Archey's frogs are widely, but not densely, distributed throughout the Wharekirauponga catchment.

Existing lizard records for the Wharekirauponga area are very limited, likely due to lack of survey effort, cryptic species behaviour and the lack of effective search techniques for the habitat. Baseline ecological surveys using a range of methods at Wharekirauponga have detected a single forest gecko (*Mokopirirakau granulatus*). Three observations of elegant geckos (*Naultinus elegans*) have been recorded in Wharekirauponga (Liam Ireland pers. comm, Ben Barr pers. comm.). Notwithstanding, their presence throughout the catchment is considered likely.

Native lizards recorded within 10 km of the area include two ground dwelling skink species and one arboreal gecko. Seven species of native lizard have been recorded on the Coromandel Peninsula including the Threatened – Nationally Vulnerable Toropuku gecko (Northern striped gecko, *Toropuku inexpectatus*).

All of NZ's native lizard species are threatened by mammalian predation, particularly by rodents. The proposed pest management area will decrease predation pressure on these species.

## 3.2 Current pest densities

### 3.2.1 Baseline Pest Monitoring 2024 - 2025

Baseline seasonal pest monitoring commenced in winter 2024, with one monitor planned in each season over a 12-month period. Two monitors have occurred to date, one in July 2024 (winter), and one in September 2024 (spring). Two further monitors are planned for January and March 2025 (summer and autumn respectively).

Undertaking baseline monitors on current pest densities is important for several reasons:

- To ensure that the proposed pest management actions will have a positive benefit on biodiversity, and that the benefits of the proposed control is additional to the current scenario;
- For customising the pest management plan to best suit current pest densities to achieve the optimal biodiversity outcomes quickly (e.g. if there are high densities of particular pests, higher toxic baits and baiting frequencies are likely to be needed at the start of the project to achieve an initial knockdown); and
- To compare ongoing pest animal monitoring once the project has commenced to a pre-control baseline, facilitating adaptive management to achieve the best biodiversity outcomes.

### 3.2.2 Monitoring methods to assess current pest densities

An assessment of current pest animal densities was conducted using a combination of methods including tracking tunnels, chew cards and lured camera traps deployed across the proposed WAPMA area (both inside and outside of the vibration footprint – see Map 4). The aim of this monitoring is to determine presence, absence, and obtain a coarse indication of relative abundance, of rats, mice, possums, mustelids, hedgehogs, cats, and ungulates across the site.

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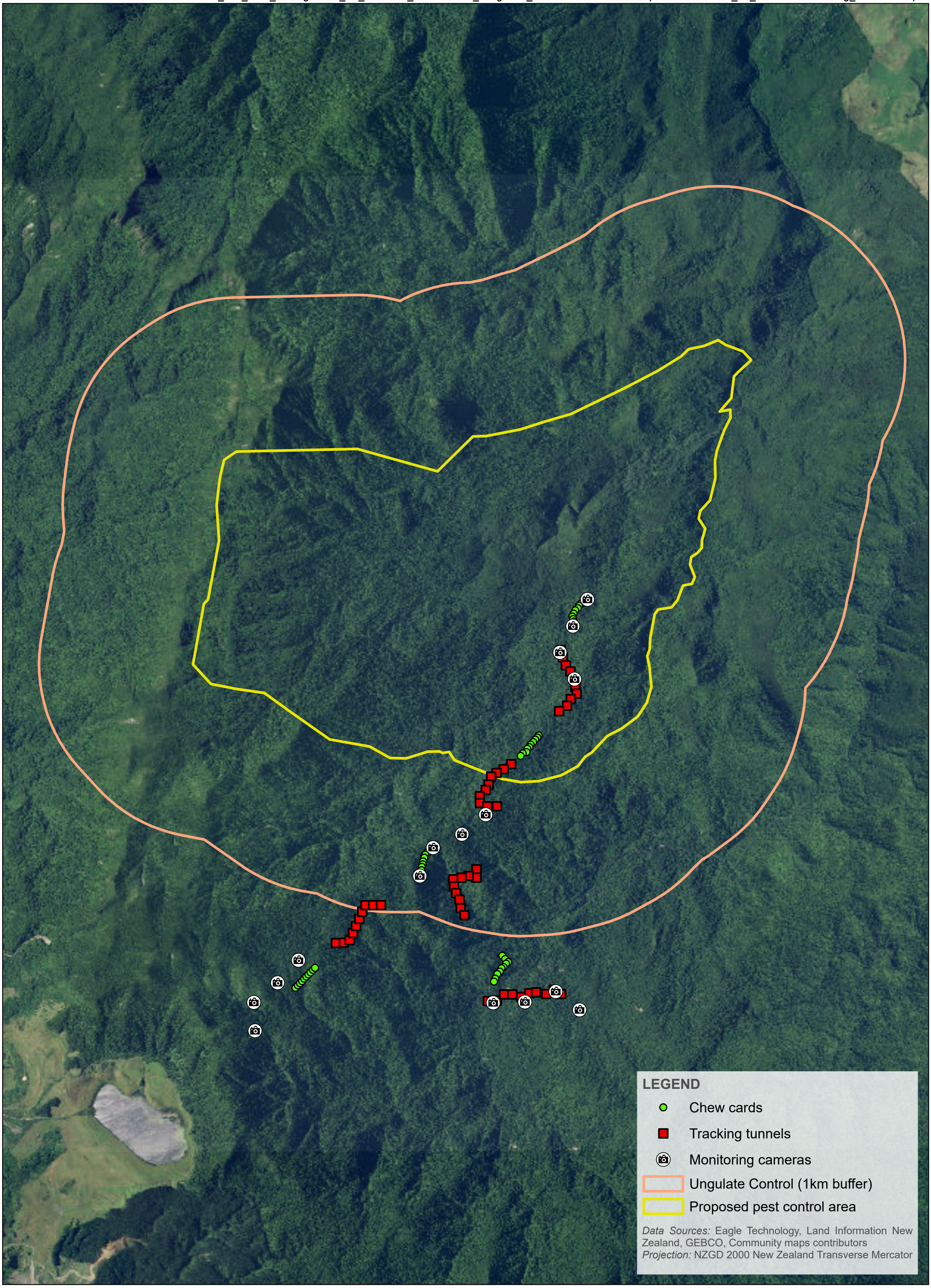


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**SOUTHERN COROMANDEL PEST MONITORING**

Map 4. Baseline Pest Monitoring Locations

**Date: 04 October 2024 | Revision: 0**

Plan prepared for OceanaGold by Boffa Miskell Limited

Project Manager: Helen.Blackie@boffamiskell.co.nz | Drawn: HCo | Checked: LMa

A DOC permit was unable to be obtained in time to allow pest monitoring to occur within the wider site so monitoring lines were restrained to paper roads.

Monitoring took place as per the following protocols:

- 5 lines of chew cards (pre-filled with herbal peanut lure from Connovation Ltd) were placed on paper roads within Wharekirauponga (Map 4). Each line comprised 10 cards spaced 20 m along each 180 m-long line. Cards were labelled in permanent marker with the location, line number, card number, date of deployment and date of retrieval, and were nailed to tree trunks 30 cm above the ground. Upon collection, cards were analysed for bite marks of the target animals. Chew card methods and analysis were as per standard best-practice methods (National Pest Control Agencies, 2015). Cards were left in place for the standard 7-night deployment.
- 4 lines of camera traps were deployed across Wharekirauponga. Each line consisted of 4 cameras at 200 metre spacings.

  Camera trap monitoring methods followed the latest version of DOC's interim camera trapping protocol (Department of Conservation, 2023). Cameras (Browning Dark Ops Dual Lens models) were set out for 21-nights and programmed to take a three-photo 'burst' every time the camera was triggered with a 5 minute forced delay between triggers. Upon collection, photos were individually viewed, and any presence of a target animal recorded.
- 5 lines of tracking tunnels were deployed across Wharekirauponga. Each line consisted of 10 tunnels spaced 50 m apart, and tracking cards were collected after one night in place, as per the standardised tracking tunnel protocols (Gillies & Williams, 2013).

### 3.2.3 Results of baseline monitoring

Baseline monitoring conducted to date has shown very high pest densities within and around Wharekirauponga. During the winter and spring monitors in 2024, pest densities across the area were consistently high, despite the expected reduction in pests in winter due to colder temperatures. In summary:

- Results of rat monitoring (see Tables 3 – 5, Figure 1) show 'very high' rat population densities. Rats are known as important predators of native frogs, and understanding their densities is a key component of designing mitigation strategies for frog recovery.
- Mouse densities were 'moderate – high (Tables 3 – 5), possibly slightly lower than rats due to outcompeting by rats over lures provided during monitoring, as well as colder temperatures. Mice are thought to predate juvenile native frogs.
- Possum activity was 'moderate – high', and although not a key predator of native frogs it could be safely assumed that there will be a significant wider gain to biodiversity through the reduction of possums in the area (i.e. through reduced browsing on native vegetation and predation of other species such as nesting birds).
- Stoats were observed in moderate – high densities, despite their seasonal behaviour meaning they usually track at low densities in colder months (peak stoat

activity is during late spring and summer and numbers are greatly reduced during colder months).

- Camera images allowed us to determine multiple individual stoats were present. Mustelid species will be key predators within the landscape (both of frogs and all other native fauna).

- Feral cats were detected on cameras and may well also be a key predation pressure on native frogs (and other species).

- Pigs were detected in moderate numbers at trail cameras, despite not being a target species for the lures and survey tools used. Pig sign (i.e. root rutting, churned up soil – Figure 2), was also noted in the field consistently across the site. This likely indicates that pig numbers are high. Pigs have been documented directly predating native frogs, so understanding and controlling their numbers is a key component of designing mitigation strategies for frog recovery.

*Figure 1: Tracking pad showing and a high density of rat footprints during July 2024.*

Overall, the monitoring shows very high pest densities through the proposed pest management area. This provides a high level of confidence that the proposed pest management will achieve substantial biodiversity gain (both for frogs and wider ecosystem benefits).

Trail camera data is shown in Table 3, with raw data reflecting individual animal detections captured by each camera, as well as a camera trap index calculated for each monitoring line (Gillies & Williams, 2013). Some bird species, including piwakawaka, blackbirds, silvereye, and tomtits, were also observed on cameras (data not shown). Chew card data to date is shown in Table 4, with numbers reflecting the percentage of cards chewed by each species on each line of chew cards. Tracking tunnel data is provided in Table 5 and reflects the percentage of tracking tunnel cards which had pest prints on each tracking tunnel line. Figures 3 – 6 show examples of pest species detected on cameras.

*Figure 2: Pig rooting sign photographed at Wharekiraupонga.*

*Table 3:* Results of camera monitoring from the spring survey, Camera Trap Index (detections per 2000 camera hours) are calculated for each line following DOC standard protocols (Gillies & Williams 2013). Camera traps are used primarily for detecting mustelids and feral cats.

**Winter monitor**

| **Camera trap hours/2000** | Possum | Ship Rat | Cat | Stoat | Pig |
|---|---|---|---|---|---|
| CT1 | 3.0 | 318.5 | 0.0 | 20.8 | 0.0 |
| CT2 | 6.0 | 435.5 | 0.0 | 3.0 | 8.9 |
| CT3 | 3.0 | 224.2 | 0.0 | 17.9 | 0.0 |
| CT4 | 11.9 | 351.2 | 0.0 | 0.0 | 0.0 |
| CT5 | 11.9 | 541.7 | 0.0 | 6.0 | 0.0 |
| CT6 | 0.0 | 420.6 | 6.0 | 3.0 | 6.0 |
| CT7 | 8.9 | 373.0 | 0.0 | 3.0 | 0.0 |
| CT8 | 8.9 | 440.5 | 0.0 | 0.0 | 3.0 |
| CT9 | 86.3 | 284.7 | 0.0 | 0.0 | 0.0 |
| CT10 | 6.0 | 335.3 | 0.0 | 3.0 | 0.0 |
| CT11 | 8.9 | 211.3 | 0.0 | 8.9 | 0.0 |
| CT12 | 8.9 | 107.1 | 0.0 | 0.0 | 0.0 |
| **Average CCH** | **13.6** | **337.0** | **0.5** | **5.5** | **1.5** |
| Standard deviation | 23.2 | 118.8 | 1.7 | 7.0 | 3.0 |
| Standard error | 6.7 | 34.3 | 0.5 | 2.0 | 0.9 |

**Spring monitor**

| **Camera trap hours/2000** | **Possum** | **Ship Rat** | **Cat** | **Stoat** | **Deer** | **Ferret** | **Pig** |
|---|---|---|---|---|---|---|---|
| CT1 | 11.9 | 113.1 | 0.0 | 41.7 | 0.0 | 0.0 | 0.0 |
| CT2 | 26.8 | 131.9 | 0.0 | 14.9 | 0.0 | 0.0 | 3.0 |
| CT4 | 3.0 | 229.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CT5 | 26.8 | 131.9 | 0.0 | 14.9 | 0.0 | 0.0 | 3.0 |
| CT6 | 8.9 | 38.7 | 0.0 | 3.0 | 0.0 | 3.0 | 0.0 |
| CT7 | 6.0 | 205.4 | 0.0 | 3.0 | 0.0 | 0.0 | 0.0 |
| CT8 | 3.0 | 111.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CT9 | 0.0 | 117.1 | 0.0 | 24.8 | 0.0 | 0.0 | 0.0 |
| CT10 | 6.0 | 108.1 | 0.0 | 29.8 | 0.0 | 0.0 | 0.0 |
| CT11 | 0.0 | 41.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CT12 | 11.9 | 113.1 | 0.0 | 41.7 | 0.0 | 0.0 | 0.0 |
| CT13 | 8.9 | 264.9 | 0.0 | 0.0 | 3.0 | 6.0 | 0.0 |
| CT14 | 3.0 | 333.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CT15 | 11.9 | 113.1 | 0.0 | 0.0 | 3.0 | 53.6 | 0.0 |
| CT16 | 0.0 | 129.0 | 0.0 | 0.0 | 3.0 | 0.0 | 11.9 |
| **Average CCH** | 8.5 | 145.4 | 0.0 | 11.6 | 0.6 | 4.2 | 1.2 |
| Standard deviation | 8.6 | 79.9 | 0.0 | 15.6 | 1.2 | 13.8 | 3.1 |
| Standard error | 2.5 | 23.1 | 0.0 | 4.5 | 0.4 | 4.0 | 0.9 |

*Table 4:* Results of chew-card monitor for winter (left) and spring (right). Results are displayed as percentage of cards chewed. Chew-cards are used to primarily detect possums and rodents.

**Winter results**

| Line no. | Mouse | Rat | Possum |
|---|---|---|---|
| Line 1 | 70 | 100 | 0 |
| Line 2 | 70 | 100 | 90 |
| Line 3 | 30 | 100 | 10 |
| Line 4 | 40 | 100 | 0 |
| Line 5 | n/a | n/a | n/a |
| **Avg. % chews per line** | 52.5 | 100 | 25 |

**Spring results**

| Line no. | Mouse | Rat | Possum |
|---|---|---|---|
| Line 1 | 20 | 80 | 20 |
| Line 2 | 20 | 100 | 70 |
| Line 3 | 60 | 100 | 60 |
| Line 4 | 50 | 90 | 20 |
| Line 5 | 20 | 80 | 100 |
| **Avg. % chews per line** | 34 | 90 | 54 |

*Table 5:* Tracking tunnel results from winter (left) and spring (right) pest survey. Results are displayed as a percentage of tracking cards tracked per line. Tracking tunnels are used to primarily detect rodents.

