HAWKE'S BAY
REGIONAL COUNCIL

Meeting of the Hawke's Bay Regional Council Maori Committee

Date: Tuesday 13 February 2018

Time: 10.15am

Venue: Te Taiwhenua O Heretaunga
Orchard Road, Hastings
NAPIER

Attachments Excluded From Agenda


HAWKE'S BAY
REGIONAL COUNCIL
PROPOSED
REGIONAL PEST
MANAGEMENT PLAN
2018-2038

Part One: Plan Establishment

1 Introduction

1.1 Proposer

The Hawke's Bay Regional Council (Council) has a regional leadership role under the Biosecurity Act 1993 (the Act), and intends to establish a regional pest management plan (RPMP). The first formal step is notification of a Proposed Regional Pest Management Plan (Proposal) for the Hawke's Bay region for the next twenty years.

Since the development of Councils first Pest Management Strategy in July 1996, significant benefits have accrued to the region's economy from pest plant and animal control. Although over the past 15 years approximately 80% of Council's biosecurity budget has been spent on pests affecting agricultural production, there have been significant biodiversity gains arising from the delivery of these programmes. It is important to recognise these gains, including the Possum Control Area (PCA) programme, which now spans over 700,000ha of the region. The response from releasing our native species from predation and browsing pressures has been noticed across the region, with increased numbers of tui and bellbird, expansion of whitehead colonies and flowering and fruiting of tree species. The Biosecurity team is now working with over 70 community groups and private land owners on biodiversity focussed pest control programmes, including the management of stoats, rodents, feral cats, feral goats, purple ragwort, boneseed, cathedral bell, old man's beard, banana passionfruit, and blue passion flower to mention a few. The team works in close partnership with organisations including the Department of Conservation, QEII, Forest and Bird and Fish and Game.

Landowner success and commitment to the regional possum control programme provides an opportunity to integrate the control of other predator pests into possum control areas, providing a platform for delivering further economic and environmental outcomes. This coupled with appropriately targeted intensive protection of sites with high biodiversity value, could provide significant long term integrated biodiversity recovery and primary production benefits across the Hawkes Bay region. In 2016 central government launched PFNZ 2050 with the goal of eradicating predators (possums, rats and stoats) from our nation by 2050. An initial fund of $7m per annum for four years was set aside largely for regional predator control initiatives. The success of Hawkes Bay's pest animal control programme has also opened the opportunity to leverage more central government and potentially philanthropic funding into our region.

While in the past the majority of Biosecurity activities have been funded by the rural community, this Plan and the programmes proposed, reflect a shift which recognises that for some programmes which deliver increased biodiversity improvement the Regional Community are significant beneficiaries. Funding sources for those programmes have been reviewed to reflect this.

1.2 Purpose

The purpose of the Proposal is to outline a framework for the RPMP to efficiently and effectively manage or eradicate specified organisms in the region. Doing so will:

- minimise the actual or potential adverse or unintended effects associated with those organisms;
- lead to certain organisms being eradicated, the extent of some being reduced and others that are well established being contained;
- monitor the presence of declared pests in the region; and

- facilitate efficient pest control through a regionally co-ordinated approach.

Many organisms in the Hawke's Bay region are considered undesirable or a nuisance. Yet, only where individual action or inaction in managing pests imposes undue effects on others is regional management needed.

The Biosecurity Act 1993 (the Act) has prerequisite criteria that must be met to justify such intervention. This Proposal identifies those organisms classified as pests to be managed through the RPMP.

Once operative, the RPMP will empower the Hawke's Bay Regional Council to exercise the relevant advisory, service delivery, regulatory and funding provisions available under the Act to deliver the specific objectives identified in Part Two: Pest Management.

The public can make submissions about the Proposal. The Council will issue decisions after reviewing those submissions. A submitter can appeal any of the points made regarding their submission to the Environment Court.

1.3 Coverage

The Proposal will operate within the administrative boundaries of the Hawke's Bay region and covers a total area (land and sea) of 1,419,153 hectares *(see Figure 1 below)*.

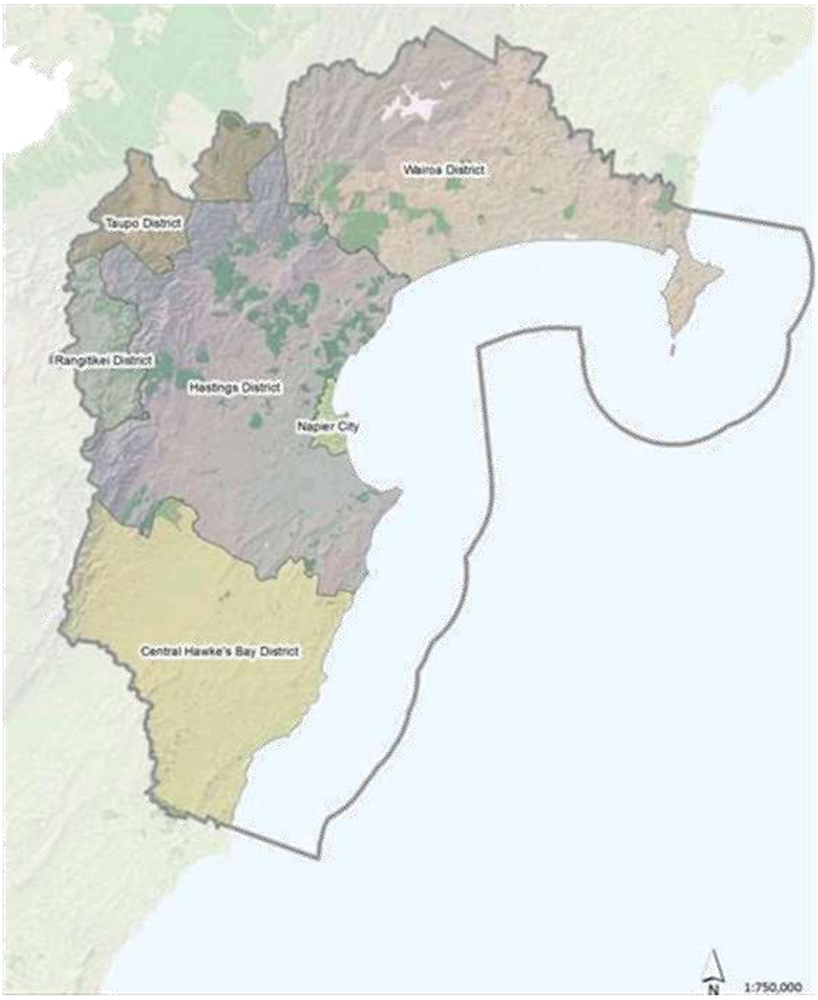

Figure 1: Map of Hawke's Bay Regional Council Area

1.4 Duration

The Proposal will take effect on the date it becomes operative, as a Regional Pest Management Plan, under s77 of the Act. It is proposed to remain in force for a period of twenty years from that date. The RPMP may cease at an earlier date if the Council declares by public notice that the RPMP has achieved its purpose. It may also cease at an earlier date if, following a review, it is revoked.

2 Planning and statutory background

2.1 Strategic background

Pest management influences, or is influenced by, the way land and water are used and managed. Several planning or operational activities contribute to the overall efficiency in reducing the impact from pests on the region's economic, environmental, social and cultural values. Such activities are both within and external to the Council.

Figure 2: Strategic relationships of the Regional Pest Management Plan

Regional pest management in the Hawke's Bay region is mandated under the Biosecurity Act 1993. It is also complemented by a number of plans, policies and strategies of the Council. Land owners and/or occupiers and the wider community, either as beneficiaries or exacerbators or both, complete the regional partnership. Actions by neighbouring regional councils and Crown agencies may also support regional pest management outcomes.

2.1.1 Council's biosecurity framework

Regional pest management sits within a biosecurity framework for the Hawke's Bay region, which includes this plan, the Hawke's Bay Biodiversity Strategy and the Hawke's Bay Strategic Plan. Land owners and/or occupiers and the wider community, either as beneficiaries or exacerbators or both, complete the partnership.

Hawke's Bay Biodiversity Strategy

The Hawke's Bay Biodiversity Strategy is a non-regulatory community document with the aim of halting biodiversity decline. It is the first time in our region's history that we have collectively taken stock of what's going on, and agreed that something better needs to be done. The Strategy has a critical success factor – it engenders a common spirit and goodwill to goals that all parties agree are important. The Strategy is a guide to inform our community in their biodiversity efforts. While it is voluntary to participate in the initiatives proposed, the organisations involved are committed to improving biodiversity.

The first two objectives of the strategy relate to the biodiversity we want to protect – native species and native habitats – and have an ultimate goal to achieve this by 2050. The remaining objectives are related to the human aspects needed for biodiversity gains – effective partnerships, community involvement and the integration of Māori values into biodiversity goals. To ensure that Hawke's Bay's biodiversity is enhanced, healthy and functioning, biodiversity activities undertaken throughout the region need to be aligned towards common goals.

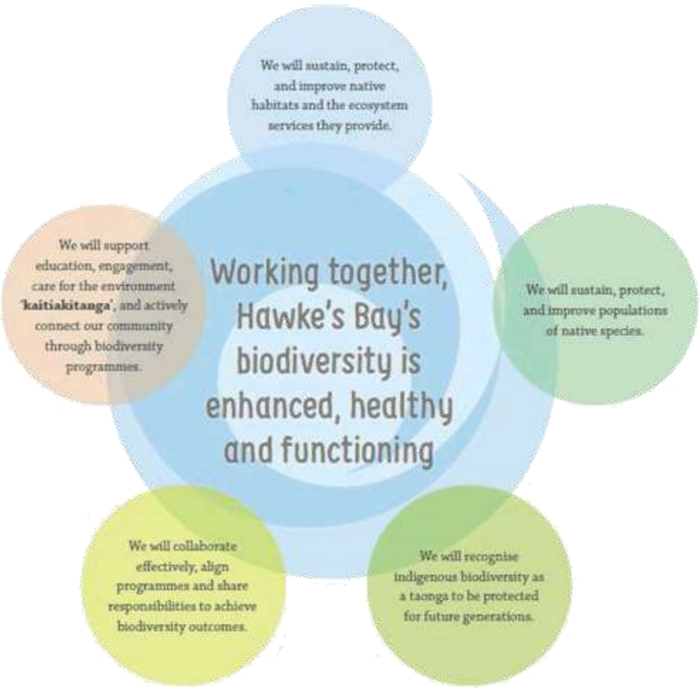

Figure 3: Council's biodiversity framework

2.1.2 Biosecurity framework outside Council

An effective biosecurity framework works both within a region and at a national level. Neighbouring regional pest plans and pathway management plans and national legislation, policy and initiatives influence the RPMP. The plans and strategies of territorial authorities may have complementary influence. As a result, an RPMP is an integral cog in a secure biosecurity framework to protect New Zealand's environmental, economic, social and cultural values from pest threats.

Figure 4: External Biosecurity Instruments

2.2 Legislative background

Regional councils undertake local government activities and actions under several legislative mandates. While managing pests is not dependent on one particular statute, its effectiveness is connected to the purpose of the particular statute. All regional councils in New Zealand prepare and operate regional pest management plans under the Biosecurity Act 1993.

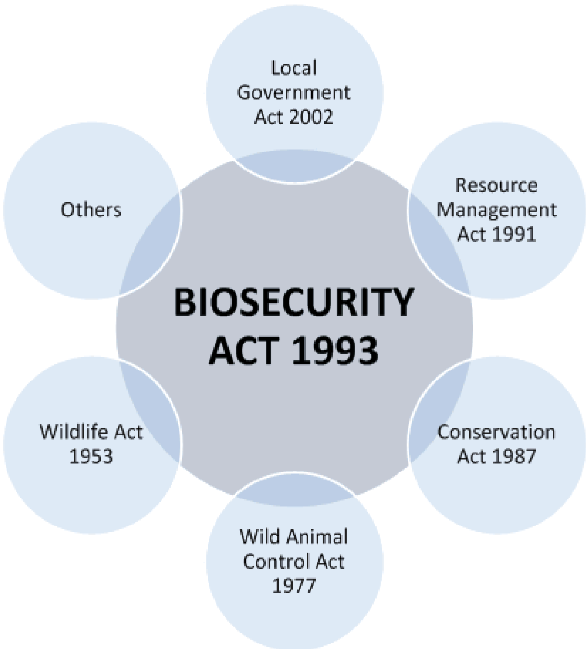

Figure 5: Biosecurity legislation

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2.2.1 Biosecurity Act 1993

A regional council can use the Biosecurity Act to exclude, eradicate or effectively manage pests in its region, including unwanted organisms. A regional council is not legally obliged to manage a pest or other organism to be controlled, unless it chooses to do so. As such, the Act's approach is enabling rather than prescriptive. It provides a framework to gather intervention methods into a coherent system of efficient and effective actions.

A number of amendments to the Act have occurred since 1993. Changes of relevance to regional pest management, and particularly advanced through the Biosecurity Law Reform Act 2012, include:

- Regional Pest Management Strategies are to be renamed Regional Pest Management Plans. Provision has also been made for explicit pathway management plans in addition to specified pest management plans.
- The Crown will be bound to the requirements of the "Good Neighbour Rules" specified in a RPMP. Such rules apply to all land occupiers within the area over which the rules apply but they can only address pest spread across a property boundary.
- Provision has been made in the Act for a National Policy Direction and the Ministry for Primary Industries has exercised that provision. As a result, RPMP's must be consistent with the NPD. Therefore:
    - Objectives must follow a prescribed content;
    - Management outcomes must align with one of 5 programmes: Exclusion, Eradication, Progressive Containment, Sustained Control or Site Led;
    - Benefits and costs must be analysed in a prescribed manner and must be documented; and
    - The construction of Good Neighbour Rules must address stipulated criteria.
- A mandatory plan review need not occur before 10 years. Minor, specific or full reviews can take place at any time if necessary.

There are three sections of the Act that are particularly pertinent to regional councils. Part 2 outlines the functions, powers and duties of a regional council, including its leadership role. Part 5 sets out the prerequisites for pest management plan formulation and Part 6 provides a menu of regulatory implementation powers that can be accessed.

Part 2: Functions, powers and duties in a leadership role

Regional councils are mandated under Part 2 (functions, powers and duties) of the Act to provide regional leadership for biosecurity activities, primarily within their jurisdictional areas.

Section 12B(1) sets out how regional councils provide leadership. It includes ways that leadership in pest management issues can help to prevent, reduce or eliminate adverse effects from harmful organisms. Some of these activities include helping to develop and align RPMPs and regional pathway management plans in the region, promoting public support for managing pests, and helping those involved in managing pests to communicate and cooperate so as to make programmes more effective, efficient, and equitable.

Section 13(1) sets out powers that support regional councils in this leadership role. These are:

- powers to establish (eg, appoint a management agency for a plan; implement a small-scale management programme);
- powers to research and prepare (eg, gather information; keep records; prepare a proposal to activate an RPMP);

- powers to enable (eg, giving councils the power to monitor pests to be assessed, managed or eradicated); and
- powers to review (eg, not allow an operational plan; review, amend, revoke or replace a plan).

Part 5: Managing pests and harmful organisms

Part 5 of the Act specifically covers pest management. Its primary purpose is to provide for harmful organisms to be managed effectively or eradicated. A harmful organism is assigned pest status if included in a pest management plan (also see the prerequisites in s69–78 of the Act). Part 5 includes the need for ongoing monitoring to determine whether pests and unwanted organisms are present, and keeping them under surveillance. Part of this process is to develop effective and efficient measures (such as policies and plans) that prevent, reduce, or eliminate the adverse effects of pests and unwanted organisms on land and people (including Māori, their kaitiakitanga and taonga). Part 5 also addresses the issue of who should pay for the cost of pest management.

Part 6: Administering an RPMP

Once operative, an RPMP is supported by parts of Part 6 (as nominated in the plan) that focus on the voluntary and mandatory actions of a regional council. For example, a regional council must assess any other proposal for an RPMP, must prepare an operational plan for any RPMP (if the management agency for it), and must prepare an annual report on the operational plan.

Changes to the Act since 1993

The Act has been amended since 1993, including through the Biosecurity Law Reform Act 2012. Important changes are:

- legislative (eg, being able to bind the Crown to stated Good Neighbour Rules (GNR) within a pest management plan, or to rules within a pathway management plan);
- structural (eg, giving regional councils a clear regional leadership role in managing pests; adding pathway management to the suite of pest management programmes; linking programmes with stated intermediate outcomes and programme objectives; using consistent terms in pest management programmes);
- compliance related (eg, setting out the extra requirements under the NPD that must be complied with; introducing greater transparency of risk assessment in the analysis of benefits and costs);
- procedural (eg, allowing funding, roles, and responsibilities related to small-scale management programmes to be delegated; allow a partial review (including adding a pest or pathway management plan) to be done at any time); and
- consultative (eg, increasing the flexibility in public consultation).

2.2.2 Resource Management Act 1991

Regional councils also have responsibilities under the Resource Management Act 1991 (RMA) to promote the sustainable management of natural and physical resources of the region, including the Coastal Marine Area (CMA). These responsibilities include sustaining the potential of natural and physical resources, safeguarding life-supporting capacity and protecting environmentally significant areas and habitats (s5(2) and 6(c)).

The RMA sets out the functions of Regional Councils in relation to the maintenance and enhancement of ecosystems in the CMA of the region (s30(1)(c)(iiia)), the control of actual or potential effects of use, development or protection of land for certain specified purposes (s30(1)(d)(v)) and the establishment, implementation and review of objectives, policies and methods for maintaining indigenous biological diversity (s30(1)(ga)).

The focus of the RMA is on managing effects of activities on the environment through regional policy statements, regional and district plans, and resource consents. The RMA, along with regional policies and plans can be used to manage activities so that they do not create a biosecurity risk or those risks are minimised. While the Biosecurity Act is the main regulatory tool for managing pests, there are complementary powers within the RMA that can be used to ensure the problem is not exacerbated by activities regulated under the RMA.

The Biosecurity Act cannot over-ride any controls imposed under the RMA, for example, bypassing resource consent requirements.

2.2.3 Local Government Act 2002

The purpose of the Local Government Act 2002 (LGA) is to provide *"a framework and powers for local authorities to decide which activities they undertake and the manner in which they will undertake them".* The LGA currently underpins biosecurity activities through the collection of both general and targeted rates. While planning and delivering pest management objectives could fall within powers and duties under the LGA, accessing legislation focused on managing pests at the regional level is the most transparent and efficient approach. The Council is mandated under s11(b) of the LGA to perform the funding function, and s11(b) provides for Council to perform duties under Acts other than the LGA.

2.2.4 Wild Animal Control Act 1977 (and Wild Animal Control Amendment Act 1997) and the Wildlife Act 1953

Activities in implementing this Plan must comply with other legislation. Two such Acts are the Wild Animal Control Act 1977 (and Wild Animal Control Amendment Act 1997) and the Wildlife Act 1953, (both administered by the Department of Conservation). Particular relevant requirements are noted below.

(a) The Wild Animal Control Act 1977 controls the hunting and release of wild animals, such as feral deer, goats and pigs, and regulates deer farming and the operation of safari parks. It also gives local authorities the power to destroy wild animals under operational plans that have the Minister of Conservation's consent

(b) The Wildlife Act 1953 (WL Act) controls and protects wildlife not subject to the WAC Act. It identifies which wildlife are not protected (eg, mustelids, possums, wallabies, rooks, feral cats), which are to be game (eg, mallard ducks, black swan), and which are partially protected or are injurious.

2.2.6 Other legislation

Other legislation (such as the Reserves Act 1977 and the Conservation Act 1987) does contain provisions that support pest management within a specific context. The role of regional councils under such legislation is limited to advocacy. As regional councils have a specific role under the Biosecurity Act, only taking on an advocacy role would be of little use. The National Animal Identification and Tracing Act 2012 (NAITA) establishes an animal identification and tracing system that provides for the rapid and accurate tracing of deer and cattle for the purpose, among other things, of improving biosecurity management. To meet NAIT requirements, all persons in charge of deer or cattle must ensure all deer are cattle are tagged with approved ear tags, registered, and records kept pf the animal's movements.

2.3 Relationship with other Pest Management Plans

An RPMP must not be inconsistent with:

(i) any national pest management plan or RPMP that is focused on the same organism; or

(ii) any regulation.

The Hawke's Bay region shares a boundary with Gisborne District Council, Bay of Plenty Regional Council, Waikato Regional Council and Horizons Regional Council. There are no known inconsistencies with other pest management plans on the same organism or any pathway management plan. It is in the interests of efficient and effective pest management that the pest management objectives between neighbouring councils are not inconsistent with each other. In developing this Plan, The Council has given regard to the aims and objectives of the pest management strategies of these neighbouring councils. Where possible, The Council will align its work programmes with neighbouring regional councils to maximise efficiencies in pest control. An example of this is Hawke's Bay working collaboratively with Horizons and Greater Wellington regional councils in managing rooks.

2.3.1 Biosecurity 2025 Direction Statement

In November 2016 the government outlined its vision for biosecurity management in Aotearoa / New Zealand through the release of the Biosecurity 2025 Direction Statement. This outlines five strategic directions necessary to strengthen the parts of the national biosecurity system that are working well, to drive change where it is needed, and harness opportunities to work more effectively:

1. "A biosecurity team of 4.7 million." A collective effort across the country: every New Zealander becomes a biosecurity risk manager and every business manages their own biosecurity risk.
2. "A toolbox for tomorrow." Harnessing science and technology to transform the way we do biosecurity.
3. "Smart, free-flowing information." Tapping into the wealth of data available, building intelligence and using powerful data analysis to underpin risk management.
4. "Effective leadership and governance." System-wide leadership and inclusive governance arrangements support all system participants in their roles.
5. "Tomorrow's skills and assets." A capable and sustainable workforce and world-class infrastructure provide the foundation for an effective system."

The programmes in this RPMP align well with these strategic directions, emphasising the shared responsibilities of pest management and the evidence basis for their inclusion. Preparation and implementation of an RPMP is core to taking regional leadership, combined with the broader operational and other programmes undertaken by the Council.

2.3.2 Proposed National Environmental Standard for Marine Aquaculture

The Ministry for Primary Industries (MPI) in partnership with the Ministry for the Environment (MFE) has proposed a National Environmental Standard for Marine Aquaculture (NES). NES' are regulations recommended by the Minister for the Environment under the RMA. The proposed NES has the objective of developing a more consistent and efficient regional planning framework for the management of existing marine aquaculture activities and on farm biosecurity management, while supporting sustainable aquaculture within environmental limits.

All marine farms would be required to prepare, implement and regularly update Biosecurity Management Plans by January 2025. The criteria for these plans would be specified in a separate document developed by MPI in close consultation with biosecurity experts and is likely to be based on MPI's Aquaculture Biosecurity Handbook.

The proposed NES was released for public consultation between June and August 2017, public consultation closed on the 8 August 2017.

2.3.3 Predator Free 2050

This is an ambitious programme to rid Aotearoa / New Zealand of possums, rats and stoats by 2050. Its aim is to connect and amplify successful efforts already underway across communities, iwi, private businesses, philanthropists, scientists and government. The intention is also to focus on developing breakthrough predator control tools and techniques (as it is recognised that currently the technology to achieve this ambition is not available).

Four interim goals for 2025 have been set for the project:

1. An additional one million hectares of land where pests have been suppressed or removed through Predator Free New Zealand partnerships.
2. Development of a scientific breakthrough capable of removing at least one small mammalian predator from Aotearoa / New Zealand entirely.
3. Demonstrate areas of more than 20,000 hectares can be predator free without the use of fences.
4. Complete removal of all introduced predators from offshore island nature reserves.

Council recognises and supports the opportunity for a step-change in pest management in Aotearoa / New Zealand. As discussed further in this document, Council is looking to partner with PF2050 in working towards this goal through key pest animal programmes within the Hawke's Bay region.

2.3.4 National Pest Plant Accord

The National Plant Pest Accord (NPPA) is a cooperative agreement between central government (MPI and the Department of Conservation (DOC)), unitary and regional councils, and New Zealand Plant Producers Incorporated (an industry body of plant growers and their industry partners) to manage risks associated with the sale, distribution and propagation of specific, harmful pest plants. Although the NPPA itself is non-statutory, the approximately 207 plant species (some listings include sub-species) identified by the NPPA have been declared unwanted organisms under Part 9 of the Biosecurity Act, and thus banned from propagation, sale or other distribution. Several plants on the NPPA list are also addressed by management programmes in this RPMP, additional to the restrictions on their spread derived from their status as unwanted organisms.

2.3.5 National Pest Pet Biosecurity Accord

The National Pest Pet Biosecurity Accord (NPPBA) is an initiative similar to the NPPA, and is a partnership between MPI, DOC, unitary and regional councils, the Pet Industry Associations and the New Zealand Companion Animal Council. Its purpose is to regulate the domestic trade of high-risk pets (excluding cats and dogs) and to encourage responsible pet ownership. The intention is to identify a list of species to be declared as unwanted organisms, although to date no species have been regulated under the NPPBA. As with pest plants on the NPPBA, inclusion of high-risk pets on the NPPBA list does not preclude their inclusion in RPMP programmes

2.4 Relationship with the National Policy Direction

The National Policy Direction (NPD) became active on 17 August 2015. The stated purpose of the NPD is to ensure that activities under Part 5 of the Act (Pest Management) provide the best use of available resources for New Zealand's best interests, and align with each other (when necessary), to help achieve the purpose of Part 5. Table 1 below sets out the NPD requirements and the steps taken to comply with them.

Table 1: NDP Requirements

NPD REQUIREMENTS	STEPS TAKEN TO COMPLY
Programme is described	Checked that the types of programmes (described in section 5 of the Proposal) comply with clause 4 of the NPD.
Objectives are set	Checked that the contents of section 6 of the Proposal comply with clause 5 of the NPD.
Benefits and costs are analysed	Analysed the costs and benefits (see clause 6 of the NPD). That analysis is contained in the companion document Cost Benefit and Impact Assessment for the Proposed Regional Pest Management Plan for Hawke's Bay.
Funding rationale is noted	Checked the funding rationale described in section 10 of the Proposal has been developed in line with clause 7 of the NPD.
Good neighbour rules (GNRs) are described	GNRs have been developed in line with clause 8 of the NPD

2.5 Relationship with Māori

One specific purpose of an RPMP under the Act is to provide for the protection of the relationship between Māori and their ancestral lands, waters, sites, wāhi tapu, and taonga, and to protect those aspects from the adverse effects of pests. Tangata whenua as kaitiaki are also a key strategic partner in regional biosecurity delivering a range of social, cultural, economic and environmental outcomes for our region. Tangata whenua carry out significant pest management through their primary sector economic interests and as land owners and/or occupiers. The HBRC Biosecurity team are currently working alongside tangata whenua through the Poutiri Ao ō Tāne, Cape to City and Whangawehi projects.

HB Regional Planning Committee

The Hawke's Bay Regional Planning Committee was established by the Hawke's Bay Regional Planning Committee Act 2015. The role of the Regional Planning Committee (RPC) is to oversee the review and development of the Regional Policy Statement and regional plans for the Hawke's Bay region, as required under the Resource Management Act 1991. With an equal number of Regional Councillors and Tāngata Whenua Group representatives, this committee is the co-governance group for the management of natural resources in Hawke's Bay. All committee members have full speaking and voting rights. This committee considers and recommends strategies, policies, rules and other methods for inclusion into the Regional Resource Management and Regional Coastal Environment Plans to Council. The committee will also make recommendations to Council to ensure the effective implementation of plans, processes, research, monitoring and enforcement to satisfy the requirements of the Resource Management Act 1991, National Policy Statements, National Environmental Standards and relevant associated legislation. Council has been working with the RPC through the Biosecurity Working Party, seeking guidance on pest programmes and engagement process. Council has also presented key Regional Pest Management Plan updates to the RPC Committee.

Maori Committee

The Māori Committee includes members appointed by various Māori groups and three elected Councilors. The committee makes recommendations to Council on matters of relevance affecting Māori people of the region and helps fulfil the Māori consultative undertaking of Council, particularly with regard to the principles of the Treaty of Waitangi (Te Tiriti O Waitangi).Council has presented key Regional Pest Management Plan updates to the Maori Committee.

The LGA requires Council to recognise and respect the Crown's responsibilities under the Tiriti o Waitangi - Treaty of Waitangi. It also requires councils to maintain and improve opportunities for Māori to contribute to decision-making processes. This includes supporting tangata whenua. These responsibilities and requirements were met while preparing this plan and will continue after it takes effect. This Plan is one of the avenues to build synergy and co-operation between Māori organisations and Hawke's Bay as partners in managing the Region's natural resources.

2.6 Consultation overview

The development of this Proposed RPMP commenced with a fit for purpose review of the previous Regional Pest Management Strategy, undertaken in 2016. Internal workshops were held, followed by meetings with key stakeholders including DOC, Horticultural sector, Federated Farmers and contractors.

A Biosecurity Working Party (BWP) was formed, which consisted of three appointed Councillors and three appointed members of the Regional Planning Committee.

The BWP had the following functions:

- Responsible for considering and recommending to staff advice on the Regional Pest Management Plan review process and key issues;
- To consider reports on the Regional Pest Management Plan and to give guidance on recommended approach and to review and give guidance on the discussion document;
- To review and give guidance on the proposal and to provide guidance on the alignment of the Regional Pest Management Plan and the objectives of the Hawke's Bay Biodiversity Strategy;
- To review and give guidance on received submissions

A discussion document was released 12 June to 7 July 2017 for public consultation. To encourage public input, the document focused on key pests and had several mechanisms for providing feedback, including via phone, email, letter, hard copy submission form or the online submission form. The release of the discussion document was advertised via the HBRC web and Facebook page, a YouTube video, an article in HBRC's 'Our Place' newsletter, an article in the Hawke's Bay Today, along with 4,500 letters being sent to stakeholders and an email sent to key stakeholders, including DOC, Federated Farmers, OSPRI, TBFree Committee, Horticultural sector, Forestry sector, MPI, Fish & Game, Forest & Bird, HB Marine group, QEII and HBRC contractors. It was presented to the Regional Policy Committee and the Maori Committee. A total of 98 submissions were received. Feedback from this consultation process was used to help guide the development of the RPMP Proposal.

This Proposed RPMP has been publicly notified for public submissions to confirm community expectations and policy directions to be incorporated into the final plan.

3. Responsibilities and obligations

3.1 The management agency

The Hawke's Bay Regional Council is proposed to be the management agency responsible for implementing this Proposal and the subsequent RPMP and is satisfied that it meets the requirements of s100 of the Act in that it:

(a) is accountable to the Plan funders, including Crown agencies, through the requirements of the LGA 2002;

(b) is acceptable to the funders and those persons subject to the RPMP's management provision because it implemented previous Regional Pest Management Strategies; and

(c) has the capacity, competency and expertise to implement the proposed RPMP.

How the Council will undertake its management responsibilities is set out in Part Three (Procedures) of the Proposal and in its Biosecurity Operational Plan.

3.2 Compensation and disposal of receipts

The proposed RPMP does not provide for compensation to be paid to any persons meeting their obligations under its implementation. However, should the disposal of a pest or associated organism provide any net proceeds, a person will be paid disbursement in the manner noted under section 100I of the Act.

3.3 Affected parties

3.3.1 Responsibilities of owners and/or occupiers

Pest management is an individual's responsibility in the first instance because generally occupiers contribute to the pest problem and in turn benefit from the control of pests. The term occupier has a wide definition under the Act and includes:

- the person who physically occupies the place; and
- the owner of the place; and
- any agent, employee, or other person acting or apparently acting in the general management or control of the place.

Under the Act, place includes: any building, conveyance, craft, land or structure and the bed and waters of the sea and any canal, lake, pond, river or stream.

Owners and/or occupiers must manage pest populations at or below levels specified in the rules. If they fail to meet the rules' requirements, they may face legal action. In some instances, owners and/or occupiers must report pests to the Council. No person shall sell, propagate, distribute or keep pests.

An owner and/or occupier cannot stop an authorised person from entering a place, at any reasonable time, to

- find out whether pests are on the property;
- manage pests; or
- ensure the owner and/or occupier is complying with biosecurity law.

While the owner and/or occupier may choose the methods they will use to control any pests, they must also comply with the requirements under other legislation (e.g. Resource Management Act and/or the Hazardous Substances and New Organisms Act 1996).

This Proposal treats all private land equitably and emphasises the responsibilities and obligations of all land owners and/or occupiers, including Māori. Council acknowledges the complex and variable relationships of Māori land ownership and occupation. This includes multiple owners (including lessees) or a range of corporate management systems under the Companies Act 1993 or Te Ture Māori Whenua Act 1993. Where owners and/or occupiers are unknown, the Maori Land Court; or the Registrar of Companies may help to identify and communicate with them.

3.3.2 Crown agencies

Four central government agencies (including State Owned Enterprises) have been identified as being significant beneficiaries or exacerbators of pest management in the Hawke's Bay Region. These are Department of Conservation, New Zealand Railways Corporation (Kiwi Rail), New Zealand Transport Agency and Land Information New Zealand. Pursuant to Section 5 and Section 69 (5) of the Act, the Act binds Crown agencies to the extent that they will be liable to meet obligations or costs associated with a good neighbour rule, or action under a plan to enforce a good neighbour rule in the Plan. In addition to implementing good neighbour rules, HBRC will also continue to pursue and maintain formal and informal relationships with Crown agencies to achieve the objectives of this Plan. As they are not Crown agencies in the strict sense, State Owned Enterprises can be bound by any rule under the Plan.

3.3.3 Territorial Authorities

Six territorial authorities are wholly or partly contained within the Hawke's Bay region. They are: Wairoa, Hastings, Taupo, Rangitikei and Central Hawke's Bay District Councils, and Napier City Council.

Each territorial authority will be bound by the rules in this Plan (with the exception of situations where adjoining occupiers of road reserves are deemed responsible in accordance with Section 3.3.4.). Each territorial authority will be responsible for meeting its costs of complying with this Plan.

3.3.4 Road reserves

Road reserves include the land on which the formed road lies and the verge area that extends to adjacent property boundaries. The Act allows the option of making either roading authorities (NZ Transport Agency and district/city councils) or adjoining land occupiers responsible for pest management in road reserves (see s6(1) of the Act).

As such, the Hawke's Bay Regional Council has decided that, for the purpose of this Plan, roading authorities are responsible for controlling pests on road reserves that they occupy. Where the road reserve boundary is unknown this will be taken as 10m from the road centreline. Areas where roading authorities are responsible for controlling pests includes:

- rest areas;
- weigh pits and stockpile areas;
- road reserves where road works have contributed to the establishment of named pests;
- road reserves adjacent to land where the landowner is undertaking programmed pest management;
- any other area where it is unreasonable to expect adjoining landowners to control pests (eg steep topography).

Except where a rule prevents occupier control, adjacent landowners are responsible for controlling pests on road reserves in the following situations:

- unformed paper roads that they occupy, or are contiguous to the land that they occupy;

- on land beyond 10 metres, of the road centreline where the road reserve boundary is unknown;
- where fences encroach onto a surveyed road reserve, the occupier adjoining the road reserve shall be responsible for pests within that fenced area;
- where adjacent occupiers do not support the use of toxins/chemicals to control pests (eg organic farming practices), the occupier adjoining the road reserve shall be responsible for pest control in the road reserve as well.

Part Two: Pest Management

4 Organism status

4.1 Organisms declared as pests

The organisms listed in Table 2 are classified as pests. The table also indicates what management programme or programmes will apply to the pest and if a Good Neighbour Rule (GNR) applies.

Attention is also drawn to the **statutory obligations** of any person under s52 and s53 of the Act. Those sections ban anyone from selling, propagating or distributing any pest, or part of a pest, covered by the RPMP. Not complying with s52 and s53 is an offence under the Act, and may result in the penalties noted in s157(1).

Table 2: Organisms classified as pests

COMMON NAME	SCIENTIFIC NAME	PROGRAMME	GNR	PAGE
PLANTS				
African feather grass*	*Cenchrus macrourus*	Eradication		35
Alligator weed*	*Alternanthera philoxeroides*	Exclusion		28
Apple of Sodom	*Solanum linnaeanum*	Progressive Containment		44
Australian sedge	*Carex longebrachiata*	Progressive Containment		44
Bathurst bur	*Xanthium spinosum*	Sustained Control		65
Blackberry	*Rubus fruticosus* agg.	Sustained Control		66
Cathedral bells*	*Cobaea scandens*	Eradication		36
Chilean needle grass*	*Nassella neesiana*	Sustained Control		53
Cotton thistle	*Onopordum acanthium*	Progressive Containment		45
Darwin's barberry*	*Berberis darwinii*	Progressive Containment		45
Goats rue	*Galega officinalis*	Eradication		36
Gorse	*Ulex europaeus*	Sustained Control		66
Japanese honeysuckle	*Lonicera japonica*	Progressive Containment		46
Marshwort*	*Nymphoides geminata*	Exclusion		29
Noogoora bur	*Xanthium strumarium*	Exclusion		29
Nassella tussock*	*Nassella trichotoma*	Progressive Containment		47
Nodding thistle	*Cardus nutans*	Sustained Control		67
Old man's beard*	*Clematis vitalba*	Progressive Containment		48
Phragmites*	*Phragmites australis*	Eradication		37
Pinus contorta (lodgepole) pine*	*Pinus contorta*	Progressive Containment		49
Purple loosestrife*	*Lythrum salicaria*	Eradication		37
Privet (Chinese and tree)	*Ligustrum sinense, L. lucidum*	Sustained Control		55
Ragwort	*Jacobaea vulgaris*	Sustained Control		67
Saffron thistle	*Carthamus lanatus*	Progressive Containment		50
Senegal tea*	*Gymnocoronis spilanthoides*	Exclusion		30
Spartina	*Spartina alterniflora, S. anglica, S. gracilis, S. maritime, S. x townsendii*	Exclusion		30
Spiny emex	*Emex australis*	Eradication		38
Variegated thistle	*Silybum marianum*	Sustained Control		68
Velvetleaf*	*Abutilon theophrasti*	Progressive Containment		50
White-edged nightshade*	*Solanum marginatum*	Eradication		38

Woolly nightshade*	*Solanum mauritianum*	Progressive Containment		51
Yellow bristle grass	*Setaria pumila*	Exclusion		31
Yellow water lily*	*Nuphar lutea*	Eradication		39
ANIMALS				
Feral cat	*Felis catus*	Sustained Control Site-led		62 77
Feral deer (incl. hybrids)	*Cervus elaphus, C. nippon, C. dama*	Site-led		77
Feral goat	*Capra hircus*	Site-led	**Yes**	77
Feral pig	*Sus scrofa*	Site-led		78
Mustelids (ferret, stoat, weasel)	*Mustelo furo, M. ermine, M. nivalis*	Sustained Control Site-led		62 78
Possum	*Trichosurus vulpecula*	Eradication Sustained Control Site-led	 **Yes**	40 59 78
Rabbit	*Oryctolagus cuniculis*	Sustained Control		57
Rat (Norway and ship)	*Rattus norvegicus, R. rattus*	Site-led		79
Rook*	*Corvus frugilegus*	Eradication		41
Wallaby (Bennett's, dama, parma, brush-tailed rock and swamp)*	*Macropus rufogriseus rufogriseus, M. eugenii, M. parma, Petrogale pencillata, Wallabia bicolour*	Exclusion		31
MARINE				
Mediterranean fanworm**	*Sabella spallanzanii*	Exclusion		31
Clubbed tunicate	*Styela clava*	Exclusion		31
PHYTOSANITARY				
Codling moth	*Cydia pomonella*	Sustained Control		71
Lightbrown apple moth (Leafroller)	*Epiphyas postvittana*	Sustained Control		73
Apple black spot	*Venturia inaequalis.*	Sustained Control		71
European canker	*Neonectria ditissima*	Sustained Control		72
Fireblight	*Erwinia amylovora*	Sustained Control		72

* Unwanted organisms (as declared by a chief technical officer)

** Notifiable organism (s45 Biosecurity Act)

4.2 Other organisms that may be controlled

The organisms specified as pests under this Plan are those that are capable of causing significant 'adverse effects' on one or a number of values encompassing economic wellbeing, the environment, human health, enjoyment of the natural environment, or the relationship between Māori, their culture, and their traditions and their ancestral lands, waters, sites, wāhi tapu, and taonga. It is also possible to specify 'any other organisms intended to be controlled' but not accorded pest status.

There are many further organisms capable of causing some adverse effects, particularly to biodiversity values. However, a number pose a sufficient future risk to warrant being watch-listed for ongoing surveillance or future control opportunities. Therefore, their placement in an 'Organisms of Interest' (OoI) category is considered prudent.

OoI are not accorded pest status but future control of them could arise, for example through Site-led programmes. A review of the Plan may be necessary to include them as pests.

Table 3: Organisms of Interest

COMMON NAME	SCIENTIFIC NAME
Argentine ant	*Linepithema humile*
Australian tubeworm	*Ficopomatus enigmaticus*
Banana passionfruit	*Passiflora 'Tacsonia' subgroup*
Boneseed	*Chrysanthemoides monilifera*
Broom	*Cytisus scoparius*
Canada goose	*Branta canadensis*
Chilean flame creeper	*Tropaeolum speciosum*
Climbing spindle berry	*Celastrus orbiculatus*
Douglas fir	*Pseudotsuga menziesii*
Blue Morning Glory/Convolvulus	*Ipomoea indica*
Eastern Rosella	*Platycercus eximius*
Feral goose	*Anser anser*
Feral pigeon	*Columba livia*
Hornwort	*Ceratophyllum demersum*
Magpie	*Gymnorhina tibicen*
Mothplant	*Araujia hortorum*
Parrot's feather	*Myriophyllum aquaticum*
Purple ragwort	*Senecio elegans*
Reed Sweet Grass	*Glyceria maxima*
Wasp German and European	*Vespula germanica Vespula vulgaris*
Water celery	*Apium nodiflorum*
Wild cotoneaster	*Cotoneaster glaucophyllus, C. franchetii*
Wilding pine	*Pinus radiata*

4.3 Unwanted Organisms

A number of species have been declared nationally as Unwanted Organisms. Some of those organisms are subject to national action under the National Interest Pest Response (NIPR) programme managed by Ministry for Primary Industries (MPI). With the exception of phragmites, none of the other eight species subject to the NIPR are known to be present in Hawke's Bay. Phragmites is included in the Proposal (under the eradication programme) as part of the collective assistance being provided by the Council to the NIPR programme.

For the most up-to-date list of Unwanted Organisms, visit the MPI website.

The National Pest Plant Accord (NPPA) currently targets 113 plant species all of which are declared Unwanted Organisms. NPPA is a cooperative agreement between the Nursery and Garden Industry Association, regional councils and government departments with biosecurity responsibilities. It seeks to prevent the sale and/or distribution of the specified plants where either formal or casual horticultural trade is the most significant way of spreading the plants in New Zealand. The most up-to-date list of Accord species is also available on the MPI website.

Unwanted organism are banned from sale, propagation and distribution in accordance with sections 52 and sections 53 of the Act. Any other control measures are the responsibility of the respective government departments, unless a regional council has been specifically asked and has agreed to undertake such work.

5 Pest management framework

5.1 Objectives

Objectives have been set for each pest or class of pests. As required by the NPD, the objectives include:

- the particular adverse effect/s (s54(a) of the Act) to be addressed;
- the intermediate outcomes of managing the pest;
- the geographic area to which the objective applies;
- the level of outcome, if applicable;
- the period for achieving the outcome; and
- the intended outcome in the first 10 years of the Plan (if the period is greater than 10 years).

5.2 Pest management programmes

One or more pest management programmes will be used to control pests and any other organisms covered by this RPMP. The types of programme are defined by the NPD and reflect outcomes in keeping with:

- the extent of the invasion; and
- whether it is possible to achieve the desired control levels for the pests.

The intermediate outcomes for five programmes are described below.

1. Exclusion Programme: to prevent the establishment of the subject, or an organism being spread by the subject, that is present in New Zealand but not yet established in an area.

2. Eradication Programme: to reduce the infestation level of the subject, or an organism being spread by the subject, to zero levels in an area in the short to medium term.

3. Progressive Containment Programme: to contain or reduce the geographic distribution of the subject, or an organism being spread by the subject, to an area over time.

4. Sustained Control Programme: to provide for ongoing control of the subject, or an organism being spread by the subject, to reduce its impacts on values and spread to other properties.

5. Site-led Pest Programme: that the subject, or an organism being spread by the subject, that is capable of causing damage to a place is excluded or eradicated from that place, or is contained, reduced, or controlled within the place to an extent that protects the values of that place.

5.3 Principal measures to manage pests

The principal measures used in the RPMP to achieve the objectives are in four main categories. Each category contains a suite of tools to be applied in appropriate circumstances.

1. Requirement to act

Land owners and/or occupiers or other persons may be required to act where RPMP rules dictate:

(a) pests are to be controlled;
(b) Written Management Agreements are to be prepared and submitted.

The development of a Written Management Agreement will enable an occupier to set out how the management agreement is intended to meet the objectives of the Plan over which the infestation lies. Council will approve plans where they believe that the land occupier has adequately provided for the containment of the infestation in accordance with the Plan. If a land occupier has an agreed Written Management Agreement with Council and is actively carrying out their requirements under this management agreement, they will not receive a written direction from an Authorised Person.

Approved pest plant management agreements may qualify for a subsidy under the incentive scheme.

(c) the presence of pests is to be reported;
(d) actions are to be reported (type, quantity, frequency, location, programme completion); or
(e) pests are not to be spread (propagated, sold, distributed), and pathways are to be managed (eg, machinery, gravel, animals).

2. Council inspection

Inspection by Council may include staff:

(a) visiting properties or doing surveys to determine whether pests are present, or rules and management programmes are complied with, or to identify areas that control programmes will apply to (places of value, exclusion zones, movement control areas);
(b) managing compliance to regulations (rule enforcement, action on default, prosecution, exemptions);
(c) taking limited control actions, where doing so is effective and cost efficient; or
(d) monitoring effectiveness of control.

3. Service delivery

Council may deliver the service:

(a) where it is funded to do so through approved management plans;
(b) on a user pays basis;
(c) where, at its discretion, it chooses to assist land occupiers in controlling the pest;
(d) by providing control tools, including sourcing and distributing biological agents, provisions (eg, traps, baits, chemicals) or subsidies.

4. Advocacy and education

Council may:

(i) provide general purpose education, advice, awareness and publicity activities to land owners and/or occupiers and the public about pests and pathways (and control of them);
(ii) encourage land owners and/or occupiers to control pests;
(iii) facilitate or fund community and land owners and/or occupier self-help groups and committees;
(iv) help other agencies with control, advocacy, and the sharing or sourcing of funding;
(v) promote industry requirements and best practice to contractors and land owners and/or occupiers;
(vi) encourage land owners and/or occupiers and other persons to report any pests they find or to control them; or
(vii) facilitate or commission research.

5.4 Rules

Rules play an integral role in securing many of the pest management outcomes sought by the Plan. They create a safety net to protect land owners and/or occupiers from the effects of the actions or inactions of others where non-regulatory means are inappropriate or do not succeed. Importantly, amendments to the Act arising from the Biosecurity Law Reform Act 2012 now make the Crown bound by those rules identified as **Good Neighbour Rules** in RPMPs.

Section 73(5) of the Act prescribes the matters that may be addressed by rules, and the need to:

(i) specify if the rule is to be designated as a 'Good Neighbour Rule';
(ii) specify if breaching the rule is an offence under the Act;
(iii) specify if an exemption to the rule, or any part of it, is allowable or not; and
(iv) explain the purpose of the rule.

Rules can apply to owners and/or occupiers or to a person's actions in general.

The NPD and accompanying guidance notes provide extra requirements to include in the rules of a new GNR. Of particular note, the GNR will:

(a) identify who the GNR applies to—either all owners and/or occupiers, or a specified class of owner and/or occupier;
(b) identify the pest to be managed;
(c) state that the pest must already be present on the owner's and/or occupier's land;
(d) state that the owner and/or occupier of the adjacent or nearby land must, in the view of the management agency, be taking reasonable measures to manage the pest on their land; and
(e) (if relevant) state the particular values or uses of the neighbouring land that the pest's spread affects, and that the GNR is intended to address.

6 Pest descriptions and programmes

Section 6 lists the pests to be managed under the Plan according to the programme(s) to which they are assigned. The Proposal is required to describe, for each pest listed:

- its adverse effects;
- the reasons for a Plan;
- the objectives to be included in the Plan (see Section 5.2 above);
- the principal measures (including rules) to be used to achieve the objectives (see section 5.3 above); and
- any other measures that would be reasonable to take to achieve the objectives.

6.1 Pests to be managed under exclusion programmes

The pests listed in Table 4 below are not known to be present in the Hawke's Bay region and preventing their establishment is considered to be of benefit to the region. These pests have the potential to establish in Hawke's Bay and may cause adverse effects on production/economic wellbeing and environmental values. These pests can displace other species, impacting pasture and native species. The impact to production or native ecosystems warrant the prevention of their establishment in the region.

Success in doing so is considered more likely under a planned and coordinated approach compared to individual land occupier responsibility.

Table 4: Pests under exclusion programmes

COMMON NAMES	SCIENTIFIC NAME
Alligator weed	*Alternanthera philoxeroides*
Marshwort	*Nymphoides geminata*
Noogoora bur	*Xanthium strumarium*
Senegal tea	*Gymnocoronis spilanthoides*
Spartina	*Spartina* spp.
Yellow bristle grass	*Setaria pumila*
Wallaby (Bennett's, dama, parma, brush-tailed rock and swamp)	*Macropus* spp., *Petrogale pencillata, Wallabia bicolor*
Mediterranean fanworm (sabella)	*Sabella spallanzanii*
Clubbed tunicate (invasive sea squirt, styela)	*Styela clava*

6.1.1 Alligator weed

Description

Perennial aquatic or terrestrial herb with long, fibrous roots. Stems root at nodes, are up to 10 m long, usually pink, soft, hollow, creep along ground or float on water with tips standing upright and form dense stands or rafts. Dark green, waxy leaves (3-13 x 1-4 cm) are opposite. White clover-like flowers in 1-2 cm diameter clusters appear from December to February, but no seed is produced.

Source: Weedbusters

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Adverse effects

Rapidly forms dense mats over water and margins, with roots down to 2 m deep. Stem sections break and root readily. Tolerant of 30% sea water, high temperatures, high pollutant levels, grazing, and other damage but intolerant of frost. Reproduces from stem sections only. Water flow, contaminated diggers, soil movement, dumped vegetation, machinery, eel nets, livestock, boats and trailers all spread fragments into new catchments, pastures, cropping land, waste places and drains.

6.1.2 Marshwort

Description

Perennial aquatic plant with floating, bright green, heart-shaped leaves (up to 10cm across, and slightly longer than wide) with often pinkish undersides and stems (stolons) that are long and branched, and float just below the water surface. Leaves, roots and flowers grow in clusters from nodes along the stem. Roots are suspended in deeper water. Flowers (25-35 mm wide) with five bright yellow petals with fringed wing margins are produced from November to April, held above the water on long (7cm) stalks, with each stalk bearing about 2-7 flowers. Seeds have not been observed in NZ.

Source: Weedbusters

Adverse effects

It grows rapidly, forming dense floating mats of foliage that fill waterways. Rapidly colonises shallow water, forming dense mats impeding drainage and shading out other aquatic plants, blocking access to water and interfering with recreational activities. It is also able to invade land in an adapted growth form. It causes adverse effects to waterways and impacts conservation and environmental values.

6.1.3 Noogoora bur

Description

An annual herb, either single stemmed and tall (up to 2.5 m) or very branched and spreading depending on competition. Its leaves are dark green, sometimes mottled purple and similar in shape to grape leaves. The stems have short coarse hairs. Flowers are inconspicuous and the fruit are woody burs covered in hooked spines. Each bur contains two seeds and each plant can produce many hundreds of burs. Burs have air pockets around the spines which allow them to float.

Source: Waikato Regional Council

Adverse effects

This plant is highly competitive, causes significant losses in many crops and displaces pasture species. The seeds are poisonous to stock, particularly pigs and cattle and the burs easily contaminate sheep's wool and reduce fleece quality. Plants carry fungal diseases capable of infecting horticultural plants.

6.1.4 Senegal tea

Description

Source: Weedbusters

Perennial aquatic herb to 1+ m high with finely fibrous roots and ability to also grow aerially from stem nodes. Hollow, inflated, floating stems (1-1.5 m long and 5-10 mm diameter at first, increasing to 20 mm with age) become prostrate and branching and take root at nodes. Dark green, slightly waxy, lance-shaped leaves (50-200 x 25-50 mm) are paired with opposite stalks joined at stem, and have serrated edges. From November to April, clover-like flowerheads are produced with many thin white 'petals' (florets), followed by yellow-brown seeds (5 mm diameter). Produces few seeds, but they are long-lived. Dormant over winter and dies back to rootstock if chilled, but re-sprouts in spring.

Adverse effects

Roots and seeds in shallow water and damp ground, matures and grows quickly, forms dense mats and scrambles over other species that live on the water margins. Tolerates warm to hot temperatures, partial drying of stems and root crowns, most soils and water nutrient levels. Excludes all other species in marginal and shallow freshwater habitats and forms mats over deep water. Prevents seedlings of native species establishing, causes flooding, and rotting vegetation ruins water quality.

6.1.5 Spartina

Description

Source: Weedbusters

A perennial, clump-forming grass to 1 m tall with rhizomes and fibrous roots and erect stems (4-9 mm diameter) with many brownish leaf sheaths. Alternate leaves (5-45 by 4-15 mm) are deeply wide-ribbed on upper surface and have ligules (1-3 mm long). Seed heads are occasionally seen, and occasionally produced at some sites. It colonises the bare inter-tidal zone where it forms dense clumps and traps sediment. Spartina tolerates all weathers and temperatures, fire, grazing, and other damage.

Rhizomes spread slowly and broken fragments re-sprout easily. Livestock, propellers, nets and similar can dislodge rhizome fragments, which are then spread by tidal and current movement. They also spread through intentional planting. Spartina can survive long-term at sea, which means that it can travel long distances with the currents.

Adverse effects

Spartina traps sediment, raising the level of the ground above the high tide mark and destroying the inter-tidal zone and habitat. Other weedy grasses succeed spartina, creating dry 'meadows'. It can reduce large estuaries and shallow harbours to thin drains surrounded by rough pasture, adversely affecting environmental values, resulting in an immense loss of biodiversity.

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6.1.6 Yellow bristle grass

Description

Source: AgPest

Yellow bristlegrass is an annual, upright growing grass 25-45cm tall. In open pasture its first leaves often grow parallel to the ground. Leaves are hairless, twisted and slightly rough at the edges, and yellow-green to green in colour. The leaf sheath is flattened and hairless and often turns reddish purple. Its seed head is a cylindrical 'spike', 2.5 – 10 cm long, with many densely packed spikelets. Each spikelet is surrounded by five to ten bristles, 5-8 mm long which are green initially but later turn golden-brown.

Adverse effects

This plant hardens off in autumn resulting in lower pasture quality, a problem particularly for milk and stock finishing producers. This represents an adverse impact on production and economic well-being and is therefore included in the Proposal.

6.1.7 Wallaby

Description

Source: Department of Conservation

Kangaroo-like marsupial animals standing 0.5 (dama)-1.5 (Bennett's) metres tall with tails as long as half their height. They range in weight from approximately 5 kilograms to in excess of 20 kilograms. Their fur colour varies from grey to reddish brown.

Adverse effects

Wallabies are capable of causing significant adverse environmental effects. These include preventing the regeneration of native bush, depletion of forest understorey and possible impacts on water quality. They can damage tall tussock grasslands, including the inter-tussock vegetation which can become depleted with a consequent increase in bare ground and higher risk of soil erosion. Pasture and feed crops are grazed, particularly in situations where suitable wallaby cover is adjacent. Exotic forests can be damaged especially in their establishment stage.

6.1.8 Mediterranean fanworm and clubbed tunicate

Description

Mediterranean Fanworm
Source: Northland Regional Council

The adult Mediterranean fanworm is a sessile tube-dwelling worm species with a prominent crown (fan) of brightly coloured (orange, purple and white) bands of feeding tentacles. Mediterranean fanworm's outer tube is tough and flexible and often muddy in appearance. In some instances, there can be other organisms growing on the surface of the tubes. It produces conspicuous amounts of mucus.

There are many native fanworms that look similar; however, with a tube length of up to 800 mm, the Mediterranean fanworm is larger than any other comparable worms in New Zealand.

Clubbed tunicate
Source: Matt Conmee, Northland Underwater Technical Services

Clubbed tunicate has a long, club-shaped body on a tough stalk. Its surface is leathery, rumpled, and nobbly. They can be brownish-white, yellowish-brown, or reddish-brown and ugly in appearance. Sometimes referred to as a 'solitary' sea squirt because each individual has its own stalk and adheres separately to a substrate.

It is known to grow rapidly overseas, reaching densities of up to 500-1500 individuals per square metre. They can live for up to two years and grow up to 160 millimetres long.

While Clubbed tunicate are hermaphrodites they have to have more than one to reproduce because the male and female sex organs mature at different times to avoid self-fertilisation. They release eggs and sperm into the water, where eggs are fertilised. The resultant larvae can float freely for 1-3 days before settling and attaching themselves to a hard surface (e.g., rocks, wharf pylons, marine farm ropes).

Adverse effects

Both organisms are highly invasive and quickly form dense beds competing with native species for food and space. As a result, existing species can be squeezed out and new generations prevented for re-establishing. They also interfere with the nutrient flow in the water column.

Their ability to securely adhere to most hard surfaces enables them to readily foul boat hulls, fishing equipment and aquaculture structures. Boats moving from or through infested areas provide a ready pathway for accelerated spread.

Objective 1

Over the duration of the Plan, exclude the establishment of:

(i) Mediterranean fanworm and clubbed tunicate in marine waterways, and
(ii) Alligator weed, marshwort, noogoora bur, Senegal tea, spartina, wallaby and yellow bristle grass within the land or aquatic environments

of the Hawke's Bay region in order to protect the region's environmental values and economic well-being.

Principal measures to be used

Appropriate measures drawing on **requirement to act, council inspection, service delivery, advocacy and education** activities described in section 5.3 of the Proposal will be used to achieve the Objective.

Considerable emphasis will be placed on developing partnerships with other organisations and community groups that hold expertise or interest in protecting the environment, and in particular the marine space.

Alternatives considered

No other reasonable measures for achieving the Objective have been identified. The Council has better skills and resources for undertaking exclusion activities than individual persons do. Therefore, relying on or requiring individual voluntary action (do nothing approach) as a means of achieving the Objective would likely fail.

Plan Rule 1

The operator of a vessel entering the waters of the Hawke's Bays Regional Council Area (Figure 6) must ensure the hull (includes hull area, niche areas and wind and water line) to be sufficiently cleaned and antifouled so that there is no more than a slime layer.

A breach of this rule creates an offence under section 154N (19) of the Act.

Explanation

This rule is to prevent human activity introducing mediterranean fanworm and clubbed tunicate into the region via a fouled hull. Boat hulls are considered the primary vector for spreading these pests.

If you're the operator of a vessel entering Hawkes's Bays waters (Figure 6), you need to:

- regularly clean and antifoul your vessel's hull and niche areas. Ensure they are kept free of biofouling and that your antifouling paint is in good condition and working effectively
- clean hull and niche areas when your vessel has been stationary for periods of time.

An operator or the person in charge of a vessel, must take all reasonable steps to comply with this rule. Any vessel that does not meet the requirements of this rule is likely be directed to take action to mitigate the risk.

It is recommended that you keep your biofouling management information in one place, like the vessel's logbook. This will help to show you have been managing your biofouling.

This rule aligns with the Ministry for Primary Industries Craft Risk Management Standard for Biofouling.

Statutory obligation

Sections 52 and 53 of the Biosecurity Act 1993, which prevent the communication, release, spread, sale and propagation of pests, must be complied with. These sections should be referred to in full in the Biosecurity Act 1993. A breach of these rules creates an offence under section 154(O) of the Act.

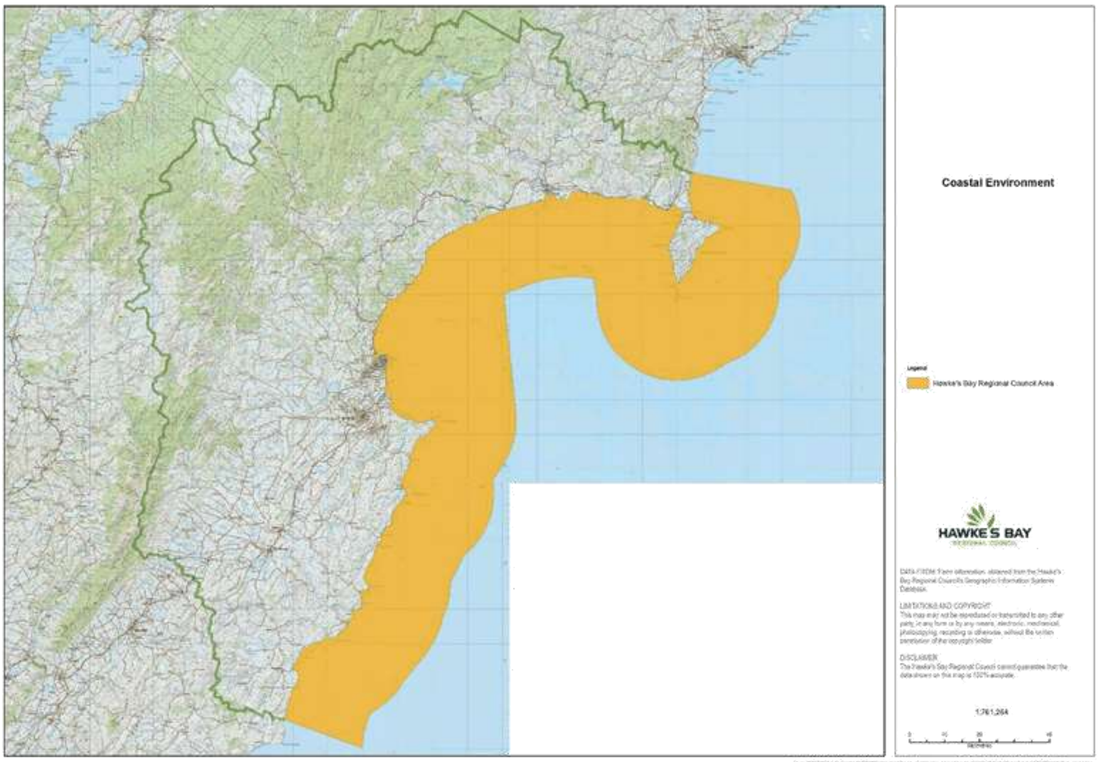

Figure 6: Waters of the Hawke's Bays Regional Council

6.2 Pests to be managed under eradication programmes

There are a number of pests in the Hawke's Bay region where eradication is possible. These pests are listed in Table 5 below.

Table 5: Pests under eradication programmes

COMMON NAME	SCIENTIFIC NAME
PLANTS	
African feather grass	*Cenchrus macrourus*
Cathedral bells	*Cobaea scandens*
Goats rue	*Galega officinalis*
Phragmites	*Phragmites australis*
Purple loosestrife	*Lythrum salicaria*
Spiny emex	*Emex australis*
White-edged nightshade	*Solanum marginatum*
Yellow water lily	*Nuphar lutea*
ANIMALS	
Possum	*Trichosurus vulpecula*
Rook	*Corvus frugilegus*

6.2.1 African feather grass

Description

African feather grass was first recorded in New Zealand in 1940, and was introduced as an ornamental grass for gardens. It is a robust, rhizomatous, perennial grass that forms dense tussocks up to 2 metres high. It resembles a small pampas grass when not flowering. African feather grass flowers from November to April. The yellow/ purple flowers are distinctive, forming a narrow cylindrical stem up to 30cm long with barbed bristles sticking out from the spike.

Source: Weedbusters

It spreads either by seeds or by advancing its stout rhizomes. It is spread by gravel distribution, wind, water, clothing, the hair or wool of animals, cultivation and machinery. It tolerates a wide range of conditions, but prefers damp situations in swamps and along the berms of rivers.

The known distribution of African feather grass in Hawke's Bay is presently limited to farmland in the Maraekakaho and Ngaruroro River berm areas (1260ha)

Adverse effects

Its extensive root system makes it difficult to remove and it produces large amount of seeds. The plant can spread quickly, crowding out other low growing plant species. It can adversely impact environmental values in wetlands, waterbodies, coastal areas and tussock landscapes. It can also adversely impact economic prosperity.

6.2.2 Cathedral bells

Description

An evergreen, perennial, climbing vine to 6 m tall, with angled stems and hook-like tips. Leaves are arranged alternately on stems, and are made up of 3 pairs of oval leaflets (including small basal pair) that are dark green above, whitish below, with branched tendrils that are purplish when young and woody at the base. Midrib has twining tendrils.

Source: Weedbusters

Bell-shaped flowers (6-7 cm long) are produced from December to May that are green and smelly when young and become deep purple. These develop into green oval pods (55-85 mm long) containing winged seeds (10-15 mm). Germination can occur throughout most of the year. Seed is carried a short distance by wind, but most spread is through dumped vegetation, soil and water movement or scrambling habit. Garden escapes are a common source of spread.

Current infestation is limited to approximately 1 hectare occupying 10 small sites across the region.

Adverse effects

Cathedral bells' smothers all plants up to medium to high canopy level and prevents the establishment of native plant seedlings. The plant is therefore capable of causing significant adverse effects to environmental values.

6.2.3 Goats rue

Description

Goats rue is a fast growing perennial, colony-forming, leguminous woody herb, which can grow up to 2 m. tall. It has lilac or pink flowers that grow in bunches on spikes of 30 cm or longer. Seed production is prolific and viability remains for long periods. While seed mainly falls near the parent plant, dispersal by water, gravel distribution and stock also occurs.

Source: Weedbusters

The plant is spindly when young but usually grows into dense clumps with tall stems which die back during autumn. Goats rue is a very robust plant, can tolerate severe frosts and is considered unpalatable to stock.

To date, the distribution of Goats rue is limited to the southern North Island, and in Hawke's Bay it is found along roadsides and railway lines at Eskdale, Omakere and Tikokino (34ha).

