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Maukahuka Pest Free Auckland Island

Summary of Feasibility Study Report

Department of Conservation
Te Papa Atawhai

Maukahuka
PEST FREE AUCKLAND ISLAND

Te Rūnanga o NGĀI TAHU

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Maukahuka Pest Free Auckland Island: summary of Feasibility Study Report

Context

The feasibility study of a project (Maukahuka) to eradicate pigs, mice and cats from Auckland Island in the New Zealand Subantarctic Islands Area (NZSIA – Campbell (Motu Ihupuku), Antipodes, Bounty, Snares (Tini Heke) and Auckland Islands (also known as Motu Maha); 76 000 ha) has been completed by New Zealand's Department of Conservation (DOC). The purpose of the feasibility study is to understand the costs, benefits, risks and technical challenges associated with the proposed eradication project and allow informed decisions on its design to give it the best chance of success. It will also allow the project to be 'shelved' before large sums of money are committed, if the study indicates a high chance of the project failing. Feasibility studies are a standard part of DOC's eradication best practice.

More than 3 year's work has gone into understanding the feasibility of eradicating pigs (*Sus scrofa*), mice (*Mus musculus*) and feral cats (*Felis catus*) from Auckland Island. The feasibility study addressed three key questions: why do it; can it be done and what will it take? An evidence-based and expert elicitation approach was used, including extensive field trials to reduce uncertainty and test methods. DOC's Island Eradication Advisory Group (IEAG) and several other experts have provided technical advice and review. The feasibility study report provides a reference and justification for stakeholders. It outlines methodologies for the eradication of each target species, identifies the scale of the undertaking so it can be considered and resourced appropriately, and highlights the next steps needed for quality project design. Findings from the work to date are addressed in detail in the document to inform project planning.

Background

Invasive mammals are a threat to global biodiversity, especially on islands where endemic species are particularly vulnerable. Auckland Island (45 889 ha; 465 km south of Bluff; Figure 1), the fifth-largest island in New Zealand's economic area, our largest uninhabited island and the largest island of the Auckland Islands group (56 816 ha) is recognised for its outstanding natural heritage values. The Auckland Islands are a stronghold of taonga, harbouring remarkable and rare subantarctic flowers and animals. Their isolation in the productive waters of the Southern Ocean has shaped extraordinary adaptions and unique biodiversity, represented by 500+ native species. There are diverse communities of seabirds, land birds, marine mammals, plants and invertebrates, many of them endemic and of conservation concern. The island is recognised internationally through its status as a United Nations Educational Scientific Cultural Organisation (UNESCO) World

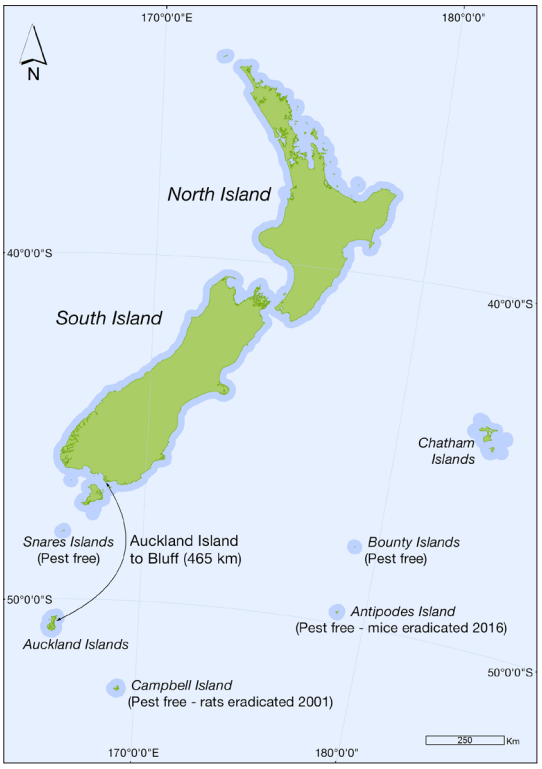

Figure 1. Location of the New Zealand subantarctic islands.

Heritage site, one of 213 recognised natural sites in the world and one of only two such sites in New Zealand. It is also a World Centre of Floristic Diversity (International Union for the Conservation of Nature; IUCN) and an Important Bird Area (Birdlife International). After nearly 30 years of pioneering pest control work in the NZSIA, Auckland Island is now the last of these islands where mammalian pests remain.

Why do it?

The Auckland Islands are the most biologically rich of the NZSIA. However, introduced pigs, mice and cats on main Auckland Island have inflicted severe ecological damage over the past 200 years and continue to erode the ecological integrity of the island (Figure 2). Native biodiversity is now severely diminished on Auckland Island relative to nearby pest-free islands in the archipelago.

