

NATIONAL BOVINE TB PLAN REVIEW OPTIONS ANALYSIS

OPTIONS ANALYSIS | JUNE 2015

CONTENTS

EXECUTIVE SUMMARY	1
INTRODUCTION	2
Purpose of this document	2
Background	2
Review of the TB National Pest Management Plan	3
The feasibility of eradication	3
THE 2011 TB PLAN	4
2011 TB Plan objectives	4
Funding	4
Vector control	4
Disease control	4
Summary of key changes	5
OPTIONS	7
The 'no control' scenario	7
Option 1 – Eradication	7
Option 2 – Faster eradication	8
Option 3 – Containment	10
Cost benefit analysis and funding	12
COMPARISON OF OPTIONS	14
Criteria for assessment of options	14
Assessment against criteria	14
Summary of the comparative advantages of each option	15
CONCLUSION	17
The case for eradication	17
Recommended option	17
DEFINITION OF TERMS	18
APPENDIX A: BENEFITS OF CONTAINMENT VS ERADICATION	20

EXECUTIVE SUMMARY

This paper assesses three future management options for bovine tuberculosis (TB) to inform the next statutory review of the National Bovine TB Pest Management Plan (the Plan) under the Biosecurity Act 1993 (the Act). The options considered include two variants on eradication, to test the impact of differing levels of annual funding, and a lower cost containment option.

The 2011 TB Plan set out to test whether eradicating TB from New Zealand is possible. Results over recent years, and an independent scientific review, have proved the concept. With considerable confidence, it can now be stated that TB can be eradicated and that eradication can be achieved cost effectively and deliver real economic benefits to farmers and the New Zealand economy.

Eradication is now clearly a more appropriate and cost effective approach to managing TB than containment. To only contain TB will cost more than an eradication programme in the medium to long term, committing farmers and the Crown to ongoing funding obligations well beyond the life of an eradication programme.

It has become clear through the Plan review process that eradication is the most desirable option, and that affordability is a key factor determining how quickly progress should be made. In this light, the slower eradication option is preferred as it provides the similar long term benefits compared to faster eradication, and passes the affordability test. Plan costs will be significantly lower than the current programme, and lower than the faster eradication option, and will not require significant increases to levies on existing funders.

Farmed livestock throughout New Zealand are expected to be TB free within 10 years, reducing programme and disease management costs to farmers. Possums are expected to be statistically free of TB from 2040. Full eradication from New Zealand will be achieved once it can be determined that wildlife are completely free of the disease, which could take around 15 years due to the life expectancy of feral vectors. This option will deliver real benefit to New Zealand's economy and the farming sector in particular, by freeing farmers of the burden of TB impacts, disease management impacts (such as testing and movement controls) and the annual costs of the TB Plan.

Following consultation, the Plan Governance Group will submit a Proposal to amend the Bovine TB National Pest Management Plan, based on the preferred option outlined in consultation documents (including this paper) and on feedback received from submitters.

INTRODUCTION

PURPOSE OF THIS DOCUMENT

This paper assesses three future management options for bovine tuberculosis (TB) to inform the next statutory review of the National Bovine TB Pest Management Plan (the Plan) under the Biosecurity Act 1993 (the Act).

This assessment of the three future management options will support the Plan Governance Group¹ to select a preferred option and will be used for the purposes of public consultation on the proposed Plan.

Following consultation, the Plan Governance Group will submit a Proposal to the Minister of Primary Industries in accordance with the Act. The Proposal will make recommendations for amendments to the TB National Pest Management Plan (the Plan), based on the preferred option and feedback that emerges from the consultation process.

BACKGROUND

TB management

TB is a disease of farmed cattle and deer in New Zealand which, if left unchecked, would lead to serious production losses and animal health and welfare issues. The main cause of TB in New Zealand cattle and deer herds is contact with TB-infected possums (vectors).

