HAWKE'S BAY
REGIONAL COUNCIL
TE KAUNIHERA Ā-ROHE O TE MATAU-A-MĀUI

Meeting of the Cyclone Recovery Committee

Date: Wednesday 8 November 2023

Time: 10.45am

Venue: Council Chamber
Hawke's Bay Regional Council
159 Dalton Street
NAPIER

Attachments Excluded From Agenda

2023-2024 Biosecurity Operational Plan

Regional Pest Management Plan 2018-38

August 2023
Hawkes Bay Regional Council Publication No.

HAWKES BAY
REGIONAL COUNCIL
TE KAUNIHERA Ā-ROHE O TE MATAU-A-MĀUI

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HAWKES BAY REGIONAL COUNCIL
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Catchment Services

2023-2024 Operational Plan

Regional Pest Management Plan 2018-38

August 2023
Hawkes Bay Regional Council Publication No.

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Version

Contents

Introduction

Regional councils have a mandate under Part 2 of the Biosecurity Act 1993 (the Act) to provide regional leadership in activities that prevent, reduce, or eliminate adverse effects from harmful organisms that are present in their region.

This operational plan sets out how Hawke's Bay Regional Council (HBRC) will implement the objectives set out in the Hawke's Bay Regional Pest Management Plan 2018-38 (the RPMP). This operational plan is effective from July 2023 to 30 June 2024.

Background

Hawke's Bay Regional Council is the management agency responsible for developing and implementing the Hawke's Bay Regional Pest Management Plan 2018-2038 in accordance with the Biosecurity Act 1993.

The RPMP sets out policies and rules that in combination seek to achieve the eradication or effective management of specified pests or groups of pests. It describes the biosecurity activities that will be undertaken throughout Hawke's Bay and outlines the management or eradication of specific organisms. Doing so will:

- minimise the actual or potential adverse or unintended effects associated with these organisms, and,
- maximise the effectiveness of individual actions in managing pests through a regionally coordinated approach.

As the management agency, Council is required to prepare an annual operational plan that sets out how the plan is to be implemented. Following the end of each financial year, staff will report to Council on the implementation of the operational plan.

This plan is the operational (management) response to supporting or directly achieving the objectives contained within the RPMP and is delivered by the Biosecurity team of the Catchment Services section within the Integrated Catchment Management (ICM) group.

Integration with Annual Plan

As far as practicable, the Operational Plan has been integrated with council's Annual Plan. The Annual Plan sets the overall priorities and work programmes for the organisation and provides an overview of related pest management activities for the 2023/2024 year. Implementation costs are included in the Annual Plan.

Integration with Biodiversity Activities

HBRC has responsibilities to manage biodiversity under the Resource Management Act 1991. The management of high value biodiversity areas across the region is coordinated by the Biodiversity team of the Catchment Services team within the ICM group. Pest plant and pest animal control is a key method for managing native biodiversity, requiring ongoing investment of council resources, with resources allocated to the Ecosystem Prioritisation programme. This programme focuses on managing the areas of highest biodiversity value in Hawke's Bay, which includes ongoing coordinated pest control. Implementation of this programme requires close coordination with the Pest Plant, Pest Animal and Predator Free Hawke's Bay teams. This work is complemented by other efforts such as deer fencing to exclude feral deer and advocating for legal protection under QEII and other covenanting agencies.

Pest Categories

Exclusion Pests

The purpose of this category is to prevent the establishment of a pest which is present in New Zealand but not yet established in the region. Eradication of an incursion exclusion pest will be attempted by the Council in conjunction with other agencies such as MPI, DOC and neighbouring Regional Councils.

Eradication Pests

The purpose of this category is to reduce the incidence or density of a pest to zero levels in an area in the short to medium term. For pests such as rooks, this could take over 30 years to achieve.

Progressive Containment Pests

The intermediate outcome for this category is to contain and reduce the geographic distribution of the pest to an area over time. Progressive containment pests are those where a pest is at high densities in parts of Hawke's Bay, but of low extent or limited range. Eradication is not feasible region-wide, but it is feasible to prevent the pest from spreading to other parts of Hawke's Bay or to eradicate the pest from parts of Hawke's Bay.

- Existing populations will be monitored and, where appropriate, systems set in place to prevent further spread.
- New technologies and methods will be investigated and introduced where possible.

Sustained Control Pests

The purpose of this category is to ensure pests are being controlled, to reduce its impacts on values and spread to other properties. This may include boundary control of pest plants or suppression of a pest animal over a large geographic area where eradication is not possible.

Pests contained within the RPMP

Table 4-1: Number of Pest Species in the Plan.

Number of species (or groups of species) in the Regional Pest Management Plan					
Type of pest	Exclusion	Eradication	Progressive containment	Site led	Sustained control
Plants	5	8	11		9
Animals	1	2		8	5
Phytosanitary					5
Marine	2				

**Note some species have more than one programme.*

Table 4-2: Pest Plant species included in RPMP

Common Name	Scientific Name	Programme
African feather grass*	*Cenchrus macrourus*	Eradication
Alligator weed*	*Alternanthera philoxeroides*	Exclusion
Apple of Sodom	*Solanum linnaeanum*	Progressive Containment
Australian sedge	*Carex longebrachiata*	Progressive Containment
Bathurst bur	*Xanthium spinosum*	Sustained Control
Blackberry	*Rubus fruticosus* agg.	Sustained Control
Cathedral bells*	*Cobaea scandens*	Eradication
Chilean needle grass*	*Nassella neesiana*	Sustained Control
Cotton thistle	*Onopordum acanthium*	Progressive Containment
Darwin's barberry*	*Berberis darwinii*	Progressive Containment
Goats rue	*Galega officinalis*	Eradication
Gorse	*Ulex europaeus*	Sustained Control
Japanese honeysuckle	*Lonicera japonica*	Progressive Containment
Marshwort*	*Nymphoides geminata*	Exclusion
Noogoora bur	*Xanthium strumarium*	Exclusion
Nassella tussock*	*Nassella trichotoma*	Progressive Containment
Nodding thistle	*Cardus nutans*	Sustained Control
Old man's beard*	*Clematis vitalba*	Progressive Containment
Phragmites*	*Phragmites australis*	Eradication
Purple loosestrife*	*Lythrum salicaria*	Eradication
Privet (Chinese and tree)	*Ligustrum sinense, L. lucidum*	Sustained Control
Ragwort	*Jacobaea vulgaris*	Sustained Control
Saffron thistle	*Carthamus lanatus*	Progressive Containment
Senegal tea*	*Gymnocoronis spilanthoides*	Exclusion
Spartina	*Spartina alterniflora, S. anglica, S. gracilis, S. maritime, S. x townsendii*	Exclusion
Spiny emex	*Emex australis*	Eradication
Variegated thistle	*Silybum marianum*	Sustained Control
Velvetleaf*	*Abutilon theophrasti*	Progressive Containment
White-edged nightshade*	*Solanum marginatum*	Eradication
Wilding Conifers	*Ref glossary pg 102*	Progressive Containment
Woolly nightshade*	*Solanum mauritianum*	Progressive Containment

Common Name	Scientific Name	Programme
Yellow bristle grass	*Setaria pumila*	Sustained Control
Yellow water lily*	*Nuphar lutea*	Eradication

** Unwanted organisms (as declared by a Chief Technical Officer)*

Table 4-3: Pest Animal species included in RPMP

Common Name	Scientific Name	Programme
Feral cat	*Felis catus*	Sustained Control, Site-led
Feral deer (incl. hybrids)	*Cervus elaphus, C. nippon, C. dama*	Site-led
Feral goat	*Capra hircus*	Sustained Control, Site-led
Feral pig	*Sus scrofa*	Site-led
Hedgehog	*Erinaceus europaeus*	Site-led
Mustelids (ferret, stoat, weasel)	*Mustelo furo, M. ermine, M. nivalis*	Sustained Control, Site-led
Possum	*Trichosurus vulpecula*	Eradication, Sustained Control, Site-led
Rabbit	*Oryctolagus cuniculis*	Sustained Control
Rat (Norway and ship)	*Rattus norvegicus, R. rattus*	Site-led
Rook*	*Corvus frugilegus*	Eradication
Wallaby (Bennett's, dama, parma, brush-tailed rock and swamp)*	*Macropus rufogriseus rufogriseus, M. eugenii, M. parma, Petrogale pencillata, Wallabia bicolour*	Exclusion

** Unwanted organisms (as declared by a Chief Technical Officer)*

Table 4-4: Marine Pests species included in RPMP

Common Name	Scientific Name	Programme
Mediterranean fanworm**	*Sabella spallanzanii*	Exclusion
Clubbed tunicate	*Styela clava*	Exclusion

*** Notifiable organism (s45 Biosecurity Act)*

Table 4-5: Phytosanitary Pests species included in RPMP

Common Name	Scientific Name	Programme
Apple black spot	*Venturia inaequalis.*	Sustained Control
Codling moth	*Cydia pomonella*	Sustained Control
European canker	*Neonectria ditissima*	Sustained Control
Fireblight	*Erwinia amylovora*	Sustained Control
Lightbrown apple moth (Leafroller)	*Epiphyas postvittana*	Sustained Control

This operational plan details the Plan objective for the control of the pests defined within the RPMP and provides a brief description of what activities HBRC will undertake to achieve the stated objective.

Principal Measures

This plan and the RPMP are based on the following core areas of HBRC's responsibility:

Regulation (standards and enforcement)

Standards, rules, and restrictions are set, and compliance enforced with penalties, when and where necessary.

Inspection

Regular property inspections ensure that rules and regulations are being met and changes in pest densities are determined over time.

Monitoring

Undertaking monitoring for pests in the region to determine their presence, distribution, and effects, and to measure the extent to which the objectives of the RPMP are being achieved.

Direct control

Funding and undertaking pest control in some circumstances as a service for regional benefit.

Advice and education

Free advice is given to raise awareness of pest problems and to provide land occupiers with the information to control their own pests.

Community initiatives

Guidance and support are provided for community driven initiatives to control pests.

Cost recovery

A full cost recovery operational service is available for pest control.

Biological control

As approved biological control agents become available, HBRC may elect to utilise them. Biocontrol is currently a key tool in the management of rabbits and various pest plant and other harmful species.

Pest Plants

1.1. Exclusion Pest Plants

Objective

Prevent the establishment of exclusion pest plants in the Hawke's Bay region.

Targets

Conduct searches in areas vulnerable to infestation, follow up on reported sightings and raise public awareness of exclusion pests. Develop partnerships with other organisations and community groups that have expertise or an interest in protecting the environment.

Eradication of exclusion species will be attempted by HBRC in conjunction with relevant Crown agencies and stakeholders where practicable.

Council will provide training to relevant council staff and stakeholders about the identification of the exclusion pests to assist in early detection. Council will provide advice, attend events, and undertake publicity campaigns to increase public awareness of exclusion pests.

Exclusion	Management Regime
Alligator weed	Develop partnerships and distribute information to interested and relevant parties to extend the area monitored for the presence of these pest plants. Investigate possible pathways for these pest plants to move into Hawke's Bay. Respond to reports of this pest, using powers under the Biosecurity Act if required. Alligator weed has been found in Hawke's Bay and a delimiting/eradication program has begun. An Operational Plan for responding to this incursion is being formulated which will detail costings and control measures.
Marshwort	
Noogoora bur	
Senegal tea	
Spartina	

1.2. Eradication Pest Plants

Objective

Destroy all known infestations of these species within the Hawke's Bay region, prior to seed set.

Targets

Undertake direct control through service delivery at all known sites. Assessment of existing infestation points to decide whether any surveys are required. Inspection and delimit regime to be carried out at all known sites.

Control work will be undertaken annually by council staff, contractors, partners and/or stakeholders and data will be recorded in Clover.

Eradication	Management Regime
African feather grass	HBRC will destroy all infestations prior to seed set.
Cathedral bells	
Goats rue	
Purple loosestrife	
Spiny emex	
White edged nightshade	
Yellow water lily	
Phragmites	In accordance with the contract between HBRC and Ministry of Primary Industries, HBRC will destroy all infestations prior to seed set.

1.3. Progressive Containment Pest Plants

Objective

Progressively contain and reduce the geographic distribution of the pest plant either across the region or specified areas within the region.

Targets

Through a combination of direct control (service delivery) and occupier responsibility (monitoring and compliance) all known infestations will be controlled prior to seed set where practical.

Council staff will control populations within the containment area through a variety of control methods, including but not limited to spraying. The long-term goal for many of these pests is eradication but is not feasible within the short to medium term.

Council staff will also support communities to reduce the impact of progressive containment pests through regulatory and non-regulatory biosecurity programmes.

Progressive containment	Management Regime
Apple of Sodom	Occupiers are responsible for the control of Apple of Sodom, Australian sedge, Cotton thistle, Darwin's barberry, Japanese honeysuckle, Saffron thistle, Velvetleaf and Woolly nightshade on their land and may qualify for a subsidy under the incentive scheme. HBRC will at its discretion control some known infestations prior to seed set where it is practical to do so.
Australian sedge	
Cotton thistle	
Darwin's barberry	
Japanese honeysuckle	
Saffron thistle	
Velvetleaf	
Woolly nightshade	
Nassella tussock	Occupiers are responsible for controlling Nassella tussock on their land and may qualify for a subsidy under the incentive scheme. HBRC will at its discretion control known infestations before the seeds set.
Old man's beard	As stated in the RPMP, Old Man's Beard (OMB) is not as widespread North of SH5 as it is South of this area, therefore it is beneficial to require occupiers to continue to control old man's beard north of SH5. Occupiers North of SH5 are responsible for controlling old man's beard on their land and may qualify for a subsidy under the incentive scheme. HBRC will at its discretion control some known infestations prior to seed set where it is practical to do so. There is also a progressive containment programme along the Ruahine and Kaweka ranges, to prevent the establishment of old man's beard in the ranges. HBRC, upon forming an agreed work programme with the Department of Conservation, will control all old man's beard within a 500-metre buffer zone along the edge of the Ruahine and Kaweka ranges (as per map in RPMP 2018-38).

Progressive containment	Management Regime
	South of SH5 and outside of the 500-metre buffer zone along the edge of the Ruahine and Kaweka ranges, Council will still encourage the control of OMB but will not enforce compliance. Land users below SH5 will still be eligible for the incentive scheme for the control of OMB. HBRC will at its discretion control some known infestations before seeds reach maturity where it is practical to do so.
Wilding Conifers	Occupiers are responsible for controlling Pinus contorta on their land and may qualify for a subsidy under the incentive scheme. HBRC will at its discretion control some known infestations where it is practical to do so. Occupiers are responsible for controlling Scots pine, mountain pine and dwarf mountain pine on their land in the designated containment area and may qualify for a subsidy under the incentive scheme. HBRC will at its discretion control some known infestations where it is practical to do so. HBRC will collaborate with other stakeholders to ensure the milestones it is responsible for within the Kaimanawa and Rangitaiki Management Units are completed, and MPI are supplied with all the necessary data required.

1.4. Sustained Control Pest Plants

Objective

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.

Targets

Several pests are well established in Hawke's Bay, many of which have been subject to various control aspirations over time. The primary objective is to prevent or minimise the spread of these pests between neighbouring properties.

Sustained Control	Management Regime
Bathurst bur	HBRC, upon receiving a written complaint, will ensure the occupier destroys all Bathurst bur within 5 metres of the property boundary that is adjacent to the adjoining occupier complainant's boundary where the adjoining occupier is also destroying, or the land is clear of, all Bathurst bur.
Blackberry	HBRC, upon receiving a written complaint, will ensure the occupier destroys all Blackberry within 10 metres of the property boundary that is adjacent to the adjoining occupier complainant's boundary where the adjoining occupier is also destroying, or the land is clear of, all Blackberry.
Chilean needle grass	Occupiers are responsible for controlling Chilean Needle grass on their land and may qualify for a subsidy under the incentive scheme. Chilean needle grass was identified in dry summer areas of Hawke's Bay - west of Napier, and at Bay View, Puketapu, Havelock North, Maraekakaho, Poukawa, Tukituki flood plain, Otane, Patangata, Waipawa, Waipukarau, Wakarara, Omakere, Onga Onga and Porangahau (approx. 700 ha in total). There are infestations on river berm land and roadsides. Biosecurity staff will arrange to control Chilean needle grass on public land. On private land, occupiers are required to meet the rules outlined in the RPMP and control Chilean

	needle grass in accordance with their agreed management programmes. HBRC will at its discretion control some known infestations before the seed set where it is practical to do so. HBRC will work with Marlborough District Council and Environment Canterbury in raising awareness of CNG within New Zealand.
Gorse	HBRC, upon receiving a written complaint, will ensure the occupier destroys all Gorse within 10 metres of the property boundary that is adjacent to the adjoining occupier complainant's boundary where the adjoining occupier is also destroying, or the land is clear of, all Gorse
Nodding thistle	HBRC, upon receiving a written complaint, will ensure the occupier destroys all Nodding thistle within 20 metres of the property boundary that is adjacent to the adjoining occupier complainant's boundary where the adjoining occupier is also destroying, or the land is clear of, all Nodding thistle
Privet (Chinese and Tree)	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 (50km speed zone or less), 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 prune to prevent flowering or destroy the plants thoroughly.
Ragwort	HBRC, upon receiving a written complaint, will ensure the occupier destroys all Ragwort within 20 metres of the property boundary that is adjacent to the adjoining occupier complainant's boundary where the adjoining occupier is also destroying, or the land is clear of, all Ragwort. The presence of biological controls will be considered when a complaint is made.
Variegated thistle	HBRC, upon receiving a written complaint, will ensure the occupier destroys all Variegated thistle within 5 metres of the property boundary that is adjacent to the adjoining occupier complainant's boundary where the adjoining occupier is also destroying, or the land is clear of, all Variegated thistle
Yellow bristle grass	HBRC will collaborate with roading authorities to manage likely vector pathways of Yellow bristle grass.

1.5. Biodiversity Pest Plants

These are plants that have a negative ecological effect which are managed outside of the RPMP. Plants that presently fall into this category are Boneseed, Climbing Spindleberry, Blue passionflower, Asiatic knotweed, Giant knotweed, Moth plant, Pampas and Purple ragwort.

1.6. Biological Control of Pest Plants

HBRC continues to support research into biological control of pest plants. HBRC's priorities for further research into bio-control agents during the life of the RPMP are Chilean needle grass, Moth plant, Nassella tussock, Old man's beard and Japanese honeysuckle. The region's biological control agents for Ragwort, Nodding thistle, and Gorse are widespread and active. A biological control agent for Californian thistle is steadily becoming established.

Over the duration of this operational plan staff will continue to work effectively to engage Māori landowners and hapu at a local and regional level in the consultation around new biocontrol releases.

