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

Meeting of the Environment and Integrated Catchments Committee

Date: Wednesday 20 March 2024

Time: 10.00am

Venue: Central Hawke's Bay Municipal Theatre
18 Kenilworth Street
Waipawa

Attachments Excluded From Agenda

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

Hawke's Bay Regional Council
S161 Building Act 2004

Proposed policy on dangerous dams, earthquake-prone dams and flood-prone dams 2024

HAWKES BAY REGIONAL COUNCIL
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1. Introduction

This document sets out the policy on dangerous dams, earthquake-prone dams and flood-prone dams adopted by the Hawke's Bay Regional Council ("**the Council**") in accordance with sections 161 and 162 of the Building Act 2004.

The policy states the approach and priorities the Council will take in performing its functions in relation to dangerous dams, earthquake-prone dams and flood-prone dams in the Hawke's Bay region, and how the policy will apply to heritage dams[1].

The Council will comply with any relevant requirements under Treaty settlement legislation when undertaking its functions in relation to dangerous, earthquake-prone dams and flood-prone dams.

This policy applies to dams defined in section 7 of the Building Act 2004 ("**the Act**").

The dam safety provisions in subpart 7 of Part 2 of the Act, including this policy, apply to:

1. Classifiable dams (defined in regulation 5 of the Building (Dam Safety) Regulations 2022 ("**the Regulations**"[2])
2. Referable dams as defined in the Regulations[3]

Only section 133B[4] (height measurement of dams) and sections 157-159 (measures by a regional authority to avoid immediate danger) apply to all other dams.

2. Application of this policy

This policy applies to dams everywhere in the Hawke's Bay region, and irrespective of the age and intended life of the dam. The terms "dangerous dam", "earthquake-prone dam" and "flood-prone dam" have the same meaning as provided in sections 153 and 153A of the Act.

This policy must be read alongside the Regulations which define terms used in the Act in relation to "dangerous dams", "earthquake-prone dams" and "flood-prone dams"[5].

The Regulations and the Act can be accessed at legislation.govt.nz[6].

[1] Refer to the section "Application to heritage dams" for a definition of heritage dams.

[2] The Regulations were made on 9 May 2022 but do not come into force until 13 May 2024. Terms defined in the Regulations are relevant to the meaning and application of this policy.

[3] The current Regulations do not define a referable dam.

[4] When measuring the height of the dam under this section, the crest of the dam includes any freeboard – refer to section 133B of the Building Act 2004 for the definition.

[5] Section 19 of the Regulations defines moderate earthquake, moderate flood, earthquake threshold event and flood threshold event.

[6] Building (Dam Safety) Regulations 2022 and Building Act 2004.

This policy does not cover consents required under the Resource Management Act 1991 or the Building Act 2004. Under section 153AA, if a dangerous dam is located in an area that has been affected by an emergency (subpart 6B of the Act), this policy and other provisions of the Act continue to apply but only in relation to:

a. action or notices issued under section 154;
b. work carried out under section 156; or
c. if a warrant is issued under section 157.

3. Commencement and review

This policy commences 13 May 2024

The Council is required to follow special consultative procedure set out in section 83 of the Local Government Act 2002 when developing and adopting this policy and will have regard to any relevant principles in the Act. This policy will be reviewed every five years or earlier as required. The policy remains in effect even if it is due for review or being reviewed.

4. Principles

The Council will apply the following principles to the exercise of its dangerous dams, earthquake-prone dams and flood-prone dams functions under the Act.

1. Dam owners have the primary responsibility for identifying, monitoring, reviewing and reporting on dangerous, earthquake-prone and flood-prone dams, and for reducing or removing the risk of harm to people, property and the environment in a timely and effective manner.

2. A recognised engineer[7] engaged (by the dam owner) to provide a certificate for the purposes of sections 135(1)(b), 142(1)(b), or 150(2)(f) must notify the Council and the owner of the dam, in writing and within five working days, if they believe that the dam is dangerous.

3. The state of all dangerous, earthquake-prone and flood-prone dams (as defined in the Act and the Regulations) must be known (noting that other dam safety provisions in the Act apply to all dams) and this information, if known to the Council, will be made readily available by the Council, to all persons potentially affected by the safety risks of a dangerous, earthquake-prone or flood-prone dam.

[7] A recognised engineer is defined in section 149 of the Act.

4. The Council will endeavour to communicate to dam owners about the responsibilities of dam owners under the policy.

5. Council's approach to performing its functions

Information on dam status

The Council will keep a register of dams as required by section 151 of the Act, recording the dangerous, earthquake- prone and flood-prone status of each classifiable dam. The Council will develop a monitoring procedure to maintain the register.

Should the Council receive information about a dangerous, earthquake-prone or flood-prone dam in the region, the Council will notify the chief executive of the Ministry of Business, Innovation and Employment, the relevant territorial authority, the Hawke's Bay Civil Defence and Emergency Management Group, and relevant mana whenua. The Council will notify Heritage New Zealand Pouhere Taonga if it becomes aware of a dangerous dam that is also a heritage dam.

Working with dam owners

The Regulations require owners of all classifiable dams to know whether their dam is dangerous, earthquake-prone or flood-prone and to take the necessary steps, in a timely manner, to comply with the Act and the Regulations. The Act requires dam owners to immediately notify the Council if they have reasonable grounds for believing their dam is dangerous. This applies to dams that are either a high potential impact dam or a medium potential impact dam and are likely to fail in the ordinary course of events, or a "moderate earthquake" or "moderate flood" (as defined in the Regulations).

The Act also requires a recognised engineer who provides a certificate for the purposes of sections 135(1)(b), 142(1)(b), or 150(2)(f), to notify the Council and the owner of the dam if they believe that the dam is dangerous. The notice must be provided in writing and be given within five working days after the engineer forms their belief.

The Council will work with the owners of identified dangerous dams and may work with owners of identified earthquake-prone and flood-prone dams, to develop an action plan (with timeframes) with the goals of increasing the safety of the dam and eliminating or reducing the risks of the dam to people, property, infrastructure and the environment. It is not realistic to specify a timeframe in this policy for achieving this goal because timeframes will be dictated by the circumstances of each case. When setting a timeframe for action, the Council will consider the state of the dam, and the likelihood and consequences of dam failure.

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Directing and taking action

The Council may exercise the powers outlined below:

- For dangerous dams
  - if the owner of any dam is not acting in accordance with an agreed action plan; or
  - where there is no agreed action plan; or
  - where it considers that the agreed action plan requires review or amendment; or
  - where ownership is not known or is disputed; or
- For all dams, where there is or is likely to be a risk of immediate danger.

Before exercising any of its powers under sections 154 to 159 of the Act, the Council will, unless the circumstances dictate otherwise (such as where there is immediate danger to the safety of persons, property, or the environment), seek to discuss options for action with the owner of the dam, with a view to obtaining from the owner a mutually acceptable proposal for reducing or removing the danger. Acceptable actions by the owner may include, but are not limited to, one or more of the following:

- operational changes such as reducing the volume of impounded fluid or completely emptying the reservoir;
- reconfiguring an existing spillway or creating a new or supplementary spillway so as to limit the maximum impounded volume and/or to safely route flood flows;
- increasing surveillance and monitoring;
- development of emergency preparedness and response plans;
- review of the dam safety assurance programme;
- requiring the owner to engage a dam specialist to investigate and make recommendations with any report provided to the Council;
- implementing measures to enable controlled, rapid emptying of the impounded fluid;
- measures downstream of the dam to mitigate the impact of dam failure;
- physical works including reconstruction or partial demolition of the dam;
- decommissioning and/or removal of the dam.

The whole or part of any proposal by the dam owner may be incorporated as a requirement in a Notice to Fix issued by the Council under section 164 of the Act. If no action is taken by the owner to address the danger, the Council may exercise any of its statutory powers in sections 154-159 and 164 of the Act.

The Council will notify potentially affected communities downstream of dangerous, earthquake-prone or flood-prone dams. The Council will do this by publishing information about any dangerous, earthquake-prone or flood-prone dams in the region. The Council will also work with the Hawke's Bay Civil Defence Emergency Management Group and where relevant, lifeline utilities[8].

The Council may at any time require the dam owner to review a dam safety assurance programme if the dam is an earthquake-prone or flood-prone dam.

[8] Lifeline utilities is defined in section 4 of the Civil Defence Emergency Management Act 2002.

In a situation where a dam is dangerous, the Council may (amongst other actions):

- erect a hoarding or fence to prevent people from approaching the dam nearer than is safe.
- attach a notice on or near the dam (or affected downstream areas) that warns people not to approach.
- give written notice to the owner requiring work to be carried out on the dam, and within the time stated in the notice to remove or reduce the danger.

In a situation where the Chief Executive of the Council considers that, because of the state of the dam, immediate danger to the safety of persons, property, or the environment is likely, then the Chief Executive of the Council may:

- cause any action to be taken that is necessary to remove that danger.
- recover the costs of taking any action from the dam owner.

6. Council's priorities in performing these functions

The Council's approach to dangerous, earthquake-prone or flood-prone dams is tailored towards achieving a reduction in the pre-existing risk whilst still being able to deal with risks that emerge in the future.

The priorities will be as follows:

1. to minimise the risk to public safety at all times.
2. to minimise the risk to damage or loss of property.
3. to minimise the risk to the environment.
4. to have regard to cultural and heritage values.

7. Application to heritage dams

For the purposes of this policy, a heritage dam means a dam that is included on:

1. the New Zealand Heritage List/Rārangi Kōrero maintained under section 65 of the Heritage New Zealand Pouhere Taonga Act 2014; or
2. the National Historic Landmarks/Ngā Manawhenua o Aotearoa me ōna Kōrero Tūturu list maintained under section 81 of the Heritage New Zealand Pouhere Taonga Act 2014.

Section 4(2)(l) of the Building Act recognises the "need to facilitate the preservation of buildings of significant cultural, historical, or heritage value".

The Council recognises the need to retain heritage values of the dam itself, but also the need to reduce or remove any risk posed by a heritage dam which has been classified as dangerous, flood prone or earthquake prone. When considering heritage dams under this policy, account will be taken of the need to facilitate the preservation of significant heritage values.

When dealing with heritage dangerous dams, the Council will seek advice from Heritage New Zealand Pouhere Taonga and the relevant territorial authority (if appropriate) before any actions are undertaken by the regional authority under sections 153 – 160 of the Act.

The Council may also engage suitably qualified professionals with engineering expertise and heritage expertise to advise and recommend actions. When considering any recommendations, the Council will have regard to the priorities set out in the previous section of this policy. Copies of all served notices for heritage dangerous dams, earthquake-prone dams and flood-prone dams will be provided to Heritage New Zealand Pouhere Taonga.

The Council will record the heritage listing of all dangerous, earthquake-prone and flood-prone dams it is made aware of in its register of dams and supply this information to the relevant territorial authority for inclusion on any relevant land information memorandum.

HAWKES BAY REGIONAL COUNCIL
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Hawke's Bay Regional Council

Statement of proposal

Proposed policy on dangerous dams, earthquake-prone dams and flood-prone dams 2024

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

1. What are we doing

The Building Act 2004 introduced a regime for managing the safety of existing and new dams in New Zealand. Under this Act, Regional Councils must prepare a policy on how they will deal with dangerous dams, earthquake-prone dams and flood-prone dams in their region, and how the policy will apply to heritage dams. We are updating our policy so that it aligns with the new dam safety requirements created by central government.

Those new requirements include the Building (Dam Safety) Regulations 2022 (**Regulations**) which come into effect in May 2024. From that date, owners of dams that meet the height and volume requirements will need to confirm the potential risk their dam poses, put in place safety plans and undertake regular dam inspections.

This document provides a summary of the proposed Policy on dangerous dams, earthquake-prone dams and flood-prone dams 2024 for your consideration. Your feedback is an important part of the policy drafting process. Once all comments and submissions have been considered, Council will make a decision on whether to adopt the amended policy.

2. Who should read this policy

You should read this policy if you have a dam that is a classifiable dam. A classifiable dam is defined in regulation 5 of the Regulations. Measures by a regional authority to avoid immediate danger also apply to all other dams.

3. What is the policy about?

Section 161 and 162 of the Building Act 2004 (**the Act**) requires all regional councils to adopt a policy on dangerous dams, earthquake-prone dams and flood-prone dams.

This policy sets out what Hawke's Bay Regional Council (**the Council**) will do in relation to a dangerous, earthquake-prone or flood-prone dam in the Hawke's Bay region. It is a short policy that covers our regulatory and legislative responsibilities in relation to these dams under the Building Act 2004.

The policy has four key sections:

1. **What principles will apply:**

   Dam owners have the primary responsibility for identifying, monitoring, and reporting on dangerous, earthquake-prone and flood-prone dams and for reducing or removing the risk of harm to people, property and the environment in a timely and effective manner.

   A recognised engineer engaged by the owner to provide a certificate must notify the Council and the owner of the dam if he or she believe that the dam is dangerous.

The state of all dangerous, earthquake-prone and flood-prone dams must be known, if this information is known by Council, this will be made readily available to all persons potentially affected by the safety risks.

2. **How we will perform our legislative functions in relation to dangerous, earthquake-prone or flood-prone dams:**

   The Council will keep and monitor a register of all dams as required by Section 151 of the Act, recording the dangerous, earthquake-prone and flood-prone status of each classifiable dam. Should the Council receive information about a dangerous, earthquake-prone or flood-prone dam within its regional boundary, the Council will notify relevant authorities and mana whenua.

   It is expected that owners of classifiable dams will know the status of their dams as required under the Regulations and will take the necessary steps to act on it responsibly. The Council will work with the owners of identified dangerous dams, earthquake-prone dams and flood-prone dams to develop an action plan with the goals of increasing the safety of the dam.

   Under certain circumstances, the Council may intervene and take action where there is or likely to be a risk of immediate danger. If appropriate, the Council will also notify potentially affected communities downstream of a dangerous, earthquake-prone or flood-prone dam.

   If the Council considers there is immediate danger, the Council may put up fencing or hoarding around the dangerous dam to stop people approaching the dam, attach a notice that warns people not to approach, and give written notice to the owner of the dam requiring work to be carried out on the dam within the time stated in the notice to remove or reduce danger.

3. **Our priorities when performing these functions:**

   The policy sets out that we will prioritise public safety at all times. When undertaking our functions, we will also seek to minimise the risk to damage or loss of property, the risk to the environment, and have regard to cultural and heritage values.

4. **How the policy will apply to heritage dams:**

   In this policy, a heritage dam includes all dams included on the New Zealand Heritage List/Rārangi Kōrero maintained under section 65 of the Heritage New Zealand Pouhere Taonga Act 2014, or the National Historic Landmarks/Ngā Manawhenua o Aotearoa me ōna Kōrero Tūturu list maintained under section 81 of the Heritage New Zealand Pouhere Taonga Act 2014.

   If a dangerous dam is also a heritage dam, we will account for the need to facilitate the preservation of significant heritage values. The Council will record the heritage listing of all dangerous, earthquake-prone and flood-prone dams it is made aware of in its register of dams. When dealing with heritage dams on this register, the Council will seek advice from Heritage New Zealand Pouhere Taonga and the relevant territorial authority before any actions are undertaken.

5. What are dangerous, earthquake-prone and flood-prone dams?

These terms are defined in the Building Act 2004.

A dam is **dangerous** for the purposes of the Act if it is a high potential or medium potential impact dam and is likely to fail –

- in the ordinary course of events; or
- in a moderate earthquake (as defined in the Regulations); or
- in a moderate flood (as defined in the Regulations).

A dam is an **earthquake-prone dam** for the purposes of the Act if the dam –

- is a high potential impact dam or a medium potential impact dam; and
- is likely to fail in an earthquake threshold event (as defined in the Regulations).

A dam is a **flood-prone dam** for the purposes of the Act if the dam –

- is a high potential impact dam or a medium potential impact dam; and
- is likely to fail in a threshold event (as defined in the Regulations).

6. What doesn't the policy cover?

The policy does not classify dams. The Regulations require dam owners to assess their dam as either low, medium or high potential impact. Their assessment considers the impact to the community, property, cultural sites, critical and major infrastructure, and the natural environment. If it is a medium or high potential impact dam, the Building Act then requires the owner to prepare a dam safety assurance programme.

The Council does not undertake this assessment nor is it responsible for preparing the dam safety assurance programme—this is the role of the dam owner and their recognised engineer. However, the dam owner must immediately notify the Council if they believe their dam is dangerous. We will then respond in accordance with the policy.

The policy also does not cover consenting matters under the Resource Management Act 1991 or Building Act 2004. **Submissions should relate to the contents of the policy. The Council is not able to change anything in the Act or Regulations.**

7. Where to find information

The statement of proposal and proposed policy are available on our website, visit https://www.hbrc.govt.nz/ and search #Dam Safety

If you have any questions about this proposal or about how to make a submission, please contact us via email damsafety@hbrc.govt.nz

8. How to make a submission

Consultation is open until 28 April 2024.

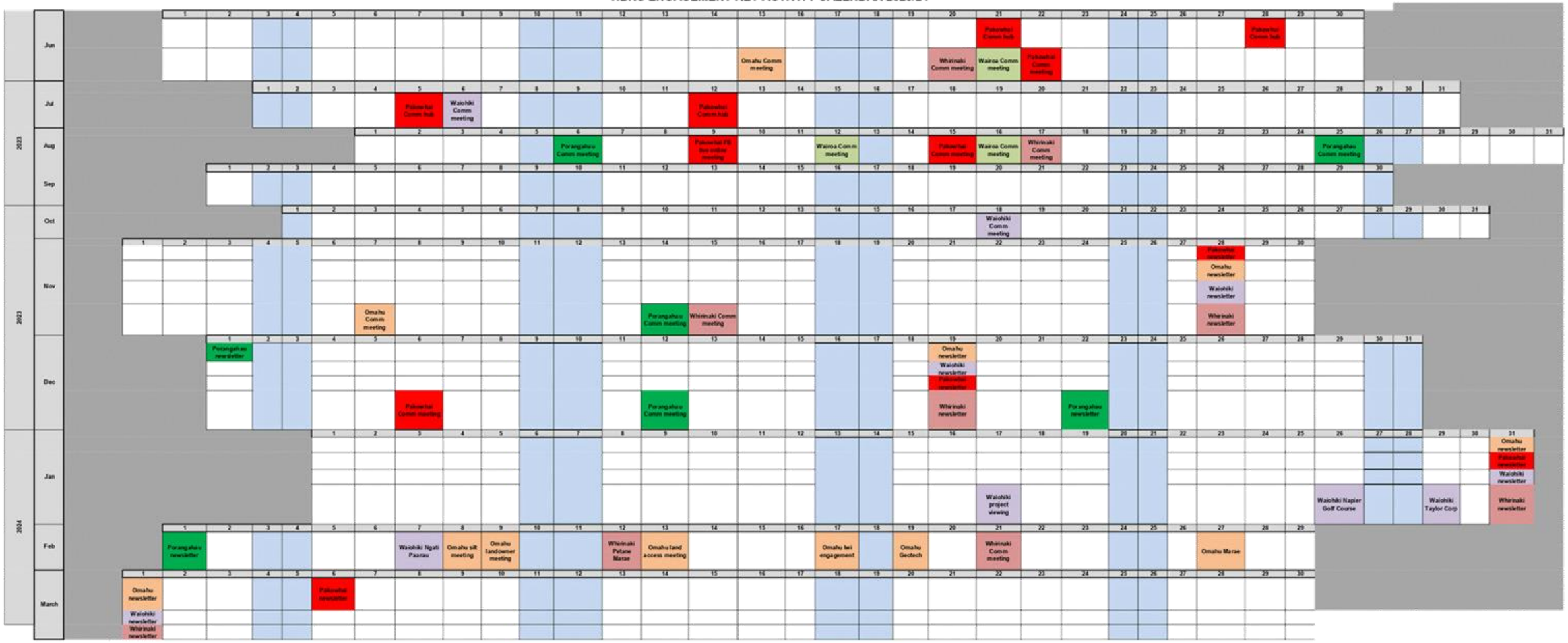
Anyone can make a submission on the proposed policy. You can make a submission via our website, visit https://www.hbrc.govt.nz/ and search #Dam Safety

As part of your submission, please tell us if you would like to attend a public hearing to speak to the Council in support of your submission, including if you wish to use New Zealand Sign Language. If you don't wish to speak, your submission will be provided to a hearings panel for consideration. Please provide your contact details so that we can notify you of the hearing date and arrange a time for you to speak (if you choose to). This will also enable the Council to inform you of the decisions on the policy following the hearing. Please be aware that all submissions will be publicly available on the Council's website.

