Project Report
Antipodes Island Mouse Eradication

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Executive Summary

The Antipodes Islands group (2100 ha) is one of the five island groups in New Zealand's Subantarctic Islands region, administered by DOC and protected as a Nature Reserve (1978). The New Zealand Subantarctic region is recognised internationally as a World Heritage site (1998) for "outstanding universal value", particularly regarding endemic albatrosses, cormorants, land birds and megaherbs; and "… a pattern of immigration of species, diversification and emergent endemism". House mice (*Mus musculus*) are the only mammalian pest species at the Antipodes, first recorded in 1907 but possibly arriving much earlier. Mice have had a significant detrimental impact on the island's endemic, rare and threatened species.

In 2012 DOC partnered with the Morgan Foundation and supporters to initiate a project to eradicate mice from the Antipodes. A high-profile fundraising campaign "Million Dollar Mouse" followed, led by philanthropist Gareth Morgan who pledged to match public donations dollar for dollar. The objectives were to protect biodiversity on the Antipodes and enable recovery by halting predation of native invertebrates and competition with endemic ground bird taxa. Removal of mice would also protect albatross (particularly Antipodean albatross) and petrel species from future prey-switching by mice that has occurred suddenly on other Subantarctic islands (Gough Island and Marion Island) where recruitment of seabirds is now severely restricted by mice preying on chicks (Angel et al, 2009; Ryan, 2015).

The project's highly publicised initiation provided opportunity for engagement but also introduced risk for DOC by committing publicly prior to feasibility work. A subsequent feasibility study concluded in 2012 that the project was both feasible and worthwhile but highlighted the challenging logistics and indicated a higher cost than previously anticipated.

This was an "expedition style" project where a team and equipment including 3 helicopters, were transported to Antipodes Island by ship where they camped until aerial bait spread was complete. At the time, this was the largest mouse eradication attempt where mice are the sole mammalian pest species and one of the most logistically complex projects DOC had attempted in recent times. The complexity related largely to the remoteness of the site, the extreme Subantarctic weather, reliance on finding a suitable ship, a lack of established infrastructure, and no harbour at the Antipodes to shelter helicopter and ship operations.

Planning commenced in 2012 and a fulltime Project Manager was employed in 2014 following a hiatus largely resulting from the impact of DOC organisational restructuring in 2012 and 2013. The eradication design drew on best practice for rat eradication with modification based on previous mouse operations with extensive technical advice and support provided by DOCs Island Eradication Advisory Group (IEAG). An initial target for implementation in winter 2015 was delayed as a ship and helicopters were not able to be sourced in time. At the project's initiation, there was an expectation that the Navy would provide the required shipping services. However, the project's scheduling requirements were not compatible and operating protocols meant the Navy could not transport civilian helicopters. The Navy was instead organised to support early infrastructure installation but this was cancelled in 2015 and again in 2016 because of re-tasking to disaster relief in the Pacific.

Planning involved extensive trials and development of contingencies for every critical item or system. A project review late in 2015 achieved engagement by managers with the establishment of a functioning steering committee, and catalysed the prioritisation of critical support in the

6 months prior to implementation. A readiness check in early May 2016 found the project was well planned by this stage, and ready for implementation.

Implementation was completed in winter 2016 over 75 days. The cargo vessel M.V. Norfolk Guardian and passenger yacht S.V. Evohe provided transport services delivering the team to the island. Helicopters flew 250 loads ashore between the 27th of May and 7th of June 2016. In this time six builders helped setup the temporary infrastructure that included a large helicopter hangar and helipad before departing with the transport vessels to leave the core operational team of 13 to complete the poison baiting. Readiness to bait was achieved by the 9th of June. Between June 18th and 12th of July 2016, two helicopters spread 65.5 tonnes of Pestoff 20R Rodent Bait containing 20 ppm of the toxin brodifacoum, in two separate treatments, comprehensively covering the islands to target mice. Four offshore islands (Bollons, Archway, East Windward and West Windward) were not baited because monitoring gave sufficient confidence that mice were absent, giving a total refuge area of 74 ha for non-target bird species.

At the completion of baiting the transport vessels returned to the Antipodes in late July for demobilisation which included the removal of all temporary infrastructure. The team returned to the South Island of New Zealand on the 6th of August 2016. The operation was delivered by a unified team and committed suppliers with an extensive network of supporters contributing to preparations and outcomes. The ongoing integrity of the site is high. Landing is by permit only and difficult because of the treacherous coastline and the lack of harbour.

Satellite internet was established on the island during the operation revolutionizing the team's ability to communicate the project. DOC's national media team, project partners and dedicated staff in the project team, achieved a high level of public engagement through T.V. news articles, radio interviews, blog posts and videos of various activities on the project's website www.milliondollarmouse.org.nz, facebook page and YouTube.

Over $800,000 of external funding, including thousands of public donations, contributed to project's operational costs, which was budgeted at $3.97 million between 2015 and 2018. The cost of the project for this period will be $3.27 million, inclusive of $140,000 allocated to fund outcome monitoring in 2018. The final cost since full time planning begun in 2014 will be $3.51 million. Savings relate to a shorter than planned operation due to better than expected weather. The success of the project will be determined by monitoring and announced in 2018.

Early indications of the effects on non-target species showed pipits and parakeets were adversely impacted by baiting but had recovered significantly six months later and are expected to recover completely and benefit in the long-term. The operation had no obvious impact on recruitment of Antipodean albatross. Anecdotal observations suggest moths and flies were in much greater abundance in summer 2017 than prior to the baiting operation. Project outcomes will be updated following further monitoring work in 2018 and beyond.

An after-action review was conducted in late 2016 confirming the need for:

- Managers to lead by championing the project and prioritising resources
- Project management to be established early
- Early engagement by support and service staff
- Simplifying procurement for specialist services to prioritise relationship building
- Team work and collaboration across management levels, regions and organisations
- Everything can only be done 'early' with good resourcing and sensible timeframe

Contents

1. Introduction

New Zealand's Department of Conservation (DOC) and external funding partners, The Morgan Foundation, WWF New Zealand, Island Conservation and public donors, undertook to eradicate mice from the Antipodes Island group (2100 ha) in a major project carried out between 2012 and 2016. This report provides a summary of the design, planning, implementation and indications of the early outcomes.

DOC is the leading central government agency responsible for the conservation of New Zealand's natural and historic heritage and is responsible for administering the Antipodes Islands Nature Reserve (1978). The statutory provisions of the Conservation Act 1987 and the Reserves Act 1977 give the Minister and DOC the mandate to manage the Antipodes Islands for the purposes set out in section 6 of the Conservation Act 1987 and section 20 of the Reserves Act 1977. One of DOC's primary functions is to preserve and protect plants, animals and ecosystems. Section 20 of the Reserves Act 1977 requires: "the indigenous flora and fauna, ecological associations, and natural environment shall as far as possible be preserved and the exotic flora and fauna (such as mice) as far as possible be exterminated".

The Antipodes Islands are part of the New Zealand Subantarctic Island region listed as a World Heritage site in 1998. The eradication project contributes directly to DOC's key intermediate outcome 1.0 for natural heritage "The diversity of our natural heritage is maintained and restored" (DOC, 2014).

In 2012 DOC's Area Manager Andy Roberts and philanthropist Gareth Morgan visited Antipodes Island as part of Gareth Morgan's Our Far South expedition. Following this the parties decided to collaborate to eradicate mice from the site. In Autumn, 2012 The Morgan Foundation ran a highly publicised fundraising campaign "Million Dollar Mouse" (MDM) with Gareth and Jo Morgan pledging to match donations dollar for dollar.

DOC is widely regarded as a world leader in animal pest eradications. This project drew heavily on learnings and expertise developed through ground breaking eradication projects since DOC's inception in 1987. These projects include significant eradication successes in the New Zealand Subantarctic region, for example removing rabbits and mice from Enderby Island (700 ha) in 1993; and eradication of rats from Campbell Island (11,300 ha) in 2001. Less is known about eradicating mice than rats. Eradicating mice is generally considered more risky than other rodent species based on their biology, behaviour and small home range that require higher bait rates and greater application precision than for rats (Mackay et al, 2007; 2011).

This was an 'expedition' style project utilising a chartered ship to transport people, helicopters and supplies to Antipodes Island where the project team camped until bait application was complete. It was one of the most logistically complex eradications DOC has undertaken in recent times due to the remoteness, the lack of infrastructure and the typically poor weather. Eradication, if successful, will halt the depletion of biodiversity by mice. It will provide benefits for the ecosystem and for the many native, endemic, rare and threatened species impacted by the presence of mice or potentially impacted if eradication was not attempted and prey behaviour had changed in the future. Success in this operation will strengthen confidence in the partnership model to facilitate future projects.

2. The Site

The Antipodes Island group (the Antipodes) lies some 760 km South East of the New Zealand mainland, the closest point being Dunedin; and 220 km from the nearest named landmass – the Bounty Island Nature Reserve. The New Zealand Subantarctic region is referred to in Maori as “Nga Moutere O Murihiku Ki Tonga” (DOC, 2016a) and is of cultural and spiritual significance to Ngāi Tahu. The region has five island groups including the Antipodes, which are scattered across the Campbell Plateau and other submerged shelves of the southern New Zealand continental region (see Figures 1 and 2 below). The Antipodes Island group comprises Antipodes Island (2012 ha) plus five offshore islands, one islet and multiple rock stacks. The approximate size of the group is 2100 ha. The Antipodes is one of the most remote parts of New Zealand both geographically and ecologically.

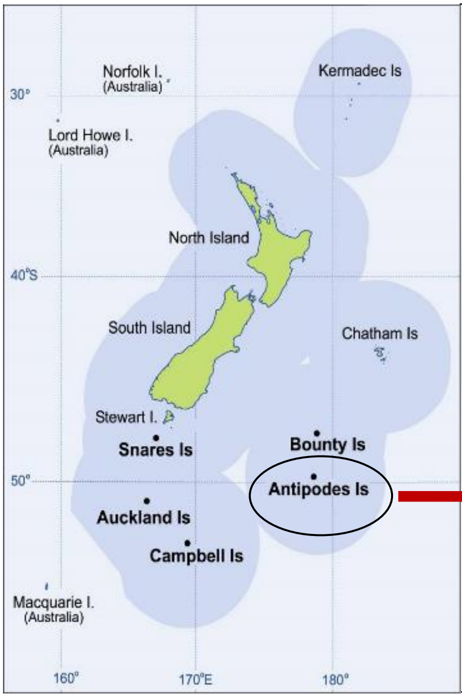


Figure 1: Map showing relative position of the New Zealand Subantarctic Island

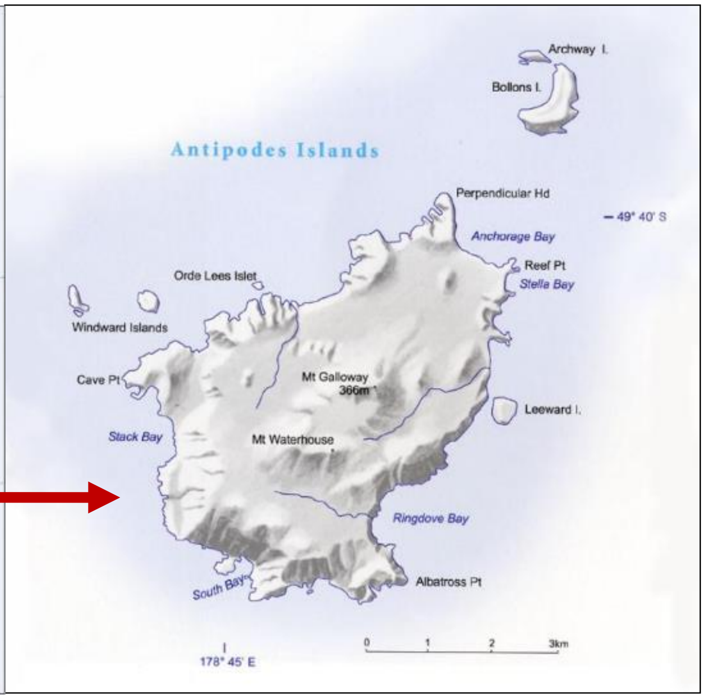


Figure 2: Map of the Antipodes Island group

2.1 Geology and landscape

The Antipodes sits on the South-East margin of the Bounty Platform. It is the youngest island group within the New Zealand Subantarctic region formed around 8 million years ago. The platform basement is granite and metamorphic rocks. The Antipodes were formed from volcanic activity and made up of basaltic lava with pyroclastic debris. The soils are “organic” i.e. peats composed almost entirely of plant remains. Deposits of peat up to 5 m thick blanket most of Antipodes Island (Higham, 1991). Several volcanic cones exist, the highest being Mt Galloway at 366 metres on Antipodes Island. Erosion by the sea has left a ragged coastline with cliffs up to 150 m high and dotted with sea caves, cliffs, rock-stacks and wave cut platforms. Bollons Island and Archway Island to the north are the remains of a large sunken caldera. The islands in the group are largely unmodified and inaccessible, generally surrounded by cliffs leading up to a flatter plateau.

2.2 Climate

The Antipodes climate is generally windy and damp, predominant strong westerly winds prevail with frequent drizzle, fog and rain. Temperatures have been recorded from Reef Point: 0-11° C June, 7-13°C in February but the Central Plateau area is approximately 3°C cooler. There is little annual or even daily temperature variation. Between May and November snow can fall but is usually light and hail can occur all year round. Limited rainfall data is available. Average records suggest between 650 mm to 1200 mm of rain falls annually and that this occurs on about 280 days of the year, with autumn being slightly damper (Taylor, 2006).

2.3 Vegetation and fauna

The Antipodes has a high level of endemism and is a haven for seabirds in the Southern Ocean. Hundreds of thousands of birds coming ashore to breed in the summer months. Nutrients are mostly ocean-derived in the form of aerosol salts from sea spray; guano and carcasses from burrow and surface nesting seabirds; and from seals. "All the native mammals and sea birds on the Islands are dependent on the ocean for food. Even the native land birds rely indirectly on the nutrients derived from the sea. From a biological point-of-view the Antipodes Islands cannot be considered apart from the surrounding ocean" (DOC, 1983). Being volcanic, the islands' species have arrived by flight, sea, wind or via humans, as in the case of mice.

Fifty-seven native bird species are known from the Antipodes, twenty-five species breed there and twenty-one of these are seabird species (Taylor, 2006). New Zealand has the highest number of seabird species in the world and many of the seabird populations on the Antipodes are internationally significant. The nationally Critical Antipodean wandering albatross *(Diomedea antipodensis*), nests on the open tussocklands and New Zealand's largest population of Grey petrel *(Procellaria cinerea)* (53,000 - 56,000 pairs) breeds here between April and November (Bell, 2002). The endemic land bird taxa comprise four species, two endemic species of parakeets: Antipodes parakeet (*Cyanoramphus unicolor*), the largest of New Zealand's parakeets; and the Reischek's parakeet (*Cyanoramphus hochstetteri*). There are also two endemic subspecies: Antipodes Island snipe (*Coenocorypha aucklandica meinertzhagenae)* and the Antipodes Island pipit *(Anthus novaeseelandiae steindachneri*).

Burrowing petrels are a feature and ten species breed on the islands. It is the only breeding site in the New Zealand Subantarctic region for the soft-plumaged petrel *(Pterodroma mollis)* and little shearwater (*Puffinus assimilis)*. Black-bellied Storm-Petrels (*Fregetta tropica*) and Subantarctic little shearwater *(Puffinus elegans),* are abundant on Bollons Island but are at very low density on Antipodes Island, attributed to the impacts of mice (Angel et al., 2009; Imber, Bell, & Bell, 2005). Scavenging seabird species such as Giant petrels (*Macronectes halli)*, skua (*Catharacta antarctica lonnbergi*) and black-backed gulls (*Larus dominicanus domincanus*) breed in small numbers around the island. Large erect-crested *(Eudyptes sclateri)* and eastern rockhopper *(Eudyptes filholi)* penguin colonies can be found along the shores but both species are sadly in severe decline. Small breeding populations of the New Zealand fur seal, kekeno, *(Arctocephalus forsteri*), slowly increasing after being wiped out by sealing in the 19th century, and Southern elephant seal *(Mirounga leonine)* are present.

The vegetation on the Antipodes is mainly rolling tussock grassland with scattered areas of shrubland, fernland, herbfield, bog and swamp (Marris 2000) broadly classified in two ecological zones, coastal and inland (Singers & Rogers, 2014). Vegetation in coastal areas is predominantly tussock grassland communities dominated by *Poa litorosa* up to 1.5 m high. Dense tussock and steep coastal topography severely restrict access to coastal terrain. Locally, *Carex trifida*, *C. appressa*, *Poa foliosa*, and short maritime vegetation (i.e. coastal turf e.g. Reef Point) form coastal communities that are often associated with seabird and/or seal colonies that are the most fertile sites and have the highest densities of mice (Russell, 2012). Peat soils of low fertility dominate elsewhere.

The inland ecosystems include *Poa litorosa* tussockland with bands of prickly shield fern (*Polystichum vestitum*). The gentle plateaus and valleys have diverse vegetation containing a mix of *Poa litorosa*, ferns, herbs, (i.e. *Stilbocarpa Polaris*) and low shrubs (i.e. *Coprosma ciliate*). Scattered bogs with sedge and herbs occur in damper areas. In upper areas, mosses and lichens are prominent. There are only three woody species, all coprosma and only *C. rugosa* forms an upright shrub. Exposure to harsh winds and salt has shaped the vegetation communities. There are 20 plant species present that are listed as Naturally Uncommon. These include the four taxa that are endemic to the Antipodes Islands – *Gentianella antipoda*, *Puccinellia antipoda*, *Senecio radiolatus* ssp. *antipodus*, *Stellaria decipiens* var. *angustata* and only one threatened species - *Lepidium oligodontum* (Nationally Vulnerable) (De Lange et al., 2013).

The Antipodes invertebrate fauna are also special. Marris (2000) found a total of 150 insects from twelve orders and recorded twenty arachnids. Of the insect species 17% are thought to be endemic (Taylor 2006). A high percentage of species that are found around, or are restricted to, the colonies of nesting seabirds. The guano enriched soil supports host plants, and feathers and detritus provide food and habitat for insects around which (particularly penguin colonies) there should be a vast number of insects to feed the land birds: primarily pipit and snipe but to a lesser extent parakeets. However, this has changed with the arrival of the mice.

Comparative studies between Antipodes Island and mouse-free Bollons and Archway Island show that mice have had a major impact on the abundance, distribution and faunal composition of invertebrates on Antipodes Island. Mice are thought to be responsible for the general absence of large beetle species on Antipodes Island and the local extinction of two species [a weta *Loxomerus* n. sp. and *Tormissus guanicola*] (Marris, 2000; Russell, 2012). The weevil *Gromilus insularis antipodarum* is virtually absent below 100 m altitude though common from about 250 m upward to the tops where mouse densities are lower (Marris, 2000). The large ground-dwelling insects e.g. *Pseudhelops liberalis clandestinus* and *Oopterus clivinoides* have very limited distributions and extremely low numbers due to predation by mice. *Pseudhelops antipodensis* has only been found on a single rock outcrop.

2.4 History

The Antipodes have a rich social history for such a remote and inhospitable place. The islands were discovered in 1800 by Captain Waterhouse of the H.M.S Reliance and originally named the “Penantipodes” for their proximity to the opposite position on the globe to London. Sealers first arrived in 1805 and 86 sealers harvested an estimated 60,000 seals in the first year. By 1880, over 330,000 seal skins had reached port from the Antipodes, the majority harvested by 1810. There is no record of pre-European visitors to the Antipodes Islands but Maori were possibly involved in sealing activities. Concern for sailors in the Subantarctic region led to a Castaway depot being built on Antipodes Island in March 1886, serviced mostly annually until 1927. Livestock were regularly released until 1904 to support Castaways. In 1888 Andreas

Reischek became the first scientist to visit the island and the endemic Reischek's parakeet was subsequently named for him. A pastoral lease was held by Mr W Dunwoodie for 21 years from 1895 but he never took stock to the island. A biodiversity hut was built in 1978 by the Lands and Survey Department supported by the Royal New Zealand Navy (RNZN).

Figure 3: Leather boot supplies from Antipodes Island (left) and Castaway Depot at the right

On 4th September 1893, the barque *Spirit of the Dawn* wrecked on the south coast of Antipodes Island. Five lives were lost but 11 survivors were rescued by Captain Fairchild of the Hinemoa after 88 days on Antipodes Island, during which time they didn't find the Castaway Depot. On 13th of March a second wreck occurred with *Président Félix Faure* wrecking near Bollons Island. All 27-crew made it to Antipodes Island where they sustained for 60 days at the Castaway Depot before rescue. They killed the last of the remaining livestock. In 1999 experienced Subantarctic yachtsmen Gerry Clark and Roger Sale perished when the yacht *Totorore* was presumed to have wrecked at South Bay. Gerry Clark supported many science expeditions to the Antipodes previously.

2.5 Invasive species

Mice were first recorded on Antipodes Island at the Castaway Depot in 1907 by Captain Bollons. Genetic studies revealed the mice have a Spanish haplotype not found elsewhere in New Zealand (Searle et al, 2009) so it is unlikely that mice arrived with supplies from the New Zealand mainland. It is more probable that mice arrived with sealers or from the wreck of the *Spirit of the Dawn* in 1893.

Several other exotic mammals have been purposefully introduced to the site but none remain (see Table 1 below). Miraculously rats never established despite at least two known close calls. On one occasion, sealers refused to load their harvest onto a vessel due an infestation of rats, which would have devalued the skins. In 1912 Captain Robert Scott's *Terra Nova* (supporting Scott's Antarctic expedition in 1912-13) was reportedly overrun with rats but thankfully unable to land due to the weather (Taylor, 2006).

Table 1: Introduced mammals on Antipodes Island

Species	Year introduced	Year eradicated
Goats	3 in 1887; additional animals in 1904	Died out by 1908

Sheep	7 in 1887; additional animals in 1904	Died out by 1908
Cattle	3 in 1889; 3 in 1903	Last cattle beast killed by castaways in 1908
Mice	Sometime before 1907 (Taylor, 2006), reported as numerous in the Castaway Depot by Captain Bollons in 1907	Eradication attempt made in 2016

Eucalyptus, fir and wattle trees were planted along with scotch broom in 1887 but none established. Invasive weeds *Poa annua*, *Sonchus aper* and *Stelerria media* were already present by 1890 and are still present but controlled. Sow thistle (*Sonchus oleraceus*) is also present. Other than *Poa annua* (which is sparse but extensively distributed) the distribution of weeds is limited. Minor incursions of weeds eradicated to date include Yorkshire fog (*Holcus lanatus*), Native pennywort (*Hydrocotyle heteromeria*) and wild turnip (*Brassica rapa*) (DOC, 2016a)

2.6 Conservation management

The Antipodes Islands are recognised nationally and internationally for their ecological significance. Declared a Flora and Fauna Reserve in 1961 and a Nature Reserve in 1978, the Antipodes were listed as a World Heritage site in 1998 as part of the New Zealand Subantarctic region. World Heritage status was given under criterion iv) for outstanding universal value, particularly in regard to endemic albatrosses, cormorants, land birds and megaherbs; and criterion (ii) "the islands display a pattern of immigration of species, diversification and emergent endemism". A marine reserve (Moutere Mahue) established in 2014, extends 12 nautical miles in all directions and is included in the World Heritage area reflecting the integral relationship between land and sea for the islands' ecosystems.

The Antipodes are administered by DOC from the Murihiku Office in Invercargill. DOC's ecosystem optimisation ranked the Antipodes Ecological Management Unit (EMU) at number twenty-four of over 900 sites in 2014. The intent for each EMU is to achieve high ecological integrity. Seven species, currently streamed for management as part of the Antipodes Management Unit, relate to pressures imparted by mice for which the action listed is eradication (DOC, 2015).