1.7. National Pest Plant Accord

The Ministry of Primary Industries manages the National Pest Plant Accord, which has declared 135 plants as unwanted organisms under the Biosecurity Act. HBRC has agreed to be responsible for ensuring that people selling plants are conforming to the requirements of the Act, and not selling or propagating these plants. All pest plants and unwanted organisms are banned from sale and propagation under the Biosecurity Act. All retail outlets that are known to sell plants will be visited at least once every three years, to ensure that they are not selling any pest plant listed in the RPMP or the Pest Plant Accord.

1.8. General Advice and Information

Biosecurity staff will provide advice, attend events and undertake publicity campaigns to increase public awareness of pests. The information is intended to assist occupiers meet their obligations under the RPMP. Biosecurity staff will also assist with the general identification of plants and provide information and education material about poisonous plants.

Staff will inspect plant outlets and markets within the Hawke's Bay region for the sale and/or propagation of RPMP species. Training will be provided to relevant staff and stakeholders in identifying pests to assist in early detection.

HBRC implemented a new website called Pest Hub. It lists many pests, including those listed within the RPMP. It contains information on their impact, best practice control techniques and can report a pest to HBRC staff. It can be found here: https://www.hbrc.govt.nz/environment/pest-control/pest-hub/

Pest Animals

1.9. Exclusion Pest Animals

Objective

Prevent the establishment of exclusion pest animals in the Hawke's Bay region.

Targets

Undertake surveillance of high-risk areas/pathways. Follow up on reported sightings or reports of illegal releases and raise public awareness of exclusion pests. Develop partnerships with other organisations and community groups that have expertise or an interest in protecting the environment.

Eradication of exclusion species will be attempted by HBRC in conjunction with relevant Crown agencies and stakeholders where practicable.

Council will provide training to relevant council staff and stakeholders about identifying the exclusion pests to assist in early detection. Council will provide advice, attend events, and undertake publicity campaigns to increase public awareness of exclusion pests.

Exclusion	Management Regime
Wallaby	Undertake active surveillance of high-risk areas/pathways for these pests. Develop partnerships with interested and relevant parties to extend the area monitored for the presence of these pests. Investigate possible pathways for these pests to move into Hawke's Bay. Respond to reports of this pest, using powers under the Biosecurity Act if required.
Mediterranean fanworm	
Clubbed tunicate	

1.10. Eradication Pest Animals

Objective

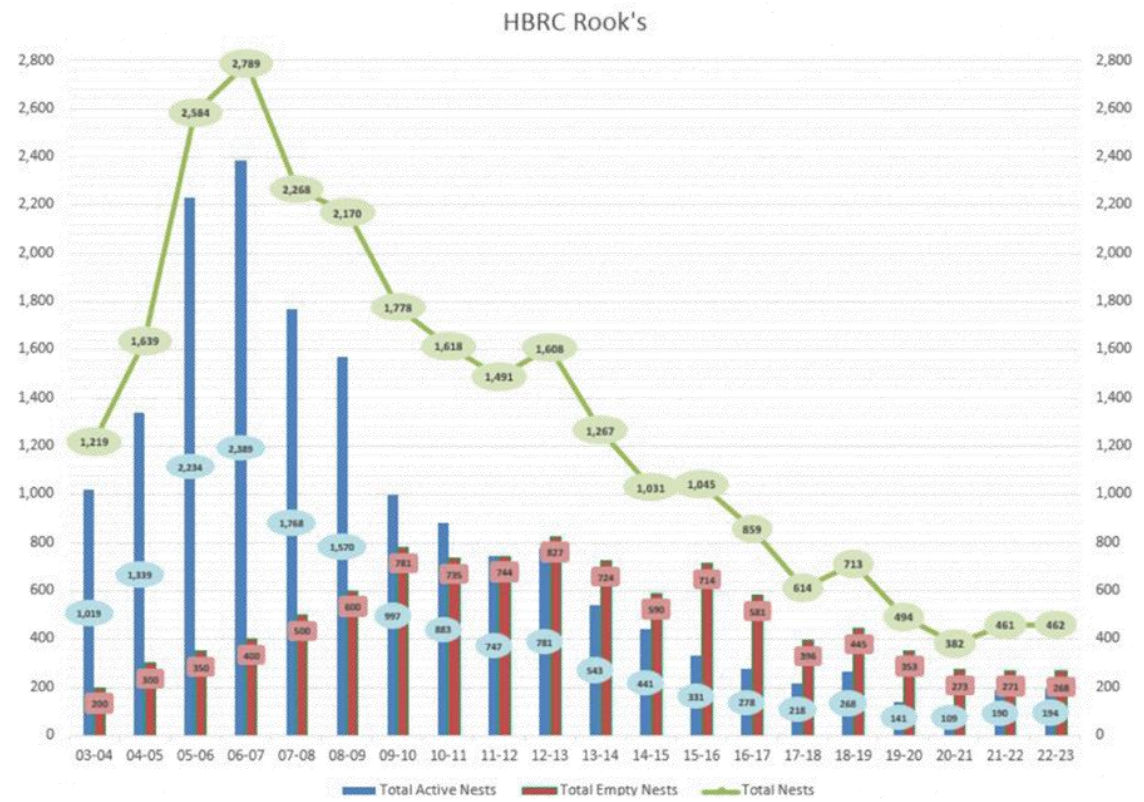
Eradicate rooks from the region. Have no active rookeries within 20 years of the commencement of the RPMP. Eradicate all possums contained within Possum Eradication Areas.

Targets

Destroy all active rook nests within the Hawke's Bay region and eradicate possums within those areas identified as Possum Eradication Areas. Inspect pet shops, online sales and wildlife shelters if reports are received of the sale and/or breeding of possums and rooks. Support appropriate research initiatives, including biological control should it become available. Undertake direct control through service delivery.

Eradication	Management Regime
Possum	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 shall maintain possum eradication status in accordance with the Hawke's Bay Regional Possum Control Technical Protocol (PN 4969).

Rook	Over the duration of the Plan, all active rook nests will be destroyed within the Hawke's Bay region. Information will be provided to land occupiers on rook identification, the potential adverse effects they cause, whom to contact for rook control, and the risks of inappropriate control.

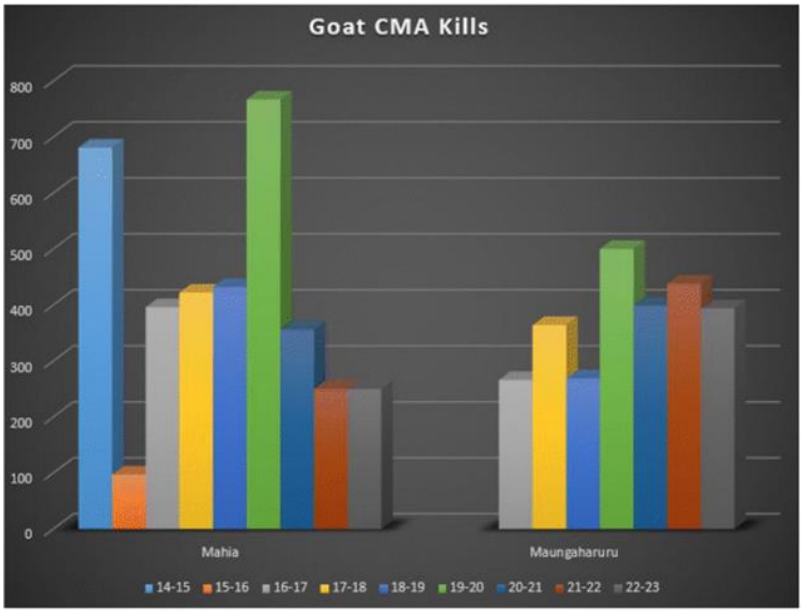


1.11. Sustained Control Pest Animals

Objective

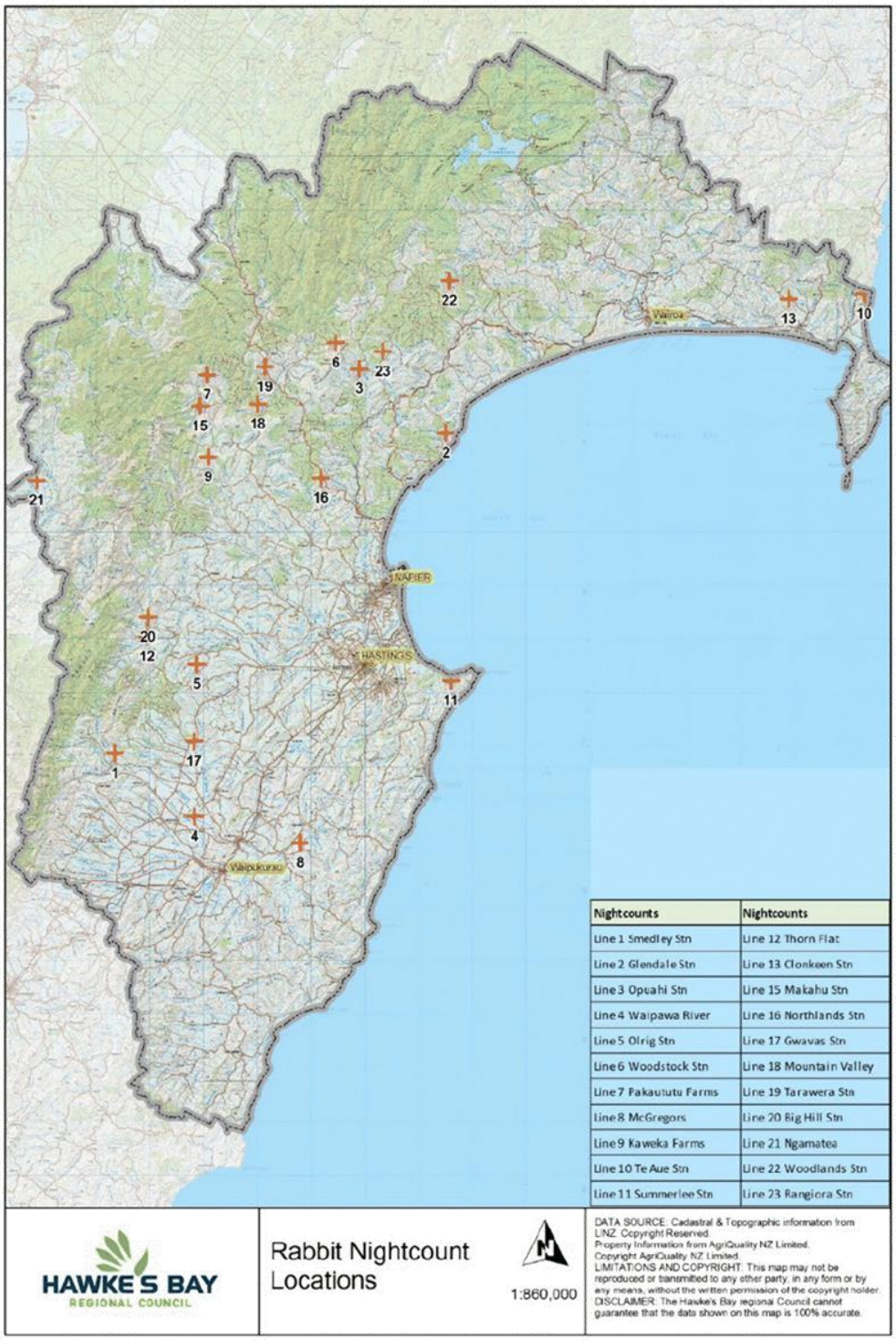
Over the duration of the Plan, sustainably control sustained control pest animals in order to minimise adverse effects on environmental values and economic well-being within the Hawke's Bay region.

Sustained Control	Management Regime
Feral Goat	Sustainably control feral goats on land contained within Feral Goat Coordinated Management Areas to zero density or to levels specified within a Written Management Agreement approved by Hawke's Bay Regional Council. A Feral Goat Coordinated Management Area is created once written agreements have been entered into with 75% or more of the total land area. The Council will coordinate initial feral goat control work within the entire Feral Goat Coordinated Management Area. Once feral goats have been

	reduced to low levels, occupiers within the area are required to maintain feral goats in accordance with this Protocol. 
Possum	Sustainably control possums contained within Possum Control Areas to ensure population density on that land is at or below 4% residual trap catch. An occupier within a Possum Control Area 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). Possum monitoring will be undertaken by council on a sample of properties within the PCA area to assess if properties are meeting the plan rule. Compliance action will be undertaken for properties that fail to meet the plan rule. This includes land where the Good Neighbour Rule applies. HBRC will support land occupiers in managing possum densities through providing best practice advice, a subsidy will be provided on a range of possum control products and financial assistance for managing possums in difficult terrain. Landowners who have a QEII block less than 20 hectares on their property are eligible to receive free possum bait sufficient to control possums within the QEII area. For landowners with QEIIs greater than 20 hectares, or where several small QEIIs are collectively greater than 20 hectares, HBRC arranges and pays for possum control.

Predators	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). 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 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.
Rabbits	Sustainably control rabbits to ensure population levels are maintained below Level 4 on the Modified McLean Scale (2012). The following will be undertaken: • Conduct biannual regional rabbit night counts. (April 2021, April 2023, April 2025) • Conduct targeted biannual surveillance of rabbit prone areas. • Provide advice and education to land occupiers, including occupiers of small blocks, to help them control rabbits by the most efficient and effective means. • Monitor for compliance and where appropriate enforce the rabbit control rule. At its discretion, and as set out in an approved management programme, Council may meet up to 50% of the cost of rabbit control on rateable land where rabbit numbers exceed 4 on the McLean Scale. Council will continue to support research initiatives, including biological control, and release biological control agents for the control of feral rabbits when appropriate.

Rabbit night count locations



Nightcounts	Nightcounts
Line 1 Smedley Stn	Line 12 Thorn Flat
Line 2 Glendale Stn	Line 13 Clonkeen Stn
Line 3 Opuahi Stn	Line 15 Makahu Stn
Line 4 Waipawa River	Line 16 Northlands Stn
Line 5 Olrig Stn	Line 17 Gwavas Stn
Line 6 Woodstock Stn	Line 18 Mountain Valley
Line 7 Pakaututu Farms	Line 19 Tarawera Stn
Line 8 McGregors	Line 20 Big Hill Stn
Line 9 Kaweka Farms	Line 21 Ngamatea
Line 10 Te Aue Stn	Line 22 Woodlands Stn
Line 11 Summerlee Stn	Line 23 Rangiora Stn

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Rabbit Nightcount Locations

1:860,000

1.12. Site-led Pest Animals

Objective

Support sustainable control of site-led pests at sites of ecological importance to levels appropriate for the protection of ecological values, recreational values, and economic well-being within the Hawke's Bay region.

Targets

Coordinated and integrated control of pests in defined areas that protect and restore specific ecological or biodiversity values which are threatened or compromised by pests. Sites include:

- Ecosystem Prioritisation (Hawke's Bay Regional Council)
- Recommended Areas for Protection (Department of Conservation)
- Sites of Special Wildlife Interest (Department of Conservation)

Site-led	Management Regime
Feral cats **Feral deer** **Feral goats** **Feral pigs** **Hedgehogs** **Mustelids** **Possums** **Rats**	Support land occupiers and community groups in managing site-led pests at areas of high biodiversity value though technical information, best practice control techniques and provision of traps or ungulate control. An agreement will be signed with the land occupier agreeing to utilise the traps and undertake best practice. HBRC staff will work with other groups to maximise outcomes of council programmes e.g., Erosion Control Scheme, Predator Free Hawke's Bay, Environmental Enhancement projects, Ecological Management and Enhancement Plans.

Phytosanitary Pests

Objective

Sustainably control 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.

Targets

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

- Apple black spot (Venturia inaequalis) on their land from the presence of green tips until fruit maturity/harvest; and
- 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;
- 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

- Fireblight (Erwinia amylovora) on their land during the pipfruit bloom period (from pink to petal fall); and
- 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 15 December until fruit harvest.

Sustained Control	Management Regime
Phytosanitary pests	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. If pest monitoring on the affected managed pipfruit production site over a reasonable time 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 HBFGA will advise the occupier of the unmanaged pipfruit production site(s), that they are deemed to be an exacerbator of phytosanitary pests. HBFGA will be entitled to give the occupier of the unmanaged pipfruit production site(s) 14 days to reach an agreement. If agreement cannot be reached and/or control is not undertaken within that time, HBFGA 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.

Financial Summary

Council's Long-Term Plan 2021 – 2031 sets out the planned expenditure and required funding, via rates and user charges, for the operational and planning activities associated with pest management.

The expenditure budgets as per the 2023-2024 Annual Plan are summarised in the table below:

Biosecurity 23-24 Annual Expenditure	Grand total
Pest Management Strategies	$155,541
Pest Plant Incentive Scheme	$112,299
Primary production Pest Plants	$595,315
Environmental/human health pest plants	$684,901
Biological Control	$59,308

Biosecurity 23-24 Annual Expenditure	Grand total
Rabbit control	$60,769
Possum control	$1,442,938
Site specific pest animal control	$221,140
Rook control	$184,071
Possum Bait and Rabbit Subsidy	$54,683
Pest Annual General Advice	$110,952
Pest Animal Research	$8,314
Marine Pests	$95,421
Total including Organisational Overheads	$3,785,653

Measuring Performance

The following criteria will be used to measure the success or otherwise in implementing the Operational Plan:

- Completion rate of programmes contained within this Operational Plan;
- Results from trend monitoring undertaken, and an assessment of these results;
- The education initiatives undertaken during the year;
- The number of Notice of Directions issued, the level of compliance with those notices, and any follow-up activity undertaken;
- The outcomes of all service delivery operations undertaken;
- The results of biological control research and monitoring, and the number of bio-control releases undertaken;
- All research initiatives to which contributions have been made during the year; and
- Any cross-boundary issues that arose and how they were resolved.

Implementation Report

A report on the Operational Plan and the success or otherwise of its implementation will be prepared no later than five months after the conclusion of the financial year. A copy of this report will be provided to council.

Biosecurity Annual Report July 2022 - 30 June 2023

Report on the 2022-23 Operational Plan

August 2023

Hawkes Bay Regional Council Publication No.

HAWKES BAY REGIONAL COUNCIL

TE KAUNIHERA Ā-ROHE O TE MATAU-A-MĀUI

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Catchment Operations

Biosecurity Annual Report 1 July 2022 - 30 June 2023

August 2023

Hawkes Bay Regional Council Publication No.

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Contents

Executive Summary

Hawke's Bay Regional Council is the management agency responsible for developing and implementing the Hawke's Bay Regional Pest Management Plan 2018-2038 in accordance with the Biosecurity Act 1993.