9. What happens next?

After the hearing, the Council will consider all of the submissions received and make decisions on any amendments to the policy as a result. All submitters will be notified of the Council's decision.

HBRC ENGAGEMENT KEY ACTIVITY CALENDAR 2023/24



Review of the HBRC Chilean Needle Grass Control Programme – Post Cyclone Gabrielle

Collins Consulting

JANUARY 2024

Contents

Executive Summary

An "efficiency and effectiveness" review of Hawke's Bay Regional Council's (HBRC) biosecurity programmes, including a short section on Chilean needle grass (CNG), was conducted in August 2020. This was followed up by a more detailed report on Chilean needle grass programme in October 2021.

This report updates the 2021 report, with a specific focus on Chilean needle grass in the wake of Cyclone Gabrielle. Much of the history, context and biology of CNG that was covered in the 2021 report remains valid and this report should be read in that context.

Topics updated and expanded in this report include:

- Cyclone Gabrielle's impacts
- Gravel extraction risks
- "Sleeper pests" and climate change
- Feedback from other regions
- Avoidance of future costs to New Zealand.

The 2021 report concluded:

> *"HBRC's programme meets current best practice for CNG control, nevertheless in its current form it is unlikely to achieve its literal objective of "stopping the spread." That is due primarily to no baseline from which to measure success (or failure), leaky pathways and the strong likelihood that the region has more CNG-infected properties than the council is aware of."*

This conclusion remains true, although the CNG programme was given additional resources that have reduced the stress and burnout that staff were facing in 2021.

Despite HBRC's best efforts, "new" CNG sites continue to be found every year. Those sites could be simply previously unknown sites, i.e., not new spread, but without a credible baseline it is impossible to know for sure. Developing a credible baseline from which to assess if the CNG programme is achieving its objectives would require engaging a modeler to explore a stratified approach that could estimate how much sampling effort is required to achieve a certain confidence level. That work is beyond the scope of this report but is recommended to help HBRC to determine what level of uncertainty it is comfortable with versus the cost of pursuing a more accurate baseline.

Cyclone Gabrielle in mid-February 2023 was unquestionably devastating for the Hawke's Bay region. There was widespread flooding, which damaged roads, tracks and infrastructure generally. The flooding also deposited silt and debris throughout the region. In addition, slips and other significant land movement occurred on many properties.

However, the evidence reviewed for this report, primarily aerial photos showing known CNG sites in flooded areas and opinions for pest management staff, did not suggest that the cyclone significantly altered the situation with Chilean needle grass in the region. Nevertheless, the flooding and landslips have increased uncertainty around CNG and enhanced surveillance for new infestations post-cyclone is certainly warranted .

This report also concluded that the council does not know enough about how the process of extracting gravel from riverbeds would affect the presence and viability of CNG seeds in the gravel. A research plan was developed by HBRC and AgResearch but was not funded.

There is some concern in the community that restrictions on gravel extraction exacerbated the cyclone-related flooding. HBRC Asset Management staff did not respond to a request for comment about the validity of this concern.

Finally, HBRC's neighbouring regional councils would strongly object to any relaxation of the council's CNG control programme. These regions do not have CNG as far as they know, and modelling shows how significantly their risks would increase if HBRC stopped managing it.[1] Councils

[1] "Decision Support for Regional Management Interventions," Methods in Ecology and Evolution, DOI: 10.1111/2041-210X.13655

interviewed for this report said they were eager to work more closely with HBRC to minimise the risk to them from CNG. Cost allocation is always a consideration with inter-regional agreements, but a conversation around councils working more closely together on CNG is undoubtedly worth initiating.

Chilean needle grass also has been low priority for the Ministry for Primary Industries (MPI) and has little or no effective national coordination. The MPI Sustainable Food and Fibre Futures Fund did contribute to the cost of trialling a new biocontrol for CNG, which it to be released next year. MPI also funded research into sleeper weeds that is cited in this report. Nevertheless, Section 12A of the Biosecurity Act says it is MPI's role to provide leadership "facilitate communication, co-operation, and co-ordination among those involved in pest management to enhance effectiveness, efficiency, and equity of programmes." In terms of CNG (and similar pests) their leadership has been lacking.

As noted in the 2021 report, successful CNG management also is hindered by the Biosecurity Act's emphasis on species-specific and region-specific approaches. CNG is just one of many pests that would be better managed by a collective, inter-regional approach.

This is not news to anyone who has been involved in regional council-led pest management. However, the shortcomings of taking purely regional view when making pest management decisions were emphasised by the recent modelling highlighted in this report. In short, if Hawke's Bay stopped controlling Chilean needle grass, the rate of spread to other regions and the costs to the nation would be much higher. The modelling shows that HBRC's efforts are holding back a tide of Chilean needle grass that would otherwise eventually sweep across much of its neighbours.

The recommendations in this report primarily fall into two categories, reducing uncertainties and increasing national and inter-regional coordination. See the Recommendations section for details.

Why Chilean Needle Grass is a Pest

The HBRC Regional Pest Management Plan has a succinct and accurate description of why Chilean needle grass is considered a pest species:

> *Agricultural productivity can be severely reduced by the replacement of palatable vegetation, injury to stock, reduction of produce quality and increased management costs. Seeds can cause pelt damage, and painful wounds both externally and internally when they move through skin into muscles. Carcasses are downgraded, blindness can occur and seeds can get into ears. Farm dogs can be similarly affected. Some sheep graziers in eastern Australia have been forced to switch to beef production.*
>
> *Chilean needle grass is likely to invade native grasslands, where it can replace native plants, and alter invertebrate community composition.*

This assessment aligns with all the published literature reviewed for this report. For example, in Australia, CNG is a Weed of National Significance and regarded as one of the worst because of its invasiveness, potential for spread, and economic and environmental impacts.

The 2021 report has more details on the biology of CNG and why it is very difficult to eradicate.

Chilean Needle Grass as a Sleeper Pest

Chilean needle grass has several attributes that make it difficult to control successfully over the long term, and almost impossible to eradicate from large areas using typical control methods. CNG also is considered a "sleeper pest." These are pests, plant or animal, that are established in New Zealand but currently restricted in their range.

In many cases, this range restriction is linked to climate suitability, which ongoing climate change will almost certainly unbalance. This is the case for CNG, with models showing it has the potential to increase the potential range by 60%.[2] Even under current climates, the evidence suggests that CNG has reached less than 2% of its potential range. Senior AgResearch scientists have taken a detailed look the impact of doing nothing (in terms of lost productivity in infested farms) in a paper that was published in December 2023.[3]

Their analysis shows that costs from CNG would increase in the absence of management and that a region-level decision to abandon or scale back management could lead to increased harm nationally over the next decades. They calculated national present value losses of between $192 million and $1.2 billion depending on whether CNG took 201 years or 100 years to infest 90% of its potential range. In a breakeven analysis, these losses justify annual expenditures of $ 5.3 million and $34 million respectively. Based on that analysis, a nationally coordinated approach to managing CNG would have a very positive cost/benefit ratio. Similar conclusions were drawn from other examinations modelling CNG's inter-regional spread.[4]

The cost benefit analysis done for the HBRC Regional Pest Management Plan also estimated the costs related to CNG. For just the sheep and beef industry, the CBA estimated a reduction in annual economic value of between $74 and $451 per hectare. There were even higher estimated costs for the horticulture industry.

In line with all the published literature, the CBA concluded that the primary beneficiary of CNG control is the agricultural sector. It is worth noting, however, that CNG can have impacts beyond farmers. One person interviewed for this report spent thousands of dollars on veterinarian bills for dogs injured by CNG seeds.

Current HBRC Chilean Needle Grass Control Programme

To recap the 2021 report, Chilean needle grass is currently a "sustained control" pest in the regional pest management plan.[5] The management objective is to ensure that current infestations levels do not increase and spread to other properties is prevented. Minimising adverse effects on production values is cited as the main reason for the control programme.

There are two RPMP rules associated with CNG. The first makes land occupier responsible for destroying all Chilean needle grass on their property.[6] The second rule says no person shall make hay/silage during the months from November to March from a paddock that has, or has had, Chilean needle grass present. No person shall move any goods contaminated with Chilean needle grass seed beyond their property boundary. The highest risk for transport of seed is in hay/silage making machinery during the panicle seeding period which is November through to March.

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[2] "Chilean needle grass -- Scoping document and methodology," 30 November 2021, Report Number 11578
[3] "The cost of doing nothing about a sleeper weed – *Nassella neesiana* in New Zealand." Graeme W. Bourdôt and Christopher E. Buddenhagen. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0295574
[4] Mason, Norman W.H., Price, Robbie, Kaine, Geoff, Buddenhagen, Chris, Kean, John. 2023. Sleeper pests final report: New approaches to understanding social factors and simulating management responses to emerging pest threats under changing climates. [Hamilton]: Manaaki Whenua - Landcare Research.)
[5] CNG had been in the "Total Control" category under the previous RPMP. The current programme is largely the same but the title has been aligned with the National Policy Direction, being Sustained Control. ECAN and MDC took the same steps.
[6] Except where an occupier of land has entered into a Written Management Agreement approved by HBRC

The indicator of success in the RPMP is the extent of Chilean needle grass in the region, informed by monitoring known sites and "surveillance of areas vulnerable to invasion."

HBRC also has established rules around gravel extraction from riverbeds to minimise the risk of spreading Chilean needle grass.

Since the 2021 report, the herbicide Taskforce has become unavailable. This has made CNG management more complicated because Taskforce left a residue in the soil that killed germinating seeds. Herbicides available now kill only on application.

Also since the 2021 report, HBRC has added two new members to the Chilean needle grass team to reduce staff stress and to improve overall effectiveness. The pest plant team says that these additional staff have made a positive difference.

HBRC staff say they have considered boundary control as an option for CNG. This might require less resources, but it would be difficult (and possibly expensive) to get accurate data, and based on previous RPMP submissions the council might face a backlash from some farmers. In addition, there would be an enhanced need to focus on the pathways around high-risk areas. Conversely, there would likely be some farmers/ratepayers who would be happy to see the council costs reduced and rely on landowners. The effectiveness of this approach from a pest management perspective would need to be examined.

Monitoring Results

Pest management programmes obviously depend on appropriate monitoring to help determine how well they are working. Most regional councils have a very limited ability to accurately measure the spread (or reduction) of pest plants, especially ones that are reasonably widespread. Hawke's Bay and CNG is no exception.

In Hawke's Bay, "new" infestations of CNG are found every year. The table below shows the trend in properties with CNG in the Hawke's Bay. However, these may be genuinely new, or they may just be newly discovered.

The increase from 2020 (259 properties) to 2023 (284 properties) is about 10 percent or three percent per year. The increase from 2010 to 2023 is about 149 percent, an average of 11.5 percent per year.

However, because the "true" amount of CNG in the Hawke's Bay region is not known with any real confidence, the implication of these numbers is uncertain. Given the risks associated with cyclone-related flooding and the worries over the gravel extraction rules, doing more to quantify a baseline should remain a priority.

Data management is obviously an important part of pest management. In 2021, biosecurity staff said they lacked appropriate tools and devices for capturing CNG data. Staff said in 2023 that a new app had helped to collect more precise GPS data.

The costs and benefits of CNG control in the Hawke's Bay Region

As required by the Biosecurity Act, HBRC commissioned a cost/benefit analysis for Chilean Needle Grass as part of its Regional Pest Management Strategy[7]. This analysis concluded that the benefits of a sustained control programme would outweigh the costs.[8] As with all CBAs, the report made a number of assumptions. Based on those assumptions, the CBA proposed an annual average benefit of $175,000 of controlling CNG over the 10-year duration of the RPMP.

Other, more recent benefit analysis from AgResearch[9] found that even with a slow rate of CNG spread, the Hawke's Bay region could justify investing nearly three times that amount to prevent the spread and associated impacts.[10] Assuming CNG spread to 90% of its potential range over 201 years, the authors calculated that the Hawke's Bay region could justify investing up to $478,293 per year in spread prevention efforts.

In FY 22/23, HBRC staff reported spending $153,391 on CNG, including staff time and external costs, mostly the incentive scheme for landowners. This was down from $185,459 CNG in FY 21/22.

Concerns from Neighbouring Regional Councils

Bay of Plenty, Waikato and Horizons have no known infestations of Chilean needle grass and regulate it as an "exclusion" pest. All three councils were adamant in their support for HBRC's CNG management programme and extremely concerned that relaxing that management would increase the risk to them. Recent modelling indicates that CNG incursion rates would increase in the Manawatu-Whanganui region[11] without management in Hawke's Bay and increase over time as climate suitability increases. It would be useful to convene an inter-regional workshop to hear from these researchers about their methodology and to discuss what, if anything, the councils should do collaboratively in response.

Staff from other councils stressed the inter-regional risks and the potential costs if they had to initiate a CNG programme from scratch. WRC noted it has 500,000 hectares that are at risk and no

[7] 2018-2038
[8] A net benefit of approximately $1.7 million over 10 years and $450 million over 50 years.
[9] "The cost of doing nothing about a sleeper weed –Nassella neesiana in New Zealand," Bourdôt and Buddenhagen. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0295574
[10] The analysis estimated the present value benefit of stopping the spread for two assumed spread rates. These benefits equate to breakeven costs of stopping the spread of CNG.
[11] Mason, Norman W.H., Price, Robbie, Kaine, Geoff, Buddenhagen, Chris, Kean, John. 2023. "Sleeper pests final report: New approaches to understanding social factors and simulating management responses to emerging pest threats under changing climates." Manaaki Whenua - Landcare Research.

ongoing grass control programmes. "It would be devastating," according to WRC staff. "The HBRC situation is tiny compared to the problem it would be in the North Island."

The councils said that all regions find themselves bearing costs to "hold the line" so that weeds do not spread to other regions. "We are all managing things for others around us and across New Zealand. If one of us falls – or stops -- then other regions fall; it's a domino effect."

HBRC's neighbouring councils said it would be extremely helpful to have more coordination and communication on CNG among the regions, especially to manage pathways. WRC reported how a house removal truck moved from Hawke's Bay to the Waikato full of dirt potentially contaminated with CNG. In 72 hours, the truck stopped in Taupo, Rotorua and Hamilton. WRC commended HBRC staff for quickly alerting them so they could stop the truck and have it cleaned, at a cost of about $5,000 plus staff time. "That's an example of how fast it can spread; the last thing we want is another weed."

WRC said the warning came from a personal communication from HBRC staff, rather than an established notification process. Better formal information sharing systems are needed. "We need systems that flag when there is a risk, for example a CNG-affected landowner who has land in multiple regions and who might be moving machines or stock. More coordinated machine hygiene is needed, particularly targeting cross-region contractors.

Horizons Regional Council staff said that getting CNG in the region would be "a huge cost and workload for us; other programmes would suffer. It would be really bad [if HBRC relaxed its regulations] because so many other areas are at risk."

All three regions said they were willing to be more involved with the HBRC programme and help where they could. "Maybe they could help train us to spot it better. Maybe we could have targeted surveillance." The bottom line for HBRC's neighbours was acknowledging a shared interest in avoiding the spread of CNG and a need to work collectively.

"Farmers in our region would fight tooth and nail to keep it out," one staff member said.

Marlborough District Council

Marlborough District Council[12] is obviously not a neighbour of HBRC but it does have the largest CNG infestation in New Zealand. Like HBRC, it lists CNG as a sustained control pest. However, its management objective is more specific: "control Chilean needle grass … to less than or equal to baseline levels…"

MDC also has similar rules but spells out in much greater detail what is not permitted. For example, there is one rule for sheep movement and another for cattle and a third for "other".

When contacted for this updated report, MDC staff echoed HBRC's neighbours. "It would be devastating for the rest of the country if it expands to its full range. It's a threat to hundreds of thousands of acres in multiple regions."

MDC staff also argued for more collective action, although that has always been difficult to achieve. "It's a big ask politically to spend money outside our regions."

[12] A unitary authority

Central government support and action has always been hard to secure. Nevertheless, "We need to think differently. People and regions can't think just of the cost impact to themselves, we all have to think of each other."

The Role of MPI

An online search for "MPI and Chilean needle grass" returns a 2017 article about farmers in Marlborough District asking the council to send a delegation to Parliament to request funding. In that same article, MDC staff said they asked MPI to reclassify Chilean needle grass as a national issue, rather than a regional one, eight years ago but were turned down.[13]

That message is roughly the same response that MPI provided for the 2021 version of this report: MPI staff get pulled into what appear to be more urgent crises and something like CNG never rises high enough on the priority list. MPI would argue that CNG control is largely a private benefit to farmers. This is a view that seems to conveniently overlook the national benefits provided by the pastoral farming industry.

MPI did not respond to requests for comment for this report, but in 2021 they said, "If we went to the minister to lead a CNG programme, the minister would say "Why doesn't industry pay for it?" They also wondered what "national coordination" regional councils would exactly want; and would they help pay for that work? That is a fair question that can only be answered through a structured conversation and analysis of long-term benefits and risks, coupled with an open-minded discussion of cost sharing options. Cost-sharing conversations between councils and Government are complex and take time. Ideally, MPI would lead this discussion in line with their responsibility under Section 12A of the Biosecurity Act to "facilitate communication, co-operation, and co-ordination among those involved in pest management to enhance effectiveness, efficiency, and equity of programmes."

