Boffa Miskell

Whaka-Ora Pest Management

Guide to Pest Control Tools and Techniques

Prepared for Whaka-Ora Healthy Harbour

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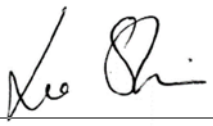
Reviewed by:	Lee Shapiro Biosecurity Consultant Senior Principal Boffa Miskell Limited	
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Glossary of Terms

CCC	Christchurch City Council
DOC	Department of Conservation
ECan	Environment Canterbury
LPC	Lyttleton Port Company
MWLR	Manaaki Whenua – Landcare Research
NAWAC	National Animal Welfare Advisory Committee
PF2050	Predator Free 2050
The plan	Whaka-Ora catchment management plan
Whakaraupō	Whakaraupō | Lyttelton Harbour
Whaka-Ora	Whaka-Ora Healthy Harbour
WOPP	Whaka-Ora Pest Plan

1.0 TĀHUHU KŌRERO | Background

Predator Free 2050 (PF2050) aspires to create a predator free Aotearoa by the year 2050. The Whaka-Ora Healthy Harbour (Whaka-Ora) team has an important part to play in aiding the localised achievement this lofty goal. This document is intended to provide guidance for pest animal control actions in the varied landscapes and reserves within which the Whaka-Ora team operates. The Whaka Ora Pest Plan (WOPP) team are responsible for the high-level coordination of the efforts of many individuals and groups within the Whakaraupō | Lyttelton Harbour catchments. They will also provide assistance to groups who need it, helping fill gaps of both resources and labour. The WOPP team are likely to be permitted to operate within a number of locations/landholdings where general community group actions may not be permitted, in order to enhance biosecurity actions and protect local biodiversity and ecological integrity across the landscape.

There is a need for the proposed pest animal monitoring and control actions to be carried out consistently and in accordance with industry safe practice particularly in urban settings. This document will help Whaka-Ora, the WOPP team, and others involved in the biosecurity mahi in the harbour to work collaboratively and effectively. This will help to preserve the health of the harbour, protect and enhance the wider landscape, and ensure the success of pest management endeavours.

The purpose of this document is to outline the tools and techniques appropriate for the monitoring and control of pest animal species present in this landscape. Three sites/reserves are used in this report as case studies. These locations are Steadfast Stream, the coastal walk between Naval Point and Pony Point and the coastal margin of Allandale and Governors Bay. The suitability of various control techniques needs to be considered in the context of the surrounding landscape in relation to public use and according to the restrictions placed by the various Christchurch City Council (CCC) reserve managers as well as addressing the desires/concerns of nearby residents. The aim is to empower Whaka-Ora, in conjunction with community groups and other stakeholders, to conduct high-quality pest monitoring and control activities across the Whakaraupō | Lyttelton Harbour landscape.

The undeveloped, often vegetated, land around the Whakaraupō harbour is highly variable. The Whaka-Ora Biosecurity Prioritisation Strategy[1] provides an overarching guidance document to direct resources to priority catchments and assist local action in pest control. These pest animal control priorities have been attributed by ecological band (according to the current Whaka-Ora delivery strategy habitat classifications). These priority actions being tailored to the pest species which have the highest impact on that habitat type and the flora and fauna which occupy it. These habitats, which are described in more detail in Section 1.1, include:

- Rocky outcrops and indigenous forests
- Hills and lowlands
- Streams
- Wetlands and saltmarsh
- Taihua | Foreshore

[1] Whaka-Ora biosecurity prioritisation strategy, Boffa Miskell, 02 August 2022.

1.1 Priority target pest species

Virtually all of the Whakaraupō | Lyttelton Harbour landscape has seen a change in land use over time, which in turn has provided habitat and opportunity for a growing number of pest animals. The wide-ranging habitats have influenced the presence, density, dispersal, and control needs of pest animal species. Each approach needs to be specifically tailored to this variability which is a result of several factors such as local population abundance, competition or predation pressure, food variability in the landscape, juvenile dispersal, and environmental disturbance. The ever-present impact of climate change stands to modify the pest animals present in terms of density, diversity of species and habitat suitability.

The following species are the primary focus of WOPP pest animal control throughout the harbour:

- Possum – *Trichosurus vulpecula*
- Hedgehogs - *Erinaceus europaeus*
- House mouse – *Mus musculus*
- Ship and Norway rats – *Rattus rattus* and *Rattus norvegicus*
- Mustelids – *Mustela* spp.
  - Ferrets (*M. potorius furo*),
  - Stoats (*M. erminea*), and
  - Weasels (*M. nivalis*).

This targeted list of species was developed by assessing the risk of each species to ecosystem health, natural biodiversity, human health, and local resident food productivity. More information on each pest animal is found in Section 4.0. Ungulates, rabbits, and hares are also problematic within the landscapes surrounding Whakaraupō | Lyttelton Harbour however their control falls outside of the capabilities of the WOPP team. Despite this fact, Whaka-Ora can continue to highlight the damage that ungulates and rabbit/hares do in the landscape to add support to any control intensions of DOC, CCC and Environment Canterbury (ECan) in the region.

Targeted pest control operations have been successful in reducing problematic populations of pest animal species in the Port Hills and various other catchments such as Te Wharau and Hidden Valley (Purau). The trapping efforts of the Kaimahi for Nature groups, CCC, Lyttleton Port Company (LPC), private sector and community groups has resulted in evident reductions of possums and rats.

A cohesive, landscape-scale pest management prioritisation strategy has recently been developed for Whakaraupō | Lyttelton Harbour (BML 2022). This is intended to guide pest control operations and provide the best outcome for reducing overall pest animal populations throughout the harbour by focussing attention on significant vegetated landscapes not currently under sustained pest control. Whaka-Ora has a vital function in the co-ordination of efforts within the harbour and surrounding catchment, and also the functional responsibility for several reserves. The WOPP activities within key reserves includes control operations and maintaining community trapping programmes according to and extending beyond the priority strategy. There are plenty of examples of excellent existing work within the harbour that have been, and will continue to be, effective. This is especially true when they are integrated into the wider harbour landscape as per the Whaka-Ora catchment management plan (henceforth referred to as “the plan”) (Whaka-Ora 2018), and the biosecurity prioritisation strategy (BML 2022).

2.0 Determining control approach

When determining the tools and techniques to use in pest animal control operations, there are several key factors that need to be considered, including:

- Target species, specifically their seasonality, behaviour, and resource needs
- Abundance of species, especially in relation to change over time
- Habitat type, including composition, density, accessibility, and vegetation age
- Non-target risks to both native and non-native animals, including domestic pets
- Public safety relating to site exposure, access, and device security
- History relating to tools previously used at the location and the adjacent area
- Social context i.e., acceptability of the tool to the local community/landowners
- Device suitability particularly the level of interaction required of the target species

The use of multiple and varied control tools, in conjunction with a diverse range of lures, will ensure effective species-specific trapping while avoiding bait shyness or trap fatigue. However, deploying a wide range of control tools throughout the landscape will not guarantee capture, unless careful methodologies using differing approaches are developed and employed.

Decision making should be well informed by previous work successes and failures, monitoring and control outcomes, best practise guidance, and site-specific data. Therefore, monitoring is essential for informing these management decisions. The success of long-term pest animal control programmes is reliant on collecting accurate information to enable an adaptive management response i.e., responding to what is happening in the field. Two types of monitoring, outcomes and results monitoring, are necessary for collecting key information. The information gathered from monitoring will help guide the control approach, by providing current indications of numbers. Abundance measures will give feedback on successes and the current state of the pest problem around the harbour.