The RPMP is a combination of the eradication or effective management of specified pests or groups of pests. It describes the biosecurity activities that will be undertaken throughout Hawke's Bay and outlines the management or eradication of specific organisms. Doing so will:

- minimise the actual or potential adverse or unintended effects associated with these organisms, and,
- maximise the effectiveness of individual actions in managing pests through a regionally coordinated approach.

As the management agency, Council is required to prepare an annual operational plan that sets out how the plan is to be implemented. Following the end of each financial year, staff will report to Council on the implementation of the operational plan.

This is the Annual Report for the 2022/2023 year relating to the Operational Plan for the Hawke's Bay Regional Pest Management Plan (RPMP).

1 Introduction

Regional councils have a mandate under Part 2 of the Biosecurity Act 1993 (the Act) to provide regional leadership in activities that prevent, reduce, or eliminate adverse effects from harmful organisms that are present in their region.

The purpose of the Hawke's Bay Regional Pest Management Plan (RPMP) is to provide for the efficient and effective management or eradication of specified harmful organisms in the Hawke's Bay Region. It builds on the 2013 Strategy and previous pest management programmes. The purpose of the Plan is to:

- Minimise the actual or potential adverse or unintended effects associated with those organisms; and
- Maximise the effectiveness of individual actions in managing pests through a regionally coordinated approach.

This Annual Report records progress in implementing the Regional Pest Management Plan via the Operational Plan 2022-2023, covering council's biosecurity activities for the period 1 July 2022 to 30 June 2023. The Annual Report of regulatory activities is a statutory requirement under section 100B(2) of the Biosecurity Act 1993 (the Act).

2 Pest Plants

The RPMP lists a total of 33 plant species as pests, which have been divided into five management categories.

For each of these pest plant categories, the Annual Report provides a brief description of what activities Council undertook in the 2022/2023 year.

2.1 Exclusion Pest Plants

These are pest plants that are not known to be present in the Hawke's Bay region and would likely have significant negative environmental and/or economic impacts if they were to establish. The objective of this programme is to prevent their establishment.

Exclusion	Staff Days	Management Regime
Alligator weed	75	Alligator weed discovered within Hawke's Bay, namely in Lake Whatuma and the Mangatarata stream. It was detected through an eDNA test in 2022. Surveillance was undertaken in April, where an infestation was confirmed. The area infested on Lake Whatuma is between 1 and 2 acres in total, with isolated rafts of Alligator weed being found down the Mangatarata stream (the outlet of the lake). Approximately 10 properties have alligator weed on them on the eastern edge of the lake. A significant response was implemented to determine the extent of this infestation and initiate control. Ongoing monitoring and control occurs on the lakeside properties and Mangatarata stream. An operational plan is being drafted to provide costings and further control measures for eradicating this pest.
Marshwort	0	
Noogoora bur	0	
Senegal tea	0	
Spartina	0	

2.2 Eradication Pest Plants

These are pest plants in the Hawke's Bay region where eradication is possible. The objective is to destroy all known infestations of these species within the Hawke's Bay region, prior to seed set. HBRC undertakes direct control through service delivery at all known sites.

Eradication	Staff days	Management Regime
African feather grass	1	Control work focussed around the Maraekakaho Stream. Consistent flooding meant the Ngaruroro sites could not be surveyed effectively.
Cathedral bells	1.25	All known rural sites are being controlled by contractors or staff. A few sites are now clear.
Goats rue	1	Staff monitored all high-risk roadside areas and known infestation sites in Eskdale. Plants were only found at one roadside area in Central Hawke's Bay and in the Eskdale area over the 2022-23 financial year.
Purple loosestrife	0.25	There are now two sites in Hawke's Bay. All plants were destroyed.
Spiny emex	5	Numbers remain static on the two infested properties. Spiny emex has a very long seed life.
White edged nightshade	1	One plant was found and destroyed.
Yellow water lily	1	One existing site of Yellow water lily was monitored, on a dam near Horseshoe Lake during the 2022-23 financial year. No plants were found.
Phragmites	15	In accordance with the contract between HBRC and Ministry of Primary Industries, HBRC will destroy all infestations before seed set. A large amount of this time was spent at one site digging out roots in the Havelock North area.

2.3 Progressive Containment Pest Plants

These are pest plants in the Hawke's Bay region where they are too widespread to eradicate but there is an opportunity to progressively contain and reduce their geographic distribution either across the region or specified areas within the region. This programme is achieved through a combination of occupier responsibility and direct control by HBRC through service delivery at all known sites.

Progressive containment	Staff days	Management Regime
Apple of Sodom	25	The main problem areas are several farms in the Seafield Road area. Improvements continue to be made each year. Time spent undertaking surveillance and control has been reduced to approximately three weeks per year. Isolated plants were removed and destroyed by staff.
Australian sedge	3.5	Only found in the Wairoa district. The majority of work is subsidised through the incentive scheme and undertaken by contractors. Less

Progressive containment	Staff days	Management Regime
		work undertaken overall owing to a shortage of contractors and Cyclone Gabrielle limiting access.
Cotton thistle	1.25	Numbers were static. Staff assisted private landowners in controlling cotton thistle to make sure control was undertaken adequately.
Darwin's barberry	14	There are two infestations, one at Gwavas and one at Puketitiri. Both were surveyed with control work being ongoing. An extensive surveillance and control programme continued at Puketitiri using contractors and a helicopter. This was the third year that landowners had to pay for contractors, which was again met with continued resistance.
Japanese honeysuckle	0	This programme applies to the Tutira area, as outlined in the RPMP. Cyclone Gabrielle had a large effect on this work, limiting access entirely.
Nassella tussock	1.5	Although plant numbers are reducing, there is a large seed bank. A site detected twelve years ago in the Tukituki area continues to be of concern due to the high numbers of plants being found each year.
Old man's beard	31.5	The main control areas at present are north of the Napier-Taupo Highway and in areas of high biodiversity value. Areas found adjacent to the Ruahine Ranges were surveyed again and controlled. This program suffered in the wake of Cyclone Gabrielle, limiting access to many infestations in the seeding period but a significant amount of the work was completed before the cyclone hit.
Saffron thistle	59	Numbers were lower this year. All known sites were controlled, and a handful of new sites were discovered.
Velvetleaf	0.25	Known sites were assessed. Machinery hygiene was enforced. No plants were found.
Wilding Conifers	23	Pinus contorta is mainly a problem in areas that are close to conservation land. Over 20,000 hectares was surveyed and controlled in the Napier/Taihape Rd area, including various Owhaoko trust blocks, a portion of Ngamatea Station and the Sparrowhawk range. In the Rangitaiki area over 12000 hectares were surveyed and controlled which included Pohokura 3B and various Wharetoto blocks in the upper Ripia river. Any Pinus contorta/Douglas fir detected were controlled. MPI have continued to help finance control programmes in the Napier/Taihape Rd area and have financed control programmes in the Rangitaiki area.
Woolly nightshade	106	New urban sites were found this season, but this program suffered from the aftermath of Cyclone Gabrielle in the rural environment, limiting access to many infestations. Known infestations on logged

Progressive containment	Staff days	Management Regime
		properties (forestry) continue to have high numbers of plants due to soil disturbance and high light environment.

2.4 Sustained Control Pest Plants

These are pest plants that are well established in Hawke's Bay were preventing or minimising the spread of these pests between neighbouring properties is the primary objective. This includes boundary control pest plants, where a neighbouring occupier may be required to control these pests on their boundary to prevent the spread onto adjacent properties.

Chilean Needle Grass

Chilean needle grass is a very difficult weed to control. With the current control tools available, HBRC are only able to contain it within known areas. However, over the last seven years, an average of 13 new properties per year have been found, due to a robust advocacy programme and an increased surveillance programme. This increase in properties has created extra pressure (in Spring/Summer) on staff resources and budgets, at an extremely busy time for the Pest Plant team.

HBRC continue to run a joint advocacy programme with Environment Canterbury and the Marlborough District Council with Chilean needle grass. Subdivision of properties that have Chilean needle grass on is increasing, increasing the number of landowners to contact each year.

Privet

The new rule within the RPMP (the requirement of a doctor's certificate by the complainant) continues to reduce the number of properties requiring privet removal. A total of 9 Privet were removed by contractors. Management programmes for hedges are ongoing. Some of this work slowed down post Cyclone Gabrielle as the contractor used for removals was fully booked out with cyclone recovery work.

Yellow bristle grass

Staff worked with NZTA and Wairoa District Council to manage the risk posed by mowing regimes during seeding and the requirement for mower washdowns. High-risk landowners were also contacted.

2.5 Sustained Control Pest Plants – Boundary Control

These are pest plants that may require neighbouring occupiers to control these pest plants on their boundary. They are Bathurst bur, Blackberry, Gorse, Nodding thistle, Ragwort and Variegated thistle.

This season, the amount of time spent in this area was minimal, with only 2 hours recorded. Complaints were related to Blackberry.

Enforcement is the key management tool for Boundary Control plants. Controls are only enforced if their location contravenes RPMP rules (e.g. gorse within 10 metres of a neighbour's boundary providing that boundary is clear), and only if there is a complaint.

2.6 Biodiversity Pest Plants

These plants have a negative ecological effect and are managed outside of the RPMP.

Climbing Spindleberry

This plant is found in the Central Hawke's Bay area along the banks of the Waipawa and Tukituki Rivers. This season most known sites were sprayed by contractors although some areas are very difficult to get through due to Blackberry, Gorse, and Broom. Some known sites were flooded in Cyclone Gabrielle, and this made work more difficult in these areas.

Giant/Asiatic Knotweed

This was reported to HBRC in the Tuai area and is present in the Waipukurau Transfer Station. The Tuai infestation was sprayed by a contractor while no plants were found at the Waipukurau Transfer Station. It is a very invasive plant that will smother native plants, especially lower growing species and samplings.

DIDYMO/Aquatic Pest Plants

No student was employed over the summer due to a lack of resources around staff time. Samples were taken from strategic sites on the main Hawke's Bay Rivers by HBRC, Fish and Game and DOC and sent away for DNA analysis to ascertain whether Didymo is present. All samples this year were negative for the presence of Didymo.

2.7 Surveillance Programme

More focus has been put into certain pest plants such as Woolly nightshade, Chilean needle grass and Alligator weed.

During each property inspection, staff record relevant pest plants found on individual farm maps. During monitoring staff use previously gathered information to assess whether or not infestations have spread or contracted. During visits, staff take the opportunity to discuss any relevant concerns with the occupier.

Biosecurity officer visits	Properties
Rural visits	1524
Urban visits	925
Nurseries and pet shop visits	2

2.8 Surveillance of Railway Land

Staff have a good working relationship with Treescape, the contractors who have responsibility for vegetation control along the rail corridor in Hawke's Bay. Staff communicate with the Area Supervisor annually, identifying areas that need control. Treescape then does the work when required. This procedure enables staff to control pest plants along the railway tracks throughout the region in a timely manner.

2.9 State Highway and District Road Monitoring

A good working relationship has been developed between staff and Waka Kotahi (NZ Transport Agency) as well as the Central Hawke's Bay, Wairoa and the Hastings District Councils, for the clearance of roadside weeds. When weeds are cleared from roadsides, staff ensure the adjacent property owner clears their side.

Both District Councils and NZTA have been very cooperative in setting up no-mow zones when Chilean needle grass is seeding in November/ December.

The NZTA provides an additional budget to control pest plants, on their roadsides, such as Old man's beard, Japanese honeysuckle, Chilean needle grass and Pampas. HBRC staff manages this budget, ensuring that these pest plants are controlled at the optimum time.

2.10 Nurseries and Pet Shops

MPI has indicated that nurseries in the Hawke's Bay area only have to be visited at least once every three years to ensure that no plants banned for sale under the National Plant Pest Accord are being stocked. Two nurseries were visited this year. Where possible, staff focus efforts on new nurseries or informal plant sale arrangements as a higher priority.

2.11 Regulatory

No Notices of Direction were issued this year. Subdivision activities are monitored by staff to ensure compliance, which has been good this year. 53 hours were spent on machinery inspections this year.

2.12 Education and Publicity

The objective of these activities is to reach a wider community than can be achieved through farm visits. In this plant pest staff work with the Environment Education section of the Council as well as the Communications team. Due to poor weather there were only two displays.

These were at the Central Hawke's Bay A&P Show and the Wairoa A&P Show.

The following topics have been printed in the media (local newspapers, newspapers, magazines).

- Chilean needle grass
- Woolly nightshade
- Alligator weed

Our Communications team also made social media posts on the following topics.

- Alligator weed
- Moth plant

Pamphlets on Woolly nightshade were distributed in selected urban areas throughout Hastings, Napier, and Wairoa.

2.13 Biological Control

HBRC contracted Landcare Research to:

- Develop new Biological Control Projects.
- Provide a plant identification service.

Landcare Research is continuing to evaluate/import possible biological controls for Aquatic weeds, Japanese honeysuckle, Woolly nightshade, Chinese privet, Field horsetail, Mothplant, Nassella tussock, Tradescantia, Pampas, Darwin's barberry, Wild ginger, Old man's beard, and Banana passionfruit.

Landcare Research (with the support of the Biocontrol Collective) has secured funding through the SFF programme to start biocontrol work on six new weeds including Sydney golden wattle and Yellow flag iris.

Staff undertook two releases of green thistle beetle (Californian thistle) in the Hawke's Bay area this season, collecting beetles from local established populations. This beetle has dispersed through over 50% of Hawke's Bay which is pleasing, with additional evidence of establishment in Southern Hawke's Bay discovered this season.

2.14 Plant Pest Subsidy Scheme

The scheme was set up to provide assistance to landowners in undertaking control programmes.

Type	Number	Amount
Rural	83	$93,455.28
Urban	2	$1,000

Chilean needle grass, Saffron thistle, Australian sedge, Pinus contorta, Darwin's barberry and Old man's beard were the main pests subsidised. Please note this subsidy only applies to a small number of land occupier responsibility pest plants within the RPMP.

2.15 Conclusion

Most pest plant programme objectives have been achieved. Generally, a downward trend in numbers of plants is continuing except for Chilean needle grass where new properties/sites are continually being found.

The discovery of Alligator weed in the region is disappointing; however, it is good that it appears to be restricted to Lake Whatuma and the Mangatarata stream. A significant amount of work still needs to be done in this space, but the team responded well to the incursion overall and continues to do so.

The surveillance and monitoring plan carried out this year has continued to target certain pest plants (particularly Chilean needle grass, Saffron thistle and Woolly nightshade) and some of the areas surrounding them, areas of high risk, QEII covenanted sites, dump sites, creeks/drains and rivers and areas that are presently being controlled for low incidence plants.

Despite the effects of Cyclone Gabrielle in February and the proceeding months, the Biosecurity team's visit numbers increased from the previous year. Given that access continues to be limited in some areas of the region and the cyclone damage is at a landscape scale, there is concern that this disturbance may increase pest plant dispersal and re-emergence.

3 Pest Animals

The RPMP lists a total of 25 animal species as pests, which have been divided into five management categories. For each of these pest categories, the Annual Report provides a brief description of what activities Council undertook in the 2022/2023 year.

3.1 Exclusion Pest Animals

These are pest animals that are not known to be present in the Hawke's Bay region and would likely have significant negative environmental and/or economic impacts if they were to establish. The objective of this programme is to prevent their establishment.

<table>
<tr><th>Exclusion</th><th>Management Regime</th></tr>
<tr><td>Wallaby</td><td>Two possible wallaby sightings were reported over the last 12 months.

The first report was from a member of the public walking along the walking track between Aniwaniwa and Lake Waikareiti at Waikaremoana in late June 2022. Bay of Plenty Regional Council has taken the lead in the investigation and has followed up with the member of the public who initially reported the sighting. After further questioning, the description was more in line with a possum than a wallaby.

The second reported sighting was in June 2023 and was from a hunter who believes he saw a wallaby between the Hopuruahine bridge and the Te Taita A Makoro campsite on SH38 northwest of Lake Waikaremoana. The person who reported the Wallaby sighting is a very experienced hunter who hunts this area frequently. HBRC are supporting the Bay of Plenty Regional Council who is taking the lead in this investigation.
Partnerships have been formed with MPI, Waikato Regional Council and Bay of Plenty Regional Council who are currently managing wallaby populations.</td></tr>
<tr><td>Mediterranean fanworm & Clubbed tunicate</td><td>When a vessel berths in the Inner Harbour an Incoming Vessel Form is completed and submitted to HBRC. A risk analysis is undertaken and if the vessel is deemed high-risk divers will inspect the vessel.