Landing on Antipodes Island is by permit only and visitation is infrequent due to the cost. Strict biosecurity standards are in place to protect the site. The topography restricts landing by boat to a few exposed sites to the north of Antipodes Island. The island is generally visited once per year by albatross scientists who also undertake weed surveillance and other monitoring activities. Monitoring of penguin colonies occurs infrequently (approximately every 5 years). Up to three tourist ships visit most years and conduct zodiac tours but are not permitted to land. No previous attempt has been made to eradicate mice from Antipodes Island. Only small-scale mouse control has occurred over the years limited to the biodiversity hut and Castaway depot when expeditioners have been present.

3. Project Objectives

3.1 Goal

The goal of the Project is the eradication of mice from the Antipodes Island group.

The project had been a goal for the past two decades but was largely awaiting resourcing for the last five years (McClelland, 2012). It was the next obvious step towards the longer-term goal of a pest-free New Zealand Subantarctic region. The Conservation Management Strategy (CMS) Subantarctic Islands 1998-2008 was the operative plan at the time of the project's inception and the outcome stated for the site was "The Antipodes are free of mice, enabling ecosystems to recover to a near pristine state". The goal aligns with the vision for the region in the current Southland Murihiku CMS 2016: "Nature dominates every corner of the Subantarctic Ngā Moutere O Murihiku Ki Tonga Place. Its wild and largely unmodified environment is consistent with its status as a National Nature Reserve and a World Heritage Area. The islands within this Place support thriving indigenous ecosystems that are free of pest mammals and wild animals, and are havens for an abundance of endemic species".

3.2 Outcomes

The project objectives and the anticipated outcomes from achieving those objectives are listed in Table 2 below:

Table 2: Project objectives, outcomes and indicators

Objective 1: Successful completion of baiting operation to eradicate mice from the Antipodes Island Group.	
Outcome	**Indicator**
1.1 Mice are eradicated from the Antipodes Islands.	No sign of mice two breeding seasons after baiting
Objective 2: Natural ecosystems recover and are protected against further impacts; conservation value of the island group is enhanced; species recover.	
2.1 Short-term adverse effects of the baiting operation are broadly understood	Distance sampling of pipits and parakeets shows a decrease in abundance following baiting if species impacted.
	Mark-recapture study of pipits shows a decline in pipit counts immediately after baiting if impacted
	Encounter rates of snipe decline if impacted
	Birds seen feeding on bait; carcasses of non-target species are found and dissected confirming bait uptake if species impacted
2.2 With time the invertebrate populations on Antipodes Island reflect the diversity and abundance referenced on mouse-free Bollons Island	Pitfall traps and leaf litter sampling show invertebrate species increase in abundance; taxa thought to have been wiped out are detected
	Monitoring with light traps shows that invertebrate species increased in abundance

2.3 Plant species and communities are healthy and functioning and dispersal returns to natural pattern.	Potentially sensitive indicator species increase in abundance and distribution at measured sites; invertebrates previously absent pollinate flowers
2.4 The populations of parakeets, pipits and snipe benefit from the eradication of mice	Monitoring shows abundance of parakeets, pipits and snipe have increased from pre-eradication levels
Objective 3. Biosecurity is managed during the operation to prevent the introduction or distribution of pest species within the island group.	
3.1 Mouse-free status of un-baited offshore islands is maintained.	Sign searching on Bollons Island shows no sign of mice two summers after eradication
3.2 Weed species, diseases, pathogens, foreign invertebrate species and mammalian pest species do not establish because of the operation.	Weed surveillance finds no new weed species have established
	Invertebrate sampling finds no new exotic species have established
	Sign searching two summers after eradication attempt finds no sign of mammalian pest species
Objective 4. Improved understanding and knowledge of techniques for eradication of mice.	
4.1 Increased capability in DOC's Southern region and DOC in general to manage mammalian pest eradications.	DOC staff nationally and in DOC's southern region contribute to and learn from involvement in the project
4.2 A robust record of the eradication project.	Project documents are completed and available for reference including Project Report
4.3 Lessons will contribute to the knowledge base particularly for eradications involving mice.	Lessons from the project are captured in project documentation and disseminated to relevant audiences
Objective 5. The sense of value for the Subantarctic region is developed and the project is showcased as a successful collaboration.	
5.1 Key stakeholders and the community are provided with sufficient information and feel engaged with the project.	Feedback from stakeholders and the public is generally positive
5.2 Recognition of New Zealand's Subantarctic region and public knowledge and appreciation for special wilderness value and natural heritage of the Antipodes Islands is improved.	Measurements of interactions with the project's media channels indicate the public were engaged

4. Preparation Phase

The preparing phase investigated feasibility and devised the methods for managing and undertaking the project. This phase was divided into 2 major components:

- Feasibility study
- Project Design

4.1 Feasibility study

A feasibility study is normally a primary step to understand the scale and complexity of a project and inform a decision on whether to commit resources to further planning. For the Antipodes project a partnership opportunity arose before a feasibility study had been undertaken. In March 2012 DOC agreed publicly to collaborate with the Morgan Foundation to raise funds and initiate the project. After this decision, a feasibility study for the project DOCDM-951558 was conducted by Pete McClelland in May 2012 measuring the project against the five principals of eradication (Parkes 1990, Bomford & O'Brian 1995). The study considered the ecological, logistical, economic and social constraints, identifying risks and knowledge gaps. The investigations drew on knowledge from previous research at the site, knowledge of the target species and relevant examples of previous rodent eradication operations particularly those involving mice.

Eradication is the appropriate option when all five principles can be met:

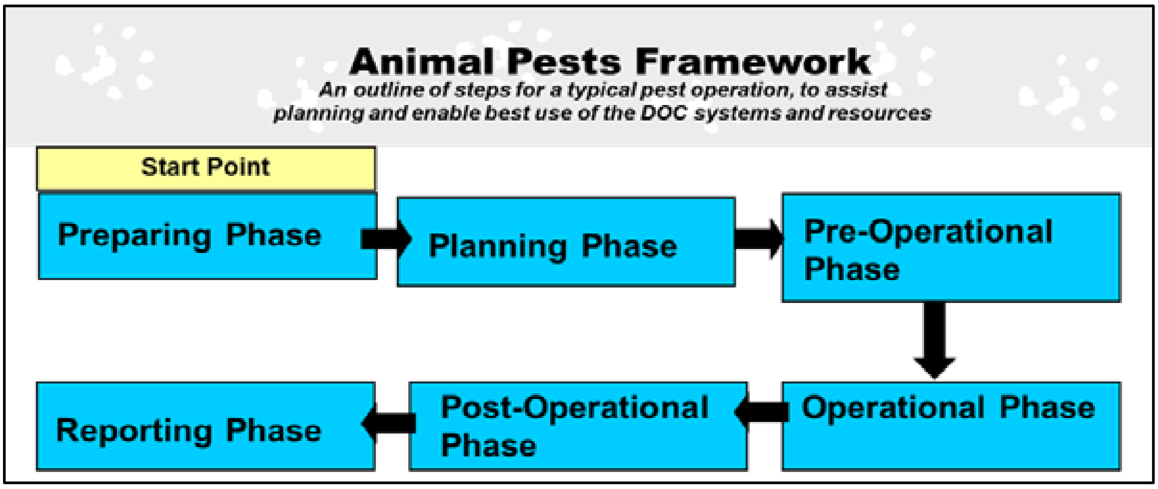
1. All individuals can be put at risk by the eradication technique(s).
2. They can be killed at a rate exceeding their rate of increase at all densities.
3. The probability of the pest re-establishing is manageable to near zero.
4. The project is socially acceptable to the community involved.
5. The benefits of the project outweigh the costs.

In answering the question "can it be done?" a commitment to the project had already been made to an external partner so unless an insurmountable issue was identified, the purpose of the study was to identify the issues that needed to be dealt with in the planning and operational phases (McClelland, 2012). The study recommended winter trials on mice and non-target species be conducted on site. Despite the significant logistical challenges identified, the study found that the key dependencies for eradication success could be met provided the project is sufficiently well resourced. The study concluded that the project was both feasible and worthwhile (McClelland, 2012).

4.2 Project Design

Thorough planning is paramount for a successful eradication project. The project design phase included the development of a 'Project Plan' as the overarching document for management of the project. The Project Plan DOCDM-1423615 was initially drafted in 2014, identifying the project's scope, the associated objectives and anticipated outcomes. It outlined the structures and processes by which the project was managed and measured, and gave a summary of the timeframe and required budget. The planning was based on DOC's animal pest framework comprising six sequential phases (see Figure 4 below). At the project's inception in 2012 an implementation date of winter 2014 was projected but there was a delay in appointing a full time Project Manager until 2014, largely due to a major restructure of the Department in 2012 and 2013. Implementation was tentatively planned for 2015 at this stage. With the tight timeframe, the demands on a small team meant the project design got out of sync and occurred in parallel with preparation and planning activities rather than preceding them. The project plan went through many iterations including a revision to reflect further delay in implementation. The plan was finally approved in the second half of 2015 alongside a detailed business case (DBC) that allowed commitments to be made to stakeholders and planning to target implementation in winter 2016.

Figure 4: The six phases of DOC's Animal Pest Framework



Project design outlined the objectives for the project phases and identified the need for the development of a highly technical operational plan as well as a range of documents required to manage risks associated with:

- Project governance and reporting
- Communications and stakeholder consultation
- Consents and permissions
- Staff recruitment and training
- Funding

4.2.1 Governance and reporting

A review of the project by DOC’s Island Eradication Advisory Group (IEAG) in October 2015 identified that the governance written into the Project Plan was inactive and personnel involved over committed (Broome & Cox, 2015). A recommendation was made to revise the governance to include the responsible Tier 3 and Tier 4 managers (Director Operations Southern South Island and Operations Manager Murihiku respectively), and a technical expert representing the IEAG on a Steering Committee. Once established, Steering Committee meetings were timed to coincide with regular technical review by the IEAG and other critical steps in the project’s timeline. The Steering Committee provided support to resolve issues beyond the Project Manager’s control and added further efficiency by having the necessary people gathered for decisions to be made. The project plan was updated to reflect the new group, which met six times between November 2015 and implementation in May 2016. The Project Manager was the main source of information and provided updates during meetings. Monthly status reports were distributed to a wider audience from April 2014 until May 2016. These became bimonthly in the last six months of the planning phase after three reports were missed in 2015 due to higher priorities and lack of capacity.

4.2.2 Communication and stakeholder consultation

In 2014 a comprehensive communications plan[DOCDM-1478562] was written as part of DOC's protocol for animal pest planning to ensure stakeholders and interested parties were identified and sufficient information was available. The plan also tracked communications to ensure compliance with statutory and regulatory obligations relating to vertebrate toxin use.

The remote and isolated location of the island and its restricted access as a Nature Reserve meant iwi were the only potentially affected party. DOC engaged early and regularly with Ngāi Tahu as a treaty partner, through Kaitiaki Roopu, a group representing the four local Runanga. Kaitiaki Roopu delegated Te Ao Marama Inc (Invercargill) to consult with DOC regarding the application for resource consent to discharge a vertebrate toxin to the site. Dean Whaanga was the delegated representative of Te Ao Marama Inc. The Project Manager kept Te Ao Marama up to date with face to face meetings and email, particularly regarding risks to taonga and other non-target species. Te Ao Marama reviewed the application for resource consent prior to submission and signed a section 95E 'Affected Person's Approval form' in support of the project. A copy of the application for resource consent was sent to Te Ao Marama inc and Te Rununga o Ngāi Tahu.

A small number of cruise ship operators hold concessions to conduct zodiac tours around Antipodes Island during the summer from the 1st of November to the 31st of March, falling outside of the planned operational period (June – October). Concession holders were informed by letter of the intended operation. Only supportive feedback was received. The Southland Conservation Board is an independent statutory body overseeing DOC's delivery of conservation outcomes in relation to the CMS for the region. The board was consulted and informed of progress through the project's Tier 4 manager and the Director for Operations, Southern South Island (SSI). Permission for the operation was not required from the Medical Officer of Health (MOH). A record of stakeholder communications was submitted as part of the Assessment of Environmental Effects (AEE) in application for resource consent.

Partnerships played a significant role in the project. The Million Dollar Mouse (MDM) campaign to raise funds and publicise the project initially resulted in partnerships with three major funding partners: The Morgan Foundation, WWF-New Zealand and a large group of collective public donors. Later, a fourth partnership was established in 2015 with Island Conservation, (a non-government organisation based in the U.S.A). The partnership with The Morgan Foundation relied on an informal agreement and a relationship at both the DOC Senior Management and Project Manager level. The Morgan Foundation largely managed the relationship with WWF-New Zealand as a major donor to the MDM campaign and a formal agreement was made with Island Conservation[DOC-2641987]. In 2012, when the original project partners signed up to support the work, it was anticipated that the eradication would be carried out in 2014. The baiting was eventually completed in 2016. The Morgan Foundation, WWF-New Zealand and public donors showed faith by maintaining their commitment over this period. The hiatus since initiation led to a loss of traction for public engagement but the additional time was essential to finding solutions to challenging logistical issues and to achieve the planning standard required.

A Media Plan[DOCDM-1401486] was developed in collaboration with partners to set out objectives, manage expectations and coordinate interactions to achieve consistent messaging and engagement through partner's communication networks. A wide range of communication tools and content were developed for the project including fact sheets, newsletters, a detailed infographic and social media sites. The Morgan Foundation hosted a project website (www.milliondollarmouse.org.nz) in addition to background content on the DOC website, and provided technical support for its function. A MDM Facebook page was setup that complimented the website. DOC largely developed the website content that included contributions from several topical experts and provided background information and a blog updating progress and activities. Branding with the MDM logo was used effectively on t-shirts, stickers and operational equipment (helicopters, baiting buckets). Once the team was established on Antipodes Island, a satellite dish was erected providing broadband quality satellite internet that revolutionised the team's ability to engage an audience and communicate the operation in close to real time.

4.2.3 Consents and permissions

Resource Consent

Several permissions were required to allow the project to progress to the implementation phase. The use of a vertebrate toxin is a discretionary activity under Section 15 of the Resource Management Act (RMA). As there is no district plan covering the Antipodes, DOC is the delegated Territorial Authority. Under section 31A of the RMA, the Minister of Conservation is given the responsibilities, duties and powers for Antipodes Island that a regional council would have under section 30(1) (d) of the RMA. The Director Planning, Permission and Land for DOC was delegated by the Minister to act as the consenting authority. The coastal marine area is managed by the Department by way of the Proposed Regional Coastal Plan: Kermadec and Subantarctic Islands (May 2012).

In application for resource consent a comprehensive Assessment of Environment Effects (AEE) was required which outlined the likely effects the project would have on the environment both positive and negative. Care was taken during the statement of eradication method in the AEE to avoid self-imposed constraints that could risk the likelihood of success. The focus of the document was on the effects of aerial bait application. Consent was applied for this in relation to (i) discharge of a contaminant (bait) to the coastal marine area and (ii) discharge to land where it may enter freshwater. Significant effort was put into interrogating the likely effects on native non-target species so a suitable mitigation strategy could be applied.

To maintain objectivity, separate DOC lawyers were assigned to represent the applicant and the decision maker respectively and communications partitioned. The AEE concluded that the adverse effects were deemed to be minor and strongly outweighed by the ensuing benefits resulting from the removal of mice. The application was not publicly notified. A consent was issued by the Director in February 2016 with 18 conditions, see Appendix 3.

DOC Consent

A DOC consent DOC-2753104 to apply vertebrate toxin to land managed by DOC was issued by DOC's Director Operations SSI as delegated by the Environmental Protection Authority.

Other permissions

Several other permissions needed to be obtained for the planned operational activities.

- The Ministry of Transport (MoT) authorised the use of an internationally flagged vessel for transporting cargo (helicopters, bait and fuel). The authorisation included 8 special conditions from Maritime New Zealand (MNZ).

- A Coastal Permit was obtained for the cargo vessel to access the coastal marine area of the Antipodes (between 300 m and 1000 m of the shore) pursuant to the Proposed Regional Coastal Plan: Kermadec and Subantarctic Islands (May 2012)

- A site-certificate was issued for the secondary containment system used for temporary storage of fuels on Antipodes Island (Jet A-1, petrol, diesel and LPG). The permission was required under the Hazardouse substances and New Organisms (HSNO) Act 1996, and Hazardous Substances Regulations, 2001.

- Changes to regional rules in early 2016 meant that a building consent was required for a temporary helicopter hangar planned for use on Antipodes Island. An exemption was applied for and granted by the Southland District Council based on the temporary and non-habitable nature of the structure, an engineering report, and inspection by a council building inspector during a trial construction in Invercargill.

4.2.4 Staff recruitment and training

A Project Manager was employed in early 2014 to lead the Project. An Assistant Project Manager commenced 8 months later and a temporary part-time role was established to coordinate communications with project partners and set up and run the social media coverage. About 6 months before implementation a DOC ranger was seconded to a logistics role and 3 months from departure a temporary staff member filled an additional that covered administration work and preparation for operational monitoring. DOC's risk manager programme (IMPAQ) was used to identify skills required and help plan training requirements. Multi-skilled team members were selected to provide flexibility and backup where practicable.

The operational team included 13 staff on the island for the duration of the operation plus an additional 6 DOC staff and contractors for the first two weeks to manage the construction of temporary infrastructure and assist pre-operational monitoring. Two of the infrastructure team returned after the completion of baiting to assist with demobilisation. The operational team included several experienced practitioners that added significant value and leadership capacity.

Figure 5: Helicopter underwater escape training in Christchurch; Photo: John Kirk-Anderson

Specific skills were needed to manage the risks involved with the planned helicopter use in this remote location. Personnel expected to fly over water in a helicopter carrying an external load (bait observers and pilots) undertook 'Helicopter Underwater Escape Training' (HUET). An interaction trial with the ship and helicopters allowed the team to practice loading a helicopter into the ship's hold and the pilots to practice landing on the ship's deck. A senior rescue doctor was included in the team as were staff experienced with managing helicopter external loads, dinghy operators for passenger transfer or rescue response, and expertise in maintenance of bait spreading buckets. A helicopter engineer was part of the contracted helicopter team on the island. To establish internet communications the team's GIS technician undertook tuition for the installation of the satellite dish and the system connection. Several of the team were trained in "working at heights" to assist with infrastructure construction including the use of mobile scaffolding. Generic training activities for the operational team included fire extinguisher use, safe lifting techniques ('First Movements' training) and helicopter safety.

4.2.5 Funding

The project was initiated during Gareth Morgan's Our Far South Journey that visited the New Zealand Subantarctic region in early 2012. With enthusiasm from the group to do something of value in the region the 'Million Dollar Mouse' project was born. The partnership with the Morgan Foundation was critical in getting the project off the ground. The Morgan Foundation and DOC achieved significant publicity and success with a fundraising campaign fronted by Gareth Morgan and backed by a pledge from Gareth and Jo Morgan to match donations received. DOC offices locally and nationally supported two auction events in 2012 by developing and delivering over 30 'DOC experiences' for public auction on Trade Me.

Public portrayal of the project in 2012 led to the understanding that the cost would be $1 million. However, a budget estimate in early 2013 was at least $1.5 million excluding planning costs or contingency and before suppliers had been identified. It was estimated that a further $880,000 would be needed if the Navy could not provide the shipping support as anticipated (DOC, 2013). As operational planning developed it became clear that shipping services would need to be contracted privately. Helicopter operators could not fly the 760 km to Antipodes Island and the Navy were not able to transport the fuel and civilian helicopters. Shipping and helicopters were the key resources that would largely determine the final cost.

In winter 2013 an expedition deployed to the Antipodes to undertake bait uptake trials and establish baseline monitoring. National Geographic sponsored Dr James Russell from the University of Auckland, supporting the work by funding most of the transport cost.

Near the completion of the planning phase DOC approved a business case to proceed with the remainder of the project (pre-operational, operational, post-operational and reporting phases). A budget of $3.97 million dollars (inclusive of 10% contingency) was approved for the period 1st of July 2015 to completion in 2018. The actual cost for this period will be approximately $3.27 million dollars of which over $800,000 came from partners and donors. External funds were used for part payment of the bait and operational activities only. The total cost of the project since fulltime planning began in 2014 through to completion will be approximately $3.51 million. The project's funding is described in Table 5 below.

Table 4: Annual spending for the Antipodes Island Mouse Eradication Project between 2013 to 2018

Year	Spending	Cumulative	Project Phase
2013/2014	$61,259	$61,259	Planning
2014/2015	$180,667	$241,926	Planning
2015/2016	$2,353,560	$2,595,486	Planning/Operational
2016/2017	$828,987	$3,428,474	Operational/Post-operational
2017/2018	$140,000	$3,568,474	Post-operational
Total	$3,568,474		

Table 5: Source of funding for the Antipodes Island Mouse Eradication Project

Group	Funds contributed
DOC	$2,718,224*
Public Donors	$202,886.82
WWF-New Zealand	$100,000
Gareth and Jo Morgan and the Morgan Foundation	$397,363.18
Island Conservation	$100,000
National Geographic (support of winter research trip 2013)	$50,000
Estimated total at completion in 2018	$3,568,474*

*Includes $140,000 for monitoring and reporting work scheduled for February 2018.

In addition to providing funds, project partners also provided value through in-kind support. Island Conservation paid $100,000 towards the purchase of bait but also covered costs for two of their staff to work on the eradication team during the operation on Antipodes Island. Significant in-kind support was also received from the Morgan Foundation in running the MDM campaign, championing the project, hosting the project website and contributing to communications content and promotions. DOC advisors and shared services have also contributed a huge amount of in-kind support since inception.

4.2.6 Technical input and peer review

Planning included technical support from a range of DOC expertise including Science and Policy, Legal, Media and Planning teams, Geospatial information specialists, Health and Safety leaders and operational experts. Technical support included input into planning and peer review to ensure quality and provide confidence that nothing had been missed. DOC is a recognised world leader in island eradications and its Island Eradication Advisory Group (IEAG) has provided a key supporting role on significant projects internationally and in almost every pest eradication project undertaken by the Department since 1998. The IEAG has facilitated transfer of lessons from previous eradication projects (Cromarty et al 2002; Broome et al 2011). The IEAG helped with peer review of key documentation, problem solving advice and project auditing throughout the project design, planning and post-operational phases. The group was also available to advise during the operational phase.

At the request of the responsible T4 manager, a review of the Antipodes project was undertaken by the IEAG in late 2015 that identified key areas where management could make changes to support the project. These changes proved critical in achieving readiness in 2016. A “readiness check” was conducted by the IEAG in early May 2016 to assess preparedness for implementation. This step is a key function of the group in the pre-operational phase, providing assurance that all planning, permissions and equipment needs are in place and risks and issues beyond the Project Manager’s control have been identified.

A specific non-target species advisory group was established that included DOC and external scientists. After initial review the only species considered at risk were the four-endemic land-bird taxa (parakeets, pipits and snipe). The group consulted widely with experts and advised on the recommend strategy to manage these risks, which was presented to the Director Operations Southern South Island for a decision prior to application for Resource Consent.

5. Planning Phase

The feasibility study noted it was imperative that operational best practice was not compromised for funding reasons. A detailed operational plan DOC-1511762 was developed over 2015 and early 2016 that built on the findings from the feasibility study. The operational plan went through six major iterations as logistical challenges evolved and advice and solutions were presented. The document was peer reviewed twice by the IEAG and a final version was accepted in May 2016. The final version (V6.4) incorporated learnings from a ship and helicopter interaction trial and calibration data for the bait spreading buckets. Care was taken to align the plan and the AEE to avoid a conflict with the consent conditions.