Adverse effects

The plant is capable of invading many habitats and crowds out other vegetation. Production and biodiversity values are therefore threatened.

6.2.4 Phragmites

Description

Phragmites australis, or common reed, is a wetland plant. It is widely distributed, ranging all over Europe, Asia, Africa, America and Australia but not New Zealand. However, the origin of the species is unclear. It was harvested for use in thatching in Britain.

Source: Weedbusters

An erect, rhizomatous, perennial grass, 2--4 m high. Vigorous rhizomes can grow to 2 m deep, with 40% of the plant underground. Its stems are hollow stems and the smooth flat leaf blades extend to 60 cm in length. The leaf margins are rough, leaf sheaths overlap and the ligule has a fringe of long hairs. The plant produces brownish or purplish feathery-shaped flowerheads that are 20--50 cm long, but does not set seed and it dies back in winter.

Phragmites grows in marshes and swamps, along streams, lakes, ponds, ditches and wet wastelands. It also tolerates moderate salinity.

There are currently 120 known sites in Hawke's Bay, with its extent being limited to streams and drains in and around the Napier City urban area, Havelock North and Puketitiri.

Adverse effects

The plant has a high degree of adaptability, competitive ability, obstructive qualities, and potential to invade native vegetation and is difficult to manage. Phragmites is considered to cause serious adverse effects on environmental and conservation values. It also impacts infrastructure through restricting or blocking water flow in drainage systems.

6.2.5 Purple loosestrife

Description

An erect, hairy, summer-green perennial herb, 1-2 m tall. With a taproot and fibrous roots it forms dense surface mats and produces up to 50 stems per rootstock. The much-branched stems are 4-8 sided, pink at base and die off in winter. Narrow lanceolate to elliptic leaves ,20-100 mm long by 5-25 mm wide are usually paired.

Source: Weedbusters

From December to February a showy, densely hairy flowerhead spike, 20-25 cm long, is produced, made up of purple-magenta flowers with 5-6 petals, which are followed by blackish seed capsules 3-5 mm long. Seed is spread by the movement of water and contaminated machinery, soil, livestock and hay.

Purple loosestrife rapidly invades damp ground and shallow water. It overtops native species with dense bushy growth, is long-lived and produces millions of long-lived, highly viable seeds from an early age. Tolerates hot or cold conditions and low to high nutrient levels in the water, but is intolerant of salt water.

To date, it has been found at one small site at Te Pohue.

Adverse effects

It causes adverse effects on environmental values because of its ability to exclude all other species and destroy wetland and marginal habitats.

6.2.6 Spiny emex

Description

Hairless semi-prostrate annual herb with a stout taproot. Leaves are dull green and a similar shape to dock; forming a rosette in early growth then branching later. Flowers are inconspicuous at the base of leaf stems, and develop into hard fruit (burs) that ripen from green to brown.

Source: Weed Futures

Burs are woody and approximately.7 mm long. Each bur has three sharp spikes. When they are shed they lie with one spike pointing upwards enabling attachment to shoes, tyres and animal feet. Burs can float on water and spread along water courses. It produces long-lived seed which can remain viable for up to 8 years (based on overseas evidence).

The plant grows in sandy or loamy soils in coastal areas. It invades pasture, crops, lawns and waste places and can tolerate temperate to subtropical climates.

The current known distribution of Spiny emex is limited to two properties at Whakaki and between Napier and Bay View.

Adverse effects

While it is a relatively weak competitor, being out-competed by grasses and legumes, its ability to invade habitats where environmental conditions such as drought or unseasonal rains modify pasture composition make it a threat. The seeds cause hoof lameness to stock.

6.2.7 White-edged nightshade

Description

White edged nightshade is a spiny, much branched, perennial shrub, growing up to 5 m. tall and forms dense thickets. It has woody stems, white to light blue flowers, and yellow-green berries about 4 cm in diameter. The berries are poisonous to stock and humans. Leaf margins are pale but its most distinguishing features are spines on both sides of the leaves and thorns on the stems. Its seed is spread by attaching to sheep fleeces, through birds eating its berries, and by machinery.

Source: Auckland Council

The plant grows in poor rough scrub-covered country, on roadsides and wastelands and bush margins. It prefers warm, sunny situations.

White edged nightshade was first discovered in the region in 1984 on one property at Eskdale. It remains restricted to 120ha.

Adverse effects

This plant can form dense impenetrable thickets and invade poor open pasture and other open areas creating a threat to stock and human health.

6.2.8 Yellow water lily

Description

Source: NIWA

Yellow water lily is a perennial aquatic plant, with both floating and submerged leaves. Floating leaves are oval, up to 30 cm long by 40 cm wide, with a deep indent at one end. Leaves are tough, leathery and dark green. Stout, tuber-like rhizomes up to 10 cm in diameter grow on the bottom to a depth of 3 m. Stalked, solitary buttercup-like 4--6 cm diameter flowers rise well above the leaves. Flowers have a strongly alcoholic aroma, hence the common name 'brandy bottle'. Fruit are 2--3 cm long, green, and flask-shaped and contain hundreds of long-lived viable seeds.

To date, Yellow water lily has only been found at two isolated spots – Horseshoe Lake at Patangata, and a nearby farm dam. It can be spread via the transport of rhizomes and seeds on boats and machinery.

Adverse effects

The plant grows from the water's edge into slow-running water up to 2 metres deep, and can invade permanent water of lakes and slow-flowing streams over mud and silt. Fast growing, along with its massive rhizomes that hold nutrient stores, enables it to outcompete all other aquatic plants.

Objective 2

Over the duration of the Plan, destroy all infestations of African feather grass, cathedral bells, goats rue, phragmites, purple loosestrife, spiny emex, white-edged nightshade and yellow water lily, prior to seed set, within the Hawke's Bay region to prevent adverse effects on economic well-being and the environment.

It is unlikely that eradication will be complete within the duration of the plan. For many of the pest plants, seed banks exist and it may take up to 50 years for these to be exhausted.

Principal measures to be used

The Council will take responsibility for undertaking the eradication programme for pests included in eradication programmes. Appropriate measures drawn from **the requirement to act, council inspection, service delivery, advocacy and education** described in section 5.3 of the Proposal will be used to achieve the Objective.

Alternatives considered

No other reasonable measures for achieving the Objective have been identified. The Council has better skills and resources for undertaking eradication activities than individual persons do. Therefore, relying on or requiring individual voluntary action (do nothing approach) as a means of achieving the Objective would likely fail.

Statutory obligation

Sections 52 and 53 of the Biosecurity Act 1993, which prevent the communication, release, spread, sale and propagation of pests, must be complied with. These sections should be referred to in full in the Biosecurity Act 1993. A breach of these rules creates an offence under section 154(O) of the Act.

6.2.9 Possums

Description

The Australian Brushtail Possum is a nocturnal marsupial introduced and liberated in New Zealand by private individuals and acclimatisation societies between 1837 and 1898 to establish a fur trade. Possums were accorded various levels of protection until 1947. When it became clear that the environmental damage inflicted by them far outweighed any profit made from their skins, this protection was lifted.

Possums in New Zealand occur as two colour types, "blacks" and "greys". Adult male blacks vary from rich red-brown to brown, the females have a darker or black-brown fur. Adult male greys are often strongly rufous in the neck and shoulders while the greys often have a distinct silver tinge in the fur.

Size and weight are dependent on habitat. In good conditions adult possums can weigh between 3 to 5 kilograms. Their life span is about nine years. Possums reach reproductive maturity at approximately two years of age. Usually females rear three young every two years.

Possums can be found throughout Hawke's Bay. Their favoured are generally found in bush/pasture margins as these provide a plentiful supply of food and suitable habitat.

Adverse effects

Possums are considered the major animal pest in New Zealand. In farming areas, they spread bovine tuberculosis to beef and dairy cattle, and to farmed deer, damage crops and orchards, kill poplars and willows planted to control hill-country erosion and stabilise riverbanks, and eat pasture. In exotic forest plantations they kill young trees and stunt the growth of older trees by ring-barking them or breaking the uppermost branches. In native vegetated areas, possums cause severe damage by altering habitats important to native animals and birds. Tree species that are palatable to possums (e.g. rata, kamahi, and pohutukawa) become much reduced or locally extinct, and are replaced by plants that are less palatable such as tree ferns and pepperwood. As well as altering the composition of native forests and competing with native fauna, possums also prey directly on native insects and birds.

Objective 3

Over the duration of the Plan, where possible, eradicate possums within those areas identified as Possum Eradication Areas in accordance with the Hawke's Bay Regional Possum Control Technical Protocol (PN 4969), to minimise adverse effects on environmental values and economic well-being within the Hawke's Bay region.

Principal measures to be used

Appropriate measures drawing on **Requirement to act, council inspection, service delivery, advocacy and education** activities described in section 5.3 of the Proposal will be used to achieve the Objective.

Alternative measures that have been considered

The following five options were considered when reviewing the Possums Control Area porgramme:

1. Council undertakes the management of possums;
2. Increase PCA programme monitoring and compliance activity;
3. Converting Possum Control Areas to Predator Control Areas;
4. Status quo; or
5. Do nothing – remove the possum programme from the RPMP.

Possum eradication was not included as an option due to not having the tools to achieve this goal. Through the release of resent research undertaken by Zero Invasive Pests Ltd and potential future funding from Predator Free Ltd, it is likely that possum eradication will be feasible within the duration of this plan. The Council has better skills and resources for undertaking eradication activities than individual persons do. Relying on or requiring individual voluntary action (do nothing approach) as a means of achieving the Objective would likely fail.

Plan Rule 2

All occupiers within a Possum Eradication Area identified in the Hawke's Bay Regional Possum Control Technical Protocol (PN 4969) shall maintain possum eradication status in accordance with that Protocol.

A breach of this rule creates an offence under section 154N (19) of the Act.

Explanation of rule

The reason for this rule is to protect the investment in possum eradication on their property by ensuring possums do not re-establish threatening the economic well-being and environmental values being protected.

Statutory obligation

Sections 52 and 53 of the Biosecurity Act 1993, which prevent the communication, release, spread, sale and propagation of pests, must be complied with. These sections should be referred to in full in the Biosecurity Act 1993. A breach of these rules creates an offence under section 154(O) of the Act

6.2.10 Rooks

Description

Source: NZ Birds Online

Rooks are large, black birds with a violet-blue sheen. They are 30-50 cm long and fly with slow wing-beats displaying ragged wing-tips. Rooks nest in rookeries, comprising up to 150 nests and several hundred birds. Rookeries are usually built in pines, eucalyptus or oak trees; poplars and walnut trees are also utilised for nesting. 2-5 eggs per female laid each year, fledglings are able to fly in 30 days. Population can increase rapidly if left uncontrolled.

The birds are native to Britain and Europe and were introduced by early settlers and liberated by acclimatisation societies throughout New Zealand between 1862 and 1873. They were introduced to control pasture pests, but their usefulness for this purpose is now considerably outweighed by the damage caused to agricultural crops and soils. Rooks are easily disturbed and can become very wary and bait shy. This makes control difficult and can lead to rookeries fragmenting with birds colonising new areas.

Rooks have been present throughout the Hawke's Bay region. During the 1980's and 1990's, the total population was reduced significantly as a result of poisoning operations. A survey during 1998 showed that there were approximately 109 occupied rookeries, with a total of 2,754 nests and 9,600 rooks. Today, rook numbers are estimated to be less than 3000 in the region, with a total of 278 active nests treated in 2016/17.

Adverse effects

For the majority of the year, rooks feed in small groups on soil invertebrates. However, they switch to maize, peas, squash, green feed and cereal crops at sowing and post emergent times, often causing extensive damage to these crops.

Rooks are included in this Proposal to prevent damage to production values and economic well-being arising from crop damage.

Objective 4

Over the duration of the Plan, destroy all active rook nests within the Hawke's Bay region to prevent adverse effects on economic well-being and the environment.

It is unlikely that eradication will be complete within the duration of the plan. Rook numbers may still be present even though their capacity to breed is prevented and it may take up to 30 years to eradicate all birds.

Principal measures to be used

The Council will take responsibility for undertaking the eradication programme for pests included in eradication programmes. Appropriate measures drawn from **the requirement to act, council inspection, service delivery, advocacy and education** described in section 5.3 of the Proposal will be used to achieve the Objective.

Alternatives considered

No other reasonable measures for achieving the Objective have been identified. The Council has better skills and resources for undertaking eradication activities than individual persons do. Therefore, relying on or requiring individual voluntary action (do nothing approach) as a means of achieving the Objective would likely fail.

Plan Rule 3

Other than under the instruction or supervision of an authorised person, no person shall:
(a) poison, capture or trap any rook; or
(b) discharge any firearm at any rook; or
(c) discharge any firearm at or within 500 metres of any tree containing a rookery; or
(d) damage, disturb or interfere in any way with a rookery.

A breach of this rule or any part thereof creates an offence under section 154N (19) of the Act.

Explanation

The purpose of this rule is to prevent humans hindering the control of rooks. The birds are wary and require a settled environment for successful control. They are also easily dispersed.

Plan Rule 4

No person may move or interfere with any article or substance left at a place by an authorised person in accordance with this Plan for the purpose of:

(a) confirming the presence, former presence, or absence of rooks; or
(b) managing or eradicating any rooks;

other than in accordance with the direction or under the supervision of an authorised person.

A breach of this rule is an offence under section 154 (19) of the Biosecurity Act 1993.

Explanation

The purpose of this rule is to prevent humans interfering with rook control tools.

Statutory obligation

Sections 52 and 53 of the Biosecurity Act 1993, which prevent the communication, release, spread, sale and propagation of pests, must be complied with. These sections should be referred to in full in the Biosecurity Act 1993. A breach of these rules creates an offence under section 154(O) of the Act.

6.3 Pests to be managed under progressive containment programmes

There are a number of pests that are well established in the Hawke's Bay region but their present infestation levels are still low enough for those levels to be reduced region-wide through the progressive containment programme. In some cases it will result in fewer sites infested or in others the overall density of the pest will reduce over a 10-year duration period. These pests are listed in Table 6 below.

In some instances the long term outcome (greater than 10 years) for pests under these programmes remains eradication.

Table 6: Pests under progressive containment programmes

COMMON NAME	SCIENTIFIC NAME
PLANTS	
Apple of Sodom	*Solanum linnaeanum*
Australian sedge	*Carex longebrachiata*
Cotton thistle	*Onopordum acanthium*
Darwin's barberry	*Berberis darwinii*
Japanese honeysuckle*	*Lonicera japonica*
Nassella tussock	*Nassella trichotoma*
Old man's beard*	*Clematis vitalba*
Pinus contorta	*Pinus contorta*
Saffron thistle	*Carthamus lanatus*
Velvetleaf	*Abutilon theophrasti*
Woolly nightshade	*Solanum mauritianum*

* within zones specified in Figures 7 & 8

6.3.1 Apple of Sodom

Description

Apple of Sodom is a strong, spiny, woody, perennial shrub growing up to a metre or more tall. It is a native of North Africa. Leaves and branches have stout prickles. Flowers are mauve or violet followed by green and white mottled globular berries (25 mm in diameter), which ripen to yellow. Leaves are egg shaped to oblong up to 9 cm long by 7 cm wide, deeply and irregularly divided into lobes with shallowly waved margins.

Source: Auckland Council

Large numbers of seeds are produced from the berries which spread by birds and animals. The seeds germinate and sprout mid spring till the end of summer. It occupies frost-free coastal areas and invades poor pasture and scrub margins. The known distribution is centred on the Bay View area, stretching from Napier to Tangoio. It is bounded inland by a line from Waipunga Road across to Seafield Road (3,162ha).

Adverse effects

Forms dense thickets in coastal areas, excluding low-growing native species. Seed dispersal by birds adds to the threat characteristics.

6.3.2 Australian sedge

Description

Australian sedge is a strong, harsh, perennial, tussock forming sedge growing 30-90 cm tall. New leaves grow from inside the leaf sheath. They are about 5 mm wide, Y-shaped in cross-section and with sharp edges, appearing yellowish towards tips. Its flowering stems are triangular in cross-section and sharply angled. The seed head is a drooping panicle with green to pale brown seeds hanging at ends of long, thin, cotton-like filaments Flowers are grouped in catkin-like spikes that hang at the end of long, thin nodding stalks. The seed is a small, smooth triangular nut. The plant normally flowers and seeds from October to February. Australian sedge is distinguishable

Source: Auckland Council

Zealand by the way it shoots from the bottom of the original stalk with its distinctive flowers/seed head.

Australian sedge prefers land which is seasonally dry and is well suited to the climate and soils of Hawke's Bay. It invades disturbed scrub, regenerating forest and short tussock grasslands, but does not compete successfully with vigorous, well managed pastures. Australian sedge is a prolific seeder, but the seeds are relatively heavy and most fall close to the parent plant. Animals may spread seeds. The leaves are generally not palatable to stock. Once established it can be difficult to control.

Infestations in Hawke's Bay occur throughout the Wairoa District.

Adverse effects

Suppresses native plants and seedlings along scrub and forest margins, and remains an obstruction under regenerating canopy. Crowds out low-growing native species in tussock grasslands. It is a fire hazard and harbours rats and mice.

6.3.3 Cotton thistle

Description

Cotton thistle is a prickly biennial thistle standing up to 3 m tall and 1.5 m wide. It has spiny grey velvety leaves and stems covered with white cottony hairs. The flowers are dark pink, lavender or purple, globe shaped and 2.5-6 cm in diameter.

Source: Hawke's Bay Regional Council

The plant invades light broken ground in low rainfall areas and on lightly grazed, low fertility pastoral land. It also occupies shingle flats, roadsides, agricultural areas, grasslands, riparian zones, scrub/shrublands, and waterways Because of its extremely hairy leaf it is very difficult to control using chemical methods and can tolerate commonly used hormone sprays. It can also tolerate droughts. It is spread mainly by animals and machinery.

Cotton thistle is primarily spread by wind, however its plumed seeds can also be dispersed by attachment to clothing and animal fur. Seeds may also be transported by water and in hay and machinery. Its distribution in the Hawke's Bay region is presently limited to the Maraekakaho area, and between Napier, Bay View and Omaranui (1660ha).

Adverse effects

Large stands are impenetrable to stock and so forage is displaced. Plants are drought resistant and can spread rapidly, as seeds are primarily dispersed by wind. Seed heads can become entangled in wool and fibre, devaluing fleeces and injuring those handling stock and fleece. The plants contaminate cereal crops in the nearby vicinity.

6.3.4 Darwin's barberry

Description

An evergreen, spiny, yellow-wooded shrub (less than 4 m tall) with woody and densely hairy stems that have tough, 5-pronged, needle-sharp spines. Its hairless, glossy, dark green leaves are 10-30 long and 5-15 mm wide and usually spiny-serrated along edges. It is not unlike holly in appearance. Hanging clusters of 7 cm long deep orange-yellow flowers 5-7 mm diameter appear from July to February followed by oval, purplish-black berries 5-7 mm in diameter with a bluish-white surface.

Source: Weedbusters

This long-lived hardy plant tolerates moderate to cold temperatures, damp to dry conditions, high wind, salt, shade, damage and a range of soils. It is not browsed by stock. Birds and possibly possums eat the berries and subsequently spread the seeds. Berries are also occasionally spread by soil and water movement.

Darwin's barberry is known to infest Gwavas & Puketitiri in the Hawke's Bay region

Adverse effects

It is capable of threatening the purity of indigenous forest by invading intact and undisturbed stands, forming impenetrable thickets. Older plants can flower and produce seeds in the shade and so perpetrate the production of fresh seed. However, the amount of seed is significantly reduced. Regardless, the potential invasion of new habitat is much greater than this suppression.

6.3.5 Japanese honeysuckle

Description

Is a vigorous, evergreen, perennial, woody, climbing vine. Stems are purplish, long, tough and hairy, and twine in a clockwise direction. Leaves are oval, stalk-less or on short stalks and in opposite pairs. Flowers are sweetly-scented, tubular and coloured white, ageing to yellow. It flowers from September to May. Fruit are small black berries, glossy, egg shaped and 5--7 mm in diameter. Seeds are approximately 2mm in diameter.

Source: Weedbusters

The plant inhabits roadsides, riverbanks, fences and hedges, shelterbelts, disturbed forest and forest edges. As it is palatable to stock it is generally only found in retired areas, usually around the margins of fences. It tolerates moderate shade, frost, salt, damage, wet or dry, most soils, and high to low temperature.

The major infestations of Japanese honeysuckle in the Hawke's Bay region occur from the Esk valley to northern Wairoa. It is dispersed mainly by birds, and possibly by possums, roading machinery, dumped vegetation, soil and fill.

Adverse effects

Forms dense, long-lived masses that climb over and smother most plants from ground to medium canopy height. Damage is most severe in young or regenerating bush. Can cause canopy collapse and succession to grasses or ground vines, in particular rare native vines and shrubs that occupy forest edge habitats (e.g. *Pittosporum obcordatum, Brachygottis sciadophila*).

The Japanese honeysuckle containment area (Figure 7 below) encompasses Lake Tūtira and Tūtira Regional Park. The regional park has an important function as a sustainable land use demonstration area which has had thousands of trees planted by school students, community groups, organisations, and HBRC staff volunteers. Lake Tūtira is also one of the six Annual Plan 2017-18 Six Hotspots sites. This containment area has been in place for 11 years, protecting the investment undertaken by the community.

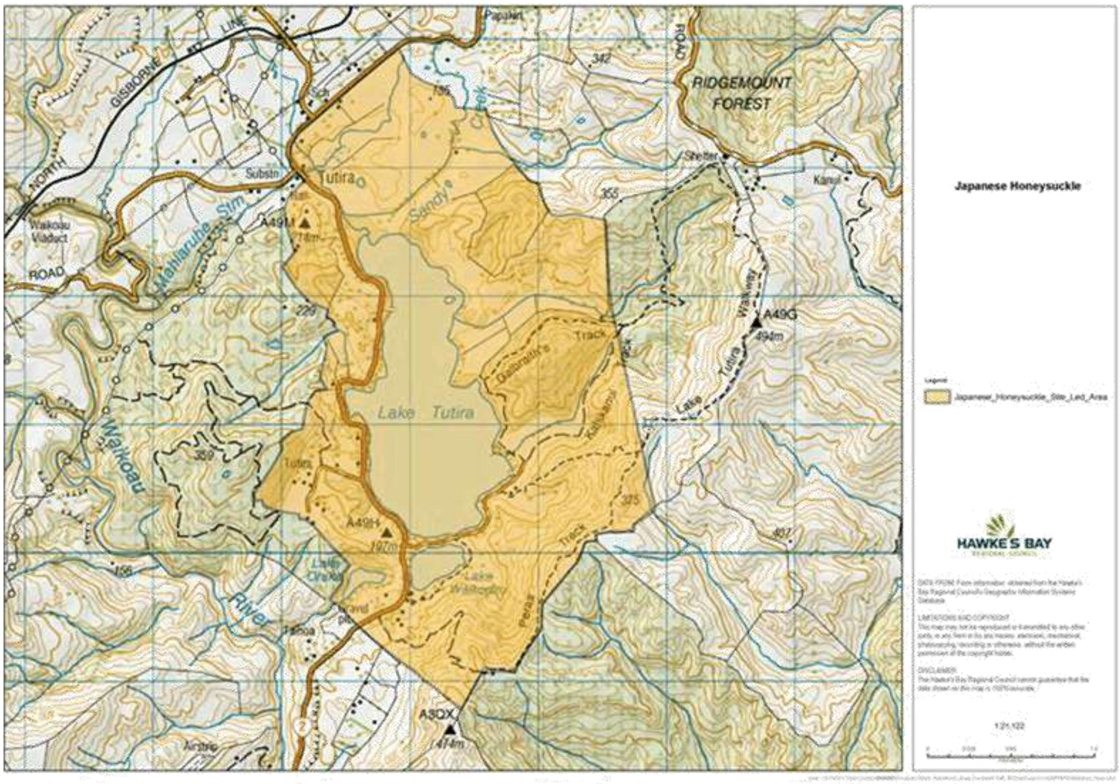

Figure 7: Japanese honeysuckle containment area

6.3.6 Nassella tussock

Description

A perennial tussock-like grass with dense, fibrous, tough roots. The leaves on young plants are erect, but older plants have a drooping habit. It is very similar in appearance to native tussocks, which makes identification difficult. Mature plants are up to 0.5m high and 1 m across. Purple flowers occur from October to December. The numerous flower heads are in the form of open-branched panicles that are erect when young but weep over the tussock when mature. Each mature plant produces up to 100,000 seeds per year.

Source: Weedbusters

Nassella tussock will grow almost anywhere, but is most commonly found on dry, low fertility land, sunny slopes, dry spurs and knobs, and stony riverbeds. The seed straw is readily carried by strong wind and can travel many kilometres. It is

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also distributed by water, stock and machinery, or on the bark of milled trees. Regular inspection of areas cleared of nassella tussock is therefore necessary to prevent re-establishment.

Intensive control measures over 30 years have prevented the spread of nassella tussock, with the two known sites in the region being Tangoio and the lower Tukituki area. Plant numbers at these sites are now low. Any failure to remove all nassella tussock plants before seeding perpetuates the problem as the amount of seed produced by a mature plant, and the mechanism of wind dispersal of the seed contribute to a high potential for spreading. By preventing seeding, and given the present limited distribution of nassella tussock in the Hawke's Bay region, an opportunity exists to progressively reduce plant incidence.

Adverse effects

The plant is capable of completely depleting a grassland sward, both native and exotic. It is indigestible if eaten by livestock and seeds spoil the fleece of sheep.

6.3.7 Old man's beard

Description

Is a deciduous, perennial vine that grows up to 5m per year. Older vines are woody, often brown or grey, although young vines are ribbed and often purple in colour. The leaf is composed of five leaflets. Loosely branched inflorescences of creamy-white flowers (2-3 cm across) are produced from December to May, which then produce conspicuous fluffy greyish white seed heads in autumn, winter and early spring. Each plant produces more than 10,000 seeds per sq m. Seed has an awn that enables it to bury into the soil for germination.

Source: Weedbusters

The seeds are dispersed by birds, wind, water or gravel distribution. It can also grow from stem fragments. Old man's beard uses other plants for support and forms a dense canopy that deprives the support plants of sunlight and eventually kills them. Its habitat is typically scrubland, wasteland, riverbanks, hedgerows and native bush margins.

Old man's beard is widespread south of State Highway 5 in Hawke's Bay. The Council do not believe that the benefits of control in this area would outweigh the costs imposed on land occupiers in continuing to require them to control old man's beard.

North of State Highway 5 in Hawke's Bay, old man's beard is not so widespread and Council believe that this is still worthwhile to require land occupiers to continue to control it (Figure 8 below). There are a large number of native bush fragments throughout this landscape that would be significantly negatively impacted by Old man's beard if left unmanaged.

The old man's beard control line is defined for this Proposal as being the line defined by State Highway 5 from the region's western boundary to its junction with State Highway 2, then along State Highway 2 from its junction with State Highway 5 to the Esk River, then down the Esk River from the State Highway 2 bridge to the sea as shown in Figure 8.

Adverse effects

Forms dense, heavy, permanent masses that can smother and kill all plants to highest canopy. It also prevents recruitment of replacement plants, particularly native species.

Figure 8: Old man's beard containment area

6.3.8 Pinus contorta

Description

Source: New Zealand Plant Conservation Network, John Smith-Dodsworth

A small to medium sized pine tree; up to 25 m high in lowland areas. It has two yellowish-green needles per fascicle (bundle), each approximately 5 cm long, with bluntly pointed tips. The bark is grey on the surface, reddish-brown underneath and fissured into small, squarish pieces. Male cones are orange-yellow and arise in clusters around young shoots; female cones arise in separate clusters, usually as a whorl of six reddish-coloured, small flowers. These grow into egg-shaped, green-coloured cones with many brown, sharp spines. Mature female cones are 3--6 cm long, persistent, and usually point backwards or downwards.

Trees typically produce seed after four or five years. The seeds are very small and light and are capable of being spread long distances with the wind. *Pinus contorta* is an aggressive coloniser and grows in dense groups. However, it is shade intolerant and seedlings struggle to compete with developed pasture species.

It is usually found in alpine and sub-alpine areas hence its presence in the Kaweka Ranges, the upland Rangitaiki areas and along the western margins of the region. Owing to its hardiness, it is used as a shelter belt species in the southern Rangitaiki area. *Pinus contorta* is not a recognised commercial timber species.

Adverse effects

The plant's aggressive colonizing characteristics aid its ability to displace low-level plant communities, especially native grasslands, and create forests. This impacts significantly on biodiversity and landscape values as well as potentially decreasing hydrological yields. Economic well-being is also threatened by the loss of grazing and increased fire hazard.

6.4.9 Saffron thistle

Description


Source: Marlborough District Council

Is an annual, spiny, glandular, woolly plant, which often looks like it is covered in spider webs because of its fine tangled fibres. Its multiple woody stems grow to about 1 m high which mat together to form small impenetrable thickets. The flowers are bright yellow.

It occurs predominantly in disturbed, open sites in grasslands, pastures, and agricultural lands, especially grain fields. Prefers seasonally dry, heavily-grazed pastures, particularly areas with 400-600 mm annual rainfall. Seed dispersal is mainly by stock wool or hair, machinery, and water. Generally the seeds are not dispersed by wind, as they are too heavy.

Saffron thistle occurs as small infestations scattered throughout the region, including Crownthorpe, Bay View, Putorino, Sherenden, Wairere, Havelock North, Maraekakaho, Waipawa, Porangahau, Kahuranaki, and Paki Paki.

Adverse effects

Saffron thistle invades space in weakened pastures and once established prevents grazing access for animals. It also germinates readily in cultivated ground. It therefore poses a threat to production values and economic well-being and is included in the Proposal for those reasons.

6.3.10 Velvetleaf

Description


Source: Waikato Regional Council

Is a tufted, multi-tillered upright annual broad-leaved plant that grows 50--2000 cm high. The leaves are large, heart-shaped and are velvety to the touch. It has buttery-yellow flowers about 3cm across. Flowering commences in the spring and continues through to autumn.

The seed head is a cylindrical 'spike' 2.5--10 cm long, characterised by 7--10 bristles emerging from below each floret. The plant has distinctive seedpods with 12 to 15 segments in a cup-like ring. Each seedpod is about 2.5cm in diameter.

It is a relatively new introduction to the region and occupies bare ground along roadsides and in pasture (e.g. pugging, wheel tracks), including areas that have recently been sprayed. Partially drought tolerant, but requires moist conditions to germinate. Grows best where rainfall exceeds 500 mm/year or in areas with high soil moisture (e.g. ephemeral drains). There are only two known sites in the region, being Paki Paki and Tutira.

Adverse effects

It is a serious cropping weed, potentially affecting many arable crops by competing for nutrients, space, and water. It is declared an Unwanted Organism in New Zealand. Its effect on indigenous biodiversity are unlikely but unknown as at this stage. Due to its preference for sites with fertile and cultivated soils, the risk of occurring in and competing with indigenous vegetation is possibly quite low.

6.3.11 Woolly nightshade

Description

Is a spreading perennial shrub or small tree growing up to 4-5m tall. Its grey-green, ovate leaves are large, up to 25 cm long by 10 cm wide, pointed at both ends and covered in thick furry hairs. They produce an unpleasant smell when crushed. It has small lilac flowers in clusters and produces green berries that are dull yellow when ripe. Flowering continues for most of the year.

Source: Weedbusters

It grows in open locations, forest and plantation margins, scrub and waste land. In Hawke's Bay, woolly nightshade is mainly found in the more temperate urban areas. It is primarily found in urban areas across approximately 8,800ha.

Adverse effects

This plant is allelopathic (produces toxins that poison the soil), forming dense, often pure, stands that outcompete most other species. It also inhibits and slows regeneration of native plant species. Woolly nightshade is poisonous and handling the plants can cause irritation and nausea.

Objective 5

Over the duration of the Plan, progressively contain and reduce the geographic distribution or extent of:

(i) Apple of Sodom, Australian sedge, cotton thistle, Darwin's barberry, nassella tussock, pinus contorta, saffron thistle, velvetleaf and woolly nightshade within the Hawke's Bay region, and

(ii) Japanese honeysuckle within the containment area shown in Figure 7, and

(iii) Old man's beard within the containment area shown in Figure 8

to prevent adverse effects on economic well-being and the environment of the Region.

Principal measures to be used

Appropriate measures drawn from **the requirement to act, council inspection, service delivery, advocacy and education** described in section 5.3 of the Proposal will be used to achieve the Objective. The Council will take responsibility for undertaking the progressive containment programme for nassella tussock.

Alternatives considered

Relying on voluntary control (do nothing approach) is unlikely to result in efficient levels of control. It is also beyond the resources of Council to fully undertake control. However, providing partial assistance to willing occupiers is in the interests of the wider beneficiaries and is therefore the preferred approach.

There are no alternative measures that provide for satisfactory inspection, education or advocacy measures.

Plan Rule 5

Except where an occupier of land has entered into a Written Management Agreement approved by Hawke's Bay Regional Council, an occupier of land shall:

(i) destroy all Apple of Sodom, Australian sedge, cotton thistle, Darwin's barberry, *Pinus contorta*, saffron thistle, velvetleaf and woolly nightshade plants on their land; and

(ii) destroy all Japanese honeysuckle plants on their land within the containment area defined in Figure 7; and

(iii) destroy all old man's beard plants on their land within the containment area defined in Figure 8.

A breach of this rule is an offence under section 154N (19) of the Biosecurity Act 1993.

Explanation

The reason for this rule is to prevent the spread of the plants to land that is currently free of infestations and to progressively increase the extent of clear land.

Statutory obligation

Sections 52 and 53 of the Biosecurity Act 1993, which prevent the communication, release, spread, sale and propagation of pests, must be complied with. These sections should be referred to in full in the Biosecurity Act 1993. A breach of these rules creates an offence under section 154(O) of the Act.

6.4 Pests to be managed under sustained control programmes

A number of pests are well established in the Hawke's Bay, many of which have been subject for some time to various control aspirations. While the spread of these pests between neighbouring properties remains the predominant risk, in some cases control within properties is still sought and warranted. The sustained control programme will at least hold populations to maximum acceptable limits over the period of the Proposed Plan.

Sustained control will apply under three separate circumstances as follows:

- within a property to protect values within that property; or
- within a boundary zone to prevent spread between properties; or
- within a pipfruit production property to protect values at adjacent or nearby pipfruit production properties (sustained phytosanitary control).

A Programmes within a property

While the pests listed in Table 7 are widespread across many properties in the region, sustained control remains necessary, in the first instance, to protect significant areas that are still clear of infestations. Secondly, limiting populations to maximum acceptable limits minimises the impact of their presence on production and environmental values.

Table 7: Pests under sustained control programmes within a property

COMMON NAME	SCIENTIFIC NAME
PLANTS	
Chilean needle grass	*Nassella neesiana*
Privet (Chinese and tree)	*Ligustrum sinense, L. lucidum*
ANIMALS	
Possum (Australian brushtail possum)	*Trichosurus vulpecula*
Rabbits	*Oryctolagus cuniculis*
Predators (Mustelids (ferret, stoat, weasel) and feral cats)	*Mustelo furo, M. ermine, M. nivalis, Felix catus*

6.4.1 Chilean needle grass

Description

Source: Hawke's Bay Regional Council

Is an erect, tufted, perennial grass that can grow to 1.2 m in height. Leaves are up to 5 mm wide, bright green and harsh. Flowers have a purple tinge and ripen into hard, sharp seeds with long twisting tails. Seeds are up to 10 mm long, with a hard, sharply-pointed head and a long, approximately 70 mm hair-like awn (tail). It is particularly difficult to identify in pasture, especially in the absence of flowering seedheads.

The plant is capable of seeding by 3 methods; aerial seeding, basal seeding (cleistogenes), and stem seeding. Aerial seeding is recognised by its panicle form (similar in appearance to oats). The flowering seed head grows from 20 cm to over a metre in height. Each seed is encased by two distinctly purple coloured glumes. The seed of the panicle has a long (7-10cms) green awn attached to it that darkens in colour when the seed is mature. On close inspection between the glumes the seed will be found. The seed is some 10-12mm long, dart shaped with a very sharp needle like point. The seeds of the panicle are mainly spread by attaching to the wool or hair of stock, machinery, water, hay or clothing.

Cleistogene seed is around 1mm in diameter and 2mm long with no awn. These seeds are initiated in autumn and are mature by the time the aerial seed head emerges. Stem seeds are found at the nodes between the leaf sheath and the stem and may or may not be awned. The seeds are between 0.5-1.0mm in diameter and 2-3mm long.

The plant can occur in, natural forests, grasslands, scrub, waterways, and riparian areas, but grows best in dry open grassland habitats in low fertility areas. This makes many areas in Hawke's Bay prone to invasion. The plant is generally palatable to stock but becomes less palatable as it matures. Eradication of Chilean needle grass is difficult once the grass is established, as seeds remain viable for at least 25 years.

Chilean needle grass has been identified in summer dry areas of Hawke's Bay - west of Napier and at Puketapu, Havelock North, Maraekakaho, Poukawa, Waipawa, Waipukarau, Wakarara, Omakere and Porangahau (665ha).

Adverse effects

Agricultural productivity can be severely reduced by the replacement of palatable vegetation, injury to stock, reduction of produce quality and increased management costs. Seeds can cause pelt damage,

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and painful wounds both externally and internally when they move through skin into muscles. Carcasses are downgraded, blindness can occur and seeds can get into ears. Farm dogs can be similarly affected. Some sheep graziers in eastern Australia have been forced to switch to beef production.

Chilean needle grass is likely to invade native grasslands, where it can replace native plants, and alter invertebrate community composition.

Objective 6

Over the duration of the Plan, sustainably control Chilean needle grass within the Hawke's Bay region to ensure:

(i) that current infestations levels do not increase; and

(ii) spread to other properties is prevented

in order to minimise adverse effects on production values.

Principal measures to be used

Appropriate measures drawn from **the requirement to act, council inspection, service delivery, advocacy and education** described in section 5.3 of the Proposal will be used to achieve the Objective.

Generally occupiers will carry out the control work, and manage the likely vector pathways, necessary to prevent Chilean needle grass spreading to other properties. In addition, Council may undertake operational programmes and facilitate or assist community initiative approaches.

Alternatives considered

Relying on voluntary control (do nothing approach) is unlikely to result in efficient levels of control. It is also beyond the resources of Council to fully undertake control. However, while making an occupier ultimately responsible, providing partial assistance, where possible, to willing occupiers is in the interests of the wider beneficiaries. This mixed approach is therefore the preferred approach.

There are no alternative measures that provide for satisfactory inspection, education or advocacy measures.

Plan Rule 6

Except where an occupier of land has entered into a Written Management Agreement approved by Hawke's Bay Regional Council, an occupier of land shall destroy all Chilean needle grass on land that they occupy.

A breach of this rule creates an offence under section 154N (19) of the Act.

Explanation of rule

The reason for this rule is to prevent Chilean needle grass from seeding and spreading to uninfested land. Without a prescribed date for completing destruction some occupiers would not complete control operations prior to seed set.

Statutory obligation

Sections 52 and 53 of the Biosecurity Act 1993, which prevent the communication, release, spread, sale and propagation of pests, must be complied with. These sections should be referred to in full in the Biosecurity Act 1993. A breach of these rules creates an offence under section 154(O) of the Act.

Plan Rule 7

> No person shall make hay/silage during the months from November to March from a paddock that has, or has had, Chilean needle grass present. No person shall move any goods contaminated with Chilean needle grass seed beyond their property boundary.

A breach of this rule creates an offence under section 154N (19) of the Act.

Explanation of rule

The reason for this rule is to prevent the transport of seed from infested properties to land free of the presence of Chilean needle grass. The highest risk for transport of seed is in hay/silage making machinery during the panicle seeding period which is November through to March.

6.4.2 Privet (Tree and Chinese)

Description

There are two common types of Privet. Tree privet and Chinese privet. Tree privet *(Ligustrum lucidum)* is a broad leafed, medium-sized, hairless shrub growing up to ten metres in height. Both species are shade-tolerant but fire intolerant. The leaves are egg-shaped and are up to 12 cm long. Chinese privet *(Ligustrum sinense)* is a more densely branched shrub growing up to five metres in height with smaller lightly hairy leaves up to seven centimetres long. Both species produce terminal clusters of white flowers with black or blue-black berries containing 100,000--10,000,000 seeds per bush or tree. Birds disperse the seed.

Chinese Privet
Source: Weedbusters

Privet can occupy lowland and coastal forest, mostly remnants and shrub land. It is mainly found in home gardens in the urban areas where it has been planted as a specimen shrub or as a hedge.

Adverse effects

It is capable of producing dense stands that prevent recruitment and displacing vulnerable shrub species. The berries are poisonous to humans and possibly to native fauna, esp. insects. The pollen and scent of privet is believed to contribute to respiratory disorders such as asthma. However, research shows privet is not a strong allergen for most people.

Tree Privet
Source: Weedbusters

Objective 7

Over the duration of the Plan, sustainably control privet where necessary within the urban area in order to minimise any adverse effects on human health that are brought to the Hawke's Bay Regional Council's attention.

Principal measures to be used

Appropriate measures drawn from the requirement to act, council inspection, service delivery, advocacy and education described in section 5.3 of the Proposal will be used to achieve the Objective.

Alternatives considered

No other reasonable measures for achieving the Objective have been identified. It is cost effective for Council to deliver these activities than continually following up individuals to make sure they have adequately controlled the pest. Therefore, relying on or requiring individual voluntary action (do nothing approach) as a means of achieving the Objective would likely fail.

Plan Rule 8

An occupier of land within the urban area will, upon receipt of a direction from an authorised person, destroy all Chinese or tree privet on their land.

For the purpose of Plan Rule 8, the urban area is defined as any property accessed from a street with a permanent speed zone of 50km or less.

A breach of this rule creates an offence under section 154N (19) of the Act

Explanation of rule

The reason for this rule is to minimise adverse effects on human health for affected privet sufferers.

Upon receipt by Council of a doctor's certificate/positive blood test clearly showing a person to be suffering a privet allergy, Council will, within the urban area, destroy any isolated Chinese and tree privet plants within 50m of the residence or place of work of that person. If, upon inspection by Council, large numbers of plants exist, including as hedges, a direction will be served on the occupier to thoroughly prune to prevent flowering or destroy the plants.

Statutory obligation

Sections 52 and 53 of the Biosecurity Act 1993, which prevent the communication, release, spread, sale and propagation of pests, must be complied with. These sections should be referred to in full in the Biosecurity Act 1993. A breach of these rules creates an offence under section 154(O) of the Act.

6.4.3 Rabbits

Description

Source: Hawke's Bay Regional Council

The wild European rabbit is a small mammalian herbivore, grey-brown (or sometimes black) in colour ranging in length from 34 to 50cm and weighing approximately 1.1 to 2.5kg. It has four sharp incisors (two on top, two on bottom) that grow continuously throughout its life, and two peg teeth on the top behind the incisors. They have long ears, large powerful hind legs to facilitate hopping movement, and short, fluffy tails. Their toes are long, and are webbed to keep from spreading apart as the animal jumps.

While some may live up to seven years, its life span is generally much shorter, with high rates of natural mortality among young animals. They have a high capacity for reproduction and female rabbits (does) may be pregnant for 70% of a year. Early-born does may breed in their natal year. They can produce a total of 20 – 50 young per adult doe. Females are also capable of adjusting litter sizes to food supply so rabbit populations are capable of rebounding quickly from natural disasters or control pressures.

Feral rabbits' preferred habitat is grassland below about 1000 metres altitude, with free draining soils, sunny aspect, and less than 1000 millimetres annual rainfall. Their distribution and population density is reflected by a propensity of land to harbour populations of rabbits and the potential rate of population increase.

While much of Hawke's Bay is unlikely to attract more than the occasional number, parts of the region are favourably prone to infestations. In the past those areas have suffered major rabbit problems. However, the spread of Rabbit Haemorrhagic Disease (RHD) throughout the region during the mid-1990's caused a significant drop in rabbit numbers. While numbers remain lower than historic pre RHD levels, recent trends indicate that the level of immunity to RHD in rabbits is increasing as are rabbit numbers. Rabbits are still susceptible to coccidiosis disease, prolonged wet conditions and predation by ferrets and cats.

Adverse effects

Rabbits can cause a number of adverse effects on economic well-being and environmental values particularly in the more rabbit-prone lands. At high numbers the control costs can be prohibitively expensive. Their impact reduces available grazing for domestic stock and subsequently decreases the financial returns to landowners and their ability to fund control.

High rabbit numbers also assist in maintaining high predator (mustelids) numbers. This can lead to significant costs being incurred in situations where predators carry bovine tuberculosis.

On rabbit prone land, rabbits, often in conjunction with other grazing animals, may cause a number of environmental effects. These including:

(i) the depletion of many plant communities and species diversity;
(ii) an increase in areas of bare ground as well as physical disturbance of the soil, both of which increase the risk of erosion;
(iii) a reduction in soil organic matter through overgrazing, which, in turn, results in deterioration in the physical and nutrient properties of the soil; and
(iv) adverse effects on indigenous and other fauna, when rabbit predators target alternative prey.

Objective 8

Over the duration of the Plan, sustainably control rabbits to ensure population levels are maintained below Level 4 on the Modified McLean Scale (2012) in order to minimise adverse effects on production and environmental values within the Hawke's Bay region.

Principal measures to be used

Appropriate measures drawn from **the requirement to act, council inspection, service delivery, advocacy and education** described in section 5.3 of the Proposal will be used to achieve the Objective.

Alternatives considered

Relying on voluntary control (do nothing approach) is unlikely to result in efficient levels of control. It is also beyond the resources of Council to fully undertake control. However, while making an occupier ultimately responsible, providing partial assistance, where possible, to willing occupiers is in the interests of the wider beneficiaries. This mixed approach is therefore the preferred approach.

There are no alternative measures that provide for satisfactory inspection, education or advocacy measures.

Plan Rule 9

Except where an occupier of land has entered into an active Written Management Agreement approved by Hawke's Bay Regional Council, and upon receipt of a written direction from an Authorised Person, an occupier of land shall

From mid-January to mid-August maintain rabbit populations at or below level 4 of the Modified McLean Scale over any part of their land.

A breach of this rule creates an offence under section 154N (19) of the Act.

Explanation of rule

The reason for this rule is to maintain the population levels of rabbits to that which prevents adverse effects on the economic values of occupiers, and in so doing, prevent the possible adverse effects on wider environmental values.

Table 8: Modified McLean Rabbit Infestation Scale (2012) to assess rabbit population levels

SCALE	DESCRIPTION
1	No sign found. No rabbits seen.
2	Very infrequent sign present. Unlikely to see rabbits.
3	Pellet heaps spaced 10m or more apart on average. Odd rabbits seen; sign and some pellet heaps showing up.
4	Pellet heaps spaced between 5 m and 10 m apart on average. Pockets of rabbits; sign and fresh burrows very noticeable.
5	Pellet heaps spaced 5 m or less apart on average. Infestation spreading out from heavy pockets
6	Sign very frequent with pellet heaps often less than 5m apart over the whole area. Rabbits may be seen over the whole area.
7	Sign very frequent with 2-3 pellet heaps often less than 5m apart over the whole area. Rabbits may be seen in large numbers over the whole area.
8	Sign very frequent with 3 or more pellet heaps often less than 5m apart over the whole area. Rabbits likely to be seen in large numbers over the whole area.

Statutory obligation

Sections 52 and 53 of the Biosecurity Act 1993, which prevent the communication, release, spread, sale and propagation of pests, must be complied with. These sections should be referred to in full in the Biosecurity Act 1993. A breach of these rules creates an offence under section 154(O) of the Act.

6.4.4 Possums

Background

Hawke's Bay Regional Council has been controlling possums through its Possum Control Area (PCA) programme since 2000. There has been a very high level of support for the PCA programme, and a strong belief by most land occupiers within the programme that it is providing value for money for programme participants. The programme has grown to over 700,000ha and is exceeding its target with an average residual trap catch (RTC) of 2.3% across all PCA programmes. This success and landowner support has provided the foundation for further strengthening PCA benefits. The proposed PCA area is shown in Figure 9 below.

Description

The Australian Brushtail Possum is a nocturnal marsupial introduced and liberated in New Zealand by private individuals and acclimatisation societies between 1837 and 1898 to establish a fur trade. Possums were accorded various levels of protection until 1947. When it became clear that the environmental damage inflicted by them far outweighed any profit made from their skins, this protection was lifted.

Possums in New Zealand occur as two colour types, "blacks" and "greys". Adult male blacks vary from rich red-brown to brown, the females have a darker or black-brown fur. Adult male greys are often strongly rufous in the neck and shoulders while the greys often have a distinct silver tinge in the fur.

Size and weight are dependent on habitat. In good conditions adult possums can weigh between 3 to 5 kilograms. Their life span is about nine years. Possums reach reproductive maturity at approximately two years of age. Usually females rear three young every two years.

Possums can be found throughout Hawke's Bay. Their favoured are generally found in bush/pasture margins as these provide a plentiful supply of food and suitable habitat.

Adverse effects

Possums are considered the major animal pest in New Zealand. In farming areas, they spread bovine tuberculosis to beef and dairy cattle, and to farmed deer, damage crops and orchards, kill poplars and willows planted to control hill-country erosion and stabilise riverbanks, and eat pasture. In exotic forest plantations they kill young trees and stunt the growth of older trees by ring-barking them or breaking the uppermost branches. In native vegetated areas, possums cause severe damage by altering habitats important to native animals and birds. Tree species that are palatable to possums (e.g. rata, kamahi, and pohutukawa) become much reduced or locally extinct, and are replaced by plants that are less palatable such as tree ferns and pepperwood. As well as altering the composition of native forests and competing with native fauna, possums also prey directly on native insects and birds.

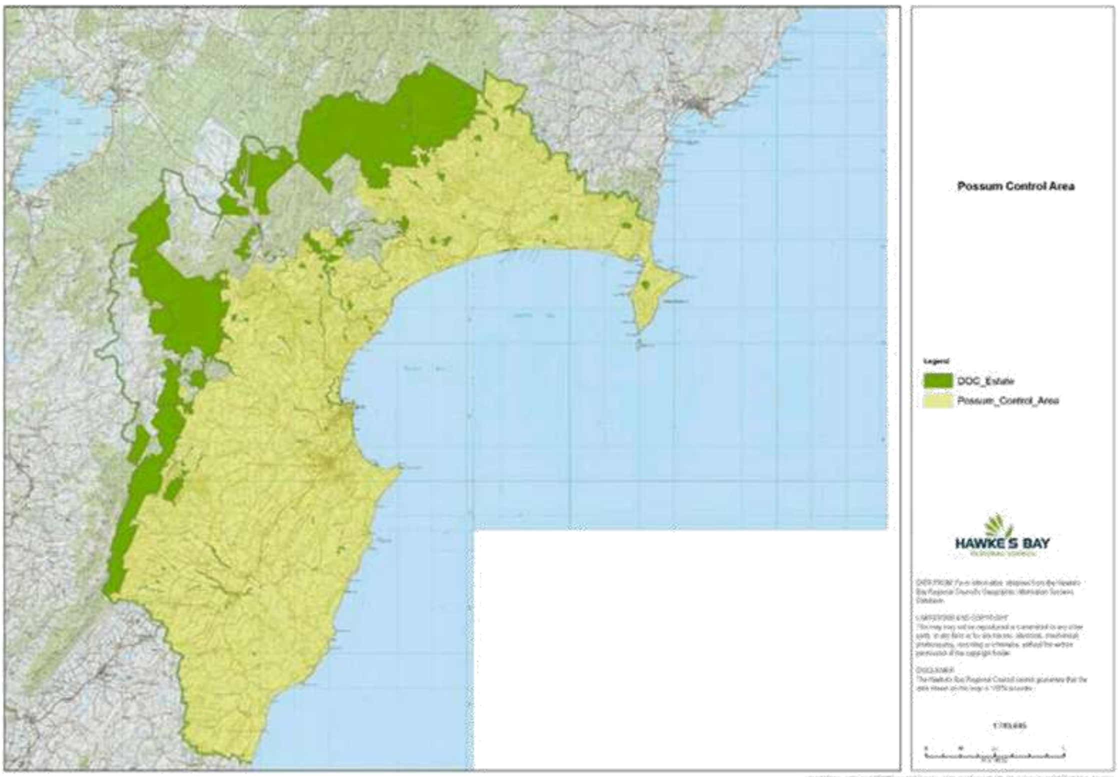


Figure 9: Possum Control Area (yellow)

Objective 9

Over the duration of the Plan, sustainably control possums contained within Possum Control Areas to ensure population density on that land is at or below 4% residual trap catch, to minimise adverse effects on environmental values and economic well-being within the Hawke's Bay region.

Principal measures to be used

Appropriate measures drawing on **Requirement to act, council inspection, service delivery, advocacy and education** activities described in section 5.3 of the Proposal will be used to achieve the Objective.

Alternative measures that have been considered

In reviewing this programme, five options were considered:

6. Council undertakes the management of possums;
7. Increase PCA programme monitoring and compliance activity;
8. Converting Possum Control Areas to Predator Control Areas;
9. Status quo; or
10. Do nothing – remove the possum programme from the RPMP.

Through discussion document feedback and discussions held with key stakeholders, option two was identified as the preferred option. It was agreed that the required increase of $2/ha to undertake option one was not acceptable to the regional community.

Plan Rule 10

> An occupier within a Possum Control Area (figure 9 above) shall maintain possum densities on their land at or below 4% residual trap catch, in accordance with the Hawke's Bay Regional Possum Control Technical Protocol (PN 4969).

A breach of this rule creates an offence under section 154N (19) of the Act.

Explanation of rule

The reason for this rule is to protect past investment in possum control on their property by ensuring possum population levels remain below the threshold at which economic well-being and environmental values are threatened.

Advice Note

This rule **will not apply** to any occupier who remains within a Tb Management Area where possums are being actively managed by OSPRI (a not-for-profit limited company consisting of two wholly-owned subsidiaries, TBfree New Zealand Ltd and NAIT Ltd.) at or below 4% residual trap catch.

Statutory obligation

Sections 52 and 53 of the Biosecurity Act 1993, which prevent the communication, release, spread, sale and propagation of pests, must be complied with. These sections should be referred to in full in the Biosecurity Act 1993. A breach of these rules creates an offence under section 154(O) of the Act.

Plan Rule 11

Note: This is designated a Good Neighbour Rule

> Except where an occupier of land has entered into a Written Management Agreement approved by Hawke's Bay Regional Council, an occupier within, or adjacent to, a Possum Control Area, shall, on receipt of a written direction from an Authorised Person maintain possum densities on their land at or below 4% residual trap catch in accordance with the Hawke's Bay Regional Possum Control Technical Protocol (PN 4969) within 500 metres of the adjoining property boundary where the occupier of the adjoining property is also maintaining possum densities on their land at or below 4% residual trap catch in accordance with the Hawke's Bay Regional Possum Control Technical Protocol (PN 4969) in order to protect economic well-being and environmental values.

A breach of this rule creates an offence under section 154N (19) of the Act.

Explanation of rule

The reason for this rule is to manage the spread of possums causing unreasonable costs to the adjacent occupier where active possum management is being undertaken by that occupier.

Advice Note

This rule **will not apply** to any occupier who remains within a Tb Management Area where possums are being actively managed by OSPRI (a not-for-profit limited company consisting of two wholly-owned subsidiaries, TBfree New Zealand Ltd and NAIT Ltd.) at or below 4% residual trap catch.

Statutory obligation

Sections 52 and 53 of the Biosecurity Act 1993, which prevent the communication, release, spread, sale and propagation of pests, must be complied with. These sections should be referred to in full in the Biosecurity Act 1993. A breach of these rules creates an offence under section 154(O) of the Act.

6.4.5 Predators (ferret, stoat, weasel and feral cat)

Background

Source: Hawke's Bay Regional Council

As discussed in the Possum programme, Hawke's Bay Regional Council has been controlling possums since 2000 and has received a very high level of support for the PCA programme. This success and landowner support has provided the foundation for further strengthening PCA benefits.

Land owners within PCAs are now requesting predator control be undertaken for species such as feral cats and mustelids. Although feral cats are known to predate on native species, their role as a key vector of toxoplasmosis also concerns many land owners. In agriculture, toxoplasmosis has a significant impact on sheep production, with recent research suggesting there is a substantial economic impact to the Hawke's Bay region through loss of lambs. A survey undertaken of NZ sheep flocks in 2011 indicated 100% seroprevalence of toxoplasmosis in the flocks surveyed. Concern was also raised by land owners around mustelid impacts on biodiversity including waterfowl and ferrets as known TB vectors.

Predator pests such as mustelid's and feral cats have a major adverse effect on NZ native flora and fauna. Predator Free New Zealand 2050 (PFNZ) and its associated funding is an important political and funding milestone in the war against predator pests. Public conservation land, sanctuaries, urban communities and farmland all have key roles in achieving a predator free nation.

Integrating predator control alongside PCA programmes can provide a key platform for delivering additional economic and environmental outcomes to land owners. This coupled with appropriately targeted intensive high biodiversity value site protection will provide the greatest likelihood of significant long term integrated biodiversity recovery and primary production benefits across the Hawke's Bay region.

However, Predator Control Areas will not replace Possum Control Areas. Rather, they are designed to add further value to possum control.

The Council will identify Predator Control Areas and will seek to enter into written agreements with individual landowners within those areas to undertake long term predator control maintenance. Once written agreements have been entered into with respect to 75% or more of the total land area, the Council will undertake initial predator control work within the entire Predator Control Area. After initial predator control work has been undertaken, occupiers within the area will be required to maintain the listed pests in accordance with the Hawke's Bay Regional Predator Control Technical Protocol.

A Predator Control Area is defined as an area identified as a Predator Control Area in the Hawke's Bay Regional Predator Control Technical Protocol (PN 4970) (the Protocol). The Protocol will contain mapped Predator Control Areas. These maps will be inserted into the Protocol once the 75% land area threshold has been reached and initial control work has been undertaken within the area. Once the Council has given notice in the NZ Gazette that the Protocol has been amended to include an additional map, the map will have legal effect as part of the RPMP. Thereafter occupiers within that mapped area will be required to comply with the requirements in the Protocol from the date specified in the Gazette notice.

Description

Ferrets, stoats, weasels are part of the Mustelid family, which is a group of small to medium sized carnivores. Mustelids have large home ranges and are active day and night. They are opportunistic predators and have a strong musk odour. Ferrets are the largest mustelid in New Zealand. Male ferrets grow up to 44cm and females up to 37cm in length. The undercoat is creamy yellow with long black guard hairs that give the ferret a dark appearance. A characteristic black face mask occurs across the eyes and above the nose. Stoats have long, thin bodies with smooth pointed heads. Ears are short and rounded. They are smaller than ferrets. Males grow up to 30cm and females up to 25cm in length. Their fur is reddish- brown above with a white to yellowish underbelly. Stoats have relatively long tails with a distinctive bushy black tip. Weasels are the smallest and least common mustelid in New Zealand. Males grow to about 20cm. Their fur is brown with white undercoat, often broken by brown spots. Their tails are short, brown and tapering.

Feral cats resemble domestic cats in both size and colouration. Coat colours vary from pure black to orange tabby and some resemble the striped dark and pale grey of the true European wild cat. Commonly revert to black, tabby or tortoiseshell with varying extents of white starting from the belly and breast. Adult male cats are generally larger than the females and can weigh up to five kg.

They tend to be solitary and territorial compared to domestic stray or unwanted cats that tend to form colonies. Territory is marked by scent secreted from anal glands and by spraying urine. Feral cats are mainly active at night. Their vision and hearing are acute.

Inhabits a wide range of urban, rural and forest habitats. Found from sea level to alpine habitats. Diet is wide-ranging and includes small mammals, fish, birds and invertebrates. They have 2-3 litters per year with an average of 4 young in each.

Adverse effects

Although habitat loss and modification remains a threat to native biodiversity, a more equally serious threat is from invasive introduced species. Introduced predators, such as ferrets, stoats, weasels and feral cats, pose a significant threat to our remaining natural ecosystems and habitats and threatened native species and can have a considerable negative impact on primary production. Ferrets, stoats, weasels and feral cats are distributed throughout the Hawke's Bay region.

Mustelids were introduced in New Zealand in the 1880's in an attempt to manage growing rabbit populations. This had minimal impact on rabbit densities but had a significant impact on New Zealand's Biodiversity. Mustelids are implicated in the extinction of some indigenous bird species and as the major cause of decline of many others. Ferrets are also a threat to agriculture, particularly through their role as a vector (carrier) of bovine tuberculosis. Mustelids are a threat to poultry farms and carry parasites and toxoplasmosis, which can cause illness in humans and livestock.

Feral cats have been branded as 'the ultimate predators' in New Zealand and have been nominated as among 100 of the "World's Worst" invaders. New Zealand's unique native wildlife is particularly vulnerable to predation by cats. Feral cats kill young and adult birds and occasionally take eggs, prey on native lizards, fish, frogs and large invertebrates. Cats are highly efficient predators, and have been known to cause local extinctions of seabird species on islands around the world. Both sea and land birds are at risk, particularly those that nest or feed on or near to the ground. Feral cats are implicated in a small way in the spread of Bovine Tuberculosis, with the potential to infect cattle. They also carry parasites and toxoplasmosis that causes abortions in sheep and illness in humans. Feral and stray cats can be aggressive towards pet cats. Through fighting they cause severe injuries sometimes resulting in the pet cat having to be put down. Stray cats are likely to interbreed with the un-neutered domestic cat population and may spread infectious diseases.

Objective 10

Over the duration of the Plan, sustainably control stoats, ferrets, weasels and feral cats on land contained within Predator Control Areas to ensure population density on that land does not exceed levels outlined in the Hawke's Bay Regional Predator Control Technical Protocol (PN 4970) to minimise adverse effects on environmental values and economic well-being within the Hawke's Bay region.

Principal measures to be used

Appropriate measures drawing on **Requirement to act, council inspection, service delivery, advocacy and education** activities described in section 5.3 of the Proposal will be used to achieve the Objective.

To assist achieving the Objective, Predator Control Areas will be established. Creating these areas will be done with agreement from landowners. The process and responsibilities to be followed are outlined in the Hawke's Bay Regional Predator Control Technical Protocol (PN 4970).

Alternative measures that have been considered

This is a new programme, converting current Possum Control Areas to Predator Control Areas, and was consulted on during the Discussion Document. Two options were put forward.

1 Council funded initial predator control and installation of trap networks followed up with land occupiers be responsible for maintaining low predator densities through the use of a contactor or clearing activated kill traps.

2 Not instigating the new programme (do nothing).

The first option received strong support from the community and for that reason it is included in the Proposal

Plan Rule 12

All occupiers within a Predator Control Area shall maintain ferrets, stoats, weasels and feral cats in accordance with the Hawke's Bay Regional Predator Control Technical Protocol (PN 4970).

A breach of this rule creates an offence under section 154N (19) of the Act.

Explanation of rule

The purpose of Predator Control Areas is to enable communities, who wish to do so, to create sustained low predator density areas to achieve both biodiversity and economic outcomes. If the community decides to form a Predator Control Area, whereby the 75% land area threshold is met, it is critical that there is a rule to both protect the initial investment to be undertaken by Council and other partners. Securing this investment in the initial knockdown phase and binding land owners that would otherwise not participate, and therefore potentially compromise, the programme is important to long term programme success.

All land owners/occupiers within a proposed Predator Control Area will be visited individually and have the programme discussed. Land owners/occupiers will be asked if they are willing to sign up to a management agreement. Initial predator control work will not commence until the 75% land area threshold has been met. Upon completion of initial predator control, whereby predator abundance has been reduced to levels required under the Hawke's Bay Regional Predator Control Technical Protocol (PN 4970), land occupiers within a Predator Control Area become responsible for maintaining stoats, ferrets, weasels and feral cats in accordance with the Hawke's Bay Regional Predator Control Technical Protocol (PN 4970).

The Hawke's Bay Regional Council will give notice to affected land occupiers and in the NZ Gazette of the date on which an area becomes a Predator Control Area.

B Programmes requiring boundary control only

There are a number of plant pests where regulatory control within a property is unwarranted because occupiers make adequate control decisions based on their individual requirements. However, the spreading attributes of the plants are such that control adjacent to property boundaries is still required. In particular, this requirement applies where an occupier is undertaking control and the neighbouring occupier is not or the control level is inadequate. The pests are listed in Table 9 below.

Table 9: Pests under sustained control programmes with boundary control only

COMMON NAME	SCIENTIFIC NAME
PLANTS	
Bathurst bur	*Xanthium spinosum*
Blackberry	*Rubus fruticosus* agg.
Gorse	*Ulex europaeus*
Nodding thistle	*Cardus nutans*
Ragwort	*Jacobaea vulgaris*
Variegated thistle	*Silybum marianum*

6.4.6 Bathurst bur

Description

Is a compact annual herb growing up to 1m tall. Stems have groups of three-pronged, stiff, yellow spines at the base of each leaf or branch. The leaves are dark grey to green, with prominent white veins and are almost silver underneath due to a cover of fine hairs. Its inconspicuous flowers develop into small oval brown burs, 10 to 12mm long, covered with hooked spines. The hooks aid dispersal by animal wool or hair, and clothing.


Source: Auckland Council

Bathurst bur grows in a range of habitats and is particularly invasive in wasteland and other open, unshaded areas. It is widespread throughout the Hawke's Bay region in both pastoral and cropping areas.

Adverse effects

Wool production value can be is significantly affected if contaminated with the burs because of the difficulty of removal. Seedlings can be toxic when they are very small. Pigs are affected more than

65

sheep or cattle. In cultivated land, infestations can swamp out crops. The spiky leaves and burs restrict both animal movement and recreational walking.

6.4.7 Blackberry

Description

Source: Weedbusters

Is a prickly, scrambling, deciduous, perennial shrub which grows from a woody rootstock into thickets up to two metres high. Stems (canes) are hairless, red-purple with many thorns and can be up to seven metres long. Canes can develop roots wherever they touch the ground. Its leaves comprise three to five separate leaflets, each toothed along the edges, and are darker green on the upper than the lower side. The flowers are white to pink, 2-3 cm in diameter with five petals. Edible berries 1-3 cm long change from green to red to black as they ripens.