The disease is controlled by TBfree New Zealand using powers under the Biosecurity Act 1993, and most recently, in accordance with the 2011 TB National Pest Management Plan. Disease management primarily involves TB-testing of cattle and deer, slaughter of stock likely to be infected, movement restrictions and vector control. These activities are supported by research, communications and farmer education. The cost of the TBfree programme has been approximately \$80 million per year, funded by central Government, the beef, dairy and deer farming sectors and regional councils. The objectives of the 2011 Plan have been to:

- establish the feasibility of eradicating TB from wildlife,
- eradicate TB from wildlife from at least 2.5 million ha by June 2026,
- protect TB free areas, and
- maintain the national prevalence of TB infected herds at no greater than 0.4%.

TBfree New Zealand has successfully delivered on the 2011 TB Plan and is ahead of projections on a number of measures. Currently there are only 46 infected herds, down from 81 in 2011 and the national TB prevalence rate is down to 0.15%. More than 1 million hectares of Vector Risk Areas have been revoked in the last three years alone - more than 40% of the target area to be reached by 2026. This TB Plan review provides an opportunity to leverage off these valuable gains over the last few years.

Objectives of TB management

TB in New Zealand is managed to:

- avoid animal health and welfare implications of TB infection;
- avoid livestock production losses and associated costs of TB infection to industry;
- satisfy market and consumer assurance requirements;
- leverage off the investments that the Crown, industry and other parties have already made in controlling TB; and
- realise cost and programme efficiencies over multiple sector programmes by coordinating resources at a national level.

¹ The Plan Governance Group has an independent chair, an independent member, the Chief Executives of DairyNZ, Beef+Lamb, and Deer Industry NZ, the Chair of the Stakeholders' Council and representatives from OSPRI and the Ministry of Primary Industries. This group is tasked with providing a Plan proposal, including any proposed changes to funding arrangements, to the Minister for Primary Industries by 30 September 2015.

REVIEW OF THE TB NATIONAL PEST MANAGEMENT PLAN

The Minister for Primary Industries is required by the Biosecurity Act 1993 to start a statutory review of the Plan by 1 July 2016. Funding parties have brought the review forward by one year to provide clarity over future funding arrangements and to ensure the Plan makes best use of the latest research and innovation. The Plan review is being led by the Plan Governance Group - supported by an independent Secretariat, OSPRI, and the Stakeholder TB Advisory Group².

The proposed future TB management options have been identified through an iterative process between funding organisations, OSPRI, the Secretariat and TB scientists. Funding organisations (through the Plan Governance Group and the Stakeholder TB Advisory Group) have guided the scientists in the development of options that meet their needs around affordability and policy changes, along with a long term view of where their constituents would like to see TB management in the future.

To this end, and given the recent operational successes in eradication trials and scientific advice, there has been strong support for an eradication option, along with a desire to consider a realistic containment option that can be achieved at lower annual cost but still captures recent gains in TB freedom and meets market access requirements. The result is the identification of two eradication variants, both of which are more cost effective than the current TB Plan, and a containment option that pursues TB freedom in small areas and prevents the expansion of, or spread from, remnant infected areas. The variants on eradication were designed to test the impact of higher or lower annual investment on the timeframes for eradication and whether higher annual investment delivers significantly greater outcomes.

Broader context of biosecurity

The TB Plan review process has identified several strategic TB management options, which have been analysed to identify which option represents optimal disease management for the investment (among other criteria). It is important to acknowledge another key consideration embedded in this analysis – how investment in TB management stacks up against competing priorities for each funding party. Farmers bear the management costs and impacts of other endemic pests and diseases (pests), and also face the choice of investment in readiness and response for new to New Zealand species. Similarly, the Ministry for Primary Industries balances the funding of other pest management programmes and biosecurity responses, against investment in new initiatives. Ultimately, for each party the selection of a preferred option must consider the cost to their constituents, the affordability of that cost and whether greater value can be gained by directing those funds towards other biosecurity, or non-biosecurity, purposes.

THE FEASIBILITY OF ERADICATION

To test the feasibility of eradication, 2.5 million ha (25% of total infected areas) were targeted for TB freedom by 2026. Progress in the last three years has been very encouraging, as possum populations across an area of 828,000 ha (33% of target areas) have become TB free, and good progress has been made in two further forest areas totalling ~160,000 ha. These results indicate that eradication could be achieved across the target area ahead of schedule.