Key challenges of operational planning were:

1. Eradication design to maximise the chance of success
2. Infrastructure to house and protect people, equipment and supplies.
3. Procurement of shipping and helicopter services
4. Navy support
5. Timing of the implementation phase

5.1 Eradication design

Eradication design was based on established "Best practice for rat eradication using aerial bait spread" (Broome et al, 2014) with a few modifications for mice as no best practice document for mice existed at the time. Development of the baiting prescription drew on lessons from previous operations, including significant recent successful eradications of mice (in combination with other pest species), on Rangitoto-Motutapu (2300 ha), Coal Island (1160 ha) and Macquarie Island (12,800 ha). Winter timing was critical as the mouse population is smallest and mice are most vulnerable to bait due to food scarcity. Non-target impacts are also minimised in winter as most species are not breeding and seabird species are generally absent from the islands, residing at sea.

Much of the Antipodes is inaccessible due to its steep topography, rugged coastline and deep coastal vegetation. The only feasible method to put all individual mice at risk was aerial bait spread combined with bait stations and hand spreading in and around infrastructure. Due to the difficult terrain and inability to detect mice at low density, it is not practicable to conduct follow up monitoring to identify and target any survivors. The eradication was therefore designed as a one-off attempt.

Trials on Antipodes Island in winter 2013 found 100% exposure of mice to non-toxic cereal baits sown at 16 kg/ha in a 6 ha trial area. Approximately 5% of mice sampled in the winter retained reproductive condition. Though no breeding was detected in the sampling, the possibility of breeding during the eradication could not be discounted (Elliott et al, 2015). The effects of brodifacoum on mouse nestlings through lactation are not well understood. The Feasibility Study concluded that if any winter breeding was suspected then bait must be made available to mice for a minimum period of three weeks to ensure that juveniles emerging from the nest are exposed (McClelland, 2012). The interval between treatments is a balance between optimising the duration of bait availability and managing the risk of failing to apply all the bait in the typically inclement weather. A preferred minimum interval of 14 days was planned.

The application rates prescribed for mice on Antipodes were higher than is usual for rats in temperate areas. The prescription was designed to ensure bait availability in every mouse home range and minimise the risk of gaps. Technical design also considered the risk of weather affecting bait spread. The agreed prescription was for two separate treatments, the first at 16kg/ha and a second treatment at 8kg/ha, with a preferred minimum interval of 14 days between. The plan included 50% overlap of baiting swaths and additional applications around the coastline, steep slopes, cliffs and other high-risk areas during each treatment. In case of an interruption greater than 3 days during a treatment, the last two swaths at the baiting front would be reapplied with 50% overlap. The last four swaths would be reapplied for interruptions greater than 8 days.

The objective was eradication of mice from the island group. The presence of mice on six offshore islands was unknown but unlikely. The offshore islands within the Antipodes group were included in the treatment area except for Bollons Island (52.6 ha) and Archway Island (6.2 ha), 1.5 km north of Antipodes Island. Previous studies comparing invertebrates and limited searching for mice sign on Bollons and Archway Islands gave sufficient confidence of mouse absence to exclude them from treatment. This provided a minimum of 58.8 ha of offshore island habitat that wouldn't be baited, acting as a natural reservoir for endemic landbird taxa in case adverse effects from baiting on Antipodes Island were worse than expected. Leeward Island and Orde Lees Island were included for treatment due to their proximity to Antipodes Island (less than 100 m offshore). East Windward (8.5 ha) and West Windward (7.0 ha) were also included despite being over 800 m offshore as it was unknown when mice arrived on Antipodes and if they could have been previously spread by sealers or other means to the offshore islands. The intention was to monitor for mice on the Windward Islands prior to the operation if practicable and exclude them from treatment if satisfied mice were absent before baiting was complete.

5.2 Infrastructure

5.2.1 Accommodation

The only permanent structures on Antipodes Island are a 6-bunk biodiversity hut built in in 1978 and a small historic Castaway Depot built in 1876. Significant infrastructure is required to sustain an eradication team of 13 people and associated equipment at a remote Subantarctic site. The development and establishment of infrastructure was a major component of the planning and operational phases. Additional structures were designed to be temporary to minimise impacts and inputs. An archaeological survey has never been completed at Antipodes Island but significant historic sites are known, including the Castaway Depot area where the team would be accommodated. Heritage New Zealand were consulted regarding planned works. Established protocols were incorporated in planning to manage the accidental discovery of historic sites during the operation. In January 2014, two visiting albatross scientists discovered extensive vegetation slips had effected 300 ha of Antipodes Island (15% of its area). The biodiversity hut was badly damaged by a slip that tore it from its piles, repositioning it 20 m downhill. During a planned retrieval of the scientists 5 weeks later, the Navy and a DOC contractor assisted with salvaging the hut. Later in 2014, two expeditions were needed to affect repairs. The hut was completely re-piled as part of this work and the opportunity was taken to improve its function for the impending eradication. Improvements included additional water storage, a diesel stove, hot water system, a shower, and a covered verandah for managing wet gear. Repairs were paid for by DOC capital funds

Figure 6: Extent of vegetation slips on Antipodes Island, 2014

with transport for the second voyage piggy backing on DOC's pre-planned penguin monitoring trip to the Antipodes in October/November 2014.

Up to 19 people were accommodated on Antipodes Island during the setup and demobilisation

Figure 7: Antipodes Island Hut and Castaway Depot January, 2013

Figure 8: Antipodes Island Hut and Castaway Depot, January 2014

phases and 13 people for the duration of the eradication. Accommodation in the biodiversity hut (6 bunks) was supplemented with the Castaway Depot (2 people), an additional personnel shelter (2 people) and up to 9 personal tents.

5.2.2 Helicopter protection

During helicopter procurement, it became clear that suppliers were reluctant to expose their machines to the elements for an unknown period in the salt-laden winds of the Subantarctic environment. A temporary hangar and associated helipad was added to the planned infrastructure to house and protect helicopters and provide an effective workspace for the engineer to carryout maintenance.

5.3 Procurement

Procurement of resources for the operation was a demanding and time-consuming part of the planning phase. Key supply contracts were developed for helicopter and shipping services, bait supply, fuel, bait pods, infrastructure, food supplies and storage for bait and equipment prior to deployment from Timaru.

Government processes for procurement were followed as required and relatively simple government model contracts worked well for most services. A two-stage open competitive process was used for larger contracts (shipping and helicopters) and was found to be unsuitable for the specialised nature of the services. The complexity of the situation required a cooperative process. The demanding parameters of the operation and rigors of the process meant the pool of potential suppliers was very small and non-existent for a time. In this situation, it was necessary to engage and establish trust, working with potential suppliers over an extended period to develop a realistic understanding of what it would take to do the job.

5.3.1 Bait pod supply

Alpine Joinery of Timaru were chosen to supply 94 pods for transport and storage of bait and exceeded all expectations in their support of the project. A further 20 pods were manufactured for secure transport and storage of supplies and equipment. A selective process was used with a Request for Quote sent to five potential suppliers following site visits to canvas interest in

Invercargill, Dunedin and Timaru. Responses were received from three suppliers and two were invited to supply prototypes for assessment. It would have been beneficial to have requested prototypes from three suppliers given the poor example provided by one supplier.

5.3.2 Bait supply

Bait supply was exempted from open competition and direct sourced from Animal Control Products (ACP now trading as Orillion) based in Whanganui as they are the only supplier in New Zealand and have a proven track record. Transport of bait to Timaru was included in the contract and subcontracted by ACP.

5.3.3 Aerial services

No helicopter suppliers were secured from a two-stage open competitive process that began with a 'Request for Information' (RFI) and suppliers meeting, followed by a 'Request for Proposal' (RFP) later in 2014. Tender documents were posted on Government Electronic Tenders Service (GETS) and sent to those who had registered interest through the RFI. Two responses were received for helicopter services from the RFP and site visits were carried out. One of the suppliers went into receivership soon after the site visit and the second withdrew during negotiations due to the tight timeframe and the risks involved. An exemption from procurement rules was later granted that allowed the direct sourcing of services because of the lack of results from the competitive process.

Peter Garden, a highly-experienced eradication pilot, well known in the helicopter industry, was subsequently engaged as a consultant to help progress operational planning until a helicopter supplier was contracted. This was vital in gaining support and establishing trust with potential suppliers as the logistics and risks of the operation were a deterrent. After engaging nationally with potential suppliers, Peter established a specialist company 'Island Aerially Solutions Limited' (IASL), which was contracted in early 2016 to deliver the helicopter services. A closed tender was offered to three companies for the supply of helicopters and pilots. Amuri Helicopters was selected to supply two helicopters and two pilots and Southern Lakes Helicopters supplied one helicopter under subcontract to IASL. IASL also subcontracted a helicopter engineer for the operation.

5.3.4 Shipping

Procurement of a supply ship to transport the project's cargo (3 x helicopters, 65 tonnes of bait in 94 bait pods, 30 tonne of fuel and 20 tonne of sundry supplies and equipment) was the crux of the project. Not only did the ship need to be able to carry the cargo, it needed to be available for a period of 2 – 4 weeks in early winter and for a similar period at an unknown time approximately 3 to 4 months later when baiting was complete. As there is no harbour at Antipodes Island, the unloading and loading of cargo by helicopter relied on 3 to 4 days of calm seas and winds, deep in the Southern Ocean.

Two responses were received from a two-stage open competitive process in 2014. Both suppliers were visited but neither option was suitable. An exemption to direct source was granted in August 2015 along with the exemption to direct source helicopter services.

The Southern Tiare, a New Zealand based vessel, was investigated in 2015 that was eventually determined to be unsuitable. The vessel was internationally flagged but operating under demise charter to a New Zealand company meaning it was free to solicit New Zealand service contracts. The decision not to use the vessel was based on several factors:

- The condition of the ship with its 5-year survey pending
- The potential for that survey to clash with operational timeframes
- The tight margins for stowing 3 helicopters in the cargo hold
- Concerns about financial stability
- Capacity of the company as the CEO was incapacitated during negotiations due to sudden illness.

It took over 18 months of process and investigations, including two site visits, before a Tongan-flagged vessel called the Norfolk Guardian, was finally identified and contracted for service through Quadrant Shipping in 2016. As an internationally-flagged vessel, authority for use was required from the Ministry of Transport (MoT) pursuant to section 198(2) of the Maritime Transport Act 1994. Authority could only be given if no “New Zealand ship” was available so issuing the authority hinged on the ‘availability’ of the Southern Tiare. Information was submitted regarding the project team’s assessment of the Southern Tiare on the 21st of December 2015. The authority was issued on the 4th of February, following delays due to the Christmas shutdown and the slow provision of information to the MoT from the Southern Tiare operators.

The issued authority required satisfaction of eight special Maritime New Zealand (MNZ) conditions. A meeting was held on the 17th of February 2016 between the Project Manager and the Chief Technical Officer for MNZ to discuss the conditions the operational risks and planned mitigations. The conditions included the requirement for a Port State control inspection immediately prior to departure to confirm compliance.

Authorisation was also sought for use of a large Italian-flagged vessel, the M.V. Italica, as a contingency option until interaction trials could prove the function of the Norfolk Guardian. This authority was granted on the 24th of February 2016. The Italica was to be stationed in Dunedin over winter 2016 and had a helicopter deck, was much larger and more expensive. This vessel wasn’t without its own logistical challenges, for example the crew would have returned to Italy by the time the team needed to be retrieved from Antipodes Island. Biosecurity was also a major issue as the ship’s antifoul was due for renewal due to wear and tear from working in the ice at Antarctica. Drydocking for this purpose was not scheduled until October 2016 and flexibility to bring that forward was limited. The M.V. Italica’s owner withdrew availability as a ‘contingency’ option in March 2016.

The yacht Evohe (12 passenger berths) was chartered for passenger transport during the delivery and pickup legs as the cargo ship was originally authorised to carry only 4 passengers and had no tender suitable for passenger transfer. The Evohe remained on site during operations to unload and load the cargo ship, providing passenger transfer and marine rescue capability. The yachts Tiama and Evohe both provided critical support in the years preceding the operational phase, supporting winter trials, baseline monitoring and infrastructure repairs.

5.4 Navy Support

At the initiation of the project it was anticipated that the Royal New Zealand Navy (RNZN) would provide the shipping services. The only vessel in the Navy fleet with the required storage capacity and helicopter support is the HMNZS Canterbury. The RNZN provide valuable support to DOC for ongoing work in remote areas such as the Subantarctic and Kermadec regions but for procedural reasons they are restricted from transporting civilian helicopters or allowing them to land onboard. Navy procedures also constrain the transport of helicopter fuel. The Navy use and transport AVCAT Military Grade JP5 fuel is transported onboard for use in military helicopters. AVCAT has a flashpoint >64°C and is transported in the ship's internal tanks. Navy protocol requires that fuel below this flashpoint be stored in a way that it can be jettisoned with a single action. The 30 tonnes of Jet-A1 in 210 litre drums for the Antipodes operation would not comply and the contracted civilian helicopter operators were not prepared to run their machines on AVCAT.

Despite these limitations, scheduling remained the key constraint. The RNZN's priorities remain national defence and disaster relief and the HMNZS Canterbury is the most versatile vessel in the New Zealand Navy's fleet. The Navy do not have the flexibility in its schedule to ensure availability considering the uncertainties relating to poor weather and the lack of a harbour at the Antipodes. Winter timing is critical for eradication success and any delay in delivery may have risked completion compromising the opportunity for success. Additionally, there was the problem of an unknown date for retrieval of the team, anticipated sometime between 2 and 4 months after arrival.

Despite the constraints, the Navy were still keen to help. Support evolved into 'Operation Endurance' with HMNZS Canterbury and two Seasprite helicopters scheduled to help complete infrastructure preparations on Antipodes Island in March 2015. The purpose of the voyage was to prepare a site and install a helipad, enabling readiness for rapid construction of a temporary hangar when the operational team arrived the following winter. Early installation would have reduced the risk of bad weather delaying the unloading operation and helipad setup when the operation occurred. However, Operation Endurance was postponed in 2015 because Cyclone Pam devastated Vanuatu and the HMNZS Canterbury was re-tasked to respond. Operation Endurance was rescheduled for late February 2016 the following year (2016). This time Cyclone Winston caused havoc in Fiji two days before departure. Cargo for the eradication was already in transit on trucks to Lyttleton at the time the HMNZS Canterbury was again re-tasked with disaster relief. Operation Endurance was at first postponed and eventually cancelled in March 2016 when it became clear HMNZS Canterbury would be engaged for two to three months in the Pacific. Infrastructure setup was unavoidably delayed and reassigned to the project team at the commencement of the operational phase.

5.5 Implementation timing

The inability to secure ship and helicopter suppliers by late 2014 led to the decision to delay implementation, tentatively planned for winter 2015, until winter 2016. After a further year of planning, a decision was made on the 30th of March 2016 to proceed following successful helicopter and ship interaction trials, allowing supply contracts to be finalised with Quadrant Shipping (Norfolk Guardian) and IASL (helicopter services) for implementation in 2016.

To manage the effect of the cancellation of the Navy's support for establishing infrastructure, a contingency plan was actioned with infrastructure setup to occur at the start of the operational phase. The departure schedule for the Evohe and the Norfolk Guardian were respectively brought forward by 1 week to the 23rd and 25th of May 2016. This was to allow more time for unloading and set up with the aim to be ready for baiting by the 15th of June 2016 unchanged. An additional 6 builders/digger drivers would join the team for the first two weeks before returning with the Evohe upon completion of infrastructure setup. Tongan Flag State approved an application for passenger berths on the Norfolk Guardian to be increased to 7 persons with conversion of office space to temporary cabins.

The duration of the eradication operation on the island was dependent on weather but estimated to take 90 days with the expected conditions. The budget allowed for an operational period of up to 120 days, port to port. Retrieval of the team could not be scheduled until the timeframe could be better defined as baiting neared completion. One of the challenges of this uncertainty was that the Norfolk Guardian operated on a monthly schedule in the Pacific, which could have seen a delay of up to 4 weeks between a request for pickup and arrival of the ship at Antipodes Island, depending on their location at the time. It was not practicable or affordable to pay the ship and yacht standby fees to be available for immediate retrieval of the team because the potential variation in the timeframe for completing baiting was more than 60 days. Communication was maintained with suppliers to optimise the turnaround time once a pickup date was set. Contingency options were identified for the passenger yacht in case the supplier was otherwise engaged

5.5.1 Readiness check

A readiness check[DOC-2774119] was carried out at DOC in Invercargill on May the 5th, 2016 by Keith Broome, Andy Cox and Kerry Brown of the IEAG. The panel met with project team members: Stephen Horn (Project Manager), Keith Hawkins (Assistant Project Manager), Keith Springer (Technical Advisor), Finlay Cox (Logistics Manager) and Sharon Trainor (Biosecurity Ranger). The DOC Operations Manager for the Murihiku Office, Tony Preston was also briefed by the group. Key operational planning documents, contracts, and permissions were reviewed and cross checked to ensure everything was in place and appropriate actions were being taken to manage risks. A compliance checklist was reviewed in accordance with step 7 of DOC's Animal Pest Planning SOP[DOCDM-1488532].

The group highlighted lessons from previous eradications in discussion of various risks and baiting strategies, adding to the preparedness of the project. No critical issues were identified that were not being managed. Key issues at the time included the requirement for further calibration trials for bait buckets, the need to identify and track cargo to ensure nothing was 'lost in transit' while loading or unloading the ship, early development of team culture and support for the Project Manager in the remaining three weeks leading up to departure. The group highlighted the task of turning the paper planning into real action – particularly in regard to safety. Off-island support is vital and a steer was given that it needs to be provided in a way that avoided interference. The report recommended proceeding to Implementation and concluded:

"Like all eradications of this type, many hundreds of things have to go right for it to succeed and only one thing going wrong can cause failure. However, we have found the planning to be comprehensive and high quality. We see no reason why the project should not proceed to implementation. Most of what we found were opportunities to further manage risks and make the project more resilient to things not going strictly to plan".

6. Pre-operational phase

The Pre-operational phase was undertaken in distinct stages.

- Pre-operational monitoring
- Pre-operational trials
- Preparation

6.1 Pre-operational monitoring

Studies comparing invertebrates on mouse-free Bollons and Archway Islands with those on mouse infested Antipodes Island were conducted by Marris and McIntosh in 1995 and Russell in 2011. Russell (2012) studied the ecology of the Antipodes mice in summer 2011, estimating population density, home range size and comparing the demographic results with those of Taylor (1969) and Moors (1978). Voucher samples of 100 mice were collected and are held at in storage by Dr James Russell at the University of Auckland for reference. Representative specimens are also lodged at the National Museum of New Zealand. Specimen reference numbers are: LM2439 and LM2478.

An expedition in 2013 tested the effectiveness of the proposed operation to target mice on Antipodes Island during winter. The likely impact on the endemic land bird taxa (two parakeet species, pipit, and snipe) was also tested. The bait used in the trials was a non-toxic version of Pestoff 20R Rodent Bait with a biotracer (Pyranine) added that fluoresces under UV light for easy detection of uptake. Mice were live captured in a grid of Longworth traps and inspected for signs of bait consumption (Elliott et al, 2015). Baseline measurements of the abundance of native land birds and invertebrates were also made during this expedition, building on the previous research.

6.2 Pre-operational trials

The remoteness of Antipodes Island and the expected short weather windows to execute operations drove the need to test and qualify systems and equipment to avoid a situation where the operation was thwarted by failure of a critical component. Identifying workable contingency options for critical elements was a key part of planning. Trials of equipment and systems also provided training opportunities for the operational team. The isolation of the site enhanced the importance of familiarising staff with safe work practices for planned operations prior to departure.

6.2.1 Infrastructure testing

In December 2015 a kitset structure, purchased from ‘Simple Shelters’ as a temporary helicopter hangar, was erected at a warehouse in Invercargill. The purpose was to practice its setup using the manual techniques available on Antipodes and prove the completeness of the kitset. Leaders of the hangar setup on Antipodes Island were present at the practice. However, it would have been advantageous to have more of the operational team available to participate. The practice proved the structure could be handled manually but highlighted an issue with some components, that were subsequently replaced. The need for additional spares was also identified. A building inspector from the regional council inspected the structure at the practice setup as part of the application for exemption from the need for a building inspection on Antipodes Island. Simple Shelters also manufactured three personnel shelters for the project which they verified by setting them up and providing a photo record of the process.

Proposed ground anchor designs to hold down shelters were tested in peat soils at Waituna in Southland, analogous to the soil structure of Antipodes Island. Load testing equipment compared the performance of screw anchors and dead-man anchors. Dead-man anchors comprised a round post, (900 mm long) and buried horizontally at 600mm deep and with a cable stay wrapped around the post. Dead-man anchors proved far superior to screw-type anchors and capable of safely holding down the shelters in extreme winds events.

The water tightness of bait pods was tested by regularly checking the inside of a prototype pod left outside in the Southland weather for weeks and again after exposure to high pressure water.

6.2.2 Helicopter/Shipping interactions trials

In February 2016, protocols for safe helicopter-ship operations was developed in conjunction with the helicopter pilots and a contracted marine engineer associated with the Norfolk Guardian. The plan[DOC-2728626] also established how we would meet the conditions set by MNZ as part of the authorisation to use the Norfolk Guardian. The safe operating procedures were based on the latest edition (4) of the International Chamber of Shipping Guide to Helicopter/Ship Operations (2008). The pilots and Project Managers made a second site visit to the ship prior to the trial to talk through the planned manoueveres and visually inspect the dimensions involved. We confirmed the modifications required to meet MNZs conditions, for example, the deck markings; and removal of the aft Hyab and the container locks protruding from the deck.

Between the 22nd and 25th of March 2016, pre-operational trials occurred in Timaru that involved bucket calibration, practice bait loading and helicopter-ship interaction trials as outlined in the trial plan[DOC-2693254]. The Norfolk Guardian visited port in Timaru to participate in helicopter interaction trials on the 24th and 25th of March. The system for loading and stowing helicopters onboard was tested and pilots practiced take-off and landing on the ship's deck while at sea. The method to lift the helicopters onboard initially involved the helicopters being strapped to a 40-foot steel flat rack (effectively the base of a container). The Marine engineer, had constructed a steel lifting-frame to attach to each corner of the flat-rack, sitting over top of the helicopter. The helicopter on the rack would then be lifted onboard the ship using the ship's crane with chains. On the morning of the trial, after two hours of failed attempts to line up the frame with the locking cams on the flat-rack, the system was abandoned as the risk to helicopters was too high. Attention was turned to takeoff and landings with the intention to return to loading the next day after more thought.

That afternoon the ship left Timaru harbour, and lay a few miles offshore in light swell (1.4 m). The two operational pilots and backup pilot each took turns flying out to the vessel and landing and taking off the deck. The ship's crew practiced emergency response and operation of firefighting equipment.

Figure 9: Pilot practicing landing on the deck of the Norfolk Guadian, off the coast of Timaru

The following morning a helicopter was successfully stowed using the ship's crane to lift the helicopter directly by the rotor head. The helicopter was controlled with multiple tag lines tied to the skids and a line on a pulley from the hook on the helicopters underbelly running down to a fixed eye on the hold of the ship. This much simpler system worked to the satisfaction of all involved and removed approximately 5 tonnes from each helicopter being loaded.

6.2.3 Calibration of deflector buckets

Bucket calibration was attempted on the 23rd of March at Timaru's Levels Motor Raceway. Four aerial bait spreading buckets were taken to Antipodes, three standard buckets (throw bait in 360°) and one deflector bucket (throws bait in 180° with a deflector shield attached). A spare deflector and spinner setup were also taken. Only two of the standard buckets and one deflector bucket planned for use on Antipodes were available for calibration on this day as a third standard bucket was still being manufactured. A grid system was setup on the ground using string lines and chalk markings, (see DOC's 'Best Practice for rat eradication – bucket calibration notes' DOCDM-835722). Undyed non-toxic Pestoff 20R cereal pellets were used.