Eradicating pigs, mice and cats from Auckland Island will achieve globally significant biodiversity benefits and many other consequential benefits including leverage for other large-scale conservation work, capability development and authentic collaboration with Ngāi Tahu and other project partners. Successful eradication of mammalian pests would complete the vision of a pest-free NZSIA and enable permanent recovery of native wildlife over time.

Figure 2. Pig (*Sus scrofa*) rooting has almost denuded Auckland Island of native megaherb species (B) as exemplified by comparison with similar habitat on pest-free Enderby Island (A). At the single remaining colony of the declining white-capped albatross (*Thalassarche cauta steadi*) species on Auckland Island a cat feeds on a freshly killed chick (C) and a pig (D) forages amongst nesting albatrosses. Pigs have been observed toppling albatross nests and preying on both adults and chicks at this site and breeding success in pig-accesible areas is zero. The impacts of cats on albatross breeding success remains unknown, though cats can access areas of the colony that pigs cannot. *Photos: R. Sagar (A), F. Cox/DOC (B), S. Bradley (C), P. Sagar (D)*

It will also reduce the risk of incursions to other pest-free islands in the region and associated catastrophic consequences and response costs. In particular, there is risk to globally significant and unmodified Adams Island (9693 ha), which is within swimming distance (min. 548 m) of pests from Auckland Island and a vital refugia for local biodiversity.

DOC administers the islands and has a clear mandate for the work. The eradication of pests from these islands is a vision shared by Ngāi Tahu ki Murihiku who are tāngata whenua and strongly support the goal. The project provides significant opportunities to strengthen and role model the relationship with iwi, hapū and whānau. Maukahuka would provide important momentum for the national Predator Free 2050 (PF2050) goal via development of capability in several fields of pest management technologies demanded by the step change in scale required for the project and would help to leverage investment in conservation, including progression of conservation goals in the global subantarctic area. It aligns with the New Zealand Government's PF2050 objectives, the New Zealand Biodiversity Strategy, the protection afforded as part of the NZSIA World Heritage Area and will fulfil statutory obligations.

Suppression of pests is not feasible because of the remote location and pioneering scale required, the complex logistics, the prohibitive ongoing cost and limited benefits (short-term relief for some native species at a few sites). Eradication of mammalian pests is the only way to achieve the desired long-term benefits.

The most efficient and likely way to achieve success is via eradication of all three species in sequential operations in short succession. Compared with separate projects over a longer timeframe, this approach extracts the most value from the large investment in setup while minimising infrastructure maintenance. The investment and effort to establish a specialised project team, supplier relationships and to retain capacity and capability is large and would not be repeatable in the short term. Removing only pigs, or pigs and mice would drastically reduce the biodiversity benefits compared to removing all three pest species.

Removing pigs alone would lead to an increase in palatable plants and likely subsequent increases in mouse and cat populations and predation on native birds and invertebrates (e.g. as seen on Marion Island in the subantarctic Indian Ocean). This would severely limit the recovery of the island, preventing the return of endemic terrestrial birds and burrowing seabirds, which are keystone species in this ecosystem. Mice can have extensive detrimental impacts on islands (e.g. Marion Island, Gough Island (South Atlantic), Antipodes Island, Midway Atoll (Northern Pacific)), including the local extinction of some invertebrates, severe suppression of land birds and, in some cases, preying on large seabirds, resulting in zero recruitment. Removing cats and mice alongside pigs would allow bird, plant and invertebrate populations to re-establish and grow, maximising ecosystem recovery and resilience.

Can it be done?

The eradication of pigs, mice and cats from Auckland Island has been assessed against five principles of eradication and found to be feasible. Methods and capabilities are available or can be developed within specified timeframes with appropriate resourcing and sequencing. The project and the associated challenges are large. The site itself presents significant challenges relating to the scale of the island, remoteness, isolation, steep terrain affecting accessibility, poor weather, lack of infrastructure, difficulty in servicing and the immense quantities of gear and personnel required to be transported.

The project's implementation encompasses an extensive infrastructure programme followed by eradication of pigs, mice then cats (in that order) and each programme timed according to the seasons to maximise assistance from the environmental conditions. Pigs must be eradicated first to make the attempts on mice and cats possible (pigs will create gaps in bait coverage for mice and interfere with traps and baits for cats). The mouse eradication method complements that

for cats. Too long a delay after the pig eradication risks vegetation regrowth that could make cat hunting unfeasible.

Assessment against the five principals of eradication:

1. ALL INDIVIDUALS OF THE TARGET SPECIES CAN BE PUT AT RISK BY THE PROPOSED ERADICATION TECHNIQUES

Pigs can be eradicated using an intensive and sustained application of a suite of overlapping techniques (trapping, aerial hunting, and ground hunting plus Judas pigs to aid validation). Aerial hunting requires the development of capability with high-resolution thermal camera technology and aerial hunting teams. This tool makes the operation feasible by reducing the area to be ground-hunted by half and significantly reducing the risk of leaving animals behind in difficult terrain. The island should be temporarily fenced in two locations to create three management blocks.