It inhabits roadsides, hedges, pasture, wasteland, forest and plantation margins, scrub, and the berms of waterways. Lightly grazed areas and wasteland in areas with moderate rainfall are particularly susceptible. It is spread mainly by birds, although stems will root where they touch the ground. It is widespread throughout the Hawke's Bay, particularly north of Napier.

Adverse effects

Blackberry is a very invasive pasture weed, growing into impenetrable thickets which not only reduce stock carrying capacity, but restrict access to streams and water supplies. Thickets entangle woolly sheep, even causing death, and provide ideal ground cover for pests such as rabbits, hares and possums. In forestry and urban areas, blackberry can be a major fire hazard.

6.4.8 Gorse

Description

Source: Weedbusters

Is a sharply spinous, woody, leguminous perennial shrub and grows up to 4m tall. It has thick stems and an extensive lateral roots just below the soil surface, a deep taproot and forms impenetrable thickets. Plants and their yellow flowers are readily recognised. Seeds are contained in hairy pods 13-25 mm long which turn black when mature and explode to release the seeds, often up to 5 metres away. Seed set may occur twice a year.

Distribution of the seed may also occur by water, birds, road-making, gravel extractions, animals and machinery. The seed can remain viable in the soil for more than 50 years. The plant is however, shade intolerant and can be totally suppress by light excluding overtopping vegetation.

Gorse is widely scattered across land throughout the region.
Density varies from light to heavy depending upon the intensity of grazing management. It is most prevalent on lightly grazed and non-grazed areas such as low fertility pasture land, river areas and wasteland.

While its attributes contribute to it being a problem weed, those same attributes enable it to play a role in restoring tree vegetation. In particular, it acts as a nursery cover for indigenous forest regeneration where such a seed source exists or where stabilising hillsides is a risky management option that is not promoted.

Adverse effects

Where land is used for pastoral activities, gorse prevents stock access for grazing, is a fire hazard and increases management costs.

6.4.9 Nodding thistle

Description

Is a spiny leafed annual or biennial that can grow up to 1.5 m in height. It has dark green upper surface leaves with irregular toothed lobes. Flowers are purplish-mauve and droop or "nod" at right angles to the stem when mature. It grows in pasture, on roadsides, on wasteland, and among crops. It thrives in all areas with light, free draining soil and low to medium rainfall. Drought prone areas in the Hawke's Bay region are particularly susceptible. It is spread by stock, hay, machinery, water and wind.

Nodding thistle is widespread throughout the Hawke's Bay region. However, biological control measures mean that in most seasons it is reasonably controlled.

Source: Auckland Council

Adverse effects

Where land is used for pastoral activities, nodding thistle prevents stock access for grazing, contaminates wool and increases management costs. Adjacent crops can also be contaminated.

6.4.10 Ragwort

Description

Is a branched, biennial or perennial plant, which grows to 0.5 to 1.5m. It has numerous bright yellow flowers; slightly furry leaves and purplish coloured stems, which have an unpleasant smell when crushed.

Adverse effects

Where land is used for pastoral activities (cattle and deer), ragwort reduces available grazing and increases management costs. Adjacent crops can also be contaminated.

Source: Weedbusters

6.4.11 Variegated thistle

Description

Is a conspicuous, spiny, annual/biennial thistle. It forms a thick rosette of glossy dark green leaves with broad white patches around the veins on the upper surface. Flower heads are purplish-mauve. Drought conditions, such as those experienced in Hawke's Bay, are ideal for the establishment of this plant. It is spread mainly by stock, birds, water and machinery.

Source: Hawke's Bay Regional Council

Variegated thistle is widespread throughout the Hawke's Bay region, especially in coastal areas.

Adverse effects

Where land is used for pastoral activities, variegated thistle prevents stock access for grazing, contaminates wool and increases management costs. Adjacent crops can also be contaminated.

Objective 11

Over the duration of the Plan, sustain control of:

(i) Bathurst bur and variegated thistle within 5 metres of an adjoining property; and
(ii) Blackberry and gorse within 10 metres of an adjoining property; and
(iii) Nodding thistle and ragwort within 20 metres of an adjoining property-

to protect economic well-being or recreational values within the Hawke's Bay region.

Principal measures to be used

Appropriate measures drawn from **the requirement to act, council inspection, advocacy and education** described in section 5.3 of the Proposal will be used to achieve the Objective.

Alternatives considered

Relying on voluntary control (do nothing approach) is unlikely to result in efficient levels of control. It is also beyond the resources of Council to fully undertake control. Therefore requiring land occupiers to act is the preferred approach.

There are no alternative measures that provide for satisfactory inspection, education or advocacy measures.

Plan Rule 13

All occupiers shall, on receipt of a written direction from an Authorised Person, destroy all
(i) Bathurst bur and variegated thistle plants within 5 metres of the property boundary; and
(ii) blackberry and gorse plants within 10 metres of the property boundary; and
(iii) nodding thistle and ragwort plants within 20 metres of the property boundary-
on land that they occupy where an adjoining occupier is also destroying or the land is clear of, all
(i) Bathurst bur and variegated thistle plants within 5 metres of the property boundary; and
(ii) blackberry and gorse plants within 10 metres of the property boundary; and
(iii) nodding thistle and ragwort plants within 20 metres of the property boundary.
Any action pertaining to non-compliance will only be initiated upon a complaint in writing from the adjoining affected occupier and at the discretion of the Authorised Person.

A breach of this rule creates an offence under section 154N (19) of the Act.

Explanation of rule

The reason for this rule is to prevent the plants from seeding within a zone that is capable of spreading to the adjacent property where the occupier is taking similar pest management.

Statutory obligation

Sections 52 and 53 of the Biosecurity Act 1993, which prevent the communication, release, spread, sale and propagation of pests, must be complied with. These sections should be referred to in full in the Biosecurity Act 1993. A breach of these rules creates an offence under section 154(O) of the Act.

C Programmes for phytosanitary purposes

Hawke's Bay currently has around 6,000 planted hectares of pipfruit orchards (61% of the national production area) and 70% of the national production at 247,000 tonnes. The pipfruit industry is worth around $300 million to the Hawke's Bay economy annually. Most orchards in Hawke's Bay have a combination of pipfruit varieties with individual businesses operating orchards ranging from 2 to more than 30 hectares. Fifteen percent of businesses have orchards more than 30 hectares, while there is still a significant portion operating less than 5 hectares (28%).

Apple production is cyclic in nature. From 2002 to 2012 there was more than a 112% reduction in the area of pipfruit planted in Hawke's Bay as growers removed uneconomic blocks of mainly Braeburn and Royal Gala due to increased production expenses, poor consumer demand and an appreciating exchange rate of the NZ dollar.

Since 2012, the industry has gone through a period of growth with increased productivity, realised high returns for new varieties and expanding export into high value Asian markets. As a result, the planted area in Hawke's Bay has grown by 14%.

With the cyclic nature of crop production it can be expected that the current years of good return may be followed by some downturn years with growers seeking to leave the industry, particularly small to medium sized owner-operators without long-term strategic relationships with exporters and packers.

With people choosing or considering whether to leave the pipfruit production sector during periods of downturn, New Zealand Apples & Pears Incorporated wishes to ensure that the occupiers of all pipfruit production sites, continue to manage and control all the phytosanitary pests on their properties in accordance with industry best practise to ensure that pipfruit production levels remain high, access to international markets is maintained, and that costs for all growers are kept as low as possible.

In addition, biosecurity is critically important to sustained growth and profitability of the NZ apple and pear industry. NZ Apples & Pears biosecurity vision is that the industry, our stakeholders and local communities, are all kept safe and secure from damaging pests and diseases. NZ Apples & Pears have been partners of the Government Industry Agreement (GIA) since 2014. GIA operates as a partnership between primary industry and government to manage pests and diseases that could badly damage New Zealand's primary industries, economy and environment.

With biosecurity pests such as brown marmorated stink bug and Queensland fruit fly having the potential to significantly damage the NZ industry, it is imperative that strategies are in place to ensure unmanaged production sites are inspected and remain vigilant for biosecurity threats.

Therefore to ensure the continued success of the pipfruit industry in Hawke's Bay, the Regional Phytosanitary Pest Management Strategy outlines methods to ensure that occupiers of unmanaged pipfruit production sites, ensure that they control the phytosanitary pests on their land.

To ensure the continued success of the pipfruit industry in Hawke's Bay, the Regional Phytosanitary Pest Management Strategy (HBRC Plan Number 3873) was made operational in March 2013. This coincided with the Regional Pest Management Strategy (HBRC Plan Number 4466) being made operative at the same time. The Council implements both strategies as per its appointment as the management agency.

There is much that is generic to both the above strategies. It is therefore considered by Council to be more efficient and cost effective to incorporate the two strategies within this Proposal. Nevertheless, the desired outcomes of the Phytosanitary Strategy remain relevant.

The controls in this Proposal are designed to support New Zealand Apples & Pears Inc. with its overall phytosanitary and other orchard pest management strategies and protocols necessary for growing pipfruit successfully.

The pests for phytosanitary control purposes are list in Table 10 below.

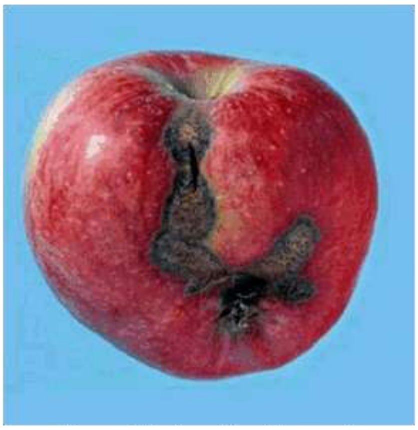
Table 10: Pests under sustained control programmes for phytosanitary purposes

COMMON NAME	SCIENTIFIC NAME
PHYTOSANITARY INSECTS	
Codling moth	*Cydia pomonella*
Lightbrown apple moth (Leafroller)	*Epiphyas postvittana*
PHYTOSANITARY DISEASES	
Apple black spot	*Venturia inaequalis.*
European canker	*Neonectria ditissima*
Fireblight	*Erwinia amylovora*

6.4.12 Apple black spot

Description

Apple Black spot is a fungal disease of apples, often referred to as apple scab outside of New Zealand. Apple black spot is a different fungus to pear black spot, and both are different to black spot on roses.



Source: Plant and Food Research

Apple black spot is found all over the world where ever apples are grown. In New Zealand, black spot is an important problem in all regions.

Apple Black spot is a wet weather disease. Rainy and humid conditions early in the growing season provide ideal conditions for infection. In general, the higher the temperature and the longer it rains, the more severe the infection period will be. Apple black spot is spread mainly through windblown leaves, carry spores of the fungus.

Adverse effects

Infection early in the season may cause misshapen fruit. By harvest, spots are dried, cracked, and brown with a black outer edge. Infection just prior to or during harvest causes small black “pepper spotting” on fruit.

Late season infection may lead to symptoms appearing in cool storage even though there may be no signs of the disease at packing.

Even the smallest black spot is unacceptable on an export apple.

6.4.13 Codling moth

Description

Codling moth is common throughout New Zealand. It was accidentally introduced to New Zealand early in European settlement and is now found wherever apples are grown and is found extensively throughout the North Island.

Source: Te Ara

Codling Moth is a small speckled, grey moth, hosted by apple, pear and walnut trees. Frass (droppings) indicate the presence of larva.

Codling Moth over-winters as a dormant caterpillar in a cocoon under the bark of the tree or in the soil. In most southern regions throughout New Zealand, Codling moth has one generation per year. In the North Island, Codling moth usually has one and a half to two generations.

Adverse effects

The larvae of Codling moth burrows into fruit leaving a small hole that result in the fruit being rejected for sale. The dispersal ability of codling moth has very important implications for management. With high levels of control achieved by insecticides or mating disruption, the resident population of codling moth in most orchards is extremely low. As a result, the immigration of Codling moth adults into orchards is often greater than the resident population, and the removal of outside sources (e.g. neglected apple trees) can make a major contribution to control. 90% of mated females move within 300m of their emergence point and maximum dispersal may be as low as 600m.

A key concern for codling moth management is the increased export into high value Asian markets where it is a significant quarantine pest.

6.4.14 European canker

Description

European canker is a fungal disease that if left unmanaged, can spread resulting in the removal of whole trees and complete blocks. Rain splash and wind spread the spores and fruiting bodies of European canker. European canker can also be spread through the movement of affected plants or plant parts. The disease can spread at any time of year as infected trees can produce spores in a broad range of temperatures. There are many hosts of European canker including neighbouring orchards and broadleaf trees such as birch, beech, oak and ornamentals.

Source: NZ Apples and Pears

Adverse effects

Initial symptoms of European canker are a small sunken area around a bud, leaf scar, or at the base of a small dead shoot or open wound. Concentric rings of canker growth then appear. The sunken area increases in size. The centre of infection becomes flaky. Eventually cankers girdle the stem, and shoots above the canker die. The fungus can cause fruit rot, which is a quarantine concern in some markets.

NZ Apples & Pears Inc. has issued a European Canker Management strategy to all growers.

6.4.15 Fireblight

Description

Fireblight is a bacterial disease. World-wide, Fireblight is found throughout North America and Canada and much of Europe.

Isolated outbreaks of fireblight occur throughout New Zealand. Pink Lady™, Gala, Royal Gala, Golden Delicious, and all pears are particularly susceptible. Other plants that can be affected by Fireblight are quince and ornamental plants of the Roseaceae family including cotoneaster, hawthorn and pyracantha.

Source: Nelson City Council

Adverse effects

Trees are most prone during October when temperatures exceed 16˚C, humidity is high and blossom is present. If unchecked, blossom infection can result in "shepherds crook" of the shoot. Blossoms appear water soaked then turn brown and finally black. Young fruit if infected turn brown, then black, wilt and drop off. The industry has become more susceptible to fire blight in recent years with an increase in susceptible rootstocks, varieties, new plantings and high density orchard systems. Fireblight is a quarantine concern for countries such as Japan and Australia.

6.4.16 Lightbrown apple moth

Description

The light brown apple moth is native to Australia and the larvae feed on a wide range of plants including fruit crops, broad-leaved weeds, some vegetables and ornamentals.

Source: Plant and Food Research

Lightbrown apple moth adults are variable in colour and may be confused with other leafroller moths. Typical males have a forewing length of 6-10 mm with a light brown area at the base distinguishable from a much darker, redbrown area at the tip. The latter may be absent, the moth appearing uniformly light brown, as in the females, with only slightly darker oblique markings distinguishing the area at the tip of the wing. Females have a forewing length of 7-13 mm. Colour varies from a uniform light brown, with almost no distinguishing markings.

Larvae [caterpillars] are not easily distinguished from the larvae of other leafrollers. The first larval instar [stage] has a dark brown head; all other instars have a light fawn head and prothoracic plate [plate behind the head]. Overwintering larvae are darker. First instar larvae are approximately 1.6 mm long, and final instar larvae range from 10 to 18 mm in length. The body of a mature larva is medium green with a darker green central stripe and two side stripes.

Pupae are at first green, but become medium brown after rapidly hardening.

Adverse effects

The larvae cause damage to foliage and fruit. Early instars feed on tissue beneath the upper epidermis [surface layer] of leaves, while protected under self-constructed silken webs on the under surface of leaves. Larger larvae migrate from these positions to construct feeding niches between adjacent leaves, between a leaf and a fruit, in the developing bud, or on a single leaf, where the "topical" leaf roll develops. The late stage larvae feed on all leaf tissue except main veins.

Superficial fruit damage is common in apple varieties which form compact fruit clusters. Leaves are webbed to the fruit and feeding injury takes place under the protection of the leaf; or larvae spin up between fruits of a cluster. Internal damage to apple, pear, and citrus fruits is less common, but a young larva may enter the interior of an apple or pear fruit through the calyx or beneath the stem of a citrus fruit. Excreta are usually ejected on to the outside of the fruit; this does not happen with the codling moth. The issue with Lightbrown Apple Moth is the potential increased phytosanitary risk posed to key markets such as the US.

Objective 12

Over the duration of the Plan, sustainably control of apple black spot, codling moth, European canker, fireblight and lightbrown apple moth on unmanaged pipfruit production sites to protect economic well-being of the pipfruit industry within the Hawke's Bay region.

Principal measures to be used

Appropriate measures drawn from **the requirement to act, council inspection, advocacy and education** described in section 5.3 of the Proposal will be used to achieve the Objective.

Alternatives considered

Relying on voluntary control (do nothing approach) is unlikely to result in efficient levels of control. It is also beyond the resources of Council to fully undertake control. NZ Apples & Pears Inc. support the Proposal. Therefore requiring land occupiers to act is the preferred approach.

There are no alternative measures that provide for satisfactory inspection, education or advocacy measures.

Plan Rule 14

Occupiers of unmanaged pipfruit production sites shall, on receipt of a written direction from an Authorised Person, control:

(i) apple black spot (*Venturia inaequalis)* on their land from the presence of green tips until fruit maturity/harvest; and
(ii) codling moth (*Cydia pomonella*) on their land if five (5) or more codling moths are caught in any one codling moth pheromone trap during any calendar week on their land;
(iii) European canker (*Neonectria ditissima)* by inspecting all pipfruit trees on their land at least four times during the year, applying post-harvest sprays if canker is found and removing and burning all infected pipfruit tree parts showing any presence of European canker; and
(iv) fireblight (*Erwinia amylovora*) on their land during the pipfruit bloom period (from pink to petal fall); and
(v) lightbrown apple moth (Leafroller) (*Epiphyas postvittana)* on their land once thirty (30) lightbrown apple moths are caught in any one lightbrown apple moth pheromone trap on their land from the 15th December until fruit harvest.

A breach of this rule creates an offence under section 154N (19) of the Act.

Explanation of rule

The reason for this rule is to prevent the spread of these pests from an unmanaged pipfruit production property to the adjacent property that is being managed.

This rule provides regulatory protection in situations of inaction by an occupier. Prior to the issue of a direction from an Authorised Person, an occupier of a managed pipfruit production site and the Hawke's Bay Fruit Growers Association will have followed a number of prerequisite steps aimed at resolving any inaction concerns. Those steps are outlined below in the ***Hawke's Bay Fruit Growers Association (HBFGA) Management Approach.***

Statutory obligation

Sections 52 and 53 of the Biosecurity Act 1993, which prevent the communication, release, spread, sale and propagation of pests, must be complied with. These sections should be referred to in full in the Biosecurity Act 1993. A breach of these rules creates an offence under section 154(O) of the Act.

Hawke's Bay Fruit Growers Association (HBFGA) Management Approach

Resolving apple black spot, codling moth, European canker, fireblight or lightbrown apple moth control disputes between neighbouring parties will be undertaken by HBFGA in the first instance. Mediation will be carried out in an attempt to achieve one of the following:

1. The occupier of pipfruit production sites manage, at their cost, the phytosanitary pests on their land in accordance with either the NZ Apples & Pears Inc. Integrated Fruit Production

Manual, J Hughes Et al, Technical Bulletin #004: Organic apple production (New Zealand Pipfruit Limited)" and subsequent amendments to these documents.

2. The occupier of an unmanaged pipfruit production site allows an affected adjacent pipfruit production site to manage their land in a manner that reduces the level of risk. Costs of control could be agreed between the two sites.

3. The occupier of an unmanaged pipfruit production site, at no cost to adjacent managed pipfruit sites, removes their pip-fruit trees.

All occupiers of pipfruit production sites are expected to undertake monitoring for the presence of apple black spot, codling moth, European canker, fireblight or lightbrown apple moth (phytosanitary pests) over their properties.

Where monitoring shows the presence of any phytosanitary pest along a boundary of a pipfruit production site above the thresholds stated in the rules of this Plan and the affected property is being managed in accordance with industry best practice, as indicated by adherence to the rules in this Plan, then the affected occupier will contact the occupier of the adjacent unmanaged pipfruit production site to seek agreement that they will control phytosanitary pests similarly

Note that more specific details of industry best practice for the management of a fruit production site are set out in either the Technical Bulletin #004: Organic apple production, (September 2002), or the New Zealand Pipfruit Integrated Fruit Production Manual, (August 2001)", and any subsequent amendments. These documents are available to the managers of pipfruit production sites in Hawke's Bay through New Zealand Apples & Pears Inc.

Where the adjacent pipfruit production site occupier does not agree to control phytosanitary pests, then the affected occupier may contact Hawke's Bay Fruit Growers Association advising them of the problem. Hawke's Bay Fruit Growers Association will act as an independent third party and investigate the issue and try to seek agreement for the control of phytosanitary pests.

Hawke's Bay Fruit Growers Association will advise the occupier of the unmanaged pipfruit production site that a complaint has been received regarding their inaction to control phytosanitary pests on their land, and that Hawke's Bay Fruit Growers Association is now investigating the issue.

If pest monitoring on the affected managed pipfruit production site over a reasonable time period confirms that:

- there is a clear difference in the management inputs required to control phytosanitary pests compared to the previous three years; and
- monitoring results indicated that the phytosanitary pest outbreak is more severe along the boundary with the adjacent unmanaged pipfruit production site;

then Hawke's Bay Fruit Growers Association will advise the occupier of the unmanaged pipfruit production site(s), that they are deemed to be an exacerbator of phytosanitary pests. Hawke's Bay Fruit Growers Association will be entitled to give the occupier of the unmanaged pipfruit production site(s) 14 days to reach an agreement with the affected owner regarding the control measures for the phytosanitary pests, and to undertake the necessary control measures. If agreement cannot be reached and/or control is not undertaken within that time, Hawke's Bay Fruit Growers Association will advise Hawke's Bay Regional Council of the situation and seek a direction to control phytosanitary pests on the unmanaged pipfruit production site.

On receiving advice regarding the situation, Hawke's Bay Regional Council will initiate appropriate enforcement procedures under the Biosecurity Act for the control of the phytosanitary pests.

6.5 Pests to be managed under site-led programmes

Background

New Zealand's biodiversity is both largely unique worldwide and is in decline despite significant efforts from agencies, organisations, community groups and individuals. Pest management, habitat protection (e.g. via fencing) and habitat restoration/creation (e.g. via planting) are key management measures in halting biodiversity decline. This Proposal significantly assists delivery of the first of those drivers. The pests listed under the site-led programmes, and most of the other pests included in this Proposal, are capable of damaging habitats and important ecosystem processes, or competing with indigenous species for food, or prey directly on native species.

Before Council can assist a landowner to protect and improve the native biodiversity at any specific site the ecological and biodiversity values that need protecting need to be determined. It is not the role of this Proposal, under the Biosecurity Act 1993, to formally identify or secure sites of ecological and biodiversity importance. Instead, that task falls on organisations (including Council), community groups or individual land owners to do so under other appropriate planning instruments (for example RMA, Reserves Act, QEII covenants). In particular, the Hawke's Bay Biodiversity Strategy has fostered a collective approach between the parties and the use of tools such as the Ecosystem Prioritisation Model.

This Proposal will provide Council with the ability to use, where necessary, appropriate provisions under the Biosecurity Act 1993 to ensure pest control activities undertaken at a site are protected from inaction by owners, both existing and new or adjacent.

What is a site led programme?

A site-led programme is the coordinated and integrated control of pests, unwanted organisms, and/or other harmful organisms in a defined area, that aims to protect and restore specific ecological or biodiversity values, which are threatened or compromised by pests, unwanted organisms, and/or other harmful organisms. Site led programmes focuses on the ecological or biodiversity values of the site rather than simply the control of pests. Values of sites can be put at risk by factors other than the presence of pests, unwanted organisms, and or other harmful organisms and these need to be taken into consideration before embarking on a site-led pest programme (e.g. fencing out stock).

A range of outcomes can be achieved through site led management. For example:

- integrity of ecosystems are protected and enhanced;
- optimised ecological health where the benefits outweigh the costs;
- positive response to or support of community concerns;
- improvement in breeding success and densities of native fauna;
- reduced soil erosion and subsequent soil conservation; and
- improvement in water quality.

The Council will monitor for the achievement of the outcomes being sought, rather than focusing on the output associated with traditional pest management.

Pests to be included in site-led programmes are listed in Table 11 below.

Table 11: Pests included in site-led programmes

COMMON NAME	SCIENTIFIC NAME
Feral cat	*Felis catus*
Feral deer incl. hybids (red, wapiti, sika samba, rusa, fallow and white-tailed)	*Cervus elaphus scoticus, C. elaphus nelsoni, C. nippon, C.unicolor, C. timorensis, Dama dama dama, Odocoileus virginianus*
Feral goat	*Capra hircus*
Feral pig	*Sus scrofa*
Mustelids (ferret, stoat, weasel)	*Mustelo furo, M. ermine, M. nivalis)*
Possum	*Trichosurus vulpecula*
Rat (Norway and ship)	*Rattus norvegicus, R. rattus*

6.5.1 Feral cat

For the description and adverse effects of feral cats please see page 57.

6.5.2 Feral deer (incl. hybrids)

Description

Medium- to large-sized ungulates ranging in weight from 40 kg (female white tailed) to 450 kg (wapiti male). Red deer have a reddish brown coat while wapiti are chesnut brown with a distinctive cream rump. The coats of samba are dark brown with a tan-rust red rump, while rusa are dark reddish-brown. Sika deer have a black dorsal stripe, white rump, chestnut brown sides with white spots. The coats of white tailed deer are light brown with white undersides and rump. Fallow deer have coats of varying brown colours.

Feral deer live in a wide range of habitats, particularly forest. They consume large quantities of native seedlings and saplings which reduces vegetation biomass and leads to failure in recruitment of a range of woody and herbaceous species and alters habitat for native fauna.

Adverse effects

Heavy and selective browsing on trees and shrubs can change forest structure and the composition of the understorey. Palatable plant species such as schefflera/pate, broadleaf, three-finger, lancewood, and hen and chicken fern can be all but removed from the ground tier. Sika often target species considered unpalatable to other deer.

6.5.3 Feral goat

Description

Feral (or wild) goats vary in size and their colour can be white, black, brown or a combination of colours. Both sexes have horns. Adult males stand approximately 70 cm high and weigh 50--60 kg. Females are smaller. Females begin breeding at 6 months and can breed twice a year. Twins are common. Males can mate from 6 months old but are usually excluded by other males until 3--4 years of age.

Source: Hawke's Bay Regional Council

They inhabit and exploit a wide range of rural and forest habitats and favours steep, dry, sunny faces. Their diet is wide-ranging.

Adverse effects

On farmland, feral goats damage fences, graze pasture, transfer animal health issues, damage the structure of exotic plantings, and browse riparian plantings. In indigenous vegetation areas, feral goats alter the composition and structure of the under-storey, inhibit regeneration and often completely removing favoured food plants from an ecosystem. Long-term intensive goat browse can ultimately lead to forest collapse and have a direct impact on fauna species, sediment runoff and water quality.

On the other hand, feral goats do provide some economic benefits to New Zealand. They are used as a management tool of woody weeds, particularly blackberry and gorse, in some hill country areas. Feral goats also have the potential to generate revenue from the production of meat and fibre at very low cost. Some value is also attached to the opportunities goats provide for recreational hunting and the fact that they can be used as a zero-cost source of bonus payments for farm staff.

Where a resource, in this case feral goats, is used to derive economic benefit and there is likely to be significant externality effects, management intervention is required. Such management, whereby externalities are internalised, mitigated or minimised is best achieved by including feral goats in the Proposal.

6.5.4 Feral pig

Description

Adults can measure 90--200 cm in length, and weigh 50--90 kg. Their colour varies from dark grey to brown or black. Adult males develop tusks that protrude from their mouth. Sexually mature at two years of age, they breed once per year with litter size ranging from 4--6 piglets. The piglets are weaned at 3--4 months of age. Vegetation forms 70% of pig diet. Pig rooting can reduce the diversity of seedlings and saplings and cause a dramatic reduction in leaf cover on the forest floor.

They are found in a wide range of habitats but mostly prefer to live on farmland and rough hill country that includes thick and extensive scrub cover. Vegetation forms 70% of pig diet. Pig rooting can reduce the diversity of seedlings and saplings and cause a dramatic reduction in leaf cover on the forest floor.

Adverse effects

A known vector of bovine Tb and can also spread other diseases and infectious microbes through the forest. They can significantly damage pasture by rooting, often leaving it in a "state of cultivation'. Predation on lambs has also been observed.

Feral pigs can also have major effects on native flora and fauna. They eat the tops of native plants and dig up their roots, resulting in the decline of some species. Also eaten are many native invertebrates, native land snails and large quantities of native earthworms. Pig predation of flightless and ground-dwelling birds (e.g. kiwi) has been suggested but rarely confirmed.

6.5.5 Mustelids (ferret, stoat, weasel)

For the description and adverse effects of mustelids please see page 57.

6.5.6 Possums

For the description and adverse effects of possums please see page 52.

6.5.7 Rats (ship and Norway)

Description

Ship rat is a slender rat with large hairless ears, grey-brown on the back with a similarly coloured or creamish-white belly, or black all over. The uniformly-coloured tail is always longer than the head and body length combined. Adults usually weigh 120-160 gm but can exceed 200 gm. Norway rat has brown fur on its back and pale grey fur on its belly. Adults normally weigh 150-300 g, may reach up to 500 g, and are up to 390 mm long. Have relatively small ears which usually do not cover the eyes when pulled forward. Tail is shorter than head-body length.

Breeding commences as early as 3-4 months of age. Females can produce 15-20 young per year. Mortality can be high.

They inhabit a wide range of urban, rural and forest habitats. Ship rats are more common within forest areas.

Adverse effects

Omnivorous and opportunistic feeders eating 10% of their body weight per day. This makes them a competitor for food with many species and predators of others. They eat a variety of native flora and fauna, in particular native birds (eggs and fledglings), lizards, and invertebrates. Eat large quantities of native seeds, which reduces regeneration of native plants.

Objective 13

Over the duration of the Plan, support sustainably controlling population levels of feral cats, feral deer, feral goats, feral pigs, mustelids, possums and rats at sites of ecological importance or native plantings to levels appropriate for the protection of ecological values, recreational values and economic well-being within the Hawke's Bay region.

Principal measures to be used

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Appropriate measures drawn from **the requirement to act, council inspection, service delivery, advocacy and education** described in section 5.3 of the Proposal will be used to achieve the Objective.

Primarily, the Council will assist willing land occupiers by undertaking or arranging suitable control programmes. The exception is managing goats where regulatory provision is made for certain circumstances.

Alternatives considered

Relying on voluntary control is unlikely to result in efficient or effective outcomes. Requiring occupiers to undertake control is not considered equitable because many of the benefits of control accrue to persons other than to the land occupiers upon whose land the sites are located. It is therefore preferable for beneficiaries to fund the Council to undertake the control programmes.

There are no alternative measures that provide for satisfactory inspection, education or advocacy measures.

Plan Rule 15

Note: This is designated a Good Neighbour Rule

Except where an occupier of land has entered into a Written Management Agreement approved by Hawke's Bay Regional Council, an occupier adjacent to an area of ecological importance or native plantings shall, on receipt of a written direction from an Authorised Person destroy all feral goats on the land that they occupy within 500 metres of the adjoining property boundary where the occupier of the adjoining property is managing feral goats across their property to protect the ecological values, recreational values or economic well-being.

A breach of this rule creates an offence under section 154N (19) of the Act.

Explanation of rule

The reason for this rule is to manage the spread of feral goats causing unreasonable costs to the adjacent occupier where active feral goat management is being undertaken by that occupier.

Advice Note

Council will only administer the rule upon receiving a written complaint from the adjacent land occupier. This rule only applies when feral goats are impacting on an area of ecological importance or native planting of an adjoining property that is actively managing feral goats. If a land occupier has an agreed feral goat Written Management Agreement with Council and is actively carrying out their requirements under this management agreement, they will not receive a written direction from an Authorised Person.

Statutory obligation

Sections 52 and 53 of the Biosecurity Act 1993, which prevent the communication, release, spread, sale and propagation of pests, must be complied with. These sections should be referred to in full in the Biosecurity Act 1993. A breach of these rules creates an offence under section 154 (O) of the Act.

Please note that this means pests listed in site-led programmes (table 11 above) cannot be released from containment in any part of the Hawke's Bay region, including deer, goats and pigs.

7 Monitoring

7.1 Measuring what the objectives are achieving

PEST	ANTICIPATED RESULT	INDICATOR	METHOD OF MONITORING	FREQUENCY OF MONITORING	FREQUENCY OF REPORTING
Exclusion Programmes					
Wallaby Noogura bur Yellow bristle grass Alligator weed Marshwort Senegal tea Spartina Sabella Styella	No exclusion pests establish in the Region	No exclusion pests found in the Region	Undertake inspections of high risk areas and respond to reports	Annually	Annually
Eradication Programmes					
African feather grass Goats rue Phragmites Spiny emex White-edged nightshade Yellow water lily Cathedral Bell Purple loostrife	All known sites controlled to zero density by 2028.	Extent and density of subject pest in the Region	Inspection of all known sites. Surveillance of areas vulnerable to invasion	Annual/bi-annual inspections until zero-density has been achieved Annual for five years after zero-density has been achieved. Biennial inspections after that.	Annually
Rooks	All known rookery sites controlled to zero active nests	Number of active nests in the Region	Inspection of all rookeries. Surveillance of areas where rookeries may establish	Annually	Annually
Progressive Containment Programmes					
Apple of Sodom Australian sedge Cotton thistle *Pinus contorta* Nassella tussock Saffron thistle Woolly nightshade Darwin's Barberry Velvet leaf	Reduction in extent and density of these pests in the Region. Pests do not establish in new areas in the Region	Extent and density of subject pest in the Region	Inspection of all known sites. Surveillance of areas vulnerable to invasion	Annually 3-5 yearly inspection of *Pinus contorta*	Annually

Japanese honeysuckle	Reduction in extent and density within the Japanese honeysuckle progressive containment area	Extent and density of Japanese honeysuckle within the progressive containment area	Inspection within the progressive containment area	Annually	Annually
Old man's beard	Reduction in extent and density within the old mans's beard progressive containment area	Extent and density of old man's beard within the progressive containment area	Inspection within the progressive containment area	Annually	Annually
Sustained Control Programmes					
Possum Control Areas	Possum densities maintained at or below 4% RTC	Possum monitoring trend/education data	Residual trap catch index (RTCI) or chew card index	Annually	Annually
Predator Control Areas	Predator densities maintained as per the Hawke's Bay Regional Predator Control Technical Protocol	Predator monitoring trend/education data	As per the Hawke's Bay Regional Predator Control Technical Protocol	Annually	Annually
Rabbit	Rabbits are maintained below level 4. on the McLean Scale	Regional rabbit monitoring trend data Complaints/enquiries received	Modified McLean Scale (2012)	Annually	Annually
Pest Plants (Boundary Control)	Prevent the spread of these pests onto adjacent, uninfested properties	Number of properties requiring boundary control enforcement	Boundary control enforcement register	Annually	Annually
Chilean needle grass	Minimise the spread of Chilean needle grass within the Region	Extent of Chilean needle grass in the Region	Inspection of all known sites. Surveillance of areas vulnerable to invasion	Annually	Annually
Privet	Minimise significant adverse effects of privet on human health	Number of privet complaints received	Privet complaints register Number of properties privet was removed from	Annually	Annually
Site led Programmes					
Feral cat Feral deer Feral goat Feral Pig Ferret	Support community in minimising adverse effects of these pests on natural ecosystems	Number of hectares under a site specific programme	Site specific pest control areas mapped on ArcGis	Annually	Annually

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Rat (ship and Norway)
Stoat
Weasel

7.2 Monitoring the management agency's performance

The Hawke's Bay Regional Council is the management agency. As the management agency responsible for implementing the Plan, the Hawke's Bay Regional Council will:

(a) prepare an operational plan within three months of the Plan being approved;

(b) review the operational plan, and amend it if needed;

(c) report on the operational plan each year, within five months after the end of each financial year;

(d) maintain up-to-date databases of complaints, pest levels and densities, and responses from Regional Council and land owners and/or occupiers.

7.3 Monitoring plan effectiveness

Monitoring the effectiveness of the Plan will ensure that it continues to achieve its purpose. It will also check that relevant circumstances have not changed to such an extent that the Plan requires review. A review may be needed if:

(a) the Act is changed, and a review is needed to ensure that the Plan is not inconsistent with the Act;

(b) other harmful organisms create, or have the potential to create, problems that can be resolved by including those organisms in the Plan;

(c) monitoring shows the problems from pests or other organisms to be controlled (as covered by the Plan) have changed significantly; or

(d) circumstances change so significantly that the Council believes a review is appropriate.

If the Plan does not need to be reviewed under such circumstances, it will be reviewed in line with s100D of the Act. Such a review may extend, amend or revoke the Plan, or leave it unchanged.

The procedures to review the Plan will include officers of the Council.

(i) assessing the efficiency and effectiveness of the principal measures (specified for each pest and other organism (or pest group or organisms) to be controlled to achieve the objectives of the Plan;

(ii) assessing the impact the pest or organism (covered by the Plan) has on the region and any other harmful organisms that should be considered for inclusion in the Plan; and

(iii) liaising with key interest groups on the effectiveness of the Plan.

Part Three: Procedures

8 Powers conferred

8.1 Powers under Part 6 of the Act

The Principal Officer (Chief Executive) of Hawke's Bay Regional Council or Chief Technical Officer (appointed by the Director-General and employed under the State Sector Act 1988) may appoint authorised persons to exercise the functions, powers and duties under the Act in relation to a Plan. The Council will use those statutory powers of Part 6 of the Act as shown in Table 12, where necessary, to help achieve the objectives of the Proposal, and give effect to its management.

Table 12: Powers from Part 6 to be used

ADMINISTRATIVE PROVISIONS	BIOSECURITY ACT REFERENCE	LEVEL OF DELEGATION
The appointment of authorised and accredited persons	Section 103(3) & (7)	Principal officer the Council
AP to comply with instructions	Section 104	Principal officer the Council
Delegation to authorised persons	Section 105	Principal officer the Council
Power to require assistance	Section 106	Authorised person
Power of inspections and duties	Section 109, 110 & 112	Authorised person
Entry in respect of offence	Section 111	Authorised person
Power to record information	Section 113	Authorised person
General powers	Section 114	Authorised person
General powers	Section 114A	Principal officer the Council
Use of dogs and devices	Section 115	Authorised person
Power to seize evidence	Section 118	Authorised person
Power to seize abandoned goods	Section 119	Authorised person
Power to intercept risk goods	Section 120	Authorised person
Power to examine organisms	Section 121	Authorised person
Power to apply article or substance to place	Section 121A	Authorised person
Power to give directions	Section 122	Authorised person
Power to vaccinate	Section 123	Authorised person
Power to act on default	Section 128	Principal officer the Council
Liens	Section 129	Principal officer the Council
Declaration of restricted areas	Section 130	Authorised person
Declaration of controlled areas	Section 131	The Council
Declaration of restricted place	Section 133	The Council
Enforcement of control areas	Section 134	Authorised person

Options for cost recovery	Section 135	The Council
Failure to pay	Section 136	The Council

8.2 Powers under other sections of the Act

Any land occupier or person in breach of a rule in the Plan that specifies that a contravention of the rule creates an offence under section 154N (19) of the Act, can be prosecuted and is liable on conviction under section 157 (5) of the Act to a fine.

8.3 Power to issue exemptions to plan rules

The Council will keep and maintain a register of exemptions granted that records the description, reasons and period of each exemption. The public will be able to inspect this register free of charge during business hours. The Council may also grant an extension of the period of an exemption.

9 Funding Analysis

9.1 Background

The Act requires that costs and benefits of the Proposal are analysed, and that the proposed allocation of costs and funding is thoroughly examined. For the Proposal, this includes (in respect of each pest):

- analysing the costs and benefits of the Plan and any reasonable alternative measures;
- noting how much any person will likely benefit from the Plan;
- noting how any persons contribute to creating, continuing or making worse the problems that the Plan proposes to resolve;
- noting the reasons for allocating costs; and
- noting whether any unusual administrative problems or costs are expected in recovering the costs from any person who is required to pay under the Plan.

9.2 Summary of analysis of benefits and costs

An analysis of the expected benefits and costs associated with implementing the plan has been undertaken. The analysis is contained within the Hawke's Bay Proposed Regional Pest Management Plan Cost Benefit Report, published alongside this document.

9.3 Beneficiaries and exacerbators

An analysis of the expected beneficiaries (those who benefit from controlling the pest) and exacerbators (those who contribute to the pest problem) associated with implementing the plan has been undertaken. This analysis is also contained within the Hawke's Bay Proposed Regional Pest Management Plan Cost Benefit Report.

9.4 Funding sources and reasons for funding

The Biosecurity Act 1993 and the Local Government (Rating) Act 2002 require that funding is sought from:

- people who have an interest in the Plan;
- those who benefit from the Plan; and
- those who contribute to the pest problem.

Funding must be sought in a way that reflects economic efficiency and equity. Those seeking funds should also target those funding the Plan and the costs of collecting funding.

These factors lead the council to consider that overall the beneficiaries of the biosecurity activity are spread across the Region. Historically, a large portion of the programmes have been funded by the rural community, this Plan and the programmes proposed reflect a shift which recognises that the Regional Community are significant beneficiaries and the funding sources have been reviewed to reflect this in the Hawke's Bay Proposed Regional Pest Management Plan Cost Benefit Report, published alongside this document.

Proposed splits for consideration as part of the Funding Review are as follows:

Production pests	30% General Rate, 70% Targeted Rate
Environmental and amenity pests	100% General Rate

Wide scale predator control	40% General rate, 60% Targeted Rate

Targeted rate

The funding from rural land occupiers will be by a targeted rate made and levied on the basis of land area, under section 16 of the Local Government (Rating) Act 2002. The rate will be made on a uniform basis, as set out as follows:

Rural land occupiers

The parts of the region comprising properties that:

- Have a land area of 4.0479 hectares or more; and
- Where the land area is more than 200 hectares, and less than 10% of the area is covered in ungrazed indigenous vegetation.

Forestry

The parts of the region comprising properties of production forestry that either:

- Have a land area of more than 40 hectares, of which more than 75% is covered in production forestry; or
- Have more than 400 hectares of planted production forest.

Exemptions

The parts of the region comprising properties that:

- Have a land area of more than 200 hectares, of which more than 90% is covered in ungrazed indigenous vegetation.

The above categories were developed to adequately distinguish between who is a rural occupier and who is not, while excluding very small properties for which the costs of levying rates outweigh the benefits obtained from the extra revenue, and very large properties of unproductive land. Large properties of unproductive land are excluded because pest management on these properties principally benefits the environment (and therefore everyone in the region), as opposed to directly benefiting the property owners.

The Forestry category was created to reflect the agreement between HBRC and the Forestry Industry, whereby these properties are responsible for managing certain pest animals and are not beneficiaries of all pest animal programmes. A reduced Targeted Rate (approximately 40% of Targeted Rate) is charged to these properties to reflect this.

These rates will be set and assessed under the Local Government (Rating) Act 2002, and in determining this, the Hawke's Bay Regional council has had regard to those matters outlined in Section 100T of the Biosecurity Act.

9.5 Anticipated costs of implementing the Plan

The anticipated costs of implementing the proposed RPMP reflect a best estimate of expenditure levels. Funding levels will be further examined and set during subsequent Long Term Plan and Annual Plan processes. While community funding is mainly sourced from rates, alternative funding sources will be sought by the Hawke's Bay Regional Council. Such funds will offset rates or be used as a value-added component in appropriate circumstances.

The proposed funding budget allocation is shown in table 13. Please refer to the Hawke's Bay Proposed Regional Pest Management Plan Cost Benefit Report for a full analysis of each programme.

Table 13. Proposed 2017-2018 funding for Regional Pest Management Plan.

ACTIVITY EXPENDITURE	
Production Pest Management	$1,810,761.00
Environmental & Amenity Pest Management	$431,284.00
Wide scale predator control	$400,000
Total Biosecurity	**$2,642,045**

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Glossary

Various technical and planning terms used in the Plan are defined in this Glossary. The use of italics indicates meanings taken from Section 2 of the Biosecurity Act 1993. In the case of any inconsistency arising from amendments to the Act, the statutory definition prevails.

Animal means any mammal, bird, fish, reptile or other vertebrate; any insect or other invertebrate. Any living organism, except a plant, micro-organism or a human being.

Authorised person means *a person for the time being appointed an authorised person under section 103* of the Act.

Beneficiary means the receiver of benefits accruing from the implementation of a pest management measure or the Plan.

Biofouling means the accumulation of aquatic organisms such as micro-organisms, plants and animals on surfaces and structures immersed in or exposed to the aquatic environment.

Biological control means the introduction and establishment of living organisms, which will prey on or adversely affect a pest.

Chief Technical Officer means *a person appointed a chief technical officer under section 101* of the Act. The Ministries of Health, Primary Industries, and the Department of Conservation all have appointed Chief Technical Officers.

Council means Hawke's Bay Regional Council

Costs and benefits *includes costs and benefits of any kind, whether monetary or non- monetary.*

Effects, *in sections 12A and 12B and Part 5,—*

(a) include the following, regardless of scale, intensity, du- ration, or frequency:
- *(i) a positive or adverse effect; and*
- *(ii) a temporary or permanent effect; and*
- *(iii) a past, present, or future effect; and*
- *(iv) a cumulative effect that arises over time or in combination with other effects; and*

(b) also include the following:
- *(i) a potential effect of high probability; and*
- *(ii) a potential effect of low probability that has a high potential impact*

Effective fence means a minimum fence standard (as per below) or greater.

Minimum fence standard:

(a) minimum overall fence height of 1100 mm; and
(b) a maximum of 5 m spacing between posts; and
(c) a minimum of 7 wires with maximum spacing of 200 mm between top wires; and
(d) spaces between wires gradually decreasing to 100 mm between bottom two wires; and,
(e) the bottom wire is a maximum of 100 mm above the ground; and
(f) a minimum of 5 battens per bay; and
(g) all wires must be strained to a minimum 150 kgs of tension; and
(h) all materials are structurally sound; and
(i) has been topped up with a netting fence that is:
   a. minimum netting specifications of height 600 mm, stay wire width 300 mm; and
   b. has two electrified outriggers at 300mm and 1200mm spacing;

In relation to any gate, whether new or top-up, a gate that is:

(a) the same height as the adjoining fence; and
(b) the bottom of the gate is a maximum of 100 mm above the ground at all points including over any ditches or hollows; and
(c) all components are structurally sound.

Electric type fences do not comply, as shortages and vegetation growth may lead to non-compliance.

Environment includes:

(a) Ecosystems and their constituent parts, including people and their communities; and
(b) All natural and physical resources; and
(c) Amenity values; and
(d) The aesthetic, cultural, economic, and social conditions that affect or are affected by any manner referred to in paragraphs (a) to (c) of this definition.

Environmental values incorporate those values that associated with the environment.

Eradication means to reduce the infestation level of the subject, or an organism being spread by the subject, to zero levels in an area in the short to medium term.

Exacerbator means a person who, by their activities or inaction, contributes to the creation, continuance or makes worse a particular pest management problem.

Exclusion means to prevent the establishment of the subject, or an organism being spread by the subject, that is present in New Zealand but not yet established in an area.

Feral Cat means any cat living in a wild state and not being kept as a domestic pet.

Feral Deer means any deer that is not:

(a) being kept or farmed in accordance with the Wild Animal Control Act 1997; and
(b) clearly identified in accordance with the National Animal Identification and Tracing Act 2012 and tagged with a NAIT approved RFID tag.

Feral Goat means any goat that is not:

(a) held behind an effective fence or otherwise constrained; and
(b) identified in accordance with an animal identification device approved under the National Animal Identification and Tracing Act 2012.

Feral Pig means any pig that is not kept within an effective fence or enclosure for faming or domestic purposes.

Hawke's Bay Regional Possum Control Technical Protocol (PN 4969) means this protocol plus any future amended Hawke's Bay Regional Possum Control Technical Protocol protocols.

Hawke's Bay Regional Predator Control Technical Protocol (PN 4970) means this protocol plus any future amended Hawke's Bay Regional Predator Control Technical Protocol protocols.

High ecological value means any existing legally protected natural areas, recommended areas for protection (RAP) identified under the Protected Natural Areas Programme or District Plans, and other areas containing nationally or regionally rare or threatened plants or species or communities.

Hull means the immersed (including occasionally immersed) surfaces of a vessel including the following three parts:

(a) **hull area** - the immersed surfaces of a vessel excluding niche areas and wind/water line.

(b) **niche areas** - areas on a vessel hull that are more susceptible to biofouling due to different hydrodynamic forces, susceptibility to coating system wear or damage, or being inadequately, or not, painted, e.g., sea chests, bow thrusters, propeller shafts, inlet gratings, dry-dock support strips, etc. Includes appendages.

(c) **wind and water line** - the area of the hull that is subject to alternating immersion due to a vessel's movement or loading conditions (also known in shipping as the Boot-top).

The definition of hull includes pontoons.

Infestation means where one or more plant pests occur.

Kaitiaki means a person or agent who cares for taonga; may be spiritual or physical. Responsible for the exercise of kaitiakitanga.

Kaitiakitanga means the exercise of guardianship under mana whenua, and, in relation to a resource, includes the ethic of guardianship and stewardship based on the nature of the resource itself.

Management agency means *the body specified as the management agency in a pest management plan* given the task of implementing the plan. For the purposes of this Plan, Hawke's Bay Regional Council is the management agency.

Mana whenua means customary authority exercised by an iwi or hapu over land and other taonga within the tribal rohe.

Modified McLean Scale (2012) refers to Version 1.0 of the Modified McLean Scale, as adopted by the New Zealand Rabbit Coordination Group, 12/10/2012, and any future Versions adopted. This guideline outlines a method for monitoring rabbit possum populations.

Nga Whenua Rahui covenant means a land covenant made pursuant to section 77A of the Reserves Act 1977.

Occupier means

(a) In relation to any place physically occupied by any person, means that person; and
(b) In relation to any other place, means the owner of the place; and
(c) In relation to any place, includes any agent, employee, or other person, acting or apparently acting in the general management or control of the place.

Operational plan means a plan prepared by the Management Agency under section 85 of the Biosecurity Act 1993.

Organism-

(a) Does not include a human being or a genetic structure derived from a human being;
(b) Includes a micro-organism;
(c) Subject to paragraph (a) of this definition, includes a genetic structure that is capable of replicating itself (whether that structure comprises all or only part of an entity, and whether it comprises all or only part of the total genetic structure of an entity);
(d) Includes an entity (other than a human being) declared by the Governor-General by Order in Council to be an organism for the purposes of the Act;
(e) Includes a reproductive cell or developmental stage of an organism;
(f) Includes any particle that is a prion.

Pest means *an organism specified as a pest in a pest management plan*

Pest management plan *means a plan to which the following apply:*
(a) it is for the eradication or effective management of a particular pest or pests;
(b) it is made under Part 5;
(c) it is a national pest management plan or a regional pest management plan.

Predator Control Area means an area identified as a Predator Control Area in the Hawke's Bay Regional Predator Control Technical Protocol (PN 4970).

Principal officer means:

(a) in relation to a regional council, its chief executive; and
(b) in relation to a region, the chief executive of the region's regional council;
and includes an acting chief executive.

Progressive containment means to contain or reduce the geographic distribution of the subject, or an organism being spread by the subject, to an area over time.

QEII covenant means a land covenant made pursuant to section 22 of the Queen Elizabeth the Second National Trust Act 1977.

Residual trap Catch refers to Possum Population Monitoring Using the Trapcatch, Waxtag and Chewcard Methods, November 2015. This Protocol outlines a method for estimating indices of relative abundance of possum populations. For example, a 4% trap catch means that for every 100 traps set for one night, 4 possums are caught.

Site led pest programme means that the subject, or an organism being spread by the subject, that is capable of causing damage to a place is excluded or eradicated from that place, or is contained, reduced, or controlled within the place to an extent that protects the values of that place.

Slime layer means a layer of microscopic organisms, such as bacteria and diatoms, and the slimy substances that they produce.

Sustained control means to provide for ongoing control of the subject, or an organism being spread by the subject, to reduce its impacts on values and spread to other properties.

Unwanted organism *means any organism that a chief technical officer believes is capable or potentially capable of causing unwanted harm to any natural and physical resources or human health; and*

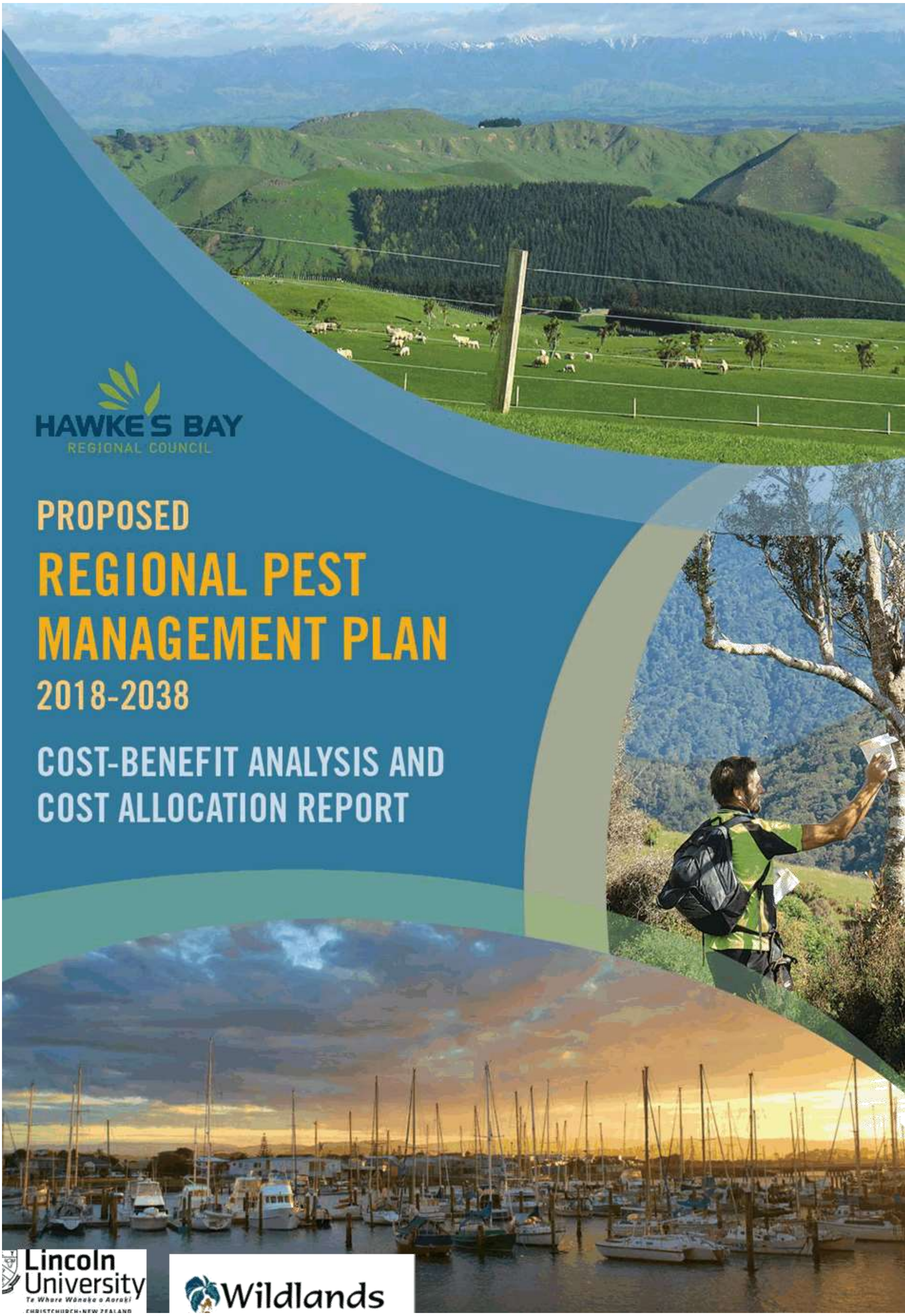
(a) *Includes—*
  (i) Any new organism, if the Environmental Risk Management Authority has declined approval to import that organism; and
  (ii) Any organism specified in the Second Schedule of the Hazardous Substances and New Organisms Act 1996; but

(b) *Does not include any organism approved for importation under the Hazardous Substances and New Organisms Act 1996, unless—*
  (i) The organism is an organism which has escaped from a containment facility; or
  (ii) *A chief technical officer, after consulting the Environmental Risk Management Authority and taking into account any comments made by the Authority concerning the organism, believes that the organism is capable or potentially capable of causing unwanted harm to any natural and physical resources or human health.*

Vessel or sea-craft means a subset of 'craft' as defined by the Act and means every description of boat or other craft used in water navigation, whether or not it has any means of propulsion; also includes: a barge, lighter, hovercraft or floating drilling rig. It does not include aircraft.

Waahi tapu means sacred site. These are defined locally by the hapu or iwi that are kaitiaki for the waahi tapu.

Zero density means when there are no known animals or plants left of the pest species of concern, in the area of concern, at the end of annual pest control operations. Zero density is a status slightly less than eradication because of the risk of re-infestation and longevity of seed banks.



PROPOSED

REGIONAL PEST MANAGEMENT PLAN

2018-2038

COST-BENEFIT ANALYSIS AND COST ALLOCATION REPORT

This document was produced by:
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INTRODUCTION

Background

Under sections 70 and 71 of the *New Zealand Biosecurity Act (1993)*, a regional council is required to be cognisant of, and evaluate and document the benefits, costs, funding arrangements and adverse effects associated with the management of pests prior to the notification of a proposed Regional Pest Management Plan (RPMP) (Appendix 1). Section 76 of the Act requires that a proposed RPMP must present the costs and benefits of each pest (76k) under different management programmes (76l).

Amendments to the Biosecurity Act in 2012 reformed the law relating to the exclusion, eradication, and effective management of pests and unwanted organisms, including:

- New policy instruments such as the *National Policy Direction for Pest Management* (NPD, finalised in August 2015*)* and pathway management plans;
- 'Good Neighbour Rules' and a requirement that the Crown comply with such rules in a regional management plan;
- Changes to the development and review process for pest management plans.

The NPD contains directions on programme objectives and terminology and specifies the requirements for analysing costs and benefits (Appendix 2).

Scope

This report assesses the impacts of pest plants and animals being considered for inclusion in a proposed RPMP for Hawke's Bay, and provides a quantitative assessment of the detrimental effects and any known beneficial effects of each pest, and a cost-benefit analysis (CBA) comparing "no regional management" to one or more proposed regional pest management programmes. The results of these assessments provide an indication of whether the benefits of the proposed regional investment in managing a pest are likely to be greater than the costs and whether the inclusion of the pest in the RPMP is justified. This assessment is required to satisfy Sections 70 and 71 of the Biosecurity Act. It also meets the requirements of section 6(1) of the NPD by conducting the cost-benefit analyses at an appropriate level in relation to the level and quality of data available and the cost of the proposed programme.

Management Options

A number of different management options are potentially available for managing adverse and unintended impacts of pests in the region:

- Exclusion

- Eradication
- Sustained Control
- Progressive Containment
- Site-led

METHODS

Overview of cost-benefit analyses

Cost-benefit analyses (CBAs) are an economic tool to estimate all relevant costs and benefits in the same currency, usually in current dollars (termed the net present value, or NPV). In this report, the cost-benefit analysis ascertains whether the benefit of each proposed pest management programme outweighs the cost.

The cost-benefit analyses are, with some modifications, based upon similar CBA exercises undertaken by regional councils. The CBAs undertaken in this report allow for the inclusion of a range of ecological values where a precise number is unknown (e.g. the potential rate of pest spread) and for the inclusion of non-production costs.

The CBA provides a monetary assessment of the benefits and costs based upon:

- The extent of the pest.
- Its preferred (and less preferred) habitats.
- The values received from the land that the pest impacts upon.
- The cost of control.

This report provides a monetary estimate of all relevant programme costs and benefits in the same currency - all future costs and benefits are 'discounted' by the amount a dollar could earn if invested now rather than spent. This is the foundation of the CBA approach; current investment made to avoid future pest impacts is considered uneconomical if the same money invested now would be worth more than the impact cost when those impacts occur.

A discount rate of 8% was used in previous cost-benefit analyses for RPMS reviews (e.g. Severinsen 2003, Auckland Regional Council 2006, Sullivan and Hutchison 2010), however we have used a 4% discount rate for the CBAs in this report, as recommended by Auckland Council, following their review of discount rates for RPMPs (Imogen Bassett pers. comm.). With an annual compounding interest rate of 8%, $1 invested today will have grown to $46.90 in 50 years. For this reason, for it to be economically sensible to spend $10,000 today on pest control to prevent impacts in 50 years' time, those impacts would need to be worth at least $469,000. By comparison, if using a discount rate of 4% (annual compounding), $1 today equals $7.11 in 50 years, so the decision to invest would depend on the pest impacts being at least $71,067. A lower discount rate gives greater weight to future costs and benefits than a higher discount rate.

Cost-benefit analysis results can give the illusion of being precise and providing robust estimates of future costs and benefits. However, there are significant data limitations in terms of how much we know about the impacts and spread of pests and the costs of their control over future decades. Because of this, there is an unknown but undoubtedly large amount of uncertainty around any CBA estimates applied to pest management.

Cost-benefit estimates are monetarised. There are, however, non-monetarised values that are relevant such as pest impacts on biodiversity, amenity and other environmental, social and cultural values. Accordingly, for environmental pests, the monetarised net benefit of regional intervention (or otherwise) is likely to be an underestimate.
For each pest species, we assessed its impacts in the region and undertook a cost-benefit analysis, comparing no coordinated regional management with one or more options under the proposed Hawke's Bay RPMP, i.e. Exclusion, Eradication, Progressive Containment, Sustained Control, or Site-led. We used data from Council staff and reviewed published information to summarise the known impacts of pest plants and animals on production values as well as environmental, social, and cultural values.

We used a modified version of the 'Harris Model' for the CBAs (see Appendix 3 for more information on the methods used and assumptions of our model)[1]. Our modifications to the Harris Model are designed to make it more flexible and less precise in its data requirements, and more capable of incorporating the diverse range of pest impacts in the Hawke's Bay Region, while retaining its robust economic foundations.

General assumptions for cost-benefit analyses

Cost-benefit analyses for pest control programmes require the adoption of a number of assumptions. These assumptions, which were generally applied to all of the proposed pest management programmes, are described below:

- When dealing with newly-established and or expanding pest populations, early action is by far the most cost effective approach even when there is inadequate knowledge of impacts (Harris and Timmins 2009).
- The economic impacts of pests scale linearly with the area of infestation e.g. twice as much area of weeds means twice as much impact on the region.
- Costs and obligations to undertake pest control through the RPMP will only be imposed on landowners and the community in circumstances where effective control is dependent upon the Council accessing the regulatory powers [Part 6] of the Act.

Management of pests in 'defined areas'

Some proposed pest management programmes only apply to a subset of the Region. Depending on the pest, this means they will only be controlled in particular defined areas, or they will be controlled everywhere except for particular areas. For example, one of the proposed programmes assessed for the proposed Hawke's Bay RPMP was Site-led control of old man's beard (*Clematis vitalba*) in the northern part of the Region only. For such programmes, the cost-benefit calculations are restricted to the current and potential extent of the pest within the defined area (costs and benefits outside this area are not considered).

CBA duration

Ten years is the standard CBA duration for a Regional Pest Management Plan. We have also included a 50-year assessment because pests typically take many decades to reach their full extent in a region, therefore pests at early stages of their invasion will incur the majority of their impacts well beyond the standard 10-year assessment duration.

Pest attributes and distribution

A brief description of the biological characteristics of each pest species is provided, followed by a table identifying the land use/habitat types that the pest currently occupies in the Region (or defined area) and those it could potentially invade if allowed to spread.

Relevant biology

The form, preferred habitats, competitive ability, reproductive ability, resistance to control, and dispersal methods (plants only) of each pest were determined from the literature. Information on the current regional distribution of each pest was provided by Hawke's Bay Regional Council.

Land use/habitat types

The Hawke's Bay Region was categorised into 11 different land use/habitat types for the cost-benefit analyses (Table 1).

[1] Developed in 2000 by economist Simon Harris specifically for RPMS reviews.

Table 1: Land use/habitat types used in the cost-benefit analyses. 'Production' land use/habitat types are highlighted in orange, 'non-production' types are highlighted in green.

LAND USE/HABITAT TYPE	DESCRIPTION
Dairy	Dairy farms
Sheep/Beef/Deer	Sheep, beef, deer, and goat farms
Horticulture	Arable cropping and orchards
Forestry	Timber producing plantations and woodlots
Aquaculture	Marine aquaculture
Urban	Cities, towns, industrial land
Native terrestrial	Native forest, shrubland, wetland vegetation, grassland
Coastal land	Beaches, sand dunes, coastal cliffs (land within *c.*50 m of coastline)
Estuarine	Harbours and estuaries (saltwater)
Freshwater	Waterways, lakes, and ponds
Marine	The ocean (within Hawke's Bay Region)

The total area of each land use/habitat type in the region (or defined area) was estimated by Hawke's Bay Regional Council. The New Zealand Land Cover Database Version 4.1 (LCDB4, Ministry for the Environment 2015) was used to estimate the area of each of the nine terrestrial land use types by assigning the relevant LCDB land cover classes to the different CBA land use types (Table 2)[1].

The total area of coastal land was estimated from the area of Sand and Gravel in LCDB4, however this is likely to be an underestimate, as we defined the coastal land use type as land within 50 metres of the coastline, including coastal cliffs. The total area of freshwater in the Region is likely to be an underestimate, as small waterways (less than 20 metres wide) and lakes (less than one hectare) were not identified in LCDB4 (due to the resolution of the satellite imagery).

[1] Several of the LCDB4 classes were not assigned to our CBA land use types because they did not correspond clearly to one land use type (i.e. Gorse and/or Broom, Gravel and Rock, Landslide, Major Shelterbelts, Mixed Exotic Shrubland, Surface Mines and Dumps). These classes cover a relatively small proportion of the region (*c.*1%).

Table 2: Total area of each CBA land use/habitat type in Hawke's Bay Region[1] and the land cover classes (from the New Zealand Land Cover Database Version 4.1, LCDB4) assigned to the nine terrestrial land use/habitat types. 'Production' land use types are highlighted in orange, 'non-production' types are highlighted in green.