The HBRC marine biosecurity surveillance program found 3 separate pest incursions. The table below has more information on these incursions:

<table>
<tr><th>Vessel/Structure</th><th>Marine pest</th><th>Method of control</th></tr>
<tr><td>Commercial fishing vessel</td><td>Clavelina lepadiformis & Styela clava</td><td>Encapsulation and chemical treatment.</td></tr>
<tr><td>Nelson Quay pontoon</td><td>Clavelina lepadiformis</td><td>Encapsulation and chemical treatment of the pontoon.</td></tr>
<tr><td>Commercial fishing vessel</td><td>Clavelina lepadiformis</td><td>Encapsulation was left in place for 4 weeks.</td></tr>
</table>

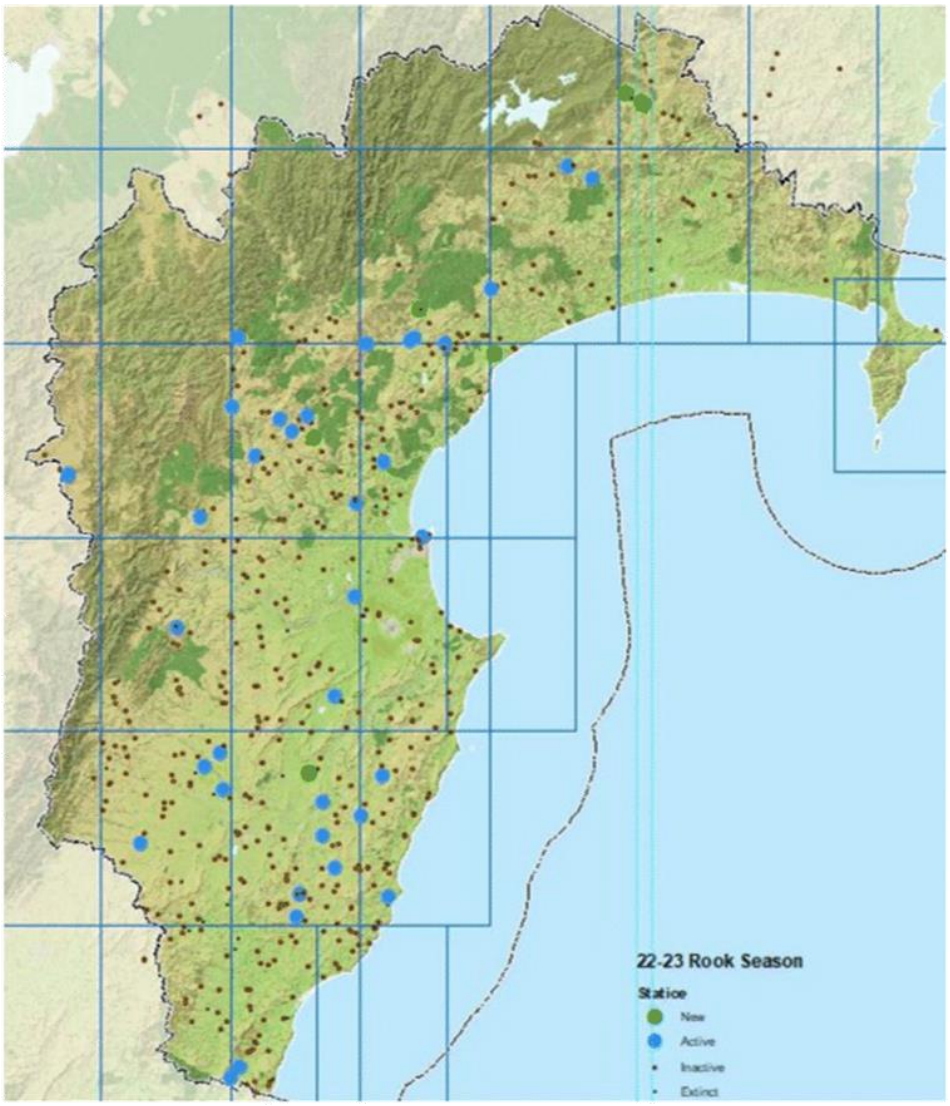
Stakeholder and Partnerships
• Relationships have been formed with key stakeholders including Napier City Council, Napier Sailing Club, Port of Napier, Legasea HB, Top of the North Marine Biosecurity Partnership, Top of the South Marine Biosecurity Partnership, NIWA and Biosecurity New Zealand.</td></tr>
</table>

3.2 Eradication Pest Animals

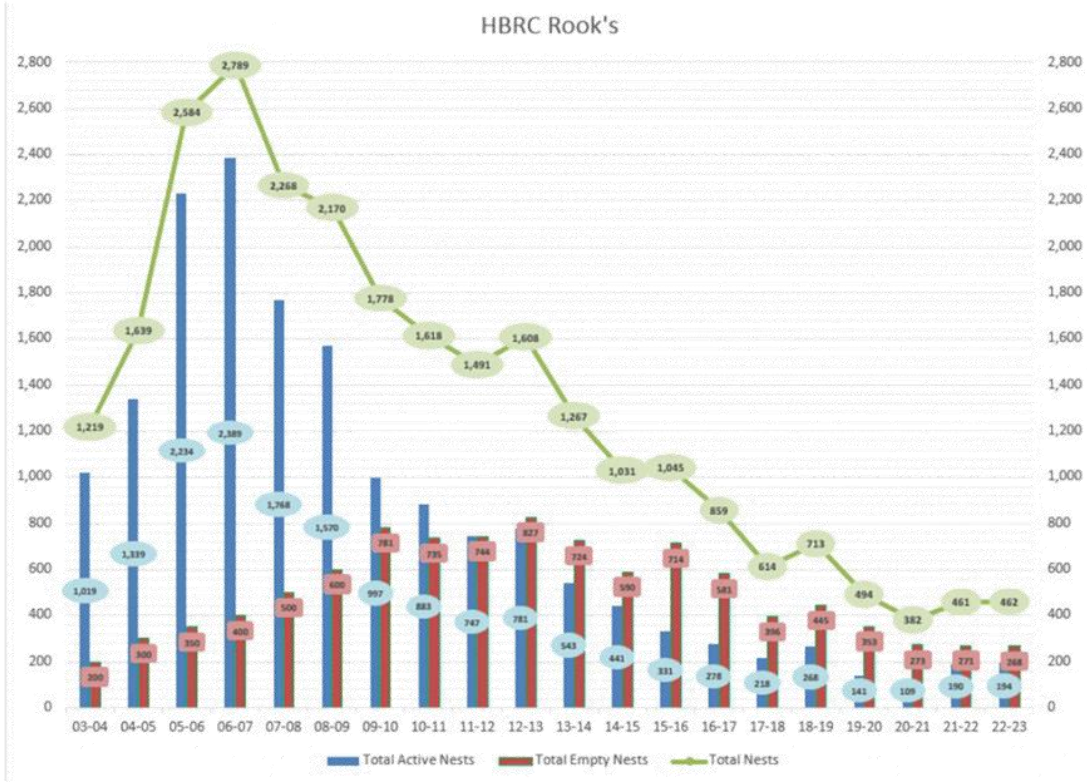
These are pest animals in the Hawke's Bay region where eradication is possible. The objective is to eradicate rooks from the region and all possums contained within Possum Eradication Areas.

Eradication	Management Regime
Possum **(within the Whakatipu Mahia area)**	HBRC is in the final stages of removing possums from the 14,600ha Māhia Peninsula as part of the Whakatipu Māhia project. Land occupiers within this area have been signed up to the Possum Eradication Area programme contained within the RPMP and will be responsible for maintaining possum eradication status in accordance with the Hawke's Bay Regional Possum Control Technical Protocol (PN 4969). The Peninsula has been split into two areas – Phase 1, the southern 5500ha – and Phase 2, the northern 9000ha. The "knockdown" using bait stations has been undertaken across the entire peninsula, and the remaining hotspots are being mopped up using targeted trapping in Phase 2. The proof of absence network monitoring (camera's) will be installed in July/August which will give confidence that no possums remain on the Peninsula, this will be supported by possum dog detector surveys in August 23. Due to using toxins as the primary control tool of possums, the total number of possums controlled is unknown.
Rook	All rookeries within the Hawke's Bay Region were aerially treated using a under-slung strop man applying DRC 1339 gel bait directly into nests. A total of 194 active nests were treated this season which is very close to what was treated last season (190 active nests). This was primarily brought about by locating 8 new rookeries within the region. Post-control inspections on some of these rookeries indicate that previous control has been successful with greatly reduced activity. Three rook ground control enquiries were responded to during the year with 200 birds poisoned as a result of these enquiries.

Map: Aerial Rook Control 2022-2023



Graph 1: Rook Nests Trends

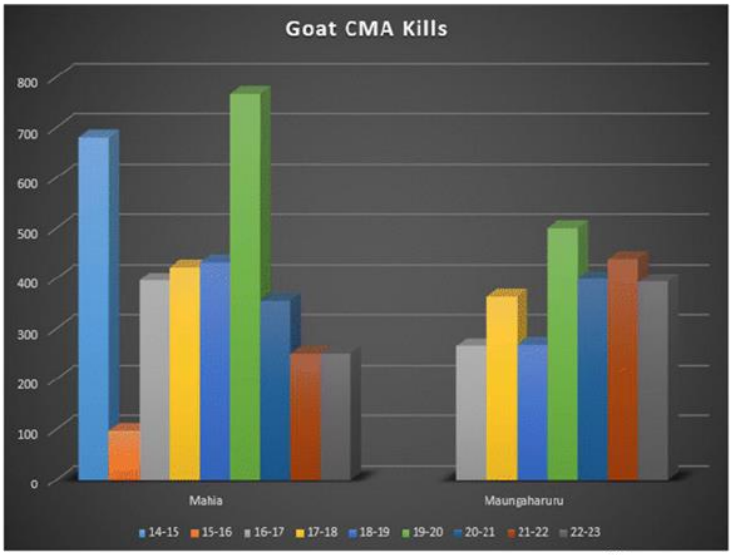


3.3 Sustained Control Pest Animals

These are pest animals that are widespread across the Hawke's Bay region. The objective is to sustainably control these pests in order to minimise adverse effects on environmental values and economic well-being within the Hawke's Bay region.

Sustained Control	Management Regime
Feral Goat	Feral goat control was undertaken across two feral goat coordinated management areas (CMA), being Mahia (7,672 ha) and Maungaharuru (28,000 ha). A total of 644 feral goats were controlled. The Mahia goat CMA is jointly managed by HBRC, Department of Conservation and supported by Grandy Lake Forests. It is now in a maintenance phase and the project objective is to maintain and enhance the results accomplished to date on the internal areas and continue to maintain low populations within the boundary properties. Reinvasion continues to be an ongoing risk with high populations still current on most boundaries. The Maungaharuru goat CMA is jointly funded by HBRC, Department of Conservation and Pan Pac. This CMA is also in a maintenance phase. Like Mahia, reinvasion continues to be an ongoing risk.

Graph 2 Goat CMA Kills



Phytosanitary pests

Occupiers are responsible for managing production pests at pipfruit production sites. Resolving apple black spot, codling moth, European canker, fireblight or lightbrown apple moth control disputes between neighbouring parties is undertaken by the HBFGA in the first instance. If an agreement cannot be reached, the HBFGA will advise Hawke's Bay Regional Council of the situation and seek appropriate enforcement action to be undertaken under the Biosecurity Act. HBRC did not receive any requests to undertake enforcement action for phytosanitary pests.

Possum (rest of region)

Occupiers within a Possum Control Area (PCA) programme must maintain possum densities on their land at or below 4% residual trap catch (RTC). The PCA programme currently covers 774,450ha.

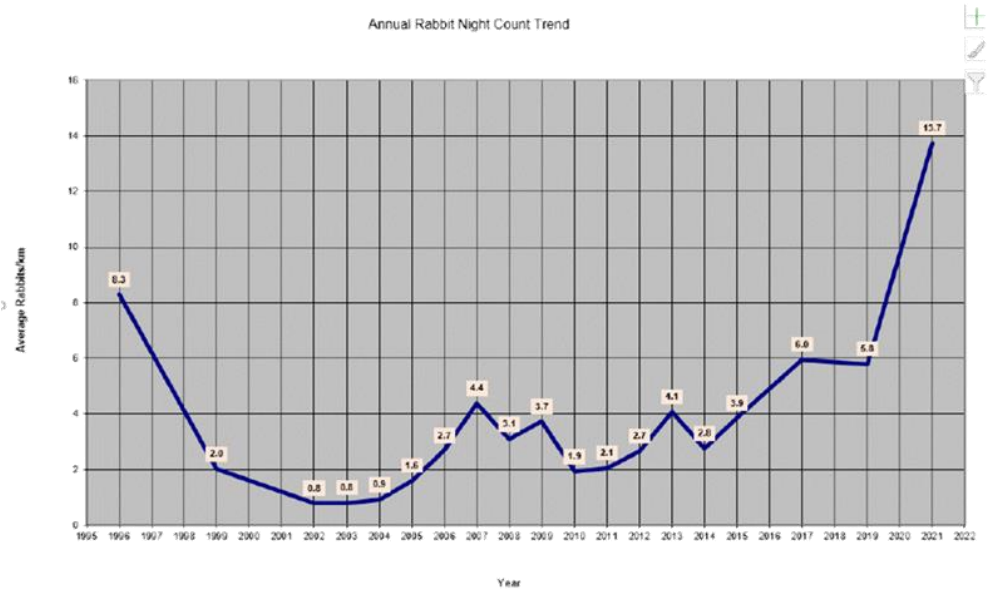
Due to the TB outbreak in Hawke's Bay, approximately 103,213ha contained within the PCA programme is now under OSPRI management. Biosecurity staff are working closely with OSPRI who have moved to a new geographically based operating model, with staff based in the region.

Possum monitoring was undertaken across 114,534ha (approximately 15% of the PCA area) of the PCA programme to monitor compliance with the RPMP rule.

PCA possum monitoring programme 2022-23				
Occupiers	**Area monitored (Ha)**	**Number of monitoring lines**	**Average Residual Trap Catch (RTC %)**	**Number of monitoring Lines > 4% RTC**
400	308,000	2,000	1.5%	254

Although the overall trap catch rate across the area monitored was 1.5%, 254 lines were above 4% with 11% or 44 of the properties monitored failing (400 properties in total monitored). Biosecurity staff worked with failed properties to ensure they comply with the RPMP rule. All properties engaged an HBRC-approved contractor to undertake possum control resulting in no requirement for enforcement action.

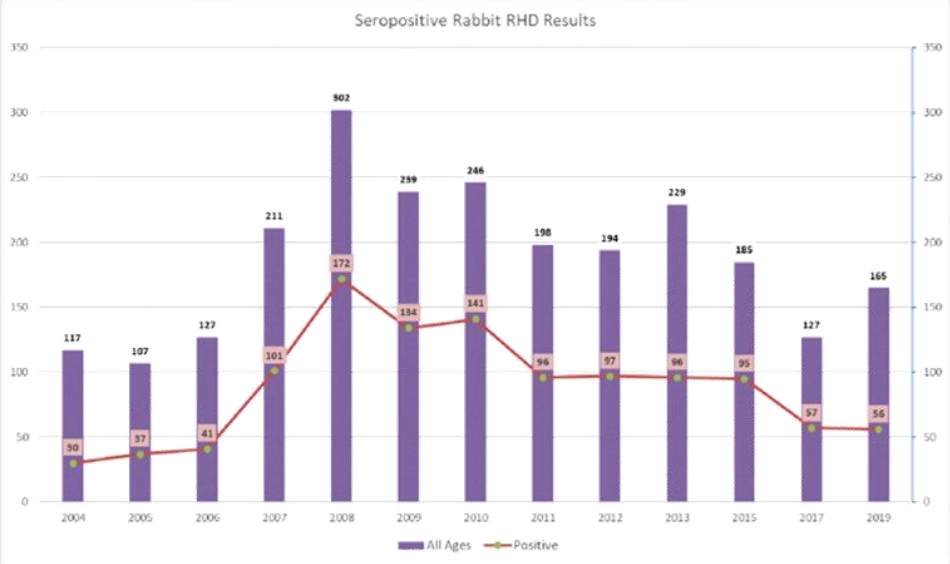
	HBRC supported land occupiers in managing possum densities by providing best practice advice, a 40% subsidy on a range of possum control products at Farmlands and PGG Wrightsons and financial assistance for managing possums in difficult terrain. Furthermore, 37 QEII covenants received either free possum control (covenants >20ha) or free bait sufficient to control possums within the QEII area (covenants <20ha). HBRC ensured possum control on all HBRC-managed river berm land using a contractor. This has been done as a good neighbour, to meet HBRC's obligations under the RPMP, and to complement the control being carried out by adjacent landowners in the PCA programme.
	
Predators	The Poutiri Ao ō Tāne trapping networks have been maintained over this year. The 'Poutiri Ao o Tane' project achieved an internationally significant conservation milestone last year with the successful breeding of tītī from returning parents, translocated as chicks to the Maungahaururu range. This internationally significant conservation success is the most inland site globally that seabirds have been successfully reintroduced. This financial year Poutiri Ao ō Tāne had three maintenance checks across 13,500ha project area, servicing 703 podiTRAP and DOC250 traps. This project is now being serviced and managed by the Department of Conservation's Boundary Stream Team.

Rabbits	A total of 15 rabbit enquiries for advice and assistance were received over the last 12 months. Assistance was provided in the form of Environment Topic handouts, verbal advice, and in some cases demonstrations on the use of Pindone pellets and Magtoxin for rabbit control. **Rabbit night counts** (April 2023, April 2025) Rabbit night counts are now carried out biannually and were last undertaken in April 2021 across 23 sites. Data indicates at the time an increase in rabbit densities from 6 rabbits per kilometre in 2017 to 13.7 rabbits per kilometre in 2021. Rabbit night-counts were scheduled for April 2023, but due to very wet field and weather conditions, this project has not been completed and is still a work in progress. We will update the below graph upon completion. Graph 1: Rabbit night counts 

Rabbit haemorrhagic disease monitoring has now been discontinued.

Regional surveillance was last carried out in 2019 to assess the prevalence of rabbit haemorrhagic disease (RHD).

Graph 2: RHD Trends



3.4 Site-Led Pest Animals

The objective is to support coordinated and integrated control of pests in defined areas that protect and restore specific ecological or biodiversity values which are threatened or compromised by pests.

Site-led	Management Regime
Feral cats **Feral deer** **Feral goats** **Feral pigs** **Hedgehogs** **Mustelids** **Possums** **Rats**	The following table outlines the projects that received assistance through the site-specific programme. These projects form a wide range of initiatives from working with individual land users through to projects with significant local community involvement. Most projects have a strong focus on predator control to restore native birdlife.

Project	Location
Ahuriri Bittern Protection group	Ahuriri
Aramoana Reserve	Aramoana
Arlie	Wanstead
Birch Hill	Porangahau
Blowhard Bush	Kaweka
Campbell / Snelling	Wairoa
Haumoana Community Care	Haumoana
Haumoana Ecology Group	Haumoana

Site-led	Management Regime	
	Hutchinsons Reserve	Puketitri
	Ian Campbell	Mangapoike Rd
	Karamu Station	73 Brownlie Rd, Frasertown
	Little Bush Reserve	Puketitiri
	Maungataniwha Forest Trust	Willowflat
	Mike Walker	Bayview
	Ngatapa	Waipunga
	Ohurakura wetland	Te Pohue
	Opoutama wetland	Mahia
	Pekapeka	SH2
	Puahanui Bush	Gwavas
	Rowe Bush	Poukawa
	Te Mata Park	Havelock North
	Tuki Tuki River	Waipawa & Haumoana
	Waipatiki Valley	Waipatiki
	Waitangai Regional Park	Awatoto
	Wetewhakaawi / McGregors	Pakututu

3.5 Education and Advice

The Biosecurity team continue to post regular articles in "Our Place", concentrating on rabbits, rooks, PCA updates and the use of maintenance contractors. Alongside pest plants, Pest Animal staff have worked closely with the HBRC Communications Team to implement a new HBRC Pest Hub website, including incorporating factsheets covering all aspects of pest animal control.

3.6 Research Initiatives

A range of research initiatives has been completed as part of stage two due diligence for wide-scale predator control (WSPC). Past research undertaken in the Cape to City project can be viewed at http://capetocity.co.nz/resources/reports/.

These initiatives include research in two main areas:

Optimising operational delivery

These projects include Wireless trap monitoring optimisation, landowner participation modelling, trap network optimisation, motion-sensitive camera monitoring,

Habitat restoration

Biodiversity recovery relies heavily on native species having the habitat to live in, thrive and spread out from. Restoring habitat is therefore a key aspect of ecological restoration. Research has been conducted into habitat needs for different native species and spatial connectivity across the farmland landscape.