Helicopter application of cereal baits containing rodenticide is the only feasible method for eradicating mice. Auckland Island is four times larger than the largest mouse eradication globally to date. Despite mice never having been eradicated at this scale, a large-scale trial over 1000 ha on Auckland Island in 2018/19 showed mice can be eradicated in the summer season at a lower bait application rate than typically used (2 applications of 4 kg/ha compared with best practice of 2 applications of 8 kg/ha, usually in winter). This departure from best practice is required to make the volume of bait and the likelihood of comprehensive bait coverage feasible, given the limited number of flyable hours available due to inclement weather and the constrained logistics of the remote location. The method requires improvement to the helicopter bucket mechanism for reliable bait application at the proposed sowing rate.

Trials on Auckland Island have greatly informed the feasibility of eradicating cats and reduced uncertainties. The eradication of cats is dependent on developing data processing capability for managing the volume of imagery from an island-wide grid of approximately 1500 trail cameras. This will help optimise the time between a cat being detected on camera and its image being processed, recognised, and responded to. The cat eradication should occur soon after baiting to eradicate mice to take advantage of potential knockdown of cats via secondary poisoning and the late autumn/winter conditions. It is also highly desirable to have a cat-specific vertebrate toxic bait (VTA) available for aerial application following the mouse eradication. This is the only tool that can potentially put every cat at risk and would greatly improve the likelihood of success and opportunity for rapid completion. A team of cat detection dogs, skilled handlers and trappers are key to the detection and dispatch of surviving cats. If a cat-specific VTA is not available, targeted trapping and use of lures with the aid of a camera grid would be relied upon to eradicate cats. This would take much longer, cost more and carry a greater risk of failure.

2. PESTS CAN BE DISPATCHED AT A RATE EXCEEDING THEIR RATE OF INCREASE AT ALL DENSITIES

To succeed, all operations require treatment and monitoring methods to be applied at sustained intensity until completion. Each operation can be designed to do this and remove individuals at a higher rate than they can be replaced, but seasonal timing is important. Well-designed monitoring with careful data collection and timely analysis is needed to inform decision making. This will allow operations to adapt as the situation changes (e.g. population density, animal behaviours, seasonal changes) and contribute to confidence that eradication has been achieved to avoid premature conclusion and failure.

Pig population density can be quickly reduced with lured trapping and aerial hunting before ground hunters are deployed. Mice will be breeding during the summer when baiting is planned. Mouse baiting will target all individuals with two comprehensive treatments of the site in the space of several months. The interval between treatments should exceed 14 days to enable young mice emerging from nests to have access to bait. Baiting should be completed by March to avoid alternative food availability if a large tussock seeding event occurs in any given year. Cat

population density can be quickly reduced by primary (cat VTA) and secondary (eating poisoned mice) poisoning, allowing ground hunters to mop up surviving cats with the aid of the island-wide network of trail cameras to target trapping effort.

3. THE PROBABILITY OF THE PEST RE-ESTABLISHING IS MANAGEABLE TO NEAR ZERO (SUSTAINABLE)

The isolation of the site and managed visitation mean that once eradication is achieved, the risk of pest incursion is low and manageable. The nearest populations of pigs, mice and cats are several hundred kilometres away, too far for the possibility of self-introduction. DOC is the authority that governs island access for management purposes and approximately 800 visitors per annum under tourism concessions with biosecurity provisions in the mandatory landing permits. A deep-sea fishing fleet regularly shelters near the island and should be engaged to manage incursion risk. The extraordinary amounts of equipment, people and supplies to be taken to and from Auckland Island during the eradication project significantly elevates the biosecurity risk. This has been effectively managed on other subantarctic islands and is achievable for Auckland Island given timely investment in planning and additional biosecurity facilities.

4. THE PROJECT IS SOCIALLY ACCEPTABLE TO THE COMMUNITY INVOLVED

The Maukahuka project is strongly supported by Ngāi Tahu, (represented on several occasions by kaumatua Tā Tipene O'Regan) and stakeholders including tourism concessionaires. DOC's project to rid Antipodes Island of mice in 2016 (Million Dollar Mouse) achieved significant recognition and public support and similar public interest is expected for Maukahuka. This project is aligned with the statements of intent in the local Conservation Management Strategy (CMS) and Ngāi Tahu's vision document Te Tangi a Tauira. The use of toxins will draw some negative response, though their use is targeted for a short period in a one-off event on an uninhabited island. Auckland Island pigs have value for specific medical research because of their disease-free status and there is interest from at least one venture in recovering some pigs before eradication.