Community and Landowner Views

An extensive survey of community views on Chilean needle grass was outside the scope of this review. However, the author spoke with or surveyed electronically a number of landowners, with or without CNG on their property. Submissions from the last HBRC Regional Pest Management (RPMP) Review also were considered.

One landowner without CNG on their property said:

"It would be a curse, but not necessarily worse than others. There always biosecurity risks with new stock coming onto the property, why is CNG singled out? If CNG appeared on my property it just feels like another weed that turns up and we have to deal with. Why is it any different from Bathurst bur?"

Bathhurst bur has some similar impacts to CNG, although it does not burrow into an animal's skin in the same way. It is a Sustained Control pest in Hawke's Bay with boundary control rules but no rules on making hay or silage or other movement controls.

A farmer with CNG on their property argued that Bathurst bur is much easier to control and can be eradicated in a single year. Their view was that CNG imposes significant costs that they would not otherwise have.

[13] https://www.stuff.co.nz/business/farming/90500527/fears-chilean-needle-grass-could-spread-across-new-zealand

The loss of the herbicide Taskforce had may the work harder, but this farmer still considered his property "total control."

"You can manage it where you can get to it with a tractor to spray everything with Roundup and then drill with chicory or brassicas. But no matter where, we don't just walk away from it."

However, another farmer with considerable CNG took another view:

"I have large areas of it and cannot definitively say I've lost an animal from being afflicted with needle grass seed. Barley grass was much worse.[14]"

Other landowners with CNG on their property said it affected their farming operations "a lot" and meant lost production, although the exact amount was hard to estimate:

"Substantial, loss in grazing, sowing crops that we can keep grasses out of e.g., lucerne. Contractors spraying for control normally costs us more than the subsidy allows for."

"This is a little difficult to put a figure against, but we have changed farming systems to accommodate the movement control…have less opportunity to stock as would normally knowing we can't move … if the conditions are poor."

These landowners did not want to see CNG rules relaxed:

"Need to keep up the funding to try to keep control, a lot of time and money from both council and landowners has gone into control; it would be a mistake to let that go."

During the 2018 RPMP review, Federated Farmers said:

"[We] consider this pest poses a significant threat to the sustainability of farming in the Hawke's Bay Region."

They expressed disappointment that CNG was being downgraded from total control in the 2013 strategy to sustained control. The submission preferred progressive containment status, "with intensified efforts to ensure it remains on the current infested properties and does not spread further."

The Chilean Needle Grass National Steering Committee made a similar submission.

Federated Farmers was contacted again for this report. A national board member said CNG is more of a problem for sheep and beef farmers, "although it doesn't seem to establish as much or as quickly as we thought it would." He added that it's true CNG area cannot be grazed during seeding, "although it's not much of a problem on flat land or cropping."

He added that farmers he has talked to want to keep it in the RPMP and maybe even increase controls, even if the regulations are not perfect.

A Beef and Lamb spokesman said that people had been "stressed" by prosecutions for moving material after the cyclone, which contributed to a sense of exasperation with the Chilean needle grass rules. However, his bigger picture view was that councils, farmers and central government should work together to manage, and hopefully eradicate, CNG. This would include more research, better awareness among farmers and a campaign built around why CNG is a concern. He said Beef

[14]Another weed with sharp seeds can penetrate fleeces, pelts, carcasses, hocks, mouths and eyes of grazing livestock.

and Lamb would be open to discussing how to improve management nationally, particularly what it could do to improve communication to farmers.[15]

Impact of Cyclone Gabrielle

Flooding

There is limited evidence available to assess the impact of Cyclone Gabrielle on Chilean needle grass in the Hawke's Bay region. Part of this is simply timing. We might not really know the full impact until any seed had time to grow and establish, possibly two to three years.

However, the evidence seen for this report suggests that the cyclone is unlikely to have made the CNG situation significantly worse. However, between the flooding, the extensive earth flows and the post-cyclone cleanup there is uncertainty about the impact of the event on CNG. More surveillance, targeted research and the passage of time will all help reduce that uncertainty.

Maps provided by HBRC staff show that the most severe flooding from the cyclone did not occur in areas with large known CNG infestations.

In the Eskdale area, shown on the map in Appendix 1, the vast majority of CNG infestations are south of the flooded area, although there is a relatively small cluster of CNG sites in the flooded area toward the sea. In the Pakowhai area, shown on the map in Appendix 2, there are no known CNG sites in the flooded area. In the Waipawa River diversion, shown on the map in Appendix 3, there are a few properties on the edge of the flooded area, but most are well outside the affected areas.

However, the Maraekakaho tributary of the Ngaruroro River did flood with significant stream bank loss and did have CNG on the banks. See Appendix 4. This is an area where more investigation and surveillance would help to understand the localised impacts.

Overall, if material came off a property with CNG during the cyclone, the flooded areas give an indication of where this material may have ended up. This is a very small area in the context of the suitable habitat for CNG and does not compare to where CNG could spread if left unmanaged

This is not to say that flooding may not have moved any CNG seed into previously uncontaminated areas. However, the maps show that the large majority of properties with CNG were not part of these large floods. Some smaller scale flooding or general runoff water probably did occur on properties with CNG, but on the regional scale this is unlikely to have spread the pest significantly further. HBRC staff noted that many of these areas will have experienced flooding in the past in less severe events.

The maps give an indication of how CNG may have been spread by cyclone-related flooding, however, surveillance in future years is clearly necessary.

This view is shared by HBRC's biosecurity staff. They noted that the Tukituki River floods regularly where the CNG is; the cyclone was not significantly different in that sense. The exact degree of seed spread is unknown, but there is no evidence that seed has not gone "everywhere", and the potentially impacted area is small in relation to the region or to where CNG could spread if controls were relaxed.

[15] HBRC currently has a "Stay alert for Chilean Needle Grass" message prominently displayed on its website.

Large landslips are also a risk. For example, one slip above the Esk River has mobilised material, CNG seeds, etc. down into the river and the valley floor. This is an example of a pathway that needs a risk assessment to better understand how it may affect the management of this pest.

One HBRC Biosecurity staffer said, "It's hard to know the impact this season, we really won't know it until a few years after, but I don't think it's a game changer."

Silt disposal

The movement of soil and silt to other properties as part of the post-cyclone cleanup also is a potential risk. Some HBRC staff consider this more of a risk than the flooding impacts.

HBRC staff note that silt removal has happened without a lot of oversight from the Biosecurity team. In one known case, a property in Eskdale that had CNG had a slip, which was removed, and soil moved back to the property it came from.

In general, though, the silt removal programme has happened without coordination with the Biosecurity team. To minimise risk, silt removal operations should be referenced on a map with known CNG sites.

Gravel Extraction

Much of the current public interest in Chilean needle grass concerns the associated restrictions on gravel extraction. This is related to both the gravel extraction industry and to landowners who need gravel for critical cyclone-related farm repairs. There also is a concern among some landowners that the CNG rules reduced the amount of gravel being taken from the river, which then exacerbated the flooding from the cyclone.

One landowner said, "If gravel had been removed, the river would have stayed in its banks. Now floods have spread it everywhere. It would be better to remove restrictions and monitor where the gravel goes."

HBRC has tried to address these concerns while simultaneously managing the risk associated with the spread of CNG via river gravel. For example, the council extended the gravel extraction buffer zone in the Tukituki catchment so more properties could extract and move gravel to their property. The council deemed this to be an acceptable level of risk, particularly because a consent is still needed to take gravel outside the catchment.

HBRC Asset Management staff did not reply to a request for comment on whether CNG gravel extraction rules exacerbated flooding from the cyclone.

Another concern among some landowners is that gravel extraction has been "singled out" as a way to stop the spread and that there is "more focus on gravel extraction rather than making hay."

HBRC pest management staff noted that earthmoving machinery is the pathway that involves the largest level of effort and active management. They remind landowners not to make hay out of CNG paddocks and staff said it is rare for the council to find non-compliance. Staff also remind landowners of the stock movement requirements, but this is more difficult to police.

Recreational use of rivers also was cited by one landowner as a risk, asking "How is that managed?"

In the opinion of HBRC staff, however, the risk from recreational users and their vehicles is likely to be low because it will mostly not involve soil movement. In their view, there will be some risk if a person or a dog walks through a seeding patch of CNG, but that is considered a smaller risk

compared to movement by machines. People and pets are certainly a potential pathway. How significant that risk is compared to other pathways (e.g., gravel extraction) is uncertain and needs to be evaluated.

Gravel Extraction Risks

The council used its powers under the Biosecurity Act to restrict gravel extraction in early 2021. This was meant to be a precautionary, temporary measure[16] while the council investigated gravel extraction methods and their biosecurity risks.

HBRC and AgResearch developed a research plan to examine gravel extraction and cleaning methods to determine what happened to any CNG seed caught up in that process, i.e., did it remain viable. A report and proposal were prepared for Hawke's Bay Regional Council in November 2021.[17] It provides relevant literature, data on the size, mass, and buoyancy of the seeds, an experiment protocol with costs, timelines and potential funding sources, and an analysis of the economic benefits of preventing the spread of the weed.

The small laboratory experiment done for this report is informative but is not a full analysis of the processes available to aggregate harvesting and processing contractors.

> *"For example, aggregate contractors are interested in understanding the process that results in most of the seed falling out (or being destroyed), leaving clean product behind. … Notably sieving machinery available to contractors allows the application of violent action on seed contaminated aggregate in terms of crushing, vibration, time on the sieve, and the downward force of large quantities of aggregate. The use of harp shaped sieves (long narrow slots) could see the long narrow seeds (sourced from the seed head) dropping out of the aggregate that is caught above the sieve. Contractors can potentially afford to separate fines as an unsellable product if it is prone to seed accumulation. If required in the product, fines can be created during crushing."*

To address this, the report proposed further experiments to understand how to remove CNG seeds from gravel:

- *"The one-site/one-year experiment to remove seeds from gravel is costed at $160,000 (excluding the components that HBRC would organise and fund). The level of confidence that the best method in the experiment removes all seeds would be high, assuming that germination levels are high in the control plots. This level of confidence would not necessarily extend to other sites with different gravel characteristics (e.g., base rock and silt content).*
- *Consideration should be given to repeating the experiment in time and space (i.e., more than one year and more than one site) to increase the level of confidence in the results. For two sites in one year, the cost would be $270,000. For two sites in each of two years, the cost would be $380,000."*

According to HBRC staff, these trials were considered by the Asset Management team, which decided not to proceed because of cost. At appears that this work is being explored again through several funding sources. For Hawke's Bay Regional Council, there is a clear need to understand exactly what CNG risk is posed by gravel extraction and how any risks might be mitigated. This would benefit the

[16] https://www.hbrc.govt.nz/home/article/1014/removing-material-from-tukituki-and-waipawa-rivers-banned-because-of-plant-pest-?t=featured&s=1

[17] "Chilean needle grass -- Scoping document and methodology," 30 November 2021, Report Number 11578

national efforts to manage Chilean needle grass and simultaneously greatly inform and assist the current debate over the council's gravel extraction restrictions.

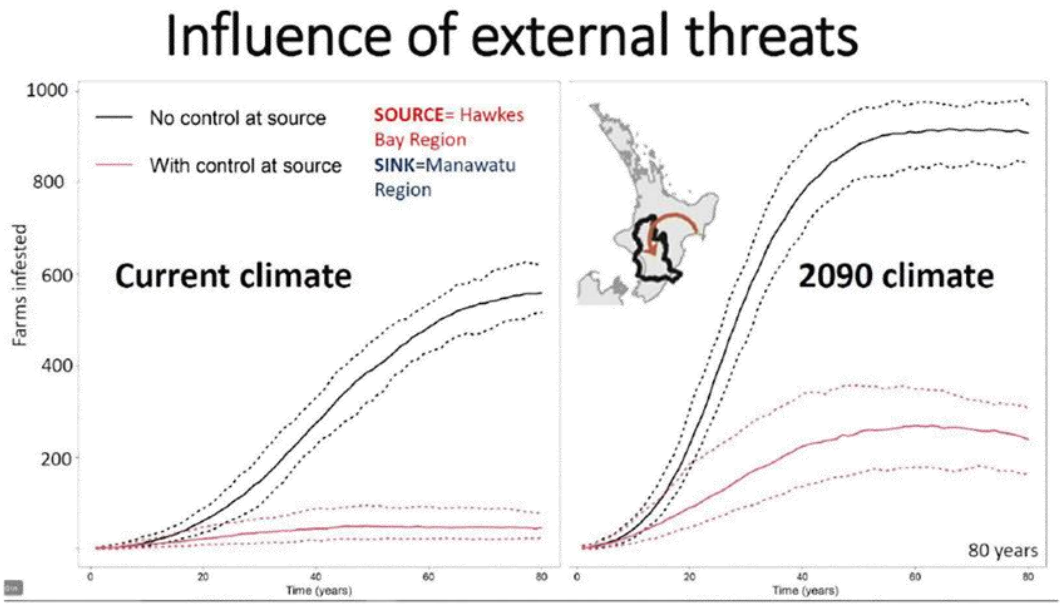
Recent Research Findings

AgResearch and Maanaki Whenua-Landcare Research have looked at CNG in several recent papers.

One piece of work[18] offered a decision support tool to model management and non-management scenarios and their impact on CNG spread. Figure 1 below from separate research[19] shows the spread of CNG to the Manawatu region with and without control in Hawke's Bay. The impact of "no control"[20] is significant even in the current climate, but under the predicted climate change models, with more areas being suitable for CNG, the number of infested farms increases even more dramatically.

Not surprisingly, communication between the regions also matters. No communication under the climate change scenario results in a very steep infestation curve in the Manawatu. See Figure 2.

Figure 1

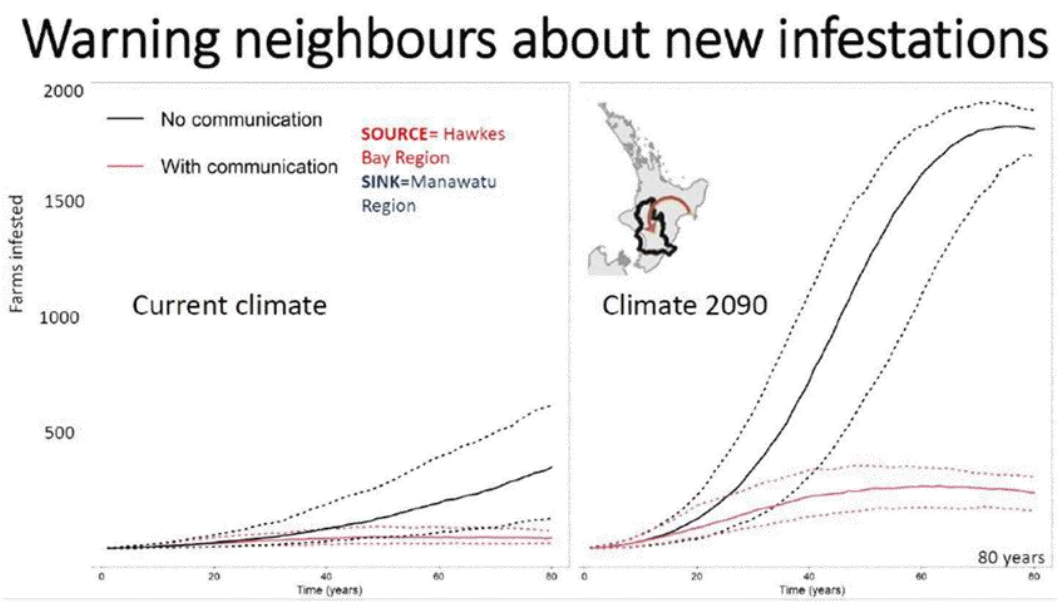


[18] "Decision Support for Regional Management Interventions," Methods in Ecology and Evolution, DOI: 10.1111/2041-210X.13655

[19] "The cost of doing nothing about a sleeper weed – Nassella neesiana in New Zealand." Graeme W. Bourdôt and Christopher E. Buddenhagen

[20] "No control at source" refers to a 200-year simulation in which the weed was allowed to spread in the absence of any management that would otherwise prevent it from doing so.

Figure 2



A related report for the Ministry for Primary Industries[21] looked at the natural and human-assisted dispersal of CNG.[22]

Modelling findings included:

- "In the Hawke's Bay region, … results for a zero-management scenario under future climates shows a potential reduction in pastoral productivity of around 150,000 stock units per year. Similarly, by the end of the simulation period an excess of around 200 farms is under management in the future climate scenario, suggesting a greatly increased management burden.
- The simulation also looked at cross-region impacts of management decisions in Hawke's Bay. For the Manawatū–Whanganui region over 25 invasion events are expected under future climatic conditions. However, the implementation of a relatively strong management response in Hawke's Bay causes a decline in invasion events to less than one per year by the end of the simulation period. This would significantly reduce the response burden in the Manawatū.
- Conversely, the model shows that the absence of management in the Hawke's Bay region greatly reduces management efficacy in the Manawatū–Whanganui region, and this effect is exacerbated under future climatic conditions.
- Model results predict that under changing climates, adding agency-led to community-led surveillance results in 250 fewer infested farms by the end of the simulation period under current climatic conditions, and avoids impacts of around 750,000 stock units per year.

[21] "New approaches to understanding social factors and simulating management responses to emerging pest threats under changing climates." June 2023

[22] All seed generally falls very near the mother plant, leading to very slow rates of natural dispersal. Available estimates suggest a maximum spread rate for CNG of 150 m per year. Dispersal over longer distances is via livestock transport, feeding out contaminated hay, and on dirty machinery.

> Corresponding numbers for future climatic conditions are around 1,500 fewer farms infested and avoided impacts of around 3.5 million stock units per year. This points to a dramatic savings for the community and the regional council."

Research done by AgResearch[23] and published in December 2023 included (for each of New Zealand's 16 local government regions) a 200-year simulation in which CNG was allowed to spread in the absence of any management. In these regional 'do-nothing' simulations, the 'cost' is the PV value of the lost pastoral production that would be avoided in the region by preventing the weed's spread. This avoided loss equates to the PV 'benefit' of investing in regional programmes that prevent the weed's spread.

When these regional figures are aggregated using a discount rate of 3%, the annual breakeven cost for a national CNG management programme ranges from $5.3 million to $34.5 million.

Conclusions

The events of February 2023 and the subsequent need to recover from the cyclone have increased scrutiny of the CNG management programme. Most of the current public concern seems to be associated with gravel extraction, however, there is no current evidence that the cyclone spread CNG widely beyond its known range.

The limited, documented evidence suggests that affected farmers support the rules to control the spread of CNG. At the same time, the increased need for gravel for cyclone recovery has complicated the picture.