4 Communications

The biodiversity and biosecurity communications and engagement plan 2022 was designed to raise awareness about the Regional Council's biodiversity work in Hawke's Bay. This included seasonal activities for public awareness and information.

The March edition of Our Environment had a particular focus on biodiversity, which was promoted through CHB Mail, Hawke's Bay Today, Wairoa Star, community papers, e-newsletter, the HBRC website and social media.

There were a range of other activities promoted, including but not limited to:

- Biosecurity week
- Biodiversity month
- PCA consultation
- Winter planting

Comms were delivered through media releases, social media, web content, and internal comms.

Website and pest control hub

The pest hub provides a very user-friendly web hub of all the pest plants and animals, including marine pests, and diseases, that fall under the Regional Pest Management Plan. It also includes many other pests in New Zealand, including those not currently known to be found in Hawke's Bay. There is the opportunity to report pests, including a geo location, provides detailed information about pests including descriptions of the pest, photos, what harm or damage they may cause, and how they can be controlled. Management programmes and rules relating to each pest are included which lets people know if they need to take any steps if found on their property - https://www.hbrc.govt.nz/environment/pest-control/pest-hub/

Web stats 22/23

Webpage	Visits:July 2022 to June 2023
Pest Hub	2582
Pest Control	315
Plant Pests	297
Biosecurity	95
Chilean needle grass	16
Animal Pests	137
Marine Pests	82

Hawke's Bay Regional Council
Summary of Cyclone Gabrielle Related Financials
As at 13 October 2023

	Workstream(s)	FY23 (Feb - Jun) Actuals Spend $000	FY23 (Feb - Jun) Actuals Funding $000	FY24 to Date Actuals Spend $000	FY24 to Date Actuals Funding $000	Current Commitments Spend $000	Current Commitments Funding $000	Total to Date Spend $000	Total to Date Funding $000	Total to Date Impact $000	Future Estimates Spend $000	Future Estimates NEMA/ Insurance -	Future Estimates Govt Funding $000	Future Estimates Reallocation of internal resources $000	Future Estimates Budgeted Rates funding $000	Total Expected Spend $000	Total Expected Funding $000	Total Expected Impact $000	Notes
Cyclone Recovery Group																			
HBRC Response & Recovery																			
HBRC Emergency Response	105210	6,829	(996)	319	-	106	(20)	**7,253**	**(1,016)**	**(6,237)**	-	(2,000)	-	(3,293)	-	**7,253**	**(6,309)**	**(944)**	FY23 includes $820,819 income from DIA Local Govt funding. Estimate $2m funding may be claimed in NEMA and Insurance costs. $3m in spend to date is internal time.
HBRC Emergency Response PPE - CAP	205210	141	(141)	167	-	48	-	**357**	**(141)**	**(215)**	-	-	-	-	-	**357**	**(141)**	**(215)**	Funding includes $125k insurance proceeds to date.
HB Disaster Relief Trust Administration	115210	1,161	(1,000)	19	-	-	(109)	**1,180**	**(1,109)**	**(72)**	-	-	-	(72)	-	**1,180**	**(1,181)**	**0**	$108.5k reimbursed from Relief Trust to assist with administration costs. Remaining reallocation of internal resources $72k.
HBRC Recovery Management	145210	576	(205)	1,023	(605)	62	(630)	**1,662**	**(1,440)**	**(221)**	-	-	-	-	-	**1,662**	**(1,440)**	**(221)**	Funding includes $706k admin fee from LAF to HBRC. FY23 = 100,857, FY24 = 605,143
Land Categorisation - General	103181	35	-	72	-	36	-	**143**	**-**	**(143)**	-	-	-	-	-	**143**	**-**	**(143)**	
Subtotal		**8,742**	**(2,342)**	**1,600**	**(605)**	**253**	**(759)**	**10,595**	**(3,706)**	**(6,889)**	**-**	**(2,000)**	**-**	**(3,365)**	**-**	**10,595**	**(9,071)**	**(1,524)**	
Infrastructure Repairs/Reinstatement	125210/135210/225210	22,462	(7,181)	7,160	(107)	12,136	-	**41,758**	**(7,288)**	**(34,471)**	50,000	(76,120)	-	-	-	**91,758**	**(83,408)**	**(8,350)**	Funding FY23 - is $4m insurance proceeds, Some DIA Local Govt allocations. Estimated a further $40m costs to rebuild/reinstate (still to be confirmed) and 10% ineligible costs.
HBRC - FOSAL agreement commitments																			
Land Categorisation - 2A Solutions	113181	-	-	289	-	-	-	**289**	**-**	**(289)**	179,361	-	(152,400)	-	-	**179,650**	**(152,400)**	**(27,250)**	
Flood protection infrastructure rebuild	103183	-	-	-	-	-	-	**-**	**-**	**-**	65,000	-	(48,846)	-	-	**65,000**	**(48,846)**	**(16,154)**	Telemetry, Pump Station and provision for Rapid Repair sites (per FOSAL agreement)
Flood Mitigation - Scheme Reviews	113183	-	-	141	-	-	-	**141**	**-**	**(141)**	2,859	-	(2,254)	-	-	**3,000**	**(2,254)**	**(746)**	Funding is the Govt contribution as part of FOSAL agreement ($203.5m over 4 years)
Subtotal		**-**	**-**	**430**	**-**	**-**	**-**	**430**	**-**	**(430)**	**247,220**	**-**	**(203,500)**	**-**	**-**	**247,650**	**(203,500)**	**(44,150)**	
Waste Management																			
CG Waste Management - silt taskforce	155210	16,937	(16,937)	31,844	(14,667)	11,307	(30,576)	**60,088**	**(62,179)**	**2,091**	2,000	-	-	-	-	**62,088**	**(62,179)**	**91**	Funding = original $40,179k + $12m from CCF + $10m additional. Spend based on PO reporting 24102023. $2m held aside for lease commitments and disestablishment of disposal sites.
Woody debris removal fund - Cyclone Gabrielle recovery	104801	35	(35)	617	(1,735)	2,242	-	**2,895**	**(1,770)**	**(1,125)**	937	-	(2,300)	-	-	**3,832**	**(4,070)**	**238**	Based on forecast prepared 25/10/23
Regional Recovery Administration Activities																			
HBRRA General Administration	107110	1,501	(1,500)	449	(7,416)	953	-	**2,902**	**(8,916)**	**6,014**	-	-	-	-	-	**2,902**	**(8,916)**	**6,014**	
DIA Sediment and Debris - Local Govt	107120	30,113	(30,113)	17,181	(40,487)	22,160	(22,000)	**69,454**	**(92,600)**	**23,146**	18,254	-	-	-	-	**87,708**	**(92,600)**	**4,892**	Based on Sep quarterly report to DIA. Future estimates = October onwards (to update at month end)
DIA Sediment and Debris - Commercial Entities	117120	2,206	(2,206)	22,602	(70,394)	13,164	22,000	**37,971**	**(50,600)**	**12,629**	12,615	-	-	-	-	**50,586**	**(50,600)**	**14**	Based on Sep quarterly report to DIA. Future estimates = October onwards (to update at month end)
Adjustment for internal allocations between DIA & HBRRA Funding and Councils other activities above		(20,785)	20,785	(15,272)	15,272	(30,576)	30,576	**(66,632)**	**66,632**	**-**	-	-	-	-	-	**(66,632)**	**66,632**	**-**	DIA Local Govt to Silt Taskforce and HBRC (see notes) DIA & HBRRA Administrative fees
		61,211	**(39,529)**	**66,612**	**(120,139)**	**31,639**	**(758)**	**159,462**	**(160,427)**	**965**	**331,026**	**(78,120)**	**(205,800)**	**(3,365)**	**-**	**490,488**	**(447,712)**	**(42,776)**	
Other Cyclone Related Areas																			
CDEM Response																			
Operational Readiness	105112	8,660	(8,567)	55	906	-	-	**8,715**	**(7,662)**	**(1,053)**	-	-	-	-	-	**8,715**	**(7,662)**	**(1,053)**	Balance date accruals and timing. Total - Welfare NEMA claims $7.6m
CDEM Emergency Response - CAP	215210	43	(62)	(1)	-	16	-	**58**	**(62)**	**5**	-	-	-	-	-	**58**	**(62)**	**5**	
Total Cyclone Related costs		**69,913**	**(48,159)**	**66,667**	**(119,233)**	**31,654**	**(758)**	**168,234**	**(168,150)**	**(84)**	**331,026**	**(78,120)**	**(205,800)**	**(3,365)**	**-**	**499,261**	**(455,436)**	**(43,825)**	

Silt Recovery Taskforce

Hawke's Bay Sediment and Debris recovery following Cyclone Gabrielle

Quarterly report #2

July to September 2023.

Version 1 | xx/10/2023
Authored by: Darren de Klerk

HERETAUNGA HASTINGS DISTRICT COUNCIL
NAPIER CITY COUNCIL Te Kaunihera o Ahuriri
HAWKES BAY REGIONAL COUNCIL TE KAUNIHERA Ā-ROHE O TE MATAU-A-MĀUI
CENTRAL HAWKE'S BAY DISTRICT COUNCIL
WAIROA DISTRICT COUNCIL

REPORTING #2 TO SEPTEMBER 2023

1. Executive Summary

A summary of works undertaken for the quarter to the end of September 2023.

This report serves as the second formal report on Schedule 1 – Local Authority share of the Funding Agreement signed between Hawke's Bay Regional Council (HBRC) and the Department of Internal Affairs (DIA) following funding announced in early May 2023 towards sediment and debris recovery in Hawke's Bay.

While this fund is for the agreed purposes as set out in Schedule 1, the funding works in conjunction with the Commercial Category and Whenua Māori funds to collect and manage sediment and debris.

The report looks to bring together the key activities undertaken across wider Hawke's Bay to deliver on the sediment and debris recovery following the Cyclone Gabrielle event.

To date **$69,454,448** of costs have been spent or committed to September 2023, and it is estimated **2.5 million tonnes** of sediment and debris has been managed across Hawke's Bay.

In September 2023, $12m was transferred from the Commercial fund to the Local Authority Fund. At the end of September, the Central Government provided an additional $10m of funding to allow sediment and debris collection and management to continue into October 2023.

Together the total amount available in the local authority fund has increased from $70.6m to $92.6m

The last quarter has seen a considerable focus on the clean-up effort, with contractors ramping up in July/August with drier weather and more efficient operations. During September there was an enforced downscaling of operations due to commitments planning to exceed the budget available.

Funding is not sufficient to complete all the jobs in the system, with an estimated 1.2 million m3 of sediment and debris in the system waiting to be collected.

Reporting as per Part 1 – Key details: Section 8(a-g) of the Funding Agreement

A. Progress

Description and analysis of actual progress of the activity set out in the Relevant Funding Schedule against planned progress for the relevant Quarter.

Council	Description and analysis of progress for Q1 (23/24) to 30 September 2023
Taskforce	Funding • Implemented downscaled operation during month of September to avoid over-spend • Transfer of $12m from Commercial Fund to Local authority fund • Secured $10m funding in late September to support ongoing taskforce recovery programme through to October 2023 CHB • Supported Porangahau community remove silt from properties • Recovery of debris in the form of tyres deposited onto Pourerere Beach • 3,648 tonnes of Woody debris recovery in Kairakau, CHB Woody Debris – Napier/ Hastings and CHB • Recovery of woody debris along river reserves and beaches including in Wairoa – circa 8,000 tonnes collected and stockpiled • 139,806 tonnes managed, recovered and processed to date • 133 jobs logged, 91 completed Silt Collections • Worked through existing and new logged jobs in the system • Coordinated with land advisory team the management and advice of silt staying in-situ • 662 jobs in the system logged, and 441 completed • 1,959,693 tonnes collected Debris • Two sites established to manage mixed waste and silt in Pakowhai and Esk • 120,383 tonnes of mixed debris received at these sites for processing • 213 jobs logged and 38 completed Site Management • Operated existing deposit and processing sites • Established new sites to cater for sediment and debris • Maximised efficiency on existing sites • Reviewed and managed hydrology and wet weather risks Reuse opportunities • Worked with industry, suppliers and contractors to continue to find end use opportunities for debris streams

	• Implemented campaigns to recover debris streams
Wairoa District	• Under-house silt removal complete for 105 houses • 42,224.50 tonnes estimated to have been collected • River reserve and Council property silt removal/restoration • Railyard transfer site silt removal and clean-up • Landfill and disposal site remediation • Woody debris recovery from beaches and around bridges has seen more than 8,000 tonnes stockpiled around the district • Stage one of the clearing involved stacking the debris into piles above the high tide mark so people can again enjoy using local beaches. Stage two will see the piles incinerated, mulched, made available firewood and community use or left to nature. • Debris clearance has been completed at most of the 26 bridge sites where work was programmed.
Napier City Urban area and Awatoto (NCC)	• Drainage works in the area to allow for free passive drainage into the Biorich drain over the winter months • Earthwork management of receptor site one • Sampling for silt acceptance into the receptor site • Removal of silt and debris from residential areas to receptor site • Continued acceptance of silt from within the Napier boundary, this includes into both receptor sites (dry and wet) • Geotec testing to establish end of life uses for silt • Establishment of taskforce for the planning and preparation for end of life silt. • Drainage, and silt and erosion measures through the receptor site areas. This is in conjunction with HBRC. • Consultation of OiC and any required resource consents • Capping of unregistered and undocumented bore on site leading to drainage issues.
Hastings District Urban area	• All work delivered by the Taskforce – removal of sediment and debris across private properties and council owned land / areas of public interest
Central Hawke's Bay	• All work delivered by the Taskforce – removal of sediment and debris across private properties and council owned land / areas of public interest
Hawke's Bay Regional Council	Continued management of sediment and debris dealt with throughout our 25 Schemes across Hawkes Bay; • Emergency works removed debris from channels to allow for channel capacity and remove risk to third party structures (e.g. bridges) – some work covered through Woody Debris Fund • Removed debris from stop banks to allow for repair • Removed silt and debris from access roads • Removed silt from HBRC drains

B. Expenditure (Q1-2023/24)

Cumulative Spend to Date Q4-2022/23 and Q1-2023/24

C. Plans for the next quarter

A summary of expenditure, actual against funds advanced (including underspend and cash float), for the relevant Quarter;

Council	The planned works for Q2 (23/24) is as follows:
Taskforce	• Continue works in October 2023 with the additional $10m funding provided. Jobs in the system will be triaged as High, Medium and Low priority to assist with prioritisation of jobs and ensure the remaining funding is spent on those with the greatest need. • A reduced number of contractors will continue in October, with a capped budget. • Deposit sites available for material to be transported to but at a reduced capacity. • Large focus on getting sites wound down and transitioned to be able to hand them over to landowners • Focus on logging information into OWLs • Focus on submitting Site Management Plan • Multi agency work on dust mitigation and management • Work the Transport Recovery East Coast (TREC) to support upgrade works in Esk and other areas • Support landowners who may be stranded with advice • A cut off for jobs to be logged for collection has been implemented which will be 6th October 2023. This will allow the Taskforce to assess and prioritise which jobs get completed and ensure there is a full picture of the job ahead. • Continue to advocate for further funding to support its community, so works can continue past October 2023. • If no further funding is provided, operations will need to wind down and cease from November 2023 to ensure there are no over-spends.
Wairoa District	• To complete any works from Q1 that remain within budget available. • Remaining houses on current list for under house silt removal, these are programmed accordingly and work through as resource is available. • River reserve and Council property silt removal/restoration – finish off this work. • Railyard transfer site silt removal and clean-up – ongoing • Manage safety risk associated with unfinished Woody Debris works • Landfill and disposal site remediation • Debris Removal Residential Properties
Napier City	• To complete any works from Q1 that remain within budget available. • Continue drainage works in the area to allow for free passive drainage into the biorich drain over the winter months • Continue earthwork management of receptor site one and two • Continued removal of silt and debris from residential areas to the receptor site, continued discussions surrounding the acceptance of septic silt from residential properties on behalf of HBRC. • Start with the sifting of the silt to remove significant debris

	• Geotechnical analysis and results • Planning and start the implementation for removal of silt to terminal sites.
Hastings District	• All work delivered by the Taskforce – ongoing removal of sediment and debris.
Central Hawke's Bay	• All work delivered by the Taskforce – ongoing removal of sediment and debris.
Hawke's Bay Regional Council	• To complete any works from Q1 that remain within budget available.

D. Forecast cashflow and costs

Forecast for each quarter through to Q4 – FY23/24 (to 30 June 2024)

E. Risks and mitigation

Any major risks arising or expected to arise with the Agreed Purposes, costs or performance of this Agreement, together with actual or proposed mitigations for those risks (including, where the actual Agreed Purposes costs are forecast to exceed the funding allocated via this agreement, how the shortfall is to be funded).