A baiting pass was completed with each bucket at a bucket flow rate of 8kg/ha and 4 kg/ha respectively at a nominal flight speed (approx. 50 kts). Baits were picked up and counted for each grid (5 m x 10 m) and the number used to measure the maximum and usable swath widths and identify the size of the aperture discs likely to be required. Not enough time was available to complete the detailed measurements as desired. Some issues occurred on the day, using valuable time, including a problem with an airline setup. A second day of calibration was later scheduled for the 17th of May 2016 with the hope of including the new bucket but again it was not ready in time. Another bucket of identical design to the other two standard buckets was brought into the mix and all buckets were calibrated at the same bucket flow rates. On this occasion some baits were painted so that multiple passes could be completed (i.e. pass 1: red baits; pass 2: natural) before collection and counting. The usable swath width for standard buckets was conservatively measured at 90 m for the standard buckets and 40 m for the deflector bucket.

6.2.4 Bait loading setup

Two completed bait pods were taken to levels raceway and some of the bait loading team practiced loading during bucket calibration, also testing the loading platform and DOC PPE.

6.3 Preparation

6.3.1 Poison bait preparation

Pestoff 20R Rodent Bait® was the bait chosen for the eradication. A total of 65.5 tonnes were purchased under a supply contract DOC-2599333 with ACP. The active ingredient in the bait is the toxin brodifacoum at a concentration of 20 ppm. Brodifacoum is a second-generation anticoagulant with a proven record for rodent eradication. The toxin acts by inhibiting the recycling of vitamin K, fatally affecting clotting function after a lethal dose has been consumed. Brodifacoum is used for eradication because it is asymptomatic prior to consumption of a lethal dose, meaning there is no risk of bait shyness so no pre-feeding is required. The bait was dyed green to deter birds. To maximise palatability to mice no lure or 'Bitrex' was used.

Pestoff 20R Rodent Bait® was manufactured in 500 kg batches at ACP in Whanganui between the 21st of April 2016 and the 3rd of May 2016 on the factory's C-Plant. The plant was stripped and cleaned prior to production to protect against contamination with other toxins or baits that could result in bait shyness and eradication failure. Production monitoring was undertaken by Josh Penn, a DOC ranger in Whanganui, who verified the factory's biosecurity, the plant strip-down and conducted spot checks during production to provide confidence that standards were met, see the bait production monitoring report [DOC-2611427]. This report also outlines bait monitoring carried out during storage in Timaru and on the Antipodes Island. The first 500 kg was labelled to allow easy inspection. Samples of 4 baits were taken from 3 bags of this first 500 kg produced and from 5 other randomised bags, while in storage in Timaru. Labelled samples of 4 baits were also taken from a random bag in the first then every third pod of bait during baiting. All samples are being kept in storage at a lockup in the DOC workshop in Invercargill until result monitoring is completed. A spill kit accompanied the bait through the various stages of its journey.

ACP provided batch analysis[DOC-2858244] for each of 131 batches produced for the order. The assay results show that production standards were met, as listed in the table in Table 6.

Table 6: Production standards and parameters measured for each 500 kg batch of Pestoff 20R Rodent Bait® produced for the Antipodes project. Results supplied by Donna Hall, Laboratory Manager ACP

Report 232 11/5/2016	Average bait weight	Average strength	Moisture	Brodifacoum Toxicity*
Production Standard	1.5 -2.5 g	>5 kg/cm^2	(<12%)	16-24 ppm
Average from 131 batches of 500kg (65.5 tonnes total)	2.1 g	7.1 kg/cm^2	11.6%	19.8 ppm
Maximum value	2.2 g	10.6 kg/cm^2	12.0%	23.9 ppm
Minimum value	1.9 g	5.1 kg/cm^2	10.9%	16.5 ppm

* The Brodifacoum determination was carried out using LM September 2013. 10.2.0 *Brodifacoum Analysis by LC/MS*. The limit of detection is $1x10^{-5}$ % (0.1ppm). The uncertainty (95% c.i) is ± 7%

Bait was packed in 4-walled paper bags each containing 25 kg of bait then stacked and shrink wrapped on oversized wooden pallets (1.6 m x 1.1 m) with 40 bags (1 tonne) to a pallet.

Figure 10: Transport truck with pallets of bait on racking system; below left is bait being loaded into bait pods with plastic liner; right shows the packing pattern

Prepared bait was stored like this for up to 8 days in a warehouse at ACP with biosecurity controls in place. Once enough was ready, the pallets of bait were stacked single layer on a rack system in a truck and trailer unit. Nolans Transport Ltd delivered the bait to Timaru in three separate loads of up to 22 tonnes each. Each load of bait was received and inspected by the project team at Brosnan Transport Ltd (BTL) in Timaru on the 28th of April (1 truck and trailer) and 6th of May (2 truck and trailer units).

The bait was packed into wooden pods at BTL by a DOC led team of volunteers and contract staff on the 28th of April and the 7th of May. A large plastic liner was used in each pod as some minor water ingress from wicking through the bottom edges of the ply could not be eliminated during testing. No bait was damaged by water during transport or storage on Antipodes Island. Each pod was loaded with 7 layers of 4 bags per layer in a pattern illustrated in Figure 10.

6.3.2 Shipping preparation

Figure 11: Helicopter placed on open hatch cover ready for the 2nd crane to pull the hatch closed.

The Norfolk Guardian required some modification to meet MNZ conditions and DOC's operational requirements. Modifications included removing container lugs and the aft hyab to clear the helipad area of obstructions. The helipad was painted as per international guidelines and a longer cable and block was fitted so the second crane could pull the deck hatch fully closed once a helicopter had been lifted out of the hold and placed on top. Additional security points were attached for tying down helicopters during transport and on the deck to secure access ladders for fitting rotor blades to helicopters. The ship's office spaces were amended to accommodate 7 DOC passengers. Specialist rescue gear was provided in case of helicopter crash onboard and firefighting capabilities were upgraded to meet international standards including high pressure foam capability and firefighting PPE with respirators.

The aft Hyab and container lugs were re-fitted after each of our three engagements with the Norfolk Guardian (1. helicopter/ship trials; 2. delivery leg to Antipodes; 3. retrieval from the Antipodes). The ship's Classification Society had to inspect and approve these modifications for compliance with technical standards after each re-fit. A Port State Control inspection was done by MNZ while the Norfolk Guardian was in Auckland loading fuel.

6.3.3 Helicopter preparation

To mitigate the risk of aircraft components expiring during the operation, aircraft were required to undertake any major inspections that could fall during deployment and at least a 150-hour inspection (as a final readiness check) and an Annual Review of Airworthiness (ARA) prior to deployment. Following the 150-hour inspection the supply contract required the aircraft to have at least 20 hours of flight time to reduce the risk of any defect or failure occurring because of the inspection. The internal spaces of the helicopters were treated with 'Dinitrol' and external panels with CRC soft or Lanalate to provide corrosion protection. This treatment was evident in HJM but not in HMD upon arrival at the island.

6.4 Biosecurity

A biosecurity plan[DOC-1516648] for the pre-operational and operational phases of the project was reworked multiple times before being adapted into a suite of biosecurity "task assignments" to achieve the functionality required. Having a plan in place for each task helped clarify what work needed to be done, who was doing what and when a task needed to be completed in the timeline. The task assignments also provided a place to record outcomes. Biosecurity tasks grew as the project evolved and when 'Operation Endurance' was cancelled the ability to be adaptable and utilise contingency options was critical. Having a good pool of experienced biosecurity staff locally, some of whom had been to the Antipodes was also valuable. DOC's national biosecurity network was drawn on to support the project with staff assisting with preparation tasks including food quarantine in Christchurch, ship inspections in Auckland, wharf biosecurity in Dunedin and quarantine of gear in Invercargill.

6.4.1 Marine biosecurity

Significant DOC time was involved working collaboratively with other agencies during pre-operational preparations to help the Norfolk Guardian meet the marine biosecurity standards and manage risks. The Evohe and Norfolk Guardian required a certified clean hull to travel within 1000 m of the Mean High-Water Spring (MHWS) of the Antipodes. Access this close was desirable to maximise opportunities for unloading cargo and transferring people onto the island. The marine biosecurity standards for the New Zealand Subantarctic region are set out in the operative 'Proposed Regional Coastal Plan Kermadec and Subantarctic Islands' (DOC, 2011).

A preliminary dive inspection on the Norfolk Guardian was conducted by DiveCo in Auckland on the 4th of March 2016 to determine the amount of hull cleaning likely to be needed (if any) prior to a full inspection. The ship's antifoul system was less than 18 months old (3-5 year life) so it was surprising to find significant macrofouling. New Zealand Dive and Salvage Ltd (NZDS) were subsequently contracted to complete a DOC inspection and collect samples from niche areas, based on established NIWA protocols (DOC, 2012). Divers detected light to moderate levels of biofouling on the general hull areas (LoF 2-3) but the niche areas were more heavily fouled (LoF 3-5). Following this inspection on the 19th of March, 2016, samples, photos and video were sent to the Marine Invasives Taxonomic Service (MITS) at NIWA for identification and risk profiling.

NIWA scientists identified six species from seven samples that were deemed to be a biosecurity risk to the Antipodes. Additionally, Mediterranean fanworm (*Sabella spallanzanii*), a notifiable invasive organism, was suspected in the internal sea-chest cavities based on video evidence. No *Sabella* was found in samples from the hull. On the 22nd March, MPI confirmed *Sabella* in the sea-chests from the video evidence. MPI and DOC agreed on a course of action that was quickly implemented by DOC and the vessel operators allowing the vessel to continue operations in New Zealand waters following its first treatment. NZDS were contracted to seal and treat the sea-chests with freshwater on the 25th of March. Salinity measurements occurred throughout this period to ensure effective treatment for a minimum of 12 hours.

The plan devised with MPI relied on repeat freshwater treatments in the absence of access to the sea-chests to prove the organisms were dead. Follow-up treatment occurred at the same time as a major hull clean (25-27th April 2016) before the vessel's departure to the Antipodes[DOC-3027472]; and again prior to retrieval of the team. The second and third freshwater treatments included chlorine dosing of the sea-chests and rope inspection ports for 27 hours and 20 hours respectively. Chlorine was used to kill any other susceptible macrofouling that may have been present in the sea-chests and was neutralised prior to discharge.

The Regional Coastal Plan for the Auckland area required a resource consent for the in-water hull clean. The RNZN supported the project by allowing the hull clean and sea-chest treatment to occur at the Devonport Naval base under the RNZN resource consent. Various stakeholders were engaged by NZDS in support of this work. Organisms removed during the hull clean were collected in catch bags lined with 50 µ filter cloth. Due to operational constraints, the cleaning was not able to remove all barnacles from the hull leaving an estimated density of approximately 2 barnacles of small size (<5 mm) for every 10 m^2 of hull area. The ship could not comply with the requirement for a certified clean hull because of the barnacles. A coastal permit[DOC-3027669] was then needed for access within 1000 m of the Antipodes MHWS as a discretionary activity. The permit was granted on the 10th of May 2016 allowing access to within 300 m of the MHWS, based on the risk assessment following repeated treatments of the sea-chests and considering the information available on the remaining barnacles.

The Norfolk Guardian exited New Zealand waters (freight run to Norfolk Island) after the delivery voyage to the Antipodes, meaning a further dive inspection was required before the vessel could return to Antipodes Island and retrieve the team, pursuant to the rules of the Coastal Plan. This inspection again occurred at the RNZN's Devonport wharf between the 25th and 26th of July and included minor spot cleaning on the hull and final treatment of the sea-chests[DOC-3027487].

The yacht Evohe was inspected by NZDS on the 21st of May 2016 and provided a clean hull and niche area inspection certificate[DOC-3027708] that was still valid for the retrieval voyage.

6.4.2 Shipping – topside biosecurity

Following hull inspection, the Norfolk Guardian berthed at Ports of Auckland for pre-departure preparations that included above waterline biosecurity checks and loading of 30 tonnes of helicopter fuel (Jet-A1). Biosecurity rangers John Nielson (DOC) and Brian Shields (Auckland City Council), and their detection dogs, checked the ship's holds and the palletised drums of fuel before it was loaded onboard. Collectively the two dogs searched for sign of rodents, Argentine ants (*Linepithema humile*) and plague skinks (*Lampropholis delicata*), all known risk species in Auckland. The biosecurity rangers identified that rodent guards were not properly secured on the mooring lines, which was corrected.

Insect traps and a visual inspection were used to assess biosecurity risks in the superstructure and accommodation areas. Rodent glue boards were set in the ship's hold while in port. These were inspected daily by the Assistant Project Manager who was overseeing preparations. Once the fuel was loaded, Genera Ltd fumigated the ship's two holds with insecticide 'Barricade 500EC' applied by thermo-fogging. The Norfolk Guardian then departed for Timaru where the bulk of the operational equipment and supplies were loaded. Glue boards were deactivated while no DOC representative was onboard and reactivated at Port Timaru where 24 hour inspections could resume. Glue board record sheets were supplied to MPI via DOC's annual reporting in 2016. On the 27th of July, DOC ranger Carol Nanning and her rodent detection dog searched the Norfolk Guardian again and re-established bait stations and detection devices prior to the ship's departure on the retrieval voyage.

6.4.3 Wharf biosecurity

The Norfolk Guardian was loaded and departed from Primeport in Timaru and the Evohe from the public wharf in Dunedin. The biosecurity risks were assessed in advance for each site and pre-departure tasks included in the Biosecurity Plan. Primeport Timaru had an existing biosecurity management system in place and their monthly biosecurity reports were requested and sent to DOC in the lead up to departure. The public wharf in Dunedin had no existing biosecurity management. A DOC ranger conducted a preliminary inspection of the Dunedin wharf and carried out weed control (hand weeding and spraying) two months before departure. This was followed up again the week before departure. Ply-wood was laid on the wharf alongside the Evohe berth to provide a clean and stable platform for loading where parts of the wharf surface was uneven. Rodent bait stations were set around the perimeter of the wharf and onboard the Evohe in the lead up to departure.

During loading of the Norfolk Guardian. The hold covers were left open and the gangway left down overnight giving unnecessary potential access for insects, windblown seeds or rodents outside of the loading operations. Additional checks were made in response.

6.4.4 Quarantine – large plant and equipment

The volume of supplies and equipment being taken to Antipodes Island was unprecedented and presented a significant biosecurity risk for the sensitive site. Adding to the challenge, the equipment and supplies were arriving from many places and suppliers around the country (DOC workshop, DOC Quarantine Store and Southland Country Freight in Invercargill; Brosnans Transport Limited, Hilton Haulage, Alpine Joinery and Primeport in Timaru; ACP in Whanganui; Southern Lakes Helicopters – Queenstown; Otago Helicopters and Public wharf – Dunedin; Amuri Helicopters – Hanmer; Trents foods and Heli-maintenance – Christchurch). Approximately one month prior to departure the DOC team established a biosecurity management system at each site where supplies were being prepared or stored. Record sheets from biosecurity checks were sent to a biosecurity ranger in DOC's Murihiku team. Tools included rodent bait stations, invertebrate glue traps, contact insecticide sprays (Aqua Key Delta, Ripcord Plus and BV2) and herbicide spray (glycophosphate). Quarantine inspections checked items were free of soil, seeds, invertebrates, lizards and rodents. Steri-gene was used to clean and disinfect select items where transmission of microorganisms was a risk. Quarantined gear was generally sealed in plastic or in wooden pods for transport.

A contract[DOC-2673685] was established with Brosnan Transport Ltd (BTL) for storage of project equipment and supplies at Timaru and subsequent transport to Primeport Timaru upon arrival of the Norfolk Guardian. The contract focused on bait storage but only touched on other equipment. Two shipping containers with oversized items (hangar and shelter framing) were delivered to BTL. The intention was for the containers to be stored outside at BTL then transported to the port for unloading the contents directly onto the ship. The containers provided a sealed environment for quarantined items where the hollow framing and pipes could easily be fumigated. Upon receipt of the containers, attending warehouse staff cut off the padlocks securing the container doors and unloaded the contents into the warehouse, compromising the biosecurity of these items. They mistakenly assumed the containers needed to be returned immediately and failed to consult the project team or BTL's Operations Manager despite the padlocks and understanding with BTL. Upon discovery of the incident, the items were re-inspected by the DOC team and individually treated with insecticide and the hollow pipes and frames sealed as best as possible. The incident highlights the importance of communication and supervision by project staff at critical steps, even for tasks that are seemingly understood. Each delivery of bait was received by a DOC team member at the warehouse. The same supervision was obviously needed for other deliveries as the emphasis on biosecurity was an extraordinary element for most of the suppliers involved. Use signage to indicate quarantine status of items and storage facilities is a recommended addition in future.

Two 1.6 tonne diggers and two power barrows were among the larger items of plant taken as part of the cargo. They were dismantled by experienced operators as far as practical, steam cleaned and fumigated inside a shipping container with Expra insecticide. Forty-six Industrial Bulk Containers (1000 litre cage tanks) were also taken to the Antipodes to be filled with water and used as ballast to anchor the hangar. Six were filled with freshwater in Timaru to provide a backup water supply on the island. The cage tanks had to be cleaned a second time by DOC rangers in Dunedin after being stored outside following the cancellation of the Navy's Operation Endurance. The biosecurity of almost 12 tonnes of timber for the helipad was also affected by cancellation of Navy support. The timber had been dried, heat-treated and sprayed with insecticide at the mill before wrapping and transport. Upon cancellation of Operation Endurance, the timber packs were returned to the timber yard for storage until departure of the operational team in late May. The yard was inspected twice and the presence of cluster flies at the yard eventually resulted in the timber being re-sprayed with insecticide and shifted to Hilton Haulage in Timaru. Subsequently the timber packs were regularly sprayed with the insecticide Aqua Key Delta at Hilton Haulage until loaded onto the Norfolk Guardian.

Food supplies came from Trents in Christchurch and were packed onsite in a biosecurity managed area. A DOC representative was present during packing to oversee checks. Some items such as leeks, were identified as high-risk and removed from the supply. A review of the food order by a biosecurity expert would have identified such items earlier. The huge quarantine effort significantly reduced the risk of unwanted organisms but sometimes the risk came from the transportation itself. In one case grass was found growing from the deck of a truck taking loads to the wharf for loading. Biosecurity includes the entire supply chain.

6.4.5 Helicopters and equipment

Two weeks before departure, a biosecurity team from DOC Invercargill completed a road trip to visit each site where helicopters and associated gear were being prepared (Queenstown, Christchurch and Hanmer). The team quarantined gear as it was packed. Additional wooden pods were supplied by DOC and used where possible for packing to maintain the integrity of the contents for transport. The helicopters themselves were inspected and sprayed with insecticide (Ripcord Plus) inside and out. Amuri's helicopter hangar was also fumigated for cluster flies because of an historic incursion. Baiting buckets were calibrated in the week before departure so were inspected in Timaru before loading. Helicopters and the biosecurity monitoring devices planted inside their various compartments were re-checked on the wharf before loading.

Otago Helicopters operate rescue helicopters out of Dunedin capable of reaching Antipodes Island. During planning Otago Helicopters were identified as the likely respondents in the event of an emergency on the Antipodes. A DOC ranger visited and inspected the hangar and the biosecurity management system. Additional devices (rodent bait stations, insect traps) and record sheets were supplied and monitored to minimise the biosecurity risk in case an emergency response was required.

6.4.6 Quarantine – personnel and supplies

The bulk of the team's personal gear was quarantined at DOC's Invercargill quarantine store over two days by local and imported DOC staff. The pilots, engineer and team doctor arrived directly in Timaru for departure and their gear was quarantined in a room at the accommodation. A better facility for quarantine in Timaru would have been advantageous. A member of the eradication team was nominated to oversee biosecurity on the island as part of their role. The main task was to employ procedures for on-island quarantine. This covered incoming gear, visits to offshore islands, procedures for an incursion response and weed surveillance of operational areas prior to departure.

7. Operational Phase

The Operational Phase comprised three key stages:

- Departure and setup
- Poison bait application
- Demobilisation

7.1 Departure and setup

7.1.1 Transport logistics

Coordinating the logistics of supplies and equipment arriving from several locations and departing from two different ports in New Zealand was a challenge. Losing a critical item between storage and offload at the island was identified as a major risk in the readiness check. An essential Logistics Manager role commenced six months before departure. This role developed an inventory and managed movement of equipment and supplies from preparation and packing through to unloading the ship at the island. A DOC ranger from Geraldine was familiarised with the inventory and the location of the items at the storage warehouse in the lead up to loading. She kept a checklist as items were loaded on the Norfolk Guardian to ensure everything made it on board as did the shipping operators.

Quarantine, briefings and basic training were completed in Invercargill between the 18th to 21st On the 22nd of May 2016, twelve of the project team were delivered to the yacht Evohe in Dunedin with the gear and initial supplies. Departure was delayed until the following morning due to stormy conditions. The Evohe eventually left two days ahead of the cargo ship (Norfolk Guardian) with the aim of commissioning the camp before the Norfolk Guardian arrived for unloading. The DOC support team who delivered the personnel to the Evohe continued to Timaru to assist with biosecurity and loading the Norfolk Guardian.

The Norfolk Guardian arrived into Primeport Timaru in the early hours of the 24th of May and was loaded over the next day and a half. She departed for Antipodes earlier than expected on the 25th of May with seven of the project team onboard including the Assistant Project Manager, Logistics Manager, the two pilots, helicopter engineer and a contracted construction expert to support the installation of temporary infrastructure. See Table 7 for the calendar of events during delivery.

There was a last-minute delay portside because the lifting eye could not be screwed into the rotor-head of one of the helicopters as the thread was burred. Time was lost while a suitable tap was sourced and a backup lifting eye was sent from Christchurch in case it was damaged.

HJM had been lifted by the rotor head during preparations but HMD had not, meaning the thread hadn't been checked. This last-minute incident illustrates the importance of comprehensive testing before departure.

Figure 12: Loading helicotpers from the wharf into the upper level of the Norfolk Guardian's hold

7.1.2 Unloading at Antipodes Island

The first two weeks of the operational phase were a flurry of activity. The Norfolk Guardian unloaded gradually over a period of 11 days and the team erected a helicopter hangar and established a field camp on the island.

The day after the Norfolk Guardian arrived, conditions eased allowing the three helicopters and 25 other priority loads to be flown onto the island. Priority loads included the two dismantled 1.6 tonne diggers that enabled ground works for the helicopter hangar to commence. The two AS350 squirrel helicopters were individually lifted to the deck of the ship, rotors fitted and then flown off. Each helicopter took approximately 1.5 hours to prepare. Access to fit the rotor blades was facilitated by mobile platform ladders secured with ratchet straps to deck fittings. The third helicopter was an R44, spectacularly flown off the ship as an underslung load. With the helicopters ashore, four of the DOC team that travelled down on the Norfolk Guardian (the pilots, helicopter engineer and construction expert John Henderson) transferred to the island.

Figure 13: A Robinson R44 being unloaded from the Norfolk Guardian by an AS350 squirrel

Three DOC team members stayed onboard the Norfolk Guardian for the duration of the offload (27th May to 7th June). Assistant Project Manager Keith Hawkins operated from the bridge liaising directly with the ship's captain who spoke English and Tongan but direct contact helped to mitigate the effects of the language barrier and ensure decisions were clearly conveyed. Finlay Cox worked in the hold of the ship, directing the crew down there and organised loads to be lifted to the deck. Jamie Doube worked on the deck as the load master and communicated with the pilots, calling the swell and informing them of the position of the helicopter's line or the load in relation to the edge of the ship.