LAND USE/HABITAT TYPE	AREA IN HAWKE'S BAY REGION (ha)	LAND COVER CLASS (from LCDB4)
Dairy	30,171	High Producing Exotic Grassland
SheepBeefDeer	821,815	Low Producing Grassland
Horticulture	22,081	Orchard Vineyard and Other Perennial Crops
		Short-rotation Cropland
Forestry	191,431	Deciduous Hardwoods
		Exotic Forest
		Forest - Harvested
Aquaculture	100	*
Urban	22,720	Built-up Area (settlement)
		Urban Parkland/Open Space
Native terrestrial	299,192	Alpine Grass/Herbfield
		Broadleaved Indigenous Hardwoods
		Depleted grassland
		Fernland
		Flaxland
		Indigenous Forest
		Manuka and/or Kanuka
		Matagouri or Grey Scrub
		Tall Tussock Grassland
Coastal land	1,424	Sand and Gravel
Estuarine	1,498	Estuarine Open Water
		Herbaceous Saline Vegetation
		Mangrove
Freshwater	13,935	Herbaceous Freshwater Vegetation
		Lake and Pond
		River
Marine	770,000	

* There is no aquaculture in Hawke's Bay Region at present, therefore we estimated the potential area of aquaculture in Hawke's Bay in 10 years' time.

Current and potential land use types occupied by each pest

Current Land Use Types Occupied

Land use/habitat types currently occupied by each pest were identified and each land use type in the Region (or defined area) was categorised as:

- Primary habitat for the pest (most infested currently), or
- Secondary habitat for the pest (less infested currently), or
- Not currently occupied by the pest (N.B. some land use types may be potentially suitable for the pest but have not yet been invaded).

[1] The model assumes that the area of each land use/habitat type in the region (or defined area) does not change over the duration of the CBA (i.e. the next 10-50 years).

Land use types currently occupied by each pest were determined by Hawke's Bay Regional Council.

Potential Land Use Types Occupied

Land use types potentially occupied by each pest were identified and categorised as:

- Primary habitat for the pest (most suitable/preferred), or
- Secondary habitat for the pest (less suitable/preferred), or
- Unsuitable for the pest.

Land use types potentially occupied by each pest were determined by Hawke's Bay Regional Council and reviewed by Wildland Consultants, based on information in the literature and expert opinion. If a land use type is currently categorised as a primary habitat for a pest, then it must be categorised as primary habitat for the pest in future.

An example for rooks (*Corvus frugilegus*) in Hawke's Bay is provided in Table 3.

Table 3: Current and potential land use types occupied by rooks in Hawke's Bay.
High = land use is a primary habitat for the pest (i.e. most infested/preferred),
Low = land use is a secondary habitat for the pest (i.e. less infested/preferred),
- = the pest is not currently present in that land use or the land use/habitat is unsuitable for the pest.

LAND USE/HABITAT TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	Low	High
Sheep/Beef/Deer	Low	High
Horticulture	Low	High
Forestry	-	High
Aquaculture	-	-
Urban	Low	Low
Native terrestrial	-	-
Coastal land	Low	Low
Estuarine	-	-
Freshwater	-	Low
Marine	-	-

Current area infested

The total area (number of hectares) in the Region (or defined area) currently infested by each pest was determined by Hawke's Bay Regional Council.

In general, data for the current area infested are considered to be reasonably accurate for Eradication pests, as the distributions of these species are relatively limited and reasonably well-known, whereas accurate distribution information is often not available for the more widespread Progressive Containment, Sustained Control, and Site-led pests, in which case the current area infested has to be estimated.

For Exclusion programmes, the current area infested is always zero, as it is assumed that the pest species is not currently present in the Region (or if the proposed programme is Exclusion from a defined area, then the pest species may be present in the Region but is not present within the defined area in which the Exclusion programme applies).

For some widespread animal pests, their overall distribution/extent in the Region (or defined area) may be known but this is not an accurate measure of the number of hectares they actually impact upon as they are mobile and their densities vary. In order to estimate the current area infested for such pests, we used the following two parameters:

- Current area infested: current extent/distribution of the pest in the Region (or defined area) (i.e. total number of hectares).

- Proportion of maximum density: current proportion of the maximum density that the pest may be able to reach if uncontrolled, averaged across its entire distribution in the Region (or defined area).

Current area impacted by the pest = Current area infested (in ha) x Proportion of maximum density.

For example, feral cats (*Felis catus*) are estimated to occupy 898,212 hectares in Hawke's Bay at present, but are only estimated to be at 5.45% of the maximum density they could reach, therefore the current area impacted is estimated as follows:

Current area impacted by feral cats in Hawke's Bay = 898,212 ha × 0.0545 = 48,952.5 hectares.

Potential area infested

In order to estimate potential impacts of the pest in future we need to estimate the maximum extent (number of hectares) a pest would be capable of occupying in the Region (or defined area) in the absence of regional control.

To calculate the number of hectares potentially infested by each pest we used information on the potential land use types occupied (see Section 2.4.3). If a land use/habitat type is a primary habitat for a pest, it was assumed that the pest could potentially infest **5-25%** of the total area of that land use type in the region (or defined area). If a land use type is a secondary habitat for a pest, then that pest could potentially infest **1-4%** of the regional area of that land use type (see Table 2).

In each CBA, the area of each land use potentially infested by each pest type (in the Region or defined area) was estimated by multiplying the area of each land use type by its habitat suitability for that pest, i.e.

Potential area infested = Area of each land use type (in the region or defined area) × Habitat suitability (primary, secondary, or unsuitable)

Exclusion programmes

For pests not currently in the region (or defined area), in order to carry out the cost-benefit analysis it has been assumed that the pest arrives in the Region in the first year of the RPMP i.e. one square metre is infested in year one (0.0001 ha). Spread of the pest is then modelled in the same way as pests that are already present in the Region.

Estimation of pest spread rates

A key part of the CBA is estimating the number of years a pest will take to reach its maximum extent in the Region (or defined area). To do this, pest life forms are matched to average times to reach maximum extent from the year they are first discovered in the wild (Table 4), based on information available in the scientific literature. For pest animals, the default value was 50 years (i.e. the model assumes that it will take 50 years for a pest animal to spread into all suitable habitat in the Region).

For pest plants, each species was categorised using one of four life forms:

- Short-lived (annual and biennial) herb.
- Long-lived (perennial) herb.
- Short-lived woody plant (woody vines and shrubs).
- Long-lived woody plant (trees).

A potential spread rate (time to reach maximum extent in the region) was then assigned to each pest according to their life form (based on data for the entire naturalised flora of New Zealand, from Gatehouse 2008). Potential spread rate was then adjusted according to the dispersal ability of the species (Table 5). An uncertainty rating has not been assigned to these estimated spread rates, but uncertainty is captured in the maximum potential area a pest is expected to infest within these time frames.

Table 4: Estimated times for pests of different life forms to reach Their maximum extent in the Hawke's Bay Region from the year first found wild.

LIFE FORM	TIME TO REACH MAXIMUM EXTENT IN THE REGION
Pest animals	50 years
Short-lived herb	75 years
Long-lived herb	100 years
Short-lived woody	125 years
Long-lived woody	150 years

Table 5: Adjustment to the anticipated spread time for pest plants of different life forms based on their dispersal capabilities

DISPERSAL RATE	ADJUSTMENT
Low	-25 years
Moderate	+0 years
High	+ 25 years

Estimating the outcome of the proposed management programme

Calculation of the costs and benefits of the proposed regional management requires both estimation of costs of the proposed management and the likely effect of this management in reducing the impacts of the pest. Estimation of the likely effectiveness of the proposed management is inherently more difficult that anticipating the costs of the programme.

We follow the Harris Model in assuming that each proposed management option (i.e. Exclusion, Eradication, Progressive Containment, Sustained Control, or Site-led) will result in a linear change in the pest extent. For most programmes, the expected outcome is a reduction in the pest over the duration of the RPMP, however for some programmes (e.g. Site-led programmes) there may still be an increase in extent or density, but this is a lesser increase than would have happened without regional management.

The expected outcome of each pest management programme (i.e. proportional rate of change in the area impacted by the pest) was estimated by Hawke's Bay Regional Council staff, based on the area to be controlled each year and their experience in controlling these pests. A minimum and maximum value was estimated, to allow for uncertainty in the expected outcome (i.e. a best-case and worse-case outcome). The model uses the average of the minimum and maximum rate of change.

Impact assessment

Qualitative impact assessment

Firstly, a qualitative assessment of the impacts of each pest in the Hawke's Bay Region was completed using the available literature and information provided by Hawke's Bay Regional Council. The assessments follow the general structure of impact assessments in other previous RPMP reviews, e.g. Severinsen 2003; Auckland Regional Council 2006. For each species a broad assessment was made of their current and potential impacts on the following aspects of the Hawke's Bay Region:

- **Production**: impacts on dairy, sheep/beef/deer farming, forestry, horticulture, viticulture, aquaculture, international trade, or other production.
- **Soil resources**: causes soil loss or erosion, alters soil fertility or moisture levels.

- **Water quality**: increases siltation or sedimentation, reduces oxygenation of water, or reduces water supply.
- **Native species diversity**: impacts on the diversity, abundance, or composition of indigenous species.
- **Threatened species**: impacts on Threatened or At Risk indigenous species (according to the New Zealand Threat Classification System, Townsend *et al.* 2008).
- **Human health**: species that are poisonous or known to sting or bite.
- **Recreation**: impacts on recreation or amenity values (prevents or restricts recreational use, causes toxic algal blooms in water ways etc.).
- **Māori culture**: impacts on food gathering, hunting, tourism, or recreation, or impacts on important cultural sites (e.g. marae, urupa) or water purity (life force, mauri).

These impacts are based upon those identified in Section 71 of the Biosecurity Act and are detrimental in nature. For each pest species, the impacts were summarised and a "Low", "Moderate", or "High" impact value was assigned to each type of impact[1]. The sources of this information are referenced for each pest.

Then the different types of impacts were assigned to different land use types (Table 6). For example, if a pest has a High impact on dairy production and occurs on Dairy land, then it is assumed that the pest has a High impact on the Dairy land use/habitat type; if a pest has a Low impact on water quality and occurs in Freshwater, then it is assumed to have a Low impact on the Freshwater land use/habitat type.

Table 6: Types of impacts associated with different land use/habitat types in Hawke's Bay. 'Production' land uses are highlighted in orange, 'non-production' land uses are highlighted in green.

LAND USE/HABITAT TYPE	IMPACT TYPE (FROM QUALITATIVE IMPACT ASSESSMENT
Dairy	Dairy
Sheep/Beef/Deer	Sheep/Beef/Deer
Horticulture	Horticulture
Forestry	Forestry
Aquaculture	Marine aquaculture
Urban	Human health
Native terrestrial	Species diversity
Coastal land	Soil resources + Water quality + Recreation + Species diversity
Estuarine	Soil resources + Water quality + Species diversity
Freshwater	Water quality + Recreation + Species diversity
Marine	Species diversity

Economic values of different land use/habitat types

Annual economic values (minimum and maximum) per hectare were estimated for each of the land use/habitat types in the Hawke's Bay Region (see Table 7).

Production land use/habitat types

The economic values (benefits) for the productive sectors (i.e. Dairy, Sheep and Beef, Forestry, Horticulture, and Aquaculture) were based on the direct, indirect and induced contribution of each sector to regional gross domestic product (GDP). The values for Dairy, Sheep and Beef, Forestry, and Aquaculture came from economic values estimated by Bay of Plenty Regional Council Economist Sandra Barns for the Bay of Plenty RPMP review. These values are considered to be appropriate for the Hawke's Bay RPMP CBAs, as both regions are broadly similar in terms of these productive sectors. The values for Horticulture were provided by Hawke's Bay Regional Council; the estimates were based on data for the Pipfruit (MPI 2017) and Viticulture (Anon. 2017) industries.

[1] Note that current impacts may be categorised as 'Low' when impacts have not actually been documented in Hawkes Bay but published information from elsewhere suggests that impacts are likely.

Non-production land use/habitat types

The non-market valuations of the other land use/habitat types (i.e. Native terrestrial, Coastal land, Estuarine, Freshwater, Marine, and Urban) are inherently more difficult to quantify, however this is essential for evaluating the economic impacts of pest species that occur primarily in non-production lands/habitats (and the potential economic benefits for the region in managing them).

In the CBAs carried out for previous RPMP reviews, relatively conservative estimates of economic values were used for non-production lands, based on the relatively small number of relevant studies listed in Geoff Kerr's New Zealand non-market valuation database (www2.lincoln.ac.nz/nonmarketvaluation). For example, Coastal land was assigned an economic value of $10-$200/hectare per year in the CBAs carried out for the Bay of Plenty RPMS review in 2010 (Sullivan and Hutchison 2010). These non-market values were based on New Zealand studies of recreation values, existence values, and ecosystem services of natural areas. Coastal and Estuarine values were based on recreation and amenity values, which have additional economic contributions to fisheries and water purification. Freshwater values were based primarily on recreation (including tourism) but also existence values of high water quality.

Table 7: Estimated annual economic value per hectare of different land use/habitat types in the Hawke's Bay Region. Values were provided by Hawke's Bay and Bay of Plenty Regional Councils. 'Production' land use/habitat types are highlighted in orange, 'non-production' types are highlighted in green.

LAND USE/HABITAT TYPE	ECONOMIC VALUE ($) PER HA PER ANNUM		EXPLANATION
	Min	Max	
Dairy	5,463	6,677	Average per hectare contribution to regional GDP, including direct, indirect and induced effects. Bay of Plenty average per hectare income, plus value-added in the regional economy. [1,2,3]
Sheep/Beef/Deer	739	903	Average per hectare contribution to regional GDP, including direct, indirect and induced effects. Bay of Plenty average per hectare income, plus value-added in the regional economy. [1,2,3]
Horticulture	10,511	19,760	Average per hectare income estimated using data from the 2016 Pipfruit Monitoring Programme for Hawke's Bay (MPI 2017) and 2016 Viticulture Gross Margin Benchmarking Report for Hawke's Bay (Anon. 2017). [1,4]
Forestry	1,747	2,135	Average per hectare contribution to regional GDP, including direct, indirect and induced effects. Bay of Plenty average per hectare income, plus value-added in the regional economy. [1,2,3]
Aquaculture	3,305	4,039	There is no aquaculture production in Hawke's Bay Region at present. The estimated economic values are based on potential production from aquaculture in the Bay of Plenty. [1,2,3]
Urban	533	1401	Hawke's Bay urban land values. [1,4]
Native terrestrial	556	680	Economic values for native terrestrial ecosystems were based on estimated ecosystem service values in Patterson and Cole (2013). [3]
Coastal land	1,247	1,525	Economic values were based on estimated values in Patterson and Cole (2013). Assuming that the main economic value of sand dunes is recreation, we used the recreational values from similar ecosystems: the minimum value came from the recreational value of 'lakes' and the maximum came from the recreational value of 'wetlands'. [3]
Estuarine	6,024	7,362	Based on ecosystem service values for estuaries in Patterson and Cole (2013). [3]
Freshwater	19,070	27,310	Based on ecosystem service values for freshwater ecosystems in Patterson and Cole (2013). [3]
Marine	81	99	Based on cultural and biodiversity values estimated for New Zealand continental shelf areas by van den Belt and Cole (2014). [3]

[1] Values for production land use/habitat types do not include ecosystem service values.
[2] The range for each sector estimate was defined as plus/minus 10% of the point estimate.
[3] Values provided by Bay of Plenty Regional Council Economist Sandra Barns.
[4] Values provided by Hawke's Bay Regional Council.

Two recent publications on the economic values of New Zealand land-based (Patterson and Cole 2013) and marine (van den Belt and Cole 2014) ecosystems have quantified the total economic values of ecosystem services i.e. supporting services, regulating services, provisioning services, cultural services, and passive values. Data in these publications were used to estimate the economic values of non-production land use/habitat types for the Hawke's Bay RPMP CBAs.

The non-market valuations used for RPMP CBAs would benefit from further development. We are not aware of any studies that have attempted to estimate the economic values of 'non-production' land use/habitat types specifically for Hawke's Bay.

Estimating quantitative impacts

Quantitative impacts of each pest (current and potential) were estimated from the proportional impact of the pest on the economic value of each land use/habitat type in the region (or defined area) (see Appendix 3, Point 8). For example, a *low* impact on a particular land use type was calculated as a 1-4% reduction in the annual economic value per hectare of that land use type (see Table 8). The assumptions used in the CBAs were:

- **Low** impact = 1-4% reduction in annual economic value per hectare.
- **Moderate** impact = 5-9% reduction in annual economic value per hectare.
- **High** impact = 10-50% reduction in annual economic value per hectare.

For most pests, there is relatively little information on their economic impacts on different land use or habitat types. The standardised percentages we have used to quantify pest impacts are based on the limited information that is available, as well as the technical opinion of the report authors and Hawke's Bay Regional Council staff. For example, giant buttercup, which is considered to have a high impact on dairy farming, was estimated to reduce overall farm profit on a typical Golden Bay dairy farm by up to 36% (AgPest website http://agpest.co.nz/? pesttypes=giant-buttercup).

Table 8: Reduction in the annual economic value (in dollars) per hectare of land use/habitat types in the Hawke's Bay Region in relation to the level of pest impact.

LAND USE/HABITAT TYPE	REDUCTION IN ANNUAL ECONOMIC VALUE ($) PER HECTARE IN RELATION TO THE LEVEL OF PEST IMPACT					
	LOW IMPACT (1-4%)		MODERATE IMPACT (5-9%)		HIGH IMPACT (10-50%)	
	Min	Max	Min	Max	Min	Max
Dairy	54.63	267.08	273.15	600.93	546.30	3,338.50
Sheep/Beef/Deer	7.39	36.12	36.95	81.27	73.90	451.50
Horticulture	105.11	790.40	525.55	1,778.40	1,051.10	9,880.00
Forestry	17.47	85.40	87.35	192.15	174.70	1,067.50
Aquaculture	33.05	161.56	165.25	363.51	330.50	2,019.50
Urban	5.33	56.05	26.64	126.11	53.29	700.61
Native terrestrial	5.56	27.20	27.80	61.20	55.60	340.00
Coastal land	12.47	61.00	62.35	137.25	124.70	762.50
Estuarine	60.24	294.48	301.20	662.58	602.40	3,681.00
Freshwater	190.70	1,092.40	953.50	2,457.90	1,907.00	13,655.00
Marine	0.81	3.96	4.05	8.91	8.10	49.50

In order to quantify the total impact of each pest on the Hawke's Bay Region we need to know how many hectares of each land use/habitat type are infested by the pest and what level of impact the pest in having on each land use. Although it is possible for Regional Council staff to estimate the overall area currently infested by each pest in the Region (or defined area), it is much more difficult to estimate how much of the current area infested occurs in each land use/habitat type, as this requires much more accurate distributional data for each species.

Instead, data on the current and potential land use types occupied (i.e. whether a land use is a primary, secondary or unsuitable habitat for each pest) were used to estimate pest impacts on each land use type. This is not ideal but the true value is still likely to lie within the minimum and maximum range.

From the estimated impacts per land use/habitat type (Table 8), the total annual per hectare impact of a pest in the Region was calculated by weighting the impact on each land use by its relative proportion of the pest's total infestation area (across all land use/habitat types), using the following equation:

Weighted impact on each land use type = Economic value of land use × Impact level × Extent in each land use

Estimating costs and benefits

The costs of implementing each pest management programme are divided into three categories:

- Regional Council costs.
- Agency compliance costs.
- Landowner (private) compliance costs.

Regional Council costs

These are costs borne directly by Hawke's Bay Regional Council in managing the proposed programme and include costs incurred to support, undertake or provide pest control, surveillance, monitoring, research, advice and information, as well as administration and governance. The total annual expenditure by the Council on each of the proposed programmes was provided by Hawke's Bay Regional Council.

In the CBAs, if the proposed management programme results in eradication of the pest (within 50 years or less), Council costs are assumed to be $1000 per year for the subsequent 20 years after the pest is eradicated, as ongoing monitoring and surveillance will be required (if Council costs in year one are less than $1000, then the costs are the same as in year one), then after this Council costs are assumed to be zero.

Agency compliance costs

These are costs borne by agencies such as the Department of Conservation (DOC) and Land Information New Zealand (LINZ) who manage Crown-owned land in the Hawke's Bay Region. Agency compliance costs are additional costs that are incurred by agencies in order to comply with the requirements of the proposed RPMP. The total annual agency compliance costs for each pest management programme (where relevant) were estimated by Hawke's Bay Regional Council staff.

In the CBAs, agency compliance costs were included in the calculations for the first 10 years, but were not estimated for subsequent years as compliance costs are difficult to estimate beyond this period and are likely to decrease over time.

Landowner compliance costs

One of the important but difficult to quantify aspects of each CBA is estimating the cost of pest control carried out by private landowners in order to comply with the requirements of the proposed RPMP. Some pest management programmes do not incur private landowner costs; for example the costs of Exclusion and Eradication pest management programmes are normally entirely met by the Council (sometimes in conjunction with agencies). Landowner compliance costs for each pest management programme were estimated by Hawke's Bay Regional Council staff.

Benefits provided by pests

Potential economic benefits arising from each pest were identified (see the Relevant Biology table in the outputs for each pest), however the annual economic value provided by a pest to the Region was unknown for most species. Benefits were quantified only for pests for which the benefit to the Region was considered to be of moderate or greater economic value (i.e. at least $0.50/hectare per year). The annual benefit per hectare was estimated using available literature. For example, a report on the possum fur industry in Taranaki stated that the income for possum control contractors from possum fur was estimated at $3-5 per hectare (Warburton 2008).

Parameters used in the cost-benefit analyses

Discount rate: 4%

Extent Parameters

Even abundant and widespread pests do not typically occupy every hectare of available habitat in a region. Each land use/habitat type is categorised as being a primary habitat (most infested/preferred)), secondary habitat (less infested/preferred), or unsuitable for the pest. The model uses the following proportions when it estimates the number of hectares of each land use/habitat type that a pest will potentially occupy if it is not managed under the RPMP:

- Primary habitat for a pest (minimum proportion of area impacted): 0.05
- Primary habitat for a pest (maximum proportion of area impacted): 0.25
- Secondary habitat for a pest (minimum proportion of area impacted): 0.01
- Secondary habitat for a pest (maximum proportion of area impacted): 0.04

Impact Parameters

Each pest is assessed as having a Low, Moderate, or High impact on each land use/habitat type. The model interprets these categories as meaning that the pest reduces the annual economic value of that land use/habitat type per hectare (e.g. annual net production of dairy farms) by the following amounts:

LOW impact on a land use/habitat type

- Minimum proportion of value removed): 0.01
- Maximum proportion of value removed: 0.04

MODERATE impact on a land use/habitat type

- Minimum proportion of value removed): 0.05
- Maximum proportion of value removed): 0.09

HIGH impact on a land use/habitat type

- Minimum reduction in economic value by the pest: 0.1
- Maximum reduction in economic value by the pest: 0.5

Landowner (private) and Agency Costs

Private (landowner) and Agency (DOC, NZTA, LINZ) costs are not scaled according to pest impact per land use/habitat type. The costs imposed on landowners by the RPMP are applied irrespective of whether a pest has high, moderate, or low impacts on a land use/habitat type. (The alternative option, not used here, is to assume that it will be economic for landowners to already be controlling high impact pests so in these land uses an RPMP rule won't impose additional control costs on these landowners.)

EXCLUSION PESTS

MEDITERRANEAN FANWORM
Sabella spallanzanii

EXCLUSION

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Builds conspicuous leathery tubes (normally 100–500 mm, up to 1000 mm long) projecting from subtidal hard structures. From the tube it extends a spiral crown of delicate, flexible radioles (the fan), which varies in colour - most often brown/cream with black and/or white bands
Habitat	Subtidal, found attached to hard structures (e.g. rocks, boats, wharf pilings, pontoons) to approx 30 m depth. Usually in estuaries or sheltered sites. Density decreases with depth. Demonstrates clear preference for sheltered, nutrient-rich waters.
Regional distribution	Not currently present in Hawke's Bay.
Competitive ability	Very competitive - forms dense monospecific groups that competes with and excludes native species. Can reach approx. 1000 individuals per square metre.
Reproductive ability	Highly robust organisms, can regenerate from fragments (caused naturally or by trauma), resulting in reproduction by fission. Sexual maturity is at approx 50 mm body length. Very fecund - approx 50,000 eggs can be produced by a female of approx 300 mm body length. Appears to have an annual spawning cycle, gametes released in midwinter in Melbourne, Australia. Larvae can remain in the water column for 14 days.
Resistance to control	Highly resistant to control. Chemical control is difficult as *S. spallanzanii* is found subtidally. Manual search and removal is difficult as small individuals are challenging to locate amongst other fouling organisms. Despite a large search and cull effort in Lyttelton and Waitemata harbours, elimination efforts were abandoned two years after first detection.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	-
Sheep and beef	-	-
Forestry	-	-
Horticulture	-	-
Aquaculture	-	High
Urban	-	-
Native terrestrial	-	-
Coastal land	-	-
Freshwater	-	-
Estuarine	-	-
Marine	-	High

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE

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Production				
Dairy	-	-		
Sheep and beef	-	-		
Forestry	-	-		1, 2, 3
Horticulture	-	-		
Aquaculture	-	H	Dense beds of Mediterranean fanworm clog recreational and commercial fishing gear. Also has negative impacts on aquaculture due to dense fouling on structures and on farmed shellfish.	
Other	-	-		
International trade	-	L	May impact volume and quality of exported seafood, e.g. oysters, mussels.	
Environment				
Soil resources	-	-		
Water quality	-	L	Mediterranean fanworm prefers waters with high nutrient levels. Thus the presence of this organism may also be an indicator of poor water quality. May displace other more effective filter feeders, resulting in a negative impact on water quality. Mediterranean fanworm excretes nitrogen in the form of ammonia, further increasing nutrient loads in the surrounding water. Also has high potential to disrupt established nutrient pathways.	3, 4
Species diversity	-	H	Major potential for Mediterranean fanworm to smother and outcompete other organisms.	1, 2, 3
Threatened species	-	L	Unknown if Mediterranean fanworm will impact threatened species (little is known about threatened species that occupy the same habitat).	1, 2, 3
Social/Cultural				
Human health	-	-	Not consumed by humans.	
Recreation	-	M	Will likely impact recreational seafood collection (e.g. mussels, oysters). Can also clog recreational scallop dredges. Will rapidly settle on and foul the hulls of recreational vessels.	1, 3
Māori culture	-	M	See Recreation. Will impact seafood collection from traditional mahinga kai areas.	

L = low, M = moderate, H = high
source 1: Read et al. (2011), 2: MPI (2016), 3: Currie et al. (2000), 4: MPI (2013)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	0

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Sheep and beef	0	0
Forestry	0	0
Horticulture	0	0
Aquaculture	0	330.50–2,019.50
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	0	0
Coastal	0	0
Freshwater	0	0
Estuarine	0	0
Marine	0	8.10–49.50

Cost-benefit analysis results

Proposed management programme: **Exclusion**

Area of Programme: **181,900 ha**

Proposed annual expenditure by Council: **$20,750**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	0 ha	Time to reach maximum extent†	50 yrs
Current impacts*	$0/ha	Potential extent in the region°	27,285 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNER COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$39,936,310	$0		$0	$0	$0	
	min: 6,753,091						
	max: 205,852,408						
Exclusion	$0	$0	$39,936,310	$4,218	$4,218	$0	$39,927,874
	min: 0		min: 6,753,091		min: 4,218		min: 6,744,655
	max: 0		max: 205,852,408		max: 4,218		max: 205,843,972

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNER COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$27,371,971,317	$0		$0	$0	$0	
	min: 4,619,149,304						
	max: 141,136,081,382						
Exclusion	$0	$0	$27,371,971,317	$11,171	$4,218	$0	$27,371,955,928
	min: 0		min: 4,619,149,304		min: 4,218		min: 4,619,133,915
	max: 0		max: 141,136,081,382		max: 4,218		max: 141,136,065,993

CBA statement and risks to success

Should the species remain unmanaged, it may be spread by human activities beyond the scope of normal species spread, and have a significant impact on species diversity and the marine farming industry. Attempted control of the effects of a widely expanded population would be significantly more costly than the preventative management of the current populations.

The proposed programme focusses on education and targeting high risk vessels. Not all vessels entering Hawke's Bays waters will be inspected. There is a risk that a vessel with *sabella* on its hull may go detected. International vessels entering Hawke's Bay waters are Ministry for Primary Industries responsibility.

The benefits of regional intervention, focused on excluding *Sabella* from the region, outweigh the cost and exceed the benefit of an individual's intervention.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Meduim	Sabella could enter enter Hawke's Bay waters on a hull and not be detected
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Marine Industry	Major	Major	Yes	Yes	Yes
Recreational Marine users	Major	Major	Yes	Yes	Yes
Regional community	Major	Minor	No	Yes	Yes

Who should pay for the proposed management approach?

Sabella is a major threat to production and conservation values in the Hawke's Bay marine system. Currently there is no active aquaculture being undertaken in Hawke's Bay but there are areas consented for this purpose. It is proposed that the general rate funds this programme.

CLUBBED TUNICATE
Styela clava

EXCLUSION

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Club–shaped body on a tough stalk, can reach 200 mm length. Leathery and conical, warty swellings at the top near the siphons. Short siphons are close together at the top of the body. Posterior half creased longitudinally. Colour brownish–white, yellowish–brown or reddish-brown.
Habitat	Low–tidal and sub–tidal, down to approx 25 m. Attaches to hard substrates (e.g. rocks, boats, wharf pilings, pontoons). Found in relatively sheltered environments with near–normal marine salinity.
Regional distribution	Not currently present in Hawke's Bay.
Competitive ability	Multiplies rapidly in suitable sites and competes strongly with other filter feeders for food and space. At overseas sites *S. clava* reaches densities of 500–1500 individuals per square metre.
Reproductive ability	Hermaphroditic. Reproductive for most of the year, not reproducing when water temperature is less than 15degC. Larvae are mobile in the water column for approximately 24 hours before settling on a surface.
Resistance to control	Manual removal is most effective, albeit time–consuming and labourous. Dessication and extreme temperature is also used. Chemical methods have also been attempted (high salinity, hydrated lime and acetic acid). The chemical medetomidine inhibits larval mobility.
Benefits	Consumed by humans in Korea in a dish called mideodok–chim.

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	-
Sheep and beef	-	-
Forestry	-	-
Horticulture	-	-
Aquaculture	-	High
Urban	-	-
Native terrestrial	-	-
Coastal land	-	-
Freshwater	-	-
Estuarine	-	-
Marine	-	High

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	-		
Sheep and beef	-	-		
Forestry	-	-		1
Horticulture	-	-		
Aquaculture	-	H	Clubbed tunicate is a major fouling organism on aquaculture gear and stock (e.g. oysters, mussels). This increases handling times, maintenance costs, cost of control efforts, and diminishes financial returns. May also influence the abundance and distribution of recreational fisheries. Also may alter aesthetics of local dive sites, potentially impacting tourism activities.	
Other	-	-		
International trade	-	L	May impact volume and quality of exported seafood, e.g. oysters, mussels	
Environment				
Soil resources	-	-		
Water quality	-	L	As a filter feeder, clubbed tunicate may have a positive impact on water quality. However, there may be negative impacts from displacement of other more effective filter feeders.	1
Species diversity	-	H	Has potential to form monospecific stands that outcompete native organisms for space, severely reducing biodiversity.	1
Threatened species	-	L	Unknown if clubbed tunicate will impact threatened species (little is known about threatened species that occupy the same habitat).	1
Social/Cultural				
Human health	-	L	Appears to be safe to consume. However, caution is advisable during periods of toxic algae blooms as clubbed tunicate is a filter feeder that can uptake toxins into tissues.	2
Recreation	-	M	Will likely impact recreational seafood collection (e.g. mussels, oysters). May have aesthetic impact on recreational diving. May also impact recreational vessels (increased cost of managing biofouling).	1, 2
Māori culture	-	M	See Human Health and Recreation, particularly regarding seafood collection from traditional areas.	

L = low, M = moderate, H = high
source 1: Grayling (2015), 2: NIWA (2016)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	0
Sheep and beef	0	0
Forestry	0	0
Horticulture	0	0
Aquaculture	0	330.50–2,019.50
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	0	0
Coastal	0	0
Freshwater	0	0
Estuarine	0	0
Marine	0	8.10–49.50

Cost-benefit analysis results

Proposed management programme: **Exclusion**

Area of Programme: **181,900 ha**

Proposed annual expenditure by Council: **$20,750**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	0 ha	Time to reach maximum extent†	50 yrs
Current impacts*	$0/ha	Potential extent in the region°	27,285 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$39,936,310	$0		$0	$0	$0	
	min: 6,753,091						
	max: 205,852,408						
Exclusion	$0	$0	$39,936,310	$4,218	$4,218	$0	$39,927,874
	min: 0		min: 6,753,091		min: 4,218		min: 6,744,655
	max: 0		max: 205,852,408		max: 4,218		max: 205,843,972

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$27,371,971,317	$0		$0	$0	$0	
	min: 4,619,149,304						
	max: 141,136,081,382						
Exclusion	$0	$0	$27,371,971,317	$11,171	$4,218	$0	$27,371,955,928
	min: 0		min: 4,619,149,304		min: 4,218		min: 4,619,133,915
	max: 0		max: 141,136,081,382		max: 4,218		max: 141,136,065,993

CBA statement and risks to success

Should the species remain unmanaged, it may be spread by human activities beyond the scope of normal species spread, and have a significant impact on species diversity and the marine farming industry. Attempted control of the effects of a widely expanded population would be significantly more costly than the preventative management of the current populations.

The proposed programme focusses on education and targeting high risk vessels. Not all vessels entering Hawke's Bays waters will be inspected. There is a risk that a vessel with *styela* on its hull may go detected. International vessels entering Hawke's Bay waters are Ministry for Primary Industries responsibility.

The benefits of regional intervention, focused on excluding *Styela* from the region, outweigh the cost and exceed the benefit of an individual's intervention.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Medium	Styela could enter enter Hawke's Bay waters on a hull and not be detected
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Marine users	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

Styela is a major threat to production and conservation values in the Hawke's Bay marine system. Currently there is no active aquaculture being undertaken in Hawke's Bay but there are areas consented for this purpose. It is proposed that the general rate funds this programme.

WALLABY

Macropus eugenii, M. parma, M. rufogriseus

EXCLUSION

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Dama wallaby (*Macropus eugenii*) stands 0.5 m high and weigh approximately 4–7 kg. Grey-brown in colour with reddish shoulders. Nocturnal.
Habitat	Prefers forested or scrubby habitat with access to pasture (bush-pasture margins), using dense vegetation for shelter and cover during the day.
Regional distribution	Not currently present in Hawke's Bay.
Competitive ability	Impacts on native vegetation by selectively browsing palatable plant species. Competes with other pastoral grazers and damages young tree crops.
Reproductive ability	Female are mature after 1 year and can produce one offspring per year (twins are rare).
Resistance to control	Controlled with poisons, trapping and shooting. No predators in New Zealand.
Benefits	Export trade in joeys and adults as pets. Some species are endangered in their native range in Australia.

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	Low
Sheep and beef	-	High
Forestry	-	High
Horticulture	-	High
Aquaculture	-	-
Urban	-	Low
Native terrestrial	-	High
Coastal land	-	Low
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	L	Grazing of pasture by wallabies can lower food availability for livestock. Potential reservoir host of bovine Tb, but no reported cases.	
Sheep and beef	-	L	Grazing of pasture by wallabies can lower food availability for livestock. Potential reservoir host of bovine Tb, but no reported cases.	
Forestry	-	M	Causes damage to newly planted radiata pine plantations.	1, 2, 3
Horticulture	-	L	May browse crops that are close to suitable cover.	
Aquaculture	-	-		
Other	-	-		
International trade	-	-	Could cause a problem if they become a reservoir host for bovine Tb.	
Environment				
Soil resources	-	M	Removal of vegetation through browsing and trampling causes erosion.	1, 2, 4
Water quality	-	M	Erosion of soil can lead to increased sedimentation in waterways.	1
Species diversity	-	H	Browses native forest seedlings and destroys understorey. Favoured species include kamahi and māhoe, also hangehange, pigeonwood, mānuka, kānuka and ferns.	2, 4
Threatened species	-	L		1, 5
Social/Cultural				
Human health	-	L	Direct transmission of bovine Tb to humans is highly unlikely, however wallaby-cattle-human transmission route is a very slight possibility.	
Recreation	-	-		
Māori culture	-	M	Can destroy ground vegetation at culturally important sites (e.g. wāhi tapu, urupa) and eat culturally important plants (e.g. koromiko).	

L = low, M = moderate, H = high

source 1: Severinsen (2003), 2: Auckland Regional Council (2004), 3: Environment Canterbury (2015), 4: Department of Conservation (2015), 5: Ritchie (2014)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	54.63–267.08
Sheep and beef	0	7.39–36.12
Forestry	0	87.35–192.15
Horticulture	0	105.11–790.40
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	5.33–56.05
Native terrestrial	0	55.60–340.00
Coastal	0	124.70–762.50
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Exclusion**
Area of Programme: **whole region ha**
Proposed annual expenditure by Council: **$500**

Assumptions

ASSUMPTIONS	VVALUES	ASSUMPTIONS	VALUES
Current area infested	0 ha	Time to reach maximum extent †	50 yrs
Current impacts *	$0/ha	Potential extent in the region °	201,536 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.
° The potential extent the pest is predicted to achieve in the absence of regional management.
† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$2,204,625,249	$0		$0	$0	$0	
	min: 484,442,517						
	max: 10,791,649,518						
Exclusion	$0	$0	$2,204,625,249	$4,218	$0	$0	$2,204,621,031
	min: 0		min: 484,442,517				min: 484,438,299
	max: 0		max: 10,791,649,518				max: 10,791,645,300

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$1.512067e+12	$0		$0	$0	$0	
	min: 332,199,360,372						
	max: 7.401881e+12						
Exclusion	$0	$0	$1.512067e+12	$11,171	$0	$0	$1.512067e+12
	min: 0		min: 332,199,360,372				min: 332,199,349,201
	max: 0		max: 7.401881e+12				max: 7.401881e+12

CBA statement and risks to success

There is a risk of intentional liberations of wallaby, despite regulations to prevent it. Having the options through rules in the Plan to be able to respond rapidly to intentional or feral incursions is a valuable tool to ensure wallaby populations never reach economically or environmentally harmful levels. While the benefits are difficult to estimate, based on the pest management concerns of other regional councils that have wallaby, some form of future control would be desired, either regulated or voluntary. The costs for these controls will be far in excess of the cost of the exclusion programme.

The plan is more appropriate than relying on voluntary action because there is likely to be a delay between the arrival of wallaby and action before the obvious effects of this pest is felt, by which time these species will be harder to eradicate. The benefits of regional intervention, focused on excluding wallabies from the region, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	No unintended adverse effects identified

Who should pay?

Beneficiaries and exacerbators

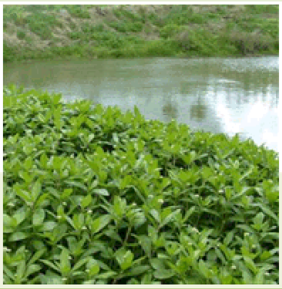
GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS
Land occupiers (Crown and private)	Major	Minor	Yes	Yes
Regional community	Major	Minor	Yes	Yes

Who should pay for the proposed management approach?

There are shared benefits, with both land occupiers and the regional community being beneficiaries of the proposed programme. The cost of the Exclusion programmes is minimal, with the general community benefiting more than individual land occupiers. It is proposed that exclusion programmes will be funded through the general rate.

ALLIGATOR WEED
Alternanthera philoxeroides

EXCLUSION



Relevant biology

Attribute	Description
Form	A floating aquatic, but sometimes terrestrial, perennial herb. Stems are green-brown, hollow and rooting at nodes. Leaves are obovate to narrow-elliptical.
Habitat	Still water to 1.5 m deep, or flowing fresh water. Tolerates up to 30% sea water. Will grow on moist banks, swampy places, damp pasture and cropping land.
Regional distribution	Not currently present in Hawke's Bay.
Competitive ability	Floating mats shade out other plants. Biomass doubles in 50 days. Will out-compete pasture species.
Reproductive ability	No viable seeds are produced.
Dispersal methods	Fragments dispersed by cultivation machinery, as weeds or contaminants of aquatic plant trade.
Resistance to control	Effective control is difficult, even in small waterways, swampy pastures and cropping land. Use of herbicide in and beside waterways makes control difficult.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	High
Sheep and beef	-	High
Forestry	-	Low
Horticulture	-	Low
Aquaculture	-	-
Urban	-	High
Native terrestrial	-	High
Coastal land	-	High
Freshwater	-	High
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	L	Can spread through wetlands and waterways. Causes photosensitivity in stock.	
Sheep and beef	-	M	Can spread through wetlands and waterways. Causes photosensitivity in stock.	
Forestry	-	-		1, 2, 3
Horticulture	-	M	Can spread from waterways onto cropping land, out-competes other species.	
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	-	-		
Water quality	-	L	Causes silt accumulation, obstructs water usage, causes flooding. Rotting vegetation degrades habitat for aquatic fauna and flora.	1
Species diversity	-	H	Replaces most other herbaceous species on water and dry land. Causes silt accumulation, obstructs water usage, causes flooding. Rotting vegetation degrades habitat for aquatic fauna and flora.	1
Threatened species	-	H	Replaces most other herbaceous species on water and dry land. Causes silt accumulation, obstructs water usage, causes flooding. Rotting vegetation degrades habitat for aquatic fauna and flora.	1
Social/Cultural				
Human health	-	L		
Recreation	-	M	Obstructs access to waterways for fishing, swimming, kayaking etc.	4
Māori culture	-	H	Could invade culturally important sites (e.g. wāhi tapu, urupa).	

L = low, M = moderate, H = high
source 1: Craw (2000), 2: Roy et al. (2004), 3: Environment Bay of Plenty (2004a), 4: Severinsen (2003)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	54.63–267.08
Sheep and beef	0	36.95–81.27
Forestry	0	0
Horticulture	0	525.55–1,778.40
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	5.33–56.05
Native terrestrial	0	55.60–340.00
Coastal	0	124.70–762.50
Freshwater	0	1,907.00–13,655.00
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Exclusion**

Area of Programme: **whole region ha**

Proposed annual expenditure by Council: **$500**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	0 ha	Time to reach maximum extent †	75 yrs
Current impacts *	$0/ha	Potential extent in the region °	183,726 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS *	PEST VALUES °	BENEFIT	COUNCIL COSTS †	LANDOWNERS COMPLIANCE COSTS ‡	AGENCY COMPLIANCE COSTS ‡	NET BENEFIT
No intervention	$1,523,503,758	$0		$0	$0	$0	
	min: 308,897,338						
	max: 7,554,434,956						
Exclusion	$0	$0	$1,523,503,758	$4,218	$0	$0	$1,523,499,540
	min: 0		min: 308,897,338				min: 308,893,120
	max: 0		max: 7,554,434,956				max: 7,554,430,738

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

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‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$1.473707e+12	$0		$0	$0	$0	
	min: 298,753,622,110						
	max: 7.307749e+12						
Exclusion	$0	$0	$1.473707e+12	$11,171	$0	$0	$1.473707e+12
	min: 0		min: 298,753,622,110				min: 298,753,610,939
	max: 0		max: 7.307749e+12				max: 7.307749e+12

CBA statement and risks to success

Alligator weed is considered highly invasive and as shown in the above 10 and 50 year assessment, it could have significant negative impacts on our region if it were to establish. It is however, difficult to detect at low densities and can be moved unknowingly into the region through dirty items such as machinery.

The principal means of delivering this programme is through education and active surveillance. Because these pests are declared under the Plan, occupiers are obliged to inform Council of the presence of them, and they are banned from sale and distribution. The benefits of regional intervention, focused on excluding alligator weed from the region, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS
Land occupiers (Crown and private)	Major	Major	Yes	Yes
Pond owners...	Major		No	Yes
Regional community	Major		No	Yes

Who should pay for the proposed management approach?

There are shared benefits, with both land occupiers and the regional community being beneficiaries of the proposed programme. The cost of the Exclusion programmes is minimal, with the general community benefiting more than individual land occupiers. It is proposed that exclusion programmes will be funded through the general rate.

MARSHWORT
Nymphoides geminata

EXCLUSION

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Aquatic perennial with branched stolons up to 1 m long usually just below surface and rounded, floating leaves with V-shaped sinus.
Habitat	Still water of swamps to fast flowing freshwater streams, lake margins and small ponds.
Regional distribution	Not currently present in Hawke's Bay.
Competitive ability	Spreads quickly and out-competes native aquatic plants.
Reproductive ability	No viable seed produced in New Zealand.
Dispersal methods	Spreads by branched runners, if a leaf is broken off a new plant will grow. Spread most commonly through accidental or purposeful human intervention.
Resistance to control	No known suitable herbicide, can be controlled with weed mat for aquatic plants.
Benefits	None

Land use/habitats occupied in Hawke's Bay

Land use type	Current infestation	Potential infestation
Dairy	-	-
Sheep and beef	-	-
Forestry	-	-
Horticulture	-	-
Aquaculture	-	-
Urban	-	-
Native terrestrial	-	-
Coastal land	-	-
Freshwater	-	High
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualltative impact assessment

Category	Current	Potential	Comment	Source
Production				
Dairy	-	-		
Sheep and beef	-	-		
Forestry	-	-		
Horticulture	-	-		
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	-	-		
Water quality	-	M	Dense mats deoxygenate water.	1, 2
Species diversity	-	M	Spreads quickly, forms dense mats of floating leaves, out-competes native aquatic plants. Deoxygenates water killing flora and fauna.	1, 2
Threatened species	-	L	See Species diversity.	1, 2
Social/Cultural				
Human health	-	-		
Recreation	-	M	Dense mats restrict access to waterways for fishing, swimming, kayaking etc.	1, 2
Māori culture	-	M	See Recreation.	

L = low, M = moderate, H = high
source 1: Anon. (2007b), 2: Clayton & Tanner (1985)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	0
Sheep and beef	0	0
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	0	0
Coastal	0	0
Freshwater	0	953.50–2,457.90
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Exclusion**

Area of Programme: **whole region ha**

Proposed annual expenditure by Council: **$500**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	0 ha	Time to reach maximum extent †	100 yrs
Current impacts *	$0/ha	Potential extent in the region °	2,090 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$27,046,633	$0		$0	$0	$0	
	min: 9,071,857						
	max: 116,920,511						
Exclusion	$0	$0	$27,046,633	$4,218	$0	$0	$27,042,415
	min: 0		min: 9,071,857				min: 9,067,639
	max: 0		max: 116,920,511				max: 116,916,293

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

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‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$15,228,442,221	$0		$0	$0	$0	
	min: 5,107,698,831						
	max: 65,832,159,175						
Exclusion	$0	$0	$15,228,442,221	$11,171	$0	$0	$15,228,431,050
	min: 0		min: 5,107,698,831				min: 5,107,687,660
	max: 0		max: 65,832,159,175				max: 65,832,148,004

CBA statement and risks to success

Marshwort is present in other North Island regions and poses a risk of being introduced to Hawke's Bay. Biodiversity values would be impacted if marshwort was discovered and no regional intervention was undertaken. An exclusion programme is the only appropriate option available.

The principal means of delivering this programme is through education and active surveillance. Because these pests are declared under the Plan, occupiers are obliged to inform Council of the presence of them, and they are banned from sale and distribution.

The benefits of regional intervention, focused on excluding marshwort from the region, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS
Land occupiers (Crown and private)	Major	Major	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes
Regional community	Major		No	Yes

Who should pay for the proposed management approach?

There are shared benefits, with both land occupiers and the regional community being beneficiaries of the proposed programme. The cost of the Exclusion programmes is minimal, with the general community benefiting more than individual land occupiers. It is proposed that exclusion programmes will be funded through the general rate.

NOOGOORA BUR
Xanthium strumarium

EXCLUSION

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Erect, annual herb less than 1m high. Stems have purple blotches, covered in short, upward pointing hairs. Roughly textured, dark green leaves have minute bristles, hairs and prominent veins. Inconspicuous flowers (Jan–Mar) clustered at ends of branches. Hard, brown, woody burs with numerous spikes and hooks each contain two seeds.
Habitat	Pasture, open areas, roadsides. Prefers warm conditions on disturbed and fertile soil.
Regional distribution	Not currently present in Hawke’s Bay.
Competitive ability	Highly competitive with an extensive root system and rapid growth rate. Can form dense patches in pastures and crops and exclude all other ground species.
Reproductive ability	Brown burs each contain two seeds.
Dispersal methods	Seed dispersed by clinging to wool, fur, clothing and machinery. Also in agricultural seeds and gravel. Air pockets on spines of burs aids dispersal by water.
Resistance to control	Mechanical control is effective but plants must be treated before any burs are formed to ensure seeding is prevented. Otherwise control must continue for at least 6 years.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	Low
Sheep and beef	-	Low
Forestry	-	-
Horticulture	-	High
Aquaculture	-	-
Urban	-	Low
Native terrestrial	-	-
Coastal land	-	Low
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	M	Foliage on young plants and seeds are toxic to cattle. Competes with pasture species.	
Sheep and beef	-	M	Foliage on young plants and seeds are toxic to stock, particularly cattle. Competes with pasture species. Burs contaminate wool.	
Forestry	-	-		1, 2, 3, 4
Horticulture	-	H	Competes with crops and can carry fungal diseases capable of infecting other plants.	
Aquaculture	-	-		
Other	-	-	Foliage on young plants and seeds are toxic to pigs.	
International trade	-	M	Can contaminate wool and crops.	1, 2, 3, 4
Environment				
Soil resources	-	L	Excludes other ground-cover plants and may leave areas of soil exposed to erosion after it dies back in autumn.	
Water quality	-	-		
Species diversity	-	-		
Threatened species	-	-		
Social/Cultural				
Human health	-	M	Prickly, poisonous, can cause allergic skin reaction. Pollen may cause hay fever.	2, 3, 5, 6
Recreation	-	L	Has prickly spines, could restrict access in coastal areas.	2, 5
Māori culture	-	L	Could obstruct access to cultural sites in coastal areas (e.g. waahi tapu, urupa).	

L = low, M = moderate, H = high

source 1: AQIS (2009), 2: Anon. (2009b), 3: Anon. (2005), 4: ARC (2009), 5: Fischer et al. (1988), 6: Anon. (2009e)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	273.15–600.93
Sheep and beef	0	36.95–81.27
Forestry	0	0
Horticulture	0	1,051.10–9,880.00
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	26.64–126.11
Native terrestrial	0	0
Coastal	0	12.47–61.00
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Exclusion**
Area of Programme: **whole region ha**
Proposed annual expenditure by Council: **$500**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	0 ha	Time to reach maximum extent †	50 yrs
Current impacts *	$0/ha	Potential extent in the region °	25,215 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$6,025,871,456	$0		$0	$0	$0	
	min: 831,875,732						
	max: 27,383,118,985						
Exclusion	$0	$0	$6,025,871,456	$4,218	$0	$0	$6,025,867,238
	min: 0		min: 831,875,732				min: 831,871,514
	max: 0		max: 27,383,118,985				max: 27,383,114,767

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$4.133329e+12	$0		$0	$0	$0	
	min: 570,597,918,290						
	max: 1.878296e+13						
Exclusion	$0	$0	$4.133329e+12	$11,171	$0	$0	$4.133329e+12
	min: 0		min: 570,597,918,290				min: 570,597,907,119
	max: 0		max: 1.878296e+13				max: 1.878296e+13

CBA statement and risks to success

Under no regional intervention there would be unacceptable loss of production values if this pest established in the region. Some residual effects would also occur on horticultural and biodiversity values. There would also be political risks to Council of doing nothing as the effects of this plant are widely known among arable farmers. Noogoora bur is present in other North Island regions and poses a risk of being introduced to Hawke's Bay.

The principal means of delivering this programme is through education and active surveillance. Because these pests are declared under the Plan, occupiers are obliged to inform Council of the presence of them, and they are banned from sale and distribution.

The benefits of regional intervention, focused on excluding noogoora bur from the region, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS
Land occupiers (Crown and private)	Major	Major	Yes	Yes
Arable farmers	Major		No	Yes
Regional community	Major		No	Yes

Who should pay for the proposed management approach?

There are shared benefits, with both land occupiers and the regional community being beneficiaries of the proposed programme. The cost of the Exclusion programmes is minimal, with the general community benefiting more than individual land occupiers. It is proposed that exclusion programmes will be funded through the general rate.

SENEGAL TEA
Gymnocoronis spilanthoides

EXCLUSION

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Mat forming perennial aquatic herb with scrambling, floating stems, which produce roots at nodes. Stems erect when flowering to 1.5 m tall.
Habitat	Wet marshy soils often spreading out from water margins to form a floating mat.
Regional distribution	Not currently present in Hawke's Bay.
Competitive ability	Dominates shorter herbaceous vegetation and floating mats shade out submerged species.
Reproductive ability	Few seeds are produced in New Zealand, however seeds are highly fertile.
Dispersal methods	Spreads by stem fragmentation, humans and machinery. Seeds dispersed by water movement.
Resistance to control	Mechanical control unsuccessful as it spreads fragments of the plant. Can be controlled with herbicides.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	-
Sheep and beef	-	-
Forestry	-	-
Horticulture	-	-
Aquaculture	-	-
Urban	-	-
Native terrestrial	-	-
Coastal land	-	-
Freshwater	-	High
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	-		
Sheep and beef	-	-		
Forestry	-	-		1
Horticulture	-	-		
Aquaculture	-	-		
Other	-	L	Blocks up water channels, which could affect irrigation.	
International trade	-	-		
Environment				
Soil resources	-	-		
Water quality	-	M	Blocks up waterways and drainage channels, can exacerbate flooding.	1, 2, 3
Species diversity	-	H	Dominates shorter vegetation, and floating mats shade out submerged species.	1, 2, 3
Threatened species	-	H	Could threaten some indigenous wetland species.	1, 2, 3
Social/Cultural				
Human health	-	-		
Recreation	-	M	Dense mats restrict access to waterways for fishing, swimming, kayaking etc.	1, 3
Māori culture	-	M	See Recreation.	

L = low, M = moderate, H = high

source 1: Environment Canterbury (2007a), 2: Craw (2000), 3: Department of Primary Industries (2009)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	0
Sheep and beef	0	0
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	0	0
Coastal	0	0
Freshwater	0	1,907.00–13,655.00
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Exclusion**
Area of Programme: **whole region ha**
Proposed annual expenditure by Council: **$500**

Assumptions

Assumptions	Values	Assumptions	Values
Current area infested	0 ha	Time to reach maximum extent †	100 yrs
Current impacts *	$0/ha	Potential extent in the region °	2,090 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$123,376,490	$0		$0	$0	$0	
	min: 18,143,065						
	max: 649,543,616						
Exclusion	$0	$0	$123,376,490	$4,218	$0	$0	$123,372,272
	min: 0		min: 18,143,065				min: 18,138,847
	max: 0		max: 649,543,616				max: 649,539,398

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

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50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

Scenario	Pest impacts*	Pest values°	Benefit	Council costs†	Landowner compliance costs‡	Agency compliance costs‡	Net benefit
No intervention	$69,468,472,158	$0		$0	$0	$0	
	min: 10,215,384,233						
	max: 365,733,911,783						
Exclusion	$0	$0	$69,468,472,158	$11,171	$0	$0	$69,468,460,987
	min: 0		min: 10,215,384,233				min: 10,215,373,062
	max: 0		max: 365,733,911,783				max: 365,733,900,612

CBA statement and risks to success

If Senegal tea were to become established it could seriously affect waterways and wetlands in Hawke's Bay, including aquatic flora and fauna species. The 10 year and 50 year assessment supports this potential impact. Senegal tea is present in other North Island regions and poses a risk of being introduced to Hawke's Bay, primarily through dirty machinery.

There are public good benefits in preventing Senegal tea from becoming established and avoiding the possibility of more significant costs for the region in the future.

The principal means of delivering this programme is through education and active surveillance. Because these pests are declared under the Plan, occupiers are obliged to inform Council of the presence of them, and they are banned from sale and distribution.

The benefits of regional intervention, focused on excluding Senegal tea from the region, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low to Medium	Increased focus is required on surveillance and public awareness to identify sites of interest. There is a risk of previously unknown infestation sites being discovered over the life of the Plan and that the distribution and abundance of the species precludes eradication.
Operational risk	Low	The eradication of known Senegal tea is technically feasible and cost-effective over a 50-year timeframe. Public intervention (whereby land occupiers do not incur the cost of control) should encourage the public reporting of infestation and the application of control techniques that will result in the effective control of the species.
Legal risk	Low	
Socio-political risk	Low	To be tested through the Plan review process but proposed approach is a continuation of the existing approach for which no public or political concerns have been raised to date.
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS
Land occupiers (Crown and private)	Minor	Major	Yes	No
Regional community	Major		No	Yes

Who should pay for the proposed management approach?

There are shared benefits, with both land occupiers and the regional community being beneficiaries of the proposed programme. The cost of the Exclusion programmes is minimal, with the general community benefiting more than individual land occupiers. It is proposed that exclusion programmes will be funded through the general rate.

SPARTINA
Spartina anglica, S. alterniflora

EXCLUSION

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Perennial, erect, clump-forming grass to 1 m with rhizomes and fibrous roots. Stems 4–9 mm diameter with many brownish leaf sheaths. Alternate leaves (5–45 x 4–15 mm) are deeply wide-ribbed on upper surface and have ligules (1–3 mm long). Seed heads are occasionally seen, and seed is occasionally produced at some sites.
Habitat	Mainly in saline wetlands, especially in estuaries where it forms dense mats in inter-tidal zones. Prefers deep, soft mud with a sandy loam texture. Can establish in the tidal ends of streams and rivers.
Regional distribution	Not currently present in Hawke's Bay.
Competitive ability	Once established forms dense stands, which may spread at a rate of 2% per annum. Tolerates all weathers and temperatures, fire, grazing, and other damage.
Reproductive ability	*S. anglica* reproduces by seed. *S. alterniflora* rarely flowers in New Zealand. *S.* x *townsendii* is a sterile hybrid.
Dispersal methods	Seed and vegetative fragments carried by water. Livestock, propellors, and nets dislodge rhizome fragments, which then spread by tidal and current movement. Can survive at sea long-term and travel long distances with the currents. Planted deliberately to aid foreshore protection and stabilise marshes.
Resistance to control	Can be controlled reasonably well with herbicide.
Benefits	Prevents erosion at estuary margins due to its ability to trap sediment. Can also assist reclamation of tidal flats.

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	-
Sheep and beef	-	-
Forestry	-	-
Horticulture	-	-
Aquaculture	-	-
Urban	-	-
Native terrestrial	-	-
Coastal land	-	-
Freshwater	-	-
Estuarine	-	High
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	-		
Sheep and beef	-	-		
Forestry	-	-		
Horticulture	-	-		
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	-			
Water quality	-	H	Can reduce large estuaries and shallow harbours to thin drains surrounded by rough pasture.	1, 2
Species diversity	-	H	Traps sediment, raising level above high tide mark, destroys intertidal zone and habitat. Adventive grasses succeed spartina, creating dry meadows, and leading to immense biodiversity loss.	1, 2, 3
Threatened species	-	M	See Species diversity.	
Social/Cultural				
Human health	-	-		
Recreation	-	M	Dense stands obstruct access to estuaries and waterways.	
Māori culture	-	H	Smothers shellfish beds, prevents kaimoana harvesting.	

L = low, M = moderate, H = high
source 1: Anon. (2009d), 2: Anon. (2009a), 3: Craw (2000)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	0
Sheep and beef	0	0
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	0	0
Coastal	0	0
Freshwater	0	0
Estuarine	0	602.40–3,681.00
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Exclusion**

Area of Programme: **whole region ha**

Proposed annual expenditure by Council: **$500**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	0 ha	Time to reach maximum extent †	75 yrs
Current impacts *	$0/ha	Potential extent in the region °	225 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$7,062,104	$0		$0	$0	$0	
	min: 1,191,888						
	max: 36,413,182						
Exclusion	$0	$0	$7,062,104	$4,218	$0	$0	$7,057,886
	min: 0		min: 1,191,888				min: 1,187,670
	max: 0		max: 36,413,182				max: 36,408,964

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$6,831,681,534	$0		$0	$0	$0	
	min: 1,152,937,101						
	max: 35,225,403,701						
Exclusion	$0	$0	$6,831,681,534	$11,171	$0	$0	$6,831,670,363
	min: 0		min: 1,152,937,101				min: 1,152,925,930
	max: 0		max: 35,225,403,701				max: 35,225,392,530

CBA statement and risks to success

Spartina can trap sediment raising ground levels above the high tide mark and stranding former intertidal habitat for birds and fish. Estuaries and shallow harbours can be reduced to thin drains surrounded by rough weedy pasture with significant loss of biodiversity. Spartina is found in other North Isand regions including Gisborne.

The principal means of delivering this programme is through education and active surveillance. Because these pests are declared under the Plan, occupiers are obliged to inform Council of the presence of them, and they are banned from sale and distribution.

The benefits of regional intervention, focused on excluding spartina from the region, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS
Regional community	Major		No	Yes

Who should pay for the proposed management approach?

There are shared benefits, with both land occupiers and the regional community being beneficiaries of the proposed programme. The cost of the Exclusion programmes is minimal, with the general community benefiting more than individual land occupiers. It is proposed that exclusion programmes will be funded through the general rate.

YELLOW BRISTLE GRASS

Setaria pumila

EXCLUSION

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Tufted, multi-tillered upright annual grass that grows 25–45 cm high.The seed head is a cylindrical 'spike' 2.5–10 cm long, characterised by 7–10 bristles emerging from below each floret.
Habitat	Bare ground along roadsides and in pasture (e.g. pugging, wheel tracks), including areas that have recently been sprayed. Partially drought tolerant, but requires moist conditions to germinate. Grows best where rainfall exceeds 500 mm/year or in areas with high soil moisture (e.g. ephemeral drains).
Regional distribution	Not currently present in Hawke's Bay.
Competitive ability	Highly competitive with perennial ryegrass and white clover. Capable of covering 20–40% of ground within 5 years of invading pasture. Severe drought, which opens up pastures, can increase the competitiveness of this species. A decline in the use of residual herbicides for controlling weeds on roadsides may increase populations.
Reproductive ability	Establishes in early summer and can produce seeds within 4 weeks. Plants can produce 50–100 seed heads, each containing 60–200 seeds. Most seeds survive only a few years under field conditions, although some may survive buried for 10 years. Seed can survive in the rumen of cattle and effluent ponds, and remain viable in silage stacks for up to 3 months.
Dispersal methods	Via water and soil movement, stock, infested hay and silage, agricultural machinery, mowers, road works machinery and other vehicles. The barbed seeds are carried in fur, feathers or clothing.
Resistance to control	Difficult to control. Summer cropping, undersowing, oversowing, grazing, and non-selective herbicide are ineffective. Fenoxaprop-Pethyl may work in pastures without damage to sown grasses or clovers (research is underway to determine livestock withholding period). At least 2 consecutive years of control needed to deplete soil seed bank. Complete renewal of pasture over 2 consecutive summers is best option, with plants such as chicory or turnips.
Benefits	Palatable to livestock during the vegetative stage, but it has poor nutritive values and stock avoid it after seed heads emerge (mid Jan–May).

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	High
Sheep and beef	-	High
Forestry	-	-

Horticulture	-	-
Aquaculture	-	-
Urban	-	-
Native terrestrial	-	Low
Coastal land	-	-
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	M	Can reduce annual feed production by up to 20%, resulting in increased on-farm costs from supplementary feed and/or pasture renovation. Seed heads can cause lesions and ulcers to mouths of grazing cattle.	
Sheep and beef	-	M	See Dairy. May be grazed by sheep during vegetative stage, but has poor nutritive value and stock avoid it after seed heads emerge.	
Forestry	-	-		1, 2, 3, 4, 5
Horticulture	-	-		
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	-	-	Mainly invades pasture and open or disturbed ground.	2, 3, 6
Threatened species	-	-		2, 3, 6
Social/Cultural				
Human health	L	L	Seeds can adhere to clothing and possibly cause irritation.	2, 3
Recreation	-	-		
Māori culture	-	-		

L = low, M = moderate, H = high

source 1: Taranaki Regional Council (2013d), 2: James et al. (2009), 3: Tozer et al. (2012), 4: AgResearch (2013), 5: James (2011), 6: James & Rahman (2009)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	273.15–600.93
Sheep and beef	0	36.95–81.27
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	0	0
Coastal	0	0
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Exclusion**
Area of Programme: **whole region ha**
Proposed annual expenditure by Council: **$500**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	0 ha	Time to reach maximum extent †	50 yrs
Current impacts *	$0/ha	Potential extent in the region °	135,278 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

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10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$5,144,325,019	$0		$0	$0	$0	
	min: 1,749,289,529						
	max: 21,896,703,603						
Exclusion	$0	$0	$5,144,325,019	$4,218	$0	$0	$5,144,320,801
	min: 0		min: 1,749,289,529				min: 1,749,285,311
	max: 0		max: 21,896,703,603				max: 21,896,699,385

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$3.52856e+12	$0		$0	$0	$0	
	min: 1.199832e+12						
	max: 1.501938e+13						
Exclusion	$0	$0	$3.52856e+12	$11,171	$0	$0	$3.52856e+12
	min: 0		min: 1.199832e+12				min: 1.199832e+12
	max: 0		max: 1.501938e+13				max: 1.501938e+13

CBA statement and risks to success

Yellow bristle grass can invade pastures across Hawke's Bay. It hardens off in autumn resulting in lower pasture quality. The 10 year and 50 year assessment give highlight to its potential regional impact.

The principal means of delivering this programme is through education and active surveillance. Because these pests are declared under the Plan, occupiers are obliged to inform Council of the presence of them, and they are banned from sale and distribution.

The benefits of regional intervention, focused on excluding yellow bristle grass from the region, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low to medium	
Operational risk	Low	
Legal risk	Low to medium	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS
Land occupiers (Crown and private)	Major	Major	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes
Regional community	Major		No	Yes

Who should pay for the proposed management approach?

There are shared benefits, with both land occupiers and the regional community being beneficiaries of the proposed programme. The cost of the Exclusion programmes is minimal, with the general community benefiting more than individual land occupiers. It is proposed that exclusion programmes will be funded through the general rate.