Risks arising or expected to arise with the Agreed Purposes, costs or performance of this Agreement

Agreed Purpose	Risks and description	Mitigation
Processing and management of sediment and debris resulting from Cyclone Gabrielle, including but not limited to testing, recycling, processing, transporting, shredding, chipping, containment, or disposal of sediment and debris;	• Finding outlets to recyclers • Impact on landfill from debris • Cost to run shredders and screeners • Cost to dispose of contaminated material	• Work with industry and suppliers to find reuse/ recycle opportunities • Identifying and trying to manage what goes to landfill • Maximise efficiency onsite • Test and be sure of material going to relevant end use locations
Maintenance of existing disposal facilities that are receiving significant quantities of sediment and debris, or the establishment of new sediment and debris processing, stockpiling and disposal sites;	• Reducing life of existing assets • Consenting of new sites • Aftercare of new sites • Meeting landowner expectations • Meeting community expectations • Dust and nuisance	• Minimise material going to existing • OIC permitting activity • Work with landowners and investigate opportunities to leave land in productive state • Ongoing communication – story telling and engagement • Seeding high risk areas, watering and cleaning roads
The collection and management of sediment and debris resulting from Cyclone Gabrielle within the public interest, such as on/in Council-Owned Property or other assets and/or where there is a health or environmental risk, and not otherwise funded or able to be funded;	• Weather events washing debris down river • Debris posing health and safety or fire risks • Damage to infrastructure • Ability to remove sediment and debris	• Moving above water line until works can be completed • Removal prioritised • Create access
The collection and transport of sediment and debris from residential properties, including clearing of accessways; and	• Impact on roading network • Silt under sub floor	• Try establish sites on higher productivity routes and engage with roading authorities • Share contractors
The Recipient may perform administrative and operational actions to support the Agreed Purposes, and its costs for these may be claimed to the extent payable as Eligible Costs.	• Hydrology risk due to adding/ removing silt • Engagement with mana whenua • Supervision of contractors • Planning and testing	• Hydrology assessment by experts to understand risks • Ongoing support from planners and engagement direct • Resource to supervise works and validate claims • Testing regime as per site management plans

General Risks

Council	Risks and description	Mitigation
Taskforce	• Funding running out before recovery completed	• Continue lobbying for further funding with Central Government, and triage jobs in system for the additional $10m funding provided
	• Public perception and anxiety due to funding constraints	• Continuous communications regarding funding updates and expectations on delivery
	• Truck movements and dust resulting in complaints	• Work with agency around comms, and monitoring data, implement solutions on hot spots, encourage landowner responsibility, coordinate support
	• Risk with new plan for October 2023 (prioritised jobs and reduced contractor number)	• Communications and relationship management
	• Leachate / odour risk (woody debris)	• Implement odour management plan
	• Log piles for Pan Pac may never be picked up, or may be stolen or vandalised if left for long periods	• Ongoing communication with Panpac and landowners
	• Cost associated with sending debris that cant be reused or recycled	• Channel and manage through 'Transfer Stations' – look for alternate uses before sending to landfill
	• A procurement approach to refine rates and contractor numbers is seen as unfair or slow	• Strong communication, ensure fairness in how evaluation is done, focus on the areas of value – e.g collection contractors to reduce numbers, and the rest to refine rates
	•	
Wairoa District	• Landfill and disposal sites – There are ongoing issues with silt to landfill and finding external sites. There are four sites operational and three proposed. Establishing these sites are key, if no sites can be established it normally reverts back to landfill which is putting pressure on our long-term sustainability at this site. A Sediment and Debris management plan has been submitted as part of this funding to try and manage these risks.	• To be investigated further with Taskforce to gain support and manage ongoing operations
	• Financial risks are present – Council is under pressure with cashflow, and it is vital that this silt funding is captured to take pressure off Council and community	• Work with HBRC and DIA to agree payment in advance where possible to avoid shortfalls
	• Woody Debris Impacting beaches and waterways	• Local PM in place to coordinate this support with local contractors

	• Sediment and Woody Debris impacting Raupanga Water Supply	
Napier City	• The inability to manage earthworks in the receptor sites due to hardening of the silt • Risk that the geotechnical findings show the silt is not useful for earthwork or landscaping and will need to go into paid storage or another solution for permanent disposal of the silt • Environmental risks due to lack of dust suppression	
Hastings District	• Funding running out before recovery completed • Land categorisation impacting decisions • Site management after care responsibilities • Demolition of properties – impact of C&D waste and asbestos • Damage to roads	• Continue lobbying for further funding with Central Government • Engagement with community • Consenting understand, landowner considerations • Investigate WM Fund and industry engagement • Look for sites on main routes, work with roading authorities
Central Hawke's Bay	• Funding running out before recovery completed • Support to isolated communities	• Continue lobbying for further funding with Central Government • Use local partners to engage
Hawke's Bay Regional Council	• Funding running out before recovery completed • Drainage issues exacerbated by silt and sediment	• Continue lobbying for further funding with Central Government

F. Additional info

Any other information that required as a condition of funding as included in the Funding Schedule; and;

No other information required to date, other than that specified in section G.

G. Additional info

Any other information that is notified by DIA in writing to the Recipient as being required.

Notified below.

In addition to the reporting requirements set out at clauses 2.7, 2.8 and item 8 of Part 1 of this Agreement, the Recipient will also provide collated information, on the basis of activities undertaken by the Recipient towards the Agreed Purposes (as well as activities undertaken by any Councils the Recipient has provided Funding to for the Agreed Purposes) , as part of Quarterly Reports and the Final Report on:

(a) *The actual weight or estimated volume of sediment and debris that have been accepted, processed, and/or treated, and/or diverted, and/or disposed of, and/or removed across all sites, noting estimated volumes of waste material can be converted to tonnage via the conversion factors for waste types listed in Schedule 1*

of the Waste Minimisation [1](Calculation and Payment of Disposal Levy) Regulations 2009;

The weights are an estimate as no weighbridges exist at majority of the deposit/ processing sites. Across the sites it is estimated 2 million tonne have been received for depositing or processing. Detailed below.

Wairoa DC

Current tallies are:

- Landfill Site = 17029.08 tonnes
- Quarry Site = 14,000m3 (converted into tonnes using 1.5 conversion factor) = 21,000tonne
- Whakamahi Road site: 1300m3 (estimate, converted into tonnes using 1.5 conversion factor) = 1950 tonnes
- Mill Road site: 1497m3 (converted into tonnes using 1.5 conversion factor) = 2245.50 tonnes

Sub Total tonnes (Sediment): 42,224.50 tonnes

8,000 tonnes of woody debris recovered on public beaches.

Total tonnes: 50,224 tonnes

Napier CC

- 286,000m3 collected to date from commercial and residential properties.

Total tonnes: 429,000 tonnes

CHB

- 1087 tonnes of sediment received at CHB Farm Road Landfill
- 143 tonnes debris received at CHB Farm Road Landfill

Total tonnes: 1,230 tonnes

Taskforce includes Hastings DC and HBRC

Across our sites based on droning volumes received at sites, we estimate we have collected/ managed **1,959,693** tonnes of sediment and debris. Plus an additional **139,806** tonnes of woody debris.

Total tonnes: 2,099,499 tonnes

(b) *Where possible, estimates on the type/category of property that the sediment and debris has been disposed from (e.g. materials from Council land, residential, commercial, whenua Māori);*

Insufficient data to be accurate at the moment, below is an estimate below as a % of the total as to where the waste is coming from;

Type/ Category – Sediment and Debris	%	Volume (tonnes)

[1] https://environment.govt.nz/assets/publications/Measuring-waste-tonnages-factsheet-final.pdf

Council land	20%	515990.6
Residential land	10%	257995.3
Commercial land including Orchards/ Vineyards etc…	65%	1676969.45
Whenua Māori incl. Marae	5%	128997.65
Other:		
TOTAL	**100%**	**2,579,953t**

(c) *The estimated quantities of sediment and debris that have been removed from Council-Owned Properties or other assets in the public interest;*

Typically council owned properties or other assets have been deemed to be – public reserves/ parks, river reserves, beaches or other similar assets of public interest.

Territorial Authority	Beaches	Public Reserves	River Reserves	TOTAL
Wairoa District Council	20,000m3 or 8000 tonnes recovered	30% or 11,000 tonnes estimated (sediment) from reserves		31,000 tonnes
Napier City Council	125,000 tonnes estimated (wood) from beaches	1,000 tonnes estimated (wood) from parks and public reserves	13,806tonnes estimated (wood) from river reserves	139,806 tonnes
Hastings District Council				
Central Hawke's Bay District Council				
Hawke's Bay Regional Council				
TOTAL				**170,806 tonnes**

(d) *The estimated quantities of sediment and debris that have been collected and transported from residential properties;*

Below is the estimated quantity of sediment and debris collected and transported from residential properties across Hawke's Bay;

Territorial Authority	# of properties	Volume (estimated)
Wairoa District Council Urban	105	
Napier City Council Urban		
Hastings District Council Urban	29	
Central Hawke's Bay District Council Urban	52	
Hawke's Bay Regional Council	166	
TOTAL		**257,995.3 tonnes**

(e) *The amount of Funding claimed as Eligible Costs;*

For clarity, Eligible costs has been described in the funding agreement as;

Eligible Costs *means the actual administrative and operational costs related to the Recovery that have been incurred since 12 February 2023 or will be reasonably incurred by the Recipient on or after the Commencement Date and no later than the End Date to deliver on* ***Agreed Purposes****, and includes any additional, specific Eligible Costs as may be set out in Schedule 1.*

Schedule 1 *- The* ***Agreed Purposes*** *for this Funding round are:*

A. *Processing and management of sediment and debris resulting from Cyclone Gabrielle, including but not limited to testing, recycling, processing, transporting, shredding, chipping, containment, or disposal of sediment and debris;*
B. *Maintenance of existing disposal facilities that are receiving significant quantities of sediment and debris, or the establishment of new sediment and debris processing, stockpiling and disposal sites;*
C. *The collection and management of sediment and debris resulting from Cyclone Gabrielle within the public interest, such as on/in Council-Owned Property or other assets and/or where there is a health or environmental risk, and not otherwise funded or able to be funded;*
D. *The collection and transport of sediment and debris from residential properties, including clearing of accessways; and*
E. *The Recipient may perform administrative and operational actions to support the Agreed Purposes, and its costs for these may be claimed to the extent payable as Eligible Costs.*

The costs to date for the eligible costs are as outlined in Section 2B, where eligible costs have been identified against the agreed purposes. For completeness, costs incurred are $76,043,701.

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(f) *The management approach towards and disposal of any contaminated materials;*

This management approach towards the disposal of any contaminated materials has been to test the material to determine a suitable location for it to disposed of, the following are the receiving environments for contaminated materials – the materials are managed within the existing resource consent conditions for each of the receiving environments.

Landfill and TA
WDC – Landfill (Fraser Street)

HDC and NCC - Omarunui Regional Landfill
Private – Okaihau Quarry, Waimarama
CHBDC – Farm Road Landfill

(g) *The number of additional facilities and their purpose and function, that have been established to meet the demand for sediment and debris management;*

Circa 20 sites have been established to manage the sediment and debris created by Cyclone Gabrielle – outlined in further detail below.

Site Status	Type	Waste Stream	Site Name/ Location	Responsible Council
Operational		On hold (budget)	Moteo Pa Road	Taskforce
Operational		On hold (budget)	23 Shaw Road	Taskforce
Operational	Permanent	Clean Silt – opened for composting and land contouring	Franklin Road (Chesterhope Station)	Taskforce
Operational	Permanent	Clean Silt	451 Omarunui Road	Taskforce
Operational	Permanent	Clean Silt	1016 Dartmoor Road (Sacred Hill)	Taskforce
Operational	Permanent	Clean Silt – on hold (budget)	2 Waipunga Road, Esk	Taskforce
Operational	Temporary	Mixed Waste/ Silt – closed (remaining silt to be extracted)	555 SH5, Esk	Taskforce
Operational	Temporary	Mixed Waste/ Silt (operating at minimum)	2099 Pakowhai Road (corner Allen)	Taskforce
Operational	Temporary	On hold (budget) - Compost and screening only	626 Omarunui Road	Taskforce
Operational	Temporary	Wood Storage / Mulch (budget almost out)	355 Dartmoor Road	Taskforce
Operational	Temporary	Clean/contaminated	Awatoto – Receptor Site 1	Napier CC
Closed	Permanent	Clean Silt	Waiohiki Golf Course	Taskforce
Closed	Permanent	Clean Silt	287 Dartmoor Road	Taskforce
Closed	Permanent	Clean Silt	Omarunui River Site	Taskforce
Closed	Temporary	Clean Silt	Mcleod Road, Awatoto	Taskforce
Closed	Temporary	Clean Silt	504 Puketapu Road	Taskforce
Operational	Temporary	Clean/contaminated	Awatoto – Receptor Site 2	Napier CC
Operational	Permanent	Clean Silt	Pits 4 U Quarry (22 Awatere Road)	Wairoa DC
Operational	Permanent	Clean Silt	Railway Road Site (Kaimoana Road)	Wairoa DC
Existing	Permanent	Silt	Keppel Street – Closed Landfill	CHB DC
Existing	Permanent	Silt/ Shingle	Farm Road - Landfill	CHB DC
Existing	Permanent	Silt and Debris	Fraser Street - WDC Landfill	Wairoa DC

Existing	Permanent	Silt and Debris	Omarunui Regional Landfill	NCC and HDC

(h) *The impacts of all other expenditure towards sediment and debris management under the funds i.e. including any retrospective costs and maintenance or improvements to existing services and infrastructure;*

The recovery has added significant pressure to resourcing and ability for the team to deliver on business as usual work. Cost implications are significant given funding constraints and works at this stage will see the Taskforce unable to continue past October 2023.

(i) *Any co-funding leveraged through the use of this funding (refer to clause 3.1(d) of this Schedule 1 above).*

- Additional funding of $10m was confirmed in late September to enable works to continue through to October 2023.
- **NEMA Solid Waste fund** - funding made by Tas for costs to 30 June 2023 - leveraged for the removal and management of flood damaged household goods.
- **Te Uru Rākau – Woody Debris Recovery Fund** in Upper Catchment posing Risk to Critical infrastructure. Funding of approx. $5.5m being managed by HBRC to investigate and prioritise woody debris up catchment at risk of damaging critical infrastructure – works overlap with the woody debris clean up the Taskforce is undertaking – collaboration is strong between both parties, with resources and intel being shared as well as contractors.

Survival rate of horticultural plant pathogens after forced aerated windrow composting

July 2023
Hawkes Bay Regional Council Publication No. 5618

HAWKES BAY
REGIONAL COUNCIL
TE KAUNIHERA Ā-ROHE O TE MATAU-A-MĀUI

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Version 1

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Environmental Science

Survival rate of horticultural plant pathogens after forced aerated windrow composting

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Prepared By:
Scheper, RWA., Fisher, B., Homer, I., Applegate, E., Donahoe, C., Horner, M., Everett, E., de Villiers, C., Pushparajah, S., Arnet, M., Hosking, J., Williams, N.

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Survival rate of horticultural plant pathogens after forced aerated windrow composting

Scheper RWA, Fisher B, Horner I, Applegate E, Donahoe C, Horner M, Everett E, de Villiers C, Pushparajah S, Husheer S, Arnet M, Hosking J, Williams N

June 2023

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Contents

Survival rate of horticultural plant pathogens after forced aerated windrow composting. June 2023. PFR SPTS No. 24080. This report is confidential to Hawke's Bay Regional Council.

Executive summary

Survival rate of horticultural plant pathogens after forced aerated windrow composting

Scheper RWA[1], Fisher B[1], Horner I[1], Applegate E[1], Donahoe C[1], Horner M[1], Everett E[2], de Villiers C[2], Pushparajah S[2], Husheer S[1], Arnet M[1], Hosking J[1], Williams N[1]
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June 2023

The Hawke's Bay Regional Council is developing a new regional plan, Kotahi, which includes rules relating to air quality. Smoke emissions (particulate matter PM_{10} and $PM_{2.5}$) associated with wood burning can have a negative effect on air quality. Outdoor burning is prohibited for Napier/Hastings residents during the winter months, but burning by orchards and vineyards for the purpose of redevelopment and disposal of diseased material is allowed. When these horticultural properties are near urban airsheds, this burning can have a substantial impact on the wider community. To improve air quality, forced aerated windrow composting is considered a potential alternative to burning of diseased horticultural materials. However, it is important also to consider the potential impacts of composting instead of burning on any disease spread to uninfected plants. It was not known whether the horticultural pathogens that are important in Hawke's Bay can survive the composting process, or what the risks might be if they do survive.

In Hawke's Bay, forced aerated windrow composting is used by the commercial compost manufacturer BioRich Limited. Horticultural pathogen survival rates after exposure to commercial composting at BioRich were determined for *Neonectria ditissima* (European canker of pomefruit), *Eutypa lata* (grapevine dieback), *Phytophthora cactorum* (root and crown rots of many plants), *Xanthomonas arboricola* pv. *pruni* (Xap; bacterial spot and canker of summerfruit), *Erwinia amylovora* (fire blight of pomefruit) and *Pseudomonas syringae* pv. *actinidifoliorum* (Psaf; a low-virulence "relative" of Psa kiwifruit disease). The pathogens were exposed to both fresh and mid-mature compost at different depths for 1 week, and the temperatures to which the pathogens were exposed were recorded during that time. In addition, the likelihood of pathogen survival at BioRich was estimated and compared with those of participating composting facilities in the Bay of Plenty and Tairāwhiti.

Findings

- None of the pathogens survived being buried in compost for 1 week, regardless of the depth (0.1 m, 0.3 m or 1 m) or compost type.
- All pathogens survived the control treatments of 1 week at either 7°C or 20°C, although very few conidia of *N. ditissima* remained viable, and the viability of Psaf also reduced compared with the starting viability.
- Continuous high temperatures, above 60°C, were recorded for several days in fresh compost and mid-mature compost, at all depths (0.1 m, 0.3 m or 1 m) and all positions.
- Fresh compost was significantly hotter than mid-mature compost, with continuous temperatures above 65°C recorded for several days, at all depths (0.1 m, 0.3 m or 1 m) and all positions.
- The probability that a piece of diseased material is present in the outer 0.1-m layer of every fresh or mid-mature compost windrow (20 x 4 x 3.2 m) at BioRich is unlikely (5.5×10^{-12} %). This probability decreases multiplicatively with each further windrow turning. The probability that a piece of diseased material is present in every outer 1-cm or 5-cm layer in four subsequent windrows is even smaller (5.1×10^{-16} % and 3.3×10^{-13} %, respectively).

To give growers confidence that complete pathogen kill is achieved during the composting process, regardless of the volume of diseased horticultural material, further research is required. Larger pieces or greater volumes of naturally infected plant material will need to be tested, and the pathogen survival rate in the outer 0.1-m layer of the windrows will need to be determined.

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1 Introduction

The Hawke's Bay Regional Council is developing a new regional plan, Kotahi, which includes rules relating to air quality (Hawke's Bay Regional Council 2022a). Smoke emissions (particulate matter PM_{10} and $PM_{2.5}$) associated with wood burning can have a negative effect on the quality of the air in the airsheds, and improvements are required to consistently attain the National Environmental Standards for particulate matter, taking into consideration the new World Health Organization guidelines.

In the Napier and Hastings airsheds, outdoor burning is prohibited for residents during the winter months of 1 May until 31 August, and restricted during the rest of the year. However, burning for the purpose of orchard redevelopment and disposal of diseased material is permitted (Hawke's Bay Regional Council 2022b), and outdoor burning of orchard and vineyard material is observed on a regular basis during winter. This is of particular concern when these orchards and vineyards are near to urban airsheds, since this burning can have a substantial impact on the wider community because of ash and smoke. Therefore, forced aerated windrow composting is considered a potential alternative to burning of diseased horticultural materials.

In Hawke's Bay, forced aerated windrow composting is used at the commercial compost manufacturer BioRich Limited, located in Awatoto and Raukawa. Using this process, fans blow air into the fresh compost to maintain oxygen levels of 5–20%, while regular watering maintains 55% dry matter (Halpin N, BioRich, pers. comm.). It is not known whether horticultural pathogens can survive the composting process, nor what the risks might be if they do survive.

The survival rates of six important horticultural pathogens were determined after exposure to commercial composting at BioRich, and the temperature profile in the compost windrows was examined. In addition, the likelihood of pathogen survival at BioRich was estimated and compared with those of participating composting facilities in the Bay of Plenty and Tairāwhiti.