This was a crucial job, requiring a good understanding of the operations and the ability to give confident and concise information to the pilots.

To unload the ship the hatch covers were partially opened and about 20 loads lifted to the deck one at a time with the ship's crane. The hatch covers were then fully closed before helicopters began flying the loads from the deck. It took about 30 minutes to get the loads up and onto the deck and another 40 minutes to sling them ashore with the helicopters working in tandem. A total of approximately 130 tonnes of equipment and supplies were unloaded off the ship in 250 helicopter loads taking 28 hours of flying. Unloading was able to occur on 5 days over a 12-day period between the 27th May and 7th of June 2016.

Initially unloading was attempted with the ship in the most sheltered position in Anchorage Bay but often the turbulence coming off the island often disrupted the helicopters. Operating conditions were optimised by:

- positioning the ship in an area with constant "laminar" flow
- reducing the ship's roll by slowly steam into / with the direction of swell as practicable
- having the wind direction at 2 o'clock to the ship's direction of travel
- having experienced crewman on the ship's deck to liaise with pilots
- defining a target (painted bullseye or cross for example) on the deck or in the hold for the pilots to aim at.

Further recommendations and learnings can be found in the IASL's Operational Report[DOC-2858257] prepared at the completion of their contract (Michelle, 2016).

At night, the Norfolk Guardian generally went to sea, steaming up and down the east coast of Antipodes and Bollons Island due to the lack of a harbour and the unchartered inshore waters. The Norfolk Guardian completed almost 1000 km in this fashion (see Figure 14 below), battling large seas at times but avoiding the risk of slipping anchor in the unsheltered waters and changeable winds. On the night of the 2nd of June, the ship recorded a wind gust of 90kts.

A radio repeater was setup on top of Mt Galloway but radio coverage with the vessels was limited. Most mornings the vessels needed to come into Anchorage Bay before effective contact could be achieved with the island team via a VHF simplex channel. Satellite phones were used but were also frustrating as it was often hard to get through or to get a clear line. Once the helicopters were in the air messages could be easily relayed via radio simplex.

The Evohe supported unloading by providing passenger transfer ashore and standing-by with a tender during helicopter operations in case of an incident over water. Some of the Evohe crew also helped onboard the Norfolk Guardian to assist with extraction of the helicopters and on the island with infrastructure work. By the completion of unloading Finlay Cox had eaten his way through the ship's Strawberry ice-cream supplies so the final three of the project team were finally transferred ashore on the 7th of June 2016.

Figure 14: GPS track of the Norfolk Guardian during the delivery voyage

7.1.3 Infrastructure establishment

During the two weeks after the Norfolk Guardian arrived, 19 people were accommodated. Three landing pads were prepared for the helicopters coming off the ship and the bait loading site was pegged out and fuel bunds set up in preparation for receiving loads of bait and fuel. Over the course of the next two weeks an additional two steel-framed temporary shelters were set up. One (6 m x 3 m) served as a recreation space near the main hut that also housed a chest freezer and an electric clothes dryer. The other (3.6 m x 3 m) was used as an additional bunkhouse and storage area. The team's Chef quickly established himself as the most important member of the team with the quality of the fare coming from the humble gas hob and diesel stove. He organised food stores in mouse proof pods and inside in sealed fish-bins in the food store. Three plastic drums were buried in the ground up to their screw lids, providing make-shift refrigerator space. Other utilities included a power supply based on petrol generators and installation of a satellite dish for internet access.

At the load site on the Northern Plains, the bait pods were received by a small team that braved the cold winds and survived mainly on chorizo sandwiches. Pods were landed on parallel wooden rails that allowed them to be slide into alignment. The rails were chocked to give a relatively level and stable loading platform on undulating ground. Two helipads and a refueling site were grubbed near the load site and 30 tonne of Jet fuel in drums received and rolled into collapsible fuel bunds. Once the ship had left and the team were waiting for the weather to start baiting, a third shelter was setup, this time at the bait loading site, to provide shelter for the GIS technician and the bait loading team during baiting operations.

Figure 15: Completed field camp at the time of the ship's departure; note hangar in the background. The load site shown inset is located on the plateau above the bluffs beyond the hangar

The major infrastructure project was the construction of the temporary helicopter hangar measuring 16 m long, 12 m wide and 5.6 m high at the apex. A large area that was part of the landslip in 2014 was levelled with great skill using the diggers and a 14 m x 30 m wooden platform constructed to support the hangar and provide space for a helipad. The hangar's nine steel hoop frames were lifted manually with the aid of push poles and a mobile scaffolding unit. A couple of days later when the wind had died down the cover was lifted on. Thirty-eight tonne of water was pumped from a nearby pool into tanks positioned around the base of the frames where they were fixed to the helipad. This system gave nearly 50 tonnes of ballast (in combination with the helipad), to anchor the hangar. Construction work involved everyone onshore and gave some good early momentum and a sense of achievement. The three helicopters were de-bladed and moved into the hangar on the 8th of June. Rotor blades were removed and fitted on each of the two squirrels approximately 25 times over the course of the operation taking approximately 15 minutes for each machine.

Figure 16: Helipad under construction

7.1.4 Boundary check

The boundary of the treatment area was flown on the 8th of June by the Chief Pilot with the Project Manager and Technical Advisor onboard. The helicopter GPS recorded the boundary line incorporating the MHWS and nearby rock outcrops. The treatment area was measured at 2114 ha (not including the Windward Islands), larger than of 2045 ha derived from maps and used in planning.

7.1.5 Emergency response training

On the 8th of June, the day after the Evohe and Norfolk Guardian departed with the build team, the remaining 13 staff took part in emergency response training. It had been planned to undertake water recovery practice on mainland New Zealand leading up to the departure. However, the weather deteriorated and the practical training was postponed until the team was on the island.

Figure 17: Rescue training on Antipodes Island using Bauman bag (left) and “dope on a rope” recovery methods

The pilots practiced with the rescue scoop net at sea but this technique proved difficult. The human sling method was prioritised and the rescue scoop net retained as the back-up option. The Assistant Project Manager and the Safety Officer trained in support roles on the helicopter for this system. The team’s doctor had extensive experience in leading the planned rescue techniques. Pilots wore immersion suits and lifejackets during all helicopter operations at the island. Equipment for water and land rescue scenarios were on hand at the load site in readiness for response (Bauman bag rescue stretcher, vacuum mattress and steep slope access gear). The recreation shelter was to serve as a temporary ward if required. The doctor brought medical equipment (kindly loaned from the South Australian Government) and drugs were on hand to enable high level management of a patient for a period likely to be sufficient to complete a medivac.

Safety briefings were conducted for the upcoming operations and the bait loading team went through a dry-run at the load site. The team did a familiarisation walk around campsite through to the fire muster point as camp had altered when the build team left. With emergency response training completed, readiness for baiting was achieved by the 9th of June. The load site shelter hadn’t been completed at this stage but baiting could commence with make shift shelter for the GIS technician if necessary. As it turned out strong winds didn’t allow baiting to commence until the 18th of June.

Table 7: Calendar of activities during delivery voyage

2016	
22nd May	Evohe loaded with 12 of the project team and initial supplies; stayed in port overnight as 45kts+ outside heads
23rd May	Evohe departs Dunedin harbour for Antipodes Island at 0845 hrs
24th May	Norfolk Guardian loading day 1 (0630 to 1645 hrs) – 1 heli loaded
25th May	Norfolk Guardian completes loading (0800 to 1300 hrs) and departs Timaru on the tide at 1807 hrs
26th May	Evohe arrives at the Antipodes at 0500 hrs. Too much swell to land.
27th May	Evohe team landed at Hut Cove on Antipodes Island by 1300hrs

	Norfolk Guardian arrives by 1415 hrs; too much swell for operations
28th May	Norfolk Guardian unloading: 25 priority loads flown ashore including 2 diggers and 3 helicopters
	Poor weather inhibits ship unloading on the 29th and 30th May.
29th May	Diggers assembled and hangar ground works commence
31st May	Norfolk Guardian unloading: 61 loads flown ashore
1st June	Norfolk Guardian unloading: 81 loads flown ashore
	Poor weather inhibits ship unloading from 2nd to 5th June
1st June	Ground work for heli-pad complete
3rd June	Helipad constructed completed by lunchtime
4th June	Hangar frames erected on heli-pad
6th June	Norfolk Guardian unloading: 45 loads flown ashore; heli ops ceased at 1447 hrs due to weather
7th June	Norfolk Guardian unloading: final 24 loads flown ashore; 9 loads returned to the ship including 6 loads for dismantled diggers; operations complete by 1530; DOC team onboard (3 people) transferred to the island.
7th June	Hangar covered and completed by 1330 hrs
7th June	Norfolk Guardian departs for Auckland at 1530 hrs Building and monitoring team (6 people) depart on the Evohe at 1700 hrs
8th June	On-island training: · Rescue scoop net and SAR training · Equipment and PPE checks · Briefing and dry-run of bait loading setup · Refuelling site setup · Boundary check
9th June	Ready for baiting

7.2 Poison bait application

The ultimate objective of the extensive planning and preparation work was to achieve comprehensive coverage of the Antipodes Islands with poison rodent baits in winter to target every mouse. Two comprehensive treatments of 10 mm (2 g) Pestoff 20R Rodent Bait containing brodifacoum at 20 ppm were completed at the Antipodes Islands between the 18th of June and the 12th of July 2016 to target mice. The timing of each treatment was ultimately determined by weather. Site specific weather information was provided daily by a forecaster based in Invercargill and internet weather sites. In deciding each day whether to proceed with baiting, the Project Manager consulted with the advisory team on the island comprising of the Chief Pilot, the Technical Advisor and the Assistant Project Manager. An early morning walk up to the load site was usually required to confirm conditions across the plateau. On cloudy or foggy days, a helicopter sometimes took to the air as conditions were improving to check visibility around the coast and far end of the island.

The two AS350 squirrel helicopters were piloted by Tony Michelle and Darron McCully, who worked in tandem to apply bait in parallel lines as described in the section 5.1 Eradication design. To minimise the risk of gaps the flight lines were set at 45 m, half the calibrated swath width (90 m) so that baiting swaths overlapped by 50%. This meant that each part of the island was covered by two passes of the sowing bucket for each treatment. To account for the double sowing the bucket flow rate was set at half the desired ground application rate. At the start of the treatment an orientation line was flown at the best angle to the wind and numbered parallel flight lines were generated from this by the GPS. The pilots then used these “flight lines” to guide bait application.

A short break in the weather arrived on the 18th of June. A decision was made to start operations by baiting a small area (54 ha) at the north-east end of Antipodes Island that incorporated Hut Cove and all the infrastructure, where the highest risk of mice accessing alternative food existed. Baiting a small area at the start gave the team the chance to iron out issues with equipment or systems before a bigger weather window. It also gave the bait loading team a chance to familiarise with the roles and allowed infrastructure baiting to commence. As required by the conditions of brodifacoum use, a warning sign was set up at the main access to the island, fixed to the hut stating the application date and the hazard.

Figure 18: Loading platform with bait loading team in action

Weather windows were generally short so each treatment was completed gradually over several days. Each day of bait application built on the previous baiting in a rolling front approach until coverage was complete. Interruptions greater than 3 days required some re-sowing at the open front as described in the eradication design. The top of the bait pods was used as a loading platform to facilitate manually loading the buckets. A sheet of fiberglass-reinforced plastic grating was placed on top spanning two bait pods to give additional stability and traction for bait loaders. The loading site was shifted along as bait was used and pods emptied. Bait was manually loaded by a team of six, including a loading supervisor. Two people tipped bags into the bucket and two others received and held empty bags while the fifth team member worked to prepare the next load. The team rotated the roles after every second bucket load to avoid fatigue. Each pod contained 700 kg of bait (28 x 25 kg bags), matching a full load for the standard buckets. The deflector bucket was filled only to 400 kg for coastal work. The higher application rate for treatment 1 meant the buckets emptied quickly, keeping the bait loading crew busy but by the second day the team found their rhythm and the process ran more smoothly.

Most of the baiting for treatment 1 occurred during a weather window on the 21st and 22nd of June but low cloud and mist delayed completion until the 29th of June. Once the across island baiting was well underway, pilot Tony Michelle concentrated on deflector bucket work to spread bait on the cliffs and along the outer flight line of the coastal swath. When the across island baiting was completed, pilot Darron McCully used a standard bucket to fly the interior flight line of the coastal swath and baiting of the slopes greater than 50° outside of the coastal swath area. Using the standard bucket for the steep slopes consumed more bait than planned because it had been intended to use the deflector bucket. However, the strategy allowed coastal baiting to continue with the deflector bucket at the same time the standard bucket was active, reducing the risk of further weather interruptions delaying completion. An observer was onboard for some of the coastal cliff baiting to check as far as possible that bait was reaching the vegetated verges. Near the end of the treatment 19 inshore rock stacks had additional bait applied by throwing paper bags of pellets (100g) from the helicopter hovering at low level. During this process, it was noted that bait was present on all the rock stacks from the across island bait spread.

More bait was used for treatment 1 than planned but sufficient remained for treatment 2. Contributing factors were:

- Monitoring the application rate for part of treatment 1 against the total area baited instead of only the area within the treatment boundary, mistakenly ignoring the effect of additional hectares due to overlaps or re-sowing.

- Actual treatment area (2114 ha) was slightly larger than the mapped area than used in planning (2045 ha) due in part to conservative boundary setting.

- Use of a standard bucket in place of a deflector bucket for steep slope baiting and some re-sowing because of weather interruptions.

Minor adjustments were made during treatment 1 to reduce the application rate but any drastic changes were ruled out to ensure the first treatment was as comprehensive as possible. Those issues were corrected for treatment 2. Rainfall was measured daily using a temporary rain gauge. Some form of precipitation fell on most days. The agreed parameters for baiting were a forecast of less than 10 mm rain in 24 hours or less than 20 mm in the 48 hours following application. Rain fell following baiting on the 22nd of June but visual inspection of baits showed they retained good condition until the start of treatment 2.

Table 8: Bait application data for operational days for treatment 1 and 2

Date	Treatment	Bait used (kg)	Precipitation in subsequent 48 hours (mm)	Flight time (hours)
18th June	1	1250	2.6	1.5
21st June	1	23815	1.8	9.4
22nd June	1	15575	7.9	7.6
27th June	1	1100	0.5	2.7
28th June	1	2325	0.8	2.6
29th June	1	1510	2.0	1.6
Sub total	1	45575		25.4
8th July	2	10160	3.3	7.4
10th July	2	5500	3.3	6.0
12th July	2	4205	0.6	7.9
Sub total	2	19865		21.3
Total	1 and 2	65440		45.4

Table 9: Average bait application rate and helicopter flight time per tonne for treatments 1 and 2

Treatment	Date	Proposed application rate	Average sowing rate	Bucket flow rate	Helicopter productivity
1	18th to 29th June, 2016	16 kg/ha	21.6 kg/ha	8 kg/ha	1.79 tonne/hr
2	8th to 12th July, 2016	8 kg/ha	9.6 kg/ha	4 kg/ha	0.93 tonne/hr
Total	18th June to 12th July	32 kg/ha (includes 20% contingency)	31.2 kg/ha		1.44 tonne/hr (average)

7.2.1 Structure baiting

While bait was primarily applied by air, the interiors (rooms, roof and wall cavities) and sub floor spaces of man-made structures needed to be treated by hand, either by throwing bait or in bait stations. A structure treatment plan DOC-2859661 was prepared with a register and assessment of all the man-made structures and food sources on the island. Initial set up started on the 18th of June and was completed on the 19th of June following aerial baiting overtop of all infrastructure sites. Ten Pestoff 20R Rodent Bait pellets were placed in a numbered shallow clear plastic petri dish in each compartment of a structure (>1 station per 10 m^2). The location and date were recorded and these were checked daily as per the the plan. At sites where stations would not provide adequate bait availability (e.g. wastewater drain, under the hut, toilet pits) bait was thrown to achieve required coverage (minimum of 4 baits/m^2).

Mice were detected near the accommodation area up to 21 days after initial bait application. Mice were recorded inside the Castaway Depot but never inside the Biodiversity hut. However, bait was taken by mice from beneath both. No bait-take occurred from stations inside the pit toilet shelters but mice were active in the toilet holes so bait was thrown in the toilet holes daily to ensure availability of fresh bait. Of the 72 stations placed in temporary structures only 5 recorded bait take. Establishment used approximately 4 kg of bait. All bait was replaced at the start of treatment 2. A maximum of 240 g of bait was taken from bait stations by mice. The highest take was in the first 3 nights with 73% of total bait take occurring by night 6 and rapidly declining after that. Trail cameras and tracking tunnels were used to monitor mouse activity near the accommodation area from the 23rd June to the 11th of July. From the imagery, it was clear that mice would comfortably pick up and carrying away whole 2 g baits. Two mice were recorded taking baits on the 7th of July, 20 days after bait spread. One mouse was trapped nearby in a bucket trap later that day and the dissection revealed brodifacoum poisoning was well progressed. The other mouse was not seen beyond this date. At the start of treatment 2, mouse sign was cleaned from structures to aid further detection.

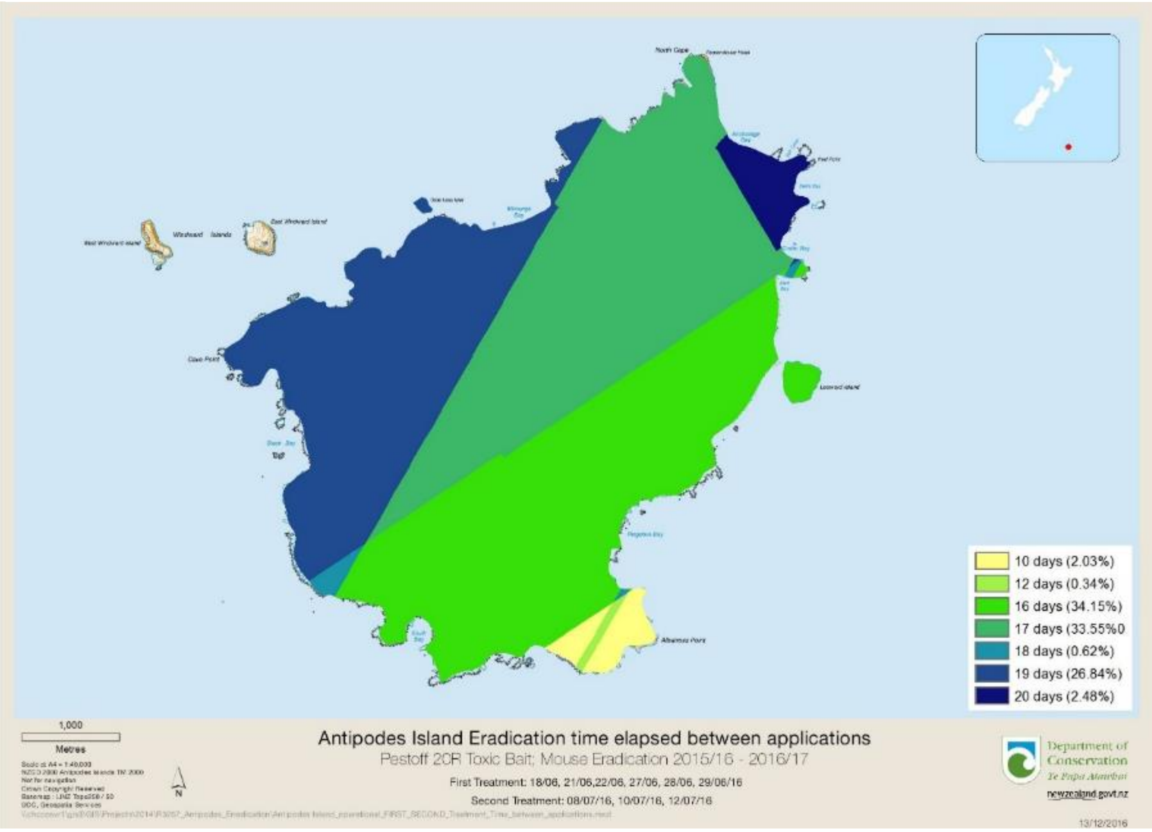
7.2.2 Offshore island monitoring

Mouse presence on East Windward Island (8.5 ha) and West Windward Island (7.0 ha) was unknown at the start of the operation but the likelihood was thought to be low. These two islands were not baited during treatment 1 in anticipation of an opportunity to monitor for mice in the interval between treatments. Six tracking tunnels were setup on the islands on the 28th of June and retrieved on the 10th of July after 12 nights with no sign of mice detected. The Windward Islands were removed from the treatment area, increasing the natural refuge area for non-target species to 74.3 ha.

7.2.3 Treatment 2

The boundary check before treatment 1 resulted in a treatment area of 2114 ha (not including the Windward Islands). The coastal perimeter was flown again before treatment 2, tightening the boundary by separating some rock stacks for direct baiting that had previously been included within the continuous boundary. The treatment area was remeasured at 2075.8 ha. The IEAG were consulted on the 30th of June regarding the timing for commencing treatment 2. The highly changeable weather to date meant there hadn't been a single day when more than 3.5 hours of baiting could be completed continuously giving impetus to take opportunities as early as possible. It was proposed to look at starting baiting again from the 7th of July which would give a 14-day interval between treatments for 97% of the treatment area (area baited by the 22nd June). The exception was approximately 50 ha in the SE corner where baiting in treatment 1 couldn't be completed until the 28th of June. The IEAG agreed in principal and supported the island team to decide based on the situational information available. The next opportunity for baiting presented itself on the 8th of July and treatment 2 commenced and was completed on the 12th of July. The interval between treatments 1 and 2 is illustrated by the map in Figure 19 below.

Figure 19: Antipodes bait application map showing time interval between treatments 1 and 2

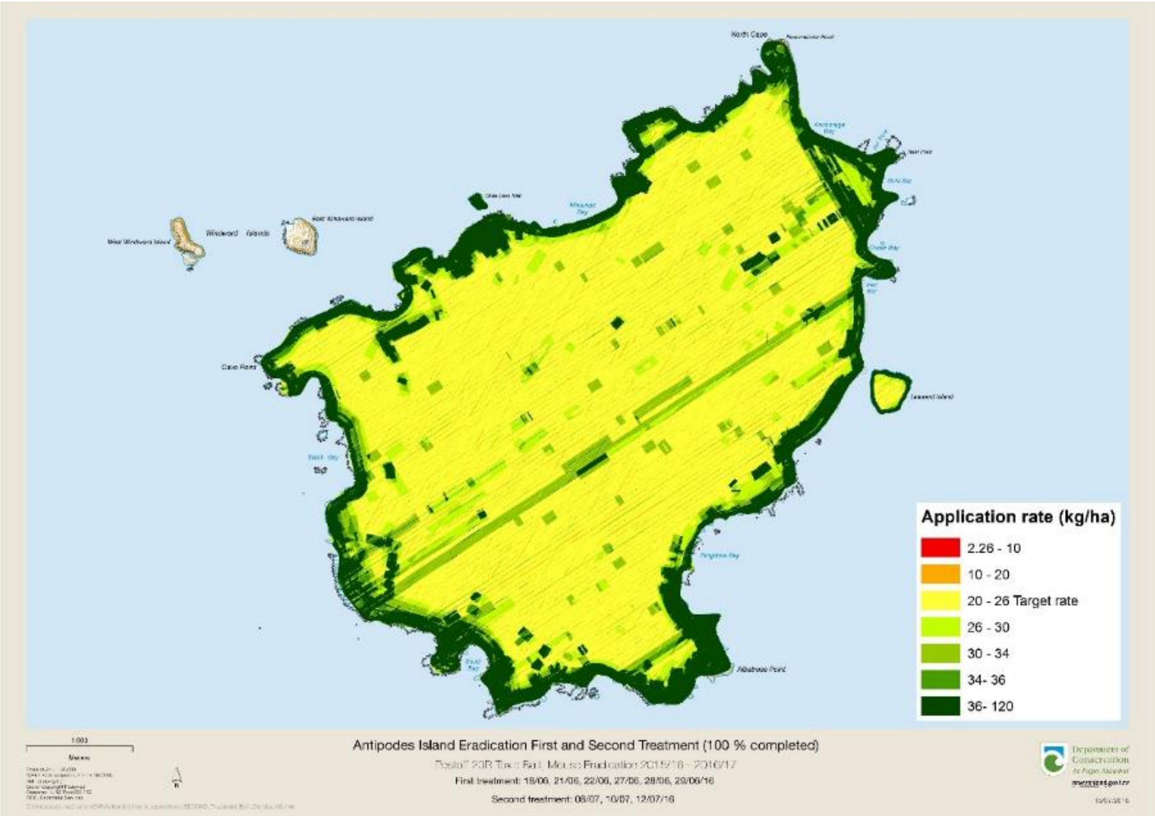


The orientation of the flight lines changed slightly for treatment 2 to suit the wind and reduce the risk of gaps. The target application rate was 8 kg/ha for treatment 2 so aperture discs were changed to adjust the bucket flow rate to 4kg/ha.