5. THE BENEFITS OUTWEIGH THE COSTS

The proposed pest eradication requires large but one-off investment for permanent and internationally significant biodiversity benefits with low to zero ongoing cost to sustain.

Eradication of pigs, mice and cats will immediately halt the destruction of indigenous fauna and flora and enable recovery and protection of over 500 native species. It would increase the total pest-free area in the NZSIA by over 250%, from 30 000 ha to 76 000 ha. This will secure the region as predator-free and reduce the extinction risk for more than 100 endemic species. The isolated landmass of the Auckland Islands makes them important breeding grounds for 25 seabird species (albatross, petrels, penguins, cormorants, terns and gulls) that forage the surrounding seas. Removing pigs, mice and cats will complement by-catch reduction work and improve the health of the Southern Ocean ecosystem, boosting resilience against projected climate change threats. Twenty-five native bird species that currently only breed in significant numbers on pest-free offshore islands in the archipelago will be able to naturally repopulate Auckland Island. Rapid recovery of invertebrate populations will provide food for returning land birds and nutrient cycling and pollination for plants. Iconic subantarctic megaherbs will again flourish in the largest habitat available to them.

Maukahuka will deliver improved predator control tools and expertise to support PF2050 and is a tangible and necessary precursor to other ambitious PF2050 projects. Disbenefits, such as by-kill of native species and disturbance to vegetation from the infrastructure programme are expected to be minor and expected to rapidly reverse over 5–20 years (as demonstrated on Enderby Island). Per hectare costs are comparable with other island eradication projects and annualised costs over 10 years are comparable with other landscape-scale conservation projects. Project failure could jeopardise political and public goodwill towards future operations, but challenges are known and can be planned for and success will inspire people to undertake even more ambitious work.

Maukahuka will continue the progress of conservation in the global subantarctic region and enhance New Zealand's reputation for conservation leadership. For Ngāi Tahu, the project is another vital step in restoring the mana and mauri (energy, power and life force) of the whenua (land) they are kaitiaki (guardians) of and hold stewardship over. Tangibly, it will provide employment opportunities, opportunities to exercise customary rights of mahinga kai, mātauranga, tikanga and kawa and to demonstrate an exemplar relationship with iwi, hapū and whānau. Operated from a regional centre in Invercargill, Southland this project will provide significant economic stimulus locally and support development of supplier capability for conservation regionally and nationally.

INFRASTRUCTURE AND LOGISTICS

Establishing appropriate infrastructure and reliable logistics are essential precursors to facilitate operations. The pig programme will take approximately 1 year to deliver, mice up to 6 months and cats between 1 year and 3 years depending on tools and efficacy. The infrastructure and logistics programme is the largest single component of the project, bigger than any of the individual eradications. It will take two to three summers to establish prior to the eradications and one to two summers to demobilise afterwards. The remote location and scale of infrastructure required greatly enhance the project cost, complexity and timeframes. Operational delivery will be land-based, as ship-based operations would be prohibitively expensive (several tens of thousands of dollars per day for ship charter) for the length of time involved and the size of a ship needed. Significant island-based infrastructure would also still be needed in addition to manage helicopters (hangarage, fuel and crews).

Facilities are needed to support year-round island occupancy for several years and facilitate regular access to all parts of the island for ground hunting. A main central base is needed to accommodate approximately 24 people, in addition to two smaller subsidiary bases (one north and one south), three boat sheds, 17 field huts, four helicopter hangars and fuel stores to manage up to 150 000 L of Jet A1 at a time. Maintenance and compliance requirements run throughout the life of the project.

A supplier is needed for shipping large volumes of cargo (approximately six voyages over the project) such as buildings and materials for infrastructure installation and extraction, helicopter fuel for each phase and mouse bait. Over 1200 t of supplies and materials are expected to be shifted to the island over the project's life. Operational preparations include several large expedition-style tasks such as placement of 500 t of mouse bait (approximately 35 × 20-foot shipping containers in volume) plus fuel at nine load sites several months before baiting; and installation of 1500 trail cameras across a rugged island 50 km long and requiring a team of 20 people. Each operation will be delivered concurrently with planning and preparing for the next. Dedicated project and contract management capacity is an important function for each stage and this requirement should not be underestimated.

Each eradication is dependent on helicopter support, ranging from two helicopters for the pig programme up to six for mouse baiting and totals approximately 80 months of helicopter support, in addition to 20 helicopter transits between the mainland and island. Multiple single-engine helicopters will need to be positioned to/from the mainland several times. Certain suitable helicopter models can fly the 465 km directly to Auckland Island from Invercargill under current rules. This simplifies the logistics, as the helicopters don't have to be shipped. The helicopter tasks and pilot skills are specialised and different for each eradication. Additionally, pilots with expert long-lining skills are required to unload and load ships for the infrastructure programme and regular resupplies. For example, the 500 t of bait and 150 000 L of fuel for the mouse eradication alone equates to over 800 helicopter movements from ship to shore.