3.0 Whakaraupō | Lyttelton Harbour landscape

This site presents a unique opportunity for cohesive pest control. The topography and geographic layout of this catchment requires a collaborative approach to pest control activities to ensure large scale success. The peninsula and harbour act as natural boundaries in the landscape that help to minimise and constrain reinvasion events. It is therefore imperative that pest control activities in any of the Whakaraupō | Lyttelton Harbour habitats are well communicated between all active parties to ensure that close collaboration is maintained. The Whaka-Ora plan and biosecurity prioritisation strategy are both useful documents to help guide these activities and ensure that the shared vision is upheld. All parties outside of the Kaimahi for nature and CCC teams may benefit from having their activities guided by this control tool and techniques document.

The area has been delineated into 16 catchments, which contain a diverse range of habitat types. Figure 1 indicates these catchments across the wider landscape.

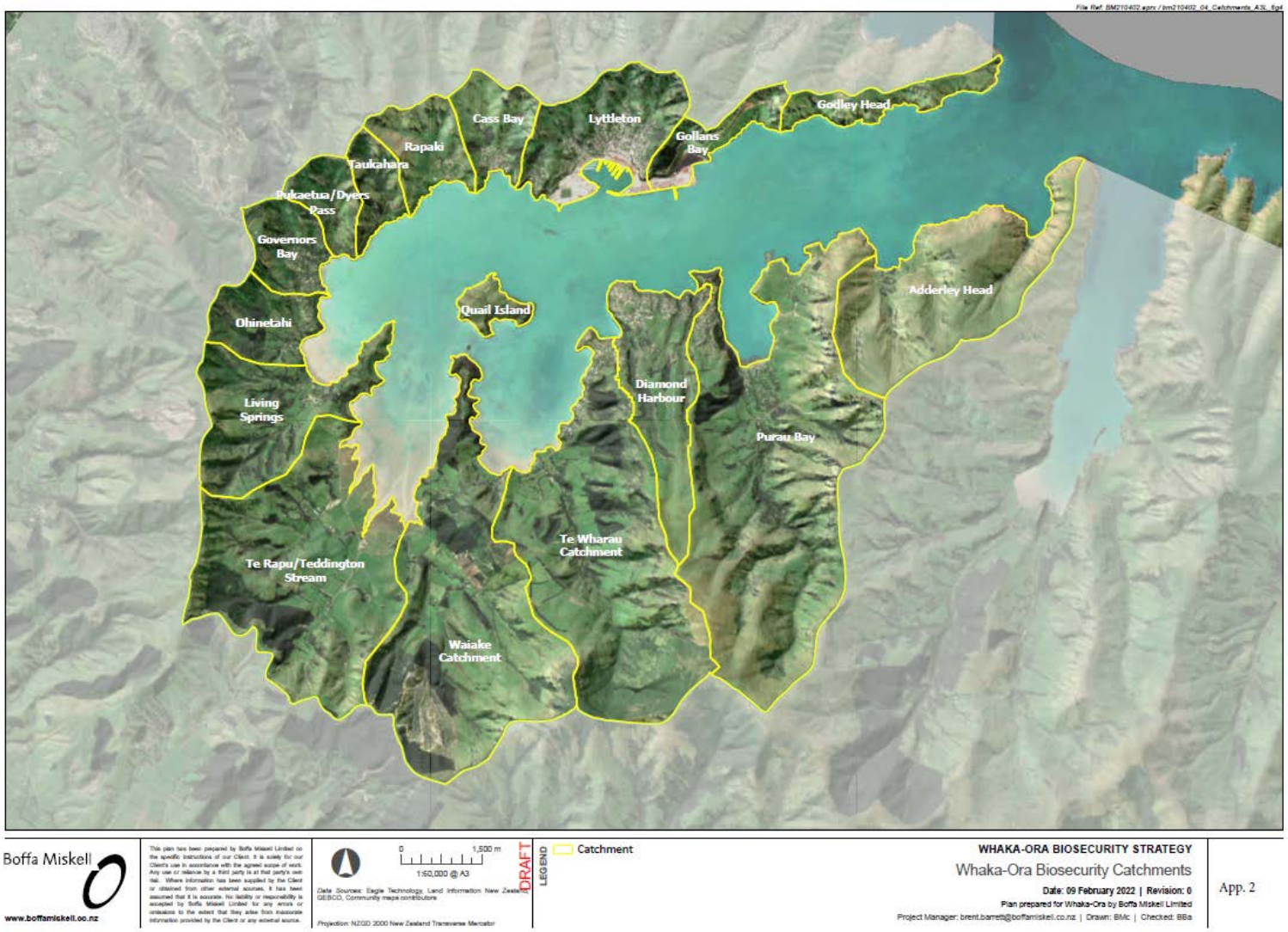

Figure 1: *Map of the catchment areas across the Whakaraupō surrounding landscape*

3.1 Pest animal prioritisation by habitat

It is important to understand the diverse habitats across Whakaraupō | Lyttelton Harbour, and the differences between them. These habitats have been split into ecological bands in the plan (Whaka-Ora 2018). This division allows for a targeted and strategic approach to pest management, considering the specific characteristics and needs of each ecological band. The biosecurity prioritisation strategy (Boffa Miskell 2022) sets out the priority species for the harbour according to these ecological bands. The table from this report is replicated as Table 1 below. By aligning the WOPP team's actions in the reserves with this prioritisation strategy, we can ensure that resources are focused on addressing the most significant pest species within each ecological band/reserve. This plan integrates these ecological bands and the priority species identified within them to provide a targeted and comprehensive approach to pest animal control for each reserve (Section 7.1).

Table 1: *Keystone species and priority pest animals and control within the five terrestrial ecological bands within Whakaraupō | Lyttelton Harbour (Whaka-Ora Healthy Harbour 2018) Modified for this report.*

Ecological Band	Keystone species within the ecosystem	Priority pest animal species and tools
Rocky outcrops and indigenous forests	Native fauna and flora - especially these taonga species: • *invertebrates* – copper butterfly, Canterbury tree wētā. • *reptiles* – waitaha gecko and Canterbury skink. • *avian fauna* – pipit, kārearea/falcon, kāhu/harrier. • *native flora* – pōhuehue/muhlenbeckia, prostrate kowhai, thin-barked totara, tussock.	Small mammals (rodents, mustelids and hedgehogs) using DOC200/250 style traps and large snap traps. Possum control using suitable methods - tree mounted traps and bait stations. Ungulate and stock exclusion is essential for understory recovery. Bait stations for mouse control around identified reptile habitat. Possum control with cage and leghold traps.
Hills and lowlands	• *invertebrates* – red admiral butterfly • *reptiles* – jewelled gecko • *avian fauna* – rūrū/morpork and kererū • *native flora* – kanuka, totara and whauwhaupaki/five-finger	Small mammals (rodents, mustelids and hedgehogs) using DOC200/250 style traps and large snap traps. Possum control using a number of suitable methods - tree mounted traps, bait stations. Possum control with cage and leghold traps.

Streams	• *freshwater invertebrates* – kōura/crayfish and kākahi/mussel, caddisfly, stonefly and mayfly • *aquatic vertebrates* – Tūna/eel, kanakana/lamprey and kokopu • *avian fauna* – pūkeko and kōtari/kingfisher • *native flora* – pūhā/wattercress	Small mammals (rodents, mustelids and hedgehogs) through the use of DOC200/250 style traps and large snap traps. Possum control using methods - Tree mounted traps, contract shooting, cage and leghold traps. Ungulate and stock exclusion is essential for habitat recovery.
Wetlands and saltmarsh	• *invertebrates* – mud crab • *aquatic vertebrates* – inanga/whitebait • *avian fauna* – pūkeko and tōrea/oystercatcher • *native flora* – harakeke/flax, kahikatea and seagrass	Small mammals (rodents, mustelids and hedgehogs) using DOC200/250 style traps and large snap traps. Stock exclusion is needed for ecosystem functionality. Possum control with cage and leghold traps.
Taihua/ Foreshore	• *invertebrates* – pāua, pipi and kūtai/mussel • *avian fauna* – karoro/seagull, kūaka/godwit and kororā/white-flippered penguin	Small mammals (rodents, mustelids, and hedgehogs) using DOC200/250 style traps and large snap traps Possum control in vegetated coastlines - tree mounted traps cage traps

4.0 NGĀ KĪREAREA | Pest animals

This section outlines the priority pest species for Whaka-Ora. It provides some context about each predator and the damage they cause in the environment.