**Winter results**

| Line no. | Rat | Mouse |
|---|---|---|
| Line 1 | 100 | 30 |
| Line 2 | 80 | 30 |
| Line 3 | 90 | 20 |
| Line 4 | 90 | 40 |
| Line 5 | n/a | n/a |
| **Avg. % tracking per line** | 90 | 30 |

**Spring results**

| Line no. | Rat | Mouse |
|---|---|---|
| Line 1 | 60 | 30 |
| Line 2 | 90 | 20 |
| Line 3 | 100 | 10 |
| Line 4 | 100 | 10 |
| Line 5 | 30 | 0 |
| **Avg. % tracking per line** | 76 | 14 |

*Figure 4: Image of a feral cat stalking a ship rat (in centre) at one of the trail camera lure setups during pest monitoring.*

*Figure 3: Image of a pair of possums at one of the trail camera lure setups during winter pest monitoring*

*Figure 5: Images of stoats attempting to access the meat lures during winter (L) and spring (R) camera monitoring. Stoat densities are generally lower during colder month so the relatively high detections here indicate populations are likely high.*

*Figure 6: A ferret (L) and pig (R) captured on cameras during trial camera monitoring.*

## 3.3 History of Control

Previous pest control in the Wharekirauponga / Otahu area has predominately consisted of aerial 1080 applications approximately every three years, with the last operation on 7 November 2021. Rat tracking indices before the aerial application were 71% TTI, and dropped to 4% TTI on 22 December 2021 following the application (Department of Conservation, 2021c, 2021b). There is localised control for rats and stoats with Goodnature traps around camps and drill sites.

# 4.0 Target pest animal species

## 4.1 Rats

Three rat species invaded New Zealand, with the Norway rats (*Rattus norvegicus*) and ship rats (*R. rattus*) being the most common on the mainland. Rats are generalist omnivores; their diet includes seed predation and preying on small animals such as invertebrates, reptiles, amphibians, and juvenile birds. They compete with native birds for nests and burrows, and have been implicated in the decline of a number of threatened birds, particularly seabirds (Auckland Council, 2019). Although rats are not as wide-ranging as mustelids, they are capable of invading areas quickly over small distances and have a high reproductive rate.

Norway rats are the largest of the rat species. As ground-dwellers, they pose significant threats to ground-nesting birds (Amori & Clout, 2002; Bellingham et al., 2010). Norway rats are the most capable swimmers of the rat species in New Zealand, are able to swim up to two kilometres across open water (Russell et al., 2008), and are frequently found around wetlands and waterways. This species is distinguishable from ship rats by small ears that are unable to fold down over their eyes and a tail that is shorter than their body length.

Ship rats are very agile and are frequent climbers, preferring to nest in trees and shrubs rather than on the ground. They can be distinguished from Norway rats by their tail which is longer than their body length and large ears that can fold down over their eyes.

Ship rats are considered the most significant predator of *Leiopelma* species with multiple predation events recorded over the years (Egeter et al., 2015). Although there are no direct records of ship rat predation on *Leiopelma* species at Wharekirauponga specifically, they are common in this area and are likely having a negative impact on the Archey's and Hochstetter's frog populations here. Rats will be controlled across the Wharekirauponga animal pest management area via intensive trapping and toxic baiting.

## 4.2 Mice

The impacts of mice on native biodiversity (flora and fauna) as either predators or competitors is not yet well understood. There is some evidence to suggest mice are predators on native lizards, frogs, and invertebrates (Egeter et al., 2015; Norbury et al., 2014; Wedding, 2007), and mouse populations and/or activity levels may increase when larger predators (particularly rats, mustelids, and feral cats) are removed from an area (Bridgman et al., 2018; Caut et al., 2007), potentially resulting in additional impacts on frogs (Germano et al., 2023).

Historically, suppression of mouse populations to low densities has been difficult to achieve at landscape scale on mainland New Zealand. However, there are some encouraging recent developments. For instance, the new toxin formulation commercially known as 'Double-Tap' (Diphacinone + Cholecalciferol) shows promise, having reduced mouse populations by 80% in field trials, despite bait stations being spaced at a density of 1/ha to target rats and possums (Eason et al., 2020). While this toxin is currently registered only for rat and possum control, work to register this toxin for mouse control is in progress. New developments in self-resetting smart trapping technology, such as the Critter Solutions AI camera, also offer a new tool in the mouse control toolbox. For example, at Mahikarau Forest Estate – a site in the Coromandel with similar habitat type and size (580 ha) to that at Wharekirauponga – both rats and mice are successfully suppressed to very low levels using conventional toxins and traps (Predator Free NZ Trust, 2020). There are no recorded 'irruptions' in mouse numbers despite intensive control at this site.

Mouse control in the WAPMA  will therefore be undertaken alongside rat control (using a combination of traps and baits), and their populations will be monitored via chew cards (with detections also possible on camera traps and novel real-time monitoring tools, if deployed in the future).

## 4.3 Possums

Possums were first introduced to New Zealand from Australia for the fur trade in 1837, followed by a second successful release 20 years later. Preferred habitats are forests, especially podocarp-broadleaf forest (Department of Conservation, 2019). Home ranges of females are between 0.6 and 2.7 ha, while that of males are between 0.7 and 3.4 ha (Department of Conservation, 2019).

In New Zealand, possums are both a predator of native wildlife and a heavy browser of many species of native trees. Although possums are mainly herbivorous and feed on flowers, fruit, and leaves, they will also opportunistically eat eggs, chicks, and invertebrates. Predation by possums on the eggs and nestlings of native bird species such as kōkako, kiwi, and kereru is widespread throughout New Zealand (James & Clout, 1996). Populations of invertebrates such as native snails and weta may also be severely depleted, particularly when alternative food sources are scarce. Possums also disrupt ecological processes such as flowering, fruiting, seed dispersal and germination. In addition, they also serve as vectors of bovine tuberculosis (TB).

Possums will be controlled across the WAPMA, primarily via trapping and toxic baiting. Possums are not particularly susceptible to first-generation anticoagulant baits that are often used for rat control (e.g. diphacinone). They can consume large quantities of these baits before consuming a lethal dose, which in turn can reduce the efficacy of rat control. For this reason, an initial population knockdown of both possums and rats will occur via an aerial 1080 operation (as proposed in Section 6.0), possum numbers can then be maintained at low densities primarily via trapping with a focus on preventing reinvasion.

## 4.4 Mustelids

Three species of mustelids are present in New Zealand; stoats (*Mustela erminea*), ferrets (*M. furo*) and weasels (*M. nivalis vulgaris*). Stoats and ferrets are able to be controlled via trapping and use of some primary and secondary poisons, but there are currently few adequate control options for weasels (although some may be caught with the tools used for targeting rats and other mustelids). Recently, gut analysis of ferrets within the Coromandel has been found to contain native frogs (Mahakirau Forest Sanctuary, unpublished data[2]).

Each species has its own unique set of behavioural and morphological characteristics:

- Stoats possess the typical ecological characteristics observed in many opportunistic species, such as their small body size, short life span and rapid reproductive cycle (Lough, 2006). Populations are typically unstable through both time and space, as their density and distribution are predominantly controlled by prey availability (King & Powell, 2007; Lough, 2006). Home range sizes vary significantly depending on a range of variables including sex, season, and food availability. In a study on the Otago Peninsula, the average home range size was 83 ha for female stoats and 133 ha for male stoats (Moller & Alterio, 1999). Stoats can cover long distances, and dispersing juveniles may come from over 20 km away (King & McMillan, 1982). Stoats can exhibit

[2] Post on Mahakirau Forest Sanctuary Facebook page, 20 September 2024. https://www.facebook.com/Mahakirau

significant neophobia or weariness of new objects in their environment, which must be factored into control strategies.

- Ferrets are wide ranging with average home range estimates of 18–265 ha for females and 19–760 ha for males, although home ranges are smaller during the breeding season between August and February (Gillies, 2007). Juvenile ferrets may only move small distances (some have been recorded having home range lengths of only 100 m). Ferrets are typically wary of novel objects, which can pose an ongoing challenge to their control. This can be addressed by placing traps that are maintained to a high standard (as per the trap setting checklist in Appendix 1) and using large, fresh meat lures (preferably rabbit) and placing traps in locations within preferred ferret habitats.
- Weasels have a typically patchy distribution and populations are subject to rapid fluctuations in both numbers and extent (King et al., 2001). They can be found in farmland and scrub, on the margins between forest and open country (King, 2005; Strang et al., 2018). In New Zealand, birds, invertebrates and reptiles are a larger component of weasels' diets than in other countries (Strang et al., 2018), but primarily they eat mice and insects (King et al., 2001).

Mustelids will be controlled across the WAPMA, primarily via trapping. Secondary poisoning (particularly 1080) is also an effective means of controlling stoats and potentially other mustelids from the landscape, particularly trap shy individuals. Mustelids are often poisoned via secondary poisoning when they scavenge rats, possums or other animals that have been killed with baits containing 1080 that have been either ground laid in bait stations or aerially dispersed (Alterio & Moller, 2000; Gillies & Pierce, 1999; Murphy et al., 1999). Further, the toxin PAPP may be used as an additional direct control tool for stoats if deemed necessary.

## 4.5 Hedgehogs

Hedgehogs are mainly insectivorous but have proven to be a major predator on eggs of riverbed breeding birds such as banded dotterel and black-fronted tern and have been known to kill and eat chicks of a variety of ground-nesting birds as well as native lizards (Department of Conservation, 2021a). There have been over 11 reported events of hedgehogs predating on Southern Bell Frogs in New Zealand, this was observed through a mixture of scat and stomach content analysis as well as direct observations of hedgehogs eating live frogs (Egeter et al., 2015). This suggests *Leiopelma* species, including Archey's frog may be potential prey items of hedgehogs within their range.

Hedgehogs are commonly captured in trap networks targeting rats and mustelids, which also means that traps triggered by hedgehogs are no longer available to these target species until the trap is checked and cleared. Reducing the hedgehog population will consequently increase the effectiveness of the trap network as well as reducing predation pressure on some native fauna. Hedgehogs will be controlled via traps and have also been shown to be effectively controlled after aerial 1080 drops.

## 4.6 Feral cats

Although the control of feral cats is a controversial topic in some areas, their control is crucial where threatened native species, including lizards and frogs, are present.

Cats are generalist predators and are significant predators of New Zealand's vulnerable native fauna. Their diet typically consists of small mammals such as rabbits, hares and rodents, birds, and their eggs, and, to a lesser extent, lizards, and invertebrates. Feral cats also have negative indirect impacts, such as through competition for food and space, as well as through the transmission of disease (Medina et al., 2011). Feral cats are usually solitary and sparsely distributed, with measured home ranges in excess of 200 ha (National Pest Control Agencies, 2018b). Young males are often driven out or leave their kin group when they near sexual maturity between 1 and 3 years old and disperse across the landscape. Feral cats live in most terrestrial habitats in New Zealand, including pasture, scrub, exotic plantations, and native forest (King, 2005).

Feral cats are excellent hunters and have been reported to kill and eat frogs in Australia and may be depredating New Zealand native frogs. Feral cats will be controlled throughout the WAPMA, primarily via trapping. As feral cats are also often poisoned when they scavenge rats, mice and possums or other animals that have been killed with baits containing ground laid and aerially dispersed 1080 or brodifacoum (Alterio, 1996; Nogales et al., 2004), secondary poisoning can be effective tool for feral cat control, particularly for trap shy individuals. The use of toxins via secondary poisoning to suppress feral cats within the project area will also be considered. Additionally, the toxin PAPP can be used for feral cat control if numbers are shown to be higher than proposed target thresholds (Sections 13.2 and 13.3) As feral cats are extremely mobile, they are capable of reinvading recently controlled areas within 3 months of a control operation (Doherty et al., 2021; Palmas et al., 2020), thus sustained control over large areas is important to keep the numbers low.

## 4.7 Feral pigs

Feral pigs are present across the Wharekirauponga site (likely in moderate – high numbers), with rooting damage evident during site visits, including during pest and frog surveys. Pigs can have devastating impacts on local flora and fauna, particularly regenerating forest understorey or areas of revegetation by uprooting trees and saplings and eating native plants and invertebrates. Feral pigs eat a wide variety of food including grasses, roots, seeds, and other plant material, as well as carrion, invertebrates, and ground-nesting birds. Their soil-associated feeding behaviours also make them a potentially important vector of kauri dieback disease (*Phytophthora agathidicia*), although this is an active topic of research and direct evidence of this impact is currently lacking (Niebuhr et al., 2024).

Recent anecdotal evidence has shown pigs are likely to be opportunistic predators of frogs, with reports 10-15 frogs being found in the stomachs of three pigs (Emily Hotham, *pers. comm*. 2022). A recent 2023 report by Smerdon and Kuypers, found that 44% of pigs tested with eDNA returned positive frog DNA (Smerdon and Kuypers 2023).

Feral pigs will be controlled across the WAPMA, primarily via shooting operations by experienced and licenced operators. Other forms of control (such as the toxin sodium nitrite), can also be used if pigs continue to be detected. As pigs are wide-ranging a buffer around the WAPMA has been established to enable optimised control and prevent reinvasion.

## 4.8 Goats

Feral goats are also likely to be present in moderate numbers across the site. Goats are social animals, typically travelling in small groups comprising one male and a group of smaller females. Females are able to conceive year round, but mating activity tends to peak December/January and June/July, with usually one or two offspring produced per year.

Goats are generalist herbivores that browse a wide variety of plant species but do prefer to feed on a small number of favoured species. Similar to feral pigs, goats destroy the understorey of vegetation and, when combined with possum damage to the upper canopy, can cause severe deterioration of native forests, often with associated pest plant invasion.

Goats will also be controlled across the WAPMA, primarily via shooting operations by experienced and licenced operators.

## 4.9 Wasps

German and Common wasps (*Vespula germanica, Vespula vulgaris*) have established in immense numbers across New Zealand since their introduction in the 1900s, resulting in New Zealand now having the highest density of wasps in the world (Barlow & Goldson, 2002). Their considerable impacts on New Zealand native forest ecosystems are becoming well understood. The impacts of *Vespula* spp. in South Island honeydew beech forest ecosystems, especially highlights the deleterious effects they have on native invertebrate communities and the resulting cascade effects that follow in our native forest ecosystems.

Wasps outcompete a range of birds, lizards and invertebrates that also feed on honeydew and in some cases have been indicated to cause a decline in abundance of several bird species as a result (Beggs, 2001). The probability of survival for some particularly vulnerable invertebrate species is near zero unless wasps are significantly reduced. There are also records of wasps attacking and killing nesting birds (Beggs, 2001; Potter-Craven et al., 2018). Although not as destructive, paper wasps (*Polistes chinensis*) were reported to collect an estimated 31-957 g of invertebrate biomass per hectare per season, with wasp nest densities varying from 20 and 210 nests per hectare in a Northland study (Clapperton, 1999).