The vast amounts of gear and supplies will require a dedicated mainland biosecurity facility in excess of current local DOC capacity, as well as island facilities to receive and handle them. The logistics and biosecurity of several large supply items (e.g. mouse bait produced in Whanganui; flat-packed buildings; large volumes of jet fuel) will need to be managed at storage facilities near to the eventual port of departure. The supply chain steps include procurement, containerisation, transport to port of departure, handling and storage in a bio-secure facility, quarantine, transport to port, shipping to island, offload by helicopter or small vessel, biosecurity check, storage on island and return of items/waste to the mainland. Logistics will need to be coordinated by dedicated roles with a fit-for-purpose inventory system.

Regular passenger transport services are required to resupply and change over island teams, with monthly voyages expected during the pig programme and 6-monthly during the cat programme. Aviation options (helicopters, floatplanes) can't provide a complete solution due to payload limitations and cost respectively, so marine transport will be necessary. However, few suppliers exist, and the frequency of work doesn't warrant the permanent allocation of a supply vessel in Bluff. Securing certainty of supply will be important.

What will it take?

A multi-species eradication using all preferred eradication tools will take up to 10 years from commencement of the infrastructure operation. This could be reduced if operations go well, but is ambitious and requires a high level of resourcing and support at all stages. There will be a lag time from the decision to proceed until momentum and readiness to implement are achieved, this can be minimised by progressing some tasks in the interim.

This will be the largest eradication project that DOC has undertaken. The operational cost of the full project is estimated at $84m over 10 years, based on conservative estimates of operational duration due to weather constraints and modelled on short staffing rotations. Longer staff deployments than proposed here are achieved in other programmes, which would be significantly cheaper and simplify logistics.

Likely funding options focus on joint Government and philanthropic sources. Personnel and helicopter costs stand out as the largest cost components of the project. Operational teams of 25–30 people will be needed for each programme with a support team of 15–20 people on the mainland to service island work and prepare operations to run sequentially as well as undertake the full range of project management tasks.

Two helicopters are required on-site for a large part of the operating period. It is estimated that the option of purchase/lease of two helicopters to remain on island could save between $4m and $5m in standby fees. This option was successfully modelled during the rodent eradication on South Georgia.

Stopping needs to be evidence-based, as stopping without adequate validation of success risks project extension and presents the greatest danger to budget over-runs. Conversely, opportunities to complete the project early (whilst retaining confidence in the result) will offer the most savings.

Each successive operation provides an obvious stage-gate decision point for continuation of the project. Once infrastructure is in place it can be maintained (at a certain cost) until operations are ready or funded.

The project is pushing the boundaries of what DOC can achieve so a partnerships approach is the preferred model, though such a model is yet to be tested or delivered by DOC at this scale. A workable partnership agreement and an operating model to control funds, govern, manage, and deliver the project would be needed in such a case. Several options are available, the final structure will be dependent on the identity and preferences of the parties involved.

Key risks

1. INCLEMENT WEATHER MAY DELAY OR INHIBIT COMPLETION OF OPERATIONS, RESULTING IN OVERRUNS IN COST AND TIME OR PROGRAMME FAILURE.

The subantarctic region provides the most challenging weather conditions in New Zealand for operations dependent on helicopters and shipping. Conditions are changeable, can be extreme and potentially damaging for equipment and could deter, delay or prevent supply and/or operational activity. Frequent low cloud and high winds about mountain passes essentially dissect the island into three parts and prohibit feasibly operating from a single location. The frequency and duration of suitable operating conditions have a direct impact on each programme's timeframe, particularly for aerial baiting of mice, where sustained poor conditions risk failure to achieve comprehensive bait coverage.

Mitigation:

- Budget for operational duration with sufficient contingencies to realistically account for potential operating conditions.
- Resource well to achieve objectives within the required timeframes (e.g. base at least six helicopters on Auckland Island for the mouse eradication to make rapid progress with baiting when conditions are suitable).
- Locate accommodation and helicopter infrastructure in each third of the island to provide localised access, enabling operations to use short weather windows and make methodical progress when travel to distant locations from one base would be inhibited.
- Use satellite internet capability and internet-based weather forecasting to predicate operating opportunities in advance.
- Prioritise work in places where access is most limited (particularly the western coast and areas above 400 m altitude) when conditions are suitable.

2. IF PROCUREMENT IS NOT FIT FOR PURPOSE IT COULD DELAY THE PROJECT BY YEARS AT SEVERAL STAGES, CREATE UNCERTAINTY FOR INTER-DEPENDANT MULTI-MILLION-DOLLAR CONTRACTS AND REQUIRE REPETITION OF COSTLY AND TIME-CONSUMING PROCESSES FOR EVERY ENGAGEMENT.