4.1 Paihamu | Possums (*Trichosurus vulpecula*)

Whilst possums are opportunistic omnivores, their main diet is leafy vegetation. Possums can spend as much time on the ground grazing as in trees. They eat all parts of a tree including the flowers, fruit, and bark. In turn, the plant's ability to supply seeds, food, or resources to other native flora and fauna is significantly reduced. The effects of possums browsing in the canopy results in often permanent damage to the native vegetation especially when possum abundance is high.

Not only do possums compete with native birds for food resources, but they will also prey on birds and their nests if the opportunity arises. These factors, paired with competition for nest sites, has a devastating impact on native bird populations. Possums have even been confirmed as predators of kea.

Hill side low scrub found throughout the Port Hills landscape and mixed hardwood forest/pasture margins are likely to provide prime habitat to possums. Field sign includes bark chewing, characteristic scats, and the formation of animal trails (pad-trails). These trails aid the movement of other pest animals through the densely vegetated habitat.

4.2 Hetiheti | Hedgehogs (*Erinaceus europaeus*)

Hedgehogs prefer lowland pastoral areas but are known to venture into larger forest tracts if habitat and food are more abundant. Hedgehogs have devastating impacts on a range of native wildlife, particularly birds as they prey on chicks and eggs found in nests. As such they are a priority pest in braided river systems. Hedgehogs also have a voracious appetite for invertebrates, significantly impacting native slug, snail, and insect populations. They have a large distribution within many habitats and are seldom victims of predation by other introduced mammals. Consequently, due to their high breading rate the only population limiting factors are habitat availability and food resources.

4.3 Kiore | Mice (*Mus musculus*)

Mice are prolific breeders and respond quickly to an increase in food abundance, which in-turn drives an increase in rat, and subsequently mustelid, populations. This is a well-known predator-prey cycle observed in New Zealand's landscape. In the absence of control only severe winters or predation reduce mouse numbers in areas with unlimited food resources. Selective predation of seeds by mice can alter plant species composition and reduce the forests' ability to naturally regenerate. Mice are also a major threat to reptiles which seek crevices to shelter from predation, since they can access narrow areas that are inaccessible to other predatory mammals. Consequently, mice heavily influence native fauna and flora.

4.4 Kiore | Ship (*Rattus rattus)* and Norway Rat (*Rattus norvegicus*)

Ship and Norway rats are amongst the world's most prolific and widespread urban pests. Ship rats are the most numerous rats in New Zealand's landscape and due to their climbing ability have the largest impact on native fauna. Norway rats are most common near human habitation and around waterways. If the environment is stable the rat populations also remain constant. Consequently, an increase in food availability results in higher survivorship and therefore higher resident rat populations. Rats prey frequently on birds, eggs, seeds, invertebrates, lizards, larvae, and flowers; all of which have ecological functions in a thriving forest. Therefore, the impact of rodents can be observed across the entire ecosystem. Like most animals, the habitat preferences of rats are dictated by the availability of food, water, and shelter. If food is scarce or unreliable, they are often present in very low numbers.

4.5 Mustelids - tori hura/ferrets, toriura/stoats, and tori uaroa/weasels (*Mustela* spp.).

Mustelids are one of the most devastating pests for native fauna. Their ability to climb trees and swim allows them to reach nests in a range of habitats. The low survivorship of many native

chicks, and corresponding decline in native bird populations, can be attributed to the presence of stoats and ferrets. Stoats are a highly mobile species which live in any habitat where they can easily access prey. Their preferred prey are rabbits, but they can switch to eating rodents throughout the year or, in their absence, the adults, chicks, and eggs of native and introduced birds. Ferrets aren't as common in large expanses of forest and tend to populate more fragmented landscapes or vegetation margins. Weasels are smaller than stoats and ferrets, and tend to eat small birds, eggs, lizards, and invertebrates. Mustelids are resilient and remain in the landscape in high numbers long after a mouse or rat plague has died off due to food shortage or harsh weather. The reduction in native species across the food web has devastating impacts on ecological functionality and habitat recovery.

5.0 KIA AROTURUKI TE TAIAO | Biosecurity monitoring

Monitoring is essential for assessing the impact of invasive species and guiding pest control efforts. By using the following monitoring methods, we can assess pest species ecological impacts, better understand pest population dynamics, track pest numbers, density, and spread. Monitoring populations helps identify areas of high predation pressure and helps to implement targeted predator control programmes.

This feeds into the adaptive management approach to pest control recommended for success. Adaptive management means responding in real time to what is happening in the field. Decisions are informed by ongoing monitoring and reflection of progress. By incorporating monitoring data into the pest control operations and planning processes, approaches can be optimised to achieve long-term pest control goals effectively. This will mean better control and ultimately boosting native biodiversity.

Pest animals require specific monitoring techniques for effective detection. Most monitoring methods are useful for detecting multiple species. For example, trail cameras can be programmed to pick up any animal that passes through their field of vision. Table 2 (below) shows the monitoring techniques that can be used for detecting different pest species. The methodology for each is listed at the end of this document in Appendix 2.

Table 2: *Species data captured by different monitoring techniques*

Monitoring Technique	Rodents	Mustelids	Hedgehogs	Possums
Tracking tunnels	x	x	x	
Chew cards	x	x		x
Wax tags	x	x		x
Trail cameras	x	x	x	x

5.1 Tracking Tunnels

Tracking tunnels are commonly used to detect the presence of small mammals such as rats, mice, and mustelids but can also be used to monitor reptiles by using targeted lure types. These tunnels are usually made from flexible black plastic and can be left out in the environment. The inked tracking cards are laid inside, stretching most of the length of the tunnel. Bait, usually peanut butter, is placed at each end to lure animals inside. As pests run through the tunnel, they leave ink footprints or tracks on the non-inked part of the tracking card. These can then be used to identify the species present and estimate pest animal population distribution in the landscape.

5.2 Chew Cards

Chew cards are an effective method for monitoring possums, mustelids, and rodents. They are small corflute cards with an attractive lure squeezed into the tubes in the plastic. The card is loosely folded in half and nailed low on a tree or fence post (30cm off the ground). The pests chew on the corflute to get the lure. In doing so, they leave distinctive bite marks which can be interpreted to determine the pest species present. These cards are placed in strategic locations along transect lines and left out for 3 clear nights.

5.3 WaxTags

WaxTags are designed to monitor the presence of possums, but also pick up other species including rodents. WaxTags are blocks of wax infused with an appealing peanut butter scent that pests investigate and bite into. The unique tooth impressions left in the wax can be analysed to identify the species. When using WaxTags, blaze (a specific mixture of flour and sugar) should also be used to mark the trees/posts where the tags are installed, in order to attract possums. Refer to Section 6.4.1 for more specifics on blaze as a possum lure.

5.4 Trail Cameras

Trail cameras are motion-activated cameras placed in strategic locations such as along distinct movement corridors, or near food sources, baited areas, or other known animal activity sites. They capture images or videos of wildlife, including pest animals. They are particularly useful for monitoring larger mammals like possums, but equally pick up rodents, and even insects depending on the programming settings and camera placement. When an animal triggers the camera's sensor, it captures images or records video footage depending on user settings. This provides valuable data on species presence, behaviour, interactions with traps/other monitoring devices, and information about population densities. Devices can be passive, left on identified animal trails or points of interest (including gridlines) or active when the site is lured to anchor the animal within the field of view.