An independent scientific assessment³ has been undertaken to thoroughly test whether TB can be eradicated from New Zealand with current scientific understanding and operational tools. The reviewer concluded that the scientific basis for eradication is sound and that the required operational methods and capability are in place to achieve eradication. Based on recent achievements by TBfree New Zealand and the independent review the Plan Governance Group is confident that eradicating TB from livestock and wildlife in New Zealand is achievable and has therefore considered two eradication options as part of this Plan review.

² The Stakeholder TB Advisory Group consists of representatives from Beef+Lamb NZ, Dairy NZ, Deer Industry NZ, ESR, Federated Farmers, Landcare Research, the Ministry for Primary Industries, OSPRI, and the Secretariat.

³ Caley, P. 2015 A review of science underpinning eradication of TB from New Zealand.

THE 2011 TB PLAN

2011 TB PLAN OBJECTIVES

The incumbent TB Plan is essentially a containment plan that tests the feasibility of eradication, with the following objectives:

1. Establish the feasibility of eradication of endemic TB from wildlife populations across a representative range of New Zealand terrains, by achieving:
 - a. Eradication of TB from vector populations in two extensive forest areas representing relatively difficult operational terrain containing vector infection
 - b. Continued freedom from wildlife infection in areas where TB is considered to have been eradicated from wildlife populations.
2. By 30 June 2025, to have eradicated TB from wild animal populations from at least 2.5 million hectares of TB Vector Risk Area, including the areas in (a) above, with consequent reclassification of this land as TB Vector Free Area
3. Prevent the establishment of TB in possum populations in Vector Free Areas during the term of the proposed strategy.
4. Maintain the national annual TB infected herd period prevalence at the lowest possible level while achieving the primary objectives, and at no greater than 0.4 per cent throughout the term of the proposed strategy.

FUNDING

Annual programme costs of the current TB Plan are around \$82 million/year. Plan costs are funded by the beef, dairy and deer farming sectors, landowners via regional councils, and the Crown. Contributions are made via various levies, rates and through Crown appropriation. OSPRI is responsible for managing these funds to implement the TB Plan objectives.

VECTOR CONTROL

The current approach to vector control takes three approaches:

1. Containment – preventing expansion of Vector Risk Areas by maintaining low possum density in the buffer zone (10-20 kms wide around the fringe). Surveillance is conducted around the boundary and occasional vector control within the core of the Vector Risk Area is undertaken to prevent significant levels of livestock infection.
2. Rollback – areas of farmland, small forests and land on the margins of some of the larger Vector Risk Areas are targeted for vector control to reduce the size of the infected area. Once the rollback in each area is achieved, a containment strategy is applied.
3. Eradication – two large forests with difficult terrain were chosen to test the concept that eradication of TB from New Zealand can be achieved - the Hauhungaroa and Rangitoto ranges in the central North Island and the Hokonui Hills in Southland. The aim was to reduce and maintain possum populations at or below 2% Residual Trap Catch Index for five years, giving a 95% probability of TB freedom.

DISEASE CONTROL

Disease control tools in the current plan broadly fall under three types:

1. Surveillance – is undertaken in various ways to detect disease
 - a. testing of farmed cattle and deer – ranging from annual or biennial testing in special testing areas, to triennial testing in surveillance areas.
 - b. post mortem examinations at slaughter of all cattle and deer, and
 - c. wild animal surveys.
2. Movement control – movement control areas are defined and managed to control the risk of TB transmission through cattle or deer movements from areas with high TB prevalence (>1%).
 - a. A negative TB test is required prior to animal movements from these areas, unless the movement is to slaughter.
 - b. Further testing and identification requirements are in place for stock being moved from Special Movement Control Areas.
 - c. Specific controls are in place for herds designated as high risk, infected or suspended status.
3. Culling – animals that test positive for TB are culled.

SUMMARY OF KEY CHANGES

During the Plan review several other policy changes have been discussed and agreed. These changes will apply regardless of the chosen option. A summary of the proposed changes are outlined below.