Although the potential effects of wasps on reptile communities is not well documented, it is highly likely wasps pose an equally significant threat to reptile populations. Also note that wasps pose a significant health and safety threat to contractors and workers (including those undertaking pest management), and are therefore included in this WAPMP.

# 5.0 Areas for pest animal management

## 5.1 Wharekirauponga Animal Pest Management Area

The proposed WAPMA (Map 2) covers 632 ha, which includes the 314 ha area that may be subject to vibration impacts, as well as an adjacent area of 318 ha that is of high habitat quality for frogs based on modelling (Map 3). This combined 632 ha area will undergo an intensive pest control regime as described in this WAPMP.

Whareorino reported significant increases in Archey's frog populations with only 300 ha under active rat management (with a 2.3 fold increase reported in Ramirez 2017). In 2017, the size of the area under management was increased to 600 ha and the rat control continues to result in population increases (Easton, 2021). We can therefore be confident that the size of the proposed area of pest control will be more than sufficient to achieve biodiversity outcomes for frogs (as well as other native species).

# 6.0 Control methods - Aerial 1080

## 6.1 Overview

Aerial 1080 remains the most viable control tool in particularly rugged terrain, is known to result in significant biodiversity gains and has been successfully used at other sites where native frog recovery is occurring (including the Hunuas and Whareorino). Aerial 1080 will be used in Year 1 - 2 of control to suppress target species populations (and thereafter only if target pest suppression levels are not met). The timing of this operation will be designed to be coordinated with wider DOC 1080 work on the Coromandel Forest Estate. This initial knock-down operation will widely suppress pest numbers, after which control can then primarily occur via the ground based bait station and trap network. Aerial 1080 application is the most efficient control option for rats, stoats, cats, and possums, especially in remote, difficult terrain. Kill rates for possums using 1080 are now usually above 90 per cent. Kill rates for rats using 1080 are often close to 100 per cent (Parliamentary Commissioner for the Environment, 2011). There is less information on kill rates for stoats using 1080, but studies have shown that most, if not all, of a stoat population can be killed in a 1080 operation.

A further benefit of using 1080 at Wharekirauponga is the reduction in the need for trap checks and application of ground-based toxins. This reduces the impact of people working in sensitive habitat areas (particularly in areas where there are risks to species such as frogs by trampling, or biosecurity concerns such as kauri dieback spread). With modern techniques – such as pre-feeding with non-toxic baits, and using helicopters with GPS systems – aerial 1080 can knock down possum, rat and stoat numbers in areas of any size in two to three weeks, even during a population irruption (Parliamentary Commissioner for the Environment, 2011).

DOC has undertaken aerial 1080 drops in the southern Coromandel previously, and this work is ongoing. The last 1080 operation occurred on 7 November 2021. Rat tracking indices before the aerial application were 71% TTI, and dropped to 4% TTI on 22 December 2021 following the application (Department of Conservation, 2021c, 2021b). Aerial 1080 is therefore recommended as an option for the WAPMA as part of the wider plan for the Coromandel to effectively reduce target pest numbers and offer the most benefit for native biodiversity

## 6.2 Planning

The area proposed for aerial 1080 control is shown in Map 5.

Planning should begin 2-3 years before an aerial 1080 operation. Planning should include key stakeholders, including iwi, hapū, local community, and DOC. During this stage, the exact area to be covered by the operation, the timing, and the people involved (including an Operations Manager, persons holding a Controlled Substance license, and pilots) will be finalised. Users of 1080 must be both an Approved Handler (AH) and hold a Controlled Substances Licence (CSL).

There are multiple conditions and consents required that must be completed. As per the DOC website, these include:

- Gaining consent of the landowner/occupiers within the operational area;

- Notifying neighbouring landowners, schools, early childhood centres, veterinary and health services about the planned operation;
- Putting public notices in the local papers before the operation;
- Identifying drinking water supplies within the area to exclude or temporarily close and to support water testing shortly after the operation;
- Working with Public Health Officers from the local District Health Board to minimise any risks and protect public safety; and
- Applying for permission under the Hazardous Substances and New Organisms Act 1996.

A draft operational plan will be developed for consultation, followed by a detailed operational plan for the aerial application of bait detailing the exact timing, personnel involved, bait quantities required, hand-sowing areas, flight plans, and other operational aspects will be developed prior to the eradication.

## 6.3 Standard protocols

Standard protocols for the aerial application of cereal pellets containing the anticoagulant toxin 1080 via helicopter are well established in New Zealand. There are several best practice guidelines which will be followed, and the procedures integrated into the operational planning.

Guideline documents to be followed include DOC's guidelines for aerial 1080 drops for biodiversity benefit will be followed (K. P. Brown & Urlich, 2005), and the current industry guideline document available from the Bionet website (National Pest Control Agencies, 2018a), unless more current guidelines are released. Note some information in the current industry guideline document is out of date regarding current legislative requirements. Part 3 of the industry guidelines contains information on the requirements for working with 1080, including legislative controls on 1080, training and licences, storage, record keeping and reporting, road transport, communication, permissions under HSNO, handling and use, operational signage, emergency management, incident management, and disposal. Part 4 of the industry guidelines covers the operational steps and requirements.

Best practice for the operational delivery of aerial 1080 will also be followed. Protocols are available from Landcare Research for both possums (Landcare Research Ltd, n.d.) and rats (Landcare Research Ltd, n.d.). In summary:

- To target both rats and possums, RS5 cereal pellets (20 mm, mean wt. 12 g) containing 0.15% 1080 should be used, made as per factory specifications. Baits should be lured with cinnamon as per factory specifications and can be ordered with EPRO deer repellent if required. Toxic baits must be dyed green as per factory specifications.
- Pre-feeding should be conducted for best results, using the same type of bait as the toxic bait. It should not contain green dye but should contain the lure. Pre-feed should be applied at the rate of 2kg/ha approximately 10 days prior to the toxic bait being applied, with a minimum of 5 days between prefeed and toxic.
- Toxic bait should be applied at a rate of 2 - 3 kg/ha. Reasons for going over 3 kg/ha are: high numbers of possums or other animals likely to consume bait, or steep/rugged terrain.
- Flight lines for the toxic bait should follow the same path as the prefeed flight lines, and there should be no gaps in coverage if possible.

- Toxic bait should be applied during a weather forecast of at least 2 fine nights post-drop. 16 mm RS5 baits begin to disintegrate after 5 mm of rain, and about 40% of the 1080 leaches out of the baits after 10mm of rain.

## 6.4 Post-operation monitoring

Toxicity monitoring - Signs must be maintained and remain in place until monitoring shows that bait and carcasses are no longer toxic. Once hazards associated with the aerial 1080 application no longer exist, or a prescribed minimum time is up (whichever is the longer), then signs must be removed.

Pest monitoring – The target pest populations (rats and possums) should be monitored via chew cards between 3 and 6 weeks following the operation to determine success.

Biodiversity monitoring – Outcome monitoring is needed to determine the effectiveness of management aimed at protecting biodiversity (K. P. Brown & Urlich, 2005). A Biodiversity Monitoring Plan will be developed in conjunction with stakeholders.

## 6.5 Timing and frequency

Unless timing is designed to specifically address a population irruption, the toxin will be applied around late winter/early spring (between 1 June and 1 November) when bait uptake by rodents is highest (Gillies et al., 2003; Speedy et al., 2007), and when little rain is forecast for the following two weeks.

The normal frequency of aerial toxin application is every 3-5 years. Reinvasion of possums normally occurs gradually over this time period, however, reinvasion by rats is normally more rapid (within a few months), which is why ground-based control strategies have also been recommended to provide for continued, ongoing suppression.

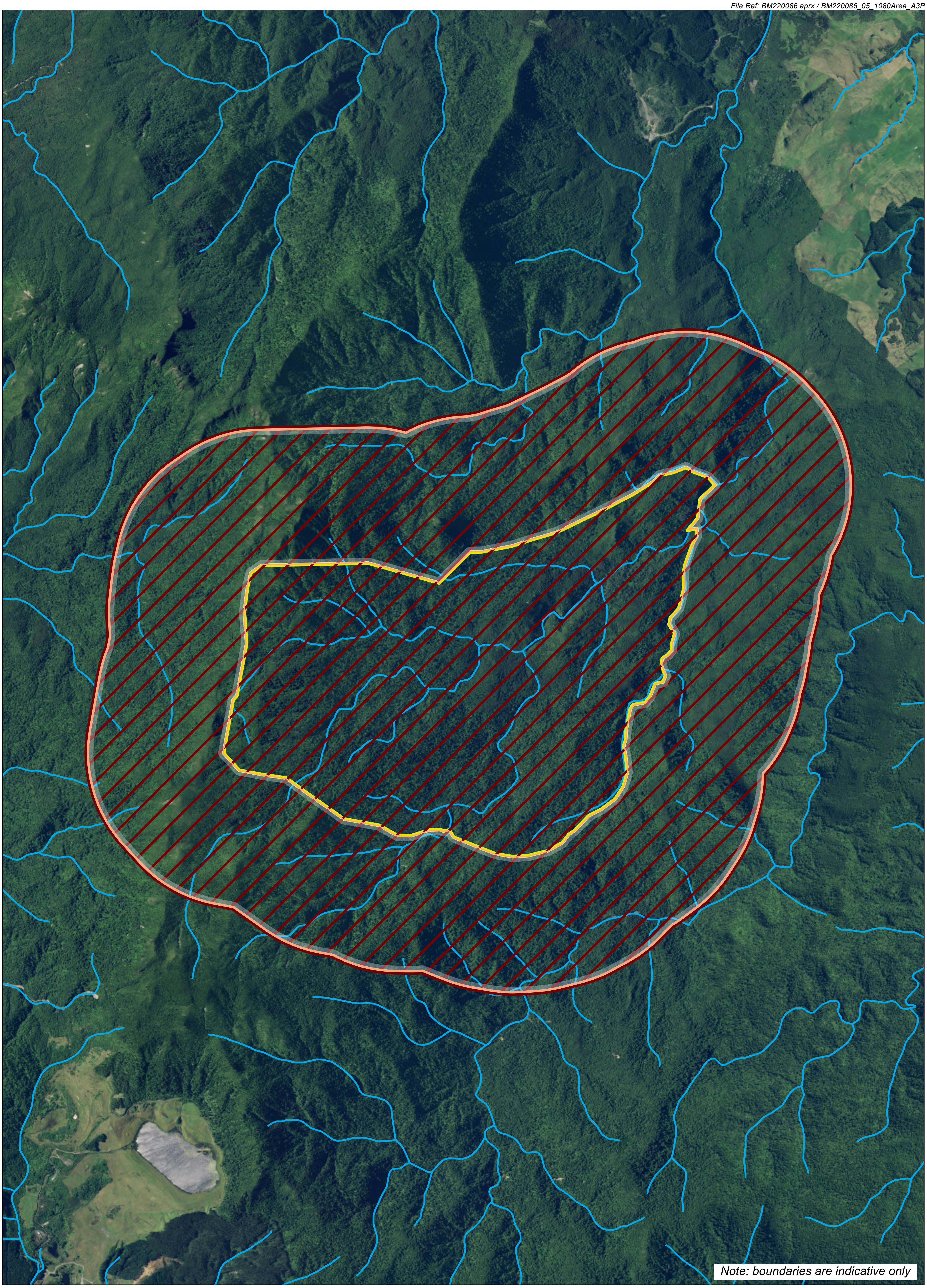
The aerial bait applications will be accompanied by intensive trapping, and ground based bait stations where necessary, as per the ground-based toxic baiting and trapping protocols in Sections 7.0 and 8.0 of this WAPMP respectively, to ensure toxin is available to the highest number of target pests and ensure maximum knock-down.

## 6.6 Risks

The application rate and sowing methods have been refined over many years to increase efficacy of reducing target populations, and the non-target kill of native species is normally very low. As with all predator control methods, there are some risks which need to be identified and appropriately mitigated.

As a toxin, 1080 must be handled, stored, transported, and deployed, as per strict protocols (National Pest Control Agencies, 2018a). It must always be used according to label instructions by personnel with a CSL and an Approved Handler license.

Notably, 1080 is particularly toxic to dogs, so any pests or hunting dogs must be kept out of the area during and post-operation. Warning signs should be in place as per standard procedure described in the best practice documents (Section 6.3).

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*Data Sources:* Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors., Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

*Projection:* NZGD 2000 New Zealand Transverse Mercator

LEGEND

- River/Stream
- Minimum Proposed 1080 Drop Area
- Proposed pest control area
- Ungulate Control (1km buffer)

**PEST MANAGEMENT**

Map 5. Recommended Area for 1080 drop (and ungulate control)

**Date: 04 October 2024 | Revision: 1**

Plan prepared by Boffa Miskell Limited

Project Manager: Helen.Blackie@boffamiskell.co.nz | Drawn: HCo | Checked: HBI

# 7.0 Control methods - Ground-based toxic baiting

## 7.1 Overview

Both rats and possums will be targeted using the same network of tree-mounted Philproof bait stations to allow for ongoing suppression. Bait stations will contain either DoubleTap (diphacinone and cholecalciferol) or cholecalciferol. These baits are recommended for Wharekirauponga as both of these toxic baits will also kill mice. DoubleTap has been shown to effectively reduce mouse populations even when deployed on a lower intensity bait station network than proposed here (Eason et al. 2020).

## 7.2 Bait stations locations, bait type & target species

A permanent bait station network (100 x 100 m) will be established across the WAPMA, targeting rodents and possums, and will supplement the permanent trap network. Recommended bait station locations are described alongside the trap spacings in Section 8.0 and shown in Map 6, which include:

- To continue to suppress the resident rodent and possum population, both of these species will be targeted using tree-mounted Philproof bait stations containing either DoubleTap (diphacinone and cholecalciferol) or cholecalciferol. Neither of these toxins require a Controlled Substance License to use, and both are low residue and are effective for both target species. Cholecalciferol, where used, will require pre-feeding for best effect.
- Following the initial toxic control, continued control will occur primarily via trapping. If possum numbers exceed 10% CCI (the threshold for additional control as per Section 13.2), an additional toxic control operation using Feracol strikers (which contain cholecalciferol as the main ingredient), will be deployed at the same locations as rat-specific bait stations. Note Feracol (i.e. cholecalciferol bait) requires pre-feeding for the best results. Other toxins approved for targeting possums may be used such as Feratox biobags, however, note this toxin requires a Controlled Substance License to use.
- Para-aminopropiophenone (PAPP) provides an additional control tool targeted specifically at stoats and feral cats. It is a vertebrate pesticide that was registered in New Zealand in 2011 as a new tool for the control of stoats and feral cats, and it is currently being evaluated for ferrets. Toxic baiting using PAPP for stoats should follow the methods outlined in Dilks et al. (2011). Detailed best practice guidelines exist for feral cat control using PAPP (Boffa Miskell Ltd, 2018a), which should be followed for any toxic operation undertaken with PAPP. PredaSTOP™ (which contains PAPP as the active ingredient) can only be purchased and used by persons who are Approved Handlers and hold a Controlled Substance License (CSL) with an endorsement for PAPP.