Procurement for the project involves at least 10 one-off procurements over $100 000 and many more repeat procurements above this threshold for helicopters, shipping, and passenger transport. Government procurement processes aim to test suppliers and provide best outcomes for DOC through competitive tendering but are not geared well for extraordinary activities with few potential suppliers, such as will be required for this project.

Mitigation:

- Investigate custom procurement options and reduce risk to attract suppliers.
- Engage openly with suppliers and seek industry advice early during planning to understand capacity and find solutions.
- Delegate financial authority, supported by Governance, to a level that provides efficient approval processes and connection with the project team.
- Understand how Government procurement rules will be affected if the project is managed and governed via an external entity.

3. INABILITY TO SECURE THE RELIABLE SUPPLY OF SHIPPING AND HELICOPTER RESOURCES TO SERVICE THE COMPLEX LOGISTICS MAY DELAY OR INHIBIT COMPLETION OF OPERATIONS, RESULTING IN OVERRUNS IN COST AND TIME OR PROGRAMME FAILURE.

Feasibility and project timeframes depend on securing transport and helicopter support services to establish an effective supply chain to Auckland Island. Significant dependencies exist such as the timing of core operations, staff rotation rosters and specifications of support infrastructure. Requirements for helicopters and shipping services involve extraordinary and infrequent activities with few potential suppliers. Capacity for the specialist helicopter piloting skills (such

as for aerial baiting and aerial hunting with thermal cameras) and helicopter engineers will be difficult to secure for deployment to the remote site. Coordination with other programmes such as Tiakina Ngā Manu for baiting pilots and helicopters will be required.

Mitigation:

- Simple, flexible and bespoke procurement options are needed to avoid lengthy processes.
- Define specific needs early in the planning phase and engage with suppliers and industry expertise to build trust, understand capacity and find solutions.
- Consult with other programmes and explore opportunities to co-develop capacity.
- Contract key logistics for the life of the project to provide certainty.
- Embed industry expertise within the team to design procurement and manage complex compliance and contract scenarios. Ensure contract management capacity is resourced appropriately.
- Contract helicopter supplier for pig programme early and perhaps separately from other helicopter services so development of thermal camera capability is ready in time.

4. THE IMPACT OF A SERIOUS INCIDENT AT ANY STAGE COULD HAVE FATAL CONSEQUENCES AND/OR RISK THE VIABILITY OF THE PROJECT.

The operations involve extensive work with helicopters, boats, firearms and chainsaws, plus construction and remote fieldwork in an isolated place. These activities are all in the eight critical risk categories identified by DOC and will be predominantly delivered by contractors. An injured or ill team member may require intensive management on island for several days before medical evacuation is possible. The presence of helicopters on the island vastly improves the ability to retrieve an injured person to a base facility or conduct search and rescue.

Mitigation:

- Run a risk assessment process to identify potentially fatal hazards and plan for them.
- Ensure good team leadership, skilled and valued staff, engage suppliers early to involve them in planning, treat them as team members and develop a shared safety culture.
- Use an effective communications network (satellite internet, VHF radio, inReach devices, helicopter tracking) to provide accurate local forecasting, enable early warning of an incident and access to off-island professional support for managing an incident/patient.
- Include a dedicated safety role on island to help with planning of day-to-day operations, reporting and debriefing to capture lessons for safety management.
- Incorporate search and rescue capability and paramedic-level medical skills in the island teams.

5. IF IMPROVED ERADICATION TOOLS AND NECESSARY CAPABILITIES ARE NOT AVAILABLE, THE PROJECT WILL BE DELAYED OR NO LONGER VIABLE.

Operations for each target species are pushing current limits of scale for available technology and skills. Technical feasibility is dependent on capability development for both personnel and eradication tools. Required developments will optimise the likelihood of success for each eradication (reduce risk, complexity, duration, cost, while increasing confidence and likelihood of success).

Mitigation:

- Prioritisation of the project's research and development objectives throughout DOC, with strategic alignment and management support of development programmes.
- Allocate seed funding so development programmes can be started as early as possible. New technologies must be tested and proven to be reliable and operationalised as far as practicable before rolling out at the scale of Auckland Island.
- Identify stage gates for feasibility to be reviewed if any critical elements change or fail to be realised.

- Ensure comprehensive training plans are in place before staff selection, with adequate lead-in time planned to train staff.
- Plan for succession and contingency throughout all team levels (field team, team leaders, programme leaders, project and contract management, training and supplier capacity).
- Use relationship vision document in development with Ngāi Tahu to contribute to project design for capability development.

6. IF DOC CAN'T PROVIDE AND SUSTAIN THE NECESSARY SUPPORT FOR A PROJECT OF THIS SIZE, THEN THE PROJECT MAY FAIL OR BE TERMINATED EARLY.