Funding shares

New funding shares for each sector are proposed which reflect the benefits generated by the plan, industry size, and affordability. To this end, a comprehensive benefit analysis has been undertaken which, with updated information on industry value and size and an assessment of the current and future state of the different sectors, has been used to identify new funding shares.

This has principally resulted in a smaller share for the beef sector, with shares for other sectors and the Crown remaining roughly the same. The proposed shares for each option are detailed in the options section of this document.

A new beneficiary was also identified – livestock exporters. Access to foreign markets for the export of livestock is made possible through the effective management of TB under the Plan, demonstrated by the closure of Australian and North American markets during the 1990's when TB was at higher levels. It is proposed to introduce a new levy under the Biosecurity Act to recover funds from the livestock export sector.

Landowner funding from regional councils is no longer sought for the TB Plan. Under the new benefits based approach, landowners are treated as beneficiaries and it is proposed to incorporate landowner shares into the industry and Crown funding shares. Regional funding also created inefficiencies in the costs of annual negotiations and the requirement to allocate regional funding to operations in those regions. The removal of regional funding creates operational efficiencies for TBfree New Zealand by allowing them to direct funds to operations with the greatest programme benefit and removing the administration associated with annual negotiations.

Collection

The change to the beef funding share will require a reduction in the Cattle Slaughter Levy. In order to maintain the dairy sector contribution from this levy, the Cattle Slaughter Levy will be differentiated between beef and dairy cattle, at the required level for the chosen option. Levy values are outlined in the options section of this document (Table 1).

In keeping with removal of regional council funding, the levy on Otago landowners as provided for by the Biosecurity (Bovine Tuberculosis–Otago Land Levy) Order 1998 would also be revoked.

Cost buckets

It is proposed that 'cost buckets' are no longer used for TBfree New Zealand's Plan funding and financial reporting system. 'Cost buckets' are currently used to define what activities particular funds are to be used for – disease control, vector control, or common programme costs. They have been useful in ensuring that industry and regional payments are directed as closely as possible to activities that benefit that industry or region e.g. for disease testing.

The use of cost buckets does, however, create inefficiencies as TBfree New Zealand is not able to direct funds towards activities that are most beneficial for the overall programme. In addition, activities that were considered beneficial for specific industries are recognised to actually have wider benefits e.g. disease testing not only identifies infection within the industry, but also serves as a surveillance tool to hone vector control to the right locations, benefiting all industries. It is therefore proposed that cost buckets are dissolved and that TBfree New Zealand has the flexibility to direct funding towards the areas of greatest programme benefit. This is expected to result in cost and operational efficiencies.

Disease control

Disease control operations will become more efficient by targeting testing at high risk herds, an approach that will be phased in over the first three years of the Plan. This new approach is expected to result in significant cost savings to the programme, through vastly reduced testing, and also ease the burden of disease management on farmers. The reduced costs resulting from the new testing regime have been reflected in the projected plan costs in this document.

This will involve applying a risk rating classification to three categories:

1. Area Risk – Local risk from infected wildlife (possums)
2. Herd History Risk – History of TB infection within a herd

3. Movement Risk – Movement of animals associated with area and herd history risk (above) and/or volume of animal movements (on an annual percentage basis)

A weighting multiplier will be applied to each category based on their relative significance. TB testing of low risk rating herds will cease.

This approach requires data from NAIT in order to conduct risk assessments. NAIT compliance is essential to establish risk rating and noncompliance will result in a default test frequency. This new risk based testing approach will replace the current system of Disease Control Area classifications (including Movement Control Areas). While movement restrictions will still be in place, risk assessments on a herd by herd basis using NAIT data will replace blanket restricted areas, as are currently used. The gradual removal of Disease Control Area classifications is expected to be completed by July 2018.