Both bait spreading helicopters were fitted with TracMap Flight 3 GPS systems that enabled their position to be tracked. The GIS technician downloaded the GPS data to build a picture of the treatment and identify gaps. Maps of flight lines were prepared during and at the end of each day and reviewed to identify any gaps or areas for re-sowing. The Project Manager directed further re-sowing as required. Pilots used their discretion to reapply bait to areas where they deviated more than 5 m from the flight line or where uncertainty existed due to wind for example. The GIS technician also used the GPS flight data to produce bait density maps for each treatment and a map showing bait density for both treatments combined (See Figure 20). At the completion of treatment 2, approximately 1100 kg of bait remained. It was felt that the high risk coastal zone had been well covered so the bait was applied to 250 ha where the bait density maps showed the application possibly fell below the target rate. A full suite of maps recording daily and cumulative bait application are stored on DOCs Southland S:\Drive linked here: Southland S:\Antips_Maps.

The total amount of bait purchased was 65500 kg, which included a contingency of 20%. Treatment 1 used 45575 kg of bait, leaving 19925 kg for treatment 2. The application did not exceed the quantity specified in the Resource Consent (65500 kg).

Figure 20: Bait density map showing application for treatments 1 and 2 combined



7.3 Demobilisation

Preparations for demobilisation began almost as soon as operations started. Empty bait pods were dismantled and helicopter loads of rubbish readied for loading back to the ship when it arrived. Preparatory work continued whenever time was available.

Late in the planning phase the team doctor's availability was impacted by bringing the departure date forward following cancellation of the Navy's Operation Endurance voyage. The doctor had to reschedule cover for his role in Australia and ultimately his availability reduced significantly meaning he needed to return to New Zealand at the end of July. As it turned out this was after the completion of baiting and close to demobilisation. The Evohe was chartered to pick up the doctor, arriving at Antipodes Island on the 24th July with replacement medic Ray Bellringer (DOC), contractor John Henderson and Cullum Boleyn (DOC) who were brought back to lead the deconstruction of temporary infrastructure. The Evohe departed back to Dunedin on the same day. The Technical Advisor also departed with the doctor at this stage. The Evohe reached Dunedin overnight on the 27th July, offloaded the passengers and returned to the Antipodes to assist with offload and retrieval of the rest of the team. It is probably the only vessel to have sailed to the Antipodes from the New Zealand mainland, twice in one week.

As the second bait treatment started the Norfolk Guardian's operators were kept informed of progress. A notification was sent at the completion of baiting to request a pickup, as required in the contract. The Norfolk Guardian arrived in Auckland for biosecurity checks on the 25 and 26th of July 2016 then departed for the Antipodes, arriving in the evening on the 30th of July. Dismantling the hangar was timed as best as possible to avoid helicopter exposure to stormy conditions at the time. However, a start had to be made as the arrival of the ship was imminent. On the 30th of July, the helicopters were moved outside and secured on the grass

Figure 21: Dismantling the hangar and helipad and the muddy team involved

helipads used at the start of operations. The hangar was dismantled that day and by the end of the 31st of July, the wooden helipad had been lifted and helicopter loads made up in wet and muddy conditions. Foul weather delayed commencement of loading until the 2nd of August. Three DOC staff were transferred to the Norfolk Guardian to oversee helicopter operations and 93 loads were flown for the day. Loading continued the 3rd of August with 56 loads flown onto the ship by mid-afternoon. Over the two days of operations 150 loads were received onboard the Norfolk Guardian in 19 hours of flight time. The helicopters landed loads directly into the open hold, a much quicker process than during the delivery where each load had to be lifted to the deck by the ship's crane before being flown off. The R44 was later flown onboard and stowed in the hold. On the 4th of August, the hut was decommissioned and the two AS350 helicopters flew to the ship and were stowed for departure. Most of the infrastructure installed for the operation was removed except the 2nd toilet and the ground anchors used to secure the last helicopter to leave the island.

At 1240 pm on the 4th of August the Evohe and the Norfolk Guardian left Antipodes Island in good conditions after a job well done. With a following breeze most of the way, the Evohe and the Norfolk Guardian arrived back in Dunedin and Timaru respectively, on the 6th of August. The ship was unloaded in Timaru by the end of the day. Over the next four days all the loads were organised and transported off the wharf to destinations in Timaru, Christchurch, Hanmer and Invercargill. Empty fuel drums were received by the fuel supplier, unused fuel was on-sold and waste was disposed of at a facility in Timaru. Two truck and trailer units of gear and equipment were sent to DOC in Invercargill where a warehouse had been hired and the DOC Murihiku team worked to clean and process items for return, storage or disposal as required.

8. Sustaining the project

The Project Manager remained employed until midway through 2017 to complete wrap-up and reporting and assist with other jobs in the Murihiku office. A significant amount of work was involved in managing the large amount of equipment returned from the operation and closing off business on the various supply contracts. A project debrief was held in October 2016 to capture lessons for future work[DOC-2928572], the findings of which are summarised in the After Action Review in section 10.

8.1 Biosecurity

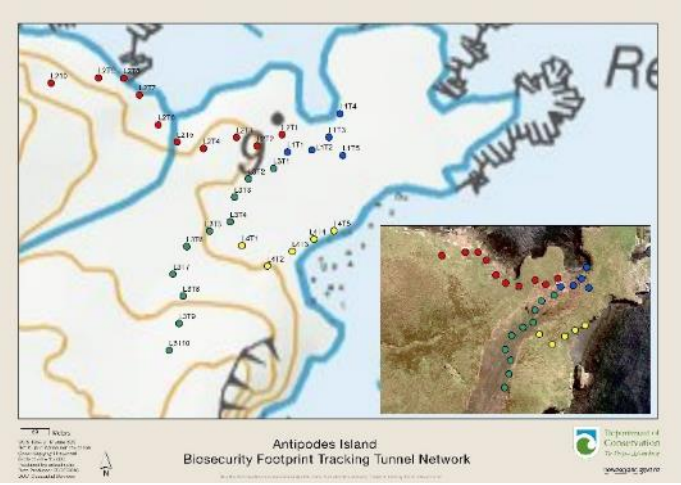


Figure 23: Tracking tunnel locations near Reef Point on Antipodes Island

Biosecurity measures are in place to prevent the introduction of pest organisms to the Antipodes and to protect the investment made if the project is successful. A permit is required to land and is issued for management purposes only. Visiting parties are required to meet DOC's pre-existing biosecurity standards for the Subantarctic Islands, managed by DOC's Murihiku team. Standards are described in the Subantarctic Operating Procedures document[DOC-1351346] that includes, quarantining of gear and equipment, visitor briefings and instructions for biosecurity monitoring on the islands. A network of 30 wooden tracking tunnels has been established around the landing and accommodation area for rodent monitoring when visitors are present for early detection of an incursion. This network will be expanded during the next visit in 2018 to include rodent motels with kill traps at landing sites and the accommodation area. Vessels visiting the inshore marine environment (within 1000m of the MHWS) are subject to the rules of the Proposed Regional Coastal Plan: Kermadec and Subantarctic Islands (DOC, 2012), which include requirements for a clean hull and anchoring restrictions.

8.2 Monitoring

Monitoring provides valuable information throughout the life of the project to assist with decision making and to eventually to gauge success and the outcomes for the ecology of the Antipodes. The Monitoring Plan[DOC-2941839] was reviewed by DOCs IEAG for approval by the Operations Manager. This document describes the result monitoring scheduled for 2018 to confirm whether the eradication was successful or not. It also presents planned outcome monitoring to better understand the benefits and short-term adverse effects of the operation. In July 2017, the Project Manager's role finishes at which time DOC's Murihiku team assume responsibility for outstanding monitoring activities and reporting. The warning sign will be removed at the first opportunity in 2018, likely to be in February 2018.

8.2.1 Operational monitoring

Formal bait degradation and carcass monitoring were not required due to the remote location and restricted access to the island. Bait degradation was monitored informally to help inform the decision for commencing treatment 2 by visually inspecting bait condition along a transect line near Reef Point. In general baits remained intact and palatable over the interval between treatments 1 and 2 but in wetter areas some colour loss and mold were apparent.

A compliance register was kept for monitoring adherence to relevant regulations, protocols and consent conditions. The project's Compliance Officer was an experienced eradication practitioner from outside of DOC. He was part of the eradication team and audited the project's operational activities against the conditions. See Appendix 3 that states how the conditions of the Resource Consent[DOC-2716456] were met.

An incident occurred during the operation that was reportable to the consent authority under condition C8 of the project's Resource Consent. On the 6th of June, "while sling-loading a net-load of Jet A-1 drums from the MV Norfolk Guardian, a net sustained a rip while lifting off the deck. The resulting hole was large enough for one drum (210 litres) of Jet A-1 to slip out of the net and fall into the sea. The drum ruptured on impact and had sunk by the time the tender from the SV Evohe arrived on the scene in support" – taken from incident report #636546 logged in DOC's Risk Manager database. The fuel was lost offshore between Bollons Island and Anchorage Bay. It was not possible to recover any of the spilt fuel, which was left to evaporate. The wind and wave action dispersed the spill quickly and away from land. The incident was reported to the consent authority via the Director Operations, Southern South Island and steps were taken to reduce the risk of damage to nets.

Health and Safety and incident reporting

The operational phase involved many challenging and hazardous tasks in a remote location. DOC Health and Safety systems and protocols (JSAs, Toolbox talks) were employed daily to manage risk. A specific Health and Safety Procedures document[DOC-2717929] and Emergency Response Plan[DOC-2719062] were developed for the operational phase. A member of the project team had the role of Safety Officer and was trained in DOC protocols for simple investigations and reporting. All reports were sent to a DOC ranger in the Murihiku office for entering in DOC's Risk Manager programme and learnings were incorporated into safety briefings. Twelve incidents and near misses were reported during the operation, most were minor but three had potentially serious consequences. The doctor was thankfully underworked in his medical capacity on the island. The most common affliction amongst the team was getting vegetation debris in an eye in periods of strong wind. Prior to baiting operations in the Reef Point area, the spouting on the biodiversity hut was disconnected from the water supply to avoid contamination. The roof and spouting were cleaned before being reconnected.

Technical issues

A few minor technical issues arose during the operation but these were managed with the expertise and spares available on the island. Expertise in general mechanics and baiting buckets is an essential part of a baiting team. The main helicopter issues related to the damp environment and the AS350 aircraft performed well, as outlined in this extract from Chief Pilot, Tony Michelle's Operational Report (Michelle, 2016).

"*The AS350 is a robust aircraft and the aircraft stood up well to the conditions experienced on the island both in flight and while secured during non-operational periods. In flight winds and turbulence were significant during* *some operational periods. The temporary hangar ensured that the aircraft were sheltered from the elements for the majority of the deployment. Undoubtedly this contributed significantly to the excellent condition of the aircraft on return to NZ"*

The good condition of the aircraft following deployment in an "extreme salt environment" was backed up by positive endorsement from the Operations Manager of Southern Lakes Helicopters Ltd who supplied the second helicopter.

Notable technical issues during the operational phase:

- Burred thread in lifting-eye socket of rotor head on HMD, undetected until departure
- An aluminium pulley on a baiting bucket pulley suffered surface corrosion that caused it to throw one of its belts. The corrosion was scraped off and the belt refitted. After a second occurrence, the pulley was run with a single belt without further issues.
- Attachment bolts on one baiting bucket needed to be tightened after the first hour of baiting, probably loosened during shipping. Other fastenings were checked at this time.
- Defective sowing switch on HMD, only recently fitted out as an agricultural helicopter so not previously detected.
- Inflight smoke from instrument panel due to Radar Altimeter burnout – circuit breaker pulled and supplier notified.
- A landing light on HMD was replaced
- The belly fuel drain on HMD was damaged when the cargo swing impacted it. A new unit was dispatched with the Evohe and replaced. This did not impact the continuity of operations.
- The steel blade pins on HMD suffered pitting despite cleaning and greasing at each deblading, whereas the stainless pins on HJM did not.
- Some false warning light activation and various minor moisture related defects were experienced that could not be avoided in the damp atmosphere.

No unscheduled maintenance was required on the aircraft. The instances of technical issues reinforce the importance of testing all equipment and systems before departure, particularly in the case of new or unproven parts or systems. It also shows the value of a short shakedown of equipment following transit to the island. Complete hot run engine compressor washes were undertaken twice during the deployment. The helicopters were outside at the start and end of the operation. When wind speeds were forecast during this period that could damage the aircraft, the blades were removed and laid in the tussock.

Helicopter fuel use

Helicopter fuel was conservatively provisioned because of the remote site. The purchased volume was 30150 litres. Of this 18850 litres was used for a total of 94 hours of flight time at an average consumption of 200 litres / hour. The remaining 11300 litres was returned and sold at the end of the operation. Of the fuel purchased, 2500 litres was held for specifically for refueling rescue helicopters if a medivac was needed. Contingency was required as helicopter operations to unload and load the ship could have incurred additional transit time if forced to operate away from the northern end of the island. However, the amount of unused fuel created additional work to handle on and off the island and it is recommended that provisioning be conservatively less conservative.

8.2.2 Environmental monitoring

Environmental monitoring was undertaken during the operation to record incidental impacts, for example the disturbance of Antipodean albatross chicks on nests near the load site.

Albatross

Bait pods were positioned at the load-site to avoid turbulence from nearby hills for helicopters hovering to fill bait buckets; and to avoid as far as practicable, impacts on Antipodean albatross chicks on nests over winter. Upon arrival, the load site was mapped and all nearby active nests were marked with stakes to stop people inadvertently walking too close. Seven albatross chicks were within 50m of active areas at the bait loading site, exposed to the highest level of helicopter activity (see map in Appendix 2). Helicopters were active at the load site on 16 days of the 70 days they were on the island. While helicopters were hovering to load bait, nearby chicks were sometimes affected by rotor wash for up to two minutes at a time. Chicks on nests were observed as the first loads were being flown to the load site and throughout the bait loading period.

The bait loading position moved along the line of pods as they were emptied so there were few occasions were chicks were affected by strong rotor wash. When exposed, chicks stayed sitting on the nest, tucking their head down or under their wing without obvious alarm. In most cases the response was like that observed during frequent stormy conditions. Contrary to this behavior, chicks would snap their beak and display obvious alarm at a person approaching too closely. On two occasions an albatross chick (from nest #166) was uplifted from its nest during loading as the wind direction and limited number of remaining bait pods meant the position of helicopter would have directed severe rotor wash towards it. The chick was placed in an empty wooden pod lined with tussock and enclosed for up to 3 hours. It was asleep when retrieved from the pod on the first occasion and again seemed settled on the second occasion. It transferred back to its nest without any issues, fledging in February 2017.

Adult birds were occasionally observed feeding chicks near the load site on operational days. At times the helicopters were grounded until feeding was complete. All seven chicks within the load site were alive at the completion of operations and six of the seven (86%) fledged successfully in early 2017 (nest #331 died). Outside the load site the fledging rate of chicks alive at the time of bait sowing was 90%; this difference is not statistically significant (personal comms, G Elliott, 2017). The fledging success of the albatross on the northern plateau in summer 2017 was comparable to the other study sites on Antipodes Island (Walker & Elliott, 2017b).

Grey Petrels

Grey petrels nest in burrows and are the only seabird other than the Antipodean albatross, breeding on the Antipodes over winter. The burrow hazard was only identified when the load site was being setup. Bait pods were placed to avoid covering active burrows and burrow entrances were spray painted with dazzle to avoid staff tripping or damaging a burrow. Only a small percentage of the Grey petrel breeding population (estimated up to 56,000 pairs) nested at the load site. Grey petrels are active at night and none were seen during activities at the load site. Grey Petrels were not monitored because of the low risk.

Non-target impact

No formal searches for dead birds were conducted following baiting due to the logistics and the difficulty in finding carcasses in the thick vegetation. Some dead birds were found incidentally while staff were traversing the island. Results are recorded in the table below. All the carcasses found showed obvious signs of brodifacoum poisoning except for the snipe that displayed no obvious sign of hemorrhaging but were emaciated. Unexpectedly, liver samples from the snipe tested positive for brodifacoum but distance sampling show no widespread impact on snipe from the baiting operation.

Species	Number of dead birds found
Antipodes parakeet	1
Reischeks parakeet	1
Pipits	3
Snipe	2
Mallard duck	1

Table 10: Dead birds found on Antipodes Island following bait application

Vegetation disturbance

Operational sites were recorded using GPS to guide future weed surveillance and monitoring the recovery of vegetation disturbance. A map of the operational sites can be seen in Appendix 1. Files (gpx) for upload to GPS, and photographs of the operational sites are available on DOC's Southland S:\Drive.

9. Project outcomes

The outcomes of the project are measured against the project objectives (see section 3) and presented here. In January 2017, five months after completion of baiting, two albatross scientists visited Antipodes Island for five weeks to continue a long-term study on Antipodean albatross. They also undertook preliminary outcome monitoring tasks for the eradication project: weed surveillance and control; distance sampling to monitor parakeets and pipits; and recording snipe encounters. Preliminary results are presented here. Monitoring to determine the success of the eradication and the next stage of outcome monitoring is planned for February 2018. This section will be updated once the results from that work have been collated and assessed.

Objective 1: Successful completion of baiting operation to eradicate mice from the Antipodes Island group

Outcome 1.1 Mice are eradicated from the Antipodes Islands Indicators: · No sign of mice detected in monitoring and surveillance network two breeding seasons after poisoning

Monitoring

Monitoring is planned for late summer 2018 and will involve sign searching for mice on Antipodes Island using rodent detection dogs and a network of monitoring devices.

Results

- The baiting operation was successfully completed in winter 2016 as described in section 7.2.
- Result of the eradication attempt on mice to be reported in 2018.

Objective 2: Natural ecosystems recover and are protected against further impacts; the conservation value of the island group is enhanced; species recover.

Outcome 2.1 Short-term adverse effects of the bait operation area broadly understood Indicators: · Distance sampling of pipits and parakeets shows a decrease in abundance following baiting if species impacted · Mark-recapture study of pipits shows a decline in pipit counts immediately after baiting if impacted · Encounter rates of snipe decline if impacted · Birds seen feeding on bait; carcasses of non-target species are found and dissected confirming bait uptake if species impacted

Monitoring

Distance sampling (for pipits and parakeets) and recording encounter rates (for snipe) has been conducted on Antipodes Island since 2013 to estimate the populations before and after bait application to eradicate mice. Distance sampling and encounter rates were repeated by the operational team immediately before baiting and in the weeks after baiting was complete to capture any immediate impacts. A basic mark-recapture study of pipits was also undertaken around Reef Point during the operation as distance sampling was difficult in coastal areas where pipits seemed to frequent in winter. Further distance sampling and snipe encounter monitoring was done by the albatross scientists in January 2017 to improve the understanding of short-term impacts. Monitoring will be repeated in late Summer 2018 to see if species have fully recovered or benefitted.

Results

- To be updated in 2018.

Distance sampling results are presented in the tables below, which include the most recent survey results for the Jan/Feb 2017 period (grey shading) and represent an update of the estimates of density and abundance for both species of parakeets and pipits. The results show that a significant number of pipits and parakeets probably succumbed to brodifacoum poisoning from the baiting operation to eradicate mice. However, the populations of all three-species sustained and have increased significantly from post-baiting levels in 2016 by early summer, 2017. This increase is particularly noticeable for Reischek's parakeets and pipits. A large decline in the number of pipits was expected as some pipits were found to consume bait during non-toxic bait trials in winter 2013 (Elliott et al, 2015). The large decline in parakeet numbers was not anticipated by the same trial. During the operation, some pipits were observed occasionally pecking at baits. Some baits were also found to have been chewed by parakeets with most of the pellet left behind, seemingly removing only part of the contents.

Please note that estimates based on small samples sizes (*n*) should not be relied upon as reflected in excessively large estimates of precision (Greene, 2017), The weather was significantly wetter during post-baiting sampling in July 2016 than during surveys immediately before baiting. The distance sampling technique relies on positive sightings of birds, which are less conspicuous in poor weather, possibly exaggerating the estimated population reductions.

Table 11: Distance sampling results for parakeet species and pipits on Antipodes Island, 2013 to 2017

Species	Survey Date	n	Density/ha (CI)	Abundance (CI)
Reischek's parakeet	July 2013	29	2.3 (1.6-3.5)	4779 (3211-7113)
	Feb 2014	46	2.1 (1.5-2.9)	4287 (3119-5894)
	Oct Nov 2014	61	3.2 (2.4-4.3)	6478 (4828-8692)
	Pre-baiting 2016	63	3.2 (2.4-4.4)	6569 (4825-8944)
	Post-baiting 2016	173	0.6 (0.5-0.7)	1127 (921-1381)
	Jan-Feb 2017	63	1.9 (1.5-2.6)	3930 (2946-5241)

Species	Survey Date	n	Density/ha (CI)	Abundance (CI)
Antipodes parakeet	July 2013	16	0.9 (0.5-1.7)	1817 (981-3366)
	Feb 2014	37	1.5 (0.9-2.5)	3002 (1816-4964)
	Oct Nov 2014	22	0.6 (0.4-1.1)	1275 (750-2168)
	Pre-baiting 2016	22	0.5 (0.3-0.8)	922 (536-1584)
	Post-baiting 2016	116	0.3 (0.2-0.4)	527 (360-772)
	Jan-Feb 2017	31	0.7 (0.4-1.1)	1397 (852-2292)

Species	Survey Date	n	Density/ha (CI)	Abundance (CI)
Pipits	July 2013	4	0.2 (0.1-0.5)	427 (164-1110)
	Feb 2014	39	1.2 (0.8-1.8)	2480 (1658-3711)
	Aug 2014	4	0.9 (0.4-2.4)	1867 (718-4857)
	Oct Nov 2014	108	1.2 (0.8-1.8)	2394 (1596-3591)
	Pre-baiting 2016	101	3.2 (2.3-4.5)	6471 (4643-9020)
	Post-baiting 2016	40	0.2 (0.2-0.3)	458 (332-632)
	Jan-Feb 2017	62	1.1 (0.8-1.6)	2245 (1572-3205)

Pipits

In addition to distance sampling a basic mark-recapture study was undertaken around Reef Point for pipits. Some pipits were killed by the poison, but the mortality rate is difficult to estimate. Explicit estimate of apparent mortality from the mark-recapture analysis do not distinguish between birds dying and birds leaving, and some of the birds that "apparently" died probably just left the study area. At the time of baiting pipits were neither breeding nor territorial and they may have wandered widely. The mark-recapture estimate of 82% mortality is almost certainly an over-estimate. Analysis of the counts suggests that the mortality rate was indeed much lower as the counts declined by only about 30% during the surveys. Mortality may have continued after the surveys stopped (Elliott, 2017).