The Feasibility Phase has shown that the project is too large and complex for DOC to undertake using business-as-usual management. A project review in July 2019 highlighted the limited capacity of DOC Tier 3 management levels in Operations to properly support the scale of the additional work, the inhibitory delegations given to the Project Manager and the need for empowered governance. Large landscape-scale projects are relatively new to DOC; corporate systems and support resources are designed to support smaller scale, annual work-plans. The scale of this project requires organisational coordination and enhanced project management.

Mitigation:

- Articulate prioritisation throughout DOC and ensure resourcing is planned and targeted.
- Establish a reporting line with direct access to decision makers, as well as an empowering mandate for the team and appropriate delegation and authority to meet timeframes and manage risk.
- Sustained organisation-wide commitment, attention and action, along with new ways of working and a willingness to look for solutions.
- Act on recognised limitations of high-level management capacity.
- Explore the substantial opportunity for in-kind support.
- Ensure flexibility to move funds between financial years to enable the timely management of a complex operational programme.

7. THE PARTNERSHIPS APPROACH AND NEED FOR COLLABORATION MAY INCREASE COMPLEXITY AND AFFECT THE ABILITY TO DELIVER ON TIME AND WITHIN BUDGET.

There is need for large-scale collaboration with partners to help fund and facilitate the project. Having multiple significant stakeholders requires the utmost care in managing expectations and facilitating governance teamwork to avoid complicating the project instead of enabling it.

Mitigation:

- Seek excellence in project design and leadership.
- Develop a workable partnership approach that reflects the unique needs of the project.
- Carefully consider the implications of partnership commitments and ensure agreements and Governance reflect expectations, mutual benefits and accountabilities including safety.
- Ensure processes allow for timely decision making, management of scope and good communication.
- Apply lessons from review of past and present landscape-scale projects in project design. A review of this Feasibility Phase should also be undertaken to complement the recommendations in this report.

8. AS PROTOCOLS AND LEGISLATION CHANGE, THE REQUIREMENTS FOR OPERATIONS AT AUCKLAND ISLAND MAY BECOME UNTENABLE.

Changes to protocols, permissions and legislation will occur over the life of the project and if not anticipated and managed well have the potential to cause significant delay, increase complexity, cost and affect feasibility. Current examples include review of the DOC helicopter operating

protocols (potentially restricting passenger transfer over water and reviewing direct flights of single-engine machines to Auckland Island), a Regional Coastal Plan review (proposing seasonal boat access restrictions at Port Ross due to the presence of breeding southern right whales / tohorā (*Eubalaena australis*) in winter) and the Conservation Management Strategy (CMS), which advises against new fuel storage that will be required for Maukahuka.

Mitigation:

- Develop strong relationships with external regulatory bodies and internally within DOC to involve them in design to ensure project needs are understood, considered and actively managed.
- Consider potential exemptions or grandfather clauses to mitigate some of the effects of changes introduced during the project.
- Design for anticipated change, where possible.

9. EXTERNAL DISRUPTIONS MAY AFFECT SUPPORT, SIGNIFICANTLY DELAY THE PROJECT OR CAUSE IT TO BE TERMINATED.

Disruptions may come from a range of sources including changing social or economic context, change in Government or partner interest, national-scale disaster, flow-on effects of a serious incident on-site or from availability of critical transport solutions or suppliers. Delays to the delivery timeline are likely to be the immediate effect, with associated compounding effects including impact on subsequent programmes and contracts, limitations of time-bound permissions, downtime for personnel, contract penalties and asset maintenance requirements. Due to the importance of seasonal timing of the work and dependencies between programmes, even short interruptions are likely to cause up to 12 month delays.

Mitigation:

- Use a collaborative approach to ensure Government and partners hold each other to account.
- Model potential scenarios during planning to ensure their implications are understood and minimised.

10. IF BIOSECURITY IS NOT PROPERLY MANAGED, OTHER ORGANISMS COULD BE INTRODUCED TO AUCKLAND ISLAND OR CURRENT PESTS SPREAD TO PEST-FREE ISLANDS IN THE ARCHIPELAGO.

Unprecedented volumes of equipment, supplies and personnel going to/from Auckland Island present significant biosecurity risk for this sensitive site. Supplies could originate from anywhere in New Zealand and provide an incursion pathway for unwanted organisms as varied as plague skinks (*Lampropholis delicata*), Argentine ants (*Linepithema humile*), rats (*Rattus* sp.) and diseases. A deep-sea fishing fleet also regularly shelters in inshore waters at the island.

Mitigation:

- Develop a biosecurity plan for the project ahead of implementation.
- Ensure standards are included in supplier contacts and biosecurity measures are implemented and additional facilities are available before commencement of the infrastructure programme.
- Engage with and educate the fishing fleet to reduce the likelihood of a vessel inadvertently transporting pests and to assist DOC to protect the place and report illegal landing activity.
- Include biosecurity observations in monitoring during and beyond the project to ensure no unwanted organisms establish (e.g. weeds around infrastructure sites).