2 Methods

2.1 Pathogens

Six horticultural pathogens were used: two isolates of the fungus *Neonectria ditissima,* which causes European canker of pomefruit; two isolates of the fungus *Eutypa lata,* which causes grapevine dieback; one isolate of the oomycete *Phytophthora cactorum,* which causes root and crown rot of many plants; one isolate of *Xanthomonas arboricola* pv. *pruni* (Xap), which causes bacterial spot and canker of summerfruit; one isolate of the bacterium *Erwinia amylovora,* which causes fire blight of pomefruit; and one isolate of the bacterium *Pseudomonas syringae* pv. *actinidifoliorum* (Psaf), which is a low-virulence "relative" of *Pseudomonas syringae* pv. *actinidiae* which causes Psa kiwifruit disease (Table 1). Psaf was previously known as Psa-LV (low virulence). These pathogens were selected because burning is currently used to dispose of horticultural materials infected with these pathogens, or pathogens that are closely related to these pathogens.

Appropriate substrates were chosen for each pathogen by an experienced plant pathologist from Plant & Food Research, and varied according to pathogen type (bacteria, fungi, oomycete, Table 2).

Table 1. Pathogen isolates used in the composting trial, and their origins.

Pathogen	Isolate	Isolation year	Host & tissue	Location
Neonectria ditissima	RS 673c	2020	'Royal Gala' apple wood	Motueka
Neonectria ditissima	RS 720c	2020	'Aurora' apple wood	Waikato
Neonectria ditissima	Field inoculum	2022	Apple wood	Motueka
Eutypa lata	F 73	2020	Sauvignon blanc wood	North Canterbury
Eutypa lata	F 74	2020	Sauvignon blanc wood	North Canterbury
Phytophthora cactorum	H-1652	2023	Apple fruit	Hawke's Bay
Erwinia amylovora	Ea 236	1998	Apple tree	Blenheim
Xanthomonas arboricola pv. *pruni*	X 16278	2016	Plum fruit	Hawke's Bay
Pseudomonas syringae pv. actinidifoliorum	ICMP 19497	2012	Kiwifruit wood	Bay of Plenty

Table 2. Substrates onto which each pathogen was inoculated prior to treatment in the composting trial.

	Fungi		Oomycete	Bacteria		
Substrate	*N. ditissima*	*E. lata*	*P. cactorum*	*E. amylovora*	Xap	Psaf
Agar plugs	+	+	+	-	-	-
Suspension	+	-	-	+	+	+
Wood pieces	+	+	-	-	-	-
Leaf discs	-	-	+	-	-	+
Oat kernels	-	-	+	-	-	-

N. ditissima = *Neonectria ditissima*, *E. lata* = *Eutypa lata*, *P. cactorum* = *Phytophthora cactorum*, *E. amylovora* = *Erwinia amylovora*, Xap = *Xanthomonas arboricola* pv. *pruni*, Psaf = *Pseudomonas syringae* pv. *actinidifoliorum*.

The fungal isolates of *N. ditissima* and *E. lata* were grown on potato dextrose agar (PDA) and on pieces of sterile apple 'Royal Gala' wood at 20°C. The apple wood pieces were 2-cm long sections of apple twigs that were split lengthways, autoclaved and placed on PDA for the fungi to colonise. After 2 weeks, mycelial PDA plugs (ø 5 mm) and wood pieces were placed in sterile 1.5-mL vials, 10 agar plugs per vial and two wood pieces per vial. For each isolate, 32 vials with agar plugs and 32 vials with

wood pieces were prepared. In addition, a suspension of field-collected conidia (asexual spores; 10^5 conidia/mL water) of *N. ditissima* (field inoculum) was aliquoted over 32 vials (1 mL/vial).

P. cactorum was grown on V8 agar, on sterile oat kernels, and on apple leaves placed on moistened tissues at 20°C. After 3 weeks, mycelial agar plugs (ø 5 mm), inoculated oat kernels and apple leaf disks (ø 5 mm) were checked for presence of mature oospores and then placed in sterile vials, 32 vials of each, containing either 10 agar plugs, 10 leaf discs or six oat kernels per vial.

The bacterial isolates of Xap and *E. amylovora* were grown on King's medium B (Barbosa et al. 1995; King et al. 1954) in Petri plates at 24°C and 26°C, respectively for 48 h. Xap bacteria were harvested and suspended in nutrient broth at a concentration of 1 x 10^9 colony forming units (cfu)/mL. *E. amylovora* bacteria were harvested from plates and suspended in Luria broth (Bertani 1951) at a concentration of 10^9 cfu/mL. The bacterial suspensions were aliquoted over 32 vials (1 mL/vial).

Psaf was grown on King's medium B in Petri plates at 20°C for 72 hours, after removal from a stock culture in the -80°C freezer. Bacterial cells were resuspended in sterile deionised water following removal from the agar plates with the aid of a sterilised bent glass rod. The concentration was adjusted with the aid of a spectrophotometer to the required concentration in bacterial saline (0.85% NaCl). The bacterial suspension (10^8 cfu/mL) was aliquoted over 32 vials (1 mL/vial) and 32 vials (300 µL/vial) containing five kiwifruit leaf disks (ø 5 mm) each.

All vials were sealed with clingwrap, wrapped in tissue paper and distributed over 32 bags and vacuum-sealed, with each bag containing the following 16 vials:

- *N. ditissima* RS 673c agar plugs
- *N. ditissima* RS 673c wood pieces
- *N. ditissima* RS 720c agar plugs
- *N. ditissima* RS 720c wood pieces
- *N. ditissima* conidial suspension
- *E. lata* F 73 agar plugs
- *E. lata* F 73 wood pieces
- *E. lata* F 74 agar plugs
- *E. lata* F 74 wood pieces
- *E. amylovora* bacterial suspension
- Xap bacterial suspension
- Psaf bacterial suspension
- Psaf inoculated leaf discs
- *P. cactorum* agar plugs
- *P. cactorum* inoculated oat kernels
- *P. cactorum* inoculated leaf discs.

Temperature loggers were placed inside 20 vacuum-sealed bags (Figure 1). The 32 vacuum-sealed bags were placed in netlon mesh bags.

Figure 1. Vacuum-sealed bags containing 16 vials with pathogens and a temperature logger.

2.2 Forced aerated windrow composting at BioRich

2.2.1 Exposure to composting

Four replicate vacuum-sealed bags were placed at 7°C, 20°C (controls), or buried in fresh or mid-mature compost at three depths at BioRich, Te Tua Site, Raukawa, Hawke's Bay for 1 week. One temperature logger was placed in each of the control incubators. The remaining 18 loggers were divided over three replicates buried in compost.

Four 1-m deep holes were dug in a windrow containing aerated fresh compost, and four 1-m deep holes were dug in a windrow of mid-mature compost. In each hole, three netlon mesh bags, attached to a rope, were placed at 0.1 m, 0.3 m and 1 m depth. The ropes were attached to flags, indicating the position (Figure 2).

The aerated fresh compost windrow had been made 1 day before the bags were buried and consisted of a mixture of chipped green waste, bark chips, sawdust, paunch grass, animal parts (ears, legs, whole dead animals), food waste, wool and "overs" (pieces bigger than 14 mm after screening of compost).

The mid-mature compost windrow was on solid ground, without aeration, and had been there for 5 days. This compost had spent 30 days in aerated windrows and had been turned twice, after 15 days and 30 days, before it was moved to solid ground.

In summary, four replicate vials of each pathogen/substrate/isolate combination (16 in total) were exposed to one of eight treatments for 7 days. The treated samples were placed in fresh or mid-mature compost at three depths (0.1, 0.3 and 1 m), and two sets of untreated controls were placed at a low temperature (7°C) and the other set at room temperature (20°C).

A B C

Figure 2. A) Vacuum-sealed bags inside netlon mesh bags attached to an orange flagging rope and pink flag about to be buried in a 1-m deep hole in mid-mature compost, B) the aerated fresh compost windrow, and C) mid-mature compost windrow, with pink and red flags indicating the position of the buried bags containing pathogens and temperature loggers.

2.2.2 Size of the windrows and the number of windrow-turns at BioRich

Most windrows at BioRich are approximately 20 m long, but vary in length from 15 m to 30 m. Their usual width is 4 m, but some windrows are 7 m wide. The height of the windrows is always 3.2 m (Nigel Halpin, pers comm.), but the shape of the top 1 m is trapezoid.

Fresh compost is always aerated for 30 days, using forced air, and is usually turned after 15 days. After 30 days of aeration, the mid-mature compost is turned and placed onto solid ground, without aeration, where it will usually spend another 30 days and will usually be turned four times. Mid-mature compost can spend 10 to 60 days on solid ground, and the number of turns can vary between two and six. After a minimum of 40 days, the mature compost is screened and any pieces that are larger than 14 mm ("overs") are returned to composting process and mixed with new fresh compost. The mature compost is placed on solid ground and may be turned a further two times to help cure the compost pre-sale. From start to finish, compost is always turned a minimum of six times.

2.3 Re-isolation after composting

The bags were retrieved after 1 week (Figure 3). Agar plugs, wood pieces, leaf discs, oat kernels and suspensions of *N. ditissima*, *E. lata*, *E. amylovora*, and Xap, Psaf and *P. cactorum* were plated onto suitable agar media.

2.3.1 *Neonectria ditissima* and *Eutypa lata*

Conidial suspensions of *N. ditissima* were spread onto PDA (100 µL/plate of the controls and 750 µL/plate of the compost-treated samples) or pipetted onto glass microscopy slides, four 60-µL droplets of each vial. The microscopy slides were placed at 100% humidity and 20°C for 24 h. The numbers of germinated and non-germinated conidia were counted using a compound microscope at x200 magnification. Inoculated wood pieces and mycelial agar plugs were placed onto PDA. All PDA plates were placed at 20°C and checked for fungal growth after 5 days and after 12 days.

2.3.2 *Phytophthora cactorum*

Inoculated agar plugs and oat kernels were placed onto V8 agar, and leaf discs onto PARP (*Phytophthora*-selective) agar, and incubated at 20°C. Agar plates were checked for pathogen growth after 4 and 7 days, then weekly for 6 weeks.

2.3.3 *Erwinia amylovora* and *Xanthomonas arboricola* pv. *pruni*

Bacterial suspensions were spread onto King's medium B plates (100 µL/plate) and incubated at either 26°C for 48 h (*E. amylovora)* or 25°C for 120 h (*Xap*). Agar plates were checked for pathogen growth and bacterial colonies counted.

2.3.4 *Pseudomonas syringae* pv. *actinidifoliorum*

Leaf discs that were inoculated with Psaf were placed in 1 mL bacterial saline at 20°C and gently agitated by placing on a shaker at 50 rpm for 16 h. Serial dilutions of Psaf suspensions were aliquoted onto modified King's medium B in Petri plates. Agar plates were checked for pathogen growth after 48 hours, and bacterial colonies were counted.

2.3.5 Temperature data

Temperature data were downloaded from the dataloggers and analysed using R version 4.3. Three separate least squared linear regression models were used to test for the effects of differences in compost type and measurement depth on maximum, buried and settled temperatures.

Figure 3. Vacuum-sealed bags inside netlon mesh bags after they had been buried in compost for 1 week.

3 Results

3.1 Pathogen survival

After 1 week buried in compost, none of the pathogens grew or germinated, regardless of the depth (Tables 3 and Figure 4).

All fungi and oomycetes on solid media (agar plugs, wood pieces, oat kernels, leaf discs) survived the control treatments (85–100%). Bacteria in suspensions also survived the control treatments. However, the number of Psaf colony forming units (cfu) had reduced after 1 week at 7°C or 20°C, with 47% and 9% survival, respectively. Conidia of *N. ditissima* had a very low survival rate compared with the original suspension, with only 7% survival at 7°C and 3% at 20°C.

Table 3a. Percentages of inocula where *Neonectria ditissima* grew after being buried for 1 week at different depths in fresh and mid-mature compost windrows, or after being placed at 7°C or 20°C for 1 week. The percentage of colony forming units (cfu) or germination rate were calculated for the conidial suspensions.

Treatment	Agar plug (both isolates)	Wood piece (both isolates)	Conidial suspension plated on agar (cfu)	Conidial suspension germination rate
Fresh, 0.1 m	0	0	0	0
Fresh, 0.3 m	0	0	0	0
Fresh, 1 m	0	0	0	0
Mid-mature, 0.1 m	0	0	0	0
Mid-mature, 0.3 m	0	0	0	0
Mid-mature, 1 m	0	0	0	0
7°C	100	100	7	3
20°C	100	100	3	0

Table 3b. Percentages of inocula where *Eutypa lata* grew after being buried for 1 week at different depths in fresh and mid-mature compost windrows, or after being placed at 7°C or 20°C for 1 week.

Treatment	Agar plug (both isolates)	Wood piece (both isolates)
Fresh, 0.1 m	0	0
Fresh, 0.3 m	0	0
Fresh, 1 m	0	0
Mid-mature, 0.1 m	0	0
Mid-mature, 0.3 m	0	0
Mid-mature, 1 m	0	0
7°C	100	100
20°C	100	100

Table 3c. Percentages of inocula where *Phytophthora cactorum* grew after being buried for 1 week at different depths in fresh and mid-mature compost windrows, or after being placed at 7°C or 20°C for 1 week.

Treatment	Agar plug	Oat kernel	Leaf disc
Fresh, 0.1 m	0	0	0
Fresh, 0.3 m	0	0	0
Fresh, 1 m	0	0	0
Mid-mature, 0.1 m	0	0	0
Mid-mature, 0.3 m	0	0	0
Mid-mature, 1 m	0	0	0
7°C	100	90	95
20°C	100	85	90

Table 3d. Colony forming units on King's medium B (cfu/mL) of *Erwinia amylovora*, Xap and Psaf bacteria, after being buried for 1 week at different depths in fresh and mid-mature compost windrows, or after being placed at 7°C or 20°C for 1 week. Values are means ± standard errors.

Treatment	*E. amylovora*	Xap	Psaf	Leaf disc inoculated with Psaf
Fresh, 0.1 m	0	0	0	0
Fresh, 0.3 m	0	0	0	0
Fresh, 1 m	0	0	0	0
Mid-mature, 0.1 m	0	0	0	0
Mid-mature, 0.3 m	0	0	0	0
Mid-mature, 1 m	0	0	0	0
7°C	+++	+++	$4.7 \times 10^7 \pm 5.1 \times 10^6$	$2.9 \times 10^7 \pm 1.5 \times 10^6$
20°C	+++	+++	$8.7 \times 10^6 \pm 6.6 \times 10^5$	$4.5 \times 10^7 \pm 8.3 \times 10^6$

Xap = *Xanthomonas arboricola* pv. *pruni*, Psaf = *Pseudomonas syringae* pv. *actinidifoliorum*
+++ bacterial mat, individual colonies not counted.

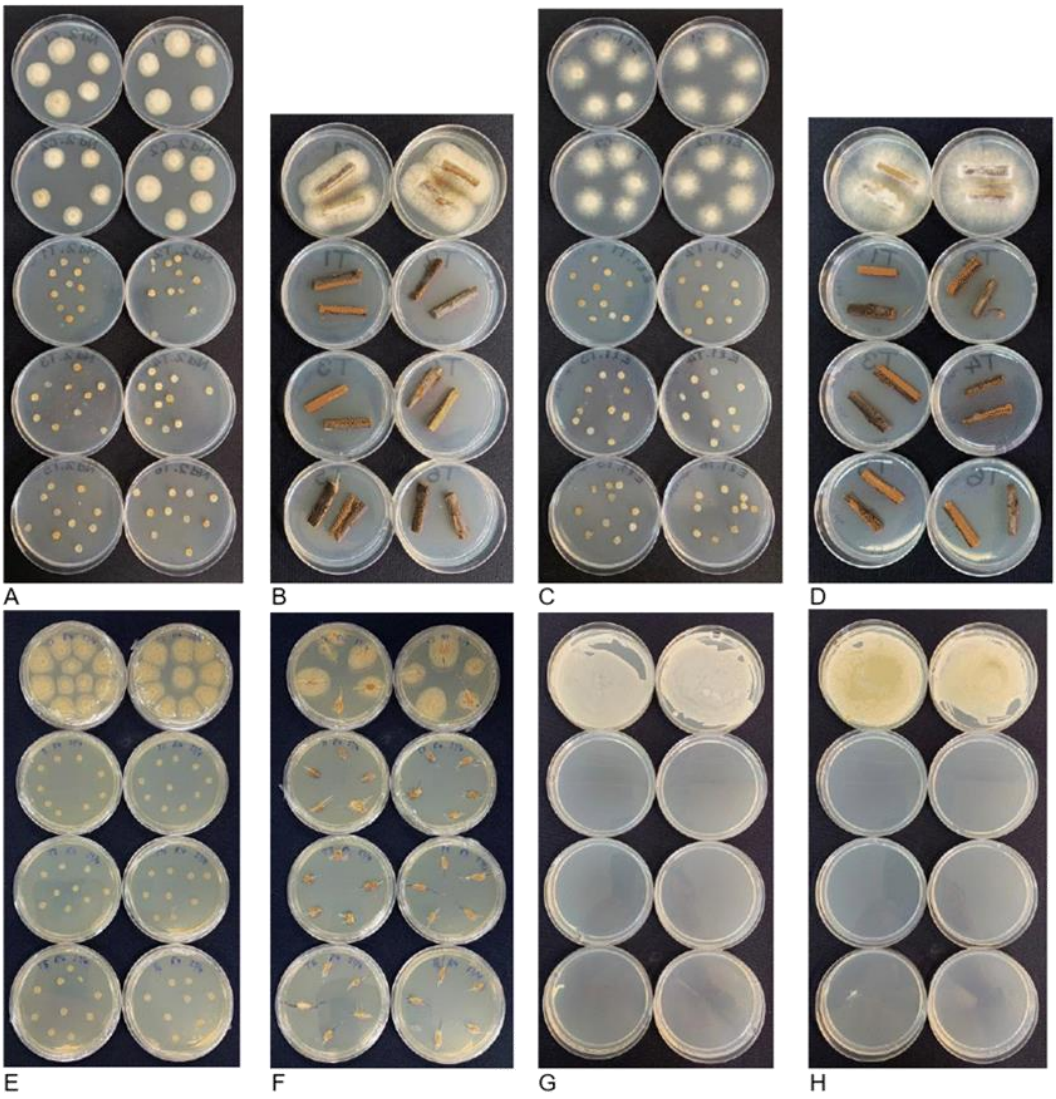

Figure 4. Survival of pathogens after being buried in compost for 1 week, compared with being placed at 7°C or 20°C. The inocula placed at 7°C and 20°C are at the top of each photograph and show pathogen growth. In each photograph, the six agar plates below the controls contain the inocula that were buried at three depths in fresh and mid-mature compost and do not show any pathogen growth. All photographs were taken 4 or 5 days after plating on agar. A) agar plugs of *Neonectria ditissima*, B) wood pieces inoculated with *N. ditissima*, C) agar plugs of *Eutypa lata*, D) wood pieces inoculated with *E. lata*, E) agar plugs *of Phytophthora cactorum*, F) oat kernels inoculated with *P. cactorum*, G) suspension of *Erwinia amylovora*, H) suspension of *Xanthomonas arboricola* pv. *Pruni* (Xap).