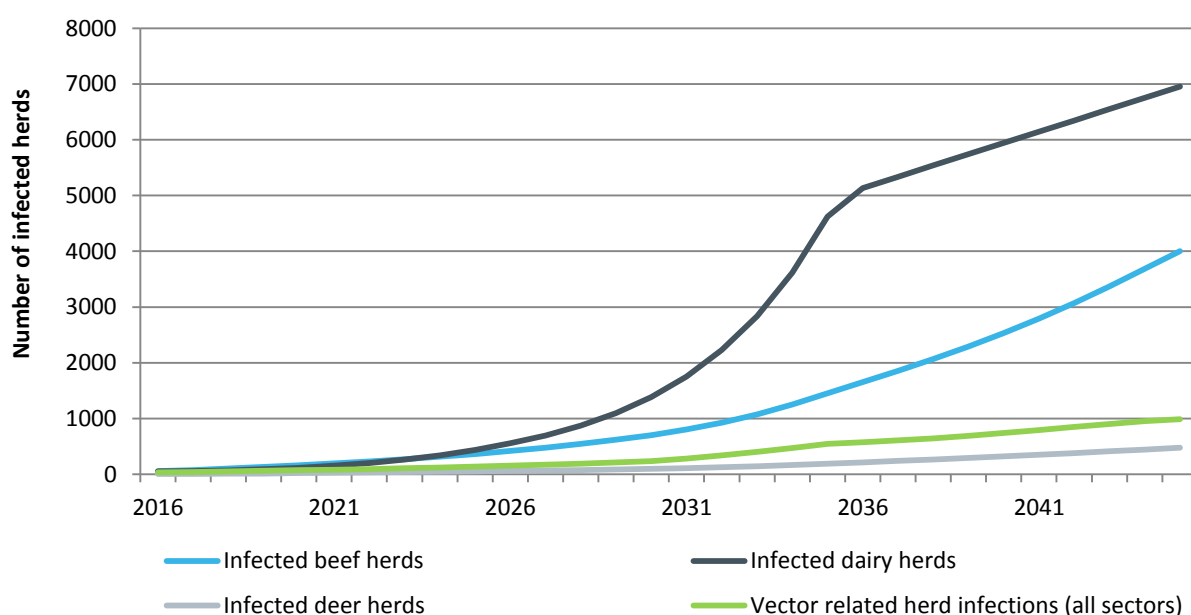
OPTIONS

THE 'NO CONTROL' SCENARIO

The analyses of options were made against a baseline scenario of 'no control' where the only interventions are pasteurisation and works surveillance (i.e. requirements under food safety legislation). There would be no organised TB testing or vector control, and no national management plan.

Under this baseline the number of infected herds would start to increase materially after 2020 (see figure 1).

Figure 1: Increase in herd infection by sector under a no control scenario



The increase in number of infected herds rises more quickly in dairy animals than it does in beef and deer. This is a result of the significant amount of inter herd movement which occurs in this sector. The beef industry also sees a material, but less dramatic, rate of increase in number of infected herds which is largely the result of livestock movement between dairy and beef sectors.

Vector-related infections in all sectors steadily rise as the number and dispersal of TB infected possums increases.

Having no national management plan for TB was discounted as an option, and is not considered further, because economic analysis shows that the impacts of the disease far outweigh the costs of management. The present value of the impacts of TB under no national plan and no control (compared to containment) is estimated at \$6.69 billion over 30 years, compared to the present value of the costs of containment of \$0.571 billion over the same time period.

A summary of the analysis of the benefits and costs of the eradication and containment options is provided in Appendix A.

OPTION 1 – ERADICATION

Objectives

1. TB freedom in wildlife throughout New Zealand by 2040
2. Biological eradication from New Zealand by 2055

The main difference between the two eradication options is the level of investment in vector control, with the resultant increase in timelines for this option.