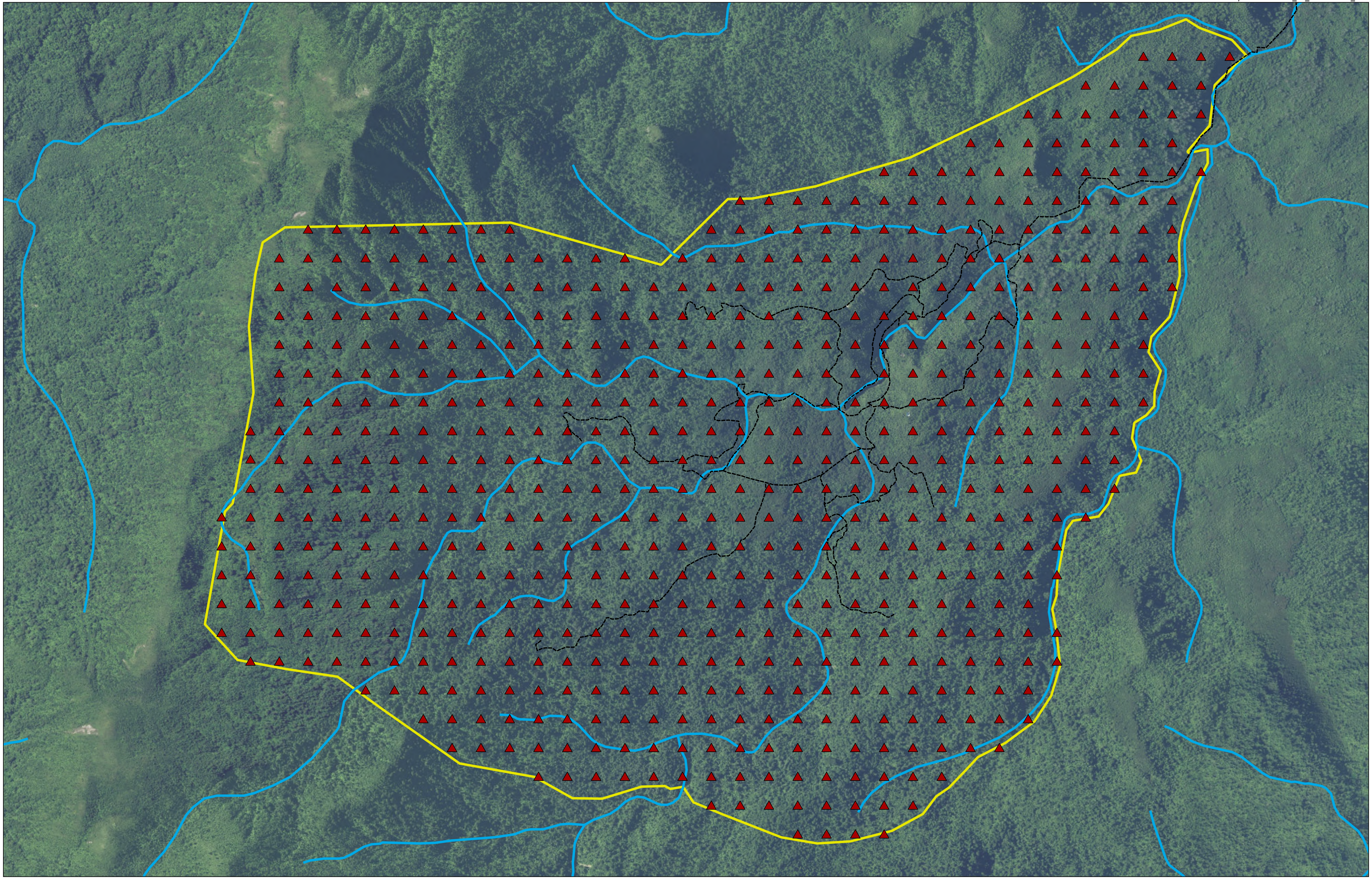
## 7.3 Frequency & timing

All toxic control operations need to be conducted by a suitably experienced and qualified contractor.

An aerial 1080 operation will occur to provide for initial pest suppression in Year 1 and potentially every 3 years thereafter (depending on target pest densities based on monitoring data). In Year 2 onwards (following the aerial 1080 drop), a ground-based toxic operation should occur every year during winter months (e.g. June – September), if rodent or possum numbers are above the threshold (unless a subsequent aerial 1080 operation occurs in any given year). This timing aims to suppress target populations before (or early in) the main native fauna breeding season, offering the maximum biodiversity benefits for the required effort, while reducing the amount of toxins deployed in the environment.

If a subsequent monitoring shows that rodent or possum presence is above the target threshold for rodents or possums, an additional control operation should be carried out within two weeks and toxic operations will increase to three times per year until the rodent and possum presence has reduced below the threshold. Pest targets and thresholds are given in Section 13.

Each toxic control operation should last until bait take has ceased (not including any pre-feeding, if required). After toxic bait is deployed on day 1, the amounts of bait in each bait station should be checked between days 6 - 10 (as per label instructions), and topped up if required (for diphacinone; cholecalciferol operations may require more frequent top-ups if bait take is high to ensure target animals are able to ingest a lethal dose). Bait should then be checked and refilled (if required), after another 3 – 4 weeks, and repeated until bait take has ceased. After each toxic control operation has ceased, all remaining bait will need to be brought in to reduce the risk to non-target species and the risk of target species receiving a sub-lethal dose and becoming bait-shy.



**LEGEND**

- ▲ Rodent and Possum Bait Stations (100x100m)
- Tracks
- Stream
- Proposed pest control area

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*Data Sources:* Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

*Projection:* NZGD 2000 New Zealand Transverse Mercator

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**PEST MANAGEMENT**

## Map 6. Approximate Bait Station Locations

**Date: 04 October 2024 | Revision: 1**

Plan prepared by Boffa Miskell Limited

Project Manager: Helen.Blackie@boffamiskell.co.nz | Drawn: HCo | Checked: HBI

# 8.0 Control methods – Trapping protocols

## 8.1 Overview

The tools recommended for use in this plan are based on those currently available (and approved for use on the DOC Estate) at the writing of this plan, but they should be supplemented or replaced with improved tools with proven efficacy as those come to market. It must be noted that pest control tools and technologies are evolving at a rapid rate, with many new tools coming into the market. These new tools will greatly enhance the efficiency of predator control regimes. A review of emerging animal pest management tools and technology should be included as part of an annual review of the Wharekirauponga programme, and new tools should be incorporated into the following years' animal pest management practice if suitable.

## 8.2 Trap types – kill traps

A kill-trap, by definition, must kill the target animal and do so quickly and consistently. Traps that have passed testing under the guidelines laid out by the National Animal Welfare Advisory Committee (NAWAC) are considered to be humane for that species. An up-to-date list of traps that have been tested under NAWAC guidelines and either passed or failed can be obtained from https://www.bionet.nz/rules/performance-traps.

Rats, mustelids, hedgehogs, possums, and feral cats can all be effectively controlled by trapping if appropriate trap type, spacing and lures are used. A mixture of trap types for each species is generally the best approach as individual animals will respond differently to different trap types and there will always be some animals that will avoid one trap type but may go into another.

Multiple new traps have been developed recently, including AI self-resetting kill traps some of which have NAWAC approval for the full range of pest species from a single trap (from mice through to possums). Resetting kill traps offer multiple benefits, including offering constant control between services and reducing the amount of servicing required (decreasing costs and reducing any target avoid of traps due to human scent left during frequent servicing). AI-triggered traps also allow for a more open trap housing to overcome neophobia of target species and thus potentially increasing trap rates while near eliminating risk to non-target species.

### 8.2.1 Rats, mustelids & hedgehogs

DOC200 traps are single-set traps which have passed National Animal Welfare Advisory Committee (NAWAC) testing protocols for humanely killing rats (both species), hedgehogs, and stoats. The entrance of DOC traps may need to be slightly enlarged for hedgehogs to fit in. The larger DOC250 has also passed NAWAC testing protocols for humanely killing ferrets as well as the same species as the DOC200. Run-through double-set DOC200 traps are useful for targeting stoats (potentially due to their behavioural affinity for tunnels). DOC series traps are robust, widely used across New Zealand, and have specific design features, including the double baffle and specified entrance size, to reduce the risk to non-target species. Most DOC series traps should always be placed inside standard DOC wooden housing to exclude non-targets. The disadvantage of DOC traps is that they are only capable of catching one pest before requiring servicing and resetting, and can have low capture rates.

The ’Rewild F Bomb’ is a newer single-set trap which has passed NAWAC for both species of rats, stoats, ferrets and hedgehogs, meaning it has the same potential target species as the DOC250 trap.

**NZAutoTraps AT220 trap** is a resetting trap which passed NAWAC testing for ship rats and possums. AT220 traps may be a good option to increase trap variety for ship rats, provide constant control between services, and to decrease ongoing servicing costs, especially when used with ‘smooth in a tube’ or ‘egg-mayo’ as a lure which drips out over several months. They do not have NAWAC approval for Norway rats, mice, stoats, ferrets or feral cats so care must be taken to avoid these species entering traps (as they may result in an inhumane death or injury).

**The Critter Solutions AI trap** is a long-life, resetting trap with NAWAC approval for mice, ship rats, Norway rats, stoats, ferrets and possums (with hedgehogs and feral cats pending). These trap types are a good option to provide continuous control for a range of species with a single trap type. They also have optimal remote notifications of trap capture and battery life and an auto-lure dispenser.

Goodnature® A24 trap for rats and stoats are not recommended for this project. They have passed NAWAC guidelines for ship rats and stoats (but have failed for Norway rats). Goodnature traps have not achieved sufficient knockdown of target species in many areas, including Pukaha Mt Bruce and Windy Hill Sanctuary on Great Barrier Island. These traps also have had issues reported with the lures clogging and thus not remaining effective at attracting target species. There are also concerns about risk to non-target species, some of which may be present at Wharekirauponga including kiwi and kaka.

### 8.2.2 Possums

A range of kill traps have passed NAWAC testing for possums. Of these, traps suitable for use include:

- **Sentinel trap**
- **Trapinator** (this trap is comparatively easy to set and offers an alternative to the Sentinel trap)
- **SA2 Kat trap** (at selected locations to increase trap diversity, but which are away from residential areas where there is a potential for domestic cats to also be caught)
- **Warrior trap** (recommended for contractor use only and not where volunteers may be servicing traps as it is comparatively harder and more dangerous to set)
- **AT220**
- **Critter Solutions AI trap.**

Traps not proposed for use include the Timms, Possum masters and SA Coni traps, which have all failed NAWAC testing and are not considered humane for killing possums.

### 8.2.3 Feral cats

For targeting feral cats, only two traps have passed NAWAC guidelines for cats:

- **SA2 Kat traps** and **Timms traps**. Note Timms traps have not passed NAWAC testing guidelines for possums, however they are effective for catching possums if present. Both of these traps can be set above the ground with a ramp or on the ground in wooden chimney boxes to help exclude non-target species. Equal numbers of each type are recommended to increase trap diversity.
- In 2024 the Critter Solutions AI trap will undergo NAWAC trials for feral cats in Australia, and if it passes it will be the first resetting trap for feral cats.

## 8.3 Trap locations

Trap locations are shown in Maps 7-8 and their spacings are summarised in Table 6. This trap network is designed to complement and work alongside the aerial control and ground based bait station network, and as such spacings are designed for suppression alongside the use of toxins.

Rat/mustelid/hedgehog capable traps will be deployed on a 100 m grid across the entire control area and at 100 m intervals along tracks, rivers, ridges, and the perimeter. If standard DOC200 traps are used, some should be swapped out with Double-set DOC200 traps to better target stoats. A trap type also capable of killing ferrets will be deployed at every second trap on a 200 m grid and all other trap lines.

For additional rat and mouse control (i.e. if thresholds are exceeded despite the existing aerial control, ground-based bait stations and trap grid), D-rat traps will be set at 50 m intervals between existing traps). D-rat traps can be set to the mouse sensitivity setting placed alternating in tunnels and on trees (to target both mice and rats).

Possum/cat-capable traps will also be deployed at 200 m intervals along rivers and ridges and 100 m on tracks and the perimeter. The control devices required are summarised in Table 6.

Note bait stations targeting rats and possums (e.g. Philproof Mini Gen II) will also be deployed, as shown in Map 6. Bait stations will be spaced on a 100 m grid at existing trap locations across the control area where possible.

Each trap location will need to be micro-sited upon deployment (i.e. refined on a fine scale within several meters in the field, based on the broad-scale locations in Maps 7-8). This ensures each trap is placed within suitable micro-habitat for the target species to maximise capture success. The target mammalian predators do not move through the landscape uniformly but instead their movements are influenced by prey abundance, population abundance and importantly by key habitat features and preferred movement corridors. Rats and mustelids tend to move along waterways and linear features including along habitat boundaries, tracks, and fence lines, so placing traps along these features often increases catch rate.

*Table 6.* Summary of control tools and spacing for each target species at Wharekirauponga. These tools should be updated as new technology becomes commercially available.

| Target species | Control tool | Spacing | Notes |
|---|---|---|---|
| Rat/hedgehog | DOC200<br>Double-set DOC200<br>DOC250<br>Re:wild F-Bomb<br>CritterSolutions AI* | • 100 m grid<br>• 200 m grid (for ferret capable)<br>• 50 m intervals on tracks, rivers, ridgelines and perimeter | Alternate trap types as appropriate. Can use same bait for mustelids and rodents. Alternate D-rat trap in tree and in tunnel on ground (set to mouse sensitivity level) |
| | D-rat (if required) | • 100 m grid (D-rat trap offset by 50 m on every DOC trap) | |
| | Toxin in bait station** | • 100 m grid across all available habitat | Also targets mice and possums |
| Mouse | D-rat trap (mouse setting) | • 50 m grid if required (D-rat trap offset by 50 m every 100 m on the grid) | Alternate D-rat traps on trees an in tunnels on ground, all traps set to mouse sensitivity level |
| | Critter Solutions AI trap | • 100 m grid | Simultaneous with rat/mustelid control |
| | Toxin in bait station** | • 100 m grid across all available habitat | Simultaneously controls possums and rats |
| Feral cat | SA2 Kat trap<br>Timms trap | • 200 m intervals on tracks rivers and ridges<br>• 100 m intervals along on perimeter | Alternate trap types and bait types to target cats and possums separately. Alternate side of tracks, but keep same side for rivers.<br>Refer to Map 8 |
| Possum | SA2 Kat trap<br>Flipping Timmy | • 200 m intervals on tracks, rivers and ridges<br>• 100 m intervals on perimeter | Alternate trap types and bait types to target cats and possums separately. Simultaneously controls rats and mice<br>Refer to Map 7 |
| | Toxin in bait station** | • 100 m grid<br>• 100 m on perimeter | Refer to Map 6 |
| Mustelid | DOC200<br>Double-set DOC200<br>DOC250<br>Critter Solutions AI trap<br><br>Re:Wild F-bomb | • 100 m grid (stoat capable)<br>• 200 m grid (ferret capable)<br>• 50 m intervals on perimeter | Alternate trap types along lines, use same location as feral cat/possum traps. Refer to Map 7 |

* Also targets mice and ferrets
** Use bait stations on existing trap lines

## 8.4 Trap preparation & deployment

Before traps are deployed, all sharp edges on the wire entrance baffles of trap boxes need to be filed back to a smooth edge. This will reduce the likelihood of a target individual either avoiding the trap or entering the trap then backing out due to injury caused by any sharp edges and subsequently developing trap shyness. All traps need be test fired and checked for mechanical reliability prior to deployment.