ERADICATION PESTS

ROOK
Corvus frugilegus

ERADICATION

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Large, totally black birds with violet-blue glossy sheen. 20-30 cm long.
Habitat	Rookeries are usually built in pines, eucalyptus or oak trees; poplars and walnut trees are also utilised for nesting.
Regional distribution	Found throughout the region, with the greatest numbers in the southern half of the region. Regional population was estimated at 3000 birds (with 278 active nests) in 2014.
Competitive ability	Can cause extensive damage to maize, peas, squash, green feed and cereal crops.
Reproductive ability	2-5 eggs per female laid each year, fledgings are able to fly in 30 days. Population can increase rapidly.
Resistance to control	Controlled by poisoning and trapping. Indiscriminate poisoning can result in the splitting of rookeries and spread of rook populations. Can become very 'shy' to shooting.
Benefits	May help control grass grub in pasture.

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	Low	High
Sheep and beef	Low	High
Forestry	-	Low
Horticulture	Low	High
Aquaculture	-	-
Urban	Low	Low
Native terrestrial	-	-
Coastal land	Low	Low
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	L	L	Causes damage to pasture by uprooting the ground in search of grass grubs. Also damages forage crops.	
Sheep and beef	L	L	Causes damage to pasture by uprooting the ground in search of grass grubs. Damages forage crops and paddocks being resown for sheep and beef.	
Forestry	-	-		1, 2
Horticulture	L	M	Causes extensive damage to cereal crops, maize, peas, squash.	
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	L	M	Tears up soil when hunting for grass grubs near the ground surface in winter.	3
Water quality	-	-		
Species diversity	-	-		
Threatened species	-	-		
Social/Cultural				
Human health	L	L	Noise disturbance by loud, harsh call.	4
Recreation	-	-		
Māori culture	-	-		

L = low, M = moderate, H = high

source 1: Heather & Robertson (1996), 2: Zahradnik & Cihar (1990), 3: Environment Bay of Plenty (2004b), 4: Environment Bay of Plenty (2004a)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	54.63–267.08	54.63–267.08
Sheep and beef	7.39–36.12	7.39–36.12
Forestry	0	0
Horticulture	105.11–790.40	525.55–1,778.40
Aquaculture	0	0
Environment/Social/Cultural		
Urban	5.33–56.05	5.33–56.05
Native terrestrial	0	0
Coastal	12.47–61.00	62.35–137.25
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Eradication**

Area of Programme: **whole region ha**

Proposed annual expenditure by Council: **$125,436**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	48,952.55 ha	Time to reach maximum extent †	50 yrs
Current impacts *	$37.15/ha	Potential extent in the region °	138,046 ha
	$11.33–62.96/ha		48,952.55–227,139.9 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$37,072,244	$0		$0	$0	$0	
	min: 5,055,423						
	max: 113,361,696						
Eradication	$12,330,023	$0	$24,742,221	$1,058,094	$0	$0	$23,684,127
	min: 3,089,978		min: 1,965,445				min: 907,351
	max: 24,631,519		max: 88,730,177				max: 87,672,083

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

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‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$244,155,972	$0		$0	$0	$0	
	min: 12,474,839						
	max: 1,285,232,567						
Eradication	$14,640,462	$0	$229,515,510	$1,779,139	$0	$0	$227,736,371
	min: 3,237,867		min: 9,236,972				min: 7,457,833
	max: 44,068,140		max: 1,241,164,427				max: 1,239,385,288

CBA statement and risks to success

Rooks can negatively impact pastoral and arable crops. The cost to eradicate rooks is likely to be significantly less than the losses that would be incurred if they were left to re-expand their range. Based on the low level of risk, and the 'high' level of support from the farming communities, it is proposed that rooks are eradicated from Hawke's Bay within the next 30 years. The benefits of regional intervention, focused on eradicating rooks from the region, outweigh the cost of the programme.

All regions in the North Island that have rooks have active rook management programmes. The aim is to eradicate rooks from New Zealand.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS
Land occupiers (Crown and private)	Major		No	Yes
Any person not declaring presence of a rookery on their land.		Major	Yes	Yes
Regional community	Major		No	Yes

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Who should pay for the proposed management approach?

Both land occupiers and the regional community are beneficiaries. The agricultural sector will benefit proportionally more than the regional community, therefore a 70% targeted rate, 30% general rate is proposed.

AFRICAN FEATHER GRASS
Cenchurus macrourus

ERADICATION

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Robust rhizomatous perennial grass up to 2 m tall with overhanging flower spikes which resemble pampas. Yellow-reddish-purple flowers form a narrow cylindrical stem 10–30 cm long x 2 cm diameter, with barbed bristles sticking out from the spike.
Habitat	Prefers damp situations such as swamps or stream and lake margins, but grows in a range of habitats and soil types, including sand.
Regional distribution	Scattered on farmland in the Maraekakaho and Ngaruroro River berm areas.
Competitive ability	Forms dense clumps that exclude other vegetation.
Reproductive ability	Seed viability is high but seedling establishment is poor.
Dispersal methods	Seeds are dispersed by wind, water, animals (in wool or fur), and machinery. Also spreads from creeping rhizomes and may spread through cultivation with contaminated machinery.
Resistance to control	Readily controlled by appropriate herbicides.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	High
Sheep and beef	Low	High
Forestry	-	Low
Horticulture	-	Low
Aquaculture	-	-
Urban	-	Low
Native terrestrial	-	Low
Coastal land	-	High
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	L	Unpalatable to livestock. Fire hazard.	
Sheep and beef	L	M	See Dairy.	
Forestry	-	-		1, 2, 3
Horticulture	-	-		
Aquaculture	-	-		
Other	-	-		
International trade	-	M	Can contaminate wool. Crop contaminant, prohibited seed (nil tolerance) in imports into Australia.	1, 4
Environment				
Soil resources	-	L	Causes accretion of sand and changes in habitat, leading to erosion or flooding.	1
Water quality	-	L	See Soil Resources.	1
Species diversity	-	M	Forms dense clumps and out-competes native pioneer species in many vulnerable habitats. Also invades established plant communities. Can harbour rats, mice and possums.	1, 2
Threatened species	-	M	Causes accretion of sand and change in habitat, leading to loss of dunelakes and wetlands, which may support threatened species.	1, 2
Social/Cultural				
Human health	-	-		
Recreation	-	M	Obstructs access to lakes, beaches.	1
Māori culture	-	M	Obstructs access to cultural sites (e.g. waahi tapu, urupa).	

L = low, M = moderate, H = high

source 1: Craw (2000), 2: Environment Bay of Plenty (2005a), 3: Environment Bay of Plenty (2004a), 4: AQIS (2009)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level

Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	54.63–267.08
Sheep and beef	7.39–36.12	36.95–81.27
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	0	27.80–61.20
Coastal	0	62.35–137.25
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Eradication**

Area of Programme: **whole region ha**

Proposed annual expenditure by Council: **$12,000**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	1 ha	Time to reach maximum extent†	75 yrs
Current impacts*	$21.75/ha	Potential extent in the region°	141,397 ha
	$7.39–36.12/ha		48,024.79–234,769.7 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$116,836	$0		$0	$0	$0	
	min: 35,222						
	max: 515,752						
Eradication	$148	$0	$116,688	$101,224	$0	$0	$15,464
	min: 41		min: 35,181				min: -66,043
	max: 289		max: 515,463				max: 414,239

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$92,916,299	$0		$0	$0	$0	
	min: 29,956,090						
	max: 400,697,909						
Eradication	$175	$0	$92,916,124	$175,841	$0	$0	$92,740,283
	min: 43		min: 29,956,047				min: 29,780,206
	max: 516		max: 400,697,393				max: 400,521,552

CBA statement and risks to success

African Feather grass can adversely impact primary production and environmental values, including wetlands, waterbodies and coastal areas. Given the total area infested in Hawke's Bay is only approximately one hectare, eradication is very feasible. The cost to eradicate African feather grass is cost beneficial both over a 10 year and 50 year period.

African feather grass produces large amount of seeds which are easily dispersed by wind and can be carried on clothing, animal hair or wool. This poses a risk to the success of the programme. If new areas are detected, these areas may require stock to be excluded to prevent seed transfer.

The benefits of regional intervention, focused on eradicating African feather grass from the region, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low to medium	
Operational risk	Low	
Legal risk	Low to medium	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS
Land occupiers (Crown and private)	Major	Major	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes
Regional community	Major		No	Yes

Who should pay for the proposed management approach?

Although both land occupiers and the regional community are beneficiaries, the agricultural sector will benefit proportionally more than the regional community, therefore a 70% targeted rate, 30% general rate is proposed.

CATHEDRAL BELLS
Cobaea scandens

ERADICATION

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Vigorous perennial climber growing to canopy height. Climbs by hooked tendrils. Bell-shaped purple flowers followed by oval pods.
Habitat	Garden escape that can smother trees, shrubs and riverside cliffs.
Regional distribution	Approx 10 small sites across the region.
Competitive ability	Highly competitive - fast growing, smothering supporting plants.
Reproductive ability	Seeds prolifically and seed can germinate throughout most of the year.
Dispersal methods	Wind or water borne seed.
Resistance to control	Easily controlled by spraying with herbicide.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	-
Sheep and beef	Low	-
Forestry	-	High
Horticulture	-	-
Aquaculture	-	-
Urban	Low	Low
Native terrestrial	Low	High
Coastal land	-	-
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	-		
Sheep and beef	-	-		
Forestry	-	M	Smothers trees in plantation forests.	1
Horticulture	-	-		
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	-	L	Could cause canopy collapse leading to erosion.	
Water quality	-	-		
Species diversity	L	H	Smothers all plants up to medium-high canopy and can bring down canopy trees, altering forest structure. Dense layers shade out ground vegetation and prevent recruitment.	1, 2
Threatened species	-	M	See Species diversity.	1, 2
Social/Cultural				
Human health	-	-		
Recreation	-	L	Dense walls of vines obstruct access to forest.	1
Māori culture	-	L	See Recreation.	

L = low, M = moderate, H = high
source 1: Anon. (2007a), 2: Craw (2000)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	0
Sheep and beef	0	0
Forestry	0	87.35–192.15
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	5.56–27.20	55.60–340.00
Coastal	0	0
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Eradication**
Area of Programme: **whole region ha**
Proposed annual expenditure by Council: **$13,600**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	1 ha	Time to reach maximum extent†	50 yrs
Current impacts*	$4.28/ha	Potential extent in the region°	74,162 ha
	$1.45–7.12/ha		24,758.38–123,564.7 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years may be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$67,873	$0		$0	$0	$0	
	min: 15,682						
	max: 328,337						
Eradication	$28	$0	$67,845	$114,721	$0	$0	$-46,876
	min: 8		min: 15,674				min: -99,047
	max: 57		max: 328,280				max: 213,559

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$44,021,478	$0		$0	$0	$0	
	min: 10,239,753						
	max: 212,620,084						
Eradication	$33	$0	$44,021,445	$192,250	$0	$0	$43,829,195
	min: 8		min: 10,239,745				min: 10,047,495
	max: 102		max: 212,619,982				max: 212,427,732

CBA statement and risks to success

Cathedral bells can grow over trees and shrubs, forming a dense canopy that out-competes desirable plants by smothering them. The total area infested in Hawke's Bay is believed to be small and eradication is believed to be feasible. Although the cost to eradicate is not cost beneficial over a 10 year period, it is significantly cost beneficial over a 50 year period. This is due to the slow establishment of cathedral bells. If Council was to do nothing over the next ten years, the impacts are likely to be minor. However, as cathedral bell establish over a longer period, the impacts increase. Eradicating now will save significant future pest impact costs.

The benefits of regional intervention, focused on eradicating cathedral bell from the region, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS
Land occupiers (Crown and private)	Major	Major	Yes	Yes
Forestry industry	Major		No	Yes
Regional community	Major		No	Yes

Who should pay for the proposed management approach?

Although forestry are a beneficiary, the primary impact of cathedral bell is on biodiversity values. For this reason is proposed that this programme is funded through the general rate.

GOATS RUE
Galega officinalis

ERADICATION

Relevant biology

Attribute	Description
Form	Fast-growing perennial, colony-forming woody herb that grows to 1.2 m tall (sometimes to 2 m tall). Nitrogen-fixer. Plants are spindly when young, but usually grow into dense clumps with tall stems, which die back in autumn. Lilac or pink pea-like flowers grow in bunches on spikes of 30 cm or more. Seeds in pods.
Habitat	Can establish in many habitats, especially irrigated pastures, irrigation canels, swamplands, river beds, railway lines and roadsides. Prefers full sun but will tolerate light shade.
Regional distribution	Roadsides and railway lines at Eskdale, Omakere and Tikokino.
Competitive ability	Very robust, fast-growing and vigorous. Can tolerate severe frosts. Considered unpalatable to stock, as they avoid it.
Reproductive ability	Plants can produce up to 15,000 seed pods per plant. The seed bank at infested sites can potentially be huge (14,000–75,000 seeds/m2), and very persistent, with little reduction in viability for up to 26 years.
Dispersal methods	Seeds mainly fall near the parent plant, but can be dispersed by water and by animals if ingested, or as a contaminent of hay or gravel.
Resistance to control	A broad range of herbicides are effective e.g. Escort, Grazon and Tordon. Small infestations can be removed by digging, with frequent removal of root-sprouts and seedlings. Fire not effective as it stimulates roots to sprout. Stock cannot be used for control, as the species is toxic under some conditions.
Benefits	Claimed to have many medicinal benefits, including increasing milk production in goats and cows. Valued as a forage crop, bee plant, green manure and a garden (ornamental) plant.

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	High
Sheep and beef	Low	High
Forestry	-	Low
Horticulture	-	Low
Aquaculture	-	-
Urban	-	Low
Native terrestrial	-	-
Coastal land	-	Low
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	M	Poisonous to livestock; can cause death. Can contaminate hay and poison animals that feed on it.	
Sheep and beef	L	M	Poisonous to sheep, but when eaten regularly in small doses resistance can build up.	
Forestry	-	-		1, 2, 3
Horticulture	-	-		
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	-	M	Has potential to invade wetlands and river margins in New Zealand where its vigorous growth could displace other species. In the US it forms dense stands in wetlands, displacing native species and reducing food and nesting habitat for wildlife.	2, 3
Threatened species	-	L	See Species diversity.	2, 3
Social/Cultural				
Human health	-	L	Can be fatal to humans if ingested due to a poisonous alkaloid.	2
Recreation	-	-		
Māori culture	-	-		

L = low, M = moderate, H = high

source 1: Keeler et al. (1986), 2: Di Tomaso et al. (2013), 3: Hawke's Bay Regional Council (2004a)

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Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACTS PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	273.15–600.93
Sheep and beef	7.39–36.12	36.95–81.27
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	5.33–56.05
Native terrestrial	0	0
Coastal	0	62.35–137.25
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Eradication**
Area of Programme: **whole region ha**
Proposed annual expenditure by Council: **$1,500**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	0.0011 ha	Time to reach maximum extent †	50 yrs
Current impacts *	$21.75/ha	Potential extent in the region °	133,739 ha
	$7.39–36.12/ha		44,975.9–222,503 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$618,763	$0		$0	$0	$0	
	min: 207,136						
	max: 2,655,148						
Eradication	$0	$0	$618,763	$12,653	$0	$0	$606,110
	min: 0		min: 207,136				min: 194,483
	max: 0		max: 2,655,148				max: 2,642,495

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$401,114,942	$0		$0	$0	$0	
	min: 137,320,956						
	max: 1,706,145,784						
Eradication	$0	$0	$401,114,942	$29,494	$0	$0	$401,085,448
	min: 0		min: 137,320,956				min: 137,291,462
	max: 1		max: 1,706,145,783				max: 1,706,116,289

CBA statement and risks to success

Goats rue is fast growing and is capable of invading many habitats. It outcompetes other vegetation, particularly pasture and crops, having a negative impact on primary production and biodiversity values.
The total known area infested in Hawke's Bay is very small and eradication is believed to be very feasible. Te proposed programme is cost beneficial over both a 10 year and 50 year period.

The benefits of regional intervention, focused on eradicating goats rue from the region, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS
Land occupiers (Crown and private)	Major	Major	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes
Regional community	Major		No	Yes

Who should pay for the proposed management approach?

Goats rue is primarily a agricultural weed, with the agricultural sector being the primary beneficiary. A 70% targeted rate, 30% general rate is proposed.

PHRAGMITES
Phragmites australis

ERADICATION

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Erect, rhizomatous, perennial grass, 2–4 m high. Rhizomes can grow to 2 m deep, with 40% of the plant underground. Hollow stems. Long, smooth flat leaf blades up to 60 cm long. Leaf margins are rough and leaf sheaths overlap. Ligule has a fringe of long hairs. Brownish or purplish feathery-shaped flowerheads, 20–50 cm long. Dies back in winter.
Habitat	Margins of water bodies, irrigation channels, drainage ditches and poorly drained areas. Can also grow away from water.
Regional distribution	Limited distribution. A few sites in some streams and drains in and around Napier City urban area.
Competitive ability	Vigorous and fast-growing. Can tolerate slightly saline conditions.
Reproductive ability	Produces flowers but does not set seed in New Zealand.
Dispersal methods	Spreads by broken rhizome fragments via water or machinery.
Resistance to control	Very difficult to control. Once established is difficult to eradicate.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	Low
Sheep and beef	-	Low
Forestry	-	Low
Horticulture	-	Low
Aquaculture	-	-
Urban	Low	High
Native terrestrial	-	Low
Coastal land	-	High
Freshwater	Low	Low
Estuarine	Low	High
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	L	Can invade low-lying pasture.	
Sheep and beef	-	L		
Forestry	-	-		1
Horticulture	-	-		
Aquaculture	-	-		
Other	-	L	Can penetrate compacted road material and grow through cracks in concrete floors.	
International trade	-	-		
Environment				
Soil resources	-	-		
Water quality	L	M	Can block drainage systems, causing flooding. Rhizomes can penetrate stop-banks, causing them to slump.	1
Species diversity	L	M	Forms dense stands and crowds out other plants. Could reduce numbers of insects and birds in wetland habitats and waterway margins.	1, 2
Threatened species	-	M	See Species diversity.	1, 2
Social/Cultural				
Human health	-	-		
Recreation	L	M	Can block access to waterways, restricting fishing and boating activities.	1
Māori culture	L	M	See Recreation.	

L = low, M = moderate, H = high
source 1: Biosecurity New Zealand (2009), 2: Environment Canterbury (2007b)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	54.63–267.08
Sheep and beef	0	7.39–36.12
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	0	27.80–61.20
Coastal	0	62.35–137.25
Freshwater	190.70–1,092.40	953.50–2,457.90
Estuarine	60.24–294.48	301.20–662.58
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Eradication**

Area of Programme: **whole region ha**

Proposed annual expenditure by Council: **$0**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	0.029 ha	Time to reach maximum extent†	75 yrs
Current impacts*	$241.28/ha	Potential extent in the region°	38,312 ha
	$72.01–410.54/ha		15,068.36–61,555.55 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years may be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$77,052	$0		$0	$0	$0	
	min: 15,088						
	max: 330,166						
Eradication	$46	$0	$77,006	$84,353	$0	$84,353	$-91,700
	min: 11		min: 15,077				min: -153,629
	max: 95		max: 330,071				max: 161,365

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$6,886,187	$0		$0	$0	$0	
	min: 2,027,618						
	max: 26,733,847						
Eradication	$54	$0	$6,886,133	$143,076	$0	$84,353	$6,658,704
	min: 11		min: 2,027,607				min: 1,800,178
	max: 170		max: 26,733,677				max: 26,506,248

CBA statement and risks to success

Phragmites is considered one of, if not the worst potential aquatic weed in New Zealand. It is an allelopathic species, where it inhibits the growth of other species. It restricts waterways and outcompetes native species. Phragmites is listed as an unwanted organism under the Biosecurity Act 1993, is a Notifiable Organism (Biosecurity (Notifiable Organisms) Order 2010) and is listed in the National Pest Plant Accord 2012. It is also one of eleven pest species that are part of the National Interest Pests Response (NIPR). Management of this pest plant is led by the Ministry for Primary Industries and they cover all costs.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

All costs for this programme will be covered by the Ministry for Primary Industries (lead agency for this programme).

PURPLE LOOSESTRIFE
Lythrum salicaria

ERADICATION

Relevant biology

Attribute	Description
Form	Erect, hairy, summer-green, hardy perennial herb, with numerous stems usually 1–2 m tall. Fibrous roots forming dense mats. Stems branched, 4–8 sided, pink at base. Leaves lanceolate to elliptic, 20–100 mm long, 5–27 mm wide, usually in pairs. Flower spike terminal, densely hairy, 200-250 mm long, flowers rose to purple-magenta, with 5-6 petals. Seed capsules, blackish, 3-5 mm long. Flowers December to February.
Habitat	Damp places along stream banks, ditches, swamps, lakesides, and waste areas. Can grow in shallow water. Once established it can spread into adjacent dry sites. Tolerates hot and cold air temperatures, and low-to-high nutrient water.
Regional distribution	One site at Te Pohue.
Competitive ability	Can form dense, impenetratable swards that smother other vegetation.
Reproductive ability	Seeds are produced in large numbers and retain their viability for a long time. Can easily spread from rooted pieces. Seedbanks in areas with established purple loosestrife populations can excede 400,000 seeds per m2. Seeds germinate quickly in 3–4 days and have high germination rates.
Dispersal methods	Spread by water, contaminated machinery, and livestock.
Resistance to control	Spray with glyphosate. Water levels can be altered by raising water level to drown plants or lowering the water levels to dry out soil. Water levels less than 30 cm deep does not kill purple loosestrife seedlings. Plantings can shade out loosestrife.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION

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Dairy	-	Low
Sheep and beef	Low	Low
Forestry	-	-
Horticulture	-	-
Aquaculture	-	-
Urban	-	Low
Native terrestrial	-	High
Coastal land	-	-
Freshwater	-	High
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	L	Can form dense stands in wetland areas.	
Sheep and beef	-	L	Can form dense stands in wetland areas.	
Forestry	-	-		1, 2
Horticulture	-	L	Can form dense stands in wetland areas.	
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	-	L	Alters decomposition rates and nutrient cycling.	2
Water quality	-	M	Causes blockages and flooding in water channels, reducing the quality of the water.	1, 2
Species diversity	-	H	Dense stands compete with indigenous species and prevent recruitment. Alters decomposition rates and nutrient cycling, leads to reductions in wetland plant diversity, and reduces habitat suitability for specialised wetland bird species.	2
Threatened species	-	H	Significant threat to indigenous biodiversity of a range of wetland habitats such as stream banks, swamps and lakesides, all of which which support specialist indigenous species. Excludes other species and destroys wetland and marginal habitat and food sources for many fish and bird species.	1, 2
Social/Cultural				
Human health	-	-		
Recreation	-	M	Forms dense and impenetratable stands that obstruct access.	1
Māori culture	-	L	Can impede or restrict access to cultural sites.	

L = low, M = moderate, H = high
source 1: Craw (2000), 2: Blossey et al. (2001)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	54.63–267.08
Sheep and beef	0	7.39–36.12
Forestry	0	0
Horticulture	0	105.11–790.40
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	0	55.60–340.00
Coastal	0	0
Freshwater	0	1,907.00–13,655.00
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Eradication**
Area of Programme: **whole region ha**
Proposed annual expenditure by Council: **$790**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	0.001 ha	Time to reach maximum extent †	75 yrs
Current impacts *	$0.1/ha	Potential extent in the region °	68,837 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

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10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$56,490,564	$0		$0	$0	$0	
	min: 8,915,126						
	max: 277,314,982						
Eradication	$0	$0	$56,490,564	$6,664	$0	$0	$56,483,900
	min: 0		min: 8,915,126				min: 8,908,462
	max: 0		max: 277,314,982				max: 277,308,318

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$54,643,895,283	$0		$0	$0	$0	
	min: 8,621,599,975						
	max: 268,259,305,822						
Eradication	$0	$0	$54,643,895,283	$15,535	$0	$0	$54,643,879,748
	min: 0		min: 8,621,599,975				min: 8,621,584,440
	max: 0		max: 268,259,305,822				max: 268,259,290,287

CBA statement and risks to success

Purple loosestrife is a highly aggressive invader of damp ground, wetlands and shallow water, smothering other vegetation. If Council was to adopt a no intervention approach, biodiversity values of wetlands in particular could be impacted. There is only one known location in the region and eradication is believed to be very feasible. The proposed programme is cost beneficial over both a 10 year and 50 year period.

The benefits of regional intervention, focused on eradicating purple loosestrife from the region, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS
Land occupiers (Crown and private)	Major	Major	Yes	Yes
Dairy/sheep and beef sector	Minor		No	Yes
Regional community	Major		No	Yes

Who should pay for the proposed management approach?

Although the agriculture sector are a beneficiary, the primary impact of purple loosestrife is on biodiversity values. For this reason is proposed that this programme is funded through the general rate.

SPINY EMEX
Emex australis

ERADICATION

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Hairless semi-prostrate annual herb with a stout taproot. Leaves are dull green and a similar shape to dock; forming a rosette in early growth then branching later. Flowers are inconspicuous at the base of leaf stems, and develop into hard fruit (burs) that ripen from green to brown. Burs are woody and c.7 mm long. Each bur has three sharp spikes, and when they are shed they lie with one spike pointing upwards.
Habitat	Sandy or loamy soils in coastal areas. Pasture, crops, lawns and waste places. Can tolerate temperate to subtropical climates.
Regional distribution	Very limited distribution. Only present on two properties: at Whakaki and between Napier and Bayview.
Competitive ability	Relatively weak competitor (being out-competed by grasses and legumes), but it can dominate in habitats where environmental conditions such as drought or unseasonal rains modify pasture composition.
Reproductive ability	Produces long-lived viable seed. Overseas, seeds can remain viable for up to 8 years.
Dispersal methods	Burs are well-equipped for dispersal, as one spike always points upward attaching to shoes, tyres, animal feet etc. Also dispersed in fodder crops like hay. Burs can float on water and spread along water courses.
Resistance to control	Can be grubbed out or controlled with glyphosate. Hormone herbicides can be used at the rosette stage only e.g. MCPA or 2,4-D.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	High
Sheep and beef	Low	High
Forestry	-	-
Horticulture	-	Low
Aquaculture	-	-
Urban	-	High
Native terrestrial	-	-
Coastal land	-	High
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

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Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	M	Competes with pasture, particularly for nitrogen. Burs can cause lameness or infection in animals.	
Sheep and beef	L	M	Contains high levels of oxalates and has caused sheep deaths in Western Australia through oxalic acid poisoning. Can attach to sheep and reduce wool quality.	
Forestry	-	-		1, 2, 3
Horticulture	-	L	Competes with crops, reducing yields.	
Aquaculture	-	-		
Other	-	-		
International trade	-	L	Can reduce wool quality.	2
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	-	-	Mainly a problem in agricultural land.	2
Threatened species	-	-		
Social/Cultural				
Human health	L	L	Sharp burs can spike into feet and cause discomfort in humans.	1, 2
Recreation	-	L	See Human Health.	1, 2
Māori culture	-	-		

L = low, M = moderate, H = high

source 1: Environment Bay of Plenty (2013), 2: Hawke's Bay Regional Council (1995b), 3: CABI (2013)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	273.15–600.93
Sheep and beef	7.39–36.12	36.95–81.27
Forestry	0	0
Horticulture	0	105.11–790.40
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	5.33–56.05
Native terrestrial	0	0
Coastal	0	12.47–61.00
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Eradication**

Area of Programme: **whole region ha**

Proposed annual expenditure by Council: **$4,600**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	0.006 ha	Time to reach maximum extent†	50 yrs
Current impacts*	$21.75/ha	Potential extent in the region°	131,972 ha
	$7.39–36.12/ha		44,027.36–219,916 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$758,056	$0		$0	$0	$0	
	min: 269,802						
	max: 3,196,877						
Eradication	$1	$0	$758,055	$38,803	$0	$0	$719,252
	min: 0		min: 269,802				min: 230,999
	max: 2		max: 3,196,875				max: 3,158,072

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

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‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$497,116,043	$0		$0	$0	$0	
	min: 180,406,563						
	max: 2,079,075,063						
Eradication	$2	$0	$497,116,041	$102,771	$0	$0	$497,013,270
	min: 1		min: 180,406,562				min: 180,303,791
	max: 3		max: 2,079,075,060				max: 2,078,972,289

CBA statement and risks to success

Spiny emex is an agricultural weed that can adversely impact production values, through invading pasture and seeds causing hoof lameness to stock. Given the total known area infested in Hawke's Bay is less than one hectare, eradication is feasible. The cost to eradicate spiny emex is cost beneficial both over a 10 year and 50 year period.

The benefits of regional intervention, focused on eradicating spiny emex from the region, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS
Land occupiers (Crown and private)	Major	Major	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes
Regional community	Major		No	Yes

Who should pay for the proposed management approach?

Spiny emex is primarily a agricultural weed, with the agricultural sector being the primary beneficiary. A 70% targeted rate, 30% general rate is proposed.

White-edged nightshade
Solanum marginatum

ERADICATION

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Much branched perennial shrub to small tree to 5 m tall. Prickles 1.5 cm only on stems and leaves. White felted twigs, white marginal zones on upper surface of mature leaves.
Habitat	Mainly in scrub, poor rough country, roadsides, wastelands and bush margins in warm, sunny situations.
Regional distribution	Very limited distribution. Only present on one property at Eskdale.
Competitive ability	Forms dense impenetrable thickets. Can invade poor open pasture and other open areas.
Reproductive ability	Produces moderate amounts of seeds. Flowers within 5–7 months of germination.
Dispersal methods	Seeds spread by soil movement and livestock.
Resistance to control	Regrows strongly after mechanical damage. Susceptible to picloram.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	High
Sheep and beef	Low	High
Forestry	-	Low
Horticulture	Low	Low
Aquaculture	-	-
Urban	-	Low
Native terrestrial	-	-
Coastal land	-	High
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
PRODUCTION				

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Dairy	-	M	Shades out and displaces pasture species. Toxic to stock. Spines can injure stock, and restrict their movement.	
Sheep and beef	L	H	Can attach to sheep wool. See Dairy.	
Forestry	-	-		1, 2, 3, 4
Horticulture	L	L	Competes with crops, reducing yields.	
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
ENVIRONMENT				
Soil resources	-	-		
Water quality	-	-		
Species diversity	-	M	Forms dense stands and can displace native ground cover and shrub species.	1, 3, 4
Threatened species	-	-		
SOCIAL/CULTURAL				
Human health	-	L	Poisonous. Sharp spines can cause injury.	4
Recreation	L	M	Dense impenetrable stands are difficult to get through.	4
Māori culture	-	L	See Recreation.	

L = low, M = moderate, H = high

source 1: Anon. (), 2: Environment Bay of Plenty (2004a), 3: Environment Canterbury (2007c), 4: Hawke's Bay Regional Council (2004)

Estimated quantitative impacts

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
PRODUCTION		
Dairy	0	273.15–600.93
Sheep and beef	7.39–36.12	73.90–451.50
Forestry	0	0
Horticulture	105.11–790.40	105.11–790.40
Aquaculture	0	0
ENVIRONMENT/SOCIAL/CULTURAL		
Urban	0	5.33–56.05
Native terrestrial	0	0
Coastal	0	62.35–137.25
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Eradication**
Area of Programme: **whole region**
Proposed annual expenditure by Council: **$740**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	0.0001 ha	Time to reach maximum extent†	125 yrs
Current impacts*	$32.9/ha	Potential extent in the region°	133,917 ha
	$9.95–55.86/ha		45,032.87–222,802 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNER COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$234,835	$0		$0	$0	$0	
	min: 38,481						
	max: 1,206,301						
Eradication	$0	$0	$234,835	$6,242	$0	$0	$228,593
	min: 0		min: 38,481				min: 32,239
	max: 0		max: 1,206,301				max: 1,200,059

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNER COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$55,565,008	$0		$0	$0	$0	
	min: 9,021,236						
	max: 285,842,289						
Eradication	$0	$0	$55,565,008	$14,732	$0	$0	$55,550,276
	min: 0		min: 9,021,236				min: 9,006,504
	max: 0		max: 285,842,289				max: 285,827,557

CBA statement and risks to success

White edged nightshade is an agricultural weed that can adversely impact production values, through forming dense impenetrable thickets and invading poor open pasture and other open areas. The berries are poisonous to stock and humans. Leaf margins are pale but its most distinguishing features are spines on both sides of the leaves and thorns on the stems. Its seed is spread by attaching to sheep fleeces, through birds eating its berries, and by machinery. The plant grows in poor rough scrub-covered country, on roadsides and wastelands and bush margins. It was first discovered in the region in 1984 on one property at Eskdale. It remains restricted to 120ha.

Given the restricted nature of the infestion in Hawke's Bay, eradication is feasible. The cost to eradicate white edged nightshade is cost beneficial both over a 10 year and 50 year period.

The benefits of regional intervention, focused on eradicating white edged nightshade from the region, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS
Land occupiers (Crown and private)	Major	Major	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes
Regional community	Major		No	Yes

Who should pay for the proposed management approach?

White edged nightshade is primarily a agricultural weed, with the agricultural sector being the primary beneficiary. A 70% targeted rate, 30% general rate is proposed.

YELLOW WATER LILY

Nuphar lutea

ERADICATION

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Plants have both floating and submerged leaves. Floating leaves are oval, up to 30 cm long by 40 cm wide, with a deep indent at one end. Leaves are tough, leathery and dark green. Stout, tuber-like rhizomes up to 10 cm in diameter grow on the bottom to a depth of 3 m. Stalked, solitary buttercup-like 4–6 cm diameter flowers rise well above the leaves. Flowers have a strongly alcoholic aroma, hence the common name 'brandy bottle'. Fruit are 2–3 cm long, green, and flask-shaped.
Habitat	Slow-running, shallow (up to 2 m deep) nutrient-rich streams, lakes, reservoirs, ponds and canals.
Regional distribution	Very limited distribution. Only found at two sites in Hawke's Bay: Horseshoe Lake at Patangata and a nearby farm dam.
Competitive ability	Fast growing, can outcompete all other aquatic plants. Has massive rhizomes that hold nutrient stores.
Reproductive ability	Fruit contain hundreds of long-lived viable seeds.
Dispersal methods	Spread by rhizome fragments and by seed. Can be spread by drain clearing machinery.
Resistance to control	Very difficult to eradicate once established. The most successful method is 3% glyphosate with a penetrant. Aerial spraying is the best method to avoid disturbing the water surface, as leaves lie on or just above the water surface, however it can be sprayed from a boat or the water edge with care. Need to spray in mid to late December during flowering.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	-
Sheep and beef	-	-
Forestry	-	-
Horticulture	-	-
Aquaculture	-	-
Urban	-	-
Native terrestrial	-	-
Coastal land	-	-
Freshwater	Low	High
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	-		
Sheep and beef	-	-		
Forestry	-	-		1, 2
Horticulture	-	-		
Aquaculture	-	-		
Other	-	L	Rhizomes may clog up hydro power intakes.	
International trade	-	-		
Environment				
Soil resources	-	-		
Water quality	L	M	Blocks up streams and drainage systems, reducing water flow leading to increased siltation and flooding. Reduces oxygen levels in water.	1, 2
Species diversity	L	H	Dense mats of leaves completely cover the water surface and block all light from below; causing die-off of submerged native water plants, excessive water loss from ponds, and oxygen deprivation.	1, 2
Threatened species	-	L	See Species diversity.	1, 2
Social/Cultural				
Human health	-	-		
Recreation	L	M	Completely blocks lakes and waterways, restricting recreational uses such as swimming, fishing, and boating.	2
Māori culture	L	M	See Recreation.	

L = low, M = moderate, H = high

source 1: Environment Canterbury (2013), 2: Hawke's Bay Regional Council (2004b)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	0
Sheep and beef	0	0
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	0	0
Coastal	0	0
Freshwater	190.70–1,092.40	1,907.00–13,655.00
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Eradication**
Area of Programme: **whole region ha**
Proposed annual expenditure by Council: **$444**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	0.0001 ha	Time to reach maximum extent†	75 yrs
Current impacts*	$641.55/ha	Potential extent in the region°	2,090 ha
	$190.7–1,092.4/ha		696.73–3,483.62 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

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10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$32,947	$0		$0	$0	$0	
	min: 5,129						
	max: 172,037						
Eradication	$0	$0	$32,947	$3,745	$0	$0	$29,202
	min: 0		min: 5,129				min: 1,384
	max: 1		max: 172,036				max: 168,291

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$23,245,523	$0		$0	$0	$0	
	min: 3,423,152						
	max: 122,357,378						
Eradication	$0	$0	$23,245,523	$8,839	$0	$0	$23,236,684
	min: 0		min: 3,423,152				min: 3,414,313
	max: 2		max: 122,357,376				max: 122,348,537

CBA statement and risks to success

Yellow water can invade permanent water of lakes and slow-flowing streams over mud and silt, outcompeting all other aquatic plants. Eradication is highly feasible due to it being present at only two isolated spots in the region. The cost to eradicate yellow water lily is cost beneficial both over a 10 year and 50 year period.

The benefits of regional intervention, focused on eradicating yellow water lily from the region, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

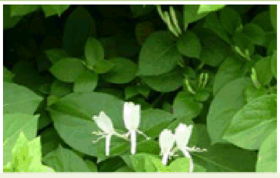
GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS
Land occupiers (Crown and private)	Minor	Major	Yes	Yes
Regional community	Major		No	Yes

Who should pay for the proposed management approach?

The primary impact of yellow water lily is on biodiversity values. For this reason it is proposed that this programme is funded through the general rate.

PROGRESSIVE CONTAINMENT

JAPANESE HONEYSUCKLE
Lonicera japonica



PROGRESSIVE CONTAINMENT

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Evergreen woody vine (semi-evergreen in cold climates). Stems are purplish, long, tough and hairy, and twine in a clockwise direction. Leaves are oval, stalkless or on short stalks and in opposite pairs. Flowers are sweetly-scented, tubular and coloured white, ageing to yellow. Flowers September-May. Berries are glossy, black and egg shaped, 5–7 mm in diameter. Seeds are c.2mm in diameter.
Habitat	Roadsides, riverbanks, hedges, shelterbelts, disturbed forest and forest edges. As it is palatable to stock it is generally only found in retired areas, usually around the margins.
Regional distribution	Region-wide but major infestations occur from the Devils Elbow to northern Wairoa.
Competitive ability	Tolerates moderate shade, frost, salt, damage, wet or dry, most soils, and high to low temperature. Has a moderate-fast growth rate.
Reproductive ability	Produces viable fleshy fruit, but is a relatively poor seeder.
Dispersal methods	Mainly dispersed by birds, possibly possums. Also spread by roading machinery, dumped vegetation, soil and fill.
Resistance to control	Small plants can be dug out. Plants can be hard to kill. Cut stumps re-sprout and need herbicide treatment (e.g. with Escort). Poor seeder, so sites usually remain clear after treatment, as long as all living material has been removed. Stock browsing can control its growth.
Benefits	Nectar for birds and insects.

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	Low	Low
Sheep and beef	Low	Low
Forestry	Low	High
Horticulture	Low	Low
Aquaculture	-	-
Urban	Low	High
Native terrestrial	Low	High
Coastal land	Low	Low
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	-		
Sheep and beef	-	-		
Forestry	-	-		
Horticulture	-	-		
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	M	M	Forms dense, long-lived masses that climb over and smoth most plants from ground to medium canopy height. Damage is most severe in young or regenerating bush. Can cause canopy collapse and succession to grasses or ground vines. Provides support for faster-growing vines (e.g. morning glory, mothplant).	1, 2
Threatened species	L	M	Could smother rare native vines and shrubs that occupy forest edge habitats (e.g. Pittosporum obcordatum, Brachygottis sciadophila).	2
Social/Cultural				
Human health	-	-		
Recreation	-	-		
Māori culture	-	-		

L = low, M = moderate, H = high

source 1: Craw (2000), 2: Department of Conservation (2001)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	0
Sheep and beef	0	0
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	27.80–61.20	27.80–61.20
Coastal	62.35–137.25	62.35–137.25
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Site-led**

Area of Programme: **995 ha**

Proposed annual expenditure by Council: **$5,000**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	Values
Current area infested	1 ha	Time to reach maximum extent†	100 yrs
Current impacts*	$17.32/ha	Potential extent in the region°	43 ha
	$10.82–23.82/ha		14.84–71.35 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will not be of net benefit to the region with the assumptions made.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$282	$0		$0	$0	$0	
	min: 167						
	max: 428						
Site-led	$33	$0	$249	$19,980	$16,871	$12,653	$-49,255
	min: 16		min: 151		min: 16,871		min: -49,353
	max: 66		max: 362		max: 16,871		max: -49,142

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits of the proposed management programme over the next 50 years will still not be of net benefit to the region with the assumptions made.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$3,549	$0		$0	$0	$0	
	min: 1,583						
	max: 9,958						
Site-led	$33	$0	$3,516	$26,574	$16,871	$12,653	$-52,582
	min: 16		min: 1,567		min: 16,871		min: -54,531
	max: 66		max: 9,892		max: 16,871		max: -46,206

CBA statement and risks to success

Japanese honeysuckle forms dense, long-lived masses that climb over and smother most plants from ground to medium canopy height. Damage is most severe in young or regenerating bush. Can cause canopy collapse and succession to grasses or ground vines, in particular rare native vines and shrubs that occupy forest edge habitats (e.g. *Pittosporum obcordatum, Brachygottis sciadophila*).

This programme only applies to the Japanese honeysuckle containment area, which encompasses Lake Tūtira and Tūtira Regional Park. The regional park has an important function as a sustainable land use demonstration area which has had thousands of trees planted by school students, community groups, organisations, and HBRC staff volunteers. Lake Tūtira is also one of the six Annual Plan 2017-18 Six Hotspots sites. Although the cost benefit analysis has come out negative, this containment area has been in place for 11 years and has been successful in protecting the investment undertaken by the community. Given the low cost and success of the programme, this programme will remain in place.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

Japanese honeysuckle is an environmental pest. This progamme only applies to the Japanese honeysuckle containment area, which encompasses Lake Tūtira and Tūtira Regional Park. It is therefore proposed this programme is funded through the general rate.

OLD MAN'S BEARD
Clematis vitalba

PROGRESSIVE CONTAINMENT

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Deciduous woody vine which grows along the ground or over trees and shrubs. Prolific white flowers.
Habitat	Scrub, wasteland, among willows, forest remnants, hedgerows, roadsides, river banks, in gardens, disturbed native bush, shelterbelts. Prefers well-drained soils.
Regional distribution	Widespread south of State Highway 5, more limited infestations occur north of State Highway 5.
Competitive ability	Rapid growth rate. Can completely shade out canopy species, preferring well-drained alluvial soil. Light-demanding in seedling stage.
Reproductive ability	Produces >10,000 seeds per sq m, which remain viable on the vine over winter. Seed has an awn that enables it to bury into the soil for germination. Germination rate >80%.
Dispersal methods	Usually spread by wind over short distances, or water over long distances. Can also be spread in road gravel.
Resistance to control	Difficult to eradicate but mature vines can be treated by cut and paint techniques using clopyralid, glyphosate or metsulfuron. Use of herbicides compromised by plants' climbing nature. Two biological control agents are available reducing plant vigour and killing seedlings.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	Low
Sheep and beef	-	Low
Forestry	Low	High
Horticulture	Low	Low
Aquaculture	-	-
Urban	Low	Low
Native terrestrial	Low	High
Coastal land	-	Low
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				

Dairy	-	-	Can smother trees in farm shelterbelts. The occasional death of cattle from eating this plant has been recorded in England.	
Sheep and beef	-	-		
Forestry	L	M	Smothers trees in plantation forests. Prevents access and creates safety hazard during harvest of plantation trees.	1, 2
Horticulture	-	L	Smothers trees in orchards.	
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	M	H	Forms dense, heavy, permanent masses. Smothers and kills all plants to highest canopy, prevents recruitment.	3
Threatened species	-	H		3
Social/Cultural				
Human health	-	-		
Recreation	-	M	Dense, heavy, long-lived masses obstruct access to forest.	3
Māori culture	L	M	See Recreation.	

L = low, M = moderate, H = high

source 1: Department of Conservation (1999), 2: Popay et al. (2010), 3: Craw (2000)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

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Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	0
Sheep and beef	0	0
Forestry	17.47–85.40	87.35–192.15
Horticulture	0	105.11–790.40
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	27.80–61.20	55.60–340.00
Coastal	0	124.70–762.50
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Site-led**

Area of Programme: **717,848.2 ha**

Proposed annual expenditure by Council: **$50,000**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	50 ha	Time to reach maximum extent†	125 yrs
Current impacts*	$47.93/ha	Potential extent in the region°	45,924 ha
	$22.61–73.24/ha		15,780.22–76,068.09 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will not be of net benefit to the region with the assumptions made.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$45,868	$0		$0	$0	$0	
	min: 20,426						
	max: 76,407						
Site-led	$3,504	$0	$42,364	$104,551	$168,707	$84,353	$-315,247
	min: 1,653		min: 18,773		min: 168,707		min: -338,838
	max: 5,355		max: 71,052		max: 168,707		max: -286,559

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$2,235,712	$0		$0	$0	$0	
	min: 761,436						
	max: 5,813,234						
Site-led	$3,504	$0	$2,232,208	$110,706	$168,707	$84,353	$1,868,442
	min: 1,653		min: 759,783		min: 168,707		min: 396,017
	max: 5,355		max: 5,807,879		max: 168,707		max: 5,444,113

CBA statement and risks to success

Old man's beard is an invasive climber which can form dense, heavy, permanent masses that can smother and kills all plants to highest canopy (especially on forest edges and along riparian margins). Old man's beard is widespread south of State Highway 5 in Hawke's Bay. The Council do not believe that the benefits of control in this area would outweigh the costs imposed on land occupiers in continuing to require them to control old man's beard.

North of State Highway 5 in Hawke's Bay, old man's beard is not so widespread and Council believe that this is still worthwhile to require land occupiers to continue to control it. There are a large number of native bush fragments throughout this landscape that would be significantly negatively impacted by Old man's beard if left unmanaged.

The old man's beard control line is defined as being the line defined by State Highway 5 from the region's western boundary to its junction with State Highway 2, then along State Highway 2 from its junction with State Highway 5 to the Esk River, then down the Esk River from the State Highway 2 bridge to the sea as shown in Figure 7.

The CBA for Old man's beard suggests that this form of regional intervention will have monetarised benefits over a 50 year timeframe.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	The pest is widespread in the region, particularly in hedgerows and some riparian margins. A focus on control in the Kaupokonui and Waingongoro catchments has achieved initial success in these areas and ongoing monitoring of maintenance control by land occupiers will be required
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	Proposed approach is largely a continuation of the existing approach, for which no public or political concerns have been raised to date. Increased public intervention in the Kaupokonui and Waingongoro catchments will be required, with costs incurred by the public. The acceptability of this increased focus to the public will be tested through the public process.
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Minor	Major	Yes	Yes	Yes
Forestry sector	Minor		Yes	Yes	Yes
Anyone intentionally dumping or disposing of the plant		Major	Yes	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

Old man's beard is a major threat to biodiversity values in the Hawke's Bay region. To maximise the effectiveness of individual control across the region and to minimise the externality impacts of the plant the Council has proposed an advisory, inspectorial, and compliance regime. The benefits of this programme are a public good rather than a private good. It is proposed this programme is funded through the general rate.

APPLE OF SODOM
Solanum linnaeanum

PROGRESSIVE CONTAINMENT

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Strongly spiny, woody, perennial shrub up to 1 m tall. Green and white berries ripen to yellow.
Habitat	Frost-free coastal areas, poor pasture and scrub margins.
Regional distribution	Occurs from Napier to Tangoio, and is bounded inland by a line from Waipunga Road to Seafield Road. Bayview/Eskdale area.
Competitive ability	Can out-compete some species in coastal areas, but does not usually form pure stands.
Reproductive ability	Produces viable seed.
Dispersal methods	Seeds dispersed by birds.
Resistance to control	Can be controlled with picloram.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	High
Sheep and beef	Low	High
Forestry	Low	Low
Horticulture	-	Low
Aquaculture	-	-
Urban	-	Low
Native terrestrial	Low	Low
Coastal land	-	Low
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	M	Forms dense thickets, which reduce pasture growth. Leaves and unripe fruit are toxic to stock.	
Sheep and beef	L	M	See Dairy.	
Forestry	-	-		1, 2, 3
Horticulture	-	-		
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	L	L	Forms dense thickets in coastal areas, excluding low-growing native species.	1
Threatened species	-	L	See Species diversity.	1
Social/Cultural				
Human health	-	M	Leaves and unripe fruit are poisonous to humans.	1, 2
Recreation	-	M	Spiny shrub restricts access to beaches.	1, 2
Māori culture	-	M	Obstructs access to cultural sites (e.g. waahi tapu, urupa).	

L = low, M = moderate, H = high
source 1: Craw (2000), 2: Roy et al. (2004), 3: Environment Bay of Plenty (2004a)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	273.15–600.93
Sheep and beef	7.39–36.12	36.95–81.27
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	26.64–126.11
Native terrestrial	5.56–27.20	5.56–27.20
Coastal	0	62.35–137.25
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Progressive Containment**

Area of Programme: **whole region ha**

Proposed annual expenditure by Council: **$12,000**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	0.05 ha	Time to reach maximum extent†	150 yrs
Current impacts*	$17.36/ha	Potential extent in the region°	141,219 ha
	$5.89–28.82/ha		47,967.83–234,470.6 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years may be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$35,700	$0		$0	$0	$0	
	min: 10,579						
	max: 158,486						
Progressive Containment	$2	$0	$35,698	$49,961	$33,741	$8,435	$-56,439
	min: 0		min: 10,579		min: 33,741		min: -81,558
	max: 7		max: 158,479		max: 33,741		max: 66,342

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$3,714,842	$0		$0	$0	$0	
	min: 1,216,547						
	max: 15,926,706						
Progressive Containment	$2	$0	$3,714,840	$56,977	$33,741	$8,435	$3,615,687
	min: 0		min: 1,216,547		min: 33,741		min: 1,117,394
	max: 7		max: 15,926,699		max: 33,741		max: 15,827,546

CBA statement and risks to success

Apple of Sodom is regarded as an invasive species in Australia, Hawaii, Fiji, New Caledonia, and other Pacific Islands. It produces large number of seeds. Its spines discourage herbivores from grazing on it, giving it a competitive advantage over more palatable species. It forms dense thickets in coastal areas, excluding low-growing native species. Seed dispersal by birds adds to the threat characteristics. The known distribution in Hawke's Bay is centred on the Bay View area, stretching from Napier to Tangoio. It is bounded inland by a line from Waipunga Road across to Seafield Road.

The CBA for Apple of Sodom suggests that this form of regional intervention will have monetarised benefits over a 50 year timeframe.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

Apple of Sodom is a threat to primary production and biodiversity values in the Hawke's Bay region. To maximise the effectiveness of individual control across the region and to minimise the externality impacts of the plant the Council has proposed an advisory, inspectorial, and compliance regime. The primary beneficiaries of this programme are land occupiers. It is proposed this programme is funded through a 70% targeted rate, 30% general rate.

AUSTRALIAN SEDGE
Carex longebrachiata

PROGRESSIVE CONTAINMENT

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Strong, harsh, dense tussocks 30–90 cm high. New leaves grow from inside leaf sheath, are about 5 mm wide and Y-shaped in cross-section, appearing yellowish towards tips. Edges are sharp. Seed head is a drooping panicle with green to pale brown seeds hanging at ends of long, thin, cotton-like filaments.
Habitat	Pasture, disturbed scrub, regenerating forest and short tussockland. Prefers seasonally dry habitats.
Regional distribution	Kotemaori, Rapunga and Mangopoike in the Wairoa District.
Competitive ability	Forms dense, long-lived clumps that exclude other grass species. Tough roots cannot be pulled by livestock. Tolerates fire, hot to moderately cold, wet, drought, wind, salt, poor soils, damage, and semi-shade. Has difficulty invading well-managed pastures.
Reproductive ability	Produces many long-lived seeds in open areas.
Dispersal methods	Seeds can disperse long distances by wind, water, livestock, and farm machinery.
Resistance to control	Control with glyphosate, then replant with other species. Grazing not effective control, only spreads seed. Need to exclude stock. Re-seeds prolifically. Re-sprouts from crown.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	High
Sheep and beef	Low	High
Forestry	-	Low
Horticulture	-	-
Aquaculture	-	-
Urban	-	-
Native terrestrial	-	Low
Coastal land	-	-
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

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Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	L	Can form dense swards, which crowd out pasture grasses. Unpalatable to stock. Persists under canopy.	
Sheep and beef	L	M	See Dairy.	
Forestry	-	-		1
Horticulture	-	-		
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	-	M	Suppresses native plants and seedlings along scrub and forest margins, and remains an obstruction under regenerating canopy. Crowds out low-growing native species in tussock grasslands. Fire hazard. Harbours rats and mice.	1, 2
Threatened species	-	L	See Species diversity.	1
Social/Cultural				
Human health	-	-		
Recreation	-	L	Can be difficult to walk through.	1
Māori culture	-	-		

L = low, M = moderate, H = high

source 1: Waikato Regional Council (2011), 2: Taranaki Regional Council (2012)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	54.63–267.08
Sheep and beef	7.39–36.12	36.95–81.27
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	0	27.80–61.20
Coastal	0	0
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Progressive Containment**

Area of Programme: **whole region ha**

Proposed annual expenditure by Council: **$21,000**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	2 ha	Time to reach maximum extent†	75 yrs
Current impacts*	$21.75/ha	Potential extent in the region°	140,064 ha
	$7.39–36.12/ha		47,505.58–232,621.6 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years may be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$122,901	$0		$0	$0	$0	
	min: 37,235						
	max: 542,271						
Progressive Containment	$64	$0	$122,837	$47,666	$84,353	$0	$-9,182
	min: 22		min: 37,213		min: 84,353		min: -94,806
	max: 170		max: 542,101		max: 84,353		max: 410,082

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

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‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$98,973,655	$0		$0	$0	$0	
	min: 31,940,698						
	max: 427,215,366						
Progressive Containment	$64	$0	$98,973,591	$53,821	$84,353	$0	$98,835,417
	min: 22		min: 31,940,676		min: 84,353		min: 31,802,502
	max: 170		max: 427,215,196		max: 84,353		max: 427,077,022

CBA statement and risks to success

Australian sedge suppresses native plants and seedlings along scrub and forest margins, and remains an obstruction under regenerating canopy. It crowds out low-growing native species in tussock grasslands. Australian sedge prefers land which is seasonally dry and is well suited to the climate and soils of Hawke's Bay. It invades disturbed scrub, regenerating forest and short tussock grasslands, but does not compete successfully with vigorous, well managed pastures. Australian sedge is a prolific seeder, but the seeds are relatively heavy and most fall close to the parent plant. Animals may spread seeds. The leaves are generally not palatable to stock. Once established it can be difficult to control. Infestations in Hawke's Bay occur throughout the Wairoa District.

The benefits of regional intervention, focused on sustainably controlling Australian Sedge as part of a Progressive Containment programme, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

Australian sedge is a threat to primary production and biodiversity values in the Hawke's Bay region. To maximise the effectiveness of individual control across the region and to minimise the externality impacts of the plant the Council has proposed an advisory, inspectorial, and compliance regime. The primary beneficiaries of this programme are land occupiers. It is proposed this programme is funded through a 70% targeted rate, 30% general rate.

COTTON THISTLE
Onopordum acanthium

PROGRESSIVE CONTAINMENT

Relevant biology

Attribute	Description
Form	Large, pricky biennial plant that can grow to 3 m tall and 1.5 m wide under some conditions. Leaves have a grey velvety appearance. Flowers are dark pink, lavender or purple, globe-shaped and 2.5-6 cm in diameter.
Habitat	Ruderal places, dry pasture, disturbed fields (including those subject to heavy grazing), shingle flats, roadsides, agricultural areas, grasslands, riparian zones, scrub/shrublands, and waterways; especially sites with fertile soils. Prefers dry summers.
Regional distribution	Maraekakaho area, and between Napier, Bayview and Omaranui.
Competitive ability	Large stands are impenetrable, and can displace forage used by stock. Plants are drought resistant and can spread rapidly, as seeds are primarily dispersed by wind. Temperature and moisture, rather than soil nutrient concentrations, determine its ecological performance.
Reproductive ability	One plant produces 70-100 flowering heads containing 100-140 seeds per head. Seed production varies with environmental conditions. Seeds can remain viable for up to 20 years.
Dispersal methods	Primarily spread by wind, however its plumed seeds can also be dispersed by attachment to clothing and animal fur. Seeds may also be transported by water and in hay and machinery.
Resistance to control	Herbicides can by effective (e.g. glyphosphate and Escort) but it is resistant to many commonly used hormone sprays (only in NZ). Healthy, dense pasture in autumn can lessen germination. When mowing is conducted too late, viable seed may still develop following cutting. Because plants can mature at different times, a single mowing is unlikely to provide satisfactory control.
Benefits	Has reportedly been used to treat cancers and ulcers and to diminish discharges of mucous membranes. The receptacle was eaten in earlier times like an artichoke. The cottony hairs on the stem have been occasionally collected to stuff pillows. Oil from seeds has been used in Europe for burning and cooking.

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION

Dairy	-	High
Sheep and beef	Low	High
Forestry	-	Low
Horticulture	-	Low
Aquaculture	-	-
Urban	-	-
Native terrestrial	-	-
Coastal land	-	Low
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMEMENT	SOURCE
Production				
Dairy	-	L	Dense stands can restrict stock access to waterways and forage and displace pasture grasses.	
Sheep and beef	M	H	Seed heads can become entangled in wool and fibre, devaluing fleeces and injuring those handling stock and fleece.	
Forestry	-	-		1, 2
Horticulture	-	H	Can contaminate cereal crops.	
Aquaculture	-	-		
Other	-	-		
International trade	-	Nil		
Environment				
Soil resources	-	-		
Water quality	-	-	NIL	
Species diversity	-	-		1
Threatened species	-	-		
Social/Cultural				
Human health	-	-		
Recreation	-	L	Can form large stands on camping grounds, lessening amenity values.	2, 3
Māori culture	-	-		

L = low, M = moderate, H = high

source 1: Invasive Species Specialist Group (2005), 2: Marlborough District Council (2014), 3: Anon. (2013)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		

Dairy	0	54.63–267.08
Sheep and beef	36.95–81.27	73.90–451.50
Forestry	0	0
Horticulture	0	1,051.10–9,880.00
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	0	0
Coastal	0	12.47–61.00
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Progressive Containment**

Area of Programme: **whole region ha**

Proposed annual expenditure by Council: **$3,000**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	0.028 ha	Time to reach maximum extent†	50 yrs
Current impacts*	$59.11/ha	Potential extent in the region°	133,171 ha
	$36.95–81.27/ha		44,748.7–221,594.1 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$2,533,837	$0		$0	$0	$0	
	min: 401,686						
	max: 13,092,178						
Progressive Containment	$5	$0	$2,533,832	$17,695	$8,435	$0	$2,507,702
	min: 2		min: 401,684		min: 8,435		min: 375,554
	max: 20		max: 13,092,158		max: 8,435		max: 13,066,028

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$1,675,003,565	$0		$0	$0	$0	
	min: 251,846,897						
	max: 8,722,430,058						
Progressive Containment	$5	$0	$1,675,003,560	$25,117	$8,435	$0	$1,674,970,008
	min: 2		min: 251,846,895		min: 8,435		min: 251,813,343
	max: 49		max: 8,722,430,009		max: 8,435		max: 8,722,396,457

CBA statement and risks to success

Cotton thistles form large stands that are impenetrable to stock. Plants are drought resistant and can spread rapidly, as seeds are primarily dispersed by wind. Seeds can also be dispersed by attachment to clothing, animal fur, water and in hay and machinery. Seed heads can become entangled in wool and fibre, devaluing fleeces and injuring those handling stock and fleece. The plants contaminate cereal crops in the nearby vicinity. Its distribution in the Hawke's Bay region is presently limited to the Maraekakaho area, and between Napier, Bay View and Omaranui.
The benefits of regional intervention, focused on sustainably controlling cotton thistle as part of a Progressive Containment programme, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

Cotton thistle is a threat to primary production. To maximise the effectiveness of individual control across the region and to minimise the externality impacts of the plant the Council has proposed an advisory, inspectorial, and compliance regime. The primary beneficiaries of this programme are land occupiers. It is proposed this programme is funded through a 70% targeted rate, 30% general rate.

DARWIN'S BARBERRY

Berberis darwinii

PROGRESSIVE CONTAINMENT

Relevant biology

Attribute	Description
Form	Evergreen shrub up to 4 m tall with holly-like leaves and purple berries.
Habitat	Shade-tolerant, can survive in a variety of habitats, including native forest, shrubland.
Regional distribution	Two areas: Gwavas and Puketitiri
Competitive ability	Can form impenetrable stands. May invade forest as it is shade tolerant.
Reproductive ability	Produces viable seed.
Dispersal methods	Has been planted as a hedge plant in some areas; birds also disperse the seed.
Resistance to control	Can be controlled with appropriate herbicides.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	Low
Sheep and beef	Low	High
Forestry	Low	High
Horticulture	-	-
Aquaculture	-	-
Urban	-	Low
Native terrestrial	Low	High
Coastal land	-	-
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	L	Excludes grass and clover, reducing pasture availability. Not palatable to stock.	
Sheep and beef	L	M	See Dairy.	
Forestry	L	M	Nuisance in plantation forestry.	1
Horticulture	-	-		
Aquaculture	-	-		
Other	-	-		

International trade	-	-		
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	L	M	Can form impenetrable thickets and compete with native plants in shrubland and regenerating forest. Once established, adult plants are very shade-tolerant and can persist under forest, however seed production is reduced and seedling survival is 10% or less. Will eventually be overtopped by native forest species.	1, 2, 3, 4, 5
Threatened species	-	L	Could be a threat to native species in shrubland and grassland habitats.	1, 2, 5
Social/Cultural				
Human health	-	-		
Recreation	-	L	Prickly spines restrict access.	2
Māori culture	-	L	Could obstruct access to cultural sites (e.g. wāhi tapu, urupa).	

L = low, M = moderate, H = high

source 1: Craw (2000), 2: Environment Canterbury (2006), 3: McAlpine (2005), 4: McAlpine & Jesson (2008), 5: McAlpine & Wotton (2012)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	54.63–267.08
Sheep and beef	7.39–36.12	36.95–81.27
Forestry	17.47–85.40	87.35–192.15
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	5.56–27.20	27.80–61.20
Coastal	0	0
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Progressive Containment**

Area of Programme: **whole region ha**

Proposed annual expenditure by Council: **$40,000**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	2 ha	Time to reach maximum extent†	50 yrs
Current impacts*	$24.86/ha	Potential extent in the region°	198,188 ha
	$8.44–41.27/ha		66,150.86–330,225.4 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years may be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$234,473	$0		$0	$0	$0	
	min: 77,628						
	max: 1,017,315						
Progressive Containment	$95	$0	$234,378	$120,993	$126,530	$25,306	$-38,451
	min: 25		min: 77,603		min: 126,530		min: -195,226
	max: 393		max: 1,016,922		max: 126,530		max: 744,093

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$121,554,601	$0		$0	$0	$0	
	min: 45,236,539						
	max: 502,534,575						
Progressive Containment	$95	$0	$121,554,506	$127,587	$126,530	$25,306	$121,275,083
	min: 25		min: 45,236,514		min: 126,530		min: 44,957,091
	max: 393		max: 502,534,182		max: 126,530		max: 502,254,759

CBA statement and risks to success

Darwin's barberry is capable of threatening the purity of indigenous forest by invading intact and undisturbed stands, forming impenetrable thickets. Older plants can flower and produce seeds in the shade and so perpetrate the production of fresh seed. However, the amount of seed is significantly reduced. Regardless, the potential invasion of new habitat is much greater than this suppression. This long-lived hardy plant tolerates moderate to cold temperatures, damp to dry conditions, high wind, salt, shade, damage and a range of soils. It is not browsed by stock. Birds and possibly possums eat the berries and subsequently spread the seeds. Berries are also occasionally spread by soil and water movement. Darwin's barberry is known to infest Gwavas & Puketitiri in the Hawke's Bay region.

The CBA for Darwin's barberry suggests that this form of regional intervention will have monetarised benefits over a 50 year timeframe.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

Darwin's barberry is a major threat to biodiversity values in the Hawke's Bay region. To maximise the effectiveness of individual control across the region and to minimise the externality impacts of the plant the Council has proposed an advisory, inspectorial, and compliance regime. The benefits of this programme are a public good rather than a private good. It is proposed this programme is funded through the general rate.

LODGEPOLE PINE
Pinus contorta

PROGRESSIVE CONTAINMENT

Relevant biology

Attribute	Description
Form	Small- to medium-sized pine tree; up to 25 m high in lowland areas. Two yellowish-green pine needles per fascicle (bundle), each c.5 cm long, with bluntly pointed tips. Bark reddish-brown, grey on the surface, fissured into small, squarish pieces. Male cones are orange-yellow and arise in clusters around young shoots; female cones arise in separate clusters, usually as a whorl of six reddish-coloured, small flowers. These grow into egg-shaped, green-coloured cones with many brown, sharp spines. Mature female cones are 3–6 cm long, persistent, and usually point backwards or downwards.
Habitat	Grows on a wide range of sites, esp. subalpine areas and low fertility sites e.g. tussockland, herbfield, fernland, disturbed and open forest, shrubland, bare land, mineralised places, screes, and volcanic habitats.
Regional distribution	Kaweka Ranges and upland Rangitaiki areas, and along the western margins of the region.
Competitive ability	An aggressive coloniser, particularly when planted at higher altitudes. Once established, it can replace most other species. Tolerant of hot to very cold, wind, salt, damp to dry, good to poor or mineralised soils. Shade intolerant. Seedlings do not compete well with introduced grasses.
Reproductive ability	Prolific seeder and early maturing - can produce cones after 6 years. Fallen trees can release seed.
Dispersal methods	Seed spread mainly by wind (up to at least 8 km). Planted as a forestry species in the past.
Resistance to control	Can be controlled by hand or herbicides. Regrowth can occur from inadequately slashed plants (i.e. if lower branches with green needles are left). Fire increases seedling numbers.
Benefits	Used for shelterbelts in areas with harsh climates, and erosion control.