Vector control

The vector control activities and approach for this option are the same as for the previous eradication option with the exception that the vector control expenditure is lower on an annual basis, and therefore timeframes are drawn out by

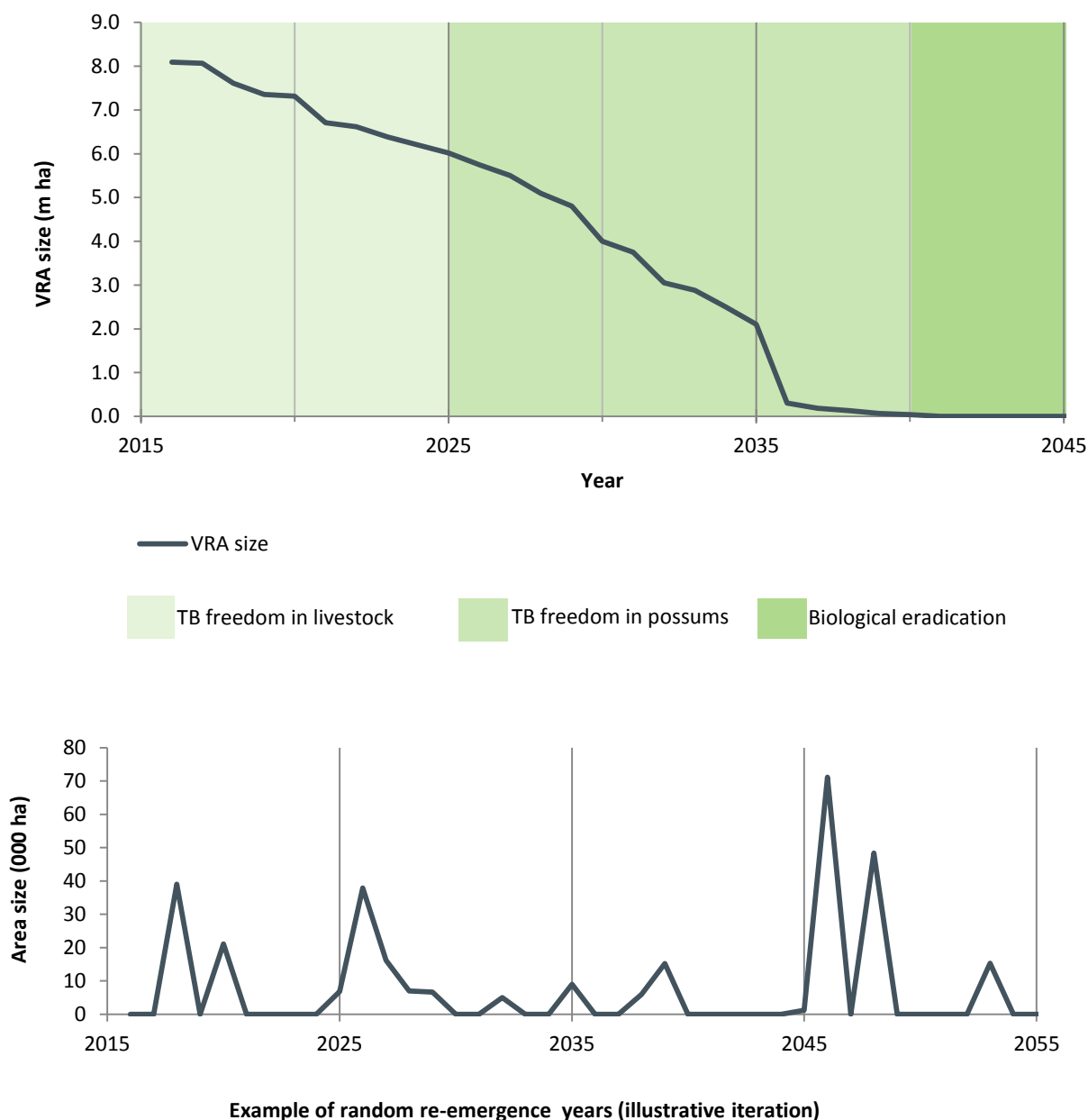
several years. It is still expected, however, that the number of vector-induced breakdowns in livestock will decline to near zero more or less linearly over the next 10 years - livestock will be almost completely TB free by 2026. The need for aerial application of 1080 is likely to extend into the early 2030s.

Total vector control costs are slightly less (\$835 million). With the initially small reduction in testing, disease management and other non-vector costs, the lower level of annual funding results in a 40% initial reduction in vector control activity, and therefore deferral of management in more areas and for longer. Deferral will likely affect some of the currently unmanaged areas that require 20 years of management. This lag results in a 4-5 year increase in the time to freedom to 2040. Total funding increases slightly to \$1,093 million as a result of non-vector costs being incurred over a longer period.