5.5 Seasonality of Monitoring activity

The frequency and seasonal timing of biosecurity monitoring activities is paramount. The highest frequency of pest animal monitoring within the limits of labour is ideal. This is because pest animal densities in the landscape are always fluctuating through immigration and emigration or via mortality and breeding.

In order to track seasonal changes in pest animal abundance accurately, all types of monitoring should be conducted, preferably four times a year, however twice a year is suitable if there are constraints on labour resources. Rather than identifying specific months, the best times are when the region is heading into and out of winter and likewise into and out of the height of summer. Therefore, monitoring for pests in Whakaraupō | Lyttelton Harbour should be conducted at the following times:

- Early November
- Late February
- Mid-May
- Late August

This is just a guideline set around current average annual temperature fluctuations in Waitaha/Canterbury. However, the aim should always be to repeat these monitoring events annually with no more than a three-week variation in timing for each of the four events (weather permitting). Therefore, the first year will set the final monitoring dates for the following years.

Each monitoring event must account for possums, rats, and mice as these are the main species that reach high densities rapidly. While the monitoring programme must also attempt to measure mustelids, the sensitivity of current methods is often not suitable for detecting at low densities. Instead, knowing the rodent density fluctuations will provide a good indicator of ideal trap checking frequency since they are most likely to lead to trap saturation. Continuing to trap for mustelids year-round will be sufficient protection if careful bait choices are made. Increases in the density of stoat traps should be considered if rodent numbers are known to be high (through monitoring data or trap-catch data).

Consequently, the four annual monitoring events must include tracking tunnel and chew card lines laid out according to the distribution indicated in Appendix 2. Both methods should follow the methodology outlined in Appendix 2. The number of each type of monitoring line should be chosen to provide the clearest picture of pest animal abundance in all reserves and protected landscapes where Whaka-ora is able to operate. It is also informative, but not essential, to monitor outside of these reserves to understand the pest animal density of any locations holding re-invasion source populations. As the programme progresses, the results will become more meaningful when compared with previous results and particularly when same season measures are compared. The trapping result data is likely to correlate with the changes in pest animals' abundance observed in the monitoring data. Monitoring lines should, therefore, be entered into Trap.NZ so that they can be compared geographically with the trapping network (Section 8.1).

Due to the dynamic but semi-predictable nature of changing pest animal abundance we are able to understand enough about potential increases in mustelid abundance by closely tracking rodent density and correlating that to likely mustelid presence. This model should always include the density of their preferred food – rabbits. Any success in excluding mustelids from the reserves will require vigilant control of rabbits. Consequently rabbits observations should be forwarded to CCC to assist compliance focussed control. WOPP has a presence on the landscape that is vital to aid good information on rabbit control needs as well as aiding the stakeholders and general public to understand the importance of their control. Monitoring mustelids is useful in a localised sense. On a landscape-scale, the very large home range and

seasonal dispersal of the larger mustelids in particular mean that ongoing secure border protection is imperative. For many months stoats and ferrets appear absent from the landscape as they enter a form of hibernation (as do hedgehogs). This period of winter denning does include infrequent bouts of foraging to maintain nutrition during the cold months. The presence of high numbers of mice or rats during these winter foraging events aids in not only the survival of the adults but leads to large increases in the number of kits pupped that year.

6.0 NGĀ KAUNEKE | Control techniques

6.1 Kill traps

A kill-trap, by definition, must ethically kill the target animal, which requires the mechanism to work 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 specific species. This list of approved traps is updated frequently.

Kill trapping is a very effective way of targeting species across the landscape. However, understanding public access, permit requirements and social context of the landscape to be trapped is critical to creating an efficient and effective trapping network. A greater presence of pests at the outset of the trapping programme will require a higher density trapping network or an increase in trap clearing frequency. This can be reduced and altered over time as changes in the landscape occur, such as a difference in animal movement patterns, forest recovery or planting success, or a transition in the dominant pest animal species present.

The social context is equally important for this programme, as these operations will be carried out in reserves that are owned by CCC, bordered by residential properties, and used in a variety of ways recreationally. The collaboration between Whaka-Ora and CCC in these reserves is a key component of the predator control work. The reserve management has been agreed under a memorandum of understanding between Whaka-Ora and CCC. The work carried out will need to align with the CCC values and regulations to be accepted. The guidance provided in this document allows all parties to be confident the trapping tools and techniques used at these sites are consistent and of a high standard.

Kill traps can be either tree-mounted or ground-set. Typically, tree-mounted devices target possums and rats, whilst ground-set traps target rodents, mustelids, hedgehogs, and feral cats. There are variations to these such as capture, rather than kill, traps. For example, leg hold traps which can be set on the ground, on a ramp or on a ledge attached to a tree.

6.2 Ground set traps for mustelids and rodents

A range of ground set trap boxes, primarily used for rats, hedgehogs, and mustelids, are available. For stoats and ferrets, traps should ideally be located in cover such as under trees or scrub, as most of the targeted predators are attracted to cover. Mustelids and rodents also tend to move along waterways and linear features such along habitat boundaries, tracks, and fence lines. 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 including preferred movement and dispersal corridors. Trapping along road verges and paths also facilitates quick and easy trap servicing. Prior

monitoring can help to determine areas with high mustelid and rodent presence, ensuring that the trapping network is positioned to target these populations.

DOC series traps (DOC200 and DOC250)

Department of Conservation (DOC) series traps are some of the most common ground-set traps utilised throughout New Zealand. DOC200 and DOC250 are spring traps that are extremely durable and fixed to a rigid base inside a tunnel box. As the pest is lured into the tunnel it steps onto a large treadle plate which ultimately results in a lethal strike to the head, fracturing the skull and causing instant death.

The DOC200 has passed NAWAC testing for rats, stoats, and hedgehogs. The DOC250 is suitable for ferrets. DOC series traps are “tried and tested”, have established best practice protocols, and have safety features including multiple baffles to exclude non-targets. The double-set, run-through version of the DOC200 is slightly more expensive to build, larger and is believed to be more effective at targeting stoats, while the single-set version is cheaper and smaller (may be easier to position in cramped locations). Stainless steel traps are recommended as they last longer in field conditions. Further information on tunnel design and trap functionality can be examined through DOC’s Practical Guide to Trapping.[2]

Victor Professional PCR Mod

This trap is effective for targeting rats and stoats and has passed NAWAC testing for both species. It was developed by Manaaki Whenua Landcare Research (MWLR) to provide a more cost-effective and lightweight alternative to the DOC200 trap and is the same as setting a standard Victor trap. The Victor Professional trap has a plastic hood to guide the animal into the trap, where it triggers a kill bar that ideally strikes the target between the eyes and neck. The PCR model is also designed to be set in a wooden box like DOC series traps and can be used as an alternative to DOC series traps to augment trap diversity. Victor Rat Traps may provide a more lightweight and cost-effective alternative to the DOC200. However, their lower durability provides risks to the integrity and longevity of the trapping network, as they may rust and stop functioning effectively.

D-Rat traps

This trap can also be placed inside trap tunnels to perform rodent control on the ground. (described in section 6.3 below)

[2] https://www.doc.govt.nz/globalassets/documents/conservation/threats-and-impacts/pf2050/pf2050-trapping-guide.pdf

Figure 2: *Tree mounted possum traps are best placed along animal trails and on trees that exhibit possum bark chewing. This photo shows a Trapinator.*

6.3 Tree mounted traps for rats and possums

Tree mounted traps can be used to target rats or possums (Figure 2). Information on possum and rodent movement is the most critical parameter in determining optimal placement of traps and bait stations, as the successful eradication of pest populations is dependent on all target species encountering and interacting with devices and baits. It is therefore crucial that traps are spaced in a manner which optimises the potential of all cohorts of the target population encountering a device. For example, since adult female possums are known to have smaller home-ranges than adult male possums, devices placed too far apart will consequently leave a higher proportion of surviving females, resulting in increasing repopulation through breeding (Warburton 2000). A similar situation applies to juveniles. If spacing of bait stations, traps or poison lines does not factor in the smaller range areas occupied by juveniles then the rates of juvenile survival following an operation will be high (Blackie 2010).