3.2 Temperature records

High temperatures were measured by every temperature logger buried in compost, regardless of the depth and the maturity, except for one data logger at 0.3-m depth in mid-mature compost, which malfunctioned and did not record any temperatures. The lowest maximum temperature that was measured was 61.5°C in mid-mature compost at 1-m depth, and the highest maximum temperature was 78°C in fresh compost at 0.1-m depth.

Different loggers at the same depth in the same compost type recorded different temperature profiles, with some loggers recording a long "warm-up" time, of up to 2 days, before the temperature settled, while other loggers recorded high temperatures (above 55°C) within an hour of being buried (Figure 5). All loggers recorded a period of 4 to 6.5 days in which the temperature remained stable (fluctuations of <10°C), called the "settled" temperature, although at 0.1-m depth in fresh compost, the settled temperature dropped nearly 20°C during a cold night, reaching 55°C, but then climbed again. The settled temperature measured by most loggers continued until they were retrieved after 7 days, but some loggers recorded lower temperatures in the last 1 or 2 days, a "cool-down" time. The duration of the settled temperature, the warm-up time and the cool-down time did not appear to be related to the type of compost, the depth or the position in the compost.

For each logger, three temperatures were determined: the maximum temperature measured; the "buried temperature", which was the average temperature while it was buried; and the "settled temperature", which was the average temperature while the temperature was settled.

Three separate linear models were used to test for the effects of differences in compost type and measurement depth on maximum, buried and settled temperatures (Table 4; R version 4.3). Significant differences were observed between fresh and mid-mature compost, but not between the different depths, with all three mean temperatures (maximum, buried and settled) being higher in fresh compost than in mid-mature compost. However, all mean temperatures were above 60°C.

The logger placed in the 7°C incubator showed that the temperature fluctuated between 6.5°C and 8°C, with an average temperature of 7.2°C. The logger placed in the 20°C incubator showed that the temperature fluctuated between 19.5°C and 20.5°C, with and average temperature of 19.9°C.

Table 4. Mean temperatures (°C) during a week at different depths in fresh and mid-mature compost windrows, specifically looking at the maximum temperature, the temperature while buried (buried temperature), and the temperature over the 5–6.5 days between the "heating up" at the start and the "cooling down" at the end of the week (settled temperature). Three separate linear models were used to test for the effects of differences in compost type and depth. Means with the same letter within each temperature criterium are not significantly different at the 0.05 probability level ($p \leq 0.05$).

Compost type	depth	Maximum temperature		Buried temperature		Settled temperature	
Fresh	0.1 m	75.5	a	68.0	a	70.7	a
Fresh	0.3 m	73.7	a	67.6	a	70.4	a
Fresh	1 m	73.5	a	67.6	a	70.3	a
Mid-mature	0.1 m	68.8	b	61.4	b	63.5	b
Mid-mature	0.3 m	71.0	ab	68.0	ab	69.0	ab
Mid-mature	1 m	63.2	c	60.8	b	61.5	b

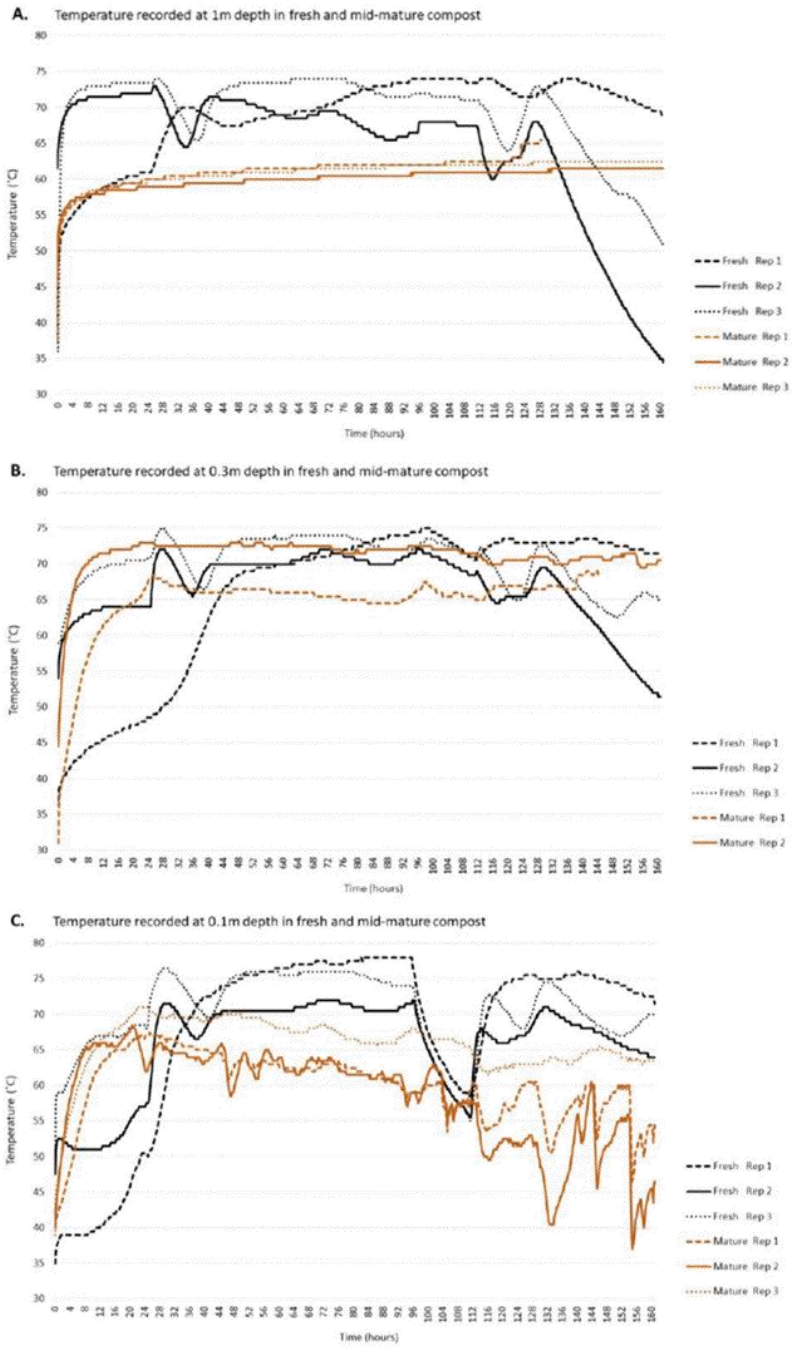

Figure 5. Temperatures recorded while buried in fresh or mid-mature compost at A) 1-m depth, B) 0.3-m depth and C) 0.1-m depth.

4 Risk of pathogen escape at BioRich

The temperature in the top 0.1-m layer of compost was not measured, and pathogen survival in this layer was not tested. Assuming a worst-case scenario in which pathogens could survive being in the top layer of a windrow, the chance of pathogen escape was calculated for a diseased shoot section of 5 cm by 1 cm in diameter. The probability that such a piece of plant material is in the top 0.1-m layer of a windrow of the most common size (4 x 20 m) is 0.0015%, and that probability decreases multiplicatively each time the windrow is turned (Table 5). The probability also decreases as the size of the piece of organic matter decreases.

Table 5. Probability (%) of a single piece of 1 cm x 5 cm wood being in the outer 1, 5 or 10 cm layer of compost windrows of different sizes, and the probability of it being in each successive windrow after turning.

Windrow size	Top layer depth	Initial windrow	One turn	Two turns	Three turns
4 x 15 m	1 cm	0.00016	2.56×10^{-08}	4.10×10^{-12}	6.55×10^{-16}
	5 cm	0.00081	6.56×10^{-07}	5.31×10^{-10}	4.30×10^{-13}
	10 cm	0.00162	2.62×10^{-06}	4.25×10^{-09}	6.89×10^{-12}
4 x 20 m	1 cm	0.00015	2.25×10^{-08}	3.38×10^{-12}	5.06×10^{-16}
	5 cm	0.00076	5.78×10^{-07}	4.39×10^{-10}	3.34×10^{-13}
	10 cm	0.00153	2.34×10^{-06}	3.58×10^{-09}	5.48×10^{-12}
4 x 30 m	1 cm	0.00014	1.96×10^{-08}	2.74×10^{-12}	3.84×10^{-16}
	5 cm	0.00071	5.04×10^{-07}	3.58×10^{-10}	2.54×10^{-13}
	10 cm	0.00143	2.04×10^{-06}	2.92×10^{-09}	4.18×10^{-12}
7 x 15 m	1 cm	0.00018	3.24×10^{-08}	5.83×10^{-12}	1.05×10^{-15}
	5 cm	0.00089	7.92×10^{-07}	7.05×10^{-10}	6.27×10^{-13}
	10 cm	0.00177	3.13×10^{-06}	5.55×10^{-09}	9.82×10^{-12}
7 x 20 m	1 cm	0.00017	2.89×10^{-08}	4.91×10^{-12}	8.35×10^{-16}
	5 cm	0.00084	7.06×10^{-07}	5.93×10^{-10}	4.98×10^{-13}
	10 cm	0.00167	2.79×10^{-06}	4.66×10^{-09}	7.78×10^{-12}
7 x 30 m	1 cm	0.00016	2.56×10^{-08}	4.10×10^{-12}	6.55×10^{-16}
	5 cm	0.00079	6.24×10^{-07}	4.93×10^{-10}	3.90×10^{-13}
	10 cm	0.00158	2.50×10^{-06}	3.94×10^{-09}	6.23×10^{-12}

5 Composting operations in Bay of Plenty and Tairāwhiti

JUDDS Ltd in-vessel composting, Gisborne, Tairāwhiti

JUDDS Ltd is currently building a new in-vessel composting system which will be operational from July 2023 onwards. The below information is based on the available knowledge of the new system on 16 May 2023 (Blair Judd, pers. comm.).

In-vessel composting confines the composting materials within a building, or vessel. This allows good control of the environmental conditions such as temperature, moisture and airflow. JUDDS will have four concrete 21 x 6 x 6 m vessels and will be able to process 30,000 tonnes of organic matter per year.

The temperature inside the vessels will be controlled automatically by a computer and the required temperature parameters can be set. The normal process will be to keep the temperature above 55°C for a minimum of 3 days and to ensure that temperatures do not exceed 76°C.

The materials that will be used are paunch grass, grape marc, wool, wood chips, sawdust, green waste, animal waste, food waste, cardboard, excess food crops and bio-solids. The temperatures that will be reached will also be determined by the blend of materials.

The fresh compost will spend 12 to 21 days in the vessels. During this time, the compost will not be turned. After the in-vessel stage, mid-mature compost will be placed in windrows, outside on solid ground. The windrows will be turned every 2 weeks, and compost will spend 4 to 6 weeks in windrows. During this time, the temperature will decrease as the compost cures, and will probably be approximately 45°C at the start, dropping to 15°C.

Plateau Compost Limited, windrow composting, Kawerau, Bay of Plenty

Plateau Compost Ltd uses a "windrow and turn" method to produce compost. They do not aerate the compost. They are able to process 9700 tonnes of green waste per year, in 50-m long windrows that are 10 m wide and 3.5 m to 4 m high, producing 12,400 tonnes of compost per year (John Fell, pers. comm.).

The temperature inside each windrow is measured every 2 weeks, at a height of 1.5 m to 2 m, using a 1-m long probe. In the first month, the temperatures of the fresh compost are around 50°C to 60°C, but a temperature of 63°C has been measured. During this time, the temperature of the compost slowly decreases but is maintained by turning.

The materials that are used are green waste, reject kiwifruit and chicken manure. The materials are mulched and then windrowed.

The fresh compost is turned every 2 to 3 weeks for 2 months. Mid-mature compost is turned twice a month for 2 months, after which it is screened and allowed to mature for at least another month in a windrow. From start to finish, compost spends a minimum of 5 months in windrows at Plateau Compost Ltd and is turned at least eight times. After the first month, the temperature decreases more rapidly and temperatures of 20°C to 45°C are measured.

Other potential composting facilities contacted

Rotorua Lakes Council does not run a composting facility and is unlikely to do this in the near future. The district's green waste is accepted by Waste Management NZ Ltd, who shred and transport it to their organics processing plant at the Tirohia landfill in Waikato (Craig Goodwin, pers. comm.).

Ecocast Limited in Kawerau uses a vermicomposting system which takes more than a year to complete. They rely on vermiculture and time to reduce the counts of pathogens to acceptable levels. The temperature of the organic material remains low enough for worms to survive (Tom McDowal, pers. comm.).

Norske Skog in Kawerau declined to participate (Steve Monk, pers. comm.).

6 Conclusions

- None of the pathogens survived being buried in compost for 1 week, regardless of the depth (0.1 m, 0.3 m or 1 m) or compost type.
- All pathogens survived the control treatments of 1 week at either 7°C or 20°C, although very few conidia of *N. ditissima* remained viable, and the viability of Psaf also reduced compared with the starting viability.
- Continuous high temperatures, above 60°C, were recorded for several days in fresh compost and mid-mature compost, at all depths (0.1 m, 0.3 m or 1 m) and all positions.
- Fresh compost was significantly hotter than mid-mature compost, with continuous temperatures above 65°C recorded for several days, at all depths (0.1 m, 0.3 m or 1 m) and all positions.
- The probability that a piece of diseased material is present in the outer 0.1-m layer of every fresh or mid-mature compost windrow (20 x 4 x 3.2 m) at BioRich is unlikely (5.5×10^{-12} %). This probability decreases multiplicatively with each further windrow turning. The probability that a piece of diseased material is present in every outer 1-cm or 5-cm layer in four subsequent windrows is even smaller (5.1×10^{-16} % and 3.3×10^{-13} %, respectively).

7 Discussion

Studies have shown that bacteria such as *E. amylovora*, *X. arboricola* pv. *corylina*, *Xanthomonas translucens* pv. *pistaciae* and *P. syringae* pv. *actinidiae* were killed after 10 minutes at 50°C, 45 minutes at 42°C, 15 minutes at 60°C and 5 minutes at 50°C, respectively (Horner & Wilton 2021; Pisetta et al. 2016; Thanh et al. 2012; Woodcock 2016). The fungus *N. ditissima* was killed after 15 minutes at 50°C (Amponsah et al. 2016; Fisher & Scheper 2019), and the oomycete *Phytophthora agathidicida* was killed after 4 hours at 45°C (Horner & Arnet 2021). Based on multiple studies, propagules of *Phytophthora* and other oomycetes, as well as most plant pathogenic fungi, will be killed after 30 minutes at 60°C (Swiecki & Bernhardt 2021). Therefore, it is not surprising that the pathogens that were tested in this pilot study did not survive being buried in compost at BioRich for a week, considering the prolonged period of time in which temperatures were above 60°C in both fresh and mid-mature compost.

Within compost systems, several mechanisms of pathogen eradication are possible, but the elevated temperature during the thermophilic phase is the most important contributor (Noble & Roberts 2004; Wichuk et al. 2011). Other mechanisms include microbial antagonism, microbial competition for nutrients, toxicity from by-products of organic matter decomposition, enzymatic breakdown and natural loss of viability of the pathogen with time. Since the temperature during composting can be monitored easily and, depending on the composting system, can be controlled, temperature-time conditions can be specified as a means of controlling pathogenic organisms (Wichuk et al. 2011).

Several studies have examined temperature-time conditions to eradicate pathogens and some have examined this in compost windrows or in-vessel composting systems (Noble & Roberts 2004; Wichuk et al. 2011). However, different studies use different exposure times and different methods to report temperature data, which means that it can be difficult to determine which temperature-time conditions are required for pathogen eradication. For example, many studies report only the maximum temperature that was reached during the exposure time, while other studies only report the average temperature. This is particularly important when composting is used to eradicate fungi or viruses that survive being at higher temperatures for extended periods. For example, the fungus *Fusarium oxysporum* f.sp. *lycopersici*, which causes tomato wilt, survived being in compost for 21 days, with a maximum temperature of 74°C (Noble & Roberts 2004), but the average temperature during the 21 days is unknown. Similarly, it is unknown whether there were continuous high temperatures above 60°C or 65°C, for several days, as was seen in mid-mature and fresh compost at BioRich.

Based on the information in this report, JUDDS Ltd in-vessel composting system is able to compost at similar temperatures to BioRich. If the system is set to maintain temperatures inside the vessels above 55°C for a minimum of 3 days, many horticultural pathogens, including those that are currently present in Hawke's Bay, are unlikely to survive. However, there are fungal and viral pathogens that can survive these conditions. Pathogen eradication will improve with prolonged exposure to high temperatures. Ideally, at least 21 days of composting, reaching temperatures of 64°C to 70°C, is recommended (Noble & Roberts 2004). These are conditions that the in-vessel system is able to reach.

Windrow composting at Plateau Compost Ltd does not reach the high temperatures of the aerated compost at BioRich. However, if the temperature remains above 50°C for a month, composting at Plateau Compost Ltd should kill the relevant horticultural pathogens that are currently present in Hawke's Bay. A research study to confirm this is recommended, particularly because the temperature profile may differ depending on the materials used. In addition, some fungal and viral pathogens can

survive composting at 50°C for a month, and potential cooler zones of the compost may increase pathogen survival.

When consulted in 2022, Horticulture New Zealand, Hawke's Bay Wine and New Zealand Avocado Growers' Association all expressed concern regarding composting at commercial composting operations to dispose of diseased plant materials that are currently being burned. Apart from the concerns about potential risk of disease distribution due to mulching and transport, their primary concern was that the composting procedures may risk pathogen spread throughout the region or the country if complete pathogen kill is not achieved during the process (Scheper & Williams 2022).

The efficacy of composting with regard to sanitising diseased material will vary between facilities depending on whether all material is exposed to kill-temperatures for the required amount of time. At BioRich, none of the pathogens in this study survived being buried in compost for 1 week, and the chance of escaping the kill-temperatures in the top layer of the windrow was calculated to be astronomically small, if only one piece of diseased material is present in a windrow. However, this was a pilot study using small amounts of pure cultures in sealed vials. To give growers confidence that all horticultural pathogens in the compost are dead, even when large volumes of diseased material are composted, further research is required to determine whether pathogens can survive the composting procedure in larger pieces of naturally infected plant material. In addition, the pathogen survival rate and temperature profile in the outer 0.1-m layer of the windrows will need to be determined,

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