The cyclone has unquestionably increased the need for:

- effective surveillance of properties potentially at risk from cyclone-related CNG spread
- robust research into the risks posed by gravel extraction and how to reduce or mitigate them.

This last point is especially important because that is where the most public concern seems to be coming from.

Operationally, the HBRC Chilean needle grass management programme will certainly be reducing the spread compared to what would happen without management. The loss of the Taskforce herbicide is unfortunate but not fatal. Encouragingly, a new biocontrol, a rust fungus, is due for formal release in the autumn of 2024. Biocontrols are rarely silver bullets for pest control, and Hawke's Bay may have a slightly different phenotype of CNG that makes the rust less effective. Nevertheless, it is good to see this being released after nearly 10 years of effort.[24]

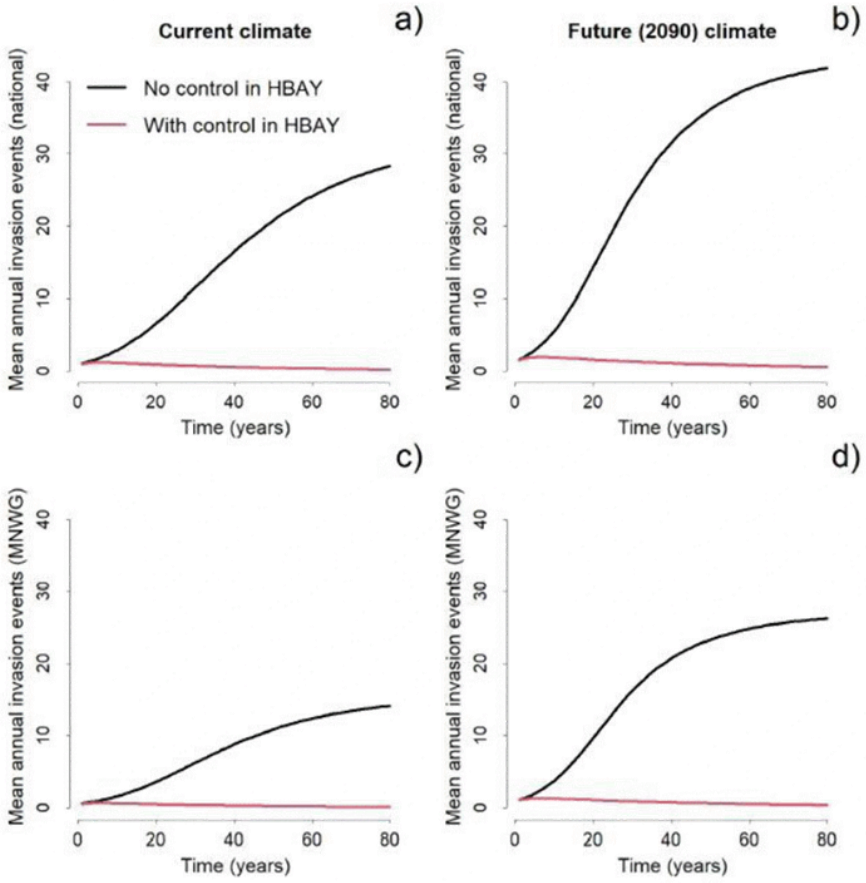
The most significant development from the 2021 report on Chilean needle grass is the release of research into how HBRC's management regime affects neighbouring regions and the nation. Figure 3 below shows the mean annual Chilean needle grass invasion events (i.e., number of farms invaded per year) from the Hawke's Bay region to all other regions in New Zealand (graphs a,b) and the Manawatū–Whanganui region (graphs c,d). These represent simulations based on initially infested farms derived from known infestations as of 2021.

[23] "The cost of doing nothing about a sleeper weed –Nassella neesiana in New Zealand," Bourdôt and Buddenhagen. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0295574

[24] For the full story on this decade-long effort, see https://youtu.be/Og4vA-Gw2hs?feature=shared.

The key message is clear: HBRC's efforts are holding back a tide of Chilean needle grass that would otherwise eventually sweep across much of its neighbours and the nation.[25]

Figure 3



[25] Other councils that manage CNG also will be reducing the spread to their neighbours and the nation. This is a collective national benefit that seems to be officially unrecognised.

Controlling CNG locally, regardless of the region, has multiple national benefits that until now have been largely unquantified. This argues for a national management programme. It would be instructive to add up what all councils, plus landowners, are spending annually on CNG now and compare that with what a national programme would cost.

CNG is a prime candidate for a Pathway Management Plan because it is almost entirely spread by humans, our machinery or our livestock. It is a classic example of a biosecurity response that requires the management of people, not the actual pest itself.

Under the Biosecurity Act, the first step in the making of a National Pathway Management Plan is a proposal made by "a person who submits the proposal to a Minister."[26] Section 12A of the Act says MPI should provide leadership by "facilitating the development and alignment of national pest management plans and national pathway management plans."

Regional councils should consider initiating a National Pest Management Plan for Chilean needle grass as a way to catalyse a national discussion.

This would need to be a joint regional council initiative because the CNG pathways are inter-regional. Initial costs would be carried by councils but there would be the immediate benefit of giving CNG a higher profile with Government because it would trigger a process under the Biosecurity Act. The proposal would need to meet the requirements of the Act, including why a national plan is more appropriate than a regional plan. This and other information, e.g., costs and benefits, would need to be developed into a proposal, but there is more than enough evidence to support a reasonable argument around Chilean needle grass. Even if a national pathway plan did not eventuate, greater engagement and discussion with central Government would be helpful.

MPI's official view on Chilean needle grass, expressed in the 2021 report, was that it is not a high enough priority, with not enough "stakeholders" and that because the industry benefits, then the industry should pay. In fact, a 2010 Cabinet paper confirmed that legal instruments in Part 5 of the Biosecurity Act are "based on the concept that those with an interest to act will do so. Where potential benefits of pest management are broader than the individual, those who benefit will band together and pool their resources based on how much they are willing to pay to avoid the costs of pests."[27]

That is a reasonable approach on the face of it, but fairness requires that central government also be willing to "band together and pool resources."

Further analysis of how to achieve greater national coordination of pest management under the Biosecurity Act is out of scope for this report. However, the Parliamentary Commissioner for the Environment commented on that general topic in a 2021 report.

Below are excerpts from the PCE's report:

> *"While there are numerous exotic plants across the country that could benefit from nationally coordinated efforts, MPI's involvement is limited to a handful of initiatives."*[28]

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[26] Biosecurity Act, section 81

[27] Parliamentary Commissioner for the Environment report, "Space invaders: A review of how New Zealand manages weeds that threaten native ecosystems"

[28] The report says that "MPI also provides some coordination and support for managing … Chilean needle grass," but in practice this has been effectively nil.

…

> *"At the time of its development, the National Policy Direction was envisaged to include national priorities for pest management. In 2010, the Ministry of Agriculture and Fisheries (MAF) wrote: "The Government has decided to create binding national policy direction that will set out processes to improve the rigour and consistency of pest management strategies and establish national priorities for pest management." However, the final NPD issued in 2015 failed to identify any. The exact reasons why this should have been the case remain opaque. … [Nevertheless] it is evident that the NPD missed a chance to set national priorities for pest management and require national coordination."*

The December 2023 AgResearch report briefly discusses the ramifications and realities of the region-led approach to pests in New Zealand.

> *"….the devolution of pest management responsibilities to regional authorities leads to an under-estimation of the potential national losses from N. neesiana and thus also the benefits of a biosecurity response nationally. Importantly any national or regional program would be expected to run for many years, and a dedicated team of committed successive professionals would need to keep the prevention benefits in mind over decades. It would require a strong commitment to early detection, land-owner extension, record-keeping, and follow-up for infested sites. Such long-term and community-minded thinking is hard to maintain in political institutions, such as regional councils, that need to justify this ongoing expenditure to ratepayers given multiple competing needs."*

It seems very unlikely that MPI will voluntarily initiate a serious effort to coordinate national efforts to manage CNG. However, there is nothing to stop councils from aggressively pursuing national coordination for their own priorities. Chilean needle grass falls into the same "sleeper pest" category as wilding pines or wallabies. Regional councils lobbied for years in favour of a national approach to those pests. It was a long and often frustrating exercise, but it was ultimately successful.

Recommendations

The 2021 Chilean needle grass report highlighted the risks associated with the "uncertainty" around the CNG management, particularly a reliable baseline and a well-designed surveillance programme. That uncertainty has been increased by the cyclone; we simply do not know whether the impact is minimal or a "game changer."

The 2023 recommendations also focus on reducing uncertainties while increasing national and inter-regional coordination.

Reducing Uncertainty

Recommendation: Contract for modelling to explore a stratified approach that could estimate how much sampling effort is required to achieve a certain confidence level. Seek support from other councils and MPI.

There is no clear evidence that the cyclone significantly altered the situation with Chilean needle grass in the region, however, it is a concern among the public and further research and analysis is needed

Recommendation: Publicise CNG-relate flood maps similar to those in this report and increase surveillance around potentially affected areas for the next few years.

It is important to consider and evaluate concern that restrictions on gravel extraction exacerbated the cyclone-related flooding.

Recommendation: Secure expert advice on whether CNG restrictions on gravel extraction exacerbated flooding.

There is a clear operational and communications need to understand exactly what CNG risk is posed by gravel extraction and how any risks might be mitigated. More information also would benefit any national efforts to manage Chilean needle grass.

Recommendation: Proceed as soon as possible with funding for a research-based risk assessment of the process of extracting gravel from riverbeds.

More research into Chilean needle grass is needed, e.g., to evaluate gravel extraction risks, but its inclusion on the Unwanted Organism list makes that complicated and arguably unnecessary for a pest that is reasonably widespread.

Recommendation: Advocate for the removal of *Nassella neesiana* from the Unwanted Organism list but retain regulations in regional pest management plans.

Improved National and Inter-regional coordination

Recent modelling shows how dramatically CNG could spread to neighbouring regions if HBRC changed its management approach. Those councils are willing to support HBRC where possible.

Recommendation: Arrange a meeting or workshop to discuss options for better inter-regional coordination to minimise the risk from CNG.

The post-cyclone silt removal programme has happened largely without coordination with the HBRC Biosecurity team.

Recommendation: To minimise risk, silt removal operations should be reviewed by the Biosecurity team before being undertaken. At a minimum, known biosecurity risks should be considered during the planning for silt removal.

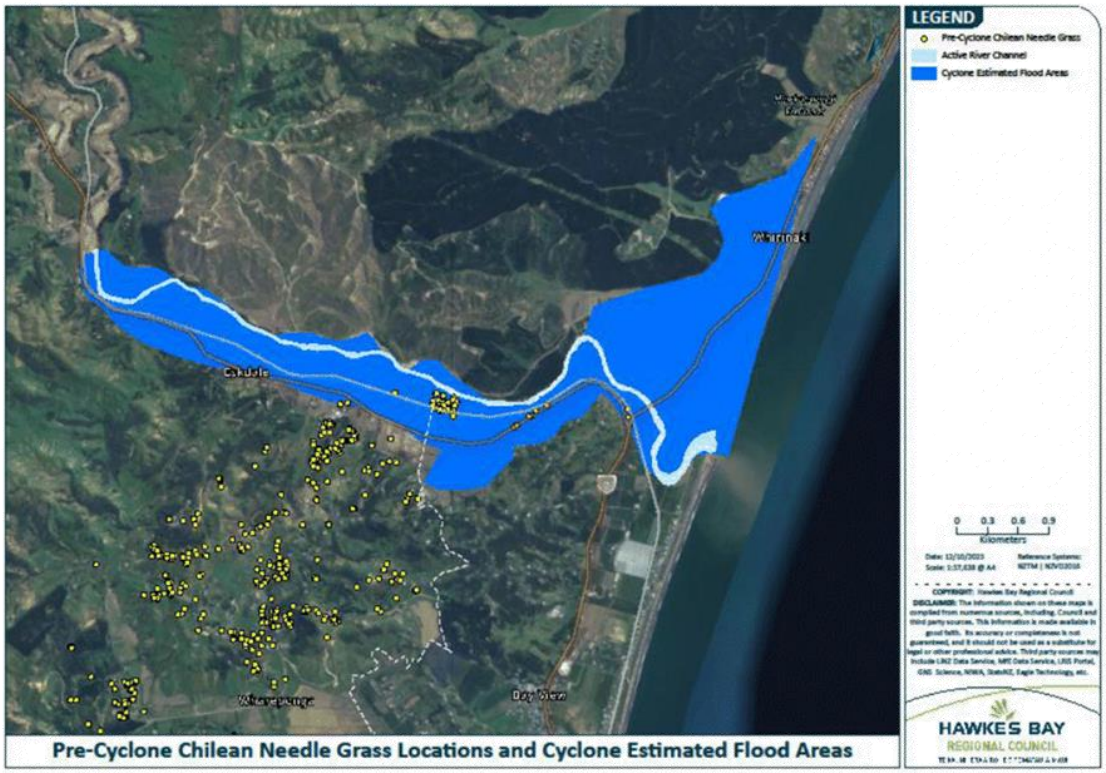
Continuing to manage CNG almost entirely region-by-region risks it becoming another wilding pine or wallaby situation, where we knew the long-term risks and delayed acting until the scale of the problem became enormous.

Recommendation: Coordinate with other regional councils and the pastoral farming sector to use the national management provisions of the Biosecurity Act to start a conversation about how to best coordinate effective national action.

-ENDS-

Appendices

Appendix 1 – Eskdale

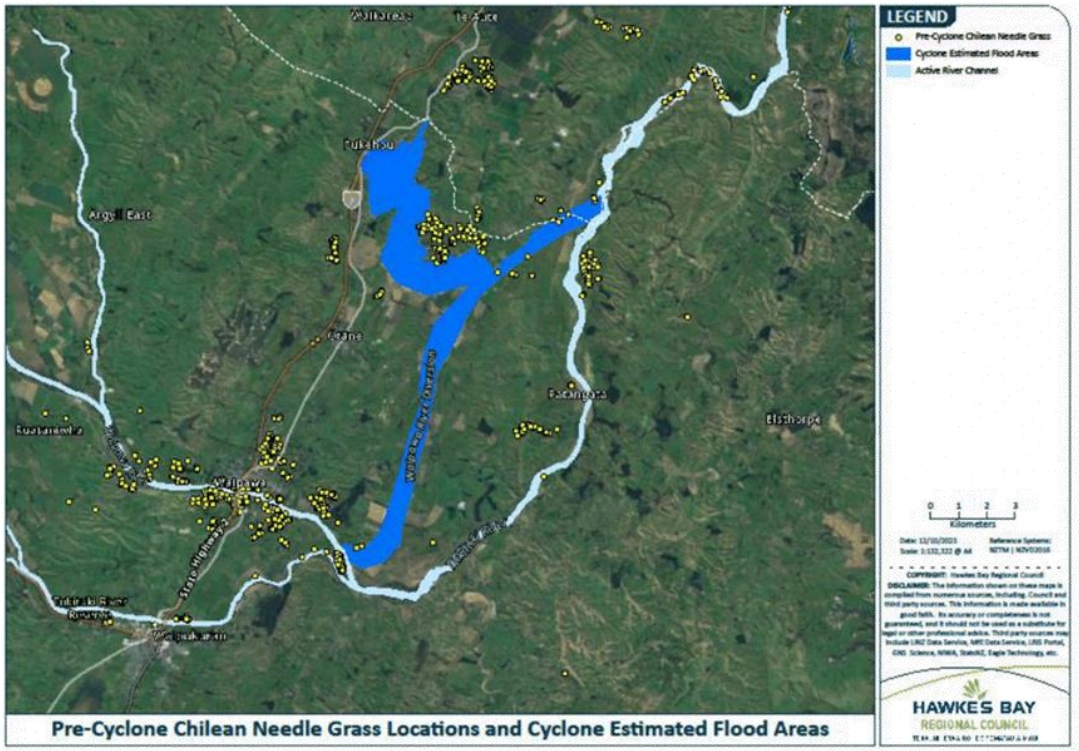


Pre-Cyclone Chilean Needle Grass Locations and Cyclone Estimated Flood Areas

Appendix 2 -- Pakowhai

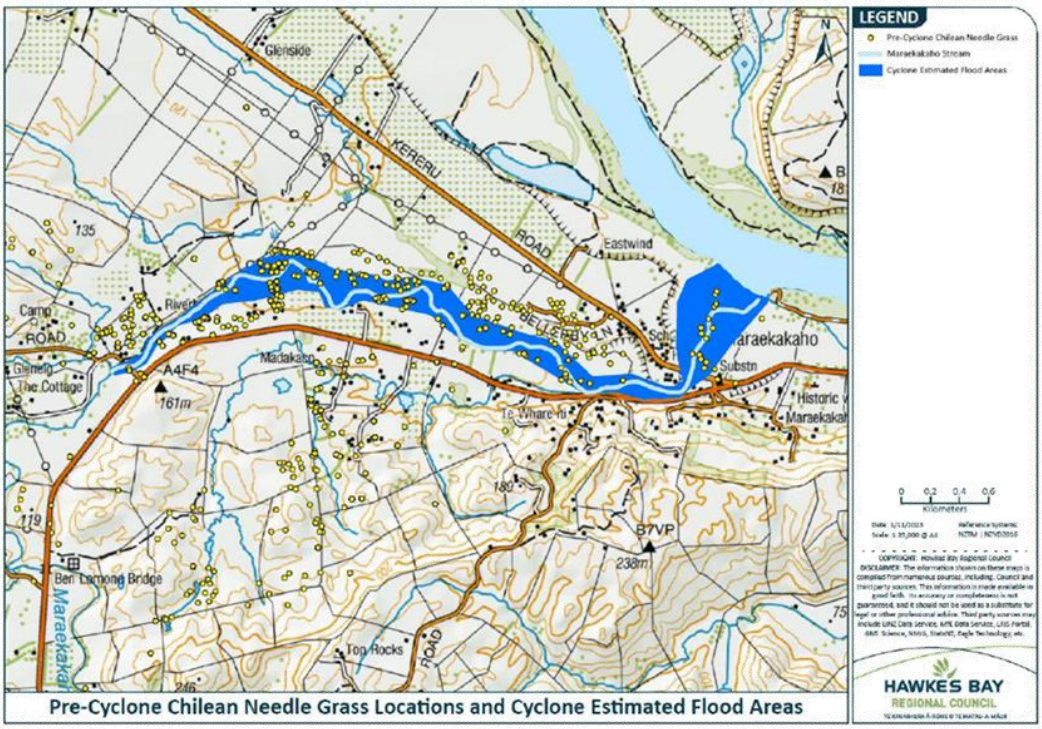
Pre-Cyclone Chilean Needle Grass Locations and Cyclone Estimated Flood Areas

Appendix 3 -- Waipawa



Pre-Cyclone Chilean Needle Grass Locations and Cyclone Estimated Flood Areas

Appendix 4 -- The Maraekakaho tributary of the Ngaruroro River



Pre-Cyclone Chilean Needle Grass Locations and Cyclone Estimated Flood Areas

Land for Life Technical Report: Additional Information on Gains for Nature

Internal report prepared for Hawke's Bay Regional Council and The Nature Conservancy Aotearoa New Zealand, November 2023

Authors: Dr Robin Holmes (Cawthron), Willie Shaw (Wildlands), Dr Ashton Eaves (HBRC), Michael Bassett-Foss (HBRC), Andrew Harrison (TNC), James Powrie (RedAxe Forestry Intelligence), Lochie MacGillivray (AgFirst)

18 December 2023

Contents

1. Executive Summary

The Land for Life (LFL) business case (BC) sets out a range of benefits to nature (aquatic and terrestrial ecosystem health and biodiversity). The potential to maximise these benefits will be progressed during the next stage, which entails preparing the project for full implementation and enhanced resilience across 300 farms (and a further 300 farms that are a stepping-stone/preparation for farms towards full implementation).