Table 12: Pipit apparent survivorship after aerial baiting estimated using Cormack-Jolly-Seber mark-recapture techniques, taken from Elliott 2017.

	Apparent survival	Lower 95% confidence interval	Upper 95% confidence interval
First bait treatment	0.40	0.20	0.60
Second bait treatment	0.56	0.20	0.81
Both treatments	0.18	0.06	0.35

Snipe

Snipe abundance decreased dramatically and significantly between 2015 and 2016 prior to the eradication operation. There was almost no change between 2016 and 2017 showing there was no dramatic by-kill of snipe during the mouse eradication. It cannot show any benefit as this would not be detectable until the next cohort of young snipe become independent. Furthermore, because there appears to have been a recent dramatic decline in snipe abundance prior to the eradication operation we will not be confident of any benefit of snipe from the mouse eradication until snipe rise to above their 2013-2015 levels: this may take several years.

Figure 25: Snipe encounter rate on Antipodes Island 2013 to 2017

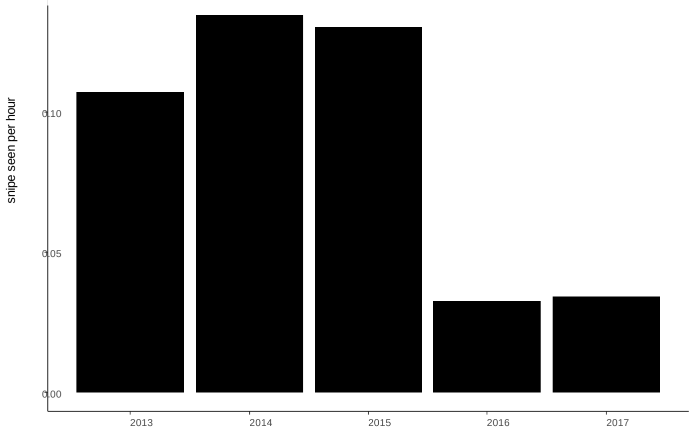


Table 13: Results of snipe encounter rate surveys on Antipodes Island between 2013 and 2017

Year	Hours	Snipe	Encounter rate	Change between years	P
2013	341	38	0.111		
2014	207	26	0.126	1.26	0.46
2015	141	17	0.121	0.97	0.93
2016	178	6	0.034	0.25	0.01**
2017	224	8	0.036	1.04	0.94

Outcome

2.2 Invertebrates recover

Indicators:

- Pitfall traps and leaf litter sampling show invertebrate species increase in abundance; taxa thought to have been wiped out are detected
- Monitoring with light traps shows that invertebrate species increased in abundance

Monitoring

Follow up monitoring is planned for late summer 2018

Results

- To be updated in 2018.
- The scientists visiting Antipodes Island in summer 2017 noted a greater abundance of flies (probably *Xenocalliphora antipoda*) and moths than in previous summers (over 20 years). Many flies were seen on flowers of native groundsel (*Senecio radiolatus*) and *Stilbocarpa Polaris* indicating flies are possibly an important pollinator for such plants.

Figure 24: Abundance of flies seen on native groundsel on Antipodes Island

Outcome

2.3 Plant species recover

Indicators:

- Potentially sensitive indicator species increase in abundance and distribution at measured sites
- Invertebrates previously absent pollinate flowers

Monitoring

Thirty-seven vegetation RECCE plots were established on Antipodes Island in 2014 and baseline measurements made. Follow up monitoring is planned at least ten years later, measuring presence and abundance of potentially sensitive indicator species (*Senecio radiolatus ssp. antipodus; Lepidium oligodontum* and *Stilbocarpa Polaris*) in vegetation plots.

Results

- To be reported when monitoring is undertaken from 2026 or beyond.

Outcome

2.4 The populations of parakeets, pipits and snipe benefit from the eradication of mice

Indicators:

- Distance sampling for parakeets and pipits; and measurements of encounter rates for snipe show populations have increased and stabilised above pre-eradication levels

Monitoring

Distance sampling and encounter rates will continue to be measured annually as the opportunities allow.

Results

To be reported in 2020

Objective 3: Biosecurity is managed during the operation to prevent the introduction or distribution of pests within the island group

Outcome

3.1 Mouse-free status of offshore islands is maintained

Indicators:

- Sign searching on Bollons Island show no sign of mice two summers after eradication

Monitoring

If practicable rodent detection dog(s) and handler(s) will access Bollons Island to search for sign of mice. Static monitoring tools will not be used unless the likelihood of returning is high (weather dependent).

Results

To be reported in 2018

<u>Outcome</u> 3.2 Weed species, diseases, pathogens, foreign invertebrate species and mammalian pest species do not establish because of the operation. <u>Indicators</u>: · Weed surveillance finds no new weed species have established · Invertebrate sampling finds no new exotic species have established · Sign searching two summers after eradication attempt finds no sign of mammalian pest species

Monitoring

Large bare areas of ground were created from the activities of the eradication operation, which are expected to quickly recover (estimated 2 to 3 years based on slip recovery). The sites most impacted were the access tracks, temporary helipads, hangar site, in front of the biodiversity hut, and the load site. The operational sites were recorded with a handheld GPS to guide future weed surveillance. A map (see Appendix 1) and associated GPS files (gpx) of waypoints and operational areas can be found linked here on DOC's Southland S:\ Drive. Weed surveillance was conducted twice, by two different staff in the final two weeks of the operational phase with no weeds found. In February 2017 visiting albatross scientists repeated weed surveillance

Weed surveillance will be followed up again in summer 2018 and monitoring for invertebrates and rodents in 2018 will further inform the outcome.

Results

- To be updated in 2018 and 2020

Weed surveillance in summer 2017 found two weed plants, both previously unknown to Antipodes Island. A small plant of broad leaved dock (*Rumex obtusifolius*) was found near the biodiversity hut and a seedling koromiko (Hebe salicifolia, the willow-leaved hebe), native to the South Island of New Zealand and to Chile was found at the hangar site. *Poa annua* existed on the island previously but with restricted distribution. As much as possible was removed from the exposed sites, which helped surveillance for other weeds (Walker and Elliott, 2017a). The finds show the value of revisiting a remote site soon after such high-risk activities

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Objective 4: Improved understanding and knowledge of techniques for eradication of mice

<u>Outcome</u> 4.1 Increased capability in DOC's Southern region and DOC in general to manage mammalian pest eradications. 4.2 A robust record of the eradication project 4.3 Lessons contribute to knowledge base <u>Indicators</u>: · Sign searching on Bollons Island show no sign of mice two summers after eradication · DOC staff nationally and in DOC's southern region contribute to and learn from involvement in the project · Project documents are completed and available for reference including Project Report · Lessons from the project are captured and disseminated to relevant audiences

Monitoring

Staff involvement is reviewed and project documentation are referenceable.

Results

To be reported in 2018

- The Project Manager and Logistics Manager were members of the project team based in DOC's Southern South Island region. The Murihiku operations team were heavily involved in preparations in the last 6 months leading up to departure. Biosecurity was a major part of preparations with up to 10 people involved at times, including three biosecurity rangers from northern regions participating in quarantine in Invercargill to support the team and share knowledge. Jo Hiscock provided significant support navigating marine biosecurity for the Norfolk Guardian, liaising with NIWA, MPI and the Navy.
- The suite of project documents includes a Project Plan, Operational Plan and this Project Report, capturing the management, methods, delivery and early indications of outcomes. The project has a 'Home Page' where all relevant documentation is linked for future reference: DOC-1465166. An After Action review was conducted to capture lessons which are presented in section 10 of this report.
- The project will be presented by the Project Manager at the Island Invasives Conference 2017 in Scotland. A paper on the project will also be included in the conference proceedings.

Objective 5: The sense of value for the Subantarctic region is developed and the project is showcased as a successful collaboration.

Outcome 5.1 Stakeholders and the community are provided sufficient information and feel engaged 5.2 Recognition of New Zealand's Subantarctic region and public knowledge and appreciation of Antipodes Island is improved Indicators: · Feedback from stakeholders and the public is positive · Interactions with the project's media channels indicate the public were engaged

Monitoring

Consultation with project partners; recording media activities during pre-operational and operational phases and project debrief.

Results

Feedback from project partners was constructive and overwhelmingly positive. WWF-New Zealand said this was one of the most productive communications partnerships they had been involved with. In the eight months leading up to and including the operation a total of 15 videos and 69 blogs were published. The Morgan Foundation produced 3 videos and raised the profile of the project through their website's 'Whiteboard Friday' sessions and supporters network. Interest in the project was high and the media team achieved a high level of mainstream media coverage including seven primetime TV news stories (TV 1 and Newshub), interviews and commentary on RNZ and Radio Live and several print and online stories. Fairfax ran a series of three science island eradication stories and the project was covered by magazines including Wilderness, New Zealand Geographic, NZ boating and NZ Today. Social media engagement peaked in the month of June 2016 with 23,906 views of the MDM website and 71,967 on the MDM facebook page. DOC social media also peaked in June at 77,710 views. Outreach was amplified by project partners including Island Conservation who also promoted the project in North America and through their networks in the Pacific.

10. After action review

10.1 What went well?

Team approach

The project was the result of tremendous team work. DOC staff from throughout the organisation contributed to planning, preparations and implementation with many going the extra mile to ensure the project came to fruition. Key suppliers and advisors were critical members of the "project team" contributing widely to planning and problem solving. Having excellent team leaders in key roles in the operational team was critical to success.

Project managers need to be great team leaders

Stakeholder support

Collaboration with committed partners provided the impetus to undertake the project. Project partners (Public donors, The Morgan Foundation, WWF-New Zealand and Island Conservation) supplied an essential component of the funding and positive relationships were formed that will enable future cooperation.

Well managed partnerships can provide opportunities to make projects happen

Communications

The operational phase of the project achieved a high level of positive media coverage, well supported by the national media team. Informative, open and engaging content was available on a range of media, including regular updates on prime-time slots with T.V. and radio outlets as well as the project's social media channels. The early establishment of the Million Dollar Mouse website and a part-time communications role provided a vehicle for engagement and complemented media releases with background and extra detail. Establishment of a satellite internet connection on the island transformed communications allowing videos to be posted and interviews to take place. Good buy-in from Project Partners and postings through their networks broadened the outreach.

Great media coverage didn't just happen, it was planned and took a lot of work by many team members.

IEAG

The expertise and support provided by DOC's Island Eradication Advisory Group (IEAG) was particularly beneficial to the project. The IEAG was engaged from the early stages of the project, providing technical advice and review that contributed hugely to achieving the robust planning required for a complex project. The group provided steadfast focus on outcomes and their input gave managers confidence in the preparations. An IEAG review of the project 8 months from implementation was crucial in achieving local prioritisation.

The IEAG can help, make them part of your planning team early in the project

Steering committee

Seven months from implementation a Steering Committee was formed to support the Project Manager with resourcing and decision making on issues beyond his control. While this was late in the project, it had the effect of greatly improving senior manager engagement in the management of the project amid many competing priorities in the region.

Large complex projects need teamwork in management oversight with a focus on supporting the project manager.

Health and safety

The operation was carried out safely with a high level of reporting. Independent review of the safety procedures and emergency plans improved quality and gave assurance to the accountable manager. Experience in the field team was important for carrying out the varied tasks safely. A Safety Officer role provided capacity to monitor activities and ensure incidents were recorded and well reported. A DOC team worked onboard the Norfolk Guardian during unloading and loading, helping to manage the ship crew's inexperience with helicopter operations. Critical during these operations was the role of Loadmaster, communicating with the pilots as loads were taken from or received at the ship. A high level of medical support was available on site and a plan in place to facilitate a medivac. The presence of the Evohe during loading and unloading provided rapid response capability.

Good preparation, experienced team members in critical roles and a strong focus on safe procedures develops a strong safety culture.

Biosecurity

The task assignment approach to biosecurity was a good way to get the plan off the page and actioned. DOC expertise in biosecurity was vital and biosecurity staff were drawn on from around the country to manage the risk posed by a major expedition to a sensitive site. DOC's dedicated quarantine store in Invercargill performed well and handled much of the gear to be checked. A dedicated team who understood the project checked large plant and equipment coming from multiple sources. Inter-agency support from NIWA, RNZN and Auckland Council was critical in managing biosecurity risks from shipping.

Biosecurity actions need to be planned, coordinated and assigned to competent people

Non-target species

Early indications from non-target research on the island highlighted a potentially serious risk to some endemic species. Mitigation options were limited but this issue was dealt with well by engaging a small group of experts to consider the risk and mitigation options and provide a recommendation for senior DOC managers. This effectively reduced the churn of the issue when it formed part of the permission applications.

For difficult non-target issues, get expert help and a solid management decision on mitigation

Testing and practice pre-departure

Several 'mission critical' aspects of the project had not been done before with the equipment or people involved. To manage the risk of unforeseen problems, many of these were trialed pre-departure. Trials identified important improvements to equipment and procedures, ensuring the function of contingencies and familiarising those involved with what to expect.

The helicopter hangar was erected in Invercargill as a rehearsal. This identified a problem with some componentry which was rectified with the supplier. It also identified a safety risk which allowed erection procedures to be improved. A helicopter and ship interaction trial allowed the pilots and ship's crew to practice with helicopters operating from the ship and to prove methods for stowing. Bait sowing and GPS equipment were also tested.

Test and practice new systems and equipment as far as practicable before departure. Allocate enough time and resource to familiarise the team.

Performing suppliers

Many of the key suppliers for the project were highly dedicated and had a genuine interest in the outcomes of the project, exceeding expectations in their delivery of services. Face to face meetings are beneficial to establish understanding and resolve issues. Developing a relationship with suppliers achieves a better outcome than a contract alone can. IASL contributed hugely to planning and provided professional service and leadership during the operation. The skipper and crew of the yacht Evohe provided outstanding service over a two-year period during the pre-operational and operational phases. The Norfolk Guardian team worked hard to meet the demands of the project and did a fantastic job at Antipodes Island. Alpine Joinery produced high quality bait pods and went out of their way to provide logistical support in Timaru. ACP (now Orillion) produced high quality bait, delivered on time and to specifications. ISO donated marshalling services at Primeport Timaru.

Suppliers are part of the project team. A partnership approach with key suppliers with constant communications pays off

Operations

Baiting a small area during a brief weather window on day one was a useful shakedown to familiarise the team and verify function of critical equipment. Using every available weather window to complete the bait application in the changeable conditions proved to be a good strategy. On-island problem solving capability allowed situational assessment to make well thought out decisions. The use of AS350 squirrel helicopters with 800kg to 900 kg lift capacity was an efficient choice for handling cargo and bait spreading.

Plan and prepare equipment to use all available weather windows at a site with inclement weather

Team unity

The team functioned well in a tight living space for the nearly 3-month expedition. Strong team unity and enjoyment was achieved by several initiatives. Good food and an outstanding and convivial Chef was important for keeping everyone happy. Other important factors were team selection, social occasions, provision of recreational space, availability of hot water for an occasional shower, access to communications home and celebration of milestones.

Personnel selection is vital to the function of a team

Dedicated Project Manager and Assistant Project Manager

From January 2014, a dedicated Project Manager was in place to develop planning and progress stakeholder relationships for the project. An Assistant Project Manager was appointed in September 2014. Although in hindsight more resources were required earlier, progress was limited until these dedicated positions were filled.

Eradication projects need full time staff

DOC's Animal Pest Framework.

DOC's Animal Pest Framework has a well-developed, logical, and well tested structure with associated processes and tools. These processes and tools were used during the project to guide operational planning and preparations.

DOC has a tailored project management system for eradication projects which works

DOC's Legal Services Unit

Excellent support was received from DOC's Legal Service team in preparation of the complex supply contracts. The Assistant Project Manager worked closely with the DOC Solicitor to test that DOC requirements were met. Having a lawyer assigned to the project allowed them to build knowledge and provide oversight. Legal advice was invaluable in ensuring the implications of interrelated contracts were considered and managed. This helped to safeguard DOC from unnecessary risks as the failure of one supply contract could have jeopardised several others. The effects of such a situation had the potential to be severe, resulting in delayed departure or postponement of implementation for a year with major penalties applied.

Good contracts need teamwork and understanding between legal staff and operational staff and a partnership approach with suppliers.

DOC GIS support

The GIS technician was appointed 7 months before the operation. She prepared equipment, engaged with partners and suppliers and performed an important role in planning. This early involvement allowed for good preparedness for baiting. The DOC GIS team provided dedicated support and prioritised the project nationally. They also wrote a script to improve the efficiency of importing and sorting flight data. The appointed GIS technician was involved in bucket calibration and pre-departure testing, gaining important project knowledge before departure.

Skilled GIS support is essential and should be engaged in a project early

10.2 What had an impact on the project?

The project was subject to pressures and influences during its lifetime. Below are the things that stood out as having an impact on the cost, time, and quality of the project but were beyond the project manager's control.

Weather

This was the biggest influence on operational activities and one of the biggest operational risks. The weather broke at the right times to support timely offload of the ship at the start of the operation. The timing of weather windows also allowed offload of essential equipment and supplies just as they were needed, enabling almost continuous progress with the infrastructure setup. Changeable weather was dealt with using the prescribed gradual baiting approach and a well-prepared team. Good weather enabled a quick demobilisation and ultimately saved thousands of dollars.

Plan the operation and budget the project to allow flexibility for known variables outside of the span of control

Project initiation

A proper feasibility study and detailed project costing were not completed before initial commitments had been made to external partners, including the "Million Dollar" price tag that was widely publicised during the fund-raising campaign. The project may have never been initiated without committing to this partnership opportunity. However, once investigations had established a realistic project cost, it was clear this was a larger financial undertaking than expected. The situation put pressure on DOC to find the additional funds and risked the perception of DOC's ability to manage projects to budget.

Feasibility is an important step in understanding the complexity of a project

DOC review & restructure

DOC initially struggled to make decisions or support the planning and pre-operational elements of the project due to the organisational restructuring during 2012 and 2013. This disruption continued into 2014 with vacancies in important positions from time to time. In total four different operations managers filled the role above the project manager with the final appointment made in late 2015, barely five months prior to departure.

Restructuring has hidden costs which can manifest for years to come

Procurement process

The procurement process was not designed with eradication projects like this in mind. There are often few potential suppliers for highly specialised skills and complex risks and the 'Buyer' (DOC) often needs the supplier more than they need the work. DOC's processes were often overly-bureaucratic and challenging for suppliers. Eighteen months passed between the initial request for proposal process and finally contracting a ship and helicopter suppliers after an exemption to Government procurement rules was granted. This undoubtedly contributed to the project being delayed by a year.

These 'expedition style' eradication projects demand high levels of skill and engagement with suppliers to deliver. From the aviation perspective, they are not financially attractive because the risks outweigh the financial benefits with very limited compensation for the opportunity cost of having aircraft unavailable for more lucrative work on the mainland. Often the requirements for built in redundancy in the aircraft, equipment spares, pilots and emergency response means the complexity of a 'normal' eradication project closer to the mainland is enhanced by the need to form partnerships among the suppliers. Operating a helicopter under another operator's licence requires significant additional and time-consuming approval from the Civil Aviation Authority. In this project, the principal contractor for aviation (IASL) required sub-contracts for engineering support, spares, additional aircraft, and back up pilots. For the Antipodes project, there was a 'chicken and egg' situation where, because it was too far to fly directly, the contract for the ship that would carry the aircraft and need unloading/loading by helicopter- was an inescapable influence on the risks and costs for the aviation contract. The procurement process had to progress both contracts simultaneously.

The shipping procurement had its own challenges. Again, the requirements for the vessel and its availability meant that there were few potential suppliers and costs were highly dependent on finding the 'Goldilocks' vessel which was big enough to meet the requirements but not too costly. This ideal size vessel is a diminishing resource of 'coastal trader' vessels, most of which are either scrapped or working in the Pacific Islands and usually registered offshore, requiring an authorisation from Ministry of Transport (MoT) to engage. It is important for future projects of this nature that we improve the adaptability of procurement processes by changing the basic underlying premise of '*many suppliers in competition to supply at a competitive price*' to '*scarce suppliers who meet our requirements and are not keen to engage without first establishing a trusting relationship*'.

Simplify procurement for specialist services to prioritise relationship building

Delegations and contract

Procurement approvals were time consuming. The procurement process for high value contracts involved significant documentation and approvals from several tiers of management at many stages. For example, procurement for helicopter services required approval from three tiers of management (Operations Manager, Director Operations, Deputy Director General Operations) in succession for the following documents: Procurement Plan, Tender Documents (RFI and RFP), Tender Evaluation, Exemption Form, Contract Approval form and eventually the Supply Contract. The Supply Contract required approval from the Director General and assurances from the Procurement Manager, Legal Services and the Financial Director. Conflict of interest forms were approved by the Operations Manager for each contract. The process of attaining approvals in hierarchical order from many busy people required focus and time. Lifting financial delegations to Tier 4 meant the Project Manager had no delegation until early 2016 when Tier 5 delegation lifted to $1000.

Delegate approval of large-scale procurements to the accountable Director Operations following approval of business case at relevant delegation.

DOC's financial management & Business Planning

This project was overlooked in initial business planning in 2013/2014 (although the information was ready and provided). A Business Case was finally approved in 2015 after initial rejection and scaling back of the budgeted timeframe to 120 operational days. However, no budget was allocated with the project activities funded from underspend in 2015 and 2016.

Financial delegations in DOC have been pulled back to Level 4 managers and above. This caused unnecessary delays chasing busy managers to sign off expenditure which has already been scrutinised and agreed to in the business case. Tracking costs has been fraught as it is almost impossible to relate the costs as agreed in the Project Plan to DOC's financial management system without allocation of a budget in business planning. A parallel system of cost tracking was therefore required by the project manager. Additional administrative support should be budgeted to manage finances.

Priority projects initiated outside of the planning cycle must be supported to be included as soon as possible.

Internal DOC capacity

Support for the project manager was initially difficult to come by as there was a lack of recognition for the project's priority nationally, and locally staff were fully committed on other projects. Although this was a simple matter of priority to rectify, it did not happen until the IEAG review in late 2015 and subsequent setting up of the Steering Committee. Support improved greatly at this point, aided by the amalgamation of the project into Murihiku Office.

Managers must champion the work and support early prioritisation of resources to enable team work

Shipping contract

The shipping contract required the supplier to develop systems and protocols for activities that were outside of their "normal" operations. As for helicopter supply, development of the shipping contract was a process of collaborative investigation and adaption to DOC's requirements and those of regulatory authorities. The shipping contract was not to be 'set and forget'- in fact quite the opposite. Marine biosecurity was an area where a huge amount of work was required from several agencies to reduce risk and ensure readiness.

Suppliers are part of the project team, some need more support than others, plan for this.

The Navy

At the beginning of the project, Navy support was being relied on for shipping and to subsidise cost. The Navy provide valuable support for DOC with routine offshore island work but the risks are far too high for eradication projects which have fixed timelines and specialist requirements. The Navy lack the flexibility in scheduling and have constraining operational parameters that make it difficult to meet the demanding needs of a specialised project. The Navy's priorities remain national defence and disaster relief. Cancellation of Navy support for the Antipodes (Operation Endurance) in 2015 and 2016 due to essential response to cyclone damage in the Pacific, highlights this risk. Hundreds of precious planning hours were lost as a result.