All DOC200 traps should have their triggers calibrated to 70 g to ensure weasels are also targeted. The factory trigger weight for DOC200 traps is reported as 80 g (Haworth, 2018) meaning that female weasels at the bottom end of the size range will likely not trigger them. How to calibrate the trigger weight of DOC traps is available on DOC's YouTube channel *DOCskillable* (https://www.youtube.com/watch?v=11t9II2FpFk).

Upon deployment, traps should be ground-truthed to ensure the most effective placement to maximise target catch. This refers to the placement of the trap within the environment at a scale of metres, which can have a dramatic impact on capture rates. For example, mustelids and other predators are attracted to cover and tend to avoid open spaces, so traps should be placed near cover such as under a tree or shrub where possible. The person deploying the traps must:

- Ensure each trap is placed near cover;
- Orient traps to allow easy entry;
- Clear the entrance of vegetation and debris;
- Check all traps to ensure they are good working condition before deployment; and
- Record an accurate GPS location.

## 8.5 Lure types

Lure types in kill and live capture traps depend on the target species:

- Traps targeting rodents, mustelids, and hedgehogs (e.g. DOC series traps) should be baited with Erayz, a hens' egg and peanut butter and/or PoaUku long-life rat and stoat lures. In spring/summer (August to February inclusive), traps should be baited with fresh rabbit meat, or salted rabbit if fresh rabbit meat is not available, to better target mustelids. Other options include Eggsellent lure and fish, and for rats only, chocolate and macadamia nuts. Auto-luring devices such as EzyLures or Motolures can also be fitted to traps to allow for continuous lure deployment, which generally results in higher captures.
- Traps targeting possums (e.g. Sentinel traps) should be baited with fresh apple and peanut butter, and/or PoaUku long-life possum lures. If the trap type is unable to support a large bait (e.g. Trapinators), peanut butter is able to be used on its own. Cat biscuits can also be an effective lure and be used intermittently to diversify lure type over time. Other options include Eggsellent lure, smooth in a tube and possum dough. A white flour and icing sugar blaze can be placed on the tree trunk below tree-mounted possum traps to act as a visual lure. Auto-luring devices can also be attached to these traps.
- Traps specifically targeting cats (i.e. SA2 Kat traps, Timms traps ) should be baited with a combination of salted rabbit, jelly meat, cat biscuits and/or fish.
- Newer resetting traps (e.g. AT220 and Critter Solutions AI trap) have inbuilt auto-luring mechanism to ensure fresh lure is deployed at a regular interval.

To maintain an effective trap network, all lures need to be replaced at least once per month (unless auto-lures are used), increasing to once per fortnight between August and March (inclusive). The lure type used needs to be recorded and entered into the selected data management system to allow analysis of which lures are most effective for each target species.

Changing between lure types (e.g. every 3 months), may help to increase trapping success by targeting individuals with differing preferences. Using multiple different lures, such as both rabbit and an egg, will also likely attract a wider range of target species and individuals of the same target species with differing preferences.

## 8.6 Trap servicing protocols & frequency

### 8.6.1 Kill traps

Trapping should occur year-round throughout the WAPMA to provide for continued suppression of pests. The frequency of trap checks varies depending on trap type and the time of year.

If not self-resetting (i.e. single-set), kill traps should be checked once per month year-round, increasing to twice monthly between August and March (inclusive), when frogs are more active and when target population threshold are exceeded for a particular species (see Section 13.2). Care will need to be taken to use the same tracks and routes for trap checks to avoid trampling disturbance, trap checks should only be undertaken during daylight when frogs are less active.

If resetting trap types are used, trap check can drop to every second month year-round, and increase to every 4 – 6 weeks August and March (inclusive). Trap checks can also occur during other activities such as baiting and pest monitoring to reduce tramping impacts.

All traps need to be regularly checked, reset and re-baited when required, and always maintained to a high standard to ensure that:

1. Lures do not become depleted or rotten;
2. The trap is regularly tested to ensure it is mechanically sound including checking for worn pivots and weakened springs and that its set to the correct trigger weight;
3. Access to traps remains open i.e. the trap has not become overgrown, and if so, any obstructing vegetation is either sprayed or cut back;
4. Traps are secured to the ground with wire to prevent being disturbed and removed by pigs and possums; and
5. Traps are clean and free of algal growth or other substances/debris that may make it unattractive to the target animal.

During routine trap checks, triggered traps should be cleared, reset, and rebaited with fresh bait. Untriggered traps should be set off, reset, and rebaited with fresh bait. Once per year in spring, all traps must be audited, comprising a full clean (e.g. with a wire brush to remove mould, fur and other debris) and 'warrant of fitness' test according to the checklist in Appendix 1.

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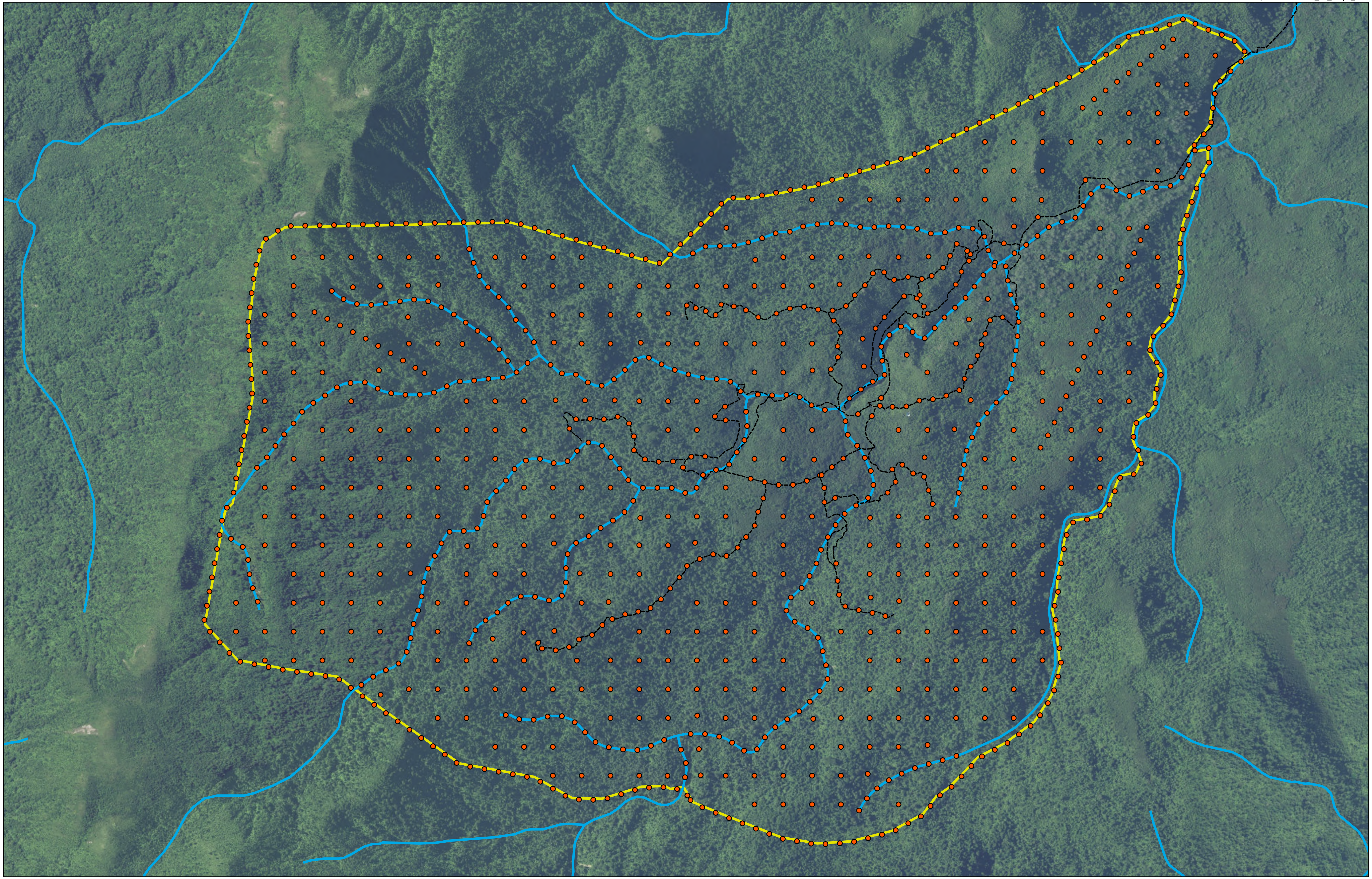

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*Data Sources:* Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

*Projection:* NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Proposed Trap Locations
- Proposed pest control area
- Stream
- Tracks

**PEST MANAGEMENT**

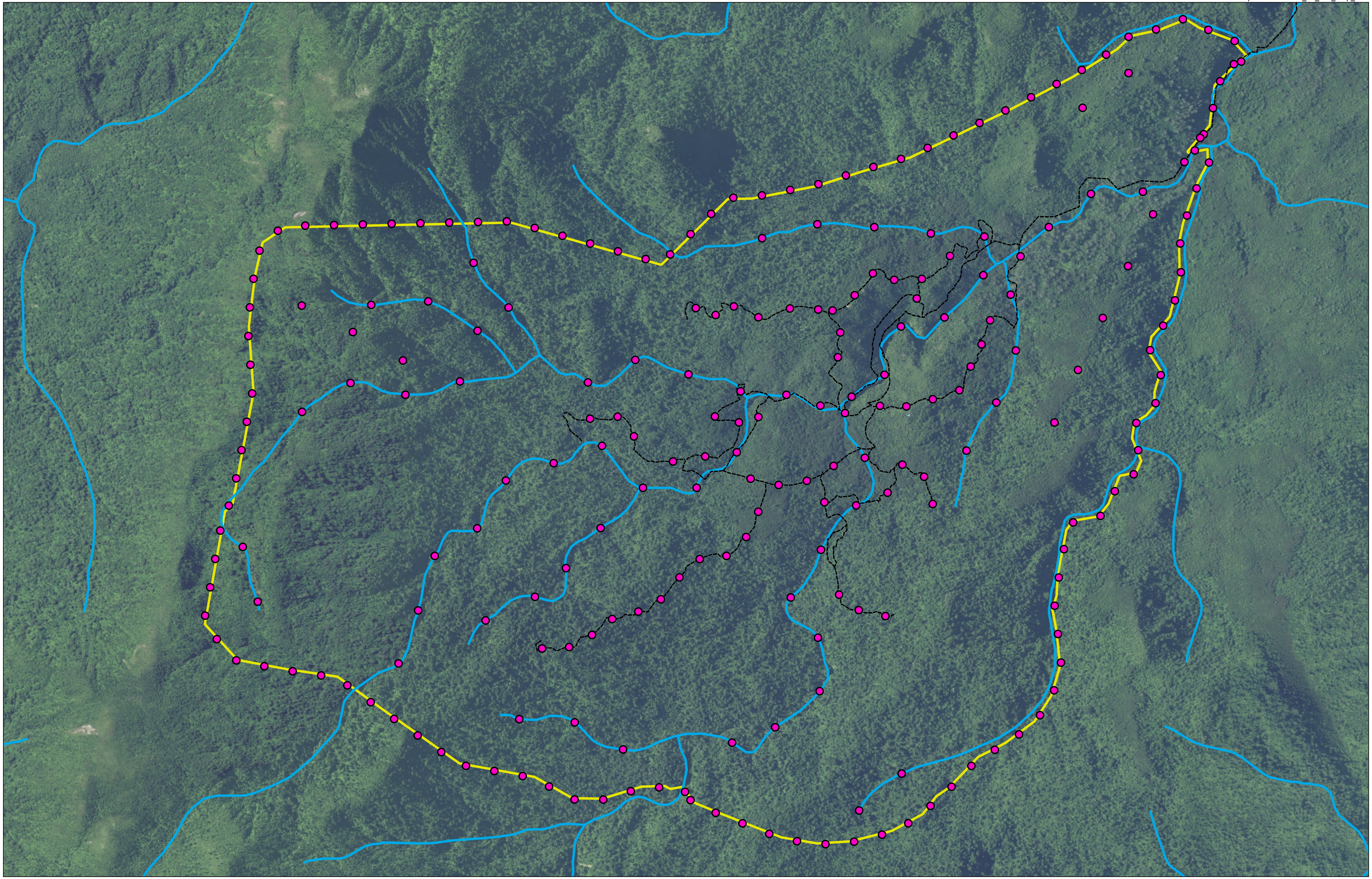
Map 7. Approximate Trap Locations – Mustelids, Rodents and Possums

**Date: 04 October 2024 | Revision: 1**

Plan prepared by Boffa Miskell Limited

Project Manager: Helen.Blackie@boffamiskell.co.nz | Drawn: HCo | Checked: HBl

File Ref: BM220086.aprx / BM220086_08_Cat_Trap_A3L



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LEGEND

- Feral Cat Device
- Tracks
- Stream
- Proposed pest control area

**PEST MANAGEMENT**

## Map 8. Approximate Trap Locations – Feral Cats

**Date: 04 October 2024 | Revision: 1**

Plan prepared by Boffa Miskell Limited

Project Manager: Helen.Blackie@boffamiskell.co.nz | Drawn: HCo | Checked: HBl

# 9.0 Control methods – Ungulates

## 9.1 Methods

Ungulates (pigs and goats, as deer are not thought to be present) will be controlled primarily via shooting by experienced contractors (not recreational hunters) with the appropriate certifications, within the 1 km buffer area shown on Map 2. Live-capture trapping (similar to pens with a one-way gate), and/or a toxic operation using sodium nitrate (for pigs) may also be undertaken if required.

The duration of each hunting effort will depend on the densities of goats and pigs present and the effort required to bring densities down to target levels. Control efforts will therefore be focused around whether ungulates are being detected during surveillance. Pigs, in particular, are likely to move in and out of the pest management area from surrounding bush areas so control efforts will need be responsive to detected increases in activity. In addition, hunting should occur when conditions are more favourable (e.g. avoiding peak of summer as too dry, or winter too cold/wet and animals are bedding down).

Hunting will primarily comprise ground hunting with dogs. Pig hunting using pig dogs is most effective, while trained indicator dogs are also more successful than hunter alone. If ungulates persist, a ‘wall-of-death’ approach may be required, whereby professional hunters are employed to systematically work their way through the patch and ideally shoot all individuals in the population. Many ungulate populations have been successfully eradicated from New Zealand using this approach (Fraser et al., 2003). Aerial shooting (e.g. via a helicopter) is unlikely to be a suitable method given the dense canopy across most of the site.