Benefit estimates in the current version of the BC reflect a bottom-up aggregation based on farm-level data derived from farmer preferences revealed in the 12 pilot farms. These were the initial and conservative preferences of farmers based on 1:1 engagement with consultants at the start of the process and based on current policy settings, and the knowledge and confidence of farmers.

This has delivered a highly conservative view of benefits, as opposed to a strategic and aspirational view of what LfL can and needs to achieve to deliver the significant nature-based benefits afforded by this approach.

Based on expert assessment provided in this report, it is clear that the conservative benefits set out in the current BC deliver valuable gains for nature and people. This includes gains for aquatic environments (rivers, wetlands, estuaries and the coastal marine area) through the significant reductions identified stressors (e.g., fine sediment, P, and N). As well as gains for terrestrial biodiversity through improving management or protection of existing indigenous forest remnants and other ecosystems. In addition to plantings, with a mixture of exotic and indigenous forest and treeland (and scrub and shrubland), this will create more diverse landscapes across the region and achieve valuable benefits for indigenous biodiversity (noting that exotic planted forest also provides valuable habitats for a reasonably diverse range of indigenous species).

However, expert assessment confirms that the benefits described currently in the BC for terrestrial ecosystem health and biodiversity are sub-optimal. The target for indigenous revegetation is too low and needs to be reset to recognise the ecological understanding of the rate of biodiversity loss when indigenous cover drops to below 15-20% of the land area.

This report establishes a strategic view of benefits that LfL needs to target, which experts consider aspirational but achievable, and which align with:

- **Increasing the overall level of planting to 20% of farms.**
- **Returning ecologically-appropriate indigenous cover and habitats to 15-20% indigenous cover across catchments.**
- **Increasing the proportion of native planting to approximately 40-50% of total new planting area (toward achieving the 15-20% indigenous cover and habitat target above).**

The strategic view of benefits that LfL needs to target is further aligned with TNC's 2030 Goals and relevant metrics in this report, to clarify the contribution LfL makes to these (a view that TNC's leadership has requested).

Indicatively, **national scaling potential is estimated at a factor of 8-10X** the benefits that LfL would contribute, taking into account both further scaling potential within the Hawke's Bay and to other suitable regions.

There are additional benefits that LfL can target and potentially measure (e.g., soil and blue carbon, cultural benefits, benefits associated with regenerative improvements in pastoral systems, future impacts avoided downstream during weather events etc.), and it is recommended these are further investigated and developed in the next stage of the project.

Achievement of the targeted benefits/upsides for nature will require a strong focus on strategic imperatives and requirements, including:

- Establishment of indigenous riparian cover along waterways (because restoration of indigenous vegetation along waterway margins will provide much improved conditions for stream ecosystems).
- Establishment of linkages/corridors between existing indigenous remnants.
- Recognition of existing early successional indigenous regeneration and the need to allow such sites to regenerate naturally.
- Establishment of 'mountains to sea' linkages.
- Establishment of ecological islands scattered through the farmed landscape.
- Priorities to re-establish indigenous biodiversity in heavily depleted parts of the landscape.

Achievement of the targeted benefits/upsides for nature will also require a strong focus on achieving buy-in by communities, mana whenua and stakeholders, and ultimately influencing the decisions of individual whenua Māori and other landowners. This is as much a social change journey as with providing the tools, processes, expertise, incentives, evidence and resources to enable it. The BC already describes such imperatives, as well as the research, landowner survey and broader market testing results that underpin these. And it describes the implementation pathway to realise benefits, including:

- Partnership arrangements, funding and governance oversight.
- Addressing the key barriers to successful uptake (identified through research, surveys and market testing), which are access to capital and resources (including labour and knowledge/expertise), as well as moving beyond feeling overwhelmed by environmental and regulatory demands and building confidence.
- A proposed financial structure, based on a financing model that blends green financing, grants, philanthropy and cost-recovery (informed my market testing, and confirming interest of major banks in structuring a green financing deal).
- A Technical Assistance (TA) Facility that develops standards, delivers catchment-based planning with communities, manages the pipeline of farmer participation, delivers farm planning and extension support and tools, coordinates a programme of supporting research, and delivers monitoring, reporting and verification for the project.
- Engagement and partnership with landowners, mana whenua, communities and key stakeholders (including central government, local government and relevant NGOs), including leveraging champions within communities.

This report identifies additional imperatives and requirements that should be reflected in the BC to further strengthen this pathway. These include:

- Developing overarching strategy/vision and policies for LfL, through processes inclusive of landowners, communities, mana whenua and key stakeholders.
- A strategic approach to catchment-scale planning, through processes inclusive of landowners, communities, mana whenua and key stakeholders.
- Strengthening integration with existing and emerging biodiversity programmes and other related programmes and initiatives.
- Pursuing opportunities to further strengthen mechanisms that improve the incentives to invest in nature (e.g., voluntary carbon credits, biodiversity credits, more cost-effective models for establishing natives).
- Strengthening the role that social science can play to help achieve buy-in and influence the decisions of individual landowners.

An overview of the approach to reduce any potential "legacy risks" associated with exotic forestry is provided. The BC already includes a risk assessment that covers such risks, and development of a comprehensive set of policies and standards to guide afforestation activities is one of the key risk management tools to be further developed in the next stage. This will be developed with implementation partners to benefit from their expertise and avoid reinventing the wheel, as well as

working with regulators (e.g., MPI, MfE, HBRC) given such policies and standards will necessarily take account of, and adapt with, a rapidly changing regulatory environment.

2. Purpose

The purpose of this paper is to provide additional advice in relation to the LfL BC on the following matters:

- the significance of estimated gains for nature in the current BC.
- the potential to optimise those gains for nature (including potential targets).
- how risks will be mitigated to avoid potential legacy issues associated with investments in plantation forestry.

It includes expert advice prepared by:

- Dr Robin Holmes (Team Leader – River and Lake Ecology, Cawthron).
- Willie Shaw (Lead Principal Ecologist, Wildlands).
- Dr Ashton Eaves (Senior Scientist, HBRC – also coordinating wider input from the HBRC science team).
- James Powrie (Director, RedAxe Forestry Intelligence).
- Lochie MacGillivray (AgFirst).

This paper provides recommended changes to the BC and for implementation during the next stage of the project.

3. Recommendations

The following recommendations are presented for LfL Steering Group consideration and it is recommended that you:

A. **Note** that expert advice suggests the benefits set out in the draft BC (based on a bottom-up aggregation based on farm-level data derived from the 12 pilot farms) are highly conservative, and even so deliver valuable gains for nature and people.

B. **Note** that expert advice also confirms the benefits set out in the draft BC are sub-optimal, and the target for indigenous revegetation is too low and needs to be reset to recognise the ecological understanding of the rate of biodiversity loss when indigenous cover drops to below 15-20% of the land area.

C. **Agree** the benefits be reset to achieve the following (and included in the BC):
   - Increasing the overall level of planting to 20% of farms.
   - Returning ecologically-appropriate indigenous cover and habitats to 15-20% indigenous cover across catchments.
   - Increasing the proportion of native planting to approximately 40-50% of total new planting area (toward achieving the 15-20% indigenous cover and habitat target above).

D. **Agree** that the strategic view of metrics and targets (set out in section 6.1 of this report) be included in the BC.

E. **Note** the estimated contribution of LfL benefits to TNC's 2030 Goals and associated metrics, for the next stage of the project in the Hawke's Bay (Figure 2) and if further scaled in the Hawke's Bay and to other regions (Figure 3)

F. **Agree** that the potential additional benefits (listed in section 6.3 of this report) be further investigated in the next stage of the project.

G. **Agree** that the potential strategic approaches set out in section 7 of this report be reflected in the BC, which include:
   i. Developing overarching strategy/vision and policies for LfL, through processes inclusive of landowners, communities, mana whenua and key stakeholders.
   ii. A strategic approach to catchment-scale planning, through processes inclusive of landowners, communities, mana whenua and key stakeholders.
   iii. Strengthening integration with existing and emerging biodiversity programmes and other related programmes and initiatives.
   iv. Pursuing opportunities to further strengthen the mechanisms that improve incentives for investment in nature.
   v. Strengthening the role that social science can play to help achieve buy-in and influence the decisions of individual landowners.

H. **Agree** that potential synergies and collaboration between Recloaking Papatūānuku and LfL, along with other related initiatives and programmes, continue to be explored in the next stage of the project.

4. Background

The BC includes a theory of change/intervention logic (**Figure 1**) and estimates a range of benefits that relate to, protection of existing indigenous ecosystems (terrestrial and aquatic), afforestation, agroforestry and sustainable land use interventions across 600 farms (refer to Box 1).

Box 1: Summary of benefits estimated in the LfL BC (Version: *Final business base for socialisation and testing with HBRC, central government and TNC governance entities, dated 27.7.2023*)

These include:

Across 300 farms with Comprehensive LfL Farm Plans (with long term resilience focus)

- Reducing sediment erosion by 25%.
- An estimated 15 million tCo2e sequestered over 30 years.
- Additional 76,650 tCo2e reduced from livestock emissions over 30 years.
- 16,385 ha of remnant indigenous vegetation under protection.
- 48,926 ha of land protected through afforestation and agroforestry activities*.
- 1,440 ha of wetlands under protection.
- 292,267 ha of land under best management practice and regenerative interventions*.
- Reduced field level leakage of N of 257,065 kg annually achieved over time from ~5% of farmland in plantation forestry/retirement.

Across a further 300 farms with Erosion and Biodiversity Plans (i.e. with recovery focus and a "stepping stone" to a Comprehensive LfL Farm Plan)

- 5,040 ha of additional pole planting.
- 235 ha of additional biodiversity protection.

Additional benefits include:

- Future impacts avoided, including impacts on public safety, infrastructure, homes, possessions and livelihoods downstream during weather events (each dollar invested in proactive riverine management, such as afforestation, saves $7 in post-flood recovery costs).
- Ecosystem services benefits, such as impacts avoided on downstream fisheries, water quality, groundwater infiltration and recreation.

**Note these metrics were incorrectly calculated in the draft BC and are corrected here*

The BC also sets out how benefits will be enabled, including:

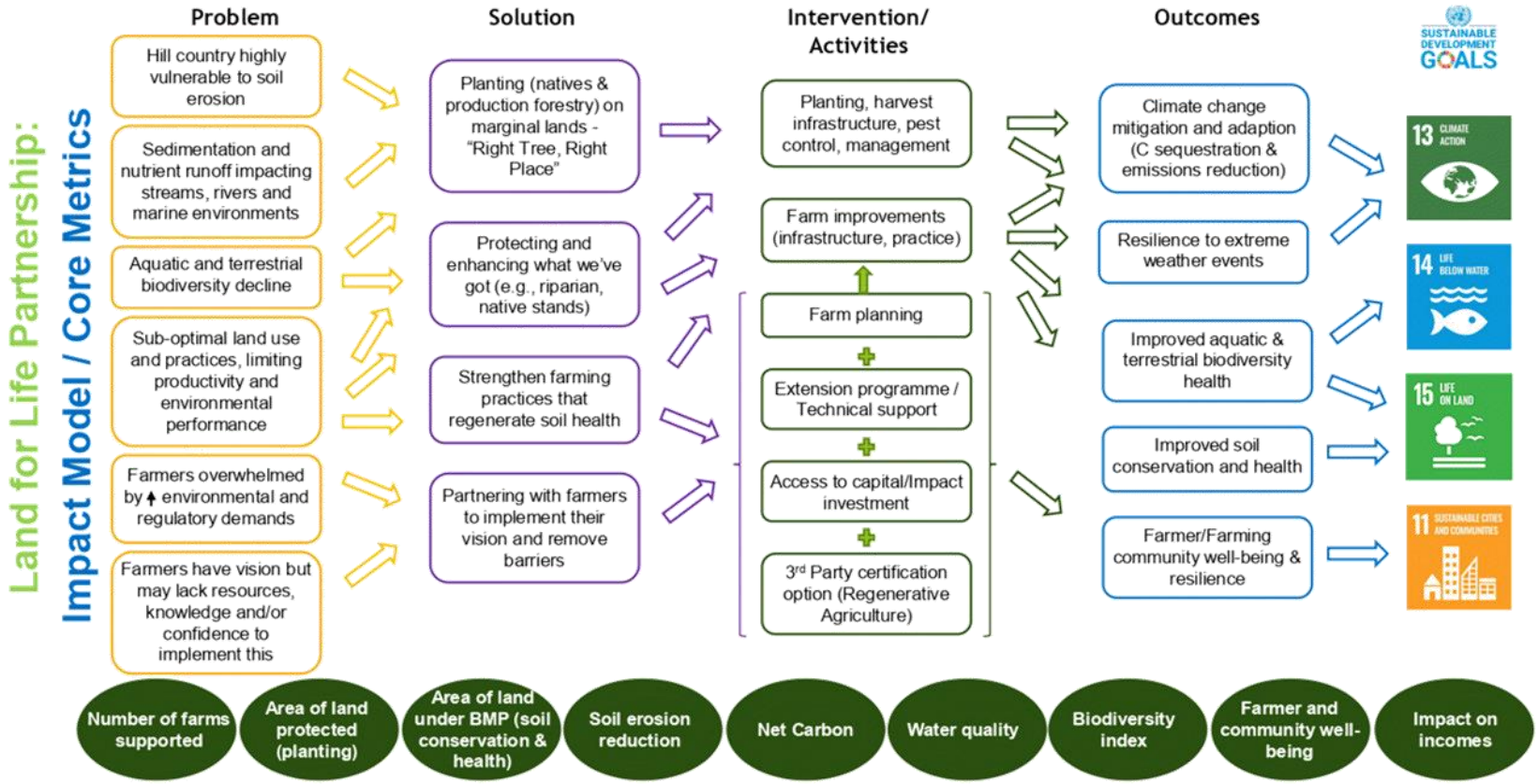
- Governance oversight.
- A proposed financial structure, based on a financing model that blends green financing, grants, philanthropy and cost-recovery (informed my market testing, and confirming interest of major banks in structuring a green financing deal).
- A Technical Assistance (TA) Facility that develops standards, delivers catchment-based planning with communities, manages the pipeline of farmer participation, delivers farm planning and extension support, coordinates a programme of supporting research, and delivers monitoring, reporting and verification for the project.
- Engagement and partnership with landowners, mana whenua, communities and key stakeholders (including central government, local government and relevant NGOs).

The benefit estimates associated with the 300 farms with Comprehensive LfL Farm Plans were conservatively modelled based on assumptions at the farm-level derived from the 12 pilot farms. These revealed preferences for the afforestation/agroforestry mix at the start of the process (i.e. where pilot farmers are comfortable starting based on their existing knowledge and confidence levels, and 1:1 engagement with consultants and prior to implementing the enabling functions) as follows:

- 10% poplar poles.
- 4.00% exotic rotation forestry.
- 1% native afforestation.

During the socialisation process the level of native afforestation was identified as sub-optimal, and additional information on benefits for nature and how to optimise these was requested.

Figure 1: LfL theory of change/intervention logic



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5. Assessment of benefits for nature and how to optimise these

5.1. Potential aquatic ecosystem health / biodiversity benefits

The key metrics in the BC related to aquatic ecosystem health and biodiversity are:

Across 300 farms with Comprehensive LfL Farm Plans

- Reducing sediment erosion by 25%.
- Reduced field level leakage of N of 257,065 kg annually achieved over time from ~5% of farmland in plantation forestry/retirement.
- 1,440 ha of wetlands under protection.

Aquatic ecological effects of land-use derived fine sediment

Human activities, in particular land use, impact the natural sediment supply cycle by increasing the rate of sediment delivery to waterways. In general, as land use intensifies, fine sediment (< 2 mm grain size) load increases because of vegetation clearance and livestock activity within waterway networks. These land-use activities cause reduced land and / or riparian bank stability, which leads to increased sediment laden run-off from agricultural land and recently harvested forestry areas (Trimble and Mendel 1995; Wood and Armitage 1997; Lyons et al. 2000; Allan 2004). Anthropogenically-derived fine sediment has been termed a 'master stressor' in aquatic systems. Therefore, any initiative that substantially reduces fine sediment load at the landscape-scale is likely to have substantial biodiversity / ecological health benefits. Fine sediment ecosystem effects can be bundled into two types of impact:

- Effects of suspended fine sediment, and
- Effects of deposited fine sediment on benthic habitats (i.e. river / lake beds and the seafloor).

Increases in suspended fine sediment have a range of detrimental aquatic ecological effects. These effects arise primarily through reduced water clarity, which affects the dynamics of primary production. Suspended sediment reduces the amount of light available for photosynthesis by algae and benthic macrophytes (Alen 2004). In addition, small decreases in water clarity can reduce the feeding efficiency of fish that forage visually. When present in excessive amounts, suspended fine sediment can stress fish and invertebrates through abrasion and clogging of gills (Ryan 1991; Waters 1995).

Deposited fine sediment alters physical habitat by clogging interstitial spaces within coarse substrata of benthic habitats. These habitats are used as refugia and egg laying sites by benthic invertebrates and fish. The smoothing of benthic habitat (in combination with reduced light penetration through the water column) can reduce food resources for aquatic life. Increased deposits of fine sediment tend to reduce the diversity and productivity of aquatic communities. In rivers and streams, the most pronounced effects occur in systems that have naturally low levels of fine sediment supply and large areas of gravel / cobble riverbed habitats. Excessive fine sediment can also homogenise stream habitat at the reach scale by reducing pool depth, which in turn reduces fish refugia during periods of low flow (Wood and Armitage 1997; Allouche 2002; Gayraud 2002).