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	-
Sheep and beef	Low	Low
Forestry	Low	High
Horticulture	-	-
Aquaculture	-	-
Urban	-	-
Native terrestrial	Low	High
Coastal land	-	Low
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	L	Can shade out and displace pasture species, particularly in higher altitude areas.	
Sheep and beef	M	H	See Dairy.	
Forestry	L	M	Could compete with more desirable plantation species.	1, 2
Horticulture	-	-		
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	L	L	Can alter nutrient profiles and mycorrhizal communities of soils.	1, 3
Water quality	-	L	Leaf litter affects water quality, can destroy freshwater habitats. Plantations remove ground water in summer, fail to retain it in winter, causing drought and flooding.	1, 3
Species diversity	M	H	Becomes permanent canopy species and forms dense, often pure stands, esp. on poor soils. Modifies habitat and extends forest above native treeline. Leaf litter inhibits growth of understory species.	1, 2, 3, 4
Threatened species	L	M	Major threat to rare plant species in subalpine/alpine grasslands and other non-forested habitats.	1, 3, 4
Social/Cultural				
Human health	-	-	There is no substantiated evidence for lodgepole pine pollen causing allergies.	5
Recreation	L	M	Forms dense stands which restrict access for trampers and hunters.	1
Māori culture	-	-		

L = low, M = moderate, H = high
source 1: Ledgard (2001), 2: EBOP (2005), 3: Craw (2000), 4: Ministry of Agriculture and Forestry (2008), 5: Anon. (2009c)

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Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	54.63–267.08
Sheep and beef	36.95–81.27	73.90–451.50
Forestry	17.47–85.40	87.35–192.15
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	27.80–61.20	55.60–340.00
Coastal	0	124.70–762.50
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Progressive Containment**
Area of Programme: **whole region ha**
Proposed annual expenditure by Council: **$55,000**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	1,000 ha	Time to reach maximum extent†	125 yrs
Current impacts*	$54.66/ha	Potential extent in the region°	94,175 ha
	$32.02–77.3/ha		32,763.57–155,585.5 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$933,029	$0		$0	$0	$0	
	min: 487,083						
	max: 1,486,870						
Progressive Containment	$128,539	$0	$804,490	$155,664	$210,883	$421,767	$16,176
	min: 46,826		min: 440,257		min: 210,883		min: -348,057
	max: 278,467		max: 1,208,403		max: 210,883		max: 420,089

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$18,596,715	$0		$0	$0	$0	
	min: 6,261,389						
	max: 52,646,936						
Progressive Containment	$128,539	$0	$18,468,176	$162,680	$210,883	$421,767	$17,672,846
	min: 46,826		min: 6,214,563		min: 210,883		min: 5,419,233
	max: 278,467		max: 52,368,469		max: 210,883		max: 51,573,139

CBA statement and risks to success

Pinus contorta's aggressive colonizing characteristics aid its ability to displace low-level plant communities, especially native grasslands, and create forests. This impacts significantly on biodiversity and landscape values as well as potentially decreasing hydrological yields. Economic well-being is also threatened by the loss of grazing and increased fire hazard.

It is usually found in alpine and sub-alpine areas hence its presence in the Kaweka Ranges, the upland Rangitaiki areas and along the western margins of the region. Owing to its hardiness, it is used as a shelter belt species in the southern Rangitaiki area. Pinus contorta is not a recognised commercial timber species.

The benefits of regional intervention, focused on sustainably controlling *Pinus contorta* as part of a Progressive Containment programme, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	

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Operational risk	Low
Legal risk	Low
Socio-political risk	Low
Other risks	Low

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

Pinus contorta is primarily a threat to biodiversity values in the Hawke's Bay region. To maximise the effectiveness of individual control across the region and to minimise the externality impacts of the plant the Council has proposed an advisory, inspectorial, and compliance regime. The benefits of this programme are a public good rather than a private good. It is proposed this programme is funded through the general rate.

NASSELLA TUSSOCK
Nassella trichotoma

PROGRESSIVE CONTAINMENT

Relevant biology

Attribute	Description
Form	Perennial tussock-forming grass growing to a height of 50 cm, with numerous drooping fine, rough leaves overtopped by slender open seed heads.
Habitat	Open sites such as sunny dry pasture, stream margins, roadsides and wasteland. Tolerates a wide range of climates.
Regional distribution	Limited distribution. Found in two areas: Tangoio and a site in the lower Tukituki.
Competitive ability	Can form a complete cover in pasture situations.
Reproductive ability	Can produce up to 100,000 seeds per plant. Seed can remain dormant in the soil for over 15 years.
Dispersal methods	Primarily by wind but also stock, machinery, water, hay and as a seed impurity.
Resistance to control	Difficult to control due to large, long-lived seed bank.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	High
Sheep and beef	Low	High
Forestry	Low	High

Horticulture	-	Low
Aquaculture	-	-
Urban	-	Low
Native terrestrial	Low	High
Coastal land	-	High
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	L	Competes with pasture and reduces food availability for stock. Cannot be digested by livestock (forms indigestible balls in the stomach).	
Sheep and beef	M	H	Competes with pasture and reduces food availability for stock. Cannot be digested by livestock (forms indigestible balls in the stomach). Seeds spoil the fleece.	
Forestry	-	-		1, 2
Horticulture	-	-		
Aquaculture	-	-		
Other	-	-		
International trade	-	L	Crop contaminant, prohibited seed (nil tolerance) in imports into Australia.	3
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	L	H	Forms pure stands in low-growing plant communities, esp. in harsh sites, excludes other species.	1, 2
Threatened species	-	H	See Species diversity.	1, 2
Social/Cultural				
Human health	-	-		
Recreation	-	-		
Māori culture	-	-		

L = low, M = moderate, H = high
source 1: Craw (2000), 2: Anon. (2004), 3: AQIS (2009)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		

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Dairy	0	54.63–267.08
Sheep and beef	36.95–81.27	73.90–451.50
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	5.56–27.20	55.60–340.00
Coastal	0	124.70–762.50
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Progressive Containment**

Area of Programme: **whole region ha**

Proposed annual expenditure by Council: **$17,000**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	50 ha	Time to reach maximum extent†	75 yrs
Current impacts*	$40.75/ha	Potential extent in the region°	202,725 ha
	$24.4–57.09/ha		67,649.73–337,800.7 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$215,751	$0		$0	$0	$0	
	min: 61,233						
	max: 1,050,209						
Progressive Containment	$3,897	$0	$211,854	$54,613	$0	$0	$157,241
	min: 1,784		min: 59,449				min: 4,836
	max: 7,934		max: 1,042,275				max: 987,662

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$153,554,395	$0		$0	$0	$0	
	min: 27,548,160						
	max: 789,873,877						
Progressive Containment	$3,897	$0	$153,550,498	$61,207	$0	$0	$153,489,291
	min: 1,784		min: 27,546,376				min: 27,485,169
	max: 7,934		max: 789,865,943				max: 789,804,736

CBA statement and risks to success

Nassella tussock is capable of completely depleting a grassland sward, both native and exotic. It is indigestible if eaten by livestock and seeds spoil the fleece of sheep. It is tolerant to drought, fire and grazing. It can form pure stands in low-growing plant communities such as pasture, preventing other species from establishing.

Nassella tussock will grow almost anywhere, but is most commonly found on dry, low fertility land, sunny slopes, dry spurs and knobs, and stony riverbeds. The seed straw is readily carried by strong wind and can travel many kilometres. It is also distributed by water, stock and machinery, or on the bark of milled trees. Regular inspection of areas cleared of nassella tussock is therefore necessary to prevent re-establishment.

Intensive control measures over 30 years have prevented the spread of nassella tussock, with the two known sites in the region being Tangoio and the lower Tukituki area. Plant numbers at these sites are now low. Any failure to remove all nassella tussock plants before seeding perpetuates the problem as the amount of seed produced by a mature plant, and the mechanism of wind dispersal of the seed contribute to a high potential for spreading. By preventing seeding, and given the present limited distribution of nassella tussock in the Hawke's Bay region, an opportunity exists to progressively reduce plant incidence.

Nassella tussock is a well-known and high-profile pastoral pest in many other parts of the country. There would be substantial political and farming concerns if this tussock species was not managed. Further, maintaining the gains of previous management efforts would be wasted if regional intervention was not instigated.
The benefits of regional intervention, focused on sustainably controlling nassella tussock as part of a Progressive Containment programme, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY

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Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

Nassella tussock is a major threat to primary production. To maximise the effectiveness of individual control across the region and to minimise the externality impacts of the plant the Council has proposed an advisory, inspectorial, and compliance regime. The primary beneficiaries of this programme are land occupiers. It is proposed this programme is funded through a 70% targeted rate, 30% general rate.

SAFFRON THISTLE
Carthamus lanatus

PROGRESSIVE CONTAINMENT

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Annual, spiny, glandular, woolly plant, which often looks like it is covered in spiderwebs due to its fine tangled fibers. Has a pale stem up to 1 m tall. Rigid, pointed, very spiny leaves. Flowers are bright yellow. One plant can produce many spiny stems which mat together to form a small thicket.
Habitat	Disturbed, open sites in grasslands, pastures, and agricultural lands, especially grain fields. Prefers seasonally dry, heavily-grazed pastures, particularly areas with 400-600 mm annual rainfall. Inhabits many soil types.
Regional distribution	Problem in dry areas. Crownthorpe, Bayview, Putorino, Sherenden, Wairere, Havlock North, Maraekakaho, Waipawa, Porangahau, Kahuranaki, Paki Paki.
Competitive ability	Regarded as a pasture weed because it competes with desired plants such as pasture or crops and eventually displaces them.
Reproductive ability	Seed production is abundant. Seed germination is most likely in areas with little vegetation or pasture cover e.g. when an area has been overgrazed. Seed germination requires specific temperature cues and water; most seeds germinate in autumn. Many seeds remain dormant (will not germinate, even in ideal conditions), and seed banks decrease by approximately 70–74% per year if no seed is added. Seeds can remain viable for 10 years.
Dispersal methods	The large seeds are mainly dispersed by water, vehicles, livestock, and contaminated forage. Seeds may remain in flower heads for long periods, allowing their spread all season-long. Plants can also snap off at the base and be wind-blown, spreading seeds. Seeds can lay dormant in soil for some time.
Resistance to control	Can be controlled using various herbicides (e.g. Tordon Brushkiller), or at the rosette stage with MCPA or 2,4-D. Mowing/grubbing before seed-set can help in low-rainfall areas but plants should be removed and incinerated. Good pasture cover in autumn will reduce germination; ideally grazing pressure should be reduced over summer to increase the cover of summer-growing perennial grasses. Biocontrol may be an option when an agent that will not attack safflower is found.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	High
Sheep and beef	Low	High
Forestry	-	Low
Horticulture	-	High
Aquaculture	-	-
Urban	-	-
Native terrestrial	-	-
Coastal land	-	Low
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	L	Form dense stands that exclude stock. Can cause eye and mouth damage to stock.	
Sheep and beef	L	M	Devalues sheep/alpaca fleece, and can injure shearers.	
Forestry	-	-		1, 2, 3
Horticulture	-	M	Crop contaminant; cereal grain contaminated with saffron thistle seed has reduced value.	
Aquaculture	-	-		
Other	-	-		
International trade	L	M	Prohibited seed of nil tolerance in Australia.	4
Environment				
Soil resources	L	L	Control with use of residual herbicides has led US farmers to drop organic status to control this weed. Some residual herbicides effect the growth of legumes.	5
Water quality	-	-		
Species diversity	-	L	Primarily a pasture/agricultural weed of low fertility, dry soils. Possible impact on native grasslands that are heavily grazed/fire damaged if a source population is nearby.	2
Threatened species	-	-		
Social/Cultural				
Human health	L	M	Spicky seed heads can injure sheep/alpaca shearers, and those handling these stock.	2, 3
Recreation	-	M	Forms dense stands which restrict access.	1
Māori culture	-	-		

L = low, M = moderate, H = high

source 1: Cowan (2010), 2: Western Australian Agriculture Authority (2012), 3: Hawke's Bay Regional Council (1995a), 4: AQIS (2009), 5: Kyser (2012)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level

Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare

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High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	54.63–267.08
Sheep and beef	7.39–36.12	36.95–81.27
Forestry	0	0
Horticulture	0	525.55–1,778.40
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	0	0
Coastal	0	62.35–137.25
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Progressive Containment**
Area of Programme: **whole region ha**
Proposed annual expenditure by Council: **$80,000**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	226 ha	Time to reach maximum extent†	50 yrs
Current impacts*	$21.75/ha	Potential extent in the region°	135,932 ha
	$7.39–36.12/ha		45,631.94–226,231.1 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$2,198,941	$0		$0	$0	$0	
	min: 927,417						
	max: 4,505,150						
Progressive Containment	$9,404	$0	$2,189,537	$149,854	$126,530	$0	$1,913,153
	min: 2,442		min: 924,975		min: 126,530		min: 648,591
	max: 38,866		max: 4,466,284		max: 126,530		max: 4,189,900

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$476,507,791	$0		$0	$0	$0	
	min: 148,443,555						
	max: 1,989,156,128						
Progressive Containment	$9,404	$0	$476,498,387	$156,448	$126,530	$0	$476,215,409
	min: 2,442		min: 148,441,113		min: 126,530		min: 148,158,135
	max: 38,866		max: 1,989,117,262		max: 126,530		max: 1,988,834,284

CBA statement and risks to success

Saffron thistle occurs predominantly in disturbed, open sites in grasslands, pastures, and agricultural lands, especially grain fields. Its multiple woody stems grow to about 1 m high which mat together to form small impenetrable thickets, preventing grazing access for animals. It Prefers seasonally dry, heavily-grazed pastures, particularly areas with 400-600 mm annual rainfall. Seed dispersal is mainly by stock wool or hair, machinery, and water.

Saffron thistle occurs as small infestations scattered throughout Hawke's Bay, including Crownthorpe, Bay View, Putorino, Sherenden, Wairere, Havelock North, Maraekakaho, Waipawa, Porangahau, Kahuranaki, and Paki Paki.

The benefits of regional intervention, focused on sustainably controlling saffron thistle as part of a Progressive Containment programme, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

Saffron thistle is a major threat to primary production. To maximise the effectiveness of individual control across the region and to minimise the externality impacts of the plant the Council has proposed an advisory, inspectorial, and compliance regime. The primary beneficiaries of this programme are land occupiers. It is proposed this programme is funded through a 70% targeted rate, 30% general rate.

VELVETLEAF
Abutilon theophrasti

PROGRESSIVE CONTAINMENT

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Erect annual, 1–2.5 m tall, densely hairy, woody at base. Leaves up to 15 cm long, heart-shaped, velvety, soft, margin toothed, tip pointed. Flowers axillary, 30 mm diameter appear spring to autumn. Petals 7–133 mm long, buttery-yellow. Seed capsules about 25 mm across, forming a cup-like ring of 13 woody and hairy segments; segments intact at maturity, each with 1–3 seeds released through a slit on the top of the capsule.
Habitat	Occurs mainly in crop production areas and pasture. In the USA it also occurs in waste areas, roadsides, vacant lots, fence rows, and gardens; but to date it has not been recorded from these areas in NZ.
Regional distribution	Two properties at Puki Puki and Tutira.
Competitive ability	Can potentially affect many arable crops by competing for nutrients, space, and water. It is known to produce allelopathic chemicals that can inhibit germination and growth in many crop plants.
Reproductive ability	A single plant can produce up to 17,000 seeds. Seeds remain viable for long periods (over 50 years),and large numbers of seed can accumulate in the soil seed bank.
Dispersal methods	Spread by contaminated crop seeds, farm machinery and livestock.
Resistance to control	Hand pulling is effective control when only few plants are present. Good control can be achieved in crops with a combination of pre- and post-herbicide applications. However, control can be difficult as seeds can germinate over a long period. Burying seeds deeper than 150 mm may help prevent them from germinating, but burial will not kill seeds as they can remain dormant for decades.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	Low	High
Sheep and beef	Low	High
Forestry	-	-
Horticulture	-	High
Aquaculture	-	-
Urban	-	-
Native terrestrial	-	-
Coastal land	-	Low
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	L	M	As velvetleaf is a new weed incursion, its impacts on pasture, crops and livestock in New Zealand are largely unknown, but they are exected to be signficant based on overseas experience. Moderate infestations that emerge the same time as a crop can reduce production by 25 Sheep and beef	L - See Dairy. Could impact and compete with grasses when establishing pasture.
Forestry	-	-		1
Horticulture	-	H	Velvet leaf is primarily a weed of high fertility, cultivated soils. Moderate infestations that emerge the same time as a crop can reduce production by 25 Aquaculture	-
Other	-	-		
International trade	-	M	As it can grow in crops it has the potential to grow among and contaminate seed crops, and therefore impact on seed exports.	
Environment				
Soil resources	L	M	It can produce allelopathic chemicals that occur in the soil and these supress the germination and growth of other plant species.	1, 2
Water quality	-	-		
Species diversity	-	L	Its threats to indigenous biodiversity are unknown as at this stage it is primarily considered to be a weed of arable land. It is possible it could establish among indigenous vegetation in open and disturbed areas, but it prefers fertile, cultivated soils and so the risk of occurring in and competing with indigenous vegetation is possibly quite low.	1, 3
Threatened species	-	L	See Species diversity.	3
Social/Cultural				
Human health	-	-	Primarily a weed of arable crops and therefore unlikely to impact on human health.	
Recreation	-	-	Primarily a weed of arable crops and therefore unlikely to impact on recreation.	
Māori culture	-	-	Primarily a weed of arable crops and therefore unlikely to impact on maori culture.	

L = low, M = moderate, H = high
source 1: AgPest (2017), 2: Colton & Einhellig (1980), 3: Uva & Neal (1997)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

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Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	54.63–267.08	273.15–600.93
Sheep and beef	7.39–36.12	7.39–36.12
Forestry	0	0
Horticulture	0	1,051.10–9,880.00
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	0	0
Coastal	0	62.35–137.25
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Progressive Containment**
Area of Programme: **whole region ha**
Proposed annual expenditure by Council: **$3,600**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	0.001 ha	Time to reach maximum extent †	50 yrs
Current impacts *	$26.68/ha	Potential extent in the region °	131,146 ha
	$9.06–44.3/ha		43,717.62–218,573.9 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$1,925,706	$0		$0	$0	$0	
	min: 287,812						
	max: 10,114,642						
Progressive Containment	$0	$0	$1,925,706	$13,535	$0	$0	$1,912,171
	min: 0		min: 287,812				min: 274,276
	max: 0		max: 10,114,642				max: 10,101,107

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$1,293,063,230	$0		$0	$0	$0	
	min: 191,744,938						
	max: 6,799,295,909						
Progressive Containment	$0	$0	$1,293,063,230	$19,690	$0	$0	$1,293,043,540
	min: 0		min: 191,744,938				min: 191,725,247
	max: 0		max: 6,799,295,909				max: 6,799,276,219

CBA statement and risks to success

Velvetleaf is a serious cropping weed, potentially affecting many arable crops by competing for nutrients, space, and water. It is declared an Unwanted Organism in New Zealand. Its effect on indigenous biodiversity are unlikely but unknown as at this stage. Due to its preference for sites with fertile and cultivated soils, the risk of occurring in and competing with indigenous vegetation is possibly quite low.

It is a relatively new introduction to the region and occupies bare ground along roadsides and in pasture (e.g. pugging, wheel tracks), including areas that have recently been sprayed. Partially drought tolerant, but requires moist conditions to germinate. Grows best where rainfall exceeds 500 mm/year or in areas with high soil moisture (e.g. ephemeral drains). There are only two known sites in the region, being Paki Paki and Tutira.

The benefits of regional intervention, focused on sustainably controlling velvetleaf as part of a Progressive Containment programme, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

Velvetleaf is a major threat to primary production. To maximise the effectiveness of individual control across the region and to minimise the externality impacts of the plant the Council has proposed an advisory, inspectorial, and compliance regime. The primary beneficiaries of this programme are land occupiers. It is proposed this programme is funded through a 70% targeted rate, 30% general rate.

WOOLLY NIGHTSHADE
Solanum mauritianum

PROGRESSIVE CONTAINMENT

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Perennial shrub or small tree of up to 4 m high. Leaves are grey green, ovate and densely covered with furry hairs. Violet flowers and a dull yellow berry.
Habitat	Able to establish in a wide variety of climates and soil types. Habitat limitations not well known in New Zealand.
Regional distribution	Mainly an urban problem.
Competitive ability	Can eliminate other species in dense stands. Effects on native bush not well known. Some believe that it will be shaded out over time, while others think it will continue to dominate.
Reproductive ability	Large numbers of seeds produced with 95% viability. 3 year-old plants recorded bearing 10,000 seeds.
Dispersal methods	Most seeds fall close to parent. Some spread by birds.
Resistance to control	Control by herbicides, cut and stump treatment, ring-barking, basal treatment and hand pulling.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	-	Low
Sheep and beef	Low	Low
Forestry	Low	High
Horticulture	-	Low
Aquaculture	-	-
Urban	Low	Low
Native terrestrial	Low	High
Coastal land	-	Low
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	L	Thought to be toxic to stock.	
Sheep and beef	L	M	Can form dense stands on rough pasture. Displaces pasture grasses and clover, thus reducing food availability for stock. Thought to be toxic to stock.	
Forestry	L	M	Could compete with young trees in plantation forests.	1, 2
Horticulture	-	L	Can form dense stands and invade open, disturbed or poorly managed areas.	
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	L	H	Forms dense, often pure stands, outcompeting most other species. Inhibits and slows regeneration of native plant species.	2
Threatened species	L	M	See Species diversity.	2
Social/Cultural				
Human health	L	M	Can cause skin irritation and respiratory problems in some people.	2
Recreation	L	M	Forms dense stands which obstruct access.	2
Māori culture	L	M	See Human Health and Recreation.	

L = low, M = moderate, H = high

source 1: Environment Bay of Plenty (2004a), 2: Environment Bay of Plenty (2005b)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	54.63–267.08
Sheep and beef	7.39–36.12	36.95–81.27
Forestry	17.47–85.40	87.35–192.15
Horticulture	0	105.11–790.40
Aquaculture	0	0
Environment/Social/Cultural		
Urban	5.33–56.05	26.64–126.11
Native terrestrial	5.56–27.20	55.60–340.00
Coastal	0	124.70–762.50
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Progressive Containment**

Area of Programme: **whole region ha**

Proposed annual expenditure by Council: **$30,000**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	1.25 ha	Time to reach maximum extent†	125 yrs
Current impacts*	$24.96/ha	Potential extent in the region°	96,049 ha
	$8.39–41.53/ha		33,513.29–158,584.4 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years may be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$20,419	$0		$0	$0	$0	
	min: 4,602						
	max: 95,187						
Progressive Containment	$46	$0	$20,373	$65,320	$16,871	$0	$-61,818
	min: 15		min: 4,587		min: 16,871		min: -77,604
	max: 144		max: 95,043		max: 16,871		max: 12,852

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

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‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$2,598,830	$0		$0	$0	$0	
	min: 642,176						
	max: 11,857,607						
Progressive Containment	$46	$0	$2,598,784	$71,475	$16,871	$0	$2,510,438
	min: 15		min: 642,161		min: 16,871		min: 553,815
	max: 144		max: 11,857,463		max: 16,871		max: 11,769,117

CBA statement and risks to success

Woolly nightshade grows very rapidly and can crowd-out or shade-out native plants to form dense stands. It poisons the soil to inhibit or prevent the establishment of native plant seedlings and slows the regeneration of native forests. It is moderately shade tolerant, tolerant to frost and requires medium to high soil fertility. Dense stands can invade pasture on poor soils, especially in hill country areas and impede livestock movement. All parts of the plant are thought to be toxic to livestock and handling the plants can cause irritation and nausea.

It grows in open locations, forest and plantation margins, scrub and waste land. In Hawke's Bay, woolly nightshade is mainly found in the more temperate urban areas. It is primarily found in urban areas across approximately 8,800ha. The CBA for woolly nightshade suggests that this form of regional intervention will have monetarised benefits over a 50 year timeframe.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

Woolly nightshade is a threat to primary production and biodiversity values in the Hawke's Bay region. To maximise the effectiveness of individual control across the region and to minimise the externality impacts of the plant the

Council has proposed an advisory, inspectorial, and compliance regime. The benefits of this programme are a public good rather than a private good, particularly given that the main infestation is within the urban environment. It is proposed this programme is funded through the general rate.

SUSTAINED CONTROL PESTS

FERAL CAT
Felis catus

PREDATOR CONTROL AREAS

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Resemble domestic cats in both size and colouration. Females average about 75% of the weight of males.
Habitat	Inhabits a wide range of urban, rural and forest habitats. Found from sea level to alpine habitats.
Regional distribution	Throughout the region.
Competitive ability	Diet is wide-ranging and includes small mammals, fish, birds and invertebrates.
Reproductive ability	2-3 litters per year with an average of 4 young in each.
Resistance to control	Controlled by poisons, trapping and shooting. No natural predators.
Benefits	Controls rodents and to some degree mustelids (young stoats and weasels).

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	High	High
Sheep and beef	High	High
Forestry	High	High
Horticulture	Low	Low
Aquaculture	-	-
Urban	Low	-
Native terrestrial	High	High
Coastal land	Low	Low
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	L	L	Can transmit bovine Tb which can be transferred to cattle. In an area with Tb-infected cattle, a study found 1 in 50 cats had gross lesions typical of Tb.	
Sheep and beef	L	L	Carry many parasites and both feral and farm cats can transmit Toxoplasma gondii to sheep, causing toxoplasmosis. Sheep become infected from eating contaminated pasture, concentrate feeds and hay. Once ingested, the toxoplasma spreads to the sheep's muscles and brain, and also into the placenta.	
Forestry	-	-		1, 2, 3, 4
Horticulture	-	-		
Aquaculture	-	-		
Other	-	-		
International trade	-	L	Tuberculosis vector - presence of bovine Tb in cattle has a major impact on exports.	
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	M	H	Eats native birds, lizards and invertebrates.	1, 2, 3, 4
Threatened species	M	H	Predator of eggs and chicks of threatened native birds and lizards (e.g. brown teal, NZ dotterel).	1, 2
Social/Cultural				
Human health	L	L	Can bite and scratch. Can transmit Toxoplasma gondii and cause toxoplasmosis to humans.	1
Recreation	-	-		1
Māori culture	-	-		

L = low, M = moderate, H = high

source 1: King (2005), 2: Auckland Regional Council (2004), 3: Environment Bay of Plenty (2003), 4: Taranaki Regional Council (2013a)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	54.63–267.08	54.63–267.08
Sheep and beef	7.39–36.12	7.39–36.12
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	5.33–56.05	0
Native terrestrial	27.80–61.20	55.60–340.00
Coastal	62.35–137.25	124.70–762.50
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Sustained Control**
Area of Programme: **whole region ha**
Proposed annual expenditure by Council: **$200,000**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	1,321,293 ha	Time to reach maximum extent†	50 yrs
Current impacts*	$26.79/ha	Potential extent in the region°	1,321,293 ha
	$11.9–41.69/ha		1,321,293–1,321,293 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$322,562,194	$0		$0	$0	$0	
	min: 143,200,004						
	max: 501,924,385						
Sustained Control	$51,770,501	$0	$270,791,693	$300,705	$2,934,796	$0	$267,556,192
	min: 22,983,276		min: 120,216,728		min: 1,956,530		min: 116,002,962
	max: 80,557,725		max: 421,366,660		max: 3,913,061		max: 419,109,425

★ Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS★	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$795,959,363	$0		$0	$0	$0	
	min: 353,362,501						
	max: 1,238,556,225						
Sustained Control	$51,770,501	$0	$744,188,862	$306,860	$2,934,796	$0	$740,947,206
	min: 22,983,276		min: 330,379,225		min: 1,956,530		min: 326,159,304
	max: 80,557,725		max: 1,157,998,500		max: 3,913,061		max: 1,155,735,110

CBA statement and risks to success

Cats are generalist predators and can have large home ranges. It is estimated that feral, stray and pet cats kill up to 100 million birds in New Zealand each year. They are a major predator of kiwi chicks and also eat eggs, lizards, invertebrates and frogs. Cats can transmit bovine Tb and carry many parasites including Toxoplasma gondii.
This programme provides the opportunity for communities to decide whether they would like to control feral cats and their impacts through a predator control programme. It is dependent on funding from central government or philanthropic providers to pay for the initial set up of maintenance infrastructure.
The benefits of regional intervention, focused on sustainably controlling feral cats as part of a predator control programme, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS
Land occupiers (Crown and private)	Major	Major	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes
Regional community	Major	Minor	Yes	Yes

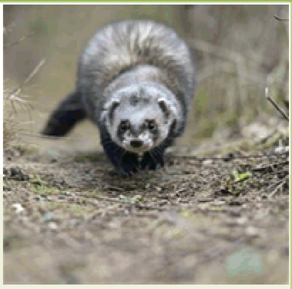
Who should pay for the proposed management approach?

There are both biodiversity benefits and primary production benefits from managing feral cat densities. Although the general community will benefit from the biodiversity gains, the primary beneficiary of feral cat control will be the agricultural sector. This is due to the programme being delivered in rural areas and the benefit from reducing the spread of parasites such as Toxoplasma gondii.

This cost benefit analysis for feral cats is one components of the predator control programme. The second component is mustelid control. It is proposed the overall predator control programme if funded through a 60% targeted rate, 40% general rate funding ratio. This funding is for initial control and setup of maintenance infrastructure. The ongoing maintenance costs will be met by land occupiers.

MUSTELID

Mustela furo, M. erminea, M. nivalis



PREDATOR CONTROL AREAS

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	See individual descriptions for ferret, stoat, and weasel
Habitat	See individual descriptions for ferret, stoat, and weasel
Regional distribution	Throughout the region.
Competitive ability	See individual descriptions for ferret, stoat, and weasel
Reproductive ability	See individual descriptions for ferret, stoat, and weasel
Resistance to control	See individual descriptions for ferret, stoat, and weasel
Benefits	See individual descriptions for ferret, stoat, and weasel

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	High	High
Sheep and beef	High	High
Forestry	High	High
Horticulture	Low	Low
Aquaculture	-	-
Urban	Low	Low
Native terrestrial	High	High
Coastal land	Low	High
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	M	M		
Sheep and beef	L	M		
Forestry	-	-		
Horticulture	-	-		
Aquaculture	-	-		
Other	-	-		
International trade	-	L		
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	M	H		
Threatened species	M	H		
Social/Cultural				
Human health	L	L		
Recreation	-	-		
Māori culture	L	H		

L = low, M = moderate, H = high

source 1:

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level

Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	273.15–600.93	273.15–600.93
Sheep and beef	7.39–36.12	36.95–81.27
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	5.33–56.05	5.33–56.05
Native terrestrial	27.80–61.20	55.60–340.00
Coastal	62.35–137.25	124.70–762.50
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Sustained Control**

Area of Programme: **whole region ha**

Proposed annual expenditure by Council: **200,000**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	1,251,752 ha	Time to reach maximum extent †	50 yrs
Current impacts *	$32.96/ha	Potential extent in the region °	1,251,752 ha
	$16.77–49.16/ha		1,251,752–1,251,752 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$375,941,684	$0		$0	$0	$0	
	min: 191,283,758						
	max: 560,599,609						
Sustained Control	$60,337,787	$0	$315,603,897	$300,705	$2,780,333	$0	$312,522,859
	min: 30,700,609		min: 160,583,149		min: 1,853,555		min: 156,575,334
	max: 89,974,966		max: 470,624,643		max: 3,707,110		max: 468,470,383

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* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$927,679,401	$0		$0	$0	$0	
	min: 472,014,703						
	max: 1,383,344,098						
Sustained Control	$60,337,787	$0	$867,341,614	$306,860	$2,780,333	$0	$864,254,421
	min: 30,700,609		min: 441,314,094		min: 1,853,555		min: 437,300,124
	max: 89,974,966		max: 1,293,369,132		max: 3,707,110		max: 1,291,208,717

CBA statement and risks to success

Mustelids can be devastating to native bird life and other fauna, through predating native birds, lizards, frogs and large native invertebrates. Mustelids can also transmit bovine Tb.

New technologies are constantly being worked on in an effort to develop cost effective tools for region-wide management of mustelids. This programme provides the opportunity for communities to decide whether they would like to control mustelids and their impacts through a predator control programme. It is dependent on funding from central government or philanthropic providers to pay for the initial set up of maintenance infrastructure.

The benefits of regional intervention, focused on sustainably controlling mustelids as part of a predator control programme, outweigh the cost of the programme

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS
Land occupiers (Crown and private)	Major	Major	Yes	Yes
Dairy/sheep and beef sector	Minor		No	Yes
Regional community	Major		No	Yes

Who should pay for the proposed management approach?

Although mustelids can transmit bovine Tb, the primary benefit of this programme will be biodiversity gains. Both the agricultural sector and the regional community will be a beneficiary of mustelid control.

This cost benefit analysis for mustelid control is one components of the predator control programme. The second component is feral cat control. It is proposed the overall predator control programme if funded through a 60% targeted rate, 40% general rate funding ratio. This funding is for initial control and setup of maintenance infrastructure. The ongoing maintenance costs will be met by land occupiers.

POSSUM

Trichosurus vulpecula

SUSTAINED CONTROL

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Small marsupial similar in size to a cat with large eyes, oval ears, cat-like whiskers and a pointed snout. Has thick bushy tail and can be grey, brown or black in colour.
Habitat	Native and exotic forest, shrubland, farmland, orchards and urban areas. Has favoured food species, but will feed on wide range of species.
Regional distribution	Throughout the region.
Competitive ability	Has the ability to cause local extinctions of palatable plant species and cause major forest structure modifications. Eats invertebrates and will also take fledging birds and eggs from nests. Significant silvicultural and horticultural pests and also compete with stock for pasture.
Reproductive ability	Females breed from age one. In ideal conditions can produce two offspring per year.
Resistance to control	Controlled by poisoning, trapping and shooting. Can become 'shy' to any one method if the same method is used constantly.
Benefits	Valuable fur trade (according to the fur buying company Basically Bush, in one year the Taranaki region produced 4800 kg of possum pelts worth $95/kg = $465,000).

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	Low	Low
Sheep and beef	Low	Low
Forestry	Low	High
Horticulture	Low	Low
Aquaculture	-	-
Urban	Low	Low
Native terrestrial	Low	High
Coastal land	Low	High
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	L	H	Competes with stock for pasture, and is the main vector for bovine Tb spread.	
Sheep and beef	M	H	See Dairy.	
Forestry	L	M	Significant silvicultural pest.	1, 2
Horticulture	M	H	Major horticultural pest.	
Aquaculture	-	-		
Other	-	-		
International trade	M	H	Vector for bovine Tb in cattle. The presence of bovine Tb in cattle herds is a risk to dairy and meat exports.	2, 3
Environment				
Soil resources	L	M	Removal of vegetation and forest collapse can lead to soil erosion.	2
Water quality	L	M	Erosion of soil can lead to increased sedimentation in waterways.	2
Species diversity	H	H	Has major impacts on native forest and shrubland. Can suppress or eliminate preferred (palatable) plant species by selective browsing, which alters vegetation composition. Excessive browse can also lead to collapse of palatable canopy species e.g. Northern rata. Competes with native bird species for food, and eats chicks and eggs.	1, 2
Threatened species	M	M	Can eliminate or suppress threatened plant species e.g. mistletoes. Predator of eggs of North Is kokako. Can compete for nest sites with hole-nesting birds such as kiwi, parakeets and saddlebacks.	2
Social/Cultural				
Human health	L	M	Could transmit Tb to humans.	2
Recreation	M	H	Damage and eliminate palatable native plant species and alter structure of native forests, which can affect recreational experiences.	2
Māori culture	M	H	Destroys native forests and eats culturally important plants (e.g. koromiko).	

L = low, M = moderate, H = high

source 1: Auckland Regional Council (2004), 2: King (2005), 3: TBfree New Zealand (2013)

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Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	54.63–267.08	546.30–3,338.50
Sheep and beef	36.95–81.27	73.90–451.50
Forestry	17.47–85.40	87.35–192.15
Horticulture	525.55–1,778.40	1,051.10–9,880.00
Aquaculture	0	0
Environment/Social/Cultural		
Urban	5.33–56.05	26.64–126.11
Native terrestrial	55.60–340.00	55.60–340.00
Coastal	124.70–762.50	124.70–762.50
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Site-led**
Area of Programme: **948,298.9 ha**
Proposed annual expenditure by Council: **$1,215,945**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	28,448.97 ha	Time to reach maximum extent†	50 yrs
Current impacts*	$88.74/ha	Potential extent in the region°	45,155 ha
	$46.47–131.01/ha		28,448.97–61,860.28 ha
Current benefits	$5/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS★	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$34,211,684	$1,342,577		$0	$0	$0	
	min: 12,044,705	min: 1,199,882					
	max: 68,188,317	max: 1,597,582					
Site-led	$22,111,130	$1,194,870	$11,952,847	$9,413,366	$274,820	$0	$2,264,661
	min: 11,578,915	min: 1,194,870	min: 63,078		min: 71,692		min: -9,828,236
	max: 32,643,345	max: 1,194,870	max: 35,539,960		max: 477,948		max: 26,054,902

★ Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS★	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$155,648,839	$3,972,260		$0	$0	$0	
	min: 29,721,697	min: 3,177,959					
	max: 416,763,804	max: 5,634,842					
Site-led	$53,741,947	$3,124,530	$101,059,162	$24,931,854	$274,820	$0	$75,852,488
	min: 28,142,995	min: 3,124,530	min: -931,610		min: 71,692		min: -26,341,412
	max: 79,340,900	max: 3,124,530	max: 337,369,475		max: 477,948		max: 312,365,929

CBA statement and risks to success

Possums can have a significant impact on production (dairy, sheep and beef, forestry, and horticulture), environmental and social/cultural values. They are widespread across all forms of habitat in Hawke's Bay.

Hawke's Bay Regional Council has been controlling possums through its Possum Control Area (PCA) programme since 2000. There has been a very high level of support for the PCA programme, and a strong belief by most land occupiers within the programme that it is providing value for money for programme participants. The programme has grown to over 700,000ha and is exceeding its target with an average residual trap catch (RTC) of 2.3% across all PCA programmes. Rules requiring land occupiers to maintain possum numbers at low levels are necessary to support the programme so as to protect production and biodiversity values and address externality impacts on neighbouring properties.

The benefits of regional intervention, focused on sustainably controlling possums as part of a possum control area programme, outweigh the cost of the programme.

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low to medium	The Self help Possum Control Programme has been demonstrated to be sustainable and cost-effective in addressing the externality impacts of possums on intensively-farmed land. There is some risk on the boundaries of the programme of high possum impact on properties adjacent to Egmont National Park of State Highway 3, but to date this has been manageable.
Operational risk	Low	See above
Legal risk	Low to medium	Continued success of Self-help Possum Control Programme will reply on willingness of Department of Conservation to undertake regular boundary control measures in the Egmont National Park and TRC allocating resources to control the eastern boundary to reduce re-infestation.
Socio-political risk	Low	Public concerns relating to Department of Conservation used of 1080 have previously been noted but the risks are considered acceptable. The proposed programme will be tested through the Plan review process but it is a continuation of the existing approach for which no public or political concerns have been raised.
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

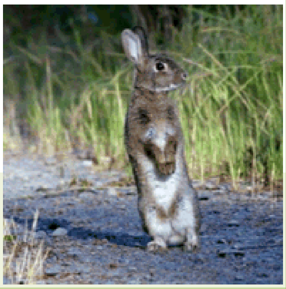
Who should pay for the proposed management approach?

Possum are a major threat to production and conservation values in Hawke's Bay. In farming areas, they spread bovine tuberculosis to beef and dairy cattle, and to farmed deer, damage crops and orchards, kill poplars and willows planted to control hill-country erosion and stabilise riverbanks, and eat pasture. In exotic forest plantations they kill young trees and stunt the growth of older trees by ring-barking them or breaking the uppermost branches.
In native vegetated areas, possums cause severe damage by altering habitats important to native animals and birds. Tree species that are palatable to possums (e.g. rata, kamahi, and pohutukawa) become much reduced or locally extinct, and are replaced by plants that are less palatable such as tree ferns and pepperwood. As well as altering the composition of native forests and competing with native fauna, possums also prey directly on native insects and birds.

It is proposed this programme is funded through a 70% targeted rate, 30% general rate.

RABBIT
Oryctolagus cuniculus

SUSTAINED CONTROL



Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Rabbits are about the size of a small domestic cat, grey-brown in colour with a reddish neck and white under-parts. Both sexes are alike.
Habitat	Generally found in open habitats e.g. pasture, orchards, arable land, parks and gardens.
Regional distribution	Throughout the region.
Competitive ability	Rabbits compete directly with stock for pasture; 8–10 rabbits eat as much as one sheep. In the Bay of Plenty they are responsible for severe browsing damage to palatable dune plants.
Reproductive ability	Can breed throughout the year. In peak years can produce up to 7 litters resulting in 45–50 young per adult doe per year.
Resistance to control	Controlled by poisoning, fumigation, shooting, trapping, exclusion fencing and predation. Become 'shy' to any one method if the same method is used constantly.
Benefits	May help control exotic weeds in coastal dunes.

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	Low	High
Sheep and beef	Low	High
Forestry	Low	Low
Horticulture	Low	High
Aquaculture	-	-
Urban	Low	Low
Native terrestrial	Low	Low
Coastal land	Low	High
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	M	M	Causes major damage to pastures.	
Sheep and beef	M	M	10 rabbits can eat as much as one sheep.	
Forestry	L	L		1, 2
Horticulture	L	L		
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	L	H	Causes major disturbance and erosion of soil through burrowing, and a reduction in vegetation cover through browsing.	2
Water quality	L	L	Erosion of soil can lead to increased sedimentation in waterways.	2
Species diversity	M	H	Eats native low-growing native plants in non-forested habitats such as sand dunes and beaches.	1, 2
Threatened species	L	M	Heavy browsing can prevent reproduction and/or eliminate low-growing threatened plant species e.g. native brooms.	1, 2
Social/Cultural				
Human health	-	-		
Recreation	L	L	Digs holes in golf courses and playing fields.	2
Māori culture	L	M	Can dig up cultural sites, esp. near the coast (e.g. waahi tapu, urupa).	

L = low, M = moderate, H = high
source 1: Auckland Regional Council (2004), 2: King (2005)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	273.15–600.93	273.15–600.93
Sheep and beef	36.95–81.27	36.95–81.27
Forestry	17.47–85.40	17.47–85.40
Horticulture	105.11–790.40	105.11–790.40
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	27.80–61.20	55.60–340.00
Coastal	62.35–137.25	124.70–762.50
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Sustained Control**
Area of Programme: **whole region ha**
Proposed annual expenditure by Council: **$59,704**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	945,767.8 ha	Time to reach maximum extent †	50 yrs
Current impacts *	$68.37/ha	Potential extent in the region °	945,768 ha
	$37.93–98.81/ha		945,767.8–945,767.8 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS *	PEST VALUES °	BENEFIT	COUNCIL COSTS †	LANDOWNERS COMPLIANCE COSTS ‡	AGENCY COMPLIANCE COSTS ‡	NET BENEFIT
No intervention	$589,118,848	$0		$0	$0	$0	
	min: 326,837,606						
	max: 851,400,091						
Sustained Control	$566,336,565	$0	$22,782,283	$503,623	$184,295	$0	$22,094,365
	min: 314,198,209		min: 12,639,397		min: 184,295		min: 11,951,479
	max: 818,474,921		max: 32,925,170		max: 184,295		max: 32,237,252

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$1,453,718,606	$0		$0	$0	$0	
	min: 806,509,434						
	max: 2,100,927,778						
Sustained Control	$1,376,502,693	$0	$77,215,913	$1,333,875	$184,295	$0	$75,697,743
	min: 763,670,771		min: 42,838,663		min: 184,295		min: 41,320,493
	max: 1,989,334,615		max: 111,593,163		max: 184,295		max: 110,074,993

CBA statement and risks to success

Rabbits eat a variety of plant matter, competing directly with stock for grazing, damaing seedlings of trees and crops as well as native species. A sustained control programme outcome (to reduce the impacts and spread to other properties) is the preferred option and represents the most pragmatic and affordable management approach.

The benefits of regional intervention, focused on sustainably controlling rabbits throughout the region, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS
Land occupiers (Crown and private)	Major	Major	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes
Regional community	Major		No	Yes

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Who should pay for the proposed management approach?

Although there minor biodiversity benefits from managing rabbit densities, the primary beneficiary of rabbit control is the agricultural sector. It is proposed that this programme is funded through a 70% targeted rate and 30% general rate.

CHILEAN NEEDLE GRASS
Nassella neesiana

SUSTAINED CONTROL

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Erect, tufted, perennial grass that grows to 1.2 m tall. Leaves are up to 5 mm wide, bright green and harsh. Flowers have a purple tinge and ripen into hard, sharp seeds with long twisting tails. Seeds are up to 10 mm long, with a hard, sharply-pointed head and a long (c.70 mm long) hair-like awn (tail). Difficult to identify (esp. when not flowering).
Habitat	Prefers disturbed grasslands and grassy woodlands with moderate rainfall. Can occur in agricultural areas, natural forests, grasslands, scrub, waterways, and riparian areas.
Regional distribution	Summer dry areas of Hawke's Bay - west of Napier and at Maraekakaho, Poukawa, Waipawa, Wakarara, Omakere and Porangahau.
Competitive ability	Forms dense stands, excluding other species, and decreasing pasture productivity. Pastures experiencing drought are most susceptible to invasion. It can establish on the hardest bare sites on disturbed ground. Is long-lived and very hardy.
Reproductive ability	Both sexual and asexual seed production. Can produce up to 22,000 seeds/plant/year via sexual reproduction (depending on moisture availability). Asexual seeds are hidden in the nodes and bases of flowering stems; these enable the plant to reproduce even with grazing, slashing and fire. Can flower all year around. Seed bank can persist for up to 12 years.
Dispersal methods	Mostly spread by stock, machinery, hay, and humans rather than wind because seeds are heavy and tend to fall close to the plant. The point of the seed is very sharp and hairy and attaches easily onto animals, vehicles and clothing.
Resistance to control	Once established, is very difficult to control as seeds are viable for many years. Individual plants should be grubbed out and destroyed by burning. Larger patches can be sprayed with glyphosate, but seedlings will readily invade bare soil and must be sprayed before they produce seed. A combination of chemical, mechanical, rehabilitation, competition, grazing management and biological control are required to eradicate it.
Benefits	Can provide winter-only food for stock, but this is balanced by the reduction in pasture-palatability at other times of year.

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	Low	High
Sheep and beef	Low	High
Forestry	Low	Low
Horticulture	Low	Low
Aquaculture	-	-
Urban	Low	High
Native terrestrial	Low	Low
Coastal land	-	High
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	L	L	Agricultural productivity can be severely reduced by the replacement of palatable vegetation, injury to stock, reduction of produce quality and increased management costs.	
Sheep and beef	L	H	Seeds can cause pelt damage, and painful wounds both externally and internally when they move through skin into muscles. Carcasses are downgraded, blindness can occur and seeds can get into ears. Farm dogs can be similarly affected. Some sheep graziers in eastern Australia have been forced to switch to beef production.	
Forestry	-	-		1, 2, 3, 4
Horticulture	-	L	Potential crop contaminant.	
Aquaculture	-	-		
Other	-	-		
International trade	-	L	A weed of National Significance in Australia. Grain, alpacas and sheep are occasionally exported to Australia.	3, 5
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	L	H	Highly invasive in native grasslands, where it can replace native plants, and alter invertebrate community composition.	3, 5
Threatened species	L	M	Potential distribution overlaps with some threatened grassland plant species.	3
Social/Cultural				
Human health	-	L	Can cause skin irritations.	3
Recreation	L	M	Seeds get caught in clothes and socks making it unpleasant for humans and dogs to walk through.	2
Māori culture	-	-		

L = low, M = moderate, H = high

source 1: Hawke's Bay Regional Council (2002), 2: Environment Canterbury (2008), 3: Laconis (2004), 4: Young & Evans (1969), 5: Invasive Species Specialist Group (2005)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	54.63–267.08	54.63–267.08
Sheep and beef	7.39–36.12	73.90–451.50
Forestry	0	0
Horticulture	0	105.11–790.40
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	5.33–56.05
Native terrestrial	5.56–27.20	55.60–340.00
Coastal	0	124.70–762.50
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Sustained Control**
Area of Programme: **whole region ha**
Proposed annual expenditure by Council: **$160,000**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	665 ha	Time to reach maximum extent†	75 yrs
Current impacts*	$19.92/ha	Potential extent in the region°	144,237 ha
	$6.76–33.07/ha		48,933.59–239,540.9 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

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10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$3,041,431	$0		$0	$0	$0	
	min: 696,987						
	max: 6,796,569						
Sustained Control	$103,169	$0	$2,938,262	$759,180	$421,767	$0	$1,757,315
	min: 16,205		min: 680,782		min: 421,767		min: -500,165
	max: 282,289		max: 6,514,280		max: 421,767		max: 5,333,333

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$452,588,175	$0		$0	$0	$0	
	min: 70,375,697						
	max: 2,181,272,273						
Sustained Control	$170,161	$0	$452,418,014	$1,872,898	$421,767	$0	$450,123,349
	min: 16,205		min: 70,359,492		min: 421,767		min: 68,064,827
	max: 1,285,338		max: 2,179,986,935		max: 421,767		max: 2,177,692,270

CBA statement and risks to success

Chilean needle grass can reduce agricultural productivity by replacing palatable vegetation, reducing produce quality and increasing management costs. Seeds can cause pelt damage, and painful wounds both externally and internally when they move through skin into muscles. Carcasses are downgraded, blindness can occur and seeds can get into ears. It is likely to invade native grasslands, where it can replace native plants, and alter invertebrate community composition.

Chilean needle grass is very hard to identify and can go undetected on a property for many years. The seeds are easily transported on stock, clothing and machinery. This makes managing Chilean needle grass very difficult. On average eight new properties are found annually within the region. There are almost no viable and effective control tools for large infestations. This poses a risk to the success of the programme.
The objective of preventing the spread of Chilean needle grass is going to be difficult to achieve but it would be irresponsible for Council to select the option of no regional intervention.

The benefits of regional intervention, focused on sustainably controlling Chilean needle grass throughout the region, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Medium	
Operational risk	Low	
Legal risk	Medium	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS
Land occupiers (Crown and private)	Major	Major	Yes	Yes
Dairy/sheep and beef sector	Major	Major	Yes	Yes
Regional community	Major		No	Yes

Who should pay for the proposed management approach?

Although there are minor biodiversity benefits from managing Chilean needle grass, the primary beneficiary is the agricultural sector. It is proposed that this programme is funded through a 70% targeted rate and 30% general rate.

PRIVET
Ligustrum lucidum, L. sinense

URBAN AREA

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Tree privet is a medium-sized evergreen tree growing up to 10 m tall. Chinese privet is an evergreen or semi-deciduous shrub or small tree up to 5 m tall.
Habitat	Widely grown as hedging plants. Occur in lowland and coastal forest, mostly remnants and shrub land. Urban areas, disturbed sites, roadside banks, waste areas.
Regional distribution	Urban problem.
Competitive ability	Tree privet is shade-tolerant and competitive on a wide range of soils. Chinese privet is also shade-tolerant (probably also shade-requiring). Fire intolerant.
Reproductive ability	Both species produce 100,000–10,000,000 seeds per bush or tree.
Dispersal methods	Seed dispersed by birds.
Resistance to control	Adequately controlled by cutting and painting with metsulfuron, but this can possibly damage surrounding vegetation.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRNET INFESTATION	POTENTIAL INFESTATION
Dairy	-	Low
Sheep and beef	Low	Low
Forestry	Low	Low
Horticulture	Low	Low
Aquaculture	-	-
Urban	Low	High
Native terrestrial	Low	High
Coastal land	-	Low
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	L	Can form dense stands and reduce pasture cover.	
Sheep and beef	L	L	Can form dense stands and reduce pasture cover.	
Forestry	L	L	Potential to invade plantation forests, and compete with young trees.	1
Horticulture	L	L	Can form dense stands and invade open, disturbed or poorly managed areas.	
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	L	M	Dense stands prevent recruitment. Displaces vulnerable shrub species. Poisonous berries may possibly impact on native fauna, esp. insects.	2
Threatened species	L	L	See Species diversity.	2
Social/Cultural				
Human health	L	M	Berries and leaves are poisonous. There is no convincing evidence that pollen affects asthma and hay fever although many people believe this.	
Recreation	L	M	Forms dense stands which obstruct access.	2
Māori culture	L	M	See Human Health and Recreation.	

L = low, M = moderate, H = high

source 1: Environment Bay of Plenty (2004a), 2: Craw (2000)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	54.63–267.08
Sheep and beef	7.39–36.12	7.39–36.12
Forestry	17.47–85.40	17.47–85.40
Horticulture	105.11–790.40	105.11–790.40
Aquaculture	0	0
Environment/Social/Cultural		
Urban	5.33–56.05	26.64–126.11
Native terrestrial	5.56–27.20	27.80–61.20
Coastal	0	62.35–137.25
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Sustained control**

Area of Programme: **22,720 ha**

Proposed annual expenditure by Council: **$180,000**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	30 ha	Time to reach maximum extent†	125 yrs
Current impacts*	$30.69/ha	Potential extent in the region°	3,408 ha
	$5.33–56.05/ha		1,136–5,680 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will not be of net benefit to the region with the assumptions made.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$14,392	$0		$0	$0	$0	
	min: 2,703						
	max: 27,808						
Sustained control	$8,097	$0	$6,295	$1,096,593	$0	$0	$-1,090,298
	min: 1,406		min: 1,297				min: -1,095,296
	max: 14,788		max: 13,020				max: -1,083,573

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits of the proposed management programme over the next 50 years will still not be of net benefit to the region with the assumptions made.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$236,252	$0		$0	$0	$0	
	min: 47,168						
	max: 705,539						
Sustained control	$19,904	$0	$216,348	$2,904,391	$0	$0	$-2,688,043
	min: 3,456		min: 43,712				min: -2,860,679
	max: 36,352		max: 669,187				max: -2,235,204

CBA statement and risks to success

Although privet has negative impacts on biodiversity, the proposed programme focusses on human health in urban areas only. The benefits of intervention, focused on sustainably controlling privet for human health purposes, do not outweigh the cost of the programme. However, given the new restrictions to the programme making it more focussed on actual privet sufferers, this programme has been retained in the Regional Pest Management Plan.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

The proposed programme focusses on human health in urban areas therefore it is proposed that it is funded through the general rate.

BATHURST BUR

Xanthium spinosum

BOUNDARY CONTROL

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Compact annual herb, which can become woody or bush, 30-100cm tall. Stems have groups of three-pronged, stiff, yellow spines at the base of each leaf or branch. Leaves are dark grey to green with prominent white veins and fine silvery hairs underneath. Tiny, greenish-crem flowers develop into hard brown burs, 10-12mm long, covered with many hooked spines. Burs contain two brown or black flattened seeds, each c. 1cm long.
Habitat	Cultivated areas, along rivers, disturbed sites, and coastal areas.
Regional distribution	Widespread throughout the region in pastoral and cropping areas.
Competitive ability	Very hardy and robust invader of pasture and open wasteland.
Reproductive ability	Each bur contains two seeds, one of which germinates the first summer, while the other remains dormant for 2-3 years, occasionally up to 15 years. Seeds germinate from November to January.
Dispersal methods	Burs remain attached to dead plants until they are trampled or transported elsewhere by animals. The burs cling to wool, fur, sacking, clothing and any fibrous material. Seeds are therefore mainly dispersed by animals and people.
Resistance to control	Isolated plants can be hand-pulled or grubbed out, and young plants can be controlled with chemicals (best in late spring). Chemical control is more difficult when plants mature and become woody.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	High	Low
Sheep and beef	High	High
Forestry	-	-
Horticulture	High	High
Aquaculture	-	-
Urban	-	-
Native terrestrial	Low	High
Coastal land	-	-
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	L	H	Spiky leaves and burs restrict animal movement, and spines can damage feet and skin of livestock.	
Sheep and beef	M	H	Burs are extremely difficult to remove from wool. Affected wool has significantly reduced value due to increased scouring costs. Can cause shearing combs to jam and break	
Forestry	-	-		1, 2, 3, 4
Horticulture	M	H	Competes with crops in cultivated land. Summer crop species such as maize, sorghum and sunflowers can be contaminated by burs.	
Aquaculture	-	-		
Other	-	L	Seedlings can be toxic to stock when very small. Pigs are affected more than sheep or cattle. Bird seed, poultry feed, horse oats and produce such as tomatoes can also carry burs.	
International trade	L	H	Affected wool has significantly reduced value due to increased scouring costs.	2
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	-	-		3
Threatened species	-	-		
Social/Cultural				
Human health	L	L	The plant is mildly poisonous, and can irritate the skin of shearers or cause contact dermatitis in some people.	4
Recreation	L	L	Spiky leaves and burs restrict access	2,4
Māori culture	-	-		

L = low, M = moderate, H = high

Source: 1: Popay et al. (2010), 2: Hawke's Bay Regional Council (1996), 3: NRC (1998), 4: Auckland Council (2008)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	51.81–207.24	297.54–1308.36
Sheep and beef	0.85–2.42	4.86–42.45
Forestry	0	0
Horticulture	100.97	579.83
Aquaculture	0	0
Non-production		
Environment	0	0
Social/Cultural	0	0

Cost-benefit analysis results

Proposed management programme: **Sustained control**

Area of Programme: **whole region**

Proposed annual expenditure by Council: **$15**

CBA statement and risks to success

Bathurst Bur is invasive and difficult to control. If no action is taken it will spread to more sites, its numbers will increase and its impact will become more severe. Bathurst Bur is a serious agricultural weed that has the potential to spread across the region if no action is taken. Unfortunately Bathurst bur's current regional distribution is beyond the scope of affordable or cost-effective region wide control. However, since most propagules fall within a short distance of parent plants, this spread between neighbouring properties can be slowed by maintaining a width of boundary land clear of this weed. The proposed boundary control width for Bathurst bur is five meters. While such boundary control is not considered likely to alter the region wide extent of the weed, for the small proposed expenditure it is considered cost beneficial from a good neighbour perspective for the regional council to assist land owners in limiting weed spread between adjacent properties.

Tcosts estimated for this programme assume rates of landowner complaints to Council regarding gorse are likely to remain similar to current levels over the lifetime of the plan.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Pastoral farmers	Major	Minor	Yes	Yes	Yes
Crop farmers	Major	Major	Yes	Yes	Yes
Regional community					

Who should pay for the proposed management approach?

Bathurst bur is an agricultural weed. It is proposed this programme is funded through a 70% targeted rate, 30% general rate mix.

BLACKBERRY
Rubus fruticosus agg.

BOUNDARY CONTROL

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Prickly scrambling, perennial shrub, with spiny prickles surrounding the stem and on the underside of the leaf along the mid-rib. Leaves are oval with jagged edges. Flowers are white to pink in clusters. Fruit are black, fleshy and edible.
Habitat	Lightly grazed pasture, roadsides, wasteland, particularly where rainfall is high.
Regional distribution	Widespread throughout the region, especially north of Napier.
Competitive ability	Can form impenetrable thickets, excluding plants underneath.
Reproductive ability	Seeds freely and regularly. 7000-13,000 seeds/m2 have been recorded in Australia.
Dispersal methods	Fleshy fruit are dispersed by birds.
Resistance to control	Not considered the threat it once was due to advances in mechanical/chemical control.
Benefits	Edible fruit.

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	High	High
Sheep and beef	High	High
Forestry	High	High
Horticulture	Low	Low
Aquaculture	-	-
Urban	Low	-
Native terrestrial	High	High
Coastal land	Low	Low
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	L	L	Stock movement is hindered by dense thickets.	
Sheep and beef	M	M	Can degrade wool and hides.	
Forestry	L	L		1
Horticulture	L	L		
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	M	H	Forms impenetrable thickets, smothers most lowgrowing species, inhibiting recruitment.	1
Threatened species	-	-		
Social/Cultural				
Human health	-	-		
Recreation	M	M	Prickly spines restrict access	
Māori culture	-	L	Restricts access to cultural sites (e.g. waahi tapu, urupa).	

L = low, M = moderate, H = high
Source: 1: Craw (2000),

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	36.24–145.79	36.86–148.29
Sheep and beef	0.59–1.7	0.6–1.73
Forestry	2.24	2.28
Horticulture	2.82	2.87
Aquaculture	0	0
Non-production		
Environment	0.02–5.12	0.04–28.95
Social/Cultural	0–0.01	0–0.07

Cost-benefit analysis results

Proposed management programme: **Sustained control**
Area of Programme: **whole region**
Proposed annual expenditure by Council: **$390**

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CBA statement and risks to success

Blackberry is a very invasive pasture weed, growing into impenetrable thickets which not only reduce stock carrying capacity, but restrict access to streams and water supplies. Thickets entangle woolly sheep, even causing death, and provide ideal ground cover for pests such as rabbits, hares and possums. In forestry and urban areas, blackberry can be a major fire hazard.

It is a widespread species now beyond the scope of affordable or cost-effective region wide control. As an important high-impact pest of production land, it can be the cause of disputes between land owners when one property is the source of the pest spreading onto adjacent properties. The sprawling nature of blackberry means its spread between neighbouring properties can be slowed by maintaining a width of boundary land clear of this weed. The proposed boundary control width for Blackberry is 10 meters. While such boundary control is not considered likely to alter the region wide extent of the weed, for the small proposed expenditure it is considered cost beneficial from a good neighbour perspective for the regional council to assist land owners in limiting weed spread between adjacent properties.

The costs estimated for this programme assume rates of landowner complaints to Council regarding gorse are likely to remain similar to current levels over the lifetime of the plan.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)					
Pastoral Farmers	Major	Major	Yes	Yes	Yes
Regional community					

Who should pay for the proposed management approach?

Blackberry is an agricultural weed. It is proposed this programme is funded through a 70% targeted rate, 30% general rate mix.

GORSE
Ulex europaeus

BOUNDARY CONTROL

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Sharply spiny perennial shrub up to 4 m tall. Leaves reduced to a spine-like tip. Spines deeply furrowed. Very deep tap root and extensive lateral roots. Flowers are pea-like, yellow, 13-20 mm long, May-Nov (sometimes all year). Seed pod hairy, turning black, 13-25 mm long, explosive
Habitat	Grassland, shrubland, forest margins (including plantation forests), hill country, coastal habitats, sand dunes, and wastelands. Tolerant of hot to cold, high to low rainfall, wind, salt, damage, grazing, and all soil types. Optimum growth on low fertility soils.
Regional distribution	Widespread throughout the region.
Competitive ability	Fast growth and being a nitrogen fixer means it can compete effectively with tree seedlings.
Reproductive ability	Seeds have hard coat, can be dormant for up to 30 years. Huge seed bank in soil (estimated 20,000 seeds/m^2).
Dispersal methods	Most seeds fall close to parent plant but may be ejected up to 6 m. Also spread by water, birds, road making gravel and machinery.
Resistance to control	Difficult to control on infertile and steep land, as burning and grazing not effective. Stumps re-sprout quickly after damage or fire. Reseeds profusely, especially after fire, disturbance or non-selective spraying. Best controlled by a combination of methods, including selective herbicide use, and management for native forest succession.
Benefits	Can increase soil nitrogen and act as a nursery crop to facilitate regeneration of native forest on cleared land. Important source of pollen for bees, particularly in winter.

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	High	Low
Sheep and beef	High	High
Forestry	High	High
Horticulture	Low	Low
Aquaculture	-	-
Urban	Low	Low
Native terrestrial	Low	High
Coastal land	High	High
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	L	M	Outcompetes grass and clover, reducing pasture availability.	
Sheep and beef	M	H	Can rapidly invade hill country pastures and outcompete grass and clover, reducing food for grazing stock. Spines pull fleece and lower value of wool.	
Forestry	M	M		1, 2, 3, 4
Horticulture	L	L		
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	-	-		
Water quality	L	L	Nitrogen leaching from dense gorse stands can increase nitrate levels in waterways and lakes.	2
Species diversity	L	M	Forms dense stands, out-competes low-growing species. Increases soil nitrogen, may induce succession to forest, to the detriment of specialised plants (e.g. herbs, orchids, low ferns). Native forest succession through gorse is vegetatively different and of lower diversity than succession through kanuka. Succession may be slower in dry sites.	1, 2, 4, 5, 6, 7
Threatened species	L	M	Can invade rare habitat types (e.g. rock outcrops), which support specialist indigenous species. Increases fire risk, which can lead to loss of rare species.	2
Social/Cultural				
Human health	-	-		
Recreation	M	M	Dense shrubs with prickly spines restrict access	8
Māori culture	-	L	Restricts access to cultural sites (e.g. waahi tapu, urupa).	

L = low, M = moderate, H = high

Source: 1: Williams & Karl (2002), 2: Craw (2000), 3: Roy et al. (2004), 4: Environment Bay of Plenty (2005b), 5: Lee et al. (1986), 6: Hill et al. (2001), 7: Sullivan et al. (2007), 8: Popay et al. (2010).

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	51.64–212.83	66.16–100.32
Sheep and beef	0.84–2.49	2.16–18.08
Forestry	15.94	20.42
Horticulture	4.03	5.16
Aquaculture	0	0
Non-production		
Environment	0–0.53	0.03–9.79
Social/Cultural	0–0.12	0–0.15

Cost-benefit analysis results

Proposed management programme: **Sustained control**
Area of Programme: **whole region**
Proposed annual expenditure by Council: **$117**

CBA statement and risks to success

Gorse can be a significant pastoral weeds, preventing stock access for grazing. It can also be a fire hazard. The benefits estimated for this option assume that spread from adjacent properties is the primary source of invasion, and that managing the source population is more cost-effective than managing the recipient land. This may not be true if adult gorse plants were present on the recipients land, as gorse has an abundant and long lived seed bank (c.30 years), and therefore in many cases reinvasion may be arising from existing seed banks rather than adjacent seed sources. Biosecurity advisors have the ability to take this into account when enforcing the rules of this programme.
Gorse is a widespread species now beyond the scope of affordable or cost-effective region wide control. As an important high-impact pest of production land, it can be the cause of disputes between land owners when one property is the source of the pest spreading onto adjacent properties. Since propagules fall within a short distance of parent plants, this spread between neighbouring properties can be slowed by maintaining a width of boundary land clear of this weed. The proposed boundary control width for gorse is 10 meters While such boundary control is not considered likely to alter the region wide extent of the weed, for the small proposed expenditure it is considered cost beneficial from a good neighbour perspective for the regional council to assist land owners in limiting weed spread between adjacent properties.