Disease control

Disease control policies are the same as for the previous eradication option.

Figure 2: TB Plan under 'Eradication' option from top to bottom: projected reduction in the size of Vector Risk Areas nationally, and randomised model of TB reoccurrence following TB freedom



OPTION 2 – FASTER ERADICATION

Objectives

1. TB freedom in wildlife throughout New Zealand by 2035
2. Biological eradication from New Zealand by 2050

The focus of this option is the intensive suppression of possum populations to remove TB infected possums, which along with culling of infected livestock, will result in the eradication of TB from New Zealand. The Vector Risk Areas of highest infection and those that are the most difficult to eradicate from are targeted first. Following the achievement of TB freedom, vector control and disease control (testing and culling) will only occur in reaction to any residual outbreaks. Outbreaks are most likely to occur within the first five years, but may occur up to 15 years after possums are TB free due to residual infection within feral deer.

Vector control

This is achieved by reducing population densities and maintaining them at a sufficiently low level that TB infected possums die before they can infect other possums. In order to achieve reduction in livestock infections, as soon as possible, vector risk areas will be prioritised for possum control by taking into account:

- current or recent infection in livestock or ferrets;
- where eradication will take the longest; and
- the type and density of farming in the area.

This prioritisation approach ('worst' areas first) is a fundamental reversal of the current strategic approach which follows a progressive roll back from the easiest areas. As the currently infected and high risk areas are prioritised the number of vector-induced breakdowns in livestock is expected to decline to near zero more or less linearly over the next 10 years - livestock will be almost completely TB free by 2026. Approximately 2 million hectares of remote country that is not currently managed will be close to being TB free by 2030, and the last of the three aerial 1080 operations required will have been complete. This will require a large increase in aerial 1080 application in the next five years, but the use of aerial 1080 will fall to near zero by 2030.

The implications of this approach is that some Vector Risk Areas that pose a lower risk of spreading TB will initially be subject to a containment approach. Areas that are not targeted for initial eradication efforts will be contained by maintaining low vector population density in the buffer zones (2 – 5% Residual Trap Catch Index) until TB freedom is achieved in the area behind the buffer. As the high priority areas are declared TB free, more Vector Risk Areas will be subject to high intensity control to remove TB.

An adaptive approach to high intensity control will be used in Vector Risk Areas using the current approach of "Survey-then-Control" policy of two controls, surveillance, final control; involving:

- Ground control every 1-3 years
- Aerial control every 4-7 years
- Vector control stops when the probability of TB freedom reaches 0.8

TBfree New Zealand will have option of using one control, then surveillance, and one final control as informed by monitoring and assessment of possum population density.

Lower intensity surveillance and control activity will continue until the probability of freedom reaches 0.95 at which point a Vector Risk Area is declared free of TB free. TBfree NZ (OSPRI) may use a lower probability of freedom stopping rule based on an assessment of risk and the consequences of dealing with residual infection if TB is actually still present.