As fine sediment is transported through waterways to lakes, estuaries and the coast, it can also profoundly affect ecosystem health in these environments. Increased turbidity in lakes can reduce the ability of macrophyte beds to stabilise lakebed sediments, making a lakebed more vulnerable to disturbance from wave action and potentially locking the system into a stable turbid state; this process can subsequently lead to algal blooms (Scheffer et al. 2001; Beisner et al. 2003). Fine sediment pollution in marine systems is of paramount ecological concern in Aotearoa New Zealand and internationally (Booth 2020). The soft sediment benthic communities dominating estuaries and nearshore habitats are often biologically diverse, influence nutrient budgets and contribute to the

global carbon cycle (e.g. Lohrer et al. 2006). Even small amounts of land-derived fine sediment in the water column, as well as on the estuary bed and seafloor, can alter how these ecosystems function. For example, sedimentation (and resuspension of sediments) can cause depressed conditions among filter feeders, such as cockles, via abrading, clogging, smothering, reducing interstitial spaces, and reducing food sources through decreased light penetration (e.g. Booth 2020).

Because fine sediment is naturally transported downstream / longitudinally through a catchment, its presence and / or transience is influenced by the underlying topography, geomorphology and rainfall / flow regime. Rivers and streams will be the first aquatic systems to benefit from reduced fine sediment loads, with ecological benefits becoming less predictable in ecosystems further down a catchment (such as estuaries and the coast). Although, as noted above, substantial reductions in fine sediment load will likely benefit these environments. In the assessment below, it is assumed that the LfL target of a 25% reduction in sediment erosion rates will be successful; however, how this target will be achieved is not discussed.

Freshwater ecosystem health and biodiversity in the Hawke's Bay Region

The LfL programme intends to reduce sediment erosion through a combination of pastoral land retirement and native planting. Existing native bush and wetland areas will be protected / expanded and selected farmland parcels targeted at vulnerable land will be converted to space planting, permanent and rotational harvest forestry. The programme aims to introduce a patchwork of forestry and retired land as part of farm systems, rather than convert entire farms to forestry.

Freshwater environments in the Hawke's Bay Region are characterised by steep erodible headwater streams. In central and southern Hawkes Bay, these emerge from the Ruahine and Kaweka Ranges and feed the mainstem rivers of the Heretaunga Plains, including the Tukituki, Ngaruroro and Tutaekuri Rivers. These large rivers are typically braided or partially braided but are confined to managed flood channels throughout the plains, with stop banks present along various river segments. There is often a surplus of gravel within the braided rivers, and many segments are actively aggrading. Hawke's Bay Regional Council operates an extensive gravel extraction programme across the major braided rivers to maintain riverbeds at levels that reduce flood risk (Holmes 2016). The northern catchments originate in landscapes with a basal geology of sandstone and highly erodible mudstones, which can release large amounts of fine sediments into waterways.

Alongside the major rivers, there are numerous associated rain-fed tributaries, spring-fed creeks and floodplain wetlands. Although lakes are not a significant feature of Hawke's Bay agricultural areas, there are numerous small- to medium-sized lakes scattered throughout the landscape. Many of these lakes have poor water quality and are resistant to restoration (e.g. Lake Tūtira). Fine sediment and sediment-bound phosphorus are major contributors to degraded lake health in the region (Wood et al. 2023).

There are 17 species of native freshwater fish (**Table 1**, excluding marine wanderers) in Hawke's Bay. Eight of these fish have a conservation threat status of (at least) 'At risk, Declining'. Hughey et al. (2012) undertook an expert panel-based evaluation of the Hawke's Bay rivers using the River Values Assessment System (RiVAS) framework. It was determined that the Wairoa, Tutaekuri, Ngaruroro and Tukituki Rivers are 'nationally significant' native fish habitats. The assessment panel identified multiple river catchments as having potential to improve river conditions. The interventions most frequently identified for enhancing native fish life were reducing stock access to waterbodies, reducing sediment inputs and removing or mitigating fish passage barriers.

Table 1. Freshwater fish species in Hawke's Bay (Hughey et al. 2012) and their national threat classifications from Dunn et al. (2017).

Common Name	Scientific name	Threat classification
Lamprey	Geotria australis	Nationally Vulnerable
Redfin bully	Gobiomorphus huttoni	At Risk, Declining
Longfin eel	Anguilla dieffenbachii	At Risk, Declining
Torrentfish	Cheimarrichthys fosteri	At Risk, Declining
Bluegill bully	Gobiomorphus hubbsi	At Risk, Declining
Inanga	Galaxias maculatus	At Risk, Declining
Koaro	Galaxias brevipinnis	At Risk, Declining
Dwarf galaxias	Galaxias divergens	At Risk, Declining
Banded kokopu	Galaxias fasciatus	Not Threatened
Giant bully	Gobiomorphus gobioides	Not Threatened
Black flounder	Rhombosolea retiaria	Not Threatened
Cran's bully	Gobiomorphus basalis	Not Threatened
Upland bully	Gobiomorphus breviceps	Not Threatened
Common smelt	Retropinna retropinna	Not Threatened
Common bully	Gobiomorphus cotidianus	Not Threatened
Shortfin eel	Anguilla australis	Not Threatened
Australian longfin eel	Anguilla reinhardtii	(natural) Colonizer
Yellow-eyed mullet	Aldrichetta forsteri	Not Threatened
Grey mullet	Mugil cephalus	Not Threatened
Estuarine triplefin	Grahamina sp.	Not Threatened
Rainbow trout	Oncorhynchus mykiss	Introduced and Naturalised
Brown trout	Salmo trutta	Introduced and Naturalised
Gambusia	Gambusia affinis	Introduced and Naturalised
Goldfish	Carassius auratus	Introduced and Naturalised

How freshwater health effects will vary across Hawke's Bay riverscapes

Based on current information, it is not possible to predict the fine sediment load reduction within Hawke's Bay aquatic systems that would result from reducing sediment erosion in surrounding farmland areas by 25%. Nevertheless, aquatic ecosystems generally display monotonic stress-response relationships to increased fine sediment loads. Therefore, any substantial reduction in fine sediment loads is likely to result in some level of improved ecological health. Reductions in

suspended sediment load are likely to benefit aquatic ecology in all aquatic habitats through increased water clarity. However, the degree of aquatic ecological benefits of the LfL programme will vary greatly across the Hawke's Bay Region. Some ecosystems will show relatively rapid improvements (in the order of months to years), whereas others may take decades to improve or potentially show a very limited response. For example, if a low-gradient spring-fed stream has received substantial fine sediment inputs in the past, and lacks stream power to mobilise embedded sediment, ecosystem effects will likely be irreversible, even if fine sediment supply rates are returned to natural levels (Gayraud et al. 2002; Lake et al. 2007). In contrast, preventing sediment from entering relatively unimpacted spring-fed streams represents an opportunity to maintain ecological health in vulnerable systems. Rivers and streams that have sufficient stream power to mobilise legacy fine sediment (stored in the riverbed) are likely to receive the most benefit from reduced sediment supply. These systems will develop a more heterogeneous substrate over time (after successive floods and freshes) and will eventually be able to support a more productive and diverse aquatic ecology.

Prioritisation of LfL initiatives while maximising aquatic health / biodiversity benefits

While there are many social, cultural and economic aspects to determining how the LfL programme should be rolled out, maximising aquatic ecological health benefits should also be considered. Undertaking a landscape-scale investigation to determine where the LfL programme can maximise aquatic ecological gains would be useful. In lieu of such an investigation, at a broad level, priority should be given to catchments and sub-catchments that have lakes downstream, as lakes will likely benefit from reduced sediment and sediment-bound phosphorus supply. Systems with spring-fed streams (that are relatively unimpacted by fine sediment) should also be considered. Typically these systems have limited flushing power and are particularly vulnerable to fine sediment pollution. Finally, rain-fed streams and rivers that are currently degraded by high levels of deposited fine sediment have the greatest potential for restoration though reduced sediment supply. Identifying systems with high native fish biodiversity is another potential way to prioritise implementation, and this can be carried out using the fish distribution data in the National Freshwater Fish Database (NZFFD; https://nzffdms.niwa.co.nz/). The programme should target systems with high native fish diversity and communities overrepresented by threatened 'riffle guild' species (such as torrent fish, kōaro and bluegill bullies).

Aquatic ecological effects of field leakage of N and P

The target proposed in the BC is 'Reduced field level leakage of N of 257,065 kg annually achieved over time from ~5% of farmland in plantation forestry/retirement'. An equivalent target for reduced field leakage of P is not currently included in the BC.

At high levels, N can be a serious stressor for freshwater flowing waterways and receiving environments in estuaries and coastal marine systems. While a reduction of N losses to waterways is meritorious, this also needs to be considered alongside the potential for decreased losses of phosphorous (P) to waterways. P is bound to and carried by sediment so there is a close relationship between sediment losses to waterways and elevated P levels in receiving waterways. More than 80% of monitored river sites in Hawkes Bay have levels of P where adverse effects would be expected (Hawkes Bay SOE Report 2018-2021). A significant reduction in sediment erosion is likely to result in substantial benefits for receiving waterways, although these will vary depending on where the reductions in sediment erosion occur and the scale of sediment reduction by waterway and catchment. This will obviously also be important for wetlands and lakes that are subject to improved management in their contributing catchments.

Through LfL interventions, any reduction in N and P loading to waterbodies in the Hawke's Bay will to some extent reduce eutrophication in lakes and estuaries, as well as the duration and extent of benthic periphyton blooms in waterways. Periphyton blooms are a recognised problem in many of

Hawkes Bay's rivers, particularly during summer low flows (Rutherford 2012). Reduced algal blooms will, in turn, improve conditions for aquatic biota through a host of linked improvements to habitat and water quality (Biggs 2000a, Biggs 2000b). At this stage it is not possible to quantify the extent of biodiversity benefits from reduced nutrient loads, as this will depend on the current state of aquatic habits within (and downstream of) the areas where LfL is implemented. Nevertheless, any reduction in nutrient pollution within the farmed landscapes of Hawkes Bay can be seen as a positive step towards more resilient and healthy aquatic communities.

In addition to changes in land use, there is considerable potential for additional reductions in nutrient losses to waterways by improving on-farm management of fertiliser inputs (while maintaining pasture production).

Improved management or protection of wetlands and lakes (1,440 ha)

This is another important element of the BC. As noted above, this will include reduction of sediment and nutrient inputs and physical protection by retirement of riparian buffers, fencing, and control of damaging pest plants and animals. For some wetlands there will be a need to improve hydrological management (i.e., water inflows and/or outflows), which may require structures to manage water levels.

Wetlands across the region have been heavily depleted and reduced to 2% of the original extent, with 40% having some type of formal protection but these are mostly in montane environments. Most wetlands in lowland environments are on private land and have little protection (Hawkes Bay Biodiversity Inventory 2014). Wetlands are biodiversity hotspots but also provide critically important roles with sediment entrapment and nutrient buffering for receiving waterways. The LFL programme in the next stage is estimated to improve management of, or protect, 2,000 ha of wetlands within the boundaries of participating farms (which is 17% of the total, 11,779 ha, in pastoral environments). Opportunities to optimise this proportion - through the farm selection process, along with an aspiration to protect 100% of wetlands (and lakes) on participating farms - would only further increase the significance of LfL benefits for nature.

There will likely be additional benefits to other wetlands or lakes downstream from participating farms (in the same immediate catchment), but this is not captured in metrics at this stage as it will be highly dependent on the location of farms selected.

Pastoral environments pose high levels of threats for wetland sustainability due to the high levels of sediment and nutrient losses into wetlands, and the long-term effects of damage by unrestricted domestic stock. Where present, wetlands play a critical role in buffering downstream catchments from the potentially adverse effects of upstream land uses.

There are similar issues with lakes (3177 ha) in pastoral environments, which are particularly vulnerable to degradation due to land use effects.

Improved management of estuaries and coastal marine areas

The Hawke's Bay Region includes three larger estuaries - Ahuriri, Waitangi, and Porangahau – all of which have very high values for ecosystems, habitats, and species, and also various other smaller estuarine systems. Sediment is a major stressor of estuarine systems and reduction of sediments loads into these environments will be a positive outcome of the LfL programme. The same applies to the extensive coastal marine area (742,000 ha) and associated ecosystems, including the elements utilised for gathering of kai moana and for recreational and commercial fishing.

Aquatic monitoring

It has been demonstrated that maintaining less than 20% deposited fine sediment cover in rivers and streams (at the reach scale) maintains populations of Ephemeroptera (mayflies), Plecoptera

(stoneflies), and Trichoptera (caddisflies) (EPT taxa) (Clapcott et al. 2011; Burdon et al. 2013). EPT taxa are important organisms because they are a key food source for fish and river birds. Achieving reductions of deposited fine sediment to levels that are below 20% cover will ensure biodiversity gains and is an appropriate target for the LfL programme. This target is in line with the National Policy Statement for Freshwater Management (NPS-FM). The Sediment Assessment Protocols contain a range of methods for assessing deposited fine sediment (Clapcott et al. 2011). These methods could be used to underpin Before-After Control-Impact assessments in waterways in the LfL implementation areas. Modelling and measuring changes in fine sediment load should be considered as an option to measure success. Deploying continuous turbidity loggers to collect baseline information on suspended sediment load – combined with stream discharge information and water samples – could be used to model suspended sediment load. However, determining the precise data requirements of these studies is beyond the scope of this document.

5.2. Potential terrestrial ecosystem health / biodiversity benefits

The relevant metrics in the BC related to terrestrial ecosystem health and biodiversity are:

Across 300 farms with Comprehensive LfL Farm Plans (with long term resilience focus)

- 16,150 ha of remnant indigenous vegetation under protection.
- 48,926 ha of land protected through new afforestation and agroforestry activities (representing c. 15% of farm area planted, comprising 9.82% in poplar poles, 4.00% in exotic rotation forestry, 0.84% in permanent native afforestation).
- 292,267 ha of land under best management practice and regenerative interventions.

Across a further 300 farms with Erosion and Biodiversity Plans (i.e. with recovery focus and a "stepping stone" to a Comprehensive LfL Farm Plan)

- 5,040 ha of additional pole planting.
- 235 ha of additional biodiversity protection.

State of biodiversity in the region

The Hawke's Bay Region has very extensive areas of highly depleted landscapes with less than 10% indigenous cover remaining, and less than 2% of the original extent of freshwater wetlands. Receiving waterways – freshwater, estuarine, and marine - have been seriously affected by sediment losses from land. Importantly, there are also very extensive areas with 10-20% indigenous cover remaining, with scattered remnants, and restoration opportunities are available throughout that part of the region. There is a strong overlap between the parts of the region with 10-20% indigenous cover and extensive areas with a slope of more than 20 degrees (e.g., the Wairoa catchment), which means that there are likely to be greater opportunities for relatively easy gains in terms of the potential to increase indigenous cover in those areas by the protection and encouragement of natural regeneration.

Improving management or protecting of existing indigenous vegetation and biodiversity (16,150 ha + additional 235ha)

The 'easiest', and most cost-efficient, way to protect and enhance indigenous biodiversity is to protect what remains and to use this as the basis of a restoration programme going forward. This is a very positive part of the programme. Most parts of the region, apart from the inland ranges, are highly depleted of indigenous vegetation so every opportunity needs to be taken to protect the full range of regenerative states, from early successional scrub and shrubland through to tall forest. It will be important to recognise the value of early successional plant communities, generally grazed and with relatively low species diversity, to achievement of the indigenous vegetation cover targets of the LfL programme.

Improved management or protection of indigenous vegetation is currently defined in the BC as requiring 'stock exclusion, planting and pest control' (which necessarily includes exclusion or control of feral goats and deer).

However, the BC is currently silent on the role of legal protection (e.g., use of legal covenants or kawenata (e.g., QEII covenants, Ngā Whenua Rāhui kawenata, Land Improvement Agreements between the funders and landowners), and there is an opportunity to encourage and support application of such legal protection through the LfL programme. Estimating the potential uptake of such tools would require careful investigation in the next stages of the project.

Improved management of land through afforestation and agroforestry (48,926 ha)

The current benefits based on pilot farmer preferences are heavily weighted to exotic afforestation and agroforestry. The programme will lead to more diverse landscapes across the region, with a mixture of exotic and indigenous forest and treeland. There will be some benefits for indigenous biodiversity as exotic forests also provide habitats for a reasonably diverse range of indigenous bird species.

However, the target for indigenous revegetation is too low and needs to be reset to recognise ecological understanding of the rate of biodiversity loss when indigenous cover drops to below 20%. A very significant part of the region has less than 10% indigenous cover, which is not even a minimum requirement to have any hope of retaining ecological resilience in these landscapes. More recent evaluations have found that at least 20% of indigenous cover is required to sustain indigenous biodiversity in Aotearoa's landscapes. It is readily evident that more than half of the Hawkes Bay Region is below this threshold. These are primarily the intensively farmed landscapes, which extend in a broad swath north-south across the region.

The broad pattern of land use and modification is reflected in the Threatened Environment Classification for the region, as attached. this reflects the representation of indigenous vegetation in predominantly pastoral environments, as set out in the table below:

Catchment Name	Total Catchment Area (Ha)	Veg Area (Ha)*	% cover
Manawatu River	3335	88	2.63
Ngaruroro River	336049	21239	6.32
Porangahau River	79092	6725	8.50
Tukituki River	249851	8121	3.25
Mohaka River	242694	15635	6.44
Wairoa River	262960	28965	11.02

* Downstream of main indigenous cover in catchment headwaters.

These areas and percentage covers were calculated for each catchment by removing the extensive areas of indigenous cover on the inland ranges. While somewhat crude (e.g., the average across the six catchments is about 6.4%) these metrics nevertheless indicate the scale of revegetation required to attain an indigenous cover of 15-20%. It should also be noted that catchment-based planning and implementation is most likely to occur at a sub-catchment scale and that further evaluation will be required catchment-by-catchment to identify where indigenous elements remain and where the most cost-effective gains can be made.

The return of indigenous cover will be a long-term process and it needs a significant boost. The next stage of the LfL Programme provides a platform for that to get underway and to markedly accelerate

the recovery process. And with opportunities to further scale this in the Hawke's Bay (as well as other regions) beyond this – refer to section 6.2.

A long-term strategic approach is required to return indigenous biodiversity to Hawkes Bay landscapes, for the betterment of future generations and the environment. Targets need to be established, for farms and catchments, and sub-catchments, for the return of ecologically-appropriate indigenous cover and habitats (e.g., 20% indigenous cover).

Acknowledging the current indigenous vegetation areas above, the following targets have been established to achieve upsides for nature in the next stage (i.e. across the 300 farms with comprehensive farm plans). These are aspirational targets, but achievable through the mechanisms identified later in this paper.

Table 2: Estimates of new planting areas, including the average proportion of farms planted (as a proportion of total farm area) and hectares to be planted for native and exotic afforestation and agroforestry.