If pig numbers are high, this may require more regular hunting efforts (e.g. monthly operations), and/or additional nights of hunting live cage traps (similar to pens with a one-way gate) may also need to be used. Traps should be set where vegetation can provide shade and shelter, near identified pig runs, and where pigs are frequenting or feeding regularly. Pigs are attracted to bait with a strong odour. Bait can include offal, grain, commercial pig or poultry pellets, vegetables or fruit. Large amounts of bait will be required, around 10-20 kg each time. Bait should be placed in the trap for a week prior to setting (with the same amount and type of bait). All traps must be inspected daily, with any trapped pigs destroyed by shooting as quickly and humanely as possible (Greater Wellington Regional Council, 2012). If trapping occurs, it is recommended that wireless cameras are used to monitor traps sites, and wireless sensors to notify the person responsible for setting the trap when trap has gone off to avoid the required daily inspections.

There is currently only a single registered vertebrate toxic agent in New Zealand for controlling pigs: sodium nitrite ($NaNO_2$) in Bait-Rite Paste® Connovation Ltd. This bait can be used as an additional control measure if the feral pig threshold is exceeded. This bait must be used as per label instructions. Baiting methodology should follow the protocols described in Shapiro et al. (2016), with baits delivered in sets of three wooden bait boxes (measuring 800 mm long, 450 mm wide and 190-mm deep and spaced 10 m apart in a triangle formation, each with a hinged lid that had a 5 cm lip protruding from the front face to allow pigs to open the lid with their snouts), secured to the ground by a metal stake at each corner. Bait box lids should be left closed, relying on pigs to open them to reduce non-target risk.

A two-night period of pre-feeding using non-toxic baits (nights one and two) should be followed by a night where the bait boxes are left empty prior to the toxic operation (night three). For the toxic operation (night four), each box should be baited with nine toxic baits giving a total of 27 baits. Each 250 g ball of toxic paste bait should contain 25 g (10%) NaNO2, 1.31 g (0.5%) encapsulant and 223.69 g (89.5%) non-toxic paste bait. Toxic baiting should continue for at least a further two nights with two 250 g baits per box on each night as required.

# 10.0 Wasp control

German and Common wasps (*Vespula germanica, Vespula vulgaris*) have established in immense numbers across New Zealand since their introduction in the 1900s, resulting in New Zealand now having the highest density of wasps in the world (Barlow & Goldson, 2002). In previous years the wasp population and density of nests within the Wharekirauponga has been considerably noticeable and they are likely having a negative impact on the Wharekirauponga forest ecosystem. They are also a significant H&S risk for people working on site.

Wasps outcompete a range of birds, lizards and invertebrates that also feed on honeydew and in some cases have been indicated to cause a decline in abundance of several bird species as a result (Beggs, 2001). Although the potential effects of wasps on native anuran communities is not documented, wasps may be a significant threat to *Leiopelma* species.

## 10.1 Methods

Control of wasps is limited to poisoning nests, toxic baiting and biological control (Potter-Craven et al., 2018). For large-scale operations, sustained control via toxic baiting is most effective. Fipronil (Vespex) is highly effective at reducing wasp numbers while having low non-target species risks and is endorsed by DOC. For small-scale and direct control upon locating a nest, powdered insecticides containing permethrin (e.g. NO Wasps Eliminator) applied at the entrance of the nest is used to exterminate a nest.

Vespex bait for large-scale control is used with Wasptek bait stations, specialised for wasps which are attached to a tree at least 70 cm above the ground (Figure 7). The bait is left out for 3 - 8 days and then removed. One treatment of Vespex has shown to reduce wasp numbers by 80% within 100m of the control line in an area with over 5 nests per hectare (Harper et al., 2016). Previous research in beech forests of the South Island has indicated that wasp numbers should be reduced by at least 85% for adequate protection of invertebrate populations (Beggs & Rees, 1999; Toft & Rees, 1998). Consequently, an aim to reduce at least 85% of the wasp numbers within the Wharekirauponga animal pest management area is expected to support invertebrate populations and the other native fauna populations.

*Figure 6: Application of Vespex wasp bait in Wasptek bait stations.*

## 10.2 Pre-monitor for wasp activity

To determine if wasp activity is high enough to undertake control (optional), fish bait, plain raw chicken meat, or rabbit meat can be placed on a container lid, around noon on fine days, with 5 m intervals between bait. After 1 hour, the presence of wasps can be inspected and recorded at each lid. If more than 10 wasps are present per 20 lids, control will be undertaken.

## 10.3 Toxic baiting protocols

Common wasps and German wasps will be controlled via Vespex poison baiting and NO Wasps Eliminator powder for known nests. NO Wasps Nest Killer Aerosol will be used to exterminate paper wasp live nests found when deploying bait stations. NO Wasps Eliminator powder will be used for German and Common wasp nests.

Bait stations locations should be as per the following specifications:

- Bait stations will be spaced at 50 m intervals along tracks and existing trap and bait station locations for other target species. Spacing should follow approximate 300 m x 50 m apart (i.e. lines that are 300 m apart with 50 m intervals of bait stations along each line). This is the standard spacing recommended for areas greater than 200 ha.
- Wasptek bait stations will be nailed onto a tree approximately 100-150 cm above the ground, so it is easy to check and service on following visits. Using gloves, 20-30 g of bait will be placed into bait well supplied with Vespex bait, using the indicator line on the bait well for indication of 20 g amount. The bait well will then be placed into Wasptek bait station.
- Bait will be left in well for 3-8 days, depending on wasp activity. Baiting will occur between late-January and late February for effective control. Control can be repeated annually or twice annually to include control in early April or four weeks after first application if high wasp activity persists. Bait will be left for a maximum 8 days before collection of remaining bait and disposing off in approved landfill.

# 11.0 Pest animal monitoring

## 11.1 Overview

Ongoing monitoring and adaptive responses are key to effective predator management. Monitoring in other frog recovery sites (including Whareorino) show that control is frequently either inadequate or ineffective, allowing (for example), rat densities in the frog recovery area to increase to 60% tracking (TTI) in some years (Easton, 2021).

Within the WAPMA, well-established monitoring tools will be used to monitor pest presence and assess their densities against the intended targets, and to initiate further control if particular thresholds are exceeded (as stated in Section 13.2).

This section outlines the monitoring methods and protocols, namely for chew cards, camera traps, and new monitoring technology.

Biodiversity outcome monitoring is also important to determine the success of pest control at not only reducing pest populations, but achieving the intended biodiversity outcomes. Regarding frogs, a draft frog monitoring programme has yet to be developed, pending discussions with frog experts in DOC and Council so that a consensus on effective monitoring techniques can be agreed.

## 11.2 Chew card methods

### 11.2.1 Description

Chew cards are a common, cost-effective, and sensitive detection and monitoring tool suitable for determining the presence, and provide a coarse index of relative abundance, of a range of pests, including rats, mice, and possums. Chew cards, rather than wax tags, have been found to be more effective at attracting possums and rodents, and are recommended by DOC in their National Biodiversity Monitoring and Reporting Framework (Forsyth et al., 2018).

Chew card indices do not require calibration with other possum monitoring indices (e.g. leg-hold or wax tag indices; Forsyth et al., 2018), so can be directly compared to these data if required. Tracking tunnel lines, another widely-used pest animal monitoring method in New Zealand, are not suitable for obtaining reliable indices of possum abundance, meaning an additional monitoring method for possums would be required and monitoring would become less cost-effective.

Chew cards have been found to have higher rates of detections for mice than tracking tunnels, and correlate to tracking tunnel rates for rats (Sweetapple & Nugent, 2011). The higher rates of detections for mice makes them a suitable choice over tracking tunnels for this project.

### 11.2.2 Chew card spacing

At minimum, there will be at least 11 lines of chew cards, as recommended for areas greater than 501 ha. Chew card lines will contain 10 chew cards spaced 20 m apart (i.e. along 180 m-long lines), as per best practice for possums (National Pest Control Agencies, 2015) and for both (Ruffell et al., 2015).

Recommended chew card lines are shown in Map 9. All chew card lines will need to be ground-truthed to ensure chew card locations are appropriate, accessible and in areas likely to provide preferred habitat for rodents and possums.

The same chew card lines are to be used year to year to enable trend monitoring and comparisons. However, lines may be repositioned in future if, for example, access becomes difficult.

### 11.2.3 Frequency & timing

Chew card monitors (of three nights each) will be repeated four times per year (simultaneously with camera trap surveys): February, May, August, and November. The three night monitor is as recommended by Ruffell et al. (2015) for monitoring both rats and possums, and also matches the best practice monitoring for possums (National Pest Control Agencies, 2015). Saturation of chew cards (when pest densities are too high and bite marks from some species may obscure marks from other species) is not expected to be an issue at this site because of the thresholds for additional control ensuring that pest numbers are maintained at low densities.

An additional monitor using chew cards may also be required if the threshold values of rats or possums are exceeded, as per the values given in Table 8 (Section 13.2). The follow-up monitor should occur 4 weeks after the additional control measures to ensure the abundance of the target species has been successfully reduced to acceptable levels.

Additional monitoring before and after toxic control operations is standard practice to assess the efficacy of control. These monitors may replace one of the four yearly monitors if timing coincides, enabling effort and resources to be focussed on control operations.

### 11.2.4 Chew card deployment

On each monitoring instance:

- Deploy cards for three nights when a mostly fine forecast is expected (no heavy rain predicted), as per the standard methodology for calculating the CCI.
- Fill the internal channels of the corflute material with peanut butter as a lure. Alternatively, cards pre-filled with herbal peanut lure can be used (available from Connovation Ltd).
- Nail each card to the closest suitable tree trunk 30 cm above the ground using 50 mm flat head nails angled upwards at 30 degrees.
- Label cards in permanent marker with the location, line number, card number, date of deployment and date of retrieval.
- Retrieve chew cards after the three-night period, then proceed to interpretation and analysis of bite marks.

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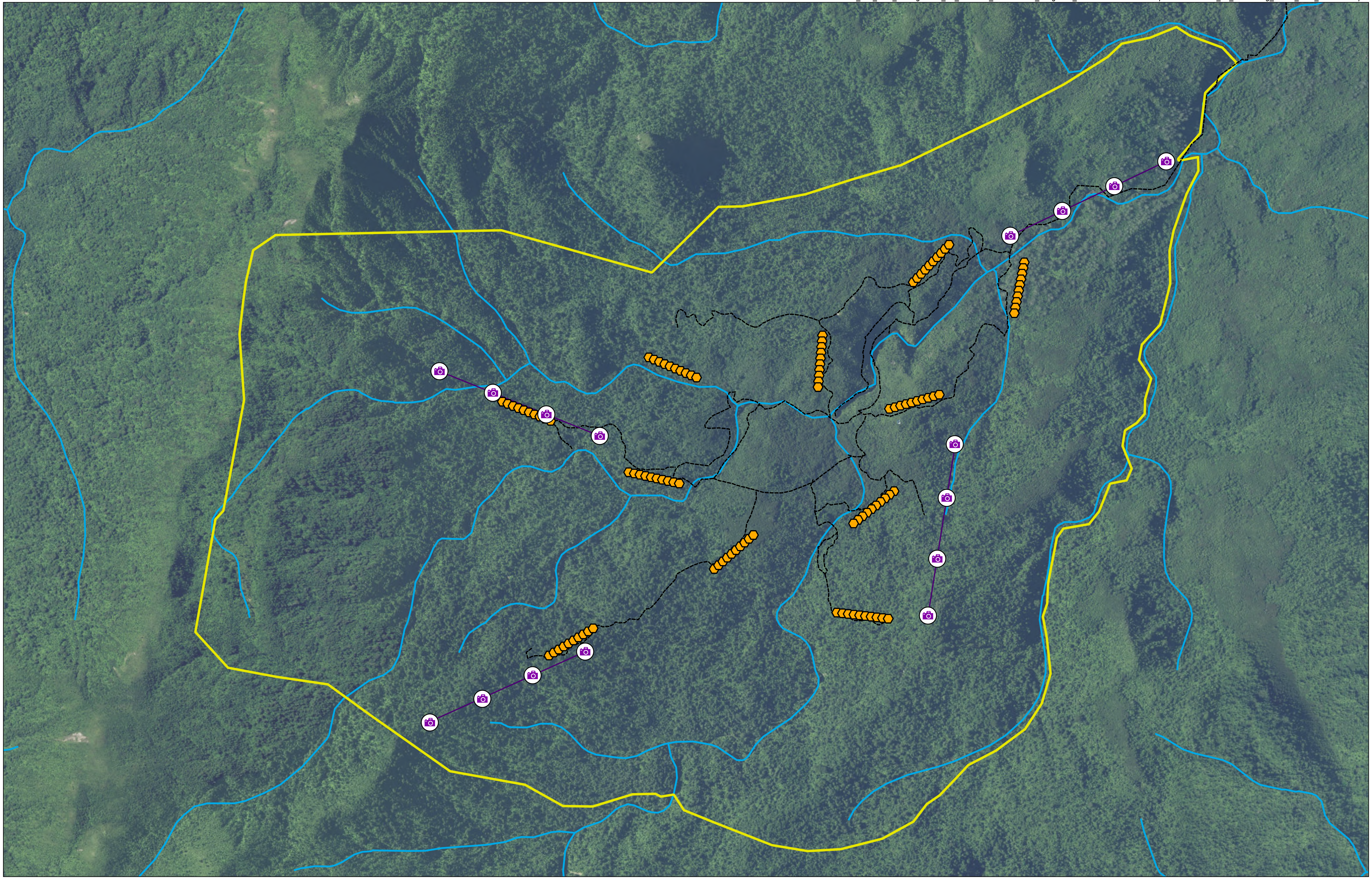

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*Data Sources:* Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

*Projection:* NZGD 2000 New Zealand Transverse Mercator

LEGEND
- Chew Card Lines
- Monitoring Cameras
- Camera Monitoring Line
- Tracks
- River/Stream
- Proposed pest control area

**SOUTHERN COROMANDEL PEST MONITORING**

## Map 9. Approximate Monitoring Locations (cameras and chew cards)

**Date: 04 October 2024 | Revision: 2**

Plan prepared for OceanaGold by Boffa Miskell Limited

Project Manager: Helen.Blackie@boffamiskell.co.nz | Drawn: HCo | Checked: HBI

### 11.2.5 Chew card analysis

Any bite marks recorded on the chew cards need to be identified to species level and CCI needs to be calculated to gain an estimate of relative population abundance for each target species.

For each target species:

- Count the total number of devices with bite marks of target species for each line. Assistance with bite mark identification can be found on the Landcare Research website (www.landcareresearch.co.nz).
- Divide the total number of devices with bite marks on each line by the total number of devices per line to get the proportion of devices with bite marks for each line.
- Calculate mean proportion of devices with bite marks for all lines for the site (i.e. the sum of the proportion of devices with bite marks of each target species).
- Multiply by 100 to get the CCI percentage.
- Calculate the standard error (SE). This is the standard deviation of the CCI / square root of the number of lines.
- Multiply the combined SE by 2 to calculate the approximate 95% confidence interval. Note that some statistical assumptions may be violated by the field layout, so the 95% confidence intervals are approximations only.