The costs estimated for this programme assume rates of landowner complaints to Council regarding gorse are likely to remain similar to current levels over the lifetime of the plan.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Medium	Some sections of the community may be concerned at the reduction of the rule boundary distance????
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Crown land managers	Minor	Major	No	Yes	Yes
Pastoral Farmers	Major	Major	Yes	Yes	Yes
Forestry	Major	Minor	No	Yes	Yes
Regional community	Major	Major	No	Yes	Yes

Who should pay for the proposed management approach?

Gorse is an agricultural weed. It is proposed this programme is funded through a 70% targeted rate, 30% general rate mix.

NODDING THISTLE
Cardus nutans

BOUNDARY CONTROL

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Grows to 1.6 m. Leaves are up to 18 cm long by 10 cm wide with spiny margins. Leaves are dissected more than half way to the midrib. Upper leaf surfaces may have rough hairs, a metallic sheen, and appear whitish at the base of the spines. Flower stalks have wings. Flowers are fragrant, bright crimson, c.4 cm across, and droop down, nodding in the wind (Nov– Feb).
Habitat	Pasture, roadsides, and rough open areas. Infrequently found in forest, but can colonise disturbed and open areas.
Regional distribution	Widespread throughout the region.
Competitive ability	Not readily grazed because of its spiny foliage and can form dense patches, achieving almost total ground cover.
Reproductive ability	Usually biennial, germinating in autumn and flowering the second summer. A single plant can produce 40-100 flower heads (normally 40-50), with c.200 seeds per flower, which are 60-80% viable. Most seeds germinate from late summer to early winter, but can germinate in spring–summer with adequate moisture.
Dispersal methods	Seeds are primarily dispersed by wind, but can also be spread in mud, water, fodder and agricultural seed, or on machinery.
Resistance to control	Grubbing plants at least 5 cm below the crown is an effective control method, provided it occurs before seed production. Spraying with herbicide before flowering can be effective, however plants may become more palatable after spraying, so stock need to be excluded until plants are dead. Mowing/topping is less effective, as plants can regrow, and repeated mowing is required. Plants mutilated before flowering may persist as perennials until they can flower. A gallfly has been released as a biocontrol agent.
Benefits	None.

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	High	Low
Sheep and beef	High	High
Forestry	Low	Low
Horticulture	Low	Low
Aquaculture	-	-
Urban	-	-
Native terrestrial	-	-
Coastal land	-	-
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	L	M	Unpalatable to cattle. Reduces pasture availability and could lead to a reduction in milk production.	
Sheep and beef	M	M	Unpalatable to stock and reduces pasture availability. Spiny seed heads will contaminate wool, decreasing its value. When flowering, can reduce stock movement and make mustering difficult. Can increase the viral diseases scabby mouth and parapox, which infect sheep through punctures on the lips and mouth.	
Forestry	-	-		1, 2
Horticulture	-	L		
Aquaculture	-	-		
Other	-	-		
International trade	-	L	Could be an issue for certified seed growers, as seed contaminated with nodding thistle cannot be exported.	2
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	-	L	Could compete with native plants in open habitats, such as grassland, dunes, and forest margins and canopy gaps. Dense patches provide cover for pest animals, particularly rabbits.	1, 2
Threatened species	-	-	Not often found competing with threatened native species.	1
Social/Cultural				
Human health	L	L	Sharp spines can penetrate skin and sometimes fester.	
Recreation	-	-		
Māori culture	-	-		

L = low, M = moderate, H = high

Source: 1: Popay (2008), 2: Environment Bay of Plenty (2005c)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	60.58–244.97	254.59–458.27
Sheep and beef	0.99–2.86	4.16–14.87
Forestry	0	0
Horticulture	0	19.85
Aquaculture	0	0
Non-production		
Environment	0	0
Social/Cultural	0	0

Cost-benefit analysis results

Proposed management programme: **Sustained control**
Area of Programme: **whole region**
Proposed annual expenditure by Council: **$117**

CBA statement and risks to success

Nodding thistle is considered to be the most aggressive thistle in New Zealand and can be a serious weed of pasture and horticulture land. If no action is taken it may spread to adjacent properties, with consequent loss of production and increased control costs. However, due to the imacts on agricultural land it is generally dealt with by occupiers as part of usual land management practice.

Nodding thistle is widespread and beyond the scope of affordable or cost-effective region wide control. As an important high-impact pest of production land, it can be the cause of disputes between land owners when one property is the source of the pest spreading onto adjacent properties. Since most propagules fall within a short distance of parent plants, this spread between neighbouring properties can be slowed by maintaining a width of boundary land clear of this weed. The proposed boundary control width for nodding thistle is 20 meters While such boundary control is not considered likely to alter the region wide extent of the weed, for the small proposed expenditure it is considered cost beneficial from a good neighbour perspective for the regional council to assist land owners in limiting weed spread between adjacent properties.

The costs estimated for this programme assume rates of landowner complaints to Council regarding nodding thistle are likely to remain similar to current levels over the lifetime of the plan. There are effective biocontrol agents now available.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Pastoral Farmers	Major	Major	Yes	Yes	Yes
Regional community	Minor	Minor	No	Yes	Yes

Who should pay for the proposed management approach?

Nodding thistle is an agricultural weed. It is proposed this programme is funded through a 70% targeted rate, 30% general rate mix.

RAGWORT
Jacobaea vulgaris

BOUNDARY CONTROL

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Erect biennial or perennial herb, usually growing to 45-60 cm. Single or several stems arise from a crown, with dark green leaves. Flowers are bright yellow and clustered at the end of the branches.
Habitat	Waste places and pasture, also riverbeds, open forest, swamps. Occurs in humid temperate regions with annual rainfall >750 mm. Tolerates frost.
Regional distribution	
Competitive ability	Establishment is poor in pasture but good in disturbed soil. Early growth is slow and seedling mortality high.
Reproductive ability	Can flower all year around. A well-developed plant may produce 250,000 seeds per year of which 80% may be viable. Seed can be viable for at least 8 years and germinate when brought to the surface.
Dispersal methods	Wind is main method of seed spread. New Zealand study showed bulk of seed fell to ground within 5 m of the parent plant and virtually none was blown more than 37 m.
Resistance to control	Can be controlled by grazing, mowing, grubbing, and herbicides, but can become resistant to chemical control as a result of poor application. Grubbing and spraying can produce multi-headed plants. Plants may regenerate after flowering. Biocontrol agents include ragwort flea beetle and cinnabar moth. When both of these are combined at one site, good control can be achieved.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	High	High
Sheep and beef	High	High
Forestry	Low	Low
Horticulture	-	-
Aquaculture	-	-
Urban	-	-
Native terrestrial	Low	-
Coastal land	-	-
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	M	M	Forms dense stands in disturbed and grazed areas. Alkaloids present are toxic to cattle, deer, and horses.	
Sheep and beef	M	M	See Dairy.	
Forestry	-	-		1, 2, 3, 4
Horticulture	-	-		
Aquaculture	-	-		
Other	-	-		
International trade	-	L	Prohibited seed of nil tolerance in Australia.	5
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	-	-		
Threatened species	-	-		
Social/Cultural				
Human health	L	L	Can cause skin irritation and allergies when handed extensively.	
Recreation	-	-		
Māori culture	-	-		

L = low, M = moderate, H = high

Source: 1: Craw (2000), 2: Roy et al. (2004), 3: Environment Bay of Plenty (2005d), 4: Environment Canterbury (2007a), 5: AQIS (2009).

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	280.08–517.1	326.02–588.01
Sheep and beef	0.91–2.68	1.06–3.05
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Non-production		
Environmental	0	0
Social/Cultural	0	0

Cost-benefit analysis results

Proposed management programme: **Sustained control**
Area of Programme: **whole region**

Proposed annual expenditure by Council: **$15**

CBA statement and risks to success

Ragwort is an aggressive, prolific flowering plant that will rapidly colonise exposed areas. It matures quickly and reduces the productivity of the land. There are effective biocontrol agents for ragwort which have significantly reduced the impact of ragwort.

Ragwort is a widespread species beyond the scope of affordable or cost-effective region wide control. Since most propagules fall within a short distance of parent plants, its spread between neighbouring properties can be slowed by maintaining a width of boundary land clear of this weed. The proposed boundary control width for ragwort is 20 meters. While such boundary control is not considered likely to alter the region wide extent of the weed, for the small proposed expenditure it is considered cost beneficial from a good neighbour perspective for the regional council to assist land owners in limiting weed spread between adjacent properties.

The costs estimated for this programme assume rates of landowner complaints to Council regarding ragwort are likely to remain similar to current levels over the lifetime of the plan.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Pastoral Farmers	Major	Major	Yes	Yes	Yes
Regional community	Minor	Minor	No	Yes	Yes

Who should pay for the proposed management approach?

Ragwort is an agricultural weed. It is proposed this programme is funded through a 70% targeted rate, 30% general rate mix.

VARIEGATED THISTLE
Silybum marianum

BOUNDARY CONTROL

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Annual or biennial thistle growing up to 2 m high. Leaves are very prickly. Stem is hollow without spines. Flowers are large (7 cm in diameter) and red/purple in colour, only one flower per stem.
Habitat	Roadsides, pastures, gardens, wasteland. Grows best on high fertility soils.
Regional distribution	Widespread throughout the region, especially in coastal areas.
Competitive ability	Very aggressive, forming dense impenetrable stands
Reproductive ability	Flowers produce large numbers of seeds which may remain viable for many years.
Dispersal methods	By wind or inclusion in hay bales.
Resistance to control	Spread of germination times increases difficulty of control but is susceptible to several herbicides especially in seedling and rosette stages.
Benefits	Edible (young leaves, peeled young stems, roots, bases of flower heads) and used as medicinal plant (liver complaints).

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	High	Low
Sheep and beef	High	High
Forestry	Low	-
Horticulture	Low	-
Aquaculture	-	-
Urban	-	-
Native terrestrial	-	-
Coastal land	-	-
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

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Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	L	M	Forms dense patches, esp. on high fertility soils. Prickles can damage stock and cause nitrate poisoning in cattle and sheep.	
Sheep and beef	L	M	See Dairy.	
Forestry	-	-		1, 2
Horticulture	-	L		
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	-	-		
Threatened species	-	-		
Social/Cultural				
Human health	-	-		
Recreation	-	M	Dense patches of large, spiky plants are nasty to work through	1, 2
Māori culture	-	-		

L = low, M = moderate, H = high
Source: 1: Roy et al. (2004), 2: Environment Bay of Plenty (2005e)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	60.58–244.97	329.33–592.79
Sheep and beef	0.2–1.27	5.38–19.23
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Non-production		
Environmental	0	0
Social/Cultural	0	0

Cost-benefit analysis results

Proposed management programme: **Sustained control**
Area of Programme: **whole region**
Proposed annual expenditure by Council: **$234**

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CBA statement and risks to success

Variegated thistle is a pastoral weed that prevents stock access for grazing, contaminates wool and increases management costs. Adjacent crops can also be contaminated. It is a widespread species now beyond the scope of affordable or cost-effective region wide control. As an important high-impact pest of production land, it can be the cause of disputes between land owners when one property is the source of the pest spreading onto adjacent properties. Since most propagules fall within a short distance of parent plants, this spread between neighbouring properties can be slowed by maintaining a width of boundary land clear of this weed. The proposed boundary control width for variegated thistle is five meters While such boundary control is not considered likely to alter the region wide extent of the weed, for the small proposed expenditure it is considered cost beneficial from a good neighbour perspective for the regional council to assist land owners in limiting weed spread between adjacent properties.
The costs estimated for this programme assume rates of landowner complaints to Council regarding variegated thistle are likely to remain similar to current levels over the lifetime of the plan.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Pastoral Farmers	Major	Major	Yes	Yes	Yes
Regional community	-	Minor	No	Yes	Yes

Who should pay for the proposed management approach?

Variegated thistle is an agricultural weed. It is proposed this programme is funded through a 70% targeted rate, 30% general rate mix.

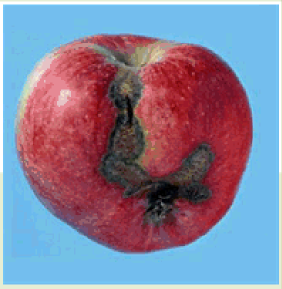
Phytosanitary Pest Management Programme

Extent of Infestation

Hawke's Bay currently has around 6,000 planted hectares of pipfruit orchards. The five key pip fruit pests are apple black spot, codling moth, European Canker, fireblight and lightbrown apple moth (leafroller). These pests are widespread across the Hawke's Bay region.

APPLE BLACK SPOT
Venturia inaequalis

PHYTOSANITARY



Description

Apple Black spot is a fungal disease of apples, often referred to as apple scab outside of New Zealand. It is a different fungus to pear black spot, and both are different to black spot on roses. It is found all over the world where ever apples are grown. In New Zealand, black spot is an important problem in all regions.

Rainy and humid conditions early in the growing season provide ideal conditions for apple black spot infection. In general, the higher the temperature and the longer it rains, the more severe the infection period will be. Apple black spot is spread mainly through windblown leaves, carry spores of the fungus.

Infection early in the season may cause misshapen fruit. By harvest, spots are dried, cracked, and brown with a black outer edge. Infection just prior to or during harvest causes small black "pepper spotting" on fruit.

Late season infection may lead to symptoms appearing in cool storage even though there may be no signs of the disease at packing. Even the smallest black spot is unacceptable on an export apple.

CODLING MOTH
Cydia pomonella

PHYTOSANITARY

Description

Codling moth is common throughout New Zealand. It was accidentally introduced to New Zealand early in European settlement and is now found wherever apples are grown and is found extensively throughout the North Island.

Codling Moth is a small speckled, grey moth, hosted by apple, pear and walnut trees. The larvae of Codling moth burrows into fruit leaving a small hole that result in the fruit being rejected for sale. Frass (droppings) indicate the presence of larva.

Codling Moth over-winters as a dormant caterpillar in a cocoon under the bark of the tree or in the soil. In most southern regions throughout New Zealand, Codling moth has one generation per year. In the North Island, Codling moth usually has one and a half to two generations.

The dispersal ability of codling moth has very important implications for management. With high levels of control achieved by insecticides or mating disruption, the resident population of codling moth in most orchards is extremely low. As a result, the immigration of Codling moth adults into orchards is often greater than the resident population, and the removal of outside sources (e.g. neglected apple trees) can make a major contribution to control. 90% of mated females move within 300m of their emergence point and maximum dispersal may be as low as 600m.

EUROPEAN CANKER
Neonectria ditissima

PHYTOSANITARY

Description

European canker occurs in warm humid areas generally with rainfall in excess of 1000mm pa. It is widespread in Waikato and found in Nelson during very wet seasons. European Canker does not often manifest itself in Hawke's Bay due to the relatively dry climate. Rain splash and wind spread the spores and fruiting bodies of European canker. European canker can also be spread through the movement of affected plants or plant parts. Spores can remain dormant for long periods until the right climatic conditions occur, and then the disease can spread quite rapidly. Apples are more affected than pears.

Initial symptoms of European canker are a small sunken area around a bud, leaf scar, or at the base of a small dead shoot or open wound. Concentric rings of canker growth then appear. The sunken area increases in size. The centre of infection becomes flaky. Eventually cankers girdle the stem, and shoots above the canker die.

NZ Apple and Pear has issued a European Canker Management strategy to all growers.

FIREBLIGHT
Erwinia amylovora

PHYTOSANITARY

Description

Fireblight is a bacterial disease. World-wide, Fireblight is found throughout North America and Canada and much of Europe.

Isolated outbreaks of fireblight occur throughout New Zealand. Pink LadyTM, Gala, Royal Gala, Golden Delicious, and all pears are particularly susceptible. Other plants that can be affected by Fireblight are quince and ornamental plants of the Roseaceae family including cotoneaster, hawthorn and pyracantha. Trees are most prone during October when temperatures exceed 16˚C, humidity is high and blossom is present. If unchecked, blossom infection can result in "shepherds crook" of the shoot. Blossoms appear water soaked then turn brown and finally black. Young fruit if infected turn brown, then black, wilt and drop off. Severe infections are rare on mature trees in New Zealand. The main issue is that Fireblight is used as a quarantine barrier by Fireblight-free countries such as Japan and Australia.

LIGHTBROWN APPLE MOTH
Epiphyas postvittana

PHYTOSANITARY

Description

The light brown apple moth (Epiphyas postvittana) is native to Australia and the larvae feed on a wide range of plants including fruit crops, broad-leaved weeds, some vegetables and ornamentals.

Lightbrown apple moth adults are variable in colour and may be confused with other leafroller moths. Typical males have a forewing length of 6-10 mm with a light brown area at the base distinguishable from a much darker, redbrown area at the tip. The latter may be absent, the moth appearing uniformly light brown, as in the females, with only slightly darker oblique markings distinguishing the area at the tip of the wing. Females have a forewing length of 7-13 mm. Colour varies from a uniform light brown, with almost no distinguishing markings.

Larvae [caterpillars] are not easily distinguished from the larvae of other leafrollers. The first larval instar [stage] has a dark brown head; all other instars have a light fawn head and prothoracic plate [plate behind the head]. Overwintering larvae are darker. First instar larvae are approximately 1.6 mm long, and final instar larvae range from 10 to 18 mm in length. The body of a mature larva is medium green with a darker green central stripe and two side stripes.

Pupae are at first green, but become medium brown after rapidly hardening.

The Lightbrown apple moth larvae cause damage to foliage and fruit. Early instars feed on tissue beneath the upper epidermis [surface layer] of leaves, while protected under self-constructed silken webs on the under surface of leaves. Larger larvae migrate from these positions to construct feeding niches between adjacent leaves, between a leaf and a fruit, in the developing bud, or on a single leaf, where the "topical" leaf roll develops. The late stage larvae feed on all leaf tissue except main veins.

Superficial fruit damage is common in apple varieties which form compact fruit clusters. Leaves are webbed to the fruit and feeding injury takes place under the protection of the leaf; or larvae spin up between fruits of a cluster. Internal damage to apple, pear, and citrus fruits is less common, but a young larva may enter the interior of an apple or pear fruit through the calyx or beneath the stem of a citrus fruit. Excreta are usually ejected on to the outside of the fruit; this does not happen with the codling moth. The issue with Lightbrown Apple Moth is the potential increased phytosanitary risk posed to key markets such as the US.

Impact of proposed phytosanitary programme

Hawke's Bay currently has around 6,000 planted hectares of pipfruit orchards (61% of the national production area) and 70% of the national production at 247,000 tonnes. The pipfruit industry is worth around $300 million to the Hawke's Bay economy annually. Most orchards in Hawke's Bay have a combination of pipfruit varieties with individual businesses operating orchards ranging from 2 to more than 30 hectares. Fifteen percent of businesses have orchards more than 30 hectares, while there is still a significant portion operating less than 5 hectares (28%).

Apple production is cyclic in nature. From 2002 to 2012 there was more than a 112% reduction in the area of pipfruit planted in Hawke's Bay as growers removed uneconomic blocks of mainly Braeburn and Royal Gala due to increased production expenses, poor consumer demand and an appreciating exchange rate of the NZ dollar.

Since 2012, the industry has gone through a period of growth with increased productivity, realised high returns for new varieties and expanding export into high value Asian markets. As a result, the planted area in Hawke's Bay has grown by 14%.

With the cyclic nature of crop production it can be expected that the current years of good return may be followed by some downturn years with growers seeking to leave the industry, particularly small to medium sized owner-operators without long-term strategic relationships with exporters and packers.

With people choosing or considering whether to leave the pipfruit production sector during periods of downturn, New Zealand Apples & Pears Incorporated wishes to ensure that the occupiers of all pipfruit production sites, continue to manage and control all the phytosanitary pests on their properties in accordance with industry best practise to ensure that pipfruit production levels remain high, access to international markets is maintained, and that costs for all growers are kept as low as possible.

In addition, biosecurity is critically important to sustained growth and profitability of the NZ apple and pear industry. NZ Apples & Pears biosecurity vision is that the industry, our stakeholders and local communities, are all kept safe and secure from damaging pests and diseases. NZ Apples & Pears have been partners of the Government Industry Agreement (GIA) since 2014. GIA operates as a partnership between primary industry and government to manage pests and diseases that could badly damage New Zealand's primary industries, economy and environment.

With biosecurity pests such as brown marmorated stink bug and Queensland fruit fly having the potential to significantly damage the NZ industry, it is imperative that strategies are in place to ensure unmanaged production sites are inspected and remain vigilant for biosecurity threats.

Therefore to ensure the continued success of the pipfruit industry in Hawke's Bay, this Regional Phytosanitary Pest Management Strategy is proposing methods to ensure that occupiers of unmanaged pipfruit production sites, ensure that they control the phytosanitary pests on their land.

That said, the need to implement this over the next five years is not expected. The industry has been in constant growth since 2012 and is not expected to slow in the foreseeable future. There are one million trees being planted annually with orders for the next three plus years. Suitable land is sought after and any old orchards quickly pulled and replanted. Although there might be an unforeseen downturn within the next 10 years, the current growth will probably even out any costs within this time frame.

Amenity or Nuisance

The control of phytosanitary pests from unmanaged pipfruit production sites will have a positive effect on land occupiers with fruit trees for personal consumption. The effective implementation of this Phytosanitary Pest Management Programme is expected to mitigate the need for increased phytosanitary management in adjacent properties.

Effects on Maori

The phytosanitary pests identified in the Phytosanitary Pest Management Programme are all introduced pests to New Zealand, which have an economic impact on introduced pipfruit species. The controls imposed by this Phytosanitary Pest Management Programme only apply to occupiers of unmanaged pipfruit production sites. Therefore the implementation of this strategy is not likely to impact on the relationship of Maori and their culture and traditions with their ancestral lands, waters, sites, waahi tapu, or taonga.

Effects on overseas marketing and international obligations

The control of phytosanitary pests from unmanaged pipfruit production sites will have a positive effect on production from the pipfruit sector in Hawke's Bay. The effective implementation of this Phytosanitary Pest Management Programme is expected to mitigate the need for increased phytosanitary management in adjacent properties therefore strengthening the international market acceptability of pipfruit products from Hawke's Bay, and thereby enhancing the economy of the region.

Cost of implementation:

The estimated annual cost of activities related to the proposed Phytosanitary Pest Management Programme have been averaged from 2013-2016 data:

Estimated cost to Hawke's Bay Regional Council $200
Estimated cost to New Zealand Apple and Pear $500
Estimated cost to land occupiers $10,000

IMPACT	EXTENT OF IMPACT	
	POTENTIAL	UNDER PLAN
Horticulture	Major	Minor
Amenity or Nuisance	Minor	Minor

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR
Primary Producers	Major	
Horticultural production sites not managing specific phytosanitary pests		Major
Regional community	Major	

CBA statement and risks to success

The horticultural sector is currently experiencing a period of large growth. The need to implement enforcement over the next five years is not expected. The industry has been in constant growth since 2012 and is not expected to slow in the foreseeable future. There are one million trees being planted annually with orders for the next three plus years. Suitable land is sought after and any old orchards quickly pulled and replanted. Although there might be an unforeseen downturn within the next 10 years.
The benefits of Regional intervention, focused on the control of phytosanitary pests from unmanaged pipfruit production sites, will have a positive effect on production from the pipfruit sector in Hawke's Bay. It is considered the benefits outweigh the cost and exceed the benefit of an individual's intervention.

Who should pay for the proposed management approach?

This is a low cost programme that will benefit both the horticvultural sector and the regioanl community. It is proposed this programme is funded through the general rate.

SITE LED PESTS

FERAL CAT
Felis catus

SITE LED

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Resemble domestic cats in both size and colouration. Females average about 75% of the weight of males.
Habitat	Inhabits a wide range of urban, rural and forest habitats. Found from sea level to alpine habitats.
Regional distribution	Throughout the region.
Competitive ability	Diet is wide-ranging and includes small mammals, fish, birds and invertebrates.
Reproductive ability	2-3 litters per year with an average of 4 young in each.
Resistance to control	Controlled by poisons, trapping and shooting. No natural predators.
Benefits	Controls rodents and to some degree mustelids (young stoats and weasels).

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	High	Low
Sheep and beef	High	High
Forestry	High	Low
Horticulture	Low	Low
Aquaculture	-	-
Urban	Low	Low
Native terrestrial	High	High
Coastal land	Low	Low
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	L	L	Can transmit bovine Tb which can be transferred to cattle. In an area with Tb-infected cattle, a study found 1 in 50 cats had gross lesions typical of Tb.	
Sheep and beef	L	L	Carry many parasites and both feral and farm cats can transmit Toxoplasma gondii to sheep, causing toxoplasmosis. Sheep become infected from eating contaminated pasture, concentrate feeds and hay. Once ingested, the toxoplasma spreads to the sheep's muscles and brain, and also into the placenta.	
Forestry	-	-		1, 2, 3, 4
Horticulture	-	-		
Aquaculture	-	-		
Other	-	-		
International trade	-	L	Tuberculosis vector - presence of bovine Tb in cattle has a major impact on exports.	
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	M	H	Eats native birds, lizards and invertebrates.	1, 2, 3, 4
Threatened species	M	H	Predator of eggs and chicks of threatened native birds and lizards (e.g. brown teal, NZ dotterel).	1, 2
Social/Cultural				
Human health	L	L	Can bite and scratch. Can transmit Toxoplasma gondii and cause toxoplasmosis to humans.	1
Recreation	-	-		1
Māori culture	-	-		

L = low, M = moderate, H = high

source 1: King (2005), 2: Auckland Regional Council (2004), 3: Environment Bay of Plenty (2003), 4: Taranaki Regional Council (2013a)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

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Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	54.63–267.08	54.63–267.08
Sheep and beef	7.39–36.12	7.39–36.12
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	5.33–56.05	5.33–56.05
Native terrestrial	27.80–61.20	55.60–340.00
Coastal	62.35–137.25	124.70–762.50
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Site-led**
Area of Programme: **128,256 ha**
Proposed annual expenditure by Council: **$6,822**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	121,843.2 ha	Time to reach maximum extent †	50 yrs
Current impacts *	$44.5/ha	Potential extent in the region °	121,843 ha
	$27.8–61.2/ha		121,843.2–121,843.2 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS *	PEST VALUES °	BENEFIT	COUNCIL COSTS †	LANDOWNERS COMPLIANCE COSTS ‡	AGENCY COMPLIANCE COSTS ‡	NET BENEFIT
No intervention	$49,399,481	$0		$0	$0	$0	
	min: 30,860,799						
	max: 67,938,163						
Site-led	$42,223,947	$0	$7,175,534	$57,546	$0	$0	$7,117,988
	min: 22,965,765		min: 7,895,034				min: 7,837,488
	max: 65,581,848		max: 2,356,315				max: 2,298,769

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$121,898,909	$0		$0	$0	$0	
	min: 76,152,577						
	max: 167,645,241						
Site-led	$68,686,060	$0	$53,212,849	$142,184	$0	$0	$53,070,665
	min: 27,269,165		min: 48,883,412				min: 48,741,228
	max: 161,209,790		max: 6,435,451				max: 6,293,267

CBA statement and risks to success

Cats are generalist predators and can have large home ranges. It is estimated that feral, stray and pet cats kill up to 100 million birds in New Zealand each year. They are a major predator of kiwi chicks and also eat eggs, lizards, invertebrates and frogs. Cats can transmit bovine Tb and carry many parasites including Toxoplasma gondii.

This programme provides the opportunity for land occupiers to control feral cats and their impacts through a site led pest control programme. Council will provide the technical knowledge and assistance in setting up a pest control programme. It is dependent on land occupiers undertaking the ongoing control.

The benefits of regional intervention, focused on sustainably controlling feral cats as part of a side led pest control programme, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

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Who should pay for the proposed management approach?

This programme focusses on supporting land occupiers and community groups manage feral cats as part of a pest control programme. Although there are significant biodiversity gains that the wider regional community is a beneficiary, almost all programmes are run on private land in rural areas. It is proposed that this programme is funded through a 70% targeted, 30% general rate.

FERAL DEER

Cervus elaphus, C. nippon, Dama dama

SITE LED

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Medium- to large-sized ungulates. There are several species in New Zealand. Red deer can reach 180 kg and their coat is reddish-brown. Fallow deer are much smaller and have a chestnut coloured coat. Fallow deer antlers are broad and flattened, measuring up to 70 cm.
Habitat	Deer live in a wide range of habitats, particularly forest.
Regional distribution	Throughout the region, except for urban areas.
Competitive ability	Consume large quantities of native seedlings and saplings, which reduces vegetation biomass and alters habitat for native fauna.
Reproductive ability	Female red deer produce 1–2 offspring per year with a gestation period of 240–262 days. Fawns are weaned and able to join the herd after two months. Fallow deer breed once per year with fawns born in spring.
Resistance to control	Most commonly controlled by shooting, which can be effective at reducing their density. At low densities their behaviour changes, and they become very wary and hard to hunt.
Benefits	A recreational resource for hunters. Wild deer populations have historically been used to source livestock for deer farms. In other parts of New Zealand (e.g. Fiordland) commercial recovery of wild deer for venison still exists.

Land use/habitats occupied in Hawke’s Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	Low	Low
Sheep and beef	High	High
Forestry	High	High
Horticulture	Low	Low
Aquaculture	-	-
Urban	-	-
Native terrestrial	High	High
Coastal land	Low	Low
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

Category	Current	Potential	Comment	Source
Production				
Dairy	L	L	NZ production losses due to deer grazing on pasture and crops have not been quantified, but are probably low. Hunting pressure usually all but eliminates deer from these habitats.	
Sheep and beef	L	L	See Dairy.	
Forestry	L	L	Can cause severe damage to young trees in plantation forests by browsing young trees and stripping bark from older trees.	1, 2
Horticulture	L	L	See Dairy.	
Aquaculture	-	-		
Other	-	-		
International trade	L	M	There is concern that bovine Tb could establish in feral deer populations and spread to farm animals. Illegal liberations are of particular concern if deer are sourced from regions where Tb occurs.	1, 3, 4
Environment				
Soil resources	L	M	Heavy browsing can impact below-ground processes in native forests by altering the nature of litter inputs into the soil.	5
Water quality	L	L	Some localised small-scale fouling of water sources by wallowing can occur.	3
Species diversity	L	H	Heavy and selective browsing on trees and shrubs can change forest structure and the composition of the understorey. Palatable plant species such as schefflera/pate, broadleaf, three-finger, lancewood, and hen and chicken fern can be all but removed from the ground tier.	2, 3, 4
Threatened species	L	H	Selective browsing can significantly reduce rare palatable subcanopy species. However these species can persist epiphytically. Plants like alpine buttercup, speargrass and tall tussocks can be impacted in subalpine habitats.	3, 4
Social/Cultural				
Human health	L	L	Hunters have alleged that they could get Tb from infected deer when gutting and cutting meat. Deer are generally considered spillover hosts rather than vectors so this is unlikely.	3
Recreation	L	L	Forest damage and loss of palatable native plant species can affect some recreational experiences. However, deer are a recreational resource for hunters.	3
Māori culture	-	L	Significant damage to ecosystems would impact on cultural values. However, deer are also viewed as a hunting resource by Māori.	

L = low, M = moderate, H = high

source 1: Greater Wellington Regional Council (2012), 2: Taranaki Regional Council (2013b), 3: King (2005), 4: Auckland Regional Council (2004), 5: Lagerstroem et al. (2011)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

Land use/habitat type	Current impact per ha	Potential impact per ha
Production		
Dairy	54.63–267.08	54.63–267.08
Sheep and beef	7.39–36.12	7.39–36.12
Forestry	17.47–85.40	17.47–85.40
Horticulture	105.11–790.40	105.11–790.40
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	5.56–27.20	55.60–340.00
Coastal	12.47–61.00	124.70–762.50
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Site-led**
Area of Programme: **128,256 ha**
Proposed annual expenditure by Council: **$1,000**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	38,476.8 ha	Time to reach maximum extent †	50 yrs
Current impacts *	$16.38/ha	Potential extent in the region °	38,477 ha
	$5.56–27.2/ha		38,476.8–38,476.8 ha
Current benefits	$1/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$5,742,142	$324,565		$0	$0	$0	
	min: 1,949,103	min: 324,565					
	max: 9,535,181	max: 324,565					
Site-led	$5,542,986	$324,429	$199,020	$8,435	$0	$0	$190,585
	min: 1,881,502	min: 324,429	min: 67,465				min: 59,030
	max: 9,204,470	max: 324,429	max: 330,575				max: 322,140

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$14,169,396	$859,628		$0	$0	$0	
	min: 4,809,636	min: 859,628					
	max: 23,529,157	max: 859,628					
Site-led	$13,625,471	$858,183	$542,480	$22,341	$0	$0	$520,139
	min: 4,625,007	min: 858,183	min: 183,184				min: 160,843
	max: 22,625,935	max: 858,183	max: 901,777				max: 879,436

CBA statement and risks to success

Deer can destroy the understorey of native forest by browsing, grazing, bark stripping and trampling, which in turn may increase soil erosion. Feral deer can reduce production by damaging crops and exotic forests. They have also been implicated in the transmission of bovine Tb.

This programme is designed to support land occupiers to control feral deer and their impacts through a site led pest control programme. Assistance may be provided through the use of professional contractors, who have technical knowledge on best practice feral deer control. Feral deer are of particular concern for QEII covenants and ecosystem prioritisation sites. Council may assist or undertake feral deer control at these sites to protect the biodiversity values within these sites.

The benefits of regional intervention, focused on sustainably controlling feral deer as part of a side led pest control programme, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	

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Operational risk	Low
Legal risk	Low
Socio-political risk	Low
Other risks	Low

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

This programme focusses on supporting land occupiers and community groups manage feral deer as part of a pest control programme or to protect QEII covenants and ecosystem prioritisation sites. Although there are significant biodiversity gains that the wider regional community is a beneficiary, almost all programmes are on private land in rural areas. It is proposed that this programme is funded through a 70% targeted, 30% general rate.

FERAL GOAT
Capra hircus

SITE LED

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Feral goats vary in size and colour. Can be white, black, brown or a combination of colours. Both sexes have horns. Adult males stand approximately 70 cm high and weigh 50–60 kg. Females are smaller.
Habitat	Inhabits a wide range of rural and forest habitats. Favours steep, dry, sunny faces.
Regional distribution	Throughout the region, except for urban areas.
Competitive ability	Diet is wide-ranging. Able to exploit a wide variety of habitats.
Reproductive ability	Females begin breeding at 6 months and can breed twice a year. Twins are common. Males can mate from 6 months old but are usually excluded by other males until 3–4 years of age.
Resistance to control	No natural predators in New Zealand. Controlled by shooting and high-quality fencing.
Benefits	Some value as feral meat. Some farmers muster out goats infrequently and sell them off.

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	Low	Low
Sheep and beef	High	High
Forestry	High	High
Horticulture	Low	Low
Aquaculture	-	-
Urban	-	-
Native terrestrial	High	High
Coastal land	Low	Low
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	L	Competes with stock for pasture and reduces pasture productivity. May spread livestock diseases.	
Sheep and beef	L	M	Removal of vegetation through browsing and trampling can cause soil erosion, particularly in the eastern hill country.	
Forestry	L	M	Can cause severe damage to young trees in plantation forests by trampling seedlings, browsing young trees and stripping bark from older trees.	1, 2, 3, 4
Horticulture	L	L	Can cause damage to fruit trees and crops.	
Aquaculture	-	-		
Other	-	-		
International trade	-	-		
Environment				
Soil resources	L	M	Removal of vegetation through browsing and trampling can cause erosion.	4
Water quality	L	M	Erosion of soil can lead to increased sedimentation in waterways.	2
Species diversity	M	H	Eats a wide variety of plant species and can eliminate preferred (palatable) species, leading to changes in plant species composition, and preventing forest regeneration and succession.	3, 4, 5, 6
Threatened species	L	H	Eats a wide variety of plant species and can eliminate preferred (palatable) species, leading to changes in plant species composition, and preventing forest regeneration and succession.	5, 6
Social/Cultural				
Human health	-	-		
Recreation	L	L	Damages and eliminates palatable native plant species and alters structure of native forest, which can affect recreational experiences. Viewed as a recreational resource by some hunters.	2, 4
Māori culture	L	M	Destroys native forests and eats culturally important plants (e.g. koromiko).	

L = low, M = moderate, H = high

source 1: King (2005), 2: Severinsen (2003), 3: Auckland Regional Council (2004), 4: Invasive Species Specialist Group (2010a), 5: Husheer (2006), 6: Clements (2004)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

Land use/habitat type	Current impact per ha	Potential impact per ha

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Production		
Dairy	0	54.63–267.08
Sheep and beef	7.39–36.12	36.95–81.27
Forestry	17.47–85.40	87.35–192.15
Horticulture	105.11–790.40	105.11–790.40
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	27.80–61.20	55.60–340.00
Coastal	62.35–137.25	124.70–762.50
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Site-led (inclusion of a good neighbour rule)**

Area of Programme: **128,256 ha**

Proposed annual expenditure by Council: **$36,000**

Assumptions

Assumptions	Values	Assumptions	Values
Current area infested	38,476.8 ha	Time to reach maximum extent†	50 yrs
Current impacts*	$44.5/ha	Potential extent in the region°	38,477 ha
	$27.8–61.2/ha		38,476.8–38,476.8 ha
Current benefits	$0.5/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$15,599,836	$162,282		$0	$0	$0	
	min: 9,745,516	min: 162,282					
	max: 21,454,157	max: 162,282					
Site-led	$13,333,878	$145,301	$2,248,977	$303,672	$0	$0	$1,945,305
	min: 7,252,347	min: 128,387	min: 2,493,101				min: 2,189,429
	max: 20,710,057	max: 162,214	max: 710,205				max: 406,533

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

Scenario	Pest impacts*	Pest values°	Benefit	Council costs†	Landowner compliance costs‡	Agency compliance costs‡	Net benefit
No intervention	$38,494,392	$429,814		$0	$0	$0	
	min: 24,048,182	min: 429,814					
	max: 52,940,602	max: 429,814					
Site-led	$21,690,335	$252,691	$16,626,934	$742,798	$0	$0	$15,884,136
	min: 8,611,315	min: 160,305	min: 15,436,145				min: 14,693,347
	max: 50,908,355	max: 429,092	max: 1,762,738				max: 1,019,940

CBA statement and risks to success

Goats destroy the under storey of vegetation and, when combined with possum damage to the upper canopy, severe deterioration of native forest occurs. Pest plant invasion can occur under these circumstances. Goats also damage vegetation planted on land retired for soil conservation purposes and newly planted or young trees in exotic forests. Goats are one of the most destructive animals found in forests. They have the ability to live in a healthy state where other animals would die out. Feral goats can breed rapidly and can occupy a wide range of habitats.

This programme is designed to support land occupiers to control feral goats and their impacts through a site led pest control programme. Assistance may be provided through the use of professional contractors, who have technical knowledge on best practice feral goat control. Feral goats are of particular concern for QEII covenants and ecosystem prioritisation sites. Council may assist or undertake feral deer control at these sites to protect the biodiversity values within these sites.

Good neighbour rule

A good neighbour rule has been applied to this programme, whereby an occupier adjacent to an area of ecological importance or native plantings may be required to destroy all feral goats on the land that they occupy within 500 meters of the adjoining property boundary where the occupier of the adjoining property is managing feral goats across their property. The reason for this rule is to manage the spread of feral goats causing unreasonable costs to the adjacent occupier where active feral goat management is being undertaken by that occupier. Feral goats ability to breed rapidly and colonise new areas. If the adjacent land occupiers want to keep feral goats as a means of weed control and a secondary source of income, they will need to contain the feral goats within their property through effective fences. Council will only administer the rule upon receiving a written complaint from the adjacent land occupier.

The benefits of regional intervention, focused on sustainably controlling feral deer as part of a side led pest control programme, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

This programme focusses on supporting land occupiers and community groups manage feral goats as part of a pest control programme, protecting QEII covenants and ecosystem prioritisation sites from feral goat damage, and preventing feral goats from causing unreasonable costs to adjacent occupiers through damage to ecological values or native plantings. Although there are significant biodiversity gains that the wider regional community is a beneficiary, almost all programmes are on private land in rural areas. It is proposed that this programme is funded through a 70% targeted, 30% general rate.

FERAL PIG
Sus scrofa

SITE LED

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Adults can measure 90–200 cm, and weigh 50–90 kg. Their colour varies from dark grey to brown or black. Adult males develop tusks that protrude from their mouth.
Habitat	Found in a wide range of habitats, however they mostly prefer to live on farmland and rough hill country that includes thick and extensive scrub cover.
Regional distribution	Throughout the region, except for urban areas.
Competitive ability	Vegetation forms 70% of pig diet. Pig rooting can reduce the diversity of seedlings and saplings and cause a dramatic reduction in leaf cover on the forest floor.
Reproductive ability	Sexually mature at two years of age. They breed once per year with gestation lasting 115 days. Litter size ranges from 4–6 piglets. The piglets are weaned at 3–4 months of age.
Resistance to control	Pigs are controlled using shooting. Dogs are widely used to locate pigs in rough terrain. In thick scrubby areas pigs can often find refuge from hunters.
Benefits	A recreational resource for hunters.

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	Low	Low
Sheep and beef	High	High
Forestry	High	High
Horticulture	-	Low
Aquaculture	-	-
Urban	-	-
Native terrestrial	High	High
Coastal land	High	High
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	L	L	Vector of bovine Tb and can also spread other diseases by spreading infectious microbes through the forest.	
Sheep and beef	L	M	Vector of bovine Tb and can also spread other diseases by spreading infectious microbes through the forest. Can prey on lambs. Can damage pasture by rooting. In North Canterbury one farmer claimed a reduction of 500 stock units due to the presence of pigs. Another had to resow a paddock at a cost of $10,000.	
Forestry	L	M	Can damage young trees through rooting.	1, 2
Horticulture	-	L	Can damage crops through rooting.	
Aquaculture	-	-		
Other	-	L	Can spread trichinosis among domestic pigs.	
International trade	-	M	Tuberculosis vector - presence of bovine Tb in cattle has a major impact on exports.	1, 3, 4, 5
Environment				
Soil resources	-	L	Soil disturbance by feral pigs can increase nitrate levels in soil.	5, 6
Water quality	-	L	It is possible that high densities of feral pigs could result in faecal contamination of water bodies.	5
Species diversity	L	H	Can have major effects on native flora and fauna. Pigs eat the tops of native plants and dig up their roots, resulting in the decline of some species. Also eat many native invertebrates and can consume large quantities of native earthworms.	5, 6, 7
Threatened species	L	H	Pig predation of flightless and ground-dwelling birds (e.g. kiwi) has been suggested but rarely confirmed. They are predators of native land snails, and can reduce remnant populations.	5, 7, 8
Social/Cultural				
Human health	L	M	Can spread the disease trichinosis among domestic pigs and then transfer to humans who consume infected pig meat. It is possible for a hunter to get Tb from an infected pig when gutting and cutting meat from the animal.	1
Recreation	L	L	Viewed as a recreational resource by hunters. Can destroy lawns and vegetable gardens through rooting.	1, 5
Māori culture	L	L	Significant damage to ecosystems would impact on cultural values. However, feral pigs are a valued hunting resource for many Māori.	9

L = low, M = moderate, H = high

source 1: Greater Wellington Regional Council (2012), 2: Parkes (2006), 3: Krull et al. (2013b), 4: Nugent et al. (2003), 5: King (2005), 6: Krull et al. (2013a), 7: Auckland Regional Council (2004), 8: Parkes et al. (2004), 9: Eggleston et al. (2003)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	54.63–267.08	54.63–267.08
Sheep and beef	7.39–36.12	36.95–81.27
Forestry	17.47–85.40	87.35–192.15
Horticulture	0	105.11–790.40
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	5.56–27.20	55.60–340.00
Coastal	12.47–61.00	124.70–762.50
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Site-led**
Area of Programme: **128,256 ha**
Proposed annual expenditure by Council: **$1,000**

Assumptions

Assumptions	Values	Assumptions	Values
Current area infested	38,476.8 ha	Time to reach maximum extent †	50 yrs
Current impacts *	$16.38/ha	Potential extent in the region °	38,477 ha
	$5.56–27.2/ha		38,476.8–38,476.8 ha
Current benefits	$1/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.
° The potential extent the pest is predicted to achieve in the absence of regional management.
† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$5,742,142	$324,565		$0	$0	$0	
	min: 1,949,103	min: 324,565					
	max: 9,535,181	max: 324,565					
Site-led	$5,542,986	$324,429	$199,020	$8,435	$0	$0	$190,585
	min: 1,881,502	min: 324,429	min: 67,465				min: 59,030
	max: 9,204,470	max: 324,429	max: 330,575				max: 322,140

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$14,169,396	$859,628		$0	$0	$0	
	min: 4,809,636	min: 859,628					
	max: 23,529,157	max: 859,628					
Site-led	$13,625,471	$858,183	$542,480	$22,341	$0	$0	$520,139
	min: 4,625,007	min: 858,183	min: 183,184				min: 160,843
	max: 22,625,935	max: 858,183	max: 901,777				max: 879,436

CBA statement and risks to success

Feral pigs can breed rapidly and damage forests by uprooting trees and saplings and eating native plants and invertebrates. They also eat pasture and crops and are known to be carriers of bovine tuberculosis and leptospirosis. Feral pigs are valued by hunters as a recreational resource.

This programme is designed to support land occupiers to control feral pigs and their impacts through a site led pest control programme. Assistance may be provided through the use of professional contractors, who have technical knowledge on best practice feral pig control. Feral pigs are of particular concern for QEII covenants and ecosystem prioritisation sites. Council may assist or undertake feral pig control at these sites to protect the biodiversity values within these sites.

The benefits of regional intervention, focused on sustainably controlling feral pigs as part of a side led pest control programme, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION

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Technical risk	Low
Operational risk	Low
Legal risk	Low
Socio-political risk	Low
Other risks	Low

Who should pay?

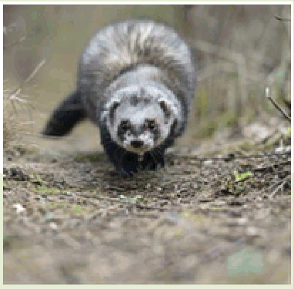
Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

This programme focusses on supporting land occupiers and community groups manage feral pigs as part of a pest control programme or to protect QEII covenants and ecosystem prioritisation sites. Although there are significant biodiversity gains that the wider regional community is a beneficiary, almost all programmes are on private land in rural areas. It is proposed that this programme is funded through a 70% targeted, 30% general rate.

FERRET
Mustela furo



SITE LED

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Up to 50 cm long and has a creamy-yellow undercoat, with long guard hairs that are black at the tip, giving a generally dark appearance. The lighter facial region has a dark mask around the eyes and across the nose.
Habitat	Live mainly in pastoral habitats, scrub, forest margins, dunelands and tussock grasslands. Not typically found in large tracts of native forest.
Regional distribution	Throughout the region.
Competitive ability	Diet is wide ranging and includes small mammals, fish, birds and invertebrates.
Reproductive ability	Females produce 1 or 2 litters per year with average 6 young, but high juvenile mortality.
Resistance to control	Highly mobile with large home ranges. Difficult to trap or poison.
Benefits	Some benefit in rabbit control.

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	High	High
Sheep and beef	High	High
Forestry	Low	Low
Horticulture	Low	Low
Aquaculture	-	-
Urban	-	-
Native terrestrial	Low	Low
Coastal land	High	High
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	M	M	Vector for bovine Tb spread. Carry parasites and spread toxoplasmosis, which can cause illness in humans and livestock.	
Sheep and beef	L	M	See Dairy.	
Forestry	-	-		1, 2, 3, 4
Horticulture	-	-		
Aquaculture	-	-		
Other	L	L	Predator of chickens and fowl. Threat to poultry farms, particularly free range farms.	
International trade	-	L	Known vector of Tb - presence of bovine Tb in cattle has a major impact on exports.	5
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	M	M	Mainly preys on rabbits, but also eats hares, possums, birds, eggs, lizards, hedgehogs, frogs, eels and various invertebrates. Diet varies with season and food availability. When rabbit numbers are low, ferrets can change their diet to other species.	1, 2, 3, 4
Threatened species	M	M	Predator of adult kiwi, particularly in fragmented forest or forest margins.	2, 6
Social/Cultural				
Human health	L	L	Can bite and scratch. Potential for Tb transmission to humans.	1
Recreation	-	-		
Māori culture	L	L	Threat to New Zealand's native fauna (taonga species).	

L = low, M = moderate, H = high

source 1: Anon. (2010), 2: Auckland Regional Council (2007), 3: King (2005), 4: Taranaki Regional Council (2013c), 5: TBfree New Zealand (2013), 6: Auckland Regional Council (2004)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type** × **Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

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Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	273.15–600.93	273.15–600.93
Sheep and beef	7.39–36.12	36.95–81.27
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	27.80–61.20	27.80–61.20
Coastal	62.35–137.25	62.35–137.25
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Site-led**

Area of Programme: **128,256 ha**

Proposed annual expenditure by Council: **$16,822**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	115,430.4 ha	Time to reach maximum extent†	50 yrs
Current impacts*	$44.5/ha	Potential extent in the region°	115,430 ha
	$27.8–61.2/ha		115,430.4–115,430.4 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$46,799,508	$0		$0	$0	$0	
	min: 29,236,547						
	max: 64,362,470						
Site-led	$40,001,634	$0	$6,797,874	$57,546	$0	$0	$6,740,328
	min: 21,757,041		min: 7,479,506				min: 7,421,960
	max: 62,130,172		max: 2,232,298				max: 2,174,752

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$115,483,177	$0		$0	$0	$0	
	min: 72,144,546						
	max: 158,821,807						
Site-led	$65,071,004	$0	$50,412,173	$142,184	$0	$0	$50,269,989
	min: 25,833,946		min: 46,310,600				min: 46,168,416
	max: 152,725,064		max: 6,096,743				max: 5,954,559

CBA statement and risks to success

Introduced predators, such as ferrets, pose a significant threat to remaining natural ecosystems and habitats and threatened native species and can have a negative impact on primary production. Ferrets are distributed throughout the Hawke's Bay region.

Mustelids were introduced in New Zealand in the 1880's in an attempt to manage growing rabbit populations. This had minimal impact on rabbit densities but had a significant impact on New Zealand's Biodiversity. Ferrets are also a threat to agriculture, particularly through their role as a vector (carrier) of bovine tuberculosis. Mustelids are a threat to poultry farms.

This programme is designed to support land occupiers to control mustelids and their impacts through a site led pest control programme. Assistance may be provided through technical knowledge on best practice mustelid control and in initial setup of a predator control programme. Mustelids are of particular concern for QEII covenants and ecosystem prioritisation sites. Council may assist or undertake mustelid control at these sites to protect the biodiversity values within these sites.

The benefits of regional intervention, focused on sustainably controlling ferrets as part of a side led pest control programme, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

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Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

This programme focusses on supporting land occupiers and community groups manage ferrets as part of a pest control programme or to protect QEII covenants and ecosystem prioritisation sites. Although there are significant biodiversity gains that the wider regional community is a beneficiary, almost all programmes are on private land in rural areas. It is proposed that this programme is funded through a 70% targeted, 30% general rate.

POSSUM
Trichosurus vulpecula

SITE LED

Please refer to page 82 for the possum cost benefit analysis.

RAT (SHIP AND NORWAY)

Rattus rattus, R. norvegicus

SITE LED

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	Ship rat is a slender rat with large hairless ears, grey-brown on the back with a similarly coloured or creamish-white belly, or black all over. The uniformly-coloured tail is always longer than the head and body length combined. Adults usually weigh 120-160 g but can exceed 200 g. Norway rat has brown fur on its back and pale grey fur on its belly. Adults normally weigh 150-300 g, may reach up to 500 g, and are up to 390 mm long. Have relatively small ears which usually do not cover the eyes when pulled forward. Tail is shorter than head-body length.
Habitat	Inhabit a wide range of urban, rural and forest habitats. Ship rats are more common within forest areas.
Regional distribution	Throughout the region.
Competitive ability	Omnivorous and opportunistic and typically eat 10% of their body weight per day. This makes them a competitor for food with many species and predators of others (i.e. bird eggs and fledglings).
Reproductive ability	Can breed as young as 3-4 months old. Females can produce 15-20 young per year. Mortality can be high.
Resistance to control	Controlled by poisoning and trapping.
Benefits	None

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	High	High
Sheep and beef	High	High
Forestry	High	High
Horticulture	High	High
Aquaculture	-	-
Urban	High	High
Native terrestrial	High	High
Coastal land	High	High
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	L	L	Can consume and contaminate stock feed.	
Sheep and beef	L	L	See Dairy.	
Forestry	-	-		1, 2
Horticulture	L	M	Destroy crops and consumes or contaminates human food supplies (with urine and faeces).	
Aquaculture	-	-		
Other	-	-		
International trade	L	L	See Production.	1, 2
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	H	H	Eat a variety of native flora and fauna, in particular native birds, lizards, and invertebrates. Eat large quantities of native seeds, which reduces regeneration of native plants.	1, 2, 3
Threatened species	H	H	Predators of eggs and chicks of North Is kokako.	3
Social/Cultural				
Human health	M	M	Can transmit a range of diseases and parasites to humans (e.g. bubonic plague). Can also chew through power cables.	1, 2
Recreation	L	L	See Human Health.	3
Māori culture	M	M	Major threat to New Zealand's native fauna (taonga species).	

L = low, M = moderate, H = high

source 1: Invasive Species Specialist Group (2010b), 2: Invasive Species Specialist Group (2010c), 3: King (2005)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	54.63–267.08	54.63–267.08
Sheep and beef	7.39–36.12	7.39–36.12
Forestry	0	0
Horticulture	105.11–790.40	525.55–1,778.40
Aquaculture	0	0
Environment/Social/Cultural		
Urban	26.64–126.11	26.64–126.11
Native terrestrial	55.60–340.00	55.60–340.00
Coastal	124.70–762.50	124.70–762.50
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Site-led**
Area of Programme: **128,256 ha**
Proposed annual expenditure by Council: **$4,000**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	121,843.2 ha	Time to reach maximum extent †	50 yrs
Current impacts *	$197.8/ha	Potential extent in the region °	121,843 ha
	$55.6–340/ha		121,843.2–121,843.2 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS *	PEST VALUES °	BENEFIT	COUNCIL COSTS †	LANDOWNERS COMPLIANCE COSTS ‡	AGENCY COMPLIANCE COSTS ‡	NET BENEFIT
No intervention	$219,577,918	$0		$0	$0	$0	
	min: 61,721,599						
	max: 377,434,237						
Site-led	$211,962,248	$0	$7,615,670	$33,741	$0	$0	$7,581,929
	min: 59,580,895		min: 2,140,704				min: 2,106,963
	max: 364,343,600		max: 13,090,637				max: 13,056,896

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$541,833,800	$0		$0	$0	$0	
	min: 152,305,153						
	max: 931,362,448						
Site-led	$521,034,254	$0	$20,799,546	$89,366	$0	$0	$20,710,180
	min: 146,458,567		min: 5,846,586				min: 5,757,220
	max: 895,609,942		max: 35,752,506				max: 35,663,140

CBA statement and risks to success

Since their arrival in New Zealand, rats have had significant impacts on native flora and fauna. Omnivorous and opportunistic feeders eating 10% of their body weight per day. This makes them a competitor for food with many species and predators of others. They eat a variety of native flora and fauna, in particular native birds (eggs and fledglings), lizards, and invertebrates. Eat large quantities of native seeds, which reduces regeneration of native plants.

This programme is designed to support land occupiers to control rodents and their impacts through a site led pest control programme. Assistance may be provided through technical knowledge on best practice rodent control and in initial setup of a rodent control programme. Rodents are of particular concern for QEII covenants and ecosystem prioritisation sites. Council may assist or undertake rodent control at these sites to protect the biodiversity values within these sites.

The benefits of regional intervention, focused on sustainably controlling rodents as part of a side led pest control programme, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

This programme focusses on supporting land occupiers and community groups manage rodents as part of a pest control programme or to protect QEII covenants and ecosystem prioritisation sites. Although there are significant biodiversity gains that the wider regional community is a beneficiary, almost all programmes are on private land in rural areas. It is proposed that this programme is funded through a 70% targeted, 30% general rate.

STOAT
Mustela ermina

SITE LED

Relevant biology

Attribute	Description
Form	Has a long thin body, smooth, pointed head, short round ears, and round black eyes. Smaller than ferrets with males growing up to 40 cm long. Fur is dark brown with creamy white underparts and a bushy black tipped tail.
Habitat	Inhabits a wide range of urban, rural and forest habitats (native and exotic forest). Found from sea level to alpine habitats.
Regional distribution	Throughout the region.
Competitive ability	Diet is wide ranging and includes small mammals, fish, birds and invertebrates.
Reproductive ability	Females produce 1 or 2 litters per year with average 6 young, but high juvenile mortality.
Resistance to control	Highly mobile with large home ranges. Difficult to trap or poison.
Benefits	Some benefit in rabbit and rodent control.

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	High	High
Sheep and beef	High	High
Forestry	High	High

Horticulture	Low	Low
Aquaculture	-	-
Urban	Low	Low
Native terrestrial	High	High
Coastal land	Low	High
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	L	Potential vector of bovine Tb.	
Sheep and beef	L	L	See Dairy.	
Forestry	-	-		1, 2, 3
Horticulture	-	-		
Aquaculture	-	-		
Other	L	L	Predator of chickens and fowl. Threat to poultry farms, particularly free range farms.	
International trade	L	L	Potential vector of Tb.	
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	M	H	A generalist predator that most commonly eat birds, mice, rabbits. rats, weta and lizards. Widespread and can occur a long beaches, in forests and pastoral land, and in remote high country.	1, 2
Threatened species	M	H	Predator of adult North Is kokako and their eggs. Significant predator of juvenile kiwi. Predator of most other forest birds and lizards.	1, 2
Social/Cultural				
Human health	-	-		
Recreation	-	-		
Māori culture	L	H	Major threat to New Zealand's native fauna (taonga species).	

L = low, M = moderate, H = high

source 1: Auckland Regional Council (2007), 2: King (2005), 3: Taranaki Regional Council (2013c)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		

Dairy	0	54.63–267.08
Sheep and beef	7.39–36.12	7.39–36.12
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	27.80–61.20	55.60–340.00
Coastal	62.35–137.25	124.70–762.50
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Site-led**

Area of Programme: **128,256 ha**

Proposed annual expenditure by Council: **$16,822**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	115,430.4 ha	Time to reach maximum extent†	50 yrs
Current impacts*	$44.5/ha	Potential extent in the region°	115,430 ha
	$27.8–61.2/ha		115,430.4–115,430.4 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$46,799,508	$0		$0	$0	$0	
	min: 29,236,547						
	max: 64,362,470						
Site-led	$40,001,634	$0	$6,797,874	$57,546	$0	$0	$6,740,328
	min: 21,757,041		min: 7,479,506				min: 7,421,960
	max: 62,130,172		max: 2,232,298				max: 2,174,752

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$115,483,177	$0		$0	$0	$0	
	min: 72,144,546						
	max: 158,821,807						
Site-led	$65,071,004	$0	$50,412,173	$142,184	$0	$0	$50,269,989
	min: 25,833,946		min: 46,310,600				min: 46,168,416
	max: 152,725,064		max: 6,096,743				max: 5,954,559

CBA statement and risks to success

Stoats are extremely fierce and will kill more prey than they need for food if they have the opportunity. They will also attack prey much larger than themselves. It is estimated that 60% of North Island brown kiwi chicks born each year are killed by stoats. Stoats hunt during the day or at night and can cover large distances. The main prey of stoats are rodents, birds, rabbits, hares, possums and invertebrates (particularly weta). Lizards, freshwater crayfish, carrion, birds, eggs, hedgehogs and fish are also taken. Stoats are distributed throughout the Hawke's Bay region.

Mustelids were introduced in New Zealand in the 1880's in an attempt to manage growing rabbit populations. This had minimal impact on rabbit densities but had a significant impact on New Zealand's Biodiversity. Mustelids are a threat to poultry farms.

This programme is designed to support land occupiers to control mustelids and their impacts through a site led pest control programme. Assistance may be provided through technical knowledge on best practice mustelid control and in initial setup of a predator control programme. Mustelids are of particular concern for QEII covenants and ecosystem prioritisation sites. Council may assist or undertake mustelid control at these sites to protect the biodiversity values within these sites.

The benefits of regional intervention, focused on sustainably controlling stoats as part of a side led pest control programme, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

This programme focusses on supporting land occupiers and community groups manage stoats as part of a pest control programme or to protect QEII covenants and ecosystem prioritisation sites. Although there are significant biodiversity gains that the wider regional community is a beneficiary, almost all programmes are on private land in rural areas. It is proposed that this programme is funded through a 70% targeted, 30% general rate.

WEASEL
Mustela nivalis

SITE LED

Relevant biology

ATTRIBUTE	DESCRIPTION
Form	The smallest and least common mustelid in New Zealand. About 20 cm long. Fur is brown with white underparts often broken by brown spots. Tail is short, brown and tapering.
Habitat	Prefers more disturbed habitats than other mustelids, such as agricultural land, scrub, and cut-over forest.
Regional distribution	Throughout the region.
Competitive ability	Diet is wide ranging and includes small mammals, fish, birds and invertebrates.
Reproductive ability	Females produce one or two litters per year with average six young, but high juvenile mortality.
Resistance to control	Highly mobile with large home ranges. Difficult to trap or poison.
Benefits	Some benefit in rodent control.

Land use/habitats occupied in Hawke's Bay

LAND USE TYPE	CURRENT INFESTATION	POTENTIAL INFESTATION
Dairy	Low	High
Sheep and beef	Low	High
Forestry	High	High
Horticulture	Low	Low
Aquaculture	-	-
Urban	Low	Low
Native terrestrial	Low	High
Coastal land	Low	High
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

CATEGORY	CURRENT	POTENTIAL	COMMENT	SOURCE
Production				
Dairy	-	L	Potential vector of bovine Tb.	
Sheep and beef	-	L	See Dairy.	
Forestry	-	-		1, 2, 3
Horticulture	-	-		
Aquaculture	-	-		
Other	-	-		
International trade	L	L	Potential vector of bovine Tb.	
Environment				
Soil resources	-	-		
Water quality	-	-		
Species diversity	L	M	Can eat small native birds, lizards, tree wetas, and other native invertebrates.	1, 2
Threatened species	L	M	Poses a threat to small, ground-dwelling and ground-nesting birds.	1, 2
Social/Cultural				
Human health	-	-		
Recreation	-	-		
Māori culture	L	M	Threat to New Zealand's native fauna (taonga species).	

L = low, M = moderate, H = high
source 1: Auckland Regional Council (2007), 2: King (2005), 3: Taranaki Regional Council (2013c)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: **Economic value per land use/habitat type × Impact level**

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

LAND USE/HABITAT TYPE	CURRENT IMPACT PER HA	POTENTIAL IMPACT PER HA
Production		
Dairy	0	54.63–267.08
Sheep and beef	0	7.39–36.12
Forestry	0	0
Horticulture	0	0
Aquaculture	0	0
Environment/Social/Cultural		
Urban	0	0
Native terrestrial	5.56–27.20	27.80–61.20
Coastal	12.47–61.00	62.35–137.25
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management programme: **Site-led**

Area of Programme: **128,256 ha**

Proposed annual expenditure by Council: **$13,220**

Assumptions

ASSUMPTIONS	VALUES	ASSUMPTIONS	VALUES
Current area infested	115,430.4 ha	Time to reach maximum extent†	50 yrs
Current impacts*	$16.38/ha	Potential extent in the region°	115,430 ha
	$5.56–27.2/ha		115,430.4–115,430.4 ha
Current benefits	$0/ha	Discount rate	4%

* Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10 year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$17,226,426	$0		$0	$0	$0	
	min: 5,847,309						
	max: 28,605,542						
Site-led	$14,724,197	$0	$2,502,229	$57,546	$0	$0	$2,444,683
	min: 4,351,408		min: 1,495,901				min: 1,438,355
	max: 27,613,410		max: 992,132				max: 934,586

* Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

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‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

SCENARIO	PEST IMPACTS*	PEST VALUES°	BENEFIT	COUNCIL COSTS†	LANDOWNERS COMPLIANCE COSTS‡	AGENCY COMPLIANCE COSTS‡	NET BENEFIT
No intervention	$42,508,189	$0		$0	$0	$0	
	min: 14,428,909						
	max: 70,587,470						
Site-led	$23,951,979	$0	$18,556,210	$142,184	$0	$0	$18,414,026
	min: 5,166,789		min: 9,262,120				min: 9,119,936
	max: 67,877,806		max: 2,709,664				max: 2,567,480

CBA statement and risks to success

Weasels are not as common in New Zealand as other mustelids, but they also have an impact on native birds and lizards, particularly skinks. They kill most of their prey underground, and are usually found where there are plenty of mice, in gardens and near buildings. Weasels are distributed throughout the Hawke's Bay region.

Mustelids were introduced in New Zealand in the 1880's in an attempt to manage growing rabbit populations. This had minimal impact on rabbit densities but had a significant impact on New Zealand's Biodiversity.

This programme is designed to support land occupiers to control mustelids and their impacts through a site led pest control programme. Assistance may be provided through technical knowledge on best practice mustelid control and in initial setup of a predator control programme. Mustelids are of particular concern for QEII covenants and ecosystem prioritisation sites. Council may assist or undertake mustelid control at these sites to protect the biodiversity values within these sites.

The benefits of regional intervention, focused on sustainably controlling weasels as part of a side led pest control programme, outweigh the cost of the programme.

Risks of the programme being unsuccessful in achieving objectives

RISK	LEVEL OF RISK	EXPLANATION
Technical risk	Low	
Operational risk	Low	
Legal risk	Low	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

GROUP	BENEFICIARY	EXACERBATOR	CHANGE BEHAVIOUR	ASSESS COSTS & BENEFITS	CONTROL COST EFFECTIVELY
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

This programme focusses on supporting land occupiers and community groups manage weasels as part of a pest control programme or to protect QEII covenants and ecosystem prioritisation sites. Although there are significant biodiversity gains that the wider regional community is a beneficiary, almost all programmes are on private land in rural areas. It is proposed that this programme is funded through a 70% targeted, 30% general rate.