	Current BC metrics		Adjusted (upsides for nature)		National scale	
	% of farm	*ha*	*% of farm*	*ha*	*ha (X8)*	*ha (X10)*
Native afforestation*	0.9%	3,262	5%	17,940	143,517	179,397
Exotic afforestation	3.6%	13,046	5%	17,940	143,517	179,397
Agroforestry (native)**	0.0%	0	3%	10,764	86,110	107,638
Agroforestry (poles)	9.1%	32,618	7%	25,116	200,924	251,155
Total planting	**13.6%**	**48,926**	**20%**	**71,759**	**574,069**	**717,586**
Total farm area		**358,793**		**358,793**	**2,870,344**	**3,587,930**

**This will require innovation (e.g., lower planting costs and alternate settings (e.g., changes to ETS settings, voluntary carbon markets, biodiversity credits).*

***This will benefit from a research programme and trials to address barriers and demonstrate the value of native spp. (e.g., kānuka, tōtara) for agroforestry to lift this proportion of native planting.*

Achieving these targets requires a strong focus on strategic imperatives and requirements, including:

- Establishment of indigenous riparian cover along waterways (because restoration of indigenous vegetation along waterway margins will provide much improved conditions for stream ecosystems).
- Establishment of linkages/corridors between existing indigenous remnants.
- Recognition of existing early successional indigenous regeneration and the need to allow such sites to regenerate naturally.
- Establishment of 'mountains to sea' linkages.
- Establishment of ecological islands scattered through the farmed landscape.
- Priorities to re-establish indigenous biodiversity in heavily depleted parts of the landscape.

Indigenous agroforestry is garnering increased interest in some rural landscapes, such as the Northland Tōtara Working Group (NTWG) which was established in 2005 to promote the management and support the research of naturally-regenerating tōtara trees on farms for multiple purposes including sustainable timber-production and a wide range of environmental benefits.

This approach also needs to better recognise that many landowners want to protect and establish more indigenous vegetation on their properties. Although there is probably little data on these landowner aspirations, this is nevertheless a clear message that being articulated, and implemented,

by many rural landowners across the country. In addition to the obvious biodiversity gains associated with such initiatives, there is increasing recognition that retirement of land 'marginal' for farming often results in no decrease in farming productivity. There is also a strong push, in some cases a requirement, for primary producers to address and meet demands from customers to improve environmental sustainability. This has resulted in guidance and standards being set by Beef and Lamb NZ and the dairy farming industry. For example, Beef and Lamb NZ have identified two key goals: every sheep and beef farm having a tailored and active environment plan and the sheep and beef sector as a whole moving towards carbon neutrality by 2050. They are also rolling out a range of environmental initiatives to support sheep and beef farmers, including a Collaborative Catchment Communities programme to help communities work together to target water quality, greenhouse gas emissions, biodiversity, and soil health issues. International standards and certification is now a longstanding feature of the plantation forest industry.

It should also be recognised that new and innovative lower cost planting processes and financial incentives and returns for indigenous vegetation are likely to change, in the relatively near future. This includes imperatives for better recognition of carbon sequestration rates by indigenous vegetation, and the likelihood of new and innovative approaches to the `recognising the value of biodiversity protection and enhancement' are likely, e.g., see Muller *et al.* (2023) and Waterford and Fitzsimons (2022) – also refer to Section 7 below).

Land under Best Management Practice (BMP) and regenerative interventions (292,267 ha)

The approach to pastoral farming interventions is set out in the BC and includes two pathways for farmers, a BMP pathway and a regenerative farming pathway. This includes provision for a small number of willing farmers to participate in established regenerative farming schemes, where LfL can support this in partnership with meat processors and marketers (market testing revealed potential to partner with several progressive meat processors already pursuing adoption of regenerative farming opportunities. There are opportunities in the next stage to leverage significant regional and national investments in regenerative farming research and extension services.

5.3. Potential climate benefits

The relevant metrics in the BC related to terrestrial ecosystem health and biodiversity are:

Across 300 farms with Comprehensive LfL Farm Plans (with long term resilience focus)

- an estimated 15 million tCo2e sequestered over 30 years
- additional 76,650 tCo2e reduced from livestock emissions over 30 years

Carbon sequestration (15 million tCo2e)

Carbon sequestration estimates are largely based on the amounts of carbon to be sequestered in planted radiata plantations and poplar pole stands. However, it should be noted that there is now good evidence that both planted indigenous stands and naturally-regenerated woody vegetation can sequester significant amounts of carbon, and this can potentially be in perpetuity. A relevant overview of sequestration rates is provided by Kimberley et al. (2021) and the following summary of the current state of knowledge is from that publication:

"New research demonstrates that well-managed planted indigenous forest is better at sequestering carbon and faster growing than commonly considered.

Data from Tāne's Tree Trust Indigenous Plantation Database show that:

- Carbon sequestration for planted forests of tōtara, kauri, kahikatea, rimu, other conifers, pūriri, beech, and other broadleaves is in the range:
  - 10.0 to 16.4 tCO2 ha-1 yr-1 (mean annual increment over 50 years) and
  - 18.2 to 29.9 tCO2 ha-1 yr-1 (current annual increment over 50 years)

- Growth rates of these native tree species increase steadily over the first 50 years achieving higher productivity as well as carbon sequestration with age.

This research is a first for planted native forest using methodology comparable to that used for planted radiata pine forest in New Zealand (mean annual increment is 21 to 27 tCO2 ha-1 yr-1 for radiata pine at age 50 years).

New Zealand's Carbon Look-up Tables for the Emission Trading Scheme should include the option for planted native forest as well as regenerating native forest.

The current Carbon Look-up Tables for natives is currently accurate only for naturally regenerating kānuka/mānuka shrubland (6.5 tCO2 ha-1 yr-1 mean annual increment over 50 years). However, Tāne's Tree Trust data indicates that, while lower than planted native forest, naturally regenerating native forest can still achieve good levels of sequestration over a long timeframe with the inclusion of climax tree species such as tōtara.

Landowners can be encouraged by this new research. The difference between pine and well managed planted native forest is much less than is often suggested. Planted native trees will store carbon at a growing pace as they age, as well as enhancing natural landscapes, indigenous biodiversity and cultural values."

Tāne's Tree Trust also provides an on-line carbon calculator which indicates, as an example, that planting of 3,000 stems – in a mixture of 25% tree species and 75% shrub species - will sequester 663.52 tonnes of CO2 from the atmosphere after 50 years. This is a generalisation and the actual amount sequestered will depend on site quality, stand character, and management.

It should also be noted that there is now good evidence (Mackay-smith et al. 2022) that the presence of kānuka trees and small kānuka stands can increase the pasture production in hill country farms, while creating multi-functional landscapes that enhance both grazing production and environmental outcomes for pastoral farms.

Such matters are appropriately considered as part of the New Zealand Emissions Trading Scheme (ETS) review and wider consideration of alternative or complementary mechanisms to achieve New Zealand's commitments and policy objectives relating to climate and biodiversity outcomes.

There are many opportunities to incorporate new techniques for transitioning exotic forestry to native forests over time (e.g., The Tīmata Method for Low-Cost Native Forest - Our Land & Water - Toitū te Whenua, Toiora te Wai (ourlandandwater.nz). These take advantage of providing ETS revenues initially from faster sequestering exotic species and through a rotational system, transitioning to planting of indigenous species. This system can significantly reduce planting costs per hectare.

There are no sequestration benefits claimed in the BC associated with improvements soil carbon (as a result of regenerative interventions) or with blue carbon (associated with improved management of wetlands or estuaries).

Emissions reductions (additional 76,650 tCo2e)

The current emissions reduction benefits in the BC are in relation to reduced numbers of livestock as a result of retiring land.

There are no emissions reduction benefits claimed in the BC associated with improvements in pastoral farming systems (e.g., improvements in feed and nutrition, animal genetics, pasture management, animal health, fertiliser use, renewable energy and energy-efficient equipment etc.). Realisation of such additional benefits will be addressed primarily through the extension

programme, but the extent to which such benefits might be achieved, and specific investments or initiatives to accelerate these, could be further investigated in the next stage of the project.

6. Strategic view of metrics and targets that optimise gains for nature (and contribution TNC 2030 Goals)

This section provides a view of updated metrics and associated targets to be included in the BC, which optimise benefits for nature. It then considers wider scaling potential and illustrates the contribution of updated LfL metrics and associated targets to TNC's 2030 goals for relevant metrics (information that TNC leadership has specifically requested).

6.1. Recommended view for the business case (the next stage of LfL in the Hawke's Bay)

Based on advice above in order to optimise gains for nature LfL benefits need to be reset as follows:

- **Increasing the overall level of planting to 20% of farms.**
- **Returning ecologically-appropriate indigenous cover and habitats to 15-20% indigenous cover across catchments.**
- **Increasing the proportion of native planting to approximately 40-50% of total new planting area (toward achieving the 15-20% indigenous cover and habitat target above).**

Recommendation: Agree that the benefits be reset (as above and included in the BC)

Table 3 provides a strategic view of metrics and targets that LfL needed to optimise outcomes for nature during the next stage, consistent with the reset of benefits proposed above. This information is specific to the next stage of the LfL project, which targets scaling to 300 farms with Comprehensive LfL Farm Plans (with long term resilience focus), and a further 300 farms with Erosion and Biodiversity Plans (i.e. with recovery focus and a "stepping stone" to a Comprehensive LfL Farm Plan).

Figure 2 illustrates how the recommended metrics contribute to TNC's 2030 Goals and associated metrics, by 2030 and after 30 years.

Recommendation: That the strategic view of metrics and targets (set out in section 6.1 of this report) be included in the BC

Table 3: Key LfL metrics and targets needed to optimise outcomes for nature during the next stage of the LfL project in the Hawke's Bay.

Key LfL Outcomes	*Outcome/ Benefit area*	*LfL HB targets (2030)*	*LfL HB targets (2053)*	*Explanation/Assumptions*
Climate change mitigation and adaption	Climate	Limited Co2e sequestered due to plants being so recent 610,000 tCo2e emissions reduced	17.5M tCo2e sequestered 1,013,000 tCo2e emissions reduced	Carbon sequestered through afforestation Carbon emissions reduced through land use change (livestock reductions)
Improved aquatic & terrestrial biodiversity health Improved soil conservation and health Resilience to extreme weather events	Freshwater, Oceans, Land	12,600 km of rivers with improved management 1,200 ha of wetlands with improved management 1,500 ha of lake area with improved management 360 ha of estuaries with improved management 19,000 ha of coastal marine area with improved management 5-10% increase in indigenous cover (aiming for 15-20% indigenous cover in all catchments) 16,385 ha of land with improved management or protection (existing forest remnants) 43,055 ha of land with improved management (afforestation/agroforestry, with the following breakdown: • native afforestation – 10,764 ha • exotic rotation forestry – 10,764 ha • agroforestry (native) – 6,458 ha • agroforestry (poles) – 15,069 ha 292,267 ha of land under best management practice and regenerative interventions Additional key project metrics: • Reduced sediment erosion by 1-5% • Reduced field level leakage of N of 257,065 kg annually • Reduced field level leakage of P in line with sediment reduction, reduced stock numbers and BMP fertiliser usage (to be modelled)	21,000 km of rivers with improved management 2,000 ha of wetlands with improved management 2,500ha of lake area with improved management 650 ha of estuaries with improved management 32,000 ha of coastal marine area with improved management 10-15% increase in indigenous cover (aiming for 15-20% indigenous cover in all catchments in the next stage of scaling in the HB region) 16,385 ha of land with improved management or protection (existing forest remnants) 71,759 ha of land with improved management (afforestation/agroforestry), with the following breakdown: • afforestation (native) – 17,940 ha • afforestation (exotic) – 17,940 ha • agroforestry (native) – 10,764 ha • agroforestry (poles) – 25,116 ha 292,267 ha of land under best management practice and regenerative interventions Additional key project metrics : • Reduced sediment erosion by 25% • Reduced field level leakage of N of 257,065 kg annually • Reduced field level leakage of P in line with sediment reduction, reduced stock numbers and BMP fertiliser usage (to be modelled)	Improved management of rivers, lakes or wetlands includes: • riparian and other restoration planting • reduced sedimentation and nutrient runoff (as a result of afforestation and BMP) • stock and pest exclusion/fencing • pest and weed control, restoration planting Improved management of land includes a mosaic of afforestation and agroforestry land uses, with farming BMP across the balance of farms (best practice/regenerative farming practices) Assumes 60% of planting targets achieved by 2030. [Note permanent legal protection through "covenants" will be an option promoted, but level of uptake has not been estimated]

Key LfL Outcomes	*Outcome/ Benefit area*	*LfL HB targets (2030)*	*LfL HB targets (2053)*	*Explanation/Assumptions*
Farmer/Farming community well-being & resilience	People	600 farms/farmers (with benefit to their wider families and staff) supported Approximately 68 marae participating and benefiting* People in HB rural communities with increased sustainable, place-based economic opportunity** People in the HB that benefit within rural communities participating, and rural and urban communities downstream** Project IRR that is sufficient to incentivise landowner participation at the levels required***	600 farms/farmers (with benefit to their wider families and staff) supported Approximately 68 marae participating and benefiting* People in HB rural communities with increased sustainable, place-based economic opportunity** People in the HB that benefit within rural communities participating, and rural and urban communities downstream** Project IRR that is sufficient to incentivise landowner participation at the levels required***	

*Approximately 40 of the marae in HB (68 marae in total) are in rural areas that would directly benefit from LfL through increased biodiversity, cultural value, environmental values and economic benefits such as increased jobs and more resilient farms. The remaining marae would receive indirect benefits through flood mitigation, infrastructure protection and as a service centre for rural areas.

**People targets will be further developed in the next stage.

*** Project IRR of 10.35% over 30-yr period under a neutral scenario identified in the BC. This is likely to be influenced over time by our strategic imperatives, community vision for LfL, the balance of interventions at a landscape scale, and financial mechanisms available to realise nature benefits (e.g., biodiversity credits, payment for ecosystems services etc.) over the term of the Programme

Recommendation: That the strategic view of metrics and targets (set out in section 6.1 of this report) be included in the BC

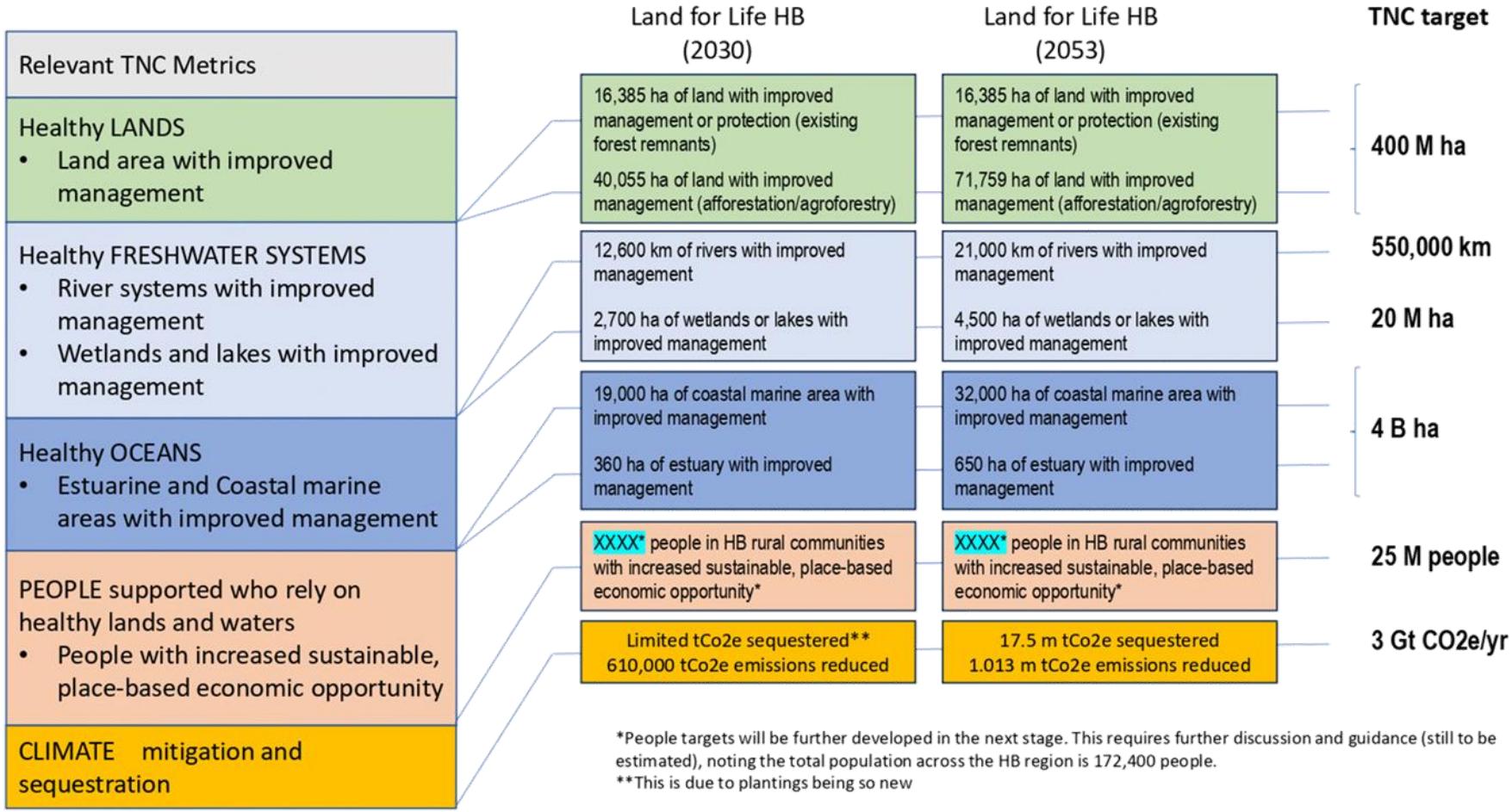

Figure 2: Estimated contribution LfL will make in the Hawkes Bay make to TNC 2030 metrics and targets, by 2030 and after 30 years

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6.2. A view of metrics and targets if scaled in the Hawke's Bay and to other regions (and contribution to TNC 2030 metrics)

The BC outlines potential for nation-wide scaling of LfL, including information on the number of potential target farms in the Hawke's Bay regions and potential applicability to other regions.

The targets in Table 3, above, do not take into account this further scaling potential and associated benefits in the Hawke's Bay region, which is estimated as **a factor of 2X** relative to benefits listed in the BC (approximately double the number of farms with Comprehensive LfL Farm Plans and associated farm area).

Nor do the targets in Table 3, above, take into account nation-wide scaling potential to other regions, which is estimated as **a factor of 8-10X** (this is based broadly on the scale of the farming in the Hawke's Bay region compared to other regions with similar problems that LfL is well positioned to address, namely Northland, Gisborne, Manawatū-Whanganui, Wellington/Wairarapa, Tasman). [Note this is estimated based on relative area of farms in these regions based on Statistics NZ 2020 Farm data: Farm numbers and size | Stats NZ).