D-Rat traps

D-Rat traps are user friendly spring traps that can be mounted on trees throughout the landscape to target rats. This may reduce the risk to non-target species. The D-Rat trap is a durable spring trap that comes in various versions depending on the location and design of the trapping network. This trap can be mounted to a tree using a reusable cable tie or fastened to a wall stud or tree trunk using a bayonet clip. The versatility of the D-Rat trap allows it to be moved throughout the landscape as rodent densities and distributions vary. Mechanically, these springs traps lure the pest onto the trigger plate, setting off the high-powered stainless-steel spring. The clamp pressure and high strike force of the trap ensures a quick and humane kill.

Self-resetting AT220's

Efficient and effective self-resetting tree mounted traps that target possums and rats. This spring-powered trap is reset by a small electric motor with a rechargeable battery. It resets and

rebaits itself automatically. It can perform up to 100 cycles and requires maintenance every 6 months. The AT220 can be deactivated in daylight and reactivated at night to minimise any risk to non-target species. Furthermore, the AT220 can deliver data logging and communication services to support monitoring.

Flipping Timmy, Trapinator, and Sentinel traps

These traps are all effective, versatile, user-friendly possum traps. This range of tree mounted traps can be used where fence posts or sturdy >30cm diameter trees occur and should be 1 metre above the ground.

Possums, attracted by a lure, put their head through the opening on the front of the trap to reach the bait inside the trap. This triggers the spring-loaded metal bar to fire, constricting the possum's neck. The catch is held off the ground by the trap, until it is cleared, rebaited, and reset. Correct possum orientation is achieved by the requirement to grip the tree with all four limbs in order to reach the lured trigger. However, in area with no domestic pet risk, a wooden platform can be placed 30-40 cm below the trap to increase trapping success, alternatively, the trap can be placed above a suitable branch on the tree at the same height. This platform should be narrow enough to allow the possum to fall off once the trap is triggered such that it's full weight is distributed properly within the jaws of the trap (aiding in an ethical kill).

Species	Preferred habitat	Ideal control technique
Possum	Hillside, low scrub found throughout the landscape, and mixed hardwood forest/pasture margins.	Tree mounted traps, including Flipping Timmy, Trapinator, Sentinel, and AT220 traps.
Mouse	Widespread throughout, in bush, pasture, domestic residence, farms, and at high altitude above the treeline.	Ground set kill traps, specifically Victor snap traps can be used. They must be housed in a trap box. Toxin may also be used to poison mice, following the product guidelines, preferably housed in bait stations.
Rat	Urban areas, near human habitation and around waterways. Abundant in the harbour, their distribution changes seasonally.	Tree-mounted (D-Rat) or ground set (Victor or DOC200) traps are both effective for targeting rats. These must be housed in trap boxes. Toxin may also be used to poison rats, following the product guidelines, and depending on the location.
Mustelids	Mustelids tend to follow linear features such along habitat boundaries, tracks, and fence lines. Near waterways, bird and small mammal habitat. Ferrets are found in open pasture, fragmented landscapes, or vegetation margins. Stoats will move through thick dense habitat, likely following trails. Weasels are widespread.	Ground set kill traps which must be housed in a trap box. Ferrets can be controlled with DOC250 traps. For stoats, DOC150, DOC200, DOC250, and Victor professional PCR mod traps can be used, with double-set DOC200's being particularly successful.

Hedgehogs	Lowland pastoral areas but may venture into larger forest tracts if habitat and food are more abundant. Present throughout the harbour catchment.	Ground set kill traps, specifically DOC150, DOC200, and DOC250 traps can be used from September – June.

***Table 3**: Habitat and ideal control techniques for different pest species in the Whakaraupō | Lyttelton Harbour landscape*

6.4 Lures

Lures entice pest species to interact with a trap by resembling their preferred food type. The longevity and appeal of the lure to the target species is vital when deciding which is most effective for the task. Prefeed, however, are products are used prior to toxin deployment, to get target species familiar with the flavour and delivery method of a non-toxic prefeed prior to toxic baits being delivered in the same way.

Lures in traps should be replaced every service. Changing between lure types (e.g. every 3-6 months), has shown to be effective at increasing trapping success by targeting individuals with differing preferences. Lure type should be recorded and entered into the selected data management system, to allow analysis of which lures are most effective for each target species.

6.4.1 Possum lures

Possums prefer a diet consisting mainly of vegetation, but they are opportunistic omnivores and are very enticed by fruits, berries, and nectar. Possums are attracted to visually striking lures, such as white icing sugar and flour. You can smear these over the tree surrounding the trap or bait station to act as a ‘blaze’, drawing the pests in. The longevity of a lure may depend on whether it is fresh, preserved, or dispensed.

- An effective blaze can be made by mixing flour, sugar, and aniseed, cinnamon or curry powder and many recipes are available on the internet.
- Peanut butter on its own can be used to lure possums but commercial products such as ‘Smooth in a Tube’ or ‘Possum Dough’ are very effective and may have a higher longevity when in the field. Peanut butter should not be used in habitats with domestic cats where sweet lures, such as apple, should be preferentially deployed
- Aerosol lures are also effective at drawing in animals from further away.
- New auto-dispensing lure systems are available and present further options for increasing trapping ability as do solid state lures which are infused with selected compounds and work for many months without being changed.

6.4.2 Mustelid lures

Mustelids prefer a diet consisting of eggs and meat, such as that from rabbits, rodents, birds, or other wildlife. Using multiple different lures, such as both salted rabbit and a long-life lure block, will also likely attract a wider range of target species and individuals of the same target species with differing preferences.

- Traps targeting mustelids should generally be lured with fresh rabbit or if checking frequency is low then preserved rabbit (Erayz) which is also suitable for targeting rats and hedgehogs.

- A long-life, solid-state block for mustelids (Poa Uku) has been proven to be more attractive than Erayz for attracting stoats for up to one month, and ferrets for up to three months. This lure is recommended as a long-life alternative to salted rabbit, in particular during summer if fresh rabbit is not available.
- Connovation's Eggsellent lure is highly effective at attracting a wide range of target predators including stoats, ferrets, rats, possums, and feral cats), however, it needs to be freshly dispensed (ideally at least every 24 hours).
- Long-life lure dispensers such as MotoLUre and EzyLure™ (still in development) are able to dispense fresh lure including Eggsellent multi-species lure and remain operational for up to a year.
- Eggs (raw hen's eggs or artificial eggs) and/or birds' nests (empty/vacated is ideal, or artificial) can also be used as a visual cue.
- Lure-It ® Salmon is a spray-on scent that can be used for scent trails between traps.
- Bird feathers can be placed in real or artificial birds' nests and can be placed in traps boxes but are most effective when female stoats are looking for den material.

6.4.3 Rodent and hedgehog lures

Rodents prefer a diet made up of seeds, grains, and other plant material, as well as invertebrates and small vertebrates. A fresh lure can easily be made using peanut butter, chocolate, or peanut butter mixed with rolled oats. However, for improved longevity using eggs, auto-dispensed lures or solid-state rat lures work best.

- Fresh lures can be used where checking and rebaiting frequency is high enough to ensure it stays appealing. Cheese, milk chocolate, Nutella, walnuts, and peanut butter are good options for fresh lures.
- Eggs (raw hen's eggs or artificial eggs) and/or birds' nests (empty/vacated is ideal, or artificial) can also be used as a visual cue. Eggs can be topped with a tablespoon of peanut butter to especially target rats and/or hedgehogs.
- Long-life lure auto-dispensers such as MotoLUre and EzyLure™ (still in development) are able to dispense fresh lure including Eggsellent multi-species lure and remain operational for up to a year.
- Solid-state rat lures such at PoaUku are available and last at least 3 months in the field. One advantage is that they do not go mouldy or wash away in the rain.