Don't rely on Navy support where complex parameters or critical timeframes exist.

Duplication of process

There has been considerable duplication of processes in this project especially in financial management and reporting. Some of these processes are conflicting such as Animal

Pests/Eradication best practice and Portfolio Management reporting requirements. In future, projects should attempt to adhere to one system or report to avoid duplication. For an eradication dictated by biology and seasons the well-developed and proven systems from IEAG and the Animal Pest Framework should be the ones to use.

Plan and agree the project management framework and reporting requirements during project design to avoid duplication.

10.3 What would be done differently?

In this section, we draw out lessons which are within the scope of the project to improve on for next time.

Project management

The purpose of the Project Manager role was to manage, coordinate and implement the project as set out in the Project Plan. The Project Manager had autonomy over day to day operational decisions within the scope of the project. Over the period of the operational planning and into the operational phase there was little respite for the Project Manager and Assistant Project Manager. Long hours were worked with almost no opportunities to take leave and recover with more deadlines looming. This requires more managing in future with supporting staff and an awareness by managers. The same situation has occurred in all recent rodent eradication projects run by DOC. Besides burn-out of key staff, one of the risks that went unmanaged was the Assistant Project Manager ends up too busy to provide the back-up for the project manager as originally intended (i.e. s/he won't be able to step up and keep the project on track if the PM is incapacitated). Unexpected and time-consuming issues occur and additional capacity needs to be available to overcome.

Large complex eradication projects need a bigger planning team available earlier. Identify 'Shared Services' needs at the project design phase so they are available when required.

Objectives

The objectives of a project have implications through the life of the project. The objectives set for this project proved difficult to quantify and measure in some cases.

Set clear, succinct objectives with outcomes that are informing and practicable to measure.

Governance

In many instances commitments to support preparations, planning and reporting were not achieved until late in the project's development including the establishment of governance. In deciding to undertake a large project with wide reaching implications, senior managers need to allocate time to engage and understand issues, constraints, risks and opportunities to provision the support needed.

Establish a relevant and suitably resourced Steering Committee with clear terms of reference as a primary step.

Finance

For a large-scale project funds need to be secured to give certainty to project team and suppliers. Ensure a budget is allocated. If the cost is unknown, then seek an initiation budget and work to understand the resourcing required and attain business case approval.

Large-scale projects must be budgeted and included in DOC Business Planning.

Health and safety

Pre-departure emergency training with the helicopter would have been better with more time devoted to it. On-island, a familiarity flight for the emergency specialist would have been beneficial should an incident have occurred. Emphasise use of toolbox talks during the day for change of task and extraordinary tasks.

Emergency readiness is an aspect of HSW that should have a stronger focus

Biosecurity

In hindsight, the project needed a dedicated biosecurity coordinator appointed to the planning team early to cope with the complexity of ship, aviation and cargo biosecurity required. Biosecurity planning was piecemeal at times with multiple people involved for short periods. The Biosecurity Plan needed to be updated to reflect the new status of the island (potentially mouse-free) before commencing the operation.

Develop a biosecurity team and use a dedicated biosecurity coordinator to plan and provide continuity in the delivery of biosecurity activities

Monitoring

As for biosecurity, monitoring planning and delivery was contributed to by multiple people at various stages. Monitoring needed to be owned by an expert who could take this off the project manager, oversee planning and coordinate science input to ensure cohesive follow through including analysis and reporting.

Use a dedicated person to plan and coordinate monitoring activities

Consents

If a Resource Consent is required agree on the process for decision making during the project design phase and stick to it. In the New Zealand Subantarctic region where DOC is the delegated authority, an external process is more transparent and probably more efficient. Aim for application 9 months early to account for possibility of public notification.

Use an external commissioner for a decision on Resource Consent

Communications

Early engagement by the national media team is desirable to optimise messaging and maximise outreach opportunities. This comes back to business planning and prioritisation of the project's access to shared services. The project was competing for with 'Battle For Our Birds' for support. It wasn't until a complaint was received from a project partner about media coverage leading up to implementation, that resourcing was allocated to the project and we could achieve the engagement that we did. Day to day communications capacity should be resourced within the project team.

National media team engagement is vital to drive wider media reach and manage risk

Partnerships

External partners can provide significant opportunity for communications, funding and knowledge sharing. Partners' expectations need to be understood, agreed to and managed to ensure the relationship is beneficial and benefits are shared. Dedicate time to this task. Eradications are not like pricing the purchase of 100 mattresses. The final cost and timeframe is dependent on variables often out of the control of the project team (weather, availability of key resources such as ships and helicopters).

Communicate the complexities and unknowns and be conservative on timeframe and budget until a solid plan is in place. Formally record agreements with partners.

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Figure 26: DOC staff with Norfolk Guardian crew at Timaru Wharf upon completion of the project

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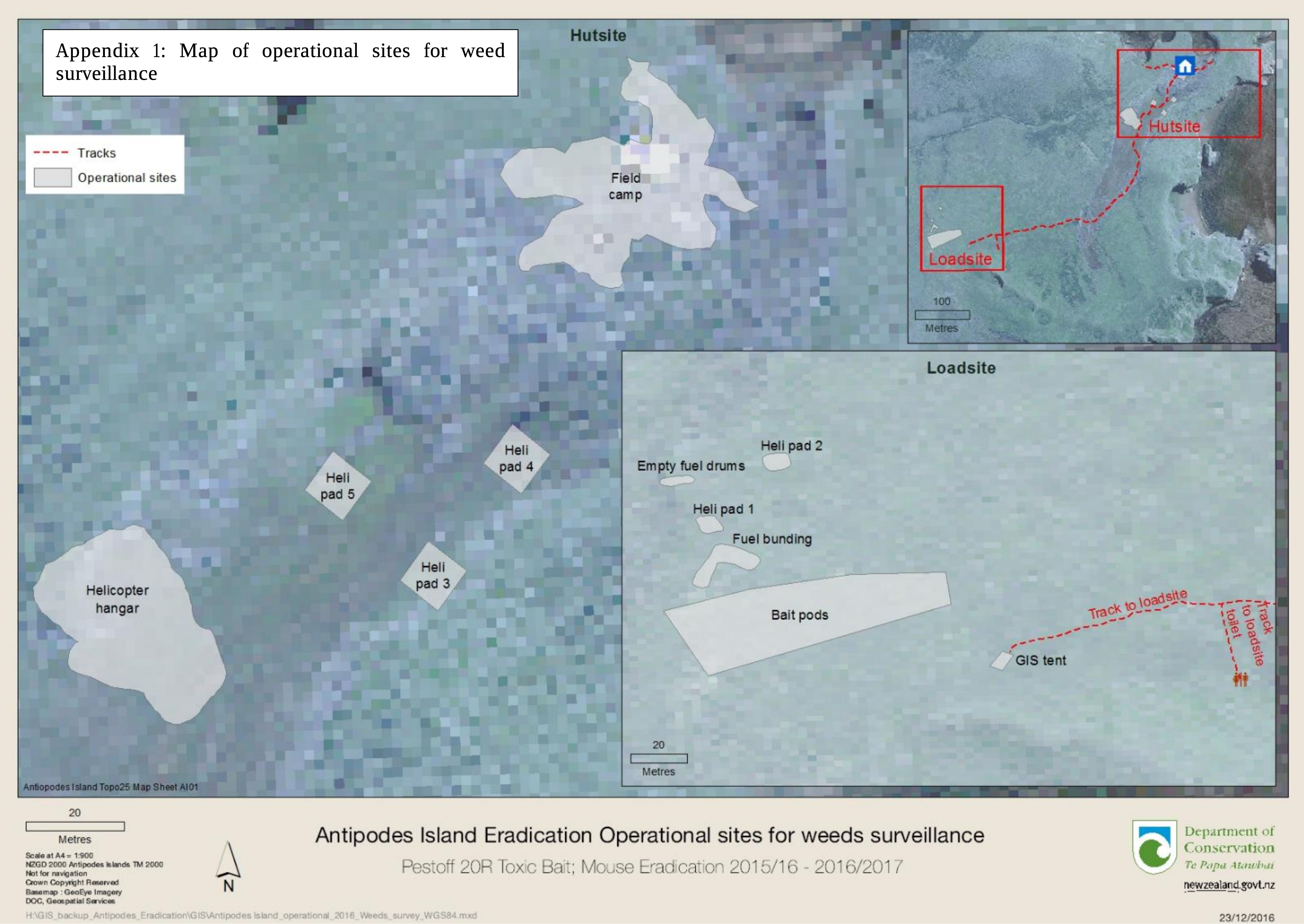
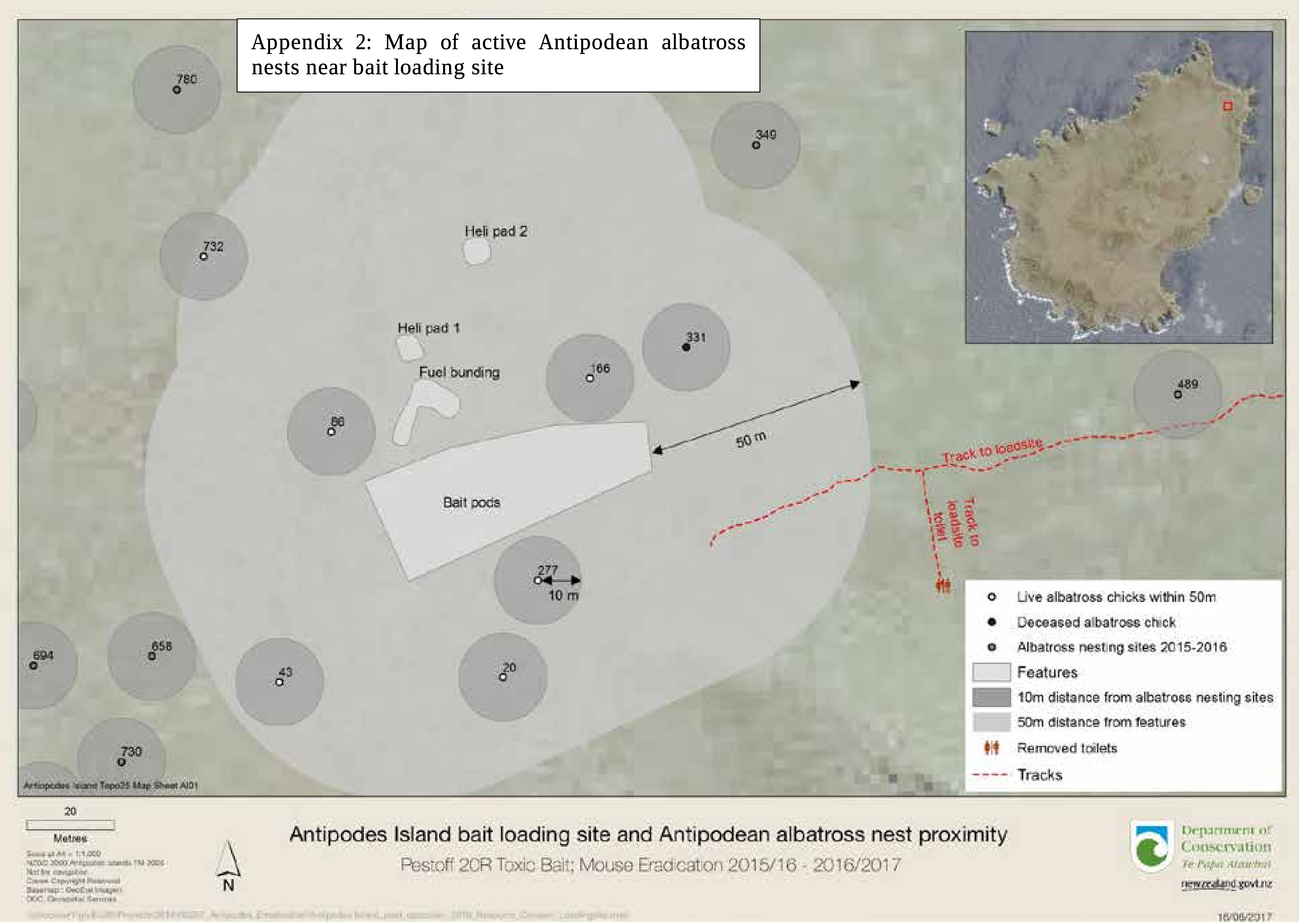
DOC and electronic files referenced

The Antipodes Mouse Eradication Homepage contains links to all relevant project documents and background information: DOC-1465166
Project infographic DOC-2765875
Treatment Maps: daily baiting maps can be found linked here on the Southland S/Drive
Shipping procurement checklist: DOC-2900925
Bait pod design:

Appendix 1: Map of operational sites for weed surveillance



Appendix 2: Map of active Antipodean albatross nests near bait loading site



Appendix 3: Resource Consent Conditions and compliance comments from auditor

No.	Condition	*Auditor response / Project Manager comment*
A1	Scope: "All activities authorised by this consent shall be carried out generally in accordance with the Application for Resource Consent dated 24th November 2015 and the accompanying Assessment of Environmental Effects titled "Assessment of Environmental Effects for the eradication of mice (Mus musculus) from Antipodes Island and associated islands, islets and rock stacks" Version 9 dated 24th November 2015, and the Antipodes Islands Mouse Eradication Operations Plan."	*Operational activities were consistent with the Operational Plan and AEE.*
A2	Term "All consents other than the exceptions listed directly below shall expire on 1 November 2020. Exceptions: The discharge of sewage from pit toilets to land where it may enter water. The discharge of greywater from the hut to land where it may enter water. Term of these two consents shall expire on 1st November 2050."	*Baiting completed on 12th July, 2016*
B1	Operational Plan and Notification to Consent Authority "The Consent Holder shall provide the Director, Planning, Permissions and Land with a copy of the Operational Plan at least 20 days prior to the helicopters arriving at the site on Antipodes Island. Any update to the Operational Plan shall be provided to the Director, Planning, Permissions and Land when the helicopters arrive at the site. The Consent Holder shall notify the Director, Planning, Permissions and Land when the helicopters have arrived on site."	*Condition met.* *Emailed Operational Plan and letter DOC-2776672 on 9/5/2016 to Director Planning, Permissions and Land. Director advised of helicopters arriving on site*
C1	Bait type and quantity "Pestoff® Rodent Bait 20R", cereal baits, approximately 2 grams in weight and about 10 mm in diameter, dyed green and containing 20ppm brodifacoum as the active ingredient (approximately 1.31kg of brodifacoum in total) shall be used for the eradication operation. The total quantity of bait used shall not exceed 65,500kg."	*65.5 tonne ordered and delivered to site. No other bait on site. All bait was used.*
C2	Excluded areas "Toxic bait shall not be discharged to Bollons Island and Archway Island.	*No baits were discharged to Bollons or Archway Islands; or Windward Islands. Bait discharge to coast of Anchorage Bay was applied with a "directional" bucket*

	Avoid, as far as practicable without compromising the operation, any discharge of bait directly into intertidal rockpools in Anchorage Bay, particularly at, or near low tide.”	*with a deflector to target application as best as practicable but some bait still entered rock pools.*
C3	Operational period “Discharge of bait shall only occur between the period 1st of June and 31st of October inclusive”	*Baiting commenced on 18th June 2016 and concluded on 12th July 2016.*
C4	Bait containment “Bait containment Prior to transport to the Antipodes the bait shall be packaged in securely fastened weather proof containers (pods) designed to ensure that the bait is protected from the environment and handlers and the environment are protected from the bait. During the operational phase on the island the bait shall be stored in the securely fastened pods until immediately required for helicopter bucket reloading.”	*Bait loaded into pods in Timaru on 28/4/2016 (22 tonnes), 7/5/2016 (43.5 tonnes) and stored securely at BTL in Timaru until shipping on 25th May 2016. Bait stored in pods on island until required for loading into helicopter bucket.*
C5	Bait storage location “Bait pod storage areas shall be determined on site by the Project Manager and the Chief Pilot in accordance with the Operational Plan, having regard to avoiding: accidental discharge of bait or helicopter fuel to freshwater or to the coastal marine area, and where possible and practicable, the nests of Antipodes wandering albatross (Diomedea antipodensis antipodensis) Bait pod storage areas shall be located at least 10 metres from albatross nests with chicks present.”	*Bait pod storage area met operational and regulatory requirements. Three wandering albatross chicks were near the bait storage area but none closer than 10 metres to bait pods. The bait storage site was not adjacent to marine or freshwater bodies.*
C6	Bait spreading “All aerial baiting using suspended buckets shall be conducted by pilots experienced in toxic bait discharge operations using this method. The flight lines for discharges shall be recorded by a Geographical Positioning System (GPS) guidance system and actual flight paths shall be downloaded and mapped in the final operation report required under condition D2.”	*Pilots Darron McCully and Tony Michelle are experienced in aerial baiting operations. Flight lines for aerial baiting were downloaded from aircraft GPS at each helicopter refuelling stop and at the end of each operational day.*
C7	Aircraft fuel storage and refueling “Until required for refuelling all aircraft fuel shall be stored in sealed drums inside a temporary secondary containment bund approved by a test certifier. Opened drums of fuel at the reloading/refueling site shall be stood on a plastic containment pallet approved by a test certifier.”	*Aircraft fuel was flown ashore and stored on their sides in approved bunds until required for aircraft refuelling. Note, the bund design collected rainwater and resulted in fuel drums lying partly in water for 2 months and thus more susceptible to rusting, and is likely to be a worse*

		scenario than this condition is attempting to avoid. Opened drums of fuel were stood upright on a plastic containment pallet.
C8	Accidental discharges and spills "In the event of any of the following accidental discharges and spills: any accidental or unintended discharges to the coastal marine area or to a stream such as the detachment or release of a bucket of bait; any accidental spillage of more than 1 litre of Jet A1 aviation fuel to fresh or coastal water; any accidental discharge of more than 1 litre of marine diesel or outboard fuel oil to coastal waters; or any significant accidental release of bait such as the detachment or release of a bucket of bait or spillage of more than 10 litres of fuel to land where it may enter water; the procedures set out below shall be implemented: All practicable steps shall be taken to contain and remove the discharge or spill to avoid, mitigate and remedy any adverse effects on the environment, Where practicable, relevant response and mitigation measures set out below shall be initiated, Bait spill: bait shall be recovered as best as possible using hand tools. Bait shall be re-used if feasible or if un-palatable or contaminated it shall be contained in a securely fastened pod for return to the New Zealand mainland for disposal. Fuel spill: fuel shall be recovered using absorbent materials if practicable and contained and sealed for disposal. If recovery is not practicable it shall be left to evaporate. (Note that no heavy fuel oils will be used.) The location, nature, extent and cause of the discharge or spill shall be fully documented. All response and mitigation measures and all observed adverse effects on the environment and wildlife shall be recorded and provided by way a written statement to the Project Manager and Director Planning, Permissions and Land as soon as possible."	*During helicopter operations to unload the ship after arrival one drum of Jet A1 fell from a torn net into the sea, and was not recovered. This incident was reported (#636546 in Risk Manager) and the Director, Planning, Permissions and Land was notified.*

C9	Wash down site location "The wash down area for plant and equipment used for the containment of toxins or contaminants shall be located to avoid wash down water directly or indirectly entering any stream or the coastal marine area. If waste water is to contain oil or petroleum, then additional measures (such as absorbent barriers) shall be utilised."	*Spill kit absorbent cloth used to dry bund near hut during pack down. Wash down area for equipment was at heli-platform draining down away from small stream to the west.*
C10	Pit toilets and grey water sumps "Pit toilets and grey water sumps associated with accommodation shall be located to avoid discharge directly or indirectly entering any stream or the coastal marine area. Temporary Pit toilets shall be covered in soil to the height of the surrounding land surface when full and at the completion of the operation."	*One additional toilet was installed to supplement the existing toilet. Pit toilets were located near the hut site where no discharge went to a stream. The water table is high and digging toilet holes had the water table a metre or less from the surface. Toilet holes were filled in as specified when they needed to be relocated. Toilets were left in place for subsequent use by hut users (researchers each summer). Grey water sump did discharge indirectly to a stream and was the existing set-up on arrival. No practical alternative is feasible with available resources. Grey water was filtered to remove any food particles*
C11	Taking and discharge of freshwater or seawater for aircraft hangar ballast "For the purpose of filling aircraft hangar ballast tanks fresh water may be pumped at a rate not exceeding 5 litres per second from a stream or streams provided that there is no significant reduction in the flow or water level below the intake point. Ballast tanks shall be clean and not previously have been used for storage of petroleum or oils. At the conclusion of the operation fresh water used as ballast may be discharged to ground provided reasonable care is taken to avoid localised soil erosion."	*Fresh water used to fill IBCs as ballast for aircraft hangar was sourced locally and pumped from a pool. Discharge was either to ground, or to supplement the hut water supply tank. IBCs were aquired that had previously contained water-treatment products for town drinking supply and were triple washed before tranpsorting to Antipodes Island.*
C12	Mooring anchor and rope "The temporary mooring anchor and attached chain to be laid in Hut Cove shall be cleaned of any sediment and marine organisms prior to use and the attached rope and buoy shall be new. The anchor, chain, rope and buoy shall be removed at the end of the operational phase."	*Temporary anchor and buoy were new. They were used in Hut Cove on Friday 27th May for offloading personnel and supplies from the SV Evohe tender onto shore, and removed the same day when this operation was completed. This process was repeated at the conclusion of the operation when staff left the island on 3/8/2016.*

D1	Removal and disposal of hazardous packaging and containers "Packaging such as bait bags and any other material used in the operation and contaminated with pesticide shall be removed from the Antipodes Islands on completion of the baiting operation and taken to the New Zealand mainland for disposal in a regional landfill. Empty fuel drums and oil containers and any waste oil or unused fuel (other than fuel retained on site specifically for future domestic requirements at the accommodation site) shall be removed from the Antipodes Island and returned to the fuel depot or other approved receiver for reuse, recycling or appropriate disposal."	*All bait bags and empty fuel drums were removed at the end of the operation and returned to the NZ mainland for appropriate disposal at the Timaru Landfill.*
D2	Reporting "Within 6 months of completing the baiting operations, the Consent Holder shall provide to the Director, Planning, Permissions and Land a written report on the operation that includes the following: How the resource consent conditions were complied with; Verification (including mapped GPS flight path information) that the bait application set out inthe Operations Plan have been achieved; A record of any accidental spill or discharge including all matters set out in condition C8; and Results of all monitoring undertaken. A copy of the report shall be publicly available and released on the Million Dollar Mouse Project website and the DOC website."	*Project Report (this report) supplied 10 months after operation completed following peer review and incorporation of monitoring work from summer work in 2017*
D3	Monitoring "The Consent Holder shall prepare a Monitoring Plan to achieve the following objectives, as far as practicable: Identify short-term adverse effects on non-target species; Identify any biosecurity incursions as a result of project activities; Evaluate the success of eradication of the mice; and Evaluate the effect of eradication of mice on natural ecosystems. The Monitoring Plan shall be reviewed by the Island Eradication Advisory Group. By 1 January 2017, the consent holder shall provide the Monitoring Plan and the Island Eradication Groups' review of the Monitoring Plan to the Director, Planning,	*A Monitoring Plan for outcome monitoring was prepared, peer reviewed and approved by DOC Operations Manager Murihiku and sent to the Director Planning, Permissions, and Land along with the Project Report.*

	Permissions and Land to certify that the Monitoring Plan meets the objectives outlined above. The Consent holder shall provide a final report on all monitoring undertaken to the Director, Planning, Permissions and Land by 1 November 2020. This report shall be reviewed by the Island Eradication Advisory Group, and this review shall be put on the Million Dollar Mouse website and the DOC website. The report shall include, but not be limited to, achievement of the objectives outlined above.”	