Dependencies

Technical feasibility is dependent on the development and readiness of several new and improved eradication capabilities: aerial hunting teams aided by high-resolution thermal camera technology; improved bait bucket for low application rates; software for automated processing

of imagery from trail cameras. A cat VTA registered for aerial distribution is highly desirable. Capacity is also required for cat detection dogs and handlers and specialist bait-spreading pilots, which are likely to require active development. If any of these cannot be delivered, project feasibility should be reassessed. Delivery of all three operations is also dependent on the ability to fly single-engine helicopters to Auckland Island by direct flight from the mainland and to reliably secure cargo and passenger shipping services.

Recommendations

A full set of recommendations to address issues, reduce risk and increase the likelihood of success for the project appear in the appendices of the full technical summary report (DOC-6083262). Here we present the 10 most critical recommendations (Table 1), many of which are actions that can be taken now, ahead of project initiation, to reduce uncertainty and progress towards optimal readiness whilst simultaneously providing benefits to other conservation work.

Table 1. Priority recommendations to address issues, reduce risk and increase the likelihood of success of the Maukahuka Pest Free Auckland Island project

PRIORITY	RECOMMENDATIONS
1.	The scope of the project should encompass eradication of all three pest species delivered in sequential operations in short succession.
2.	DOC should provide a lead commitment to the project by securing the Crown investment and articulating an investment strategy for the life of the project, thereby providing investor confidence and enabling the required third-party contributions.
3.	Investment in capability developments to optimise technical feasibility is required for: • Thermal camera technology and experienced aerial hunting teams. • Improved helicopter bait bucket for reliable low sow rate application. • Automated image processing software to label and triage imagery from trail cameras. • An effective toxic bait registered for cats that can be aerially applied. • Cat detection dogs and handlers.
4.	The following project design tasks should be completed as soon as possible and incorporated into the project plan: finalising the relationship vision document between Ngāi Tahu and DOC, finalising the governance model and finalising the team structure; defining delegations, defining decision-making accountabilities and defining financial management.
5.	The project operating model must include dedicated high-level management support from within DOC, so decision-makers are engaged in the project and connected to project management.
6.	Overarching site management plans, including the NZSIA Biosecurity Plan, a Subantarctic Research Strategy and a Subantarctic Strategy should be updated/completed by DOC's relevant district and national teams to guide project design and ensure strategic alignment.
7.	The project infrastructure plan should be shared to initiate consultation with relevant DOC teams and external authorities to progress any interim actions identified.
8.	Shipping and helicopter industry expertise should be embedded into the project team designing procurement and managing complex compliance and contract scenarios. Management capacity must be resourced appropriately.
9.	Biosecurity planning and the infrastructure programme must be funded early in the process to ensure they are ready to go when the project gets underway.
10.	Engagement with potential funding partners and stakeholders must continue to facilitate better understanding of relative costs, wider benefits, stopping points, complexities and opportunities.

Conclusion

Eradication of pigs, mice and cats from Auckland Island is worthwhile, achievable and sustainable. Maukahuka is a priority eradication project because of its special protection status, the severity of damage from mammalian pests to this taonga and the lessons that will enable further scale up. The project is complex with a long timeframe and the scale is significantly increased by the lack of pre-existing infrastructure and remoteness. However, the challenges can be planned for and overcome. The large investment is spread over the life of the project and well protected by the isolation of the site as the risk of pests returning is low. It is the largest island eradication objective for PF2050 that is understood and ready to progress. It offers an attractive opportunity for partnerships and for tangible large-scale outcomes in the medium term to create momentum and advance New Zealand's PF2050 goal.

Several risks require high-level attention during project design and are critical to success. Consideration of these can start early in anticipation of project initiation. Steps that can be taken immediately include initiating/continuing development of required capabilities, progressing permissions, completion of site management plans, securing funding and completing project design. These actions will aid in minimising the lag between a decision to proceed and achieving the readiness required to commence implementation. To progress, a decision to proceed and a committed investment strategy are the priority next steps that would allow critical path tasks to commence.

Maukahuka is a wonderful example of the ambition that DOC has demonstrated in its history of acting to protect and undo damage in our most treasured but challenging places. The feasibility of this project carefully builds on the lessons from the past – we stand on the shoulders of giants. Armed with this knowledge, the wero of kaitiakitanga has been laid down to restore the mana of Auckland Island.

PEOPLE—NATURE
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TUIA TE TAIAO

Cover: Victoria Passage, looking towards the cliffs of Adam Island, Auckland Island group / Motu Maha.
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The full technical feasibility study report is available at: DOC-6083262 or on request.

Maukahuka
PEST FREE AUCKLAND ISLAND

New Zealand Government