6.5 Emerging technology

PF2050 is a national movement to eradicate stoats, rats, and possums from mainland Aotearoa by 2050. The establishment of PF2050 has seen the growth of innovative tools and technologies to ensure this goal is met. Department of Conservation's Tools-2-Market has also provided funding for commercialisation of novel technology for pest control application. Using innovative solutions such as artificial intelligence recognition-based triggering, onboard control of toxin release, and self-resetting and self-reporting traps, the future of pest control is set to be revolutionised. Below is an outline of some technologies that may become commercialised in

the coming years and should be incorporated into any Whakaraupō | Lyttelton Harbour trapping program if they increase the safety and effectiveness of control:

- **ZIP-Inn** *(Zero Invasive Predators (ZIP)*) – a long, run-through trap with lure placed inside and outside (hood). When triggered, it closes the entrance doors and floods the internal chamber with CO^2 to euthanize the animal in accordance with laboratory protocol. The trigger is weight sensitive to exclude lighter animals and the entrance is curved specifically to exclude non-target species.
- **LoLa** – "Low Labour" bait station is in development by ZIP. The LoLa tunnel can be used to dispense cereal baits and could be modified to hold a D-block style bait if required. It is also designed to deliver toxin through an auto-lure dispenser.
- Possum **Spitfire** (*Envico*)[3] – the possum Spitfire is a toxin delivery system capable of delivering 80 species-targeted, lethal doses, with a longevity of up to one year. It is currently being field tested ahead of commercialisation. The device is reinforced, and tree mounted, to ensure that the toxin remains safely contained inside the device.
- Rat/stoat **Spitfire** (*Envico*)[4] – this is a classic, ground-based run-through trap which uses an array of sensors to identify small mammals and deliver a lethal dose of toxin. It has a strong box-like structure and can be securely pegged to the ground to ensure the toxin remains safely contained.
- ***Hammerforce*** possum trap[5] – a tree mounted trap with a bite block trigger. When triggered, it delivers a fatal impact to the back of the skull. The device resets, the dead possum drops to the ground, leaving the device clear.
- ***Cacophony*** High Interaction Rate trap[6] – this device uses thermal cameras and sensors to drop curtain-like doors at each end of the 'tunnel' to capture anything that moves through the trap. The animal is then funnelled to a holding cage, that may contain a kill trap (controlled remotely by an operator). AI that can differentiate introduced mammals from native birds is still being developed, therefore the risk to non-target species remains high.
- ***Critter Solutions* AI triggered trap** (*Crittersolutions*)[7] – This device uses a small camera and on-board algorithm to identify the target species in order to trigger the device. The species identification is passive and does not require a "bite-bar" style interaction in order to fire. This algorithm can therefore completely exclude native birds and other non-target animals. This is completely self-resetting and incorporates an auto-dispensing lure. Field trials will be conducted with non-targets in the coming year.
- **Norbormide** rat specific toxin (*Invasive Pest Control*)[8] – Norbormide is a species selective toxicant and has been shown to lead to vasoconstriction and subsequent death in rats only. Mice are not affected nor any native animals or domestic stock/pets. There is no secondary poisoning risk and no bioaccumulation. Consequently, this toxin has huge potential in locations where operators wish to specifically target rats.

[3] https://www.envicotech.co.nz/spitfire-devices

[4] https://www.envicotech.co.nz/spitfire-devices

[5] https://pf2050.co.nz/news/new-transformational-tools-for-the-predator-free-2050-effort/

[6] https://www.2040.co.nz/collections/frontpage/products/high-interaction-rate-trap

[7] https://www.todayfm.co.nz/home/technology/2022/06/new-trap-uses-ai-to-identify-predators-and-protect-native-animals.html

[8] https://predatorfreenz.org/research/rats-mice-future/

7.0 Habitat and species determine best control

7.1 Site led pest animal control activities.

7.1.1 Steadfast stream

This site is managed by regional parks managers within CCC. Monitoring should be conducted four times a year with the use of WaxTags/chew cards and tracking tunnel lines. As this is a valley with mixed habitats, the lines should cross habitats as they zigzag across the riparian vegetation into the surrounding habitat. Two to three tracking tunnel lines should be laid out with the tunnels remaining in the landscape to aid rapid deployment of monitoring tracking cards through the year. This site is very suitable for good clear permanent signage explaining what is being protected through the 'how' and 'why' of pest control approaches. A similar number of chew card, or WaxTags, lines should be mapped out for use at the same time as the tracking tunnels are run. Tree mounted possum traps are acceptable but land managers have restricted these to Trapinators only once written permission has been obtained. It is the CCC's wish that these devices are not observable from the publicly used tracks.

7.1.2 Coastal Pathway Navel Point to Pony Point

This is one of the community parks managed by CCC. It has various hazards relating to steep bluff country and should be surveyed carefully to ensure locations chosen are safely accessed. Consequently, tracking tunnel or WaxTag/chew card lines should be laid out horizontal to the coast to reduce risks for the team monitoring this area. If placed in the bush uphill of the walking track this should be sufficient to understand the pest animals within these vegetated areas.

7.1.3 Coastline between Allandale and Governors Bay

This region passes through a number of stakeholder's land and therefore has differing activity restrictions. Since it is coastal it has been identified as a priority for pest control within Whakaraupō | Lyttelton Harbour. This is also frequented by dog walkers and families with children so placement of traps should observe guidelines outlined in this document and signage should be provided wherever possible to inform the walkway users of the intentions of the control effort.

7.2 Habitat quality

The quality of the habitat in an area will influence the presence, abundance, and distribution of pest animals and the behavioural patterns they may follow. **Table 4** below describes the habitat types that are found in, and bordering, the reserves that Whaka-Ora manages, the pests present, and recommended control.

Table 4: *Habitat types, species, and recommended control approaches in and around the reserves and wider Whakaraupō | Lyttelton Harbour catchment.*

Habitat type	Description	Example locations	Primary pest species	Appropriate tree-mounted control	Appropriate ground trapping
Riparian margins bordering on lagoons, rivers, swamps, and estuaries	Riparian zones comprise the area between land and water. When forested or well-vegetated, riparian edges are important for protecting aquatic environments from excessive sedimentation, pollution caused by surface runoff, and erosion. Riparian zones can be home to rich biodiversity including native birds, insects, and plant species.	Head of the harbour, Allandale Reserve	Possums, rodents, mustelids, hedgehogs	Place single-set, tree-mounted devices at recommended height. Set at a moderate trap density (1/1ha) when traps are able to be regularly serviced (checked, cleared, rebaited or reset). Set traps at a lower density if using resetting AT220s. No ramps to be used on any devices. Sporadic cage trapping operations in high residency areas. Toxin not appropriate. Tree mounted D-Rat traps can be used on large enough trees, while controlling the mounting position and lure to exclude domestic cats.	Linear traplines along margins to target animals using waterways as corridors. Place ground set traps in boxes 75-100m apart. Ensure trap entrance is clear of grass etc, and lures can be used to increase engagement.
Thick remnant or restored native vegetation	Well-vegetated land is present in patches across the landscape. There are areas of native bush, native tussock land, vegetation along waterways, in reserves, and along shorelines. Some areas may not have been cleared or have regrown since. Native vegetation is especially important for ecosystem revitalisation.	Orton Bradley Park, Buckleys Reserve	Possums, rodents, mustelids, hedgehogs	If closer to rural setting, place single-set, tree-mounted devices at recommended height. Place traps at densities appropriate to the device type (i.e., moderate for singe set, low for resetting) and possum density. Increase density of traps or trap check frequency when possums are in high densities. Toxin use possible with careful application and consideration of proximity to residential housing (e.g. D+C).	Traplines along forest margins, targeting rats moving through the landscape and into the denser bush areas. Place ground set traps in boxes 75-100m apart. Ensure trap entrance is clear of grass etc. Lures should be used to increase engagement. Tree mounted D-Rat traps can be used on large enough trees, while controlling the mounting position and lure to exclude domestic cats.
Plantation and exotic trees	Fruit trees, orchards, and ornamental tree plantings are scattered in former backyards, lining pathways and streets. There are no large-scale forestry plantations in the Red Zone. Exotic and especially fruiting trees attract predators like rodents and possums.	Redzone Governors Bay	Possums, rodents, mustelids	Place single-set, tree-mounted devices at recommended height for low to moderate densities. Use possum 'pad-trails' to guide placement, particularly on the forest edge or where there is regenerating thick undergrowth. An ideal target of 1 trap per hectare could be reduced to 1 trap per 2 hectare block to resourcing is an issue. Toxin use should be considered if the site is suitably isolated and public access is limited.	Traplines along forest margins, targeting rats moving through the landscape around plantations. Place ground set traps in boxes 100m apart. Ensure trap entrance is clear of grass etc. Lures should be used to increase engagement.