## 11.3 Camera trap methods

### 11.3.1 Description

Camera traps have become an increasingly used tool in the past 5 years (e.g. (Gillies & Brady, 2018; Glen, Cockburn, et al., 2013; Glen et al., 2014). Cameras are much more effective for detecting the larger pest species (cats, ferrets and stoats) (Norbury et al., 2017), including in comparison to standard tracking tunnels (Department of Conservation, 2020; Smith & Weston, 2017; Dilks et al., 2020). This success of camera traps is likely due in part to the reduction of a neophobic response (the avoidance of new objects in the environment such as tracking tunnels) with this passive method (Smith & Weston, 2017).

***Note: DOC's best practice guidelines for camera trapping (and potential indices from camera trap data for key target species) is currently under development and expected to be completed in 2024. Camera trap methods and targets outlined in this document are based on the draft recommendations (Department of Conservation, 2023) and should be updated based on the final guidelines as they become available.***

### 11.3.2 Camera spacing

For monitoring feral cats and mustelids, four cameras should be deployed along lines spaced 200 m apart in areas of preferred habitat for cats and mustelids. All lines should be spaced at least 1000 m apart, with a minimum of 4 lines. Recommended camera monitoring lines are shown in Map 9.

### 11.3.3 Timing and frequency

Camera trapping along each line should occur four times each year, in February, May, August, and November. This information will help to determine pest presence and assist with determining where to focus control efforts (i.e. location of additional efforts).

On each instance, cameras should be deployed for 21 nights when fine weather is forecast.

### 11.3.4 Camera settings

The key settings to consider when setting up a camera trapping network for cats or mustelids include:

- Trigger speed (the time taken from when an animal is detected by the sensor until it is photographed);
- Sensitivity (low, medium, or high amounts of movement required to trigger the camera);
- Type of sensor (passive infrared (PIR) vs microwave);
- Type of flash (white vs infrared);
- Type of image recorded (still photograph vs video of specified duration); and
- Interval (time between trigger events).

camera trap to detect mustelids and feral cats should be set to capture three rapid-fire still photographs (termed a 'photo burst') per trigger event, with a five-minute forced interval between photo busts. Capturing three images improves the chance that an animal which triggers the camera is successfully caught and able to be identified to species level. Still images also do not require the same time-consuming analysis as video. The three photos within one photo 'burst' are considered as one 'capture' if the animal appears in one or more of the three images.

Cameras should have a trigger speed of no more than 1.6 sec, medium sensitivity, use a PIR sensor and initially use cameras with an infrared flash. If images taken with a PIR sensor are unable to be identified, a white flash should then be considered, however, a white flash is more likely to frighten animals (Glen, Cockburn, et al., 2013). These settings are typically able to detect and allow clear identification of the key species of interest, including cats, stoats and rats (Glen, Cockburn, et al., 2013) and are in line with the recommended standard protocols for camera trapping (Department of Conservation, 2023).

**Camera deployment, orientation, and lure**

Each camera should be oriented so as to standardise the size of the detection zone, i.e. placing cameras at the same orientation and height (Glen et al., 2013). Cameras should be close to the ground (6–50 cm above ground).

Cameras need to be securely mounted to a firm structure, such as a tree trunk. Cameras can be attached to trees using a screw-in tree mount and/or straps. If no solid structure is available at the desired location, a waratah or strong wooden garden stake (2.5 x 2.5 x 1.5 m is suitable for most situations) can be hammered into the ground. Cameras can be secured with a screw. Stakes will need to be pre-drilled to prevent the wood from splitting and hammered at least 50 cm into the ground, or more if the ground is soft or in an exposed location. Avoid positioning cameras directly into the sun (i.e. at sunrise or sunset).

A lure needs to be placed in the centre of the camera's field of view (e.g. Figure 8) to increase the probability of detecting a target animal in the area, and also to encourage animals to pause in front of the camera, which increases the likelihood of capturing a clear image (Glen et al., 2013). As per DOC's interim trail camera guide (Department of Conservation, 2023), the lure should consist of an approximately 150 g piece rabbit meat between two pieces of Erayz wrapped in chicken wire, threaded onto a c.150 mm W × c.260 mm H No.8 wire 'croquet style' hoop and pegged to the ground between 60 cm–1 m in front of the camera, perpendicular to the camera's line of sight (Figure 8).

*Figure 7: Camera trap set-up with the lure (comprising 150 g fresh rabbit meat between two pieces of Connovation's Erayz wrapped in chicken wire) pegged to the ground c.60cm in front of the device. Image from DOC's interim camera trapping guidelines (Department of Conservation, 2023).*

### 11.3.5 Image analysis

All camera images need to be manually viewed and scanned for appearances of target predator species (in particular stoats, ferrets, and feral cats). Cameras should be set to take three rapid-fire still photos per trigger event to increase the likelihood of capturing a clear, identifiable image. As such, animals captured in one or more image within the photo burst should only be counted as a single capture during analysis.

The camera trap index of relative abundance for feral cats, mustelids and rats is expressed as the mean number of feral cat, stoat, weasel, ferret or rat detections per 2000 camera hours (2000 CH) per camera trap line (Department of Conservation, 2023). This is calculated as follows:

1. Total the number of detections on each camera and total these for each survey line. Do this separately for each of the target species.

2. Calculate the number of hours each camera was operating during the survey and total these for each line. For the purposes of this index, assume the camera traps have been operating from midday of the day they were set, until midday of the day they were recovered. So, for a 21-night survey session each camera is assumed to have been operating for 504 hours, with 4 cameras on a line (4 x 504 hours) the total is 2016 camera hours
3. If there is evidence to suggest a camera has malfunctioned during the survey, assume it was operating from midday of the day it was set, until either midday or midnight (whichever comes first) following the time stamp on the last photo taken. If no images are collected (including those of the operator placing or recovering the device) on a camera trap, assume the device has been inoperable for the duration of the survey.
4. Calculate the relative abundance index of the number of target animal detections (2000 CH) for each survey line based upon the following formula; do this separately for each of the target species:

**Detections per 2000 CH = (number of detections / number of camera trap hours) × 2000**

5. Calculate the mean (average) number of target animal detections (2000 CH) over all the lines. To do this, add the number of target animal detections (2000 CH) from each line and divide the total by the number of lines. Do this separately for each species.
6. Calculate the standard error of the mean. The standard error (SE) is simply a measure of the precision of the mean. It is often very useful to express the mean number of target animal detections (2000 CH) plus or minus SE. If you use a calculator with statistics functions you can calculate the standard deviation ($^{\delta}$n-1 button) of your sample (of the target animal detections (2000 CH) from each of your survey lines). The standard error can then be calculated from the standard deviation. The standard error is equal to the standard deviation divided by the square root of the sample size, which for these surveys is the square root of the number of lines. Do this separately for each species.

***Note this index may change based on any new best practice guidelines released by DOC.***

## 11.4 Monitoring for ungulates

As the target for this WAPMP is zero density, with the threshold for additional control “any sign” of feral ungulates, a single monitoring method is not proposed. Instead, ungulate sign may include faecal pellets, camera trap imagery, prints, and pig rooting. Experienced hunter(s) will also be brought in four times a year around the time of the quarterly predator monitoring (i.e. deployment of chew cards and camera traps), to check for sign.

Faecal pellets are widely recognised as a useful and efficient method of monitoring ungulates. Faecal pellet counts have been widely used to index deer abundance and population change, particularly in habitats in which animals are difficult to count directly (e.g. forests with a closed canopy via aerial methods) (Latham et al., 2012). A Faecal Pellet Index (FPI) protocol was developed for the Department of Conservation by Landcare Research to standardise methods of estimating changes in the relative abundance of feral deer in New Zealand, which remains the most common method of estimating long-term changes in the relative abundance of feral deer in New Zealand (Forsyth, 2005). Goat pellets are smaller than deer, approximately 10 mm wide. Pig droppings are usually dark, flattened, roughly oval pellets joined in a large cylinder. For pigs, a modified transect method looking for disturbance / rooting is also recommended.

Camera traps will be deployed for monitoring predators, and may also detect ungulates. Any detection on a camera trap, regardless of the target species, will initiate further control. Obvious damage caused by feral ungulates may also include uprooted seedlings, digging up of earth (in the case of pigs), and chewed bark, leaves or branches (Greater Wellington Regional Council, 2012).

## 11.5 Monitoring for wasps

Wasp nests will be monitored both before and after treatment with bait to determine success of the operation as per the standard Wasp Nest Flight Count Monitoring Method (DOC-2597036).

If wasp activity threshold increases within one year, wasp control should remain in place for one more season.

## 11.6 ‘Smart’ monitoring technology

In addition, new real-time monitoring technology (e.g. Critter Solutions AI camera remote monitoring system with AI species identification) will be incorporated into the WAPMA as it becomes available, which will allow for instant (real-time) detection of pests and tracking of populations. New technologies also have the advantage of higher detections of all pest species, but particularly smaller species such as rats and mice. This greatly enhances management approaches by allowing rapid responses to pest increases, and the set-and-forget nature of these technologies also reduces human impact associated with frequent monitoring which has the potential to disturb / kill frogs. Real time AI monitoring tools can also be used to detect the presence of larger predators e.g. feral cats and ungulates.

# 12.0 Proposed pest control and monitoring schedule

*Table 7.* Proposed timing of control operations and monitoring for target species at Wharekirauponga.

| Year | Months | Target species | Proposed control | Frequency | Notes |
|---|---|---|---|---|---|
| **1 (and every 3 years following)** | June-November | Possums, Rats Mice, Hedgehogs Mustelids, Feral cats | 1080 Aerial application | In year 1, and every 3 years following as required | Prefeed aerial drop twice with non-toxic pellets to improve efficacy. Repeat every three years (or as monitoring deems necessary based on pest thresholds). |
| **1** | n/a | All except ungulates | Deploy trap and bait station network | n/a | Deploy bait station and trap network prior to 1080 drop. |
| **1 +** | Year round | All except ungulates | Service traps (check, reset and rebait traps) | Once per month if single-set *Or every 2 months if resetting** | Trapping will commence after the aerial application. Increase single-set trap servicing to twice per month if target species thresholds are exceeded or when frog activity is high, and during summer. Aim to check all predator traps in same window of time to minimise disturbance. Resetting traps can be checked on a less frequent basis (as they do not require clearing and resetting). |
| **2 +** | June-September | Possums Rats | Ground-based toxic baiting in Philproof bait stations | 1 x / year *or* up to 4 x / year** | Toxic baiting will commence one year after any 1080 aerial application or if target species thresholds are exceeded. |
| **All** | Year round | Ungulates | Professional hunting | Monthly or as detected | |
| **Year** | **Months** | **Target species** | **Proposed monitoring** | **Frequency** | **Notes** |
| **1 (and every 3 years following)** | TBD | Possums, Rats Mustelids, Feral cats | Monitor with chew cards and camera monitoring | Before and after 1080 aerial application | Post-monitor 3 – 6 weeks after aerial drop (to coincide with fine weather) |
| **3 +** | February, May, August November | All | Chew card and camera monitoring | 4 x / year | Months can be shifted to follow aerial toxic applications, targeted toxic applications or 4 weeks after additional control measures for threshold exceedance species |

*Increase frequency of trap checks to twice per month August to March (inclusive) for single-set traps, and when frogs are more active or target species threshold is exceeded.
** Increase frequency of baiting up to 4 x per year when target species threshold is exceeded (may be localised control).

# 13.0 Targets and thresholds

## 13.1 Overview

The proposed pest control targets for the Wharekirauponga animal pest management area (outlined in the targets and thresholds section following), are more stringent than that of Whareorino (which appears to only have threshold for rat tracking exceedance), and also includes additional key target species (including pigs, feral cats, mice, and mustelids). The comprehensive range of species targeted for control here are therefore expected to result in significant habitat enhancement gains for frogs beyond just the reduction in predation risk.

The pest control targets proposed in this report are more in keeping with that used in the Hunua Ranges KMA, where significant benefits were observed for both native frogs and other sensitive species (Baber et al., 2009; Baber et al., 2008).

## 13.2 Targets and thresholds

Management targets in pest control relate to the "maximum allowable residual pest abundance targets" which allow native species to recover (Brown et al., 2015). That is, the management target for each species is the ideal goal that the control actions aim to achieve. The proposed management targets for rats, possums, and mustelids as well as the thresholds for initiating additional control measures, are based on the Chew Card Index (CCI) or camera trapping index for each target species. If monitoring identifies that the targets are not met on any single monitor, this will trigger a requirement for further control.

It should be noted that DOC has no recommended pest control targets and thresholds for native frog recovery (an area of research which urgently needs to be addressed). However, he pest control targets to achieve breeding success for kokako, which are particularly sensitive to rat predation, are some of the best understood for any species (and also the most stringent). This may be an explanation for Baber's findings regarding the success of frog recovery in the Hunuas (which incorporates the kokako management targets and also undergoes regular ungulate control).

**Note:** some targets outlined in Table 8 are seasonal to best protect frogs when they are most conspicuous (Archey's frogs breed from November to February, while frogs do not tend to emerge much over winter).

*Table 8.* Summary of management targets, thresholds for initiating additional control and monitoring frequency for each target pest species within each pest control area.

| Pest Species | Management Target | Threshold | Monitoring frequency |
|---|---|---|---|
| Mice | <5% CCI (year-round) | ≥10% CCI (year-round) | Before and after toxic control, four monitors per year in February, May, August, and November. Ongoing |
| Rats | <2.5% CCI (Nov-Feb); <5% (Mar-Oct) | ≥ 5% CCI (Nov-Feb); ≥10% (Mar-Oct) | |
| Possums | <1% CCI and/or RTC (Nov-Feb); <5% (Mar-Oct). | ≥ 5% CCI and/or RTC (Nov-Feb); ≥10% (Mar-Oct) | |

| | | | |
|---|---|---|---|
| Mustelids (stoats and ferrets) | A combination of camera trap indices (<3 detections per 2000 CH) and catch rates, based on DOC best-practice[1] | >3 detections per 2000 CH[1] | monitoring using automated technology |
| Feral cats | A combination of camera trap indices (<3 detections per 2000 CH) and catch rates, based on DOC best-practice[1] | >3 detections per 2000 CH[1] | |
| Ungulates | Zero density | Any observation (incl. sign) | |

[1] These numbers are based on the draft DOC best-practice guidelines for targets and thresholds for mustelids and feral cats using camera trap indices, DOC does not yet have recommended targets for camera trap indices for these species. The completion of the new DOC best practice guidelines is expected in 2024 and these targets can be updated at that stage.

## 13.3 Response to exceedance of targets

If monitoring identifies that the thresholds for control targets have not been achieved, this will trigger a requirement for further control. This use of thresholds facilitates adaptive management and ensures that pest populations are continuously and effectively suppressed. See Table 9 for the response measures to be undertaken for threshold exceedance for each target species.