SUMMARY OF PROGRAMMES

The Biosecurity Act 1993 and the Local Government (Rating) Act 2002 require that funding is sought from:

- people who have an interest in the Plan;
- those who benefit from the Plan; and
- those who contribute to the pest problem.

Funding must be sought in a way that reflects economic efficiency and equity. Those seeking funds should also target those funding the Plan and the costs of collecting funding. The following is a summary of the programmes and proposed funding source.

GENERAL RATE		
Sabella	$	20,750.00
Styela	$	20,750.00
Wallaby	$	500.00
Alligator weed	$	500.00
Marshwort	$	500.00
Noogoora bur	$	500.00
Senegal tea	$	500.00
Spartina	$	500.00
Yellow bristle grass	$	500.00
Cathedral bells	$	13,600.00
Goats rue	$	1,500.00
Phragmites	$	-
White-edged nightshade	$	740.00
Yellow water lily	$	444.00
Darwin's barberry	$	40,000.00
Lodgepole pine	$	55,000.00
Woolly nightshade	$	30,000.00
Japanese honeysuckle	$	5,000.00
Old man's beard	$	50,000.00
Privet	$	190,000.00
Total	$	431,284.00

TARGETED RATE		
Possum	$	1,215,945.00
Rook	$	125,436.00
African feather grass	$	12,000.00
Purple loosestrife	$	790.00
Spiny emex	$	4,600.00
Apple of Sodom	$	12,000.00
Australian sedge	$	21,000.00
Cotton thistle	$	3,000.00
Nassella tussock	$	17,000.00
Saffron thistle	$	80,000.00
Velvetleaf	$	3,600.00
Chilean needle grass	$	160,000.00
Feral cat (WSPC)	$	200,000.00
Mustelid (WSPC)	$	200,000.00
Rabbit	$	59,704.00
Feral cat	$	6,822.00
Feral deer	$	1,000.00
Feral goat	$	36,000.00
Feral pig	$	1,000.00
Ferret	$	16,822.00
Rat (ship and Norway)	$	4,000.00
Stoat	$	16,822.00
Weasel	$	13,220.00
Total	$	2,210,761.00

Anticipated costs of implementing the Plan

The anticipated costs of implementing the proposed RPMP reflect a best estimate of expenditure levels. Funding levels will be further examined and set during subsequent Long Term Plan and Annual Plan processes. While community funding is mainly sourced from rates, alternative funding sources will be sought by the Hawke's Bay Regional Council. Such funds will offset rates or be used as a value-added component in appropriate circumstances.

The proposed funding budget allocation is shown in table 13. Please refer to the Hawke's Bay Proposed Regional Pest Management Plan Cost Benefit Report for a full analysis of each programme.

Table 13. Proposed 2017-2018 funding for Regional Pest Management Plan.

ACTIVITY EXPENDITURE	
Production Pest Management	$1,810,761.00
Environmental & Amenity Pest Management	$431,284.00
Wide scale predator control	$400,000
Total Biosecurity	**$2,642,045**

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APPENDIX 1: Section 71 of the amended Biosecurity Act (2012)

71 Second step: satisfaction on requirements

If the council is satisfied that section 70 has been complied with, the council may take the second step in the making of a plan, which is to consider whether the council is satisfied—

1. that the proposal is not inconsistent with—
   (a) the national policy direction; or
   (b) any other pest management plan on the same organism; or
   (c) any pathway management plan; or
   (d) a regional policy statement or regional plan prepared under the Resource Management Act 1991; or
   (e) any regulations; and

2. that, during the development of the proposal, the process requirements for a plan in the national policy direction, if there were any, were complied with; and

3. that the proposal has merit as a means of eradicating or effectively managing the subject of the proposal, which means—
   (a) the organism proposed to be specified as a pest under the plan or the organisms proposed to be specified as pests under the plan; or
   (b) the class or description of organism proposed to be specified as a pest under the plan or the classes or descriptions of organisms proposed to be specified as pests under the plan; and

4. that each subject is capable of causing at some time an adverse effect on 1 or more of the following in the region:
   (a) economic wellbeing:
   (b) the viability of threatened species of organisms:
   (c) the survival and distribution of indigenous plants or animals:
   (d) the sustainability of natural and developed ecosystems, ecological processes, and biological diversity:
   (e) soil resources:
   (f) water quality:
   (g) human health:
   (h) social and cultural wellbeing:
   (i) the enjoyment of the recreational value of the natural environment:
   (j) the relationship between Māori, their culture, and their traditions and their ancestral lands, waters, sites, wāhi tapu, and taonga:
   (k) animal welfare; and

1. that, for each subject, the benefits of the plan would outweigh the costs, after taking account of the likely consequences of inaction or other courses of action; and

2. that, for each subject, persons who are required, as a group, to meet directly any or all of the costs of implementing the plan—
   (a) would accrue, as a group, benefits outweighing the costs; or
   (b) contribute, as a group, to the creation, continuance, or exacerbation of the problems proposed to be resolved by the plan; and

3. that, for each subject, there is likely to be adequate funding for the implementation of the plan for the shorter of its proposed duration and 5 years; and

8. that each proposed rule—
   (a) would assist in achieving the plan's objectives; and
   (b) would not trespass unduly on the rights of individuals; and

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9. that the proposal is not frivolous or vexatious; and
10. that the proposal is clear enough to be readily understood; and
11. that, if the council rejected a similar proposal within the last 3 years, new and material information answers the council's objection to the previous proposal.

APPENDIX 2: National Policy Direction For Pest Management 2015

6. Directions on analysing benefits and costs

Pest management plan and pathway management plan

1. When determining the appropriate level of analysis of the benefits and costs of the plan for each subject for the purposes of a proposal for a pest management plan or pathway management plan, a proposer must consider:
   - (a) the level of uncertainty of the impacts of the subject, or an organism being spread by the subject, and of the effectiveness of measures; and
   - (b) the likely significance of the subject, or an organism being spread by the subject, or of the proposed measures, in terms of stakeholder interest and contention, and total costs of the proposed plan; and
   - (c) the likely costs of the programme relative to the likely benefits; and
   - (d) the level of certainty and the quality of the available data.

2. In the proposal for a pest management plan, or in a pathway management plan, an analysis of the benefits and costs of the plan for each subject must:
   - (a) identify, and quantify (if practicable) the impacts of the proposed subject or an organism being spread by the subject; and
   - (b) identify two or more options for responding to the subject or an organism being spread by the subject (one option must be either taking no action or taking the actions that would be expected in the absence of a plan); and
   - (c) identify, and quantify (if practicable), the benefits of each option; and
   - (d) identify, and quantify (if practicable), the costs of each option; and
   - (e) state the assumptions (if any) on which the impacts, benefits and costs are based; and
   - (f) be at an appropriate level of detail as determined in accordance with sub clause (1); and
   - (g) take into account any risks that each option will not achieve its objective; and
   - (h) identify any realistic mitigation options for the risks identified in sub clause (2)(g); and
   - (i) adjust the benefits and costs for each option as appropriate to take account of subclause (2)(g) and (h); and
   - (j) clearly identify which option is preferred.

3. When taking into account any risks that each option will not achieve its objective under subclause (2)(g), a proposer must consider:
   - (a) the technical and operational risks of the option; and
   - (c) the extent to which the option will be implemented and complied with; and
   - (d) the risk that compliance with other legislation will adversely affect implementation of the option; and
   - (e) the risk that public or political concerns will adversely affect implementation of the option; and
   - (f) any other material risk.

4. When taking into account any risks that each option will not achieve its objective under sub clause (2)(g), a proposer must:
   - (a) for analyses where the benefits are fully quantified, either:
     - i. estimate the residual risks as a probability of success and calculate the expected benefits of the option by multiplying the benefits by the probability of success; or
     - ii. state the residual risks to the programme and calculate what the probability of success would need to be to make the expected benefits equal the costs; and
   - (b) for all other analyses (where the benefits are not fully quantified):
     - i. state the residual risks to the programme and, where practicable, give an indication of likelihood and impact; and
     - ii. specify which of the benefits are most likely to be affected if the risk eventuated.

5. The proposer of a pest management plan or pathway management plan must document the assessments made in sub clauses (1), (3) and (4) and make them publicly available with the proposal for a pest or pathway management plan.

APPENDIX 3: Cost-benefit analysis methods

Cost-benefit analyses: use with caution

Cost-benefit analyses are an economic tool to estimate all relevant costs and benefits in the same currency, usually in current dollars (termed the net present value, or NPV). To make these calculations, all future costs and benefits are "discounted" by the amount a dollar could earn if invested now rather than spent. Past applications of the Harris Model for RPMS reviews have used a standard discounting rate of 8% (although other values can be used in the Model). With an annual compounding interest rate of 8%, $1 invested today will have grown to $46.90 in 50 years' time. For this reason, for it to be economically sensible to spend $10,000 today on pest control to prevent impacts in 50 years' time, those impacts would need to be worth $469,000.

CBA estimates can give the illusion of being precise, robust estimates of future costs and benefits. Models like the Harris Model (described below) require precise data estimates and provide precise cost and benefit estimates calculated down to the dollar (or lower). This hides great uncertainty in our ability to predict the impacts and spread of pests and the costs of their control in the next decades. Because of this, there is an unknown but undoubtedly large amount of uncertainty around all final Harris Model estimates costs and benefits, or any CBA estimates applied to the environment.

The scenarios evaluated in pest animal and plant cost-benefit analyses cannot be regarded as accurate predictions of the future. There is enormous ecological uncertainty surrounding future pest spread and impacts. There is also uncertainty, often large, in our current knowledge of the distribution and impacts of pest populations. Applying a cost-benefit analysis becomes a task of extrapolating into the future from the available data, and using this to make as robust conclusions as can be warranted from the data. It is therefore important that decisions made based wholly or in part on CBA results are revisited with updated data at regular intervals.

Another reason to be cautious in interpreting results from CBA methods when applied to pests is because most pests take many decades, sometimes centuries, to become widespread. While we may wish that our ancestors had acted against weeds like boneseed when they first appeared in the wild over 100-years ago, a CBA done at the time may well have concluded that they would have been better off saving their money rather than helping us out. Spending the equivalent of $10,000 (in current dollars) back in 1870 when boneseed (*Chrysanthemoides monilifera*) was first detected in the wild could well have eradicated it from the country, preventing all of the environmental impacts it is causing now. However, investing the equivalent of $10,000 in 1870 would now be worth $477,887,607 at an 8% annual compounding interest rate. A CBA at the time would therefore have required the impacts of boneseed today to cost us half a billion dollars to warrant them taking action against it. That is a big impact even for a rapidly expanding environmental weed like boneseed. The big problem with using CBA in this way is that we do not now have half a billion dollars that was invested from 1870 to deal with today's boneseed problem. Deciding not to control an incipient pest now therefore transfers a financial burden onto the next generation, who may or may not be as wealthy as us, and who will certainly be dealing with many more pest species than we are now. CBA recommendations should therefore be treated with some caution.

While CBA is undoubtedly a useful tool for making political decisions about pest control, it needs be used alongside other political, social, and environmental considerations. Like with so many environmental issues, there is always the temptation to pass costs on to future generations while we enjoy the benefits of delaying action. Future generations are likely to bear the brunt of a great many such decisions. Regardless of CBA results, decisions about whether or not to act against pests now still boil down to "is it the right thing to do?" and "can we afford it?".

The 'Harris model' for cost-benefit analyses

The 'Harris Model' was developed in 2000 by Simon Harris for the Biosecurity Managers Group, for use in the preparation of Regional Pest Management Strategies (RPMS) (now referred to as Regional Pest Management Plans). The Harris Model is used to carry out cost-benefit analyses (CBA) for pest control under different regional pest management scenarios, including no regional control. It has been used for a number of RPMS reviews in different regions, including the 2003 Bay of Plenty RPMS (Severinsen 2003) and previous Auckland RPMS reviews (Auckland Regional Council 2006). We ran into difficulties implementing the standard Harris model for the 2009 review of the Bay of Plenty RPMS, because the standard of data it requires is typically is difficult to obtain and unavailable to most councils. It requires unrealistically precise values for ecological parameters, ignores the costs of non-production impacts, and provides no estimate of the uncertainty around the final estimates of costs and benefits.

Our modified model attempts to improve on these areas. We are ecologists, not economists, and so have not changed the underlying economic equations in the Harris model. Instead, we have attempted to simplify the Harris Model to deal with greater uncertainty in the available data and made our modifications around these equations. For example, allowing for a range of values rather than a single value is the same as running the Harris model twice with the high and low value of a range. Adding costs of non-production impacts simply requires re-running the Harris Model with the addition of per hectare impacts on things like soil quality and biodiversity (such values are notoriously difficult to assign dollar values but excluding them altogether is at least as unrealistic – we have typically assigned these small, non-zero numbers relative to production impacts to assess their possible importance). When we do this, we are sure to also include the CBA results when only production impacts are included.

Our most fundamental modification is the use of a mathematically different “S-shaped” growth curve to the Harris Model when we predict the expansion of pests. We use a logistic growth curve widely used in ecology for weed modelling. In comparison to the Harris Model growth curve, our logistic growth curve includes a shorter “establishment-phase” (the time before a species begins to rapidly spread), a longer spread phase, and a shorter plateau. Our model has each phase occupying a third of the invasion. Long lag-phases are well documented in invasion biology, especially in the period between the introduction of a species (e.g., for forestry) and its first wild establishment (e.g., Mulvaney 2001), but most of the species listed in the RPMP are expected to be beyond this early phase. Our shorter establishment phase is more likely to reflect the behaviour of an already identified weed. Usefully, the logistic growth curve also simplifies the mathematics allowing for an easier separation to the population growth time and the time period over which the costs are calculated. This is very helpful in that it makes it easy to not run out the model for all the time required for a pest to reach its full extent. It is also flexible enough to add a lag-phase for other pests if it is considered likely. We have also been careful to identify all of our data sources which will add transparency to this process and make it simple to incorporate new information into revised cost and benefit estimates as it becomes available.

Our changes to the Harris model

Our modifications to the Harris Model are described below and summarised in Table A.1.

Table A.1: Our key modifications to the Harris Model.

HARRIS MODEL	OUR REVISED MODEL
Production impacts only	Impacts by land use, including non-production land
Single values	Min, average, max values
Sigmoidal curve	Logistic growth curve
CBA duration = pest growth	CBA duration ≠ pest growth
Max extent and spread rate calculated separately	Estimates min and max values for extent and spread when data is absent
Current impacts only	Impacts per hectare can increase

1. Precise estimates of cost and benefit.

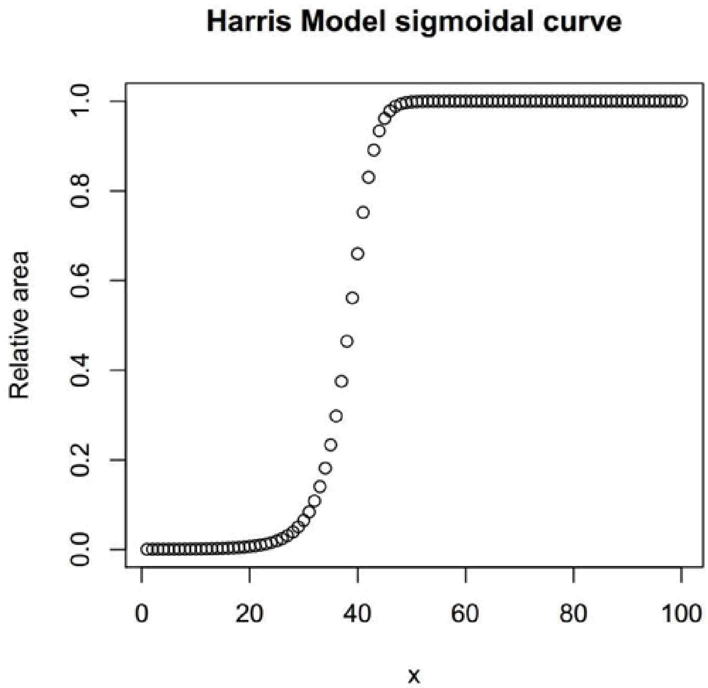
The Harris Model requires precise estimates of all parameters in its calculations, such as the total number of hectares a pest is expected to eventually occupy and the exact number of years it will take to reach this extent. Getting precise and ecologically realistic values for these parameters is not practical for even a large subset of the pest species typically included in an RPMS. Predicting pest spread and total potential range is complicated, requires more information than is available for most pests, and is sensitive to changes in human-assisted dispersal processes (and land use and climate change). For example, building a recent spread model in New Zealand for argentine ants, one of the world’s best studied insect environmental pests, took Lincoln University PhD student Joel Pitt three years of work. While the Harris Model does not preclude being run several times with minimum and maximum estimates of different parameters, past applications of the Model have only reported single available best estimates of pests’ total extent and rate of spread. Our modified model allows for direct input of coarsely estimated parameters and, when these are used, it outputs maximum and minimum estimates of costs and benefits rather than single values.

2. Duration

Severinsen (2003) applied the Harris Model for a 50-year duration since it required pests to reach their maximum extent. Pests that were expected to spend longer than 50 years to reach their maximum extent were capped at 50 years to deal with discounting of impacts to net present value. It is likely that most incipient pests in the Bay of Plenty will take longer than 50 years to reach their maximum extent (for example, according to Bay of Plenty Regional Council staff rabbits reached the last areas of the Bay of Plenty region only in the past 20 years or so, well over a century after their initial introduction to the region). We have revised the Harris Model to grow pest populations for much longer than 50 years (when appropriate) but still make the CBA calculations for a shorter, more economically reasonable time period (e.g. 10 or 50 years).

3. Population growth model

The Harris Model used a sigmoidal growth curve with a rapid, short growth phase in the middle of a pest's spread (Figure A.1a). We have replaced the pest spread equations of the Harris Model with the logistic growth curve (Figure A.1b), commonly used in ecology to model population growth. This is a mathematically useful, and simple, growth curve that allows us to easily calculate growth and associated discounted impacts over only a portion of the growth curve. We have highlighted this portion in the graphs provided with the CBA outputs i.e. where a pest is expected to be now until its maximum extent.



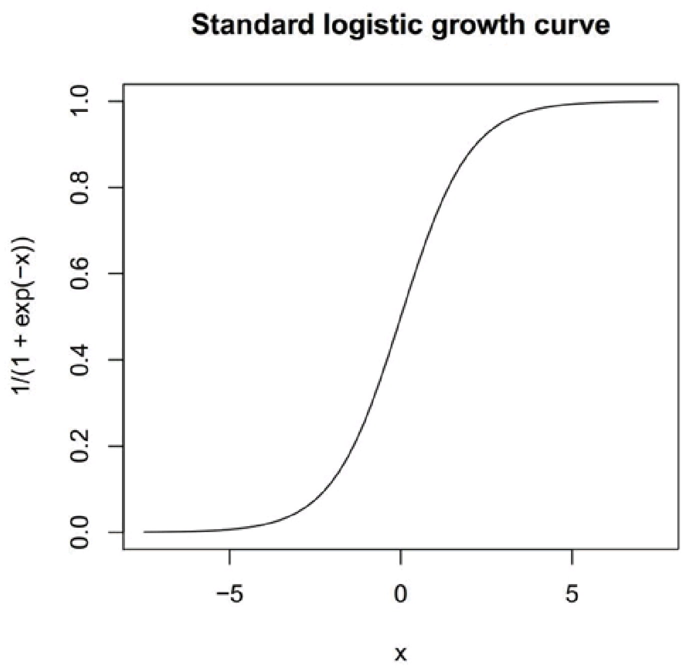


Figure A.1: *(a) The sigmoidal growth curve used to model pest spread in the Harris Model. (b) The standard logistic growth curve used to model pest spread in our CBAs.*

4. Estimating the potential area infested by each pest

The Harris Model requires a single estimate of the total area a pest is likely to infest in the region, given sufficient time. It is impossible to provide such a value with any useful level of certainty for almost any pest in a particular region. What is possible is to define broad land use types in each region and categorise them as primary (preferred), secondary (less preferred), or unsuitable habitat for each pest. The land use types we used were Dairy, Sheep/Beef/Deer, Horticulture, Forestry, Aquaculture, Native terrestrial, Urban, Coastal land, Estuarine, Freshwater, and Marine (see the Methods section for definitions).

We then make the assumption that if a land use/habitat type is a *primary* habitat for a pest, then it will have the potential to occur in 5-25% of the regional area of that land use type. If a land use/habitat type is a *secondary* habitat for a pest, then we assume that pest will have the potential to occur in 1-4% of the regional area of that land use type. These are the percentages a pest would be capable of reaching at its maximum regional extent in the absence of regional (RPMP) management. This approach was much quicker but also likely no less accurate than the more precise parameter required by the Harris Model.

5. Pest spread

While it is prohibitively expensive and time consuming to accurately estimate a single total extent and rate of spread for a pest, what we can do with confidence is assign all listed pests into categories of current extent in each land use/habitat type, dispersal ability, and life form. These estimates can then be used to assign species to a range of likely spread rates. Our modified Harris Model uses this more coarse but realistic ecological data to estimate the range of costs and benefits within which the true value likely lies, and allows us to present maximum and minimum cost and benefit estimates around average values.

6. Impacts

The Harris Model bases its estimate of pest impacts on the value of production land, the proportion of this production that is lost due to a pest, and the cost of pest control and the proportion of landowners controlling the pest. The current total loss of production and total cost of control per year are combined to give a current impact per hectare per year for each pest. Getting accurate, detailed data of this kind for many pests is typically prohibitively difficult. This is especially the case for non-agricultural land, which the Harris Model avoids. We have used a simpler but habitat specific approach to estimating impacts that simply requires each pest to be identified as a low, moderate, or major pest (or not a pest) in each land use/habitat type.

7. Non-production impacts

The Harris Model for simplicity ignores the impacts, however large, on non-production values such as recreation, conservation, and human health. While difficult to quantify economically,
the exclusion of these impacts altogether can lead to clearly unrealistic conclusions. For example, this is the reason why the cost-benefit analysis from the 2003 Bay of Plenty RPMS concluded that there was no regional net benefit in controlling parrot's feather (*Myriophyllum aquaticum*), one of the country's worst aquatic weeds, since it caused no annual loss of production to terrestrial agriculture. To avoid these erroneous conclusions, our revised methods allow for the incorporation of non-production impacts of species. Even if these costs are very small per hectare compared with impacts on agricultural production, they can add up to regionally important impacts for widespread and rapidly expanding pests.

8. Estimating impacts

We have taken a similar approach to impacts as we have taken to estimating the potential area occupied by each pest. It is possible to accurately (and relatively quickly) categorise each pest as a low, moderate, or high impact pest in each of our land use/habitat types. Using past Harris Model CBA estimates and pest literature, we assigned each of these categories to the following ranges of impacts on the per hectare value of each land use/habitat type:

1. **Low impact** on a land use/habitat = 1-4% reduction in the per hectare economic value
2. **Moderate impact** on a land use/habitat = 5-9% reduction in the per hectare economic value
3. **High impact** on a land use/habitat = 10-50% reduction in the per hectare economic value

From these impact estimates per land use/habitat type, we calculated the total annual per hectare impact of a pest in the region by weighting each land use impact by its estimated proportion of the pest's total area. This is illustrated with the following example from the Bay of Plenty (Sullivan and Hutchison 2010).

Apple of Sodom (Solanum linnaeanum)

Current impacts (annual, per hectare)
- Low Dairy (0.01× 1263 to 0.09× 4477)
- Low Native (0.01× 1 to 0.09× 150)

Current land use weighting
- Primary pest in Dairy (68.7%-73.3%)
- Secondary pest in Native (26.7%-31.3%)

Total current annual impact per hectare: 8.67- 83.30

Potential impacts
- Moderate Dairy (0.1× $1263 to 0.49× 4477)
- Low Native (0.01× 1 to 0.09× 150)
- Moderate Urban (human health, recreation values) (0.1× 100 to 0.49× 500)

Potential habitat weighting
- Primary pest in Dairy (68%-72.5%)
- Secondary pest in Native (26%-31%)
- Secondary pest in Urban (0.6%-0.7%)
- Primary pest in Coastal (0.3 %)

Total potential annual impact per hectare: $85.92 - $449.51

The range of our current impacts span the estimate in landowner control costs and lost production from the 2003 Bay of Plenty RPMS CBAs (Severinsen 2003), where the Harris Model was used. In the absence of regional control for many decades, which is likely to result in higher densities over much of its range, it is entirely plausible that the annual costs per hectare for this spiny, toxic weed could be much higher than they are now.

9. Increasing pest impacts

Assessing the full costs of current and potential pest impacts is also a complicated exercise. Predicting pest impacts is an active area of research and there is a great deal that is not well understood, especially about the impacts of pests on natural ecosystems. The Harris Model uses precise estimates of the dollar value of the annual loss of production per pest species. Estimating these parameters with a useful degree of precision is impractical in all but the simplest cases. The Harris Model simply extrapolates the best estimate of current pest impacts per hectare per year into the future, multiplied by the projected increase in pest area with a compounding 8% discount. We found that this simplification led to inaccurate results for some species, particularly low-incidence pests. For example, the notorious pasture pest, nassella tussock, has been so thoroughly controlled that it is not currently found in pastoral land and its current average annual per hectare impacts are low. However, if regional control was relaxed, it is likely that it would reinvade high value land and reach damaging densities, in which case its annual impacts per hectare would become much higher than they are now. The same applies to incipient pests that experience elsewhere shows will become a serious problem if they are not controlled, but which are currently restricted to low-value lands or occur in low densities. To deal with these kinds of cases, we have modified the Harris Model to allow the annual per hectare pest impacts to increase through the pest invasion.

We allowed for estimates of annual pest impacts per hectare to increase through the duration of the CBA (unlike the Harris Model). In year one we use our estimates of the current annual impacts per hectare (see above) then increase this value linearly up to our estimated potential impact at the mid-point of the species spread. For example, if a weed was estimated to take 100 years to reach its maximum extent, we assume that it will reach its potential annual impact per hectare by 50 years. If this weed was estimated to be already 30 years into its spread, we increase the weed's per hectare impacts linearly to reach its potential in 20 more years.

Hawke's Bay Regional Possum Control Technical Protocol (PN 4969)

This Regional Possum Control Protocol sets out areas that are **Possum Control Areas** and **Possum Eradication Areas** and the requirements to meet the programme rules in the Hawke's Bay Regional Pest Management Plan 2018 -2038. These rules apply to all Possum Control Areas and Possum Eradication Areas as identified in this document.

Possum description

The Australian Brushtail Possum is a nocturnal marsupial introduced and liberated in New Zealand by private individuals and acclimatisation societies between 1837 and 1898 to establish a fur trade. Possums were accorded various levels of protection until 1947. When it became clear that the environmental damage inflicted by them far outweighed any profit made from their skins, this protection was lifted.

Possums in New Zealand occur as two colour types, "blacks" and "greys". Adult male blacks vary from rich red-brown to brown, the females have a darker or black-brown fur. Adult male greys are often strongly rufous in the neck and shoulders while the greys often have a distinct silver tinge in the fur.

Size and weight are dependent on habitat. In good conditions adult possums can weigh between 3 to 5 kilograms. Their life span is about nine years. Possums reach reproductive maturity at approximately two years of age. Usually females rear three young every two years.

Possums can be found throughout Hawke's Bay. Their favoured are generally found in bush/pasture margins as these provide a plentiful supply of food and suitable habitat.

Adverse effects

Possums are considered the major animal pest in New Zealand. In farming areas, they spread bovine tuberculosis to beef and dairy cattle, and to farmed deer, damage crops and orchards, kill poplars and willows planted to control hill-country erosion and stabilise riverbanks, and eat pasture. In exotic forest plantations they kill young trees and stunt the growth of older trees by ring-barking them or breaking the uppermost branches. In native vegetated areas, possums cause severe damage by altering habitats important to native animals and birds. Tree species that are palatable to possums (e.g. rata, kamahi, and pohutukawa) become much reduced or locally extinct, and are replaced by plants that are less palatable such as tree ferns and pepperwood. As well as altering the composition of native forests and competing with native fauna, possums also prey directly on native insects and birds.

HBRC Publication Number 4969
HBRC Report Number AM18-02

Possum Control Area

Purpose

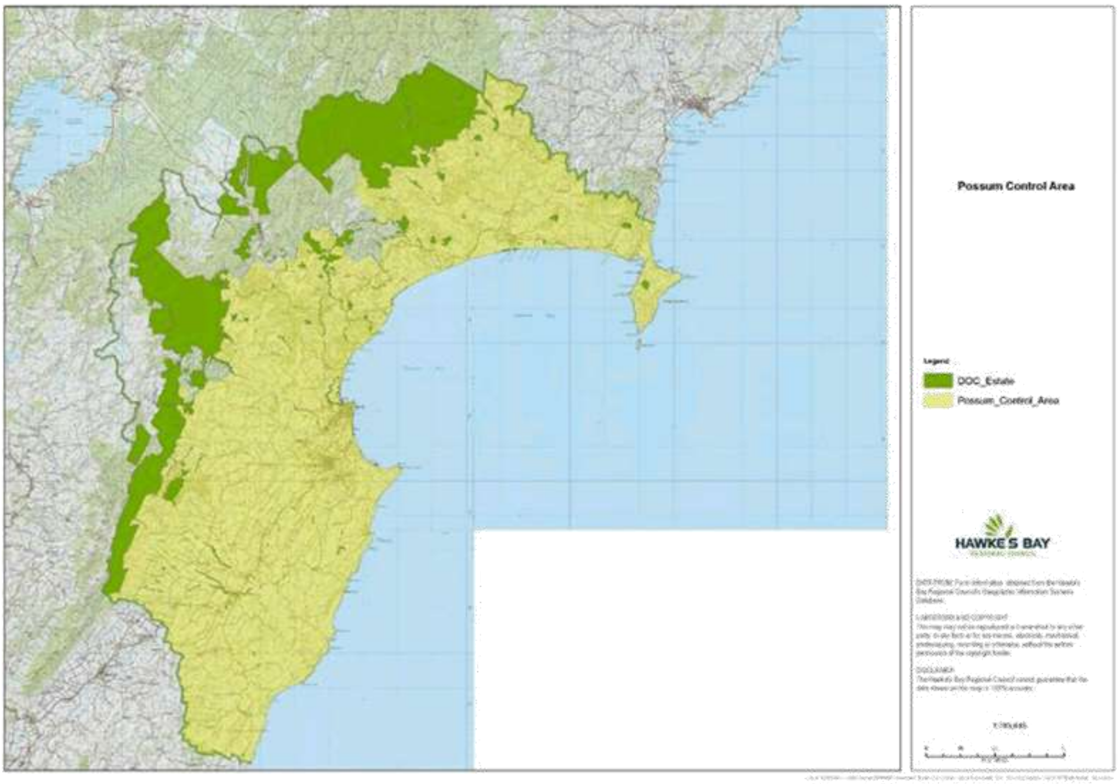
Hawkes Bay Regional Council has been controlling possums through its Possum Control Area (PCA) programme since 2000. There has been a very high level of support for the PCA programme, and a strong belief by most land occupiers within the programme that it is providing value for money for programme participants. The programme has grown to over 700,000ha and is exceeding its target with an average residual trap catch (RTC) of 2.3% across all PCA programmes. This success and landowner support has provided the foundation for further strengthening PCA benefits.

Process

A Possum Control Area is defined as an area identified as a Possum Control Area within this Protocol. All Possum Control Areas will be mapped and identified in this Protocol (*Figure 1*).

If the Council amends this Protocol to include an additional map, the map will have legal effect as part of the Hawke's Bay Regional Pest Management Plan 2018 – 2038 once notice has been given to affected land occupiers and in the NZ Gazette that this Protocol has been amended. Occupiers within that mapped area will be required to comply with the requirements within this Technical Protocol from the date specified in the letter to land occupiers and the Gazette notice.

This Technical Protocol is incorporated by reference into the Hawke's Bay Regional Pest Management Plan 2018 – 2038 (Appendix 1). If technical requirements in the Protocol are updated, occupiers of land within a Possum Control Area are required to maintain pests in accordance with the amended Protocol from the date specified in the Gazette notice. There is no further requirement for the Council to re-enter into written agreements with land occupiers to ensure compliance with the amended Protocol.



HBRC Publication Number 4969
HBRC Report Number AM18-02

Figure 1: Possum Control Area (yellow)

Maintenance requirement

An occupier within a Possum Control Area (*Figure 1*) shall maintain possum densities on their land at or below 4% residual trap catch.

The ongoing maintenance of possums within a Possum Control Area must be undertaken on a regular basis as to keep possum densities at or below 4% residual trap catch. Possum maintenance is the responsibility of the land occupier. To meet this requirement it is recommended that possum control is undertaken annually. Details of the requirements on land occupiers are set out as follows:

Private land occupiers:	Occupiers of land greater than 4ha in a Possum Control Area will at their own cost be responsible for maintaining Possum densities at or below 4% residual trap catch. They may elect to carry out their own control or engage a contractor to carry out control.
Council:	HBRC will maintain possum numbers at or below 4% residual trap catch on land that it occupies or manages within a Possum Control Area. (See River margins below).
Department of Conservation:	HBRC will arrange maintenance control work over DOC land in a Possum Control Area. HBRC will seek to recover the costs associated with the maintenance control work from DOC.
River margins:	The occupiers of land adjoining a river and in a Possum Control Area will at their own cost be responsible for the ongoing maintenance of the river margin. Where HBRC occupies or manages the land for river protection, it is deemed to be the occupier. The areas of responsibility will be clearly defined prior to initial control work proceeding.
Multi-ownership land:	Occupiers of multi-ownership land in a Possum Control Area will at their own cost be responsible for maintaining possum densities at or below 4% residual trap catch. They may elect to carry out their own control or engage a contractor to carry out control.
Production forestry:	Where production forestry land borders other private land that is being included into a Possum Control Area, then a marginal strip no less than 500 metres into the production forestry land will be included into the possum Control Area. The Occupier is required to maintain this marginal strip below a 4% residual trap catch and will meet the cost of this work. Maintaining a marginal strip of 500m at a 4% residual trap catch or less is likely to require control over an area of forest greater than 500m.
Regional boundaries:	Where a Possum Control Area borders a regional boundary, the occupier of the land in the Possum Control Area is responsible for maintaining possums at or below 4% residual trap catch at their cost.
Tb Management Area:	This rule will not apply to any occupier who remains within a Tb Management Area where possums are being actively managed by OSPRI (a not-for-profit limited company consisting of two wholly-owned subsidiaries, TBfree New Zealand Ltd and NAIT Ltd.) at or below 4% residual trap catch, in accordance with this protocol.

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Covenanted Areas

HBRC supports land occupiers covenanting areas of ecologically significant land in Hawke's Bay and has in the past carried out possum control over QEII covenanted areas. The regime outlined below continues the support for covenanted areas with Possum Control Areas.

For the purposes of this Plan, and possum control in particular, covenanted areas mean those lands which have a QEII Trust covenant. HBRC may at its discretion provide possum control assistance over the covenanted land, including Nga whenua rahui.

Covenanted areas within a Possum Control Area

Covenanted Area

Less than 20 hectares:	HBRC will make available free possum bait to enable land occupiers to maintain possum densities below 4% trap catch over the covenanted land.
21 hectares to 300ha:	HBRC will limit its assistance to the cost of the most cost effective maintenance technique necessary to allow a landowner to meet their Plan Management obligations. Where a covenantor disagrees with HBRC's opinion of what is the most cost effective maintenance technique, they will be required to meet the additional costs of maintenance
Greater than 300ha:	HBRC may at its discretion provide possum control assistance over the covenanted land.

Good Neighbour Rule

Unless an occupier of land has entered into a Written Management Agreement approved by Hawke's Bay Regional Council, an occupier within, or adjacent to, a Possum Control Area, shall, on receipt of a written direction from an Authorised Person maintain possum densities on their land at or below 4% residual trap catch (in accordance with this Protocol) within 500 metres of the adjoining property boundary where the occupier of the adjoining property is also maintaining possum densities on their land at or below 4% residual trap catch (in accordance with this Protocol) in order to protect economic well-being and environmental values.

HBRC Publication Number 4969
HBRC Report Number AM18-02

Possum Eradication Area

Purpose

Possums cause significant adverse impacts across a range of values within the Hawke's Bay region and have been the subject of a substantial community investment to minimise these pest impacts over the last two decades. The eradication of possums on farmland will allow these adverse impacts to cease and provide a significant opportunity for the community to shift resources currently applied to possum control towards controlling predator pests such as mustelids, feral cats and rats. Large scale control of these additional predator pests will allow the region to realise a much greater range of economic and environmental benefits while minimising additional costs to the community.

Process for forming a Possum Eradication Area

A Possum Eradication Area is created once written agreements have been entered into with 75% or more of the total proposed land area. The Council will undertake possum eradication work within the entire Possum Eradication Area. Once possum eradication commences, land occupiers within the area are required to comply with this Protocol.

A Possum Eradication Area is defined as an area identified as a Possum Eradication Area within this Protocol. All Possum Eradication Areas will be mapped and inserted into this Protocol once the 75% land area threshold has been reached and initial control work has been completed within the area.

Once the Council has given notice to affected land occupiers and in the NZ Gazette that this Protocol has been amended to include an additional map, the map will have legal effect as part of the Hawke's Bay Regional Pest Management Plan 2018 - 2038. Therefore occupiers within that mapped area will be required to comply with the requirements within this Technical Protocol from the date specified in the letter to land occupiers and the Gazette notice.

This Technical Protocol is incorporated by reference into the Hawke's Bay Regional Pest Management Plan 2018 – 2038 (Appendix 2). If technical requirements in the Protocol are updated, occupiers of land within a Possum Eradication Area are required to comply with the amended Protocol from the date specified in the Gazette notice. There is no further requirement for the Council to re-enter into written agreements with land occupiers to ensure compliance with the amended Protocol.

Possum Eradication Areas

1) Names and description
2) Map of area

Possum Eradication Area requirements

1) No person shall move or allow to be moved any possum to or within a Possum Eradication Area. This includes commercial transport operators moving goods or people to or among Possum Eradications Areas.
2) No person within a Possum Eradication Area, as shown on Map two, may move or interfere with any article or substance left at a place by an authorised person in accordance with this technical protocol for the purpose of:
    a. confirming the presence, former presence, or absence of possums; or
    b. managing or eradicating any possums;

   other than in accordance with the direction or under the supervision of an authorised person.

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Appendix 1 – Possum control area programme insert from Hawke's Bay Regional Pest Management Plan 2018 – 2038

6.4.4 Possums

Background

Hawke's Bay Regional Council has been controlling possums through its Possum Control Area (PCA) programme since 2000. There has been a very high level of support for the PCA programme, and a strong belief by most land occupiers within the programme that it is providing value for money for programme participants. The programme has grown to over 700,000ha and is exceeding its target with an average residual trap catch (RTC) of 2.3% across all PCA programmes. This success and landowner support has provided the foundation for further strengthening PCA benefits. The proposed PCA area is shown in Figure 9 below.

Description

The Australian Brushtail Possum is a nocturnal marsupial introduced and liberated in New Zealand by private individuals and acclimatisation societies between 1837 and 1898 to establish a fur trade. Possums were accorded various levels of protection until 1947. When it became clear that the environmental damage inflicted by them far outweighed any profit made from their skins, this protection was lifted.

Possums in New Zealand occur as two colour types, "blacks" and "greys". Adult male blacks vary from rich red-brown to brown, the females have a darker or black-brown fur. Adult male greys are often strongly rufous in the neck and shoulders while the greys often have a distinct silver tinge in the fur.

Size and weight are dependent on habitat. In good conditions adult possums can weigh between 3 to 5 kilograms. Their life span is about nine years. Possums reach reproductive maturity at approximately two years of age. Usually females rear three young every two years.

Possums can be found throughout Hawke's Bay. Their favoured are generally found in bush/pasture margins as these provide a plentiful supply of food and suitable habitat.

Adverse effects

Possums are considered the major animal pest in New Zealand. In farming areas, they spread bovine tuberculosis to beef and dairy cattle, and to farmed deer, damage crops and orchards, kill poplars and willows planted to control hill-country erosion and stabilise riverbanks, and eat pasture. In exotic forest plantations they kill young trees and stunt the growth of older trees by ring-barking them or breaking the uppermost branches. In native vegetated areas, possums cause severe damage by altering habitats important to native animals and birds. Tree species that are palatable to possums (e.g. rata, kamahi, and pohutukawa) become much reduced or locally extinct, and are replaced by plants that are less palatable such as tree ferns and pepperwood. As well as altering the composition of native forests and competing with native fauna, possums also prey directly on native insects and birds.

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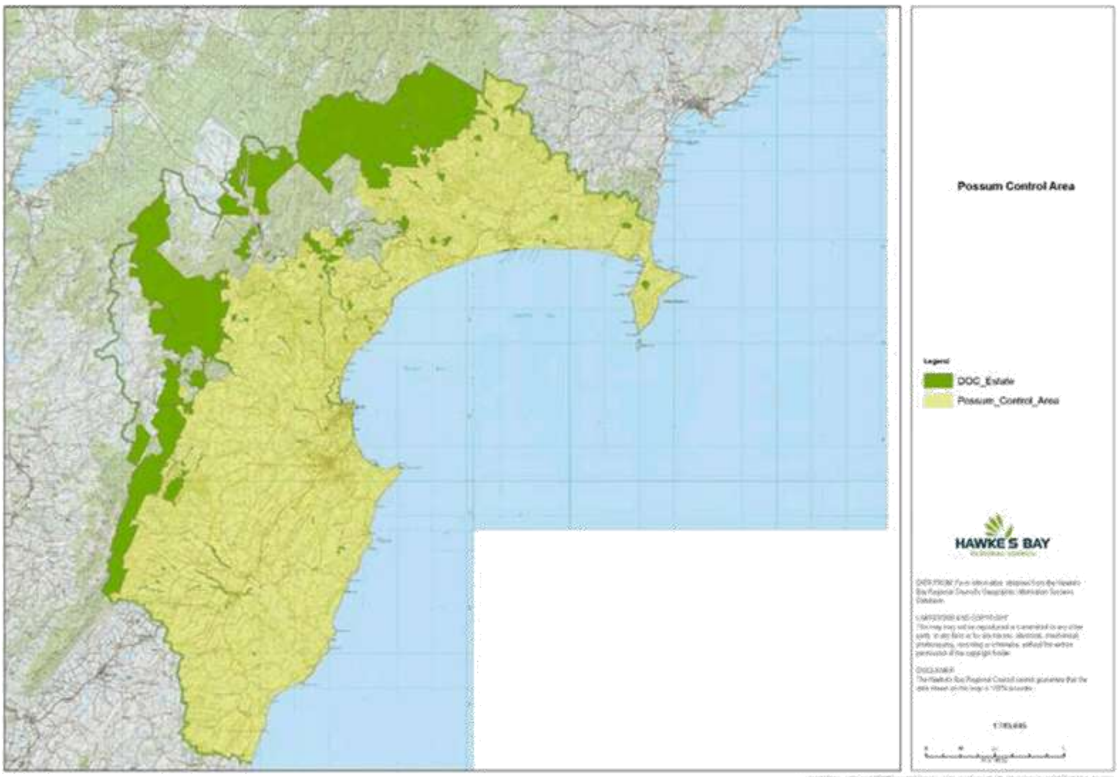

Figure 9: Possum Control Area (yellow)

Objective 9

Over the duration of the Plan, sustainably control possums contained within Possum Control Areas to ensure population density on that land is at or below 4% residual trap catch, to minimise adverse effects on environmental values and economic well-being within the Hawke's Bay region.

Principal measures to be used

Appropriate measures drawing on **Requirement to act, council inspection, service delivery, advocacy and education** activities described in section 5.3 of the Proposal will be used to achieve the Objective.

Alternative measures that have been considered

In reviewing this programme, five options were considered:

1. Council undertakes the management of possums;
2. Increase PCA programme monitoring and compliance activity;
3. Converting Possum Control Areas to Predator Control Areas;
4. Status quo; or
5. Do nothing – remove the possum programme from the RPMP.

Through discussion document feedback and discussions held with key stakeholders, option two was identified as the preferred option. It was agreed that the required increase of $2/ha to undertake option one was not acceptable to the regional community.

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Plan Rule 10

An occupier within a Possum Control Area (figure 9 above) shall maintain possum densities on their land at or below 4% residual trap catch, in accordance with the Hawke's Bay Regional Possum Control Technical Protocol (PN 4969).

A breach of this rule creates an offence under section 154N (19) of the Act.

Explanation of rule

The reason for this rule is to protect past investment in possum control on their property by ensuring possum population levels remain below the threshold at which economic well-being and environmental values are threatened.

Advice Note

This rule **will not apply** to any occupier who remains within a Tb Management Area where possums are being actively managed by OSPRI (a not-for-profit limited company consisting of two wholly-owned subsidiaries, TBfree New Zealand Ltd and NAIT Ltd.) at or below 4% residual trap catch.

Statutory obligation

Sections 52 and 53 of the Biosecurity Act 1993, which prevent the communication, release, spread, sale and propagation of pests, must be complied with. These sections should be referred to in full in the Biosecurity Act 1993. A breach of these rules creates an offence under section 154(O) of the Act.

Plan Rule 11

Note: This is designated a Good Neighbour Rule

Except where an occupier of land has entered into a Written Management Agreement approved by Hawke's Bay Regional Council, an occupier within, or adjacent to, a Possum Control Area, shall, on receipt of a written direction from an Authorised Person maintain possum densities on their land at or below 4% residual trap catch in accordance with the Hawke's Bay Regional Possum Control Technical Protocol (PN 4969) within 500 metres of the adjoining property boundary where the occupier of the adjoining property is also maintaining possum densities on their land at or below 4% residual trap catch in accordance with the Hawke's Bay Regional Possum Control Technical Protocol (PN 4969) in order to protect economic well-being and environmental values.

A breach of this rule creates an offence under section 154N (19) of the Act.

Explanation of rule

The reason for this rule is to manage the spread of possums causing unreasonable costs to the adjacent occupier where active possum management is being undertaken by that occupier.

Advice Note

This rule **will not apply** to any occupier who remains within a Tb Management Area where possums are being actively managed by OSPRI (a not-for-profit limited company consisting of two wholly-owned subsidiaries, TBfree New Zealand Ltd and NAIT Ltd.) at or below 4% residual trap catch.

Statutory obligation

Sections 52 and 53 of the Biosecurity Act 1993, which prevent the communication, release, spread, sale and propagation of pests, must be complied with. These sections should be referred to in full in the Biosecurity Act 1993. A breach of these rules creates an offence under section 154(O) of the Act.

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Appendix 2 – Possum eradication programme insert from Hawke's Bay Regional Pest Management Plan 2018 – 2038

6.2.9 Possums

Description

The Australian Brushtail Possum is a nocturnal marsupial introduced and liberated in New Zealand by private individuals and acclimatisation societies between 1837 and 1898 to establish a fur trade. Possums were accorded various levels of protection until 1947. When it became clear that the environmental damage inflicted by them far outweighed any profit made from their skins, this protection was lifted.

Possums in New Zealand occur as two colour types, "blacks" and "greys". Adult male blacks vary from rich red-brown to brown, the females have a darker or black-brown fur. Adult male greys are often strongly rufous in the neck and shoulders while the greys often have a distinct silver tinge in the fur.

Size and weight are dependent on habitat. In good conditions adult possums can weigh between 3 to 5 kilograms. Their life span is about nine years. Possums reach reproductive maturity at approximately two years of age. Usually females rear three young every two years.

Possums can be found throughout Hawke's Bay. Their favoured are generally found in bush/pasture margins as these provide a plentiful supply of food and suitable habitat.

Adverse effects

Possums are considered the major animal pest in New Zealand. In farming areas, they spread bovine tuberculosis to beef and dairy cattle, and to farmed deer, damage crops and orchards, kill poplars and willows planted to control hill-country erosion and stabilise riverbanks, and eat pasture. In exotic forest plantations they kill young trees and stunt the growth of older trees by ring-barking them or breaking the uppermost branches. In native vegetated areas, possums cause severe damage by altering habitats important to native animals and birds. Tree species that are palatable to possums (e.g. rata, kamahi, and pohutukawa) become much reduced or locally extinct, and are replaced by plants that are less palatable such as tree ferns and pepperwood. As well as altering the composition of native forests and competing with native fauna, possums also prey directly on native insects and birds.

Objective 3

Over the duration of the Plan, where possible, eradicate possums within those areas identified as Possum Eradication Areas in accordance with the Hawke's Bay Regional Possum Control Technical Protocol (PN 4969), to minimise adverse effects on environmental values and economic well-being within the Hawke's Bay region.

Principal measures to be used

Appropriate measures drawing on **Requirement to act, council inspection, service delivery, advocacy and education** activities described in section 5.3 of the Proposal will be used to achieve the Objective.

Alternative measures that have been considered

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The following five options were considered when reviewing the Possums Control Area porgramme:

6. Council undertakes the management of possums;
7. Increase PCA programme monitoring and compliance activity;
8. Converting Possum Control Areas to Predator Control Areas;
9. Status quo; or
10. Do nothing – remove the possum programme from the RPMP.

Possum eradication was not included as an option due to not having the tools to achieve this goal. Through the release of resent research undertaken by Zero Invasive Pests Ltd and potential future funding from Predator Free Ltd, it is likely that possum eradication will be feasible within the duration of this plan. The Council has better skills and resources for undertaking eradication activities than individual persons do. Relying on or requiring individual voluntary action (do nothing approach) as a means of achieving the Objective would likely fail.

Plan Rule 2

All occupiers within a Possum Eradication Area identified in the Hawke's Bay Regional Possum Control Technical Protocol (PN 4969) shall maintain possum eradication status in accordance with that Protocol.

A breach of this rule creates an offence under section 154N (19) of the Act.

Explanation of rule

The reason for this rule is to protect the investment in possum eradication on their property by ensuring possums do not re-establish threatening the economic well-being and environmental values being protected.

Statutory obligation

Sections 52 and 53 of the Biosecurity Act 1993, which prevent the communication, release, spread, sale and propagation of pests, must be complied with. These sections should be referred to in full in the Biosecurity Act 1993. A breach of these rules creates an offence under section 154(O) of the Act

Hawke's Bay Regional Predator Control Technical Protocol (PN 4970)

This Regional Predator Control Protocol sets out areas that are Predator Control Areas and the required monitoring threshold to meet the Predator Control Area programme rule in the Hawke's Bay Regional Pest Management Plan 2018 -2038. This rule and monitoring threshold applies to all Predator Control Areas identified in this document.

Predator description

Ferrets, stoats, weasels are part of the Mustelid family, which is a group of small to medium sized carnivores. Mustelids have large home ranges and are active day and night. They are opportunistic predators and have a strong musk odour. Ferrets are the largest mustelid in New Zealand. Male ferrets grow up to 44cm and females up to 37cm in length. The undercoat is creamy yellow with long black guard hairs that give the ferret a dark appearance. A characteristic black face mask occurs across the eyes and above the nose. Stoats have long, thin bodies with smooth pointed heads. Ears are short and rounded. They are smaller than ferrets. Males grow up to 30cm and females up to 25cm in length. Their fur is reddish- brown above with a white to yellowish underbelly. Stoats have relatively long tails with a distinctive bushy black tip. Weasels are the smallest and least common mustelid in New Zealand. Males grow to about 20cm. Their fur is brown with white undercoat, often broken by brown spots. Their tails are short, brown and tapering.

Feral cats resemble domestic cats in both size and colouration. Coat colours vary from pure black to orange tabby and some resemble the striped dark and pale grey of the true European wild cat. Commonly revert to black, tabby or tortoiseshell with varying extents of white starting from the belly and breast. Adult male cats are generally larger than the females and can weigh up to five kg.

They tend to be solitary and territorial compared to domestic stray or unwanted cats that tend to form colonies. Territory is marked by scent secreted from anal glands and by spraying urine. Feral cats are mainly active at night. Their vision and hearing are acute.

Inhabits a wide range of urban, rural and forest habitats. Found from sea level to alpine habitats. Diet is wide-ranging and includes small mammals, fish, birds and invertebrates. They have 2-3 litters per year with an average of 4 young in each.

Adverse effects

Although habitat loss and modification remains a threat to native biodiversity, a more equally serious threat is from invasive introduced species. Introduced predators, such as ferrets, stoats, weasels and feral cats, pose a significant threat to our remaining natural ecosystems and habitats and threatened native species and can have a considerable negative impact on primary production. Ferrets, stoats, weasels and feral cats are distributed throughout the Hawke's Bay region.

Mustelids were introduced in New Zealand in the 1880's in an attempt to manage growing rabbit populations. This had minimal impact on rabbit densities but had a significant impact on New Zealand's Biodiversity. Mustelids are implicated in the extinction of some indigenous bird species and as the major cause of decline of many others. Ferrets are also a threat to agriculture, particularly through their role as a vector (carrier) of bovine tuberculosis. Mustelids are a threat to poultry farms and carry parasites and toxoplasmosis, which can cause illness in humans and livestock.

Feral cats have been branded as 'the ultimate predators' in New Zealand and have been nominated as among 100 of the "World's Worst" invaders. New Zealand's unique native wildlife is particularly vulnerable to predation by cats. Feral cats kill young and adult birds and occasionally take eggs, prey on native lizards, fish, frogs and large invertebrates. Cats are highly efficient predators, and have been known to cause local extinctions of seabird species on islands around the world. Both sea and land birds are at risk, particularly those that nest or feed on or near to the ground. Feral cats are implicated in a small way in the spread of Bovine Tuberculosis, with the potential to infect cattle. They also carry

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parasites and toxoplasmosis that causes abortions in sheep and illness in humans. Feral and stray cats can be aggressive towards pet cats. Through fighting they cause severe injuries sometimes resulting in the pet cat having to be put down. Stray cats are likely to interbreed with the un-neutered domestic cat population and may spread infectious diseases.

Purpose of Predator Control Areas

Hawkes Bay Regional Council has been controlling possums through its Possum Control Area (PCA) programme since 2000. There has been a very high level of support for the PCA programme, and a strong belief by most land occupiers within the programme that it is providing value for money for programme participants. The programme has grown to over 600,000ha and is exceeding its target with an average residual trap catch (RTC) of 2.3% across all PCA programmes. This success and landowner support has provided the foundation for further strengthening PCA benefits.

Land owners within PCAs are now requesting predator control be undertaken for species such as cats and mustelids. Although cats are known to predate on native species it is their role as a key vector of toxoplasmosis that concerns most land owners. In agriculture, toxoplasmosis has a significant impact on sheep production, with recent research suggesting there is a substantial economic impact to the Hawkes Bay region through loss of lambs. A survey undertaken of NZ sheep flocks in 2011 indicated 100% seroprevalence of Toxoplasmosis in the flocks surveyed. Concern was also raised by land owners around mustelid impacts on biodiversity including waterfowl and ferrets as known TB vectors.

Predator pests such as mustelid's and feral cats have a major adverse effect on NZ native flora and fauna. Predator Free New Zealand 2050 (PFNZ) and its associated funding is an important political and funding milestone in the war against predator pests. Public conservation land, sanctuaries, urban communities and farmland all have key roles in achieving a predator free nation.

Integrating large scale predator control into PCA programmes can provide a key platform for delivering additional economic and environmental outcomes to land owners. This coupled with appropriately targeted intensive high biodiversity value site protection will provide the greatest likelihood of significant long term integrated biodiversity recovery and primary production benefits across the Hawkes Bay region.

Process for forming a Predator Control Area

A Predator Control Area is created once written agreements have been entered into with 75% or more of the total land area. The Council will undertake initial predator control work within the entire Predator Control Area. It is only once that initial predator control work is completed that land occupiers within the area are required to maintain stoats, ferrets, weasels and feral cats in accordance with this Protocol.

A Predator Control Area is defined as an area identified as a Predator Control Area within this Protocol. All Predator Control Areas will be mapped and inserted into this Protocol once the 75% land area threshold has been reached and initial control work has been completed within the area.

Once the Council has given notice to affected land occupiers and in the NZ Gazette that this Protocol has been amended to include an additional map, the map will have legal effect as part of the Hawke's Bay Regional Pest Management Plan 2018 - 2038. Therefore occupiers within that mapped area will be required to comply with the requirements within this Technical Protocol from the date specified in the letter to land occupiers and the Gazette notice.

This Technical Protocol is incorporated by reference into the Hawke's Bay Regional Pest Management Plan 2018 – 2038. If technical requirements in the Protocol are updated, occupiers of land within a Predator Control Area are required to maintain pests in accordance with the amended Protocol from the date specified in the Gazette notice. There is no further requirement for the Council to re-enter into written agreements with land occupiers to ensure compliance with the amended Protocol.

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Predator Control areas

1) Names and description
2) Area mapped

Predator Maintenance requirement

Permanent ferret, stoat, weasel and feral cat traps must be cleared and maintained regularly as such that the average camera trap rate (CTR) over any parcel of land in a Predator Control Area does not exceed <1%. Traps must be serviced a minimum four times per calendar year and a trap must be cleared and reset within one month of being set off.

The ongoing maintenance of predator densities within a Predator Control is the responsibility of the land occupier. Details of the requirements on land occupiers are set out as follows:

Private land occupiers:	Occupiers of land in a Predator Control Area will at their own cost be responsible for maintaining predator densities in alignment with the **Predator Maintenance Requirement**. They may elect to carry out their own control or engage a contractor to carry out control.
Council:	HBRC will maintain predator densities in alignment with the **Predator Maintenance Requirement** on land that it occupies or manages within a Predator Control Area.
Department of Conservation:	HBRC will agree a maintenance control programme with the Department of Conservation DOC land in a Predator Control Area.
River margins:	The occupiers of land adjoining a river and in a Predator Control Area will at their own cost be responsible for the ongoing maintenance of the river margin. Where HBRC occupies or manages the land for river protection, it is deemed to be the occupier. The areas of responsibility will be clearly defined prior to initial control work proceeding.
Multi-ownership land:	Occupiers of multi-ownership land in a Long Control Area will at their own cost be responsible for maintaining predator densities in alignment with the **Predator Maintenance Requirement**. They may elect to carry out their own control or engage a contractor to carry out control.
Production forestry:	Where production forestry land borders other private land that is being included into a Predator Control Area, then a marginal strip no less than 500 metres into the production forestry land will be included into the Long Term Predator Control Area. The Occupier is required to maintain predator densities within this marginal strip in alignment with the **Predator Maintenance Requirement** and will meet the cost of this work. Maintaining a marginal strip of 500m is likely to require control over an area of forest greater than 500m.

Wireless network system

If a wireless network trap monitoring system has been installed, land occupiers must clear activated traps within 30 days of activation.

Note: serviced means the removal of dead animals, inspection of trap to make sure it is functioning properly, grass/obstacles removed from around the trap entrance and trap rebaited with fresh bait.

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Appendix one – Predator Control Area insert from Hawke's Bay Regional Pest Management Plan 2018 - 2038

6.4.5 Predators (ferret, stoat, weasel and feral cat)

Background

As discussed in the Possum programme, Hawke's Bay Regional Council has been controlling possums since 2000 and has received a very high level of support for the PCA programme. This success and landowner support has provided the foundation for further strengthening PCA benefits.

Source: Hawke's Bay Regional Council

Land owners within PCAs are now requesting predator control be undertaken for species such as feral cats and mustelids. Although feral cats are known to predate on native species, their role as a key vector of toxoplasmosis also concerns many land owners. In agriculture, toxoplasmosis has a significant impact on sheep production, with recent research suggesting there is a substantial economic impact to the Hawke's Bay region through loss of lambs. A survey undertaken of NZ sheep flocks in 2011 indicated 100% seroprevalence of toxoplasmosis in the flocks surveyed. Concern was also raised by land owners around mustelid impacts on biodiversity including waterfowl and ferrets as known TB vectors.

Predator pests such as mustelid's and feral cats have a major adverse effect on NZ native flora and fauna. Predator Free New Zealand 2050 (PFNZ) and its associated funding is an important political and funding milestone in the war against predator pests. Public conservation land, sanctuaries, urban communities and farmland all have key roles in achieving a predator free nation.

Integrating predator control alongside PCA programmes can provide a key platform for delivering additional economic and environmental outcomes to land owners. This coupled with appropriately targeted intensive high biodiversity value site protection will provide the greatest likelihood of significant long term integrated biodiversity recovery and primary production benefits across the Hawke's Bay region.

However, Predator Control Areas will not replace Possum Control Areas. Rather, they are designed to add further value to possum control.

The Council will identify Predator Control Areas and will seek to enter into written agreements with individual landowners within those areas to undertake long term predator control maintenance. Once written agreements have been entered into with respect to 75% or more of the total land area, the Council will undertake initial predator control work within the entire Predator Control Area. After initial predator control work has been undertaken, occupiers within the area will be required to maintain the listed pests in accordance with the Hawke's Bay Regional Predator Control Technical Protocol.

A Predator Control Area is defined as an area identified as a Predator Control Area in the Hawke's Bay Regional Predator Control Technical Protocol (the Protocol). The Protocol will contain mapped

Predator Control Areas. These maps will be inserted into the Protocol once the 75% land area threshold has been reached and initial control work has been undertaken within the area. Once the Council has given notice in the NZ Gazette that the Protocol has been amended to include an additional map, the map will have legal effect as part of the RPMP. Thereafter occupiers within that mapped area will be required to comply with the requirements in the Protocol from the date specified in the Gazette notice.

Description

Ferrets, stoats, weasels are part of the Mustelid family, which is a group of small to medium sized carnivores. Mustelids have large home ranges and are active day and night. They are opportunistic predators and have a strong musk odour. Ferrets are the largest mustelid in New Zealand. Male ferrets grow up to 44cm and females up to 37cm in length. The undercoat is creamy yellow with long black guard hairs that give the ferret a dark appearance. A characteristic black face mask occurs across the eyes and above the nose. Stoats have long, thin bodies with smooth pointed heads. Ears are short and rounded. They are smaller than ferrets. Males grow up to 30cm and females up to 25cm in length. Their fur is reddish- brown above with a white to yellowish underbelly. Stoats have relatively long tails with a distinctive bushy black tip. Weasels are the smallest and least common mustelid in New Zealand. Males grow to about 20cm. Their fur is brown with white undercoat, often broken by brown spots. Their tails are short, brown and tapering.

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They tend to be solitary and territorial compared to domestic stray or unwanted cats that tend to form colonies. Territory is marked by scent secreted from anal glands and by spraying urine. Feral cats are mainly active at night. Their vision and hearing are acute.

Inhabits a wide range of urban, rural and forest habitats. Found from sea level to alpine habitats. Diet is wide-ranging and includes small mammals, fish, birds and invertebrates. They have 2-3 litters per year with an average of 4 young in each.

Adverse effects

Although habitat loss and modification remains a threat to native biodiversity, a more equally serious threat is from invasive introduced species. Introduced predators, such as ferrets, stoats, weasels and feral cats, pose a significant threat to our remaining natural ecosystems and habitats and threatened native species and can have a considerable negative impact on primary production. Ferrets, stoats, weasels and feral cats are distributed throughout the Hawke's Bay region.

Mustelids were introduced in New Zealand in the 1880's in an attempt to manage growing rabbit populations. This had minimal impact on rabbit densities but had a significant impact on New Zealand's Biodiversity. Mustelids are implicated in the extinction of some indigenous bird species and as the major cause of decline of many others. Ferrets are also a threat to agriculture, particularly through their role as a vector (carrier) of bovine tuberculosis. Mustelids are a threat to poultry farms and carry parasites and toxoplasmosis, which can cause illness in humans and livestock.

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Objective 10

Over the duration of the Plan, sustainably control stoats, ferrets, weasels and feral cats on land contained within Predator Control Areas to ensure population density on that land does not exceed levels outlined in the Hawke's Bay Regional Predator Control Technical Protocol (PN 4970) to minimise adverse effects on environmental values and economic well-being within the Hawke's Bay region.

Principal measures to be used

Appropriate measures drawing on **Requirement to act, council inspection, service delivery, advocacy and education** activities described in section 5.3 of the Proposal will be used to achieve the Objective.

To assist achieving the Objective, Predator Control Areas will be established. Creating these areas will be done with agreement from landowners. The process and responsibilities to be followed are outlined in the Hawke's Bay Regional Predator Control Technical Protocol (PN 4970).

Alternative measures that have been considered

This is a new programme, converting current Possum Control Areas to Predator Control Areas, and was consulted on during the Discussion Document. Two options were put forward.

1 Council funded initial predator control and installation of trap networks followed up with land occupiers be responsible for maintaining low predator densities through the use of a contactor or clearing activated kill traps.

2 Not instigating the new programme (do nothing).

The first option received strong support from the community and for that reason it is included in the Proposal

Plan Rule 12

All occupiers within a Predator Control Area shall maintain ferrets, stoats, weasels and feral cats in accordance with the Hawke's Bay Regional Predator Control Technical Protocol (PN 4970).

A breach of this rule creates an offence under section 154N (19) of the Act.

Explanation of rule

The purpose of Predator Control Areas is to enable communities, who wish to do so, to create sustained low predator density areas to achieve both biodiversity and economic outcomes. If the community decides to form a Predator Control Area, whereby the 75% land area threshold is met, it is critical that there is a rule to both protect the initial investment to be undertaken by Council and other partners. Securing this investment in the initial knockdown phase and binding land owners that would otherwise not participate, and therefore potentially compromise, the programme is important to long term programme success.

All land owners/occupiers within a proposed Predator Control Area will be visited individually and have the programme discussed. Land owners/occupiers will be asked if they are willing to sign up to a management agreement. Initial predator control work will not commence until the 75% land area threshold has been met. Upon completion of initial predator control, whereby predator abundance has been reduced to levels required under the Hawke's Bay Regional Predator Control Technical Protocol (PN 4970), land occupiers within a Predator Control Area become responsible for maintaining stoats, ferrets, weasels and feral cats in accordance with the Hawke's Bay Regional Predator Control Technical Protocol (PN 4970).

The Hawke's Bay Regional Council will give notice to affected land occupiers and in the NZ Gazette of the date on which an area becomes a Predator Control Area.

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