Habitat type	Description	Example locations	Primary pest species	Appropriate tree-mounted control	Appropriate ground trapping
Open areas of park, sports grounds, or fields	May include peri-urban areas, which are zones of transition from rural to urban areas, located between the outer limits of an urban centre and the rural environment.	Reserves including Teddington, Allandale, Orton Bradley, golf course	Hedgehogs, mustelids	Place single-set, tree-mounted traps (Sentinel or Trapinator), self-resetting AT220s at a height of >1.5m on clean (not lower limbs) straight trunks. Licenced night shooting according to legal guidelines. Toxin not appropriate.	Focus on vegetated strips that border open grass fields. Place trap boxes among moderate tree cover, hedgerows, remnant border shrubs, and intermittent revegetation planting. Tree mounted D-Rat traps can be used on large enough trees or fence posts, controlling the lure and mounting position to exclude domestic cats.
Residential housing	Housing and infrastructure including access roads, gardens, hedgerows, sheds, garages, streetlights, and power junction boxes.	Lyttleton, Cass Bay, Rāpaki, Governors Bay, Diamond Harbour, Purau	Rodents, hedgehogs	Place single-set, tree-mounted devices at low to moderate densities using possum 'pad-trails' or treelines/hedges to guide placement. Discuss the use of ramps with residents. If using ramps, carefully control the lure to exclude cats. Cage trapping can be used if residents are able to make daily checks and dispose of the possum. Licenced night shooting according to the guidelines in this document. Toxin not appropriate.	Ground set traps must be housed in boxes. They should be placed along fence lines, near walls, compost bins, or under cover. Tree mounted D-Rat traps can be used on large enough trees or fence posts, controlling the lure and mounting position to exclude domestic cats.
Pasture/ farmland	Agricultural land, pasture, active farm properties. Industrial zones are not generally within the central residential area of a city.	Godley Head, Mt Herbert	Rodents, ferrets, possums and hedgehogs	Traps must be carefully placed, secured, and monitored in commercial areas and needs to be led by businesses.	Ground set traps securely housed in boxes can be used, trapping led by and coordinated with businesses. Traps should be placed along key movement corridors: along fence lines, near compost bins, or vegetation.
Cliff or steep hillside	Steep and hilly terrain, often exposed to strong winds. Vegetation is variable – lichen and mosses on rocks, mature totara, and matai trees in pockets of remnant forest, and silver tussock and grasses. The land is subject to rockfall and cliff collapse.	Port Hills, Mt Herbert, Mt Bradley	Possums, rodents, mustelids	Mark trap lines and place single-set traps at a high density, or low density if using AT220s. Ensure AT220s are at key movement points or along topographical boundaries with high likelihood of encounter. Toxin appropriate if needed.	Boundaries of steep land can be trapped to target animals moving in or out of the inaccessible cliff areas. Traps should be places at key movement points, or along topographical boundaries.

7.3 Trap use limitations and safety measures.

The habitat that borders the Whaka-Ora managed reserves will have an influence on the species present within the reserve. It is important to consider these locations within the wider context. This will help to determine where the source populations of pests are, the transportation routes, likely species present (both pests, natives, and domestic pets), and therefore the most appropriate control methods. The Whaka-Ora reserves share boundaries with many different land use types (**Table 4**). The boundary habitat type will influence the predators present in the reserves and the most suitable control methods. The habitat infrastructure will determine which control techniques are most suitable, and which tools are restricted.

Table 5 below indicates which tools and techniques are most appropriate for each habitat type, and the associated restrictions to their use.

***Table 5**: Trap types and use restrictions*

Device designs/types	Images of devices	Use restrictions
DOC 200 boxes (incl. DOC150, BT150, and BT200)		Safe to use in all contexts if locking screw is hex or similar, standard cat exclusion design required, i.e., a larger distance between outer mesh and inner baffle to keep the kill mechanism out of reach.
DOC 250 boxes or standalone Podi Traps		Due to large aperture at entrance not suitable near penguin habitat or around domestic pets. Preferably used in rural margins where ferrets are likely to live.
Rat trap boxes Victor style, T-rex, D-rat		Option to use in all urban and peri-urban areas. Standard trap box designs or variations on them that are fed from the PF2050 community. Traps should be 'secured in the back recess of the trap using a nail or similar to reduce non-target bird kills.
Stand-alone rat traps D-Rat - Supervisor		Can be tree mounted but placement must be carefully considered around pets unless using the design pictured, which should always be pegged or nailed into place.

Tree mounted devices Sentinel, Trapinator, Flipping Timmy, D-Rat		Mounting position and lure choice are paramount to exclude domestic cats. A stepladder or other device should be used to set these up and maintain them with ideal mounting height being 1.5-2m off the ground. Don't place above branches or artificial platforms if there are domestic cats in or around the trapping area
Gas powered devices A12 (decommissioned) and A24		Care must be taken to place A24's out of public view/ reach in most settings. A12s are no longer made commercially and may be of limited value in trapping networks.
Self-resetting devices AT220		No ramps or lower perch points appropriate in areas with likely visits from domestic cats. Devices must have warning signs and be on day/night switching anywhere near public use areas. These should be set >1.5m up on the tree, above where young people can reach easily from the ground. All devices should be off tracks and obscured by vegetation to reduce public interference.

8.0 Data recording and management

All control data (trapping) and all monitoring data needs to be entered into a single, cohesive data management system as soon as it is collected. Trap.NZ 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 early as possible. The GPS waypoints or approximate location of all ground-truth 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.

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 pest management decisions.

8.1 Trap.NZ

Data from trapping and biosecurity monitoring should be recorded using Trap.NZ. Trap.NZ is a free service used throughout New Zealand to record biosecurity data relating to traps use, capture, bait station placement and monitoring effort. The map feature can be used to draw the

outline perimeter of the pest control programme and summarise trapping results in order to identify areas of high catch rates where more traps would be beneficial.

At each trap check, the following data should be recorded:

- The date, time, trap line, assessor, and type of trap that is being checked,
- The status of the trap (i.e., sprung but empty, still set),
- What species was caught if any,
- Whether it was rebaited and what lure and bait was used.

Trap.NZ can also be used to record the monitoring data captured at the same or different sites. Each time a monitoring station is checked, species data can be entered and associated to the corresponding chew card, tracking tunnel, WaxTag, or other monitoring method. This helps to create a clear and accurate picture of where pests are located, and which areas have been consistently monitored.

Trap.NZ can demonstrate this data in a range of maps, charts, and tables that are extremely useful. These outputs give an overall picture of the number of pests caught and where they are located, which can help to identify hotspots or trap success rates and develop the project accordingly. The ability to monitor what pests are present in the landscape and where, as well as what trapping lines are producing successful outcomes, allows you to focus resources with greater efficiency. It also allows management to conduct quality assurance estimates of the trap maintenance and checking regimes. For community trapping groups, Trap.NZ allows volunteers to independently conduct their work, while allowing coordinators to keep track of the site as a whole. There is location information, space for notes i.e. maintenance needed, and pictures.