*Table 9*. Summary of threshold exceedance response measures including additional control for each target pest species.

| Species | Threshold % | Exceedance response measures |
|---|---|---|
| **Mice** | ≥10% CCI (year-round) | • Trap checks and rebaiting of mouse capable traps and/or D-rat traps service increased to once every two weeks, if not already at this interval. May be localised to address area where mice were in exceedance.<br>• Up to three additional ground-based toxic control operations will be repeated per year where possible (i.e. where bait station networks targeting rats and mice have been established), as per the methods outlined in this Strategy). May be localised.<br>• Additional aerial 1080 control operation (likely only to occur if multiple pest species targets are in excess of the threshold/s for multiple consecutive monitors).<br>A follow-up monitor 4 weeks after the start of any additional toxic control operations needs to occur to determine whether the mouse population has been successfully reduced to below the threshold. |
| **Rats** | ≥ 5% CCI (Nov-Feb); ≥10% (Mar-Oct) | • Additional aerial control operation or switch to a novel or new toxin (such as norbormide).<br>• Up to three additional ground-based toxic control operations will be repeated per year where possible (i.e. where bait station networks targeting rats have been established), as per the methods outlined in this Strategy). Control may be localised to the area with higher densities. |

| | | |
|---|---|---|
| | | • Trap checks and rebaiting of any single-set rat capable traps needs to increase to once every two weeks, if not already at this interval.<br>• Additional aerial 1080 control operation (likely only to occur if multiple pest species targets are in excess of the threshold/s for multiple consecutive monitors).<br>A follow-up monitor 4 weeks after the start of any additional toxic control operations needs to occur to determine whether the rat population has been successfully reduced to below the threshold. |
| **Possums** | ≥ 5% CCI and/or RTC (Nov-Feb); ≥10% (Mar-Oct) | • Additional aerial control operation or switch to a new toxin such as Feracol of Feratox (CSL required)<br>• Up to three additional ground-based toxic control operations will be repeated per year where possible (i.e. where bait station networks targeting possums have been established), as per the methods outlined in this Strategy)<br>• Trap checks and rebaiting needs to increase to once every two weeks, if not already at this interval,<br>• Additional aerial 1080 control operation (likely only to occur if multiple pest species targets are in excess of the threshold/s for multiple consecutive monitors).<br>A follow-up monitor 4 weeks after the start of any additional toxic control operations needs to occur to determine whether the possum population has been successfully reduced to below the threshold. |
| **Mustelids** | >3 detections per 2000 CH[1] | • Trap checks and rebaiting of single-set traps needs to increase to once every two weeks, if not already at this interval.<br>• A single ground-based toxic control operation with PAPP can be introduced with toxic baits placed in wooden DOC boxes (without the trap) or similar. Bait stations can be placed along all existing trap lines at 200-300 m intervals as suggested for stoats by Dilks et al. (2011)<br>• Additional aerial 1080 control operation (likely only to occur if multiple pest species targets are in excess of the threshold/s for multiple consecutive monitors).<br>A follow-up monitor for 3 weeks after 1 week at the end of the PAPP toxic control operations needs to occur to determine whether the mustelid population has been successfully reduced to below the threshold.<br>A follow-up monitor 4 weeks after the start of the aerial toxic control operation needs to occur to determine whether the mustelid population has been successfully reduced to below the threshold. |
| **Feral cats** | >3 detections per 2000 CH[1] | • Trap checks and rebaiting needs to increase to once every two weeks, if not already at this interval.<br>• A single ground-based toxic control operation with PAPP can be introduced with chimney and submarine bait stations. Bait stations can be placed along all existing trap lines at 500 m intervals as suggested for feral cats in the Best practice guidelines for the use of PredaSTOP™ for feral cat control |

| | | |
|---|---|---|
| | | • Additional aerial 1080 control operation (likely only to occur if multiple pest species targets are in excess of the threshold/s for multiple consecutive monitors).<br>• Trap checks and rebaiting of DOC traps needs to increase to once every two weeks, if not already at this interval.<br>A follow-up monitor 4 weeks after the start of the aerial toxic control operation needs to occur to determine whether the feral cat population has been successfully reduced to below the threshold.<br>A follow-up monitor for 3 weeks after 1 week at the end of the PAPP toxic control operations needs to occur to determine whether the mustelid population has been successfully reduced to below the threshold. |
| **Ungulates** | Any observation (incl. sign) | • If detected, a surveillance and hunt operation will be initiated to remove the detected ungulates.<br>• If feral pig numbers persist a sodium nitrite ($NaNO2$) in Bait-Rite Paste® operation should be considered (Section 9.1).<br>A follow up monitor immediately after the hunting operation needs to occur to determine whether the detected ungulates have been completely removed from the control area |

# 14.0 Data management and reporting

## 14.1 Data management

Data recording will align with PF2050's Data Standards. The quick read guide to the Data Standards, and the Master Lookup Spreadsheet with value names, is available at Data Management - Predator Free 2050 Limited : Predator Free 2050 Limited (pf2050.co.nz). The one-page schema diagram of mandatory and optional data required by the Data Standards is also provided in Appendix 2.

All control data (for pest plants and pest animals, including both trapping and toxic control), as well as all monitoring data, need to be entered into a single, cohesive data management system as soon after field work as possible. TrapNZ is the recommended platform, as it is widely used across New Zealand, user friendly, and is able to record spatial distribution of traps and catches.

The data management system needs to be set up as soon as possible. The GPS waypoints of all ground-truthed traps and their type need to be entered into the system. This includes traps that are either pre-existing or those deployed as per this Strategy.

All contractors and other persons undertaking pest control need to record all trapping data on the selected system. Each person/group that needs to access the system, will need an account and be instructed on how to enter the required information correctly.

For each trap check, all data needs to be accurate and complete, as per the minimum information to be recorded below:

- Date of trap servicing & time taken to complete trap/bait station servicing;
- Name of the trap servicer;
- Device location, unique identifier, model type and model name;
- Lure type and whether the lure was refreshed;
- Whether the trap has been triggered (trap status);
- Trap catch (species); and if possible/relevant: sex and age of individual, number of individuals, or record trap catch as zero if nothing is caught;
- Bait type and quantity deployed (for bait stations);
- General comments (e.g. if trap needs fixing or replacing, if bait is gone).

Maintaining accurate and precise records of both pest control and pest monitoring are crucial to evaluate the success of predator control at each site. Spatial and temporal trends in pest populations and catch rates can be identified in the analysis of this data, which can then inform future animal pest management decisions.

## 14.2 Data reporting

An annual animal pest management report will be prepared by the pest animal manager appointed by OceanaGold Ltd.

Each annual report (submitted by end of June each year) needs to align with consent condition reporting requirements. At a minimum it should include:

- A summary of all pest control (plant and animal) activities undertaken within the area in the preceding 12 months, detailing dates, and methods of each control activity:
- Maps of control devices/area, labelled by type;
- Summaries of trap catch statistics by species (both target and any non-target catch), including by trap type, trap location, lure type as well as CCI of rats, possums, and CCH for mustelids and feral cats, with comparison to management targets and thresholds for additional control;
- Summaries of results of toxic control operations, including target species, bait type and bait take;
- Any trends in the data, such as high-catch/high bait-take locations, the main species caught and comparisons to previous years;
- Incursions and incursion responses within the pest exclusion fence; and
- Any challenges/issues encountered in undertaking control or monitoring, and how these difficulties were overcome or if they remain ongoing;

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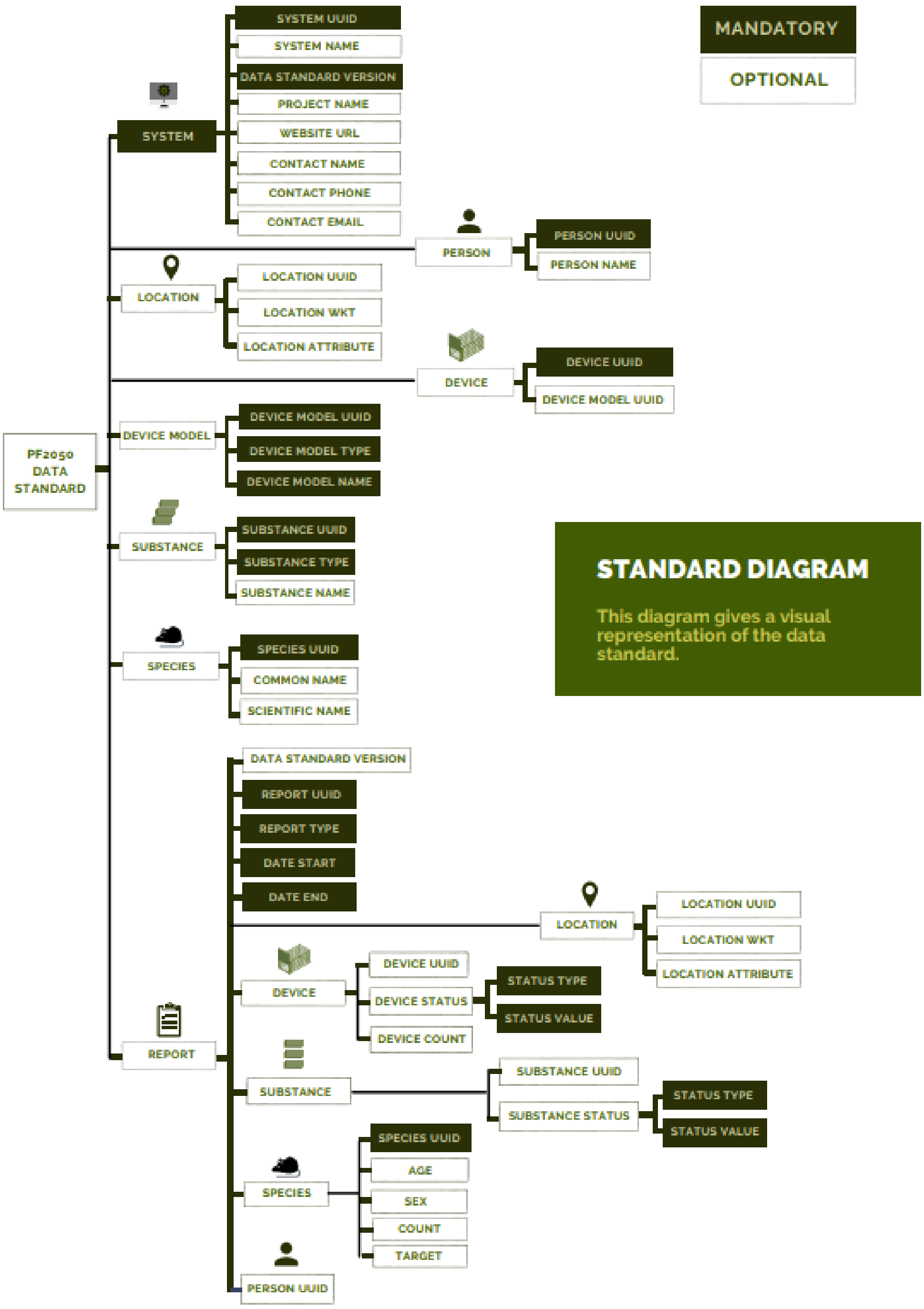
# Appendix 1: Trap audit checklist

| | Performance Standard | Evidence |
|---|---|---|
| 1. | Trap is set correctly | a) Correct bait for the current month is positioned in the holder.<br>b) Trigger plate is angled approximately horizontal and as close to the baffle as possible.<br>c) All trap plates move freely when the trap is set (springs are tensioned in a set position)<br>d) The trap box is marked correctly with the trap number. |
| 2. | Trap is secured correctly | a) Trap is secure in within the tunnel and correctly positioned.<br>b) All mesh is securely fixed to the trap box with no gaps other than the opening aperture which shall measure no greater than fifty millimetres square.<br>c) Internal baffle is in line with the trigger plate<br>d) Tunnel lid is secured firmly |
| 3. | Trap functions correctly | a) The trap can be sprung by gently lowering a 100 g weight onto the distal end (end furthest from the hinge) of the trigger plate.<br>b) When it sets off the moving parts do not touch any part of the tunnel or baffles<br>c) Double set traps do not spring off 'sympathetically' i.e. when one trap is sprung by a dummy capture (e.g. rolled newspaper ~40 mm diameter) the other trap remains set.<br>d) All moving parts on non-stainless-steel traps are lubricated with builder's pencil or graphite powder so that they move freely without binding when the trap is actuated. |
| 4. | Trap is sited correctly | a) The trap box is positioned in such a way that it is unlikely to be damaged or accidentally sprung by stock and where located on visitor walking tracks is not obstructing passage.<br>b) The trap box is seated firmly on the ground so that it is stable and does not move in any direction when moderately firm pressure is applied to it (palms placed flat on top of the box at opposite ends).<br>c) Tunnel has been pegged to the ground if specified. |
| 5. | Trap is cleaned correctly | a) The entire trap is substantially free of animal matter (fur, tissue and bone) from previous captures.<br>b) Any uneaten bait and captures have been discarded at least 5m from traps and away from waterways.<br>c) Both ends of the tunnel are clear of vegetation to 300mm.<br>d) Tunnel is in good condition.<br>e) Both ends of the tunnel are clear of vegetation to 300mm.<br>f) Tunnel is in good condition. |

# Appendix 2: PF2050 Data Standards Schema Diagram



# Appendix 3: Predator management program for camp

| Species | Control device | Number of devices | Notes | Monitoring* |
|---|---|---|---|---|
| **Rat** | DOC200<br>D-rat trap | At least 5 devices 25 m apart around the camp. Space traps evenly around camp and key areas of rat activity | Bait with either egg, peanut butter or PoaUku long-life rat & stoat lure | Use trail cameras around set traps or key areas of rat activity<br><br>Use chew cards loaded with peanut butter |
| | Rat & mouse specific bait station | 2 to 3 directly outside walls or inside camp | Use Diphacinone or DoubleTap | Check bait stations and bait for signs of nibbles |
| **Mouse** | D-rat trap<br>Snap-trap in tunnel box | At least 5 devices every 10 m within camp vicinity. Space traps and bait stations in key areas of mouse activity | Bait with peanut butter | Use chew cards loaded with peanut butter |
| | Rat & mouse specific bait station | 2 to 3 directly outside walls or inside camp | Use Diphacinone or DoubleTap | Check bait stations and bait for signs of nibbles |
| **Possum** | SA2 Kat trap, Flipping Timmy, etc | 2 to 5 devices 25 m apart within camp location. Space traps evenly around camp and strategically on trees with possum sign (scratches) | Bait with peanut butter or apple. Use flour/icing sugar blaze spread up the tree trunk below each trap to visually attract possums | Use trail cameras around set traps or key areas of possum activity |
| **Feral cat** | SA2 Kat trap<br>Timms trap, etc | 2 to 5 devices 25 m within camp location. Space traps evenly around camp and strategically on linear features (e.g. fences) and tracks | Bait with pungent bait such as fresh meat or fish, or tinned cat food | Use trail cameras around set traps or key areas of cat activity |
| **Mustelid** | Double-set DOC 200<br>Doc 250 | 2 to 5 devices 25 m within camp location. Space traps evenly around camp and strategically on linear features (e.g. fences) and tracks | Bait with pungent bait such as fresh meat or PoaUku long-life rat & stoat lure | Use trail cameras around set traps or key areas of mustelid activity |

**Note:** Check traps and replace bait once per week when known predator activity is apparent around camps, change bait type if still no capture. Reduce frequency of checks to every 2 weeks if activity has reduced and target species capture is successful
* monitor as per monitoring schedule for the main Management Plan or when target species activity is notable around camp.

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