Figure 3 provides an indication of the potential contribution LfL could make to TNC 2030 metrics if scaled in the Hawke's Bay and nationally after 30 years, applying a factor of X8-X10 as above. [Note the contribution by 2030 has not been estimated, as the timing of scaling decisions and planning/lead in times will determine this, and these have not been estimated]

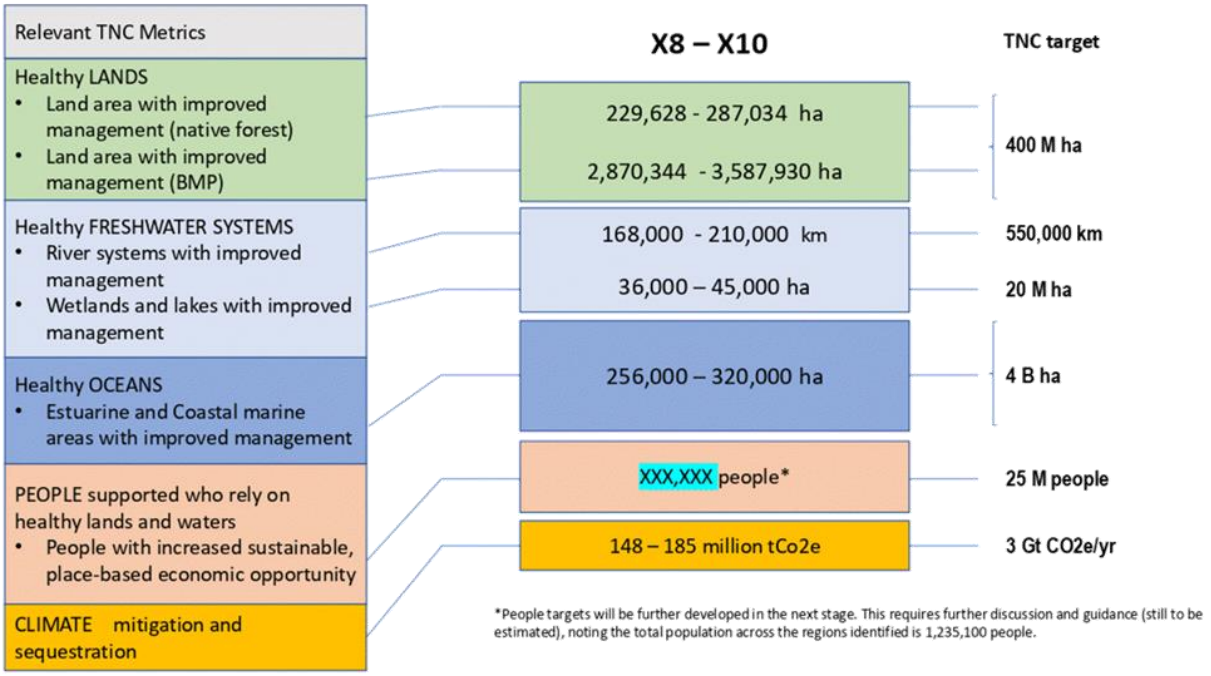

Figure 3: Estimated contribution LfL will make to TNC 2030 metrics if scaled in the Hawke's Bay and nationally after 30 years.

6.3. Additional benefits not accounted for in the business case

The BC does take into account of a range of potential "additional" benefits, and it is recommended these are further investigated, and estimated where possible, in the next stage of the project. These include additional:

- future impacts avoided, including impacts on public safety, infrastructure, homes, possessions and livelihoods downstream during weather events (each dollar invested in proactive riverine management, such as afforestation, saves $7 in post-flood recovery costs).
- reduced erosion and sediment supply leading to reduced river channel infilling. To some extent this will reduce HBRC's requirements to extract gravel from aggrading segments of braided rivers channels, which is currently necessary to protect infrastructure and prevent flooding.
- emissions reduction and other benefits associated with improvements in pastoral farming systems (e.g., improvements in feed and nutrition, animal genetics, pasture management, fertiliser management etc.)
- ecosystem services benefits, such as impacts avoided on downstream fisheries, water quality, groundwater infiltration and recreation.
- Cultural benefits associated with relationship between Māori, their culture, and their traditions and their ancestral lands, waters, sites, wāhi tapu, and taonga, including restoring and futureproofing the pre-colonial transfer of mātauranga Māori
- Biodiversity benefits associated with threatened species protection or reintroductions

Recommendation: That the potential additional benefits (listed in section 6.3 of this report) be further investigated in the next stage of the project

7. Pathway to realise gains for nature

Potential strategic approaches to ensure gains for nature (targets in the previous section) are realised are set out below. This complements the approach to implementation already laid out in the BC, informed by prior research, survey and market testing summarised in the BC.

A. Developing overarching strategy/vision and policies for LfL, through processes inclusive of landowners, communities, mana whenua and key stakeholders

The BC needs to provide for development of a clear, land-owner and community aligned, vision and strategy for LfL. This will include an overarching vision, goals and objectives (what the project is aiming to achieve, where, and when, and how the targets fit within the overall goals for indigenous biodiversity (and soil and water conservation) within Hawkes Bay landscapes.

An example of a vision is:

'Papatuanuku is cloaked by an interconnected network of indigenous vegetation and habitats, based on waterways, extending from the mountains to the sea, to maintain the mauri (life force) of terrestrial, freshwater, estuarine, and marine ecosystems.'

Such a vision will need to be owned by governance and subject to community engagement and soundly grounded in the landowner, catchment groups, and tangata whenua communities of the region, and the regulatory environment.

The BC also needs to provide for setting clear policies to guide catchment- and farm-scale planning processes and the outcomes these need to achieve. For example, a long-term strategic approach is required to return indigenous biodiversity to Hawkes Bay landscapes, for the betterment of future generations and the environment.

Targets need to be established, for farms and catchments, and sub-catchments, for the return of ecologically-appropriate indigenous cover and habitats, e.g. 20%.

B. A strategic approach to catchment-scale planning, through processes inclusive of landowners, communities, mana whenua and key stakeholders

A catchment-based strategic approach is required that provides ecological connectivity with existing native forest areas, along catchments, and connectivity between sub-catchments.

We recommend that the Steering Group confirm targets for native afforestation (and potentially other biodiversity-related outcomes) on a catchment-by-catchment basis through community-based catchment plans.

This entails a strategy of concentrating our effort when rolling out LfL to priority catchments by:

- working with existing catchment groups that are well organised and prepared to engage,
- focusing where there is highest potential to achieve uptake (i.e. there is likely to be a critical mass of farmers ready and willing to participate)
- prioritising effort where there is potential to maximise outcomes (i.e. highest potential to reduce erosion, maximise biodiversity benefits etc.).

There would be merit in aligning the programme to catchment-based landowner/ community/mana whenua groups. This includes opportunity to leverage existing catchment groups/community hubs and integrated catchment/resilience planning initiatives that MPI and HBRC are investing in. These groups could even become part of the priority setting and funding approval process for the programme.

We envisage an overarching output of this process being a series of catchment plans (or part of an integrated catchment plan) that identifies the aspirations or vision of the community for LfL in their catchment/rohe. Such catchment plans would, amongst other things, identify the optimal land for native afforestation considering factors such as connectivity (e.g., ecological corridors), cultural and heritage considerations, and Land Use Classification (i.e. which gives a measure of likely suitability or otherwise for different productive or non-productive purposes, based on limiting factors such as soil type and erodibility).

We envisage that such processes will be shaped by communities, with benefit of input from appropriate experts (ecological/conservation, cultural, farming, afforestation, scientists) and key agency support (including HBRC, MPI, MfE, DOC, and TNC). Groups will be supported with a range of tools (e.g., 3D mapping, GIS, modelling and other conservation planning tools) and other opportunities (e.g., site visits to catchments or farms that demonstrate what's possible) that help communities to visualise and shape their LfL vision. Farmers will be supported to estimate and maximise and gains impacts for people, farm landscapes and nature and ensure alignment with overall outcomes and strategic intent of LfL. The collective nature of these groups allows for learning to occur at pace and with peer support and for provisions one stop training and educational situations.

We envisage that catchment-level plans will be ultimately owned by communities - including landowners, mana whenua and other key community leaders – with Steering Group endorsement. We envisage that catchment-level plans will then guide and shape individual farm level plans and those preparing these, and enable the Steering Group to set "catchment-scale" native afforestation targets for those preparing farm plans.

C. Strengthening integration with existing and emerging biodiversity programmes and other related programmes and initiatives

The BC needs to provide for a more integrated approach to the enhancement of biodiversity and soil and water conservation. These imperatives are closely linked, and, ultimately, the approach needs to recognise that indigenous cover is a preferred approach, in particular where difficult access, poor harvestability or long-term erosion control, without roading or harvest impacts, are drivers for reasonably extensive parts of the target landscapes.

The BC already recognises opportunity to integrate LfL with HBRC's existing grant-based programmes to support achieving biodiversity outcomes, including:

- The Priority Ecosystem Programme.
- The Protection and Engagement Programme.
- Targeted Catchment Work Fund.
- Environmental Enhancement Fund.

There are additional community groups and initiatives with kaupapa that focuses on protecting local biodiversity and taonga species, giving effect to kaitiakitanga and embracing mātauranga. We envisage LfL operating "alongside" these, with LfL playing a connecting role (working closely with others, such as DOC, TPK, MPI, Trees that Count etc.) to help catchment groups, mana whenua, whenua Māori and individual landowners to tap into additional support and opportunities.

There are other aligned initiatives with which LfL can continue to explore potential for collaboration, including:

- Pure Advantage: Recloaking Papatūānuku.
- Reconnecting Northland.
- Toha.
- Tāmata Hauhā.

<u>Pure Advantage</u>

TNC and Pure Advantage have already signed an NDA to facilitate information sharing between LfL and Pure Advance in relation to its initiative, "Recloaking Papatūānuku" (RP). RP is an ambitious new project that aims to strategically restore and enhance at least 2.1 million hectares of indigenous forests across Aotearoa New Zealand over the next 10 years.

We understand that several policy options for achieving RP are proposed, with a recommended option being that the Crown funds reforestation, gets carbon credits in return and covers all upfront costs, while landowners pay 100% of maintenance costs and receive a yearly incentive payment to support land use change (modelled at 150% of the average productivity of their land) provided that a permanent forest is maintained. We understand this is still at a conceptual stage, with further work underway on incentive design, policy evaluation, market development, and implementation planning (the LfL BC has been shared with Pure Advantage to assist this). And a decision on this model still to be taken by the NZ Government.

We also understand the primary focus of RP implementation is likely to be on marginal and non-productive lands in public and whenua Maori ownership cf. working with farmers in pastoral landscapes. And that RP has not done the groundwork needed to understand how this policy option/model would be implemented in practice in a pastoral context (which has been done for the LfL model).

There appears to be complementarity, and significant synergies and opportunity for collaboration, between RP and LfL initiatives and models. LfL revenues are currently modelled based on current ETS settings (which are sub-optimal as they do not recognise co-benefits to nature, such as

biodiversity co-benefits), and RP represents one of several key potential future policy mechanisms to strengthen those incentives for native afforestation (biodiversity credits and voluntary carbon markets being two other examples).

Recommendation: That potential synergies and collaboration between Recloaking Papatūānuku and LfL, along with other related initiatives and programmes, continue to be explored in the next stage of the project.

D. Pursuing opportunities to further strengthen the mechanisms that improve incentives for investment in nature

Financial incentives and returns for indigenous vegetation are likely to change, in the relatively near future. Areas of potential opportunity to further explore in the next stage of the project are outlined below.

Different models for restoration forestry

There are different models for restoration forestry available, with different costs and benefits, including:

- Unassisted natural regeneration - "shut the gate" - where native seed source allows.
- Direct seeding with indigenous species, or planting seed islands to enhance local seed supply.
- Assisted regeneration where targeted planting, and weed and pest control are conducted.
- Planting of nursery-raised stock.

For a detailed review of these and recommended planting strategies refer to Wildland Consultants (2019).

There are also emerging 'restorative forest carbon' strategies, which entail planting of exotic forests and transitioning these to permanent indigenous forest over time (refer to Ekos 2019).

And new lower costs methods for retiring farms into indigenous cover using forestry grade seedlings (e.g., Timata method).

Further exploration of these with potential implementing entities will be considered further within the next implementation planning stage, with upsides expected in terms of cost-effectiveness and positive impact on internal rates of return.

Exploring potential for premiums through voluntary carbon markets

In voluntary carbon markets, demand is not a legal obligation imposed by a jurisdiction, but instead is a voluntary form of social responsibility action. The most common example is a net zero carbon assertion for a business that has no legal obligation to reduce emissions.

Because demand is voluntary, supply of carbon credits to service this demand is not restricted to carbon credits produced in a compliance regime. Instead voluntary carbon credits can be sourced from either compliance carbon market instruments (such as the NZETS), or from voluntary carbon markets around the world.

Voluntary carbon credits across all activity types includes a large volume of large-scale industrial projects with few co-benefits.

Voluntary carbon buyers include businesses seeking to maximise the "feel good" factor in their corporate social responsibility undertaking. This means that these buyers tend to have a stronger willingness to pay price premiums for high quality carbon projects, subject to additional co-benefits such as biodiversity.

The international voluntary carbon market is a useful reservoir of eligible carbon credits for net zero carbon offsetting purposes. New Zealand has two main suppliers of zero carbon certification: Toitu Envirocare (Government owned) and Ekos (privately owned).

For a detailed review of voluntary and compliance carbon markets, please refer to EKOS (2019).

Note that financial modelling in this BC is based on compliance carbon markets only (i.e. the New Zealand Emissions Trading Scheme).

Further exploration of options to further incentivise biodiversity co-benefits through voluntary carbon markets will be considered further within the next implementation planning stage.

Exploring future mechanisms for incentivising native afforestation

The following initiatives and trends may provide future options to help strengthen incentives for native afforestation and associated biodiversity impacts/benefits. While these currently fall outside the scope of the LfL project, there may be future and mutually beneficial opportunities for the LfL project to trial new tools or initiatives.

Biodiversity Financing

There is growing interest nationally and internationally in establishing a biodiversity market – a means of monetising the value of delivering positive biodiversity outcomes, and thereby incentivising actions such as native afforestation. The Taskforce for Nature-Related Financial Disclosures will further encourage exploration of such approaches as we move toward nature-positive development. Early examples are already underway globally:

- Climate Trade and Terrasos have a voluntary biodiversity credit in Colombia
- Australia has introduced EcoAustralia Credits
- The Wallacea Trust has a global biodiversity credit methodology
- And in New Zealand, Ekos developed a Sustainable Development Unit to help fund Sanctuary Mountain Maungatautari

There are also other approaches underway to help value and incentivise nature based solutions, including the Verra Community Climate and Biodiversity Standard, the cloud based technology and methodology Ecometrics, and Stanford's InVest.

The New Zealand Government has recently consulted on a Biodiversity Credit scheme for New Zealand: Helping nature and people thrive: Exploring a biodiversity credit system for Aotearoa New Zealand – Snapshot of the discussion document | Ministry for the Environment.

Green Infrastructure Investment:

Another alternative to monetising biodiversity is to recognise the value of natural infrastructure – to treat green infrastructure the same way we treat grey infrastructure (bricks and mortar investment), as means of delivering critical services such as flood mitigation and improved water quality. This would enable investment in green infrastructure, just as we invest in grey infrastructure, thereby incentivising/financing native afforestation.

The TNC Floodplains by Design concept is an example of a process to implement this approach. A window of opportunity currently exists to align Government disaster recovery (i.e.flood recovery) policy and funding criteria so that expenditure includes application of nature-based solutions to build back better, more resilient systems/ecosystems.

MPI's Native Afforestation Programme

Native forests are key to meet Aotearoa New Zealand's long-term needs for carbon sequestration and providing environment benefits such as erosion control, increased biodiversity, and improved freshwater and marine water quality.

MPI's Native Afforestation programme of work is focused on how native afforestation can contribute to increased climate resilience. Extreme weather events such as Cyclone Gabrielle present potential opportunities to trial initiatives that would support climate resilience and support erosion control.

E. Strengthening the role that social science can play to help achieve buy-in and influence the decisions of individual landowners

The role that social science can play is introduced briefly in the BC. This requires further development, including opportunities to design and implement a supporting programme of research and application of frameworks to improve community outcomes (e.g., Community-Based Social Marketing : Doug McKenzie-Mohr (cbsm.com)).

Recommendation: that the potential strategic approaches set out in section 7 of this report be reflected in the BC.

8. Risk and assurance associated with proposed radiata pine and other plantation forests

In relation to the radiata afforestation proposed, it is essential that this is evaluated within the full context of the rotational harvest cycle, i.e., riparian protection during harvest, slash management to avoid adverse impacts on waterways, and avoiding the potential for major sediment fluxes following harvesting.

In the next stage we propose development of a comprehensive set of policies and standards to guide afforestation activities. These will cover matters such as:

- Land use and species selection, including maximising native afforestation.
- Reference to best practise guidance and innovation from industry.
- Regulatory context including National Policy Statements for Indigenous Biodiversity and Freshwater Management and National Environmental Standards for Commercial Forestry.
- Environment and sustainability (including harvest strategies and slash management, use of buffers, infrastructure, biosecurity and Plant Pass certification, pest and weed control).
- Quality and continual improvement.
- Occupational health and safety.
- Inspiring communications relating to the above.

We envisage these will be developed in collaboration with key implementation partners (once these are selected).

Notably, potential implementation partners are likely to already operate to existing policies and standards, so there may be opportunity to efficiently adapt, adopt and/or augment these rather than reinvent wheels.

Such policies and standards will also need to take account of and adapt to a rapidly changing regulatory context, including changes in response to:

- The *Ministerial Inquiry into Land Use (following Cyclone Gabrielle)* - The Ministerial Inquiry into Land Use causing woody debris and sediment-related damage in Tairāwhiti and Wairoa has been delivered (May 2023). Work is now underway to progress recommendations. Government and Council responses to this will play out during 2023 and may influence policy settings relating to forestry. Link: Ministerial-inquiry-into-land-use

- *Changes to NES for Plantation Forestry* - The Government announced on 14 June 2023 decisions to amend the National Environmental Standards for Plantation Forestry (NES-PF). New legislation now exists, the National Environmental Standard for Commercial Forestry (NES-CF) to amend the NES-PF. The three key areas of change are to:
  - Expand the types of forests controlled by the NES-PF to include exotic, continuous-cover forests ('carbon forests') to manage their environmental (biophysical) effects as if they are plantation forests.
  - Enable councils to develop local rules and policies to manage the location of exotic continuous-cover and plantation forests.
  - Make operational changes to enable foresters and councils to better manage the environmental effects of forestry including slash and wilding pines – these changes respond to the Year One Review.

  The regulatory changes, were enacted in November 2023 and are found here https://environment.govt.nz/acts-and-regulations/regulations/national-environmental-standards-for-commercial-forestry/

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