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Appendix 1: Traps that have met NAWAC test specifications (Accessed 21 November 2023)

Traps that have met the NAWAC 09 guideline test specification for effective kill or effective restraint.

Trap	Ship Rat	Norway Rat	Stoat	Ferret	Hedgehog	Possum	Feral Cat
DOC 150		☑	☑		☑		
DOC 200	☑	☑	☑		☑		
DOC 250	☑	☑	☑	☑	☑		
BT 200	☑		☑				
BT 250				☑			
PodiTRAP				☑			
Rewild F-Bomb	☑	☑	☑	☑	☑		
Goodnature A24	☑		☑				
Envirotools D-Rat 'Lumberjack'[1]	☑						
Envirotools Supervisor MAX	☑						
Victor Professional PCR mod	☑	☑	☑				
Victor Professional	☑						
T-Rex[2]/Tomcat	☑						
Timms							☑
Flipping Timmy						☑	
Sentinel						☑	
Warrior						☑	
Trapinator						☑	
Goodnature A12 (discontinued)						☑	
SA Coni (discontinued)							☑
Twizel kill trap (discontinued)							☑
Belisle Super X 220							☑
SA2 Kat trap						☑	☑
NZ AutoTraps "AT220"	☑					☑	
Victor No.1 double coil spring unpadded						☑	
No. 1 double coil spring unpadded with chain-spring and swivel modifications[3]						☑	

Notes:

1. Testing was undertaken using the standard Envirotools D-Rat trap (includes shroud/yellow cover) in a wooden box.
2. Includes the T-Rex trap with the EVO tunnel.
3. Details on modifications and pass grade can be found in the testing report available here: https://nzfurcouncil.org.nz/wp-content/uploads/2020/05/Final-Report-Possum-leg-hold-trap-modifications.pdf

Appendix 2: Methodology for biosecurity monitoring techniques

Three monitoring tasks are described below using a methodology which is modelled on the Department of Conservation's DOCDM-1199768 (Gillies & Williams 2013) and NPCA Code A1 Best Practice (Bionet & NPCA 2020).

- Tracking Tunnels measures for small rodents (1-night)
- Tracking Tunnel for mustelids (3-nights)
- Chew Card index for Possums (3-nights)

Concurrent and sequential monitoring

The methodology does require that both tracking tunnel operations occur sequentially with a one-night rodent measure followed by a three-night mustelid measure (preceded by a three-week tunnel conditioning period). The possum Chew Card Index lines can be conducted concurrently i.e within the three-week tunnel conditioning period. Otherwise, this can be undertaken following the completion of the Tracking Tunnel monitoring events.

Tracking tunnels for stoats should be conducted at half of the full tracking tunnel lines used for monitoring rodents. When these lines are switched over to stoat measures.

Methods for Tracking Tunnel Monitoring

The following timeframes should be adhered to in operating this monitoring, although conditioning period can be longer than 21 days:

Operation	Duration	Timing
Tracking Tunnel layout (conditioning):	3 weeks	Day 1
Rodent measure setup:	1 - night	Day 21
Rodent card retrieval and stoat setup	3 - nights	Day 22
Stoat card and tunnel retrieval	All removed	Day 25

The following table outlines the parameters of the two monitoring periods for tracking tunnel:

Target Spp.	Bait Type	Line Length	Tunnel Spacing	#Tunnels per line	Line-line distance	# lines	# nights
Rats/mice	Peanut Butter	450 m	50 m	10	100 m	variable	1
Stoats	Fresh Rabbit	400 m	100 m	5	1000 m	half of above	3

Rodent Monitoring with Tracking Tunnels

- Each line should contain ten tunnels spaced at 50 m apart from the point at 0 m until 450 m. They should follow your landscape plan as accurately as possible (in relation to vegetation available), but a tunnel may be placed at a greater distance than the 50 m if no suitable site is immediately available.

- Each tunnel is best to have a standard pre-inked card pinned at each end to reduce risk from possum interference. “Pics” Peanut butter is to be placed in the centre of the **entrance at both ends** on the tunnel base.

- Numbering of tunnel sites is to be sequential using the line number provided with a dot then a **letter** designating which tunnel it is in a sequence of ten (i.e. for tunnel line 4 – 4.a is the first tunnel where 4.j is the tenth tunnel in that line). Or similar standardised numbering system

- Each card is to have the location number, the word “rodent”, bait type, staff name and deployment/retrieval date clearly written on it. Enter each tunnel location into Trap.NZ.

- When the card is retrieved the following day, the following information must be recorded on it:

    - Card removed or interfered with (attempt to identify the source)

    - Droppings present?

    - Bait gone/present?

    - Prints present/absent (identify the species if possible)

    - Bait present with no droppings or tracks

- Raw data tracking cards should be collected and securely stored (air out if very damp) and assessed by a second trained person for confirmation. Use rubber bands and **do not store in plastic bags**.

Stoat Monitoring with Tracking Tunnels

- Each line will contain five tunnels spaced at 100 m apart from the point at 0m until 400 m. They should follow the mapped line as accurately as possible. This is achieved by missing every second tunnel from the rodent tracking tunnel line. Use half as many tunnel lines as were used for rodents and ensure those selected are 1km apart.

- Each tunnel should have a standard pre-inked card pinned at each end to reduce risk from possum interference. A 2.5 cm square piece of **fresh** rabbit meat is to be placed in the centre of the ink pad within the tunnel.

- Numbering of tunnel sites is to be sequential using the line number provided with a dot then a **number** designating which tunnel it is in a sequence of five (i.e. for tunnel line 4 – 4.1 is the first tunnel where 4.5 is the fifth)

- Each card is to have the location number, target species, bait type, researcher's name and deployment/retrieval date clearly written on it. Locations of tunnels for stoat monitoring must be entered separately into Trap.NZ.
- When the card is retrieved after three-nights, the following information must be recorded on it:
    - Card removed or interfered with (attempt to identify the source)
    - Droppings present?
    - Bait gone/present?
    - Prints present/absent (identify the species if possible)
    - Bait present with no droppings or tracks
- Raw data tracking cards must be collected and securely stored (air out if very damp) and confirmed by a second trained person.

Methods for Possum Chew Card Index Monitoring.

- Deployment must be timed with a three-night window of clear weather (no rain events).
- Pre-baited (Peanut butter) Chew Cards are to be deployed at 20 m spacing. Ten per line will result in a total length of 180 m. These are to remain in situ for three nights.

Target Spp	Bait Type	Line Length	Tunnel Spacing	#Tunnels per line	Line-line distance	# lines	# nights
Possum	Peanut Butter	180 m	20 m	10	200 m	variable	3

- Cards are to be marked with the site number, date of deploy/retrieval.
- Around publicly accessed areas all attempts should be made to hide the deployed cards either by placing them on trunks in dense vegetation or on the opposite side of the trunk from the main public thoroughfare. Use flagging tape along the line if necessary.
- No blaze is to be used. Chew cards are to be placed as per instructions given in the Code A1 from NPCA.
- When retrieved, the cards should be interpreted and the identified species (if any) recorded on the card. Record the presence of any plastic at the base of the tree.
- Cards are to be collected and stored carefully then checked by a second person.

Together. Shaping Better Places.

Boffa Miskell is a leading New Zealand environmental consultancy with nine offices throughout Aotearoa. We work with a wide range of local, international private and public sector clients in the areas of planning, urban design, landscape architecture, landscape planning, ecology, biosecurity, Te Hīhiri (cultural advisory), engagement, transport advisory, climate change, graphics, and mapping. Over the past five decades we have built a reputation for creativity, professionalism, innovation, and excellence by understanding each project's interconnections with the wider environmental, social, cultural, and economic context.

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