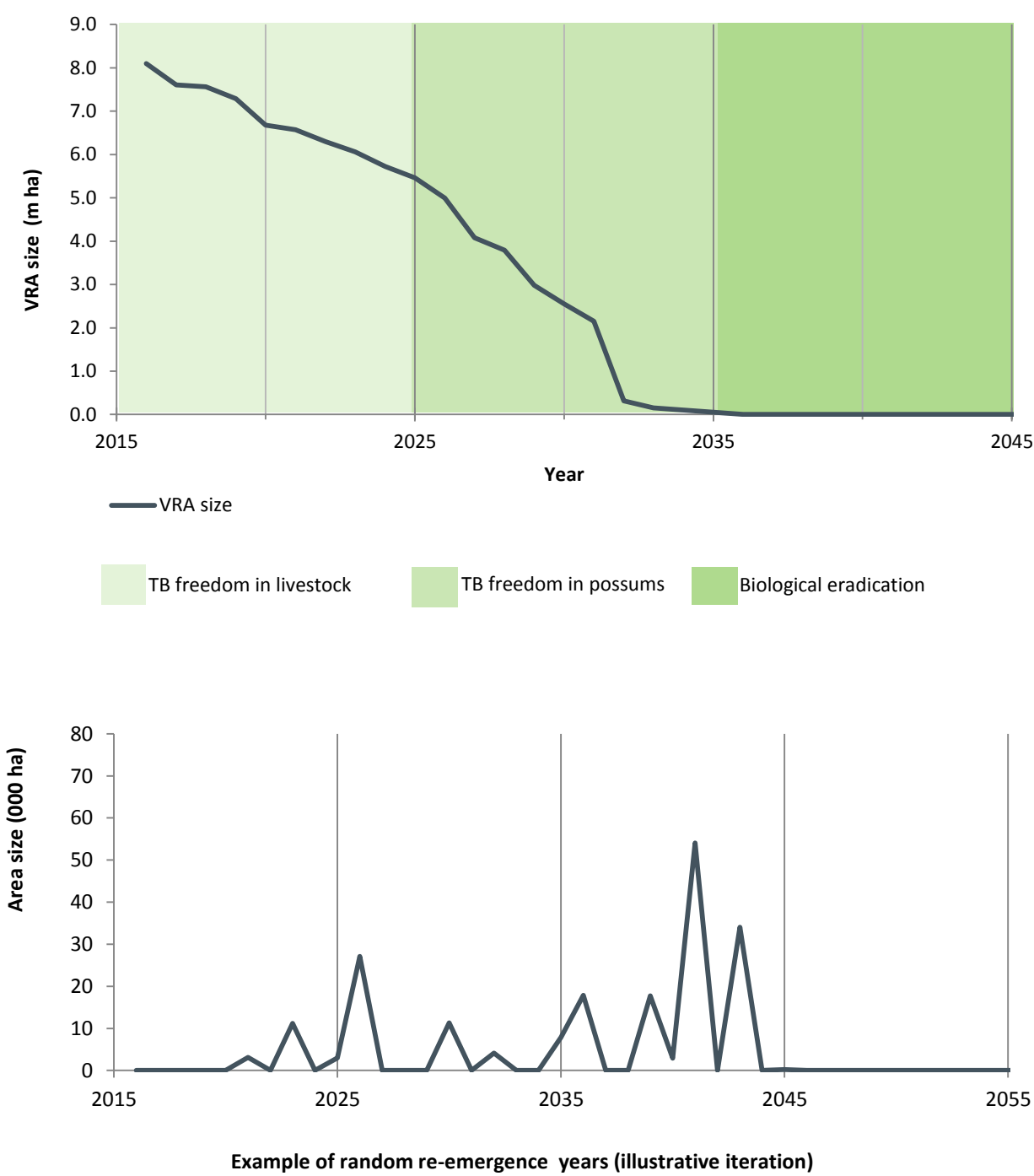
Total vector control costs are \$839m from 2016. After an initial drop, declining testing and disease management costs enable increased vector control until about 2025 when the declining size of Vector Risk Areas enables a reduction in vector control activity. The savings will result in reduced annual programme costs, rather than be used to accelerate progress.

Disease control

Following the achievement of TB freedom in wildlife throughout New Zealand, passive wildlife surveillance and post mortem examinations will continue in order to identify any residual outbreaks.

The pursuit of eradication requires an amendment to the current movement policy of animals from infected herds. Animals from infected herds will only be permitted to move to slaughter.

Figure 3: TB Plan under 'Faster Eradication' option from top to bottom: projected reduction in the size of Vector Risk Areas nationally, and randomised model of TB reoccurrence following TB freedom



OPTION 3 – CONTAINMENT

Objectives

1. TB freedom in an additional 3 million ha by 2025
2. Maintain TB prevalence at 0.2% or less

This option sees TB in wildlife contained within five large areas, and initial investment in achieving TB freedom as soon as possible from:

- Vector Control Zones with Proof of Freedom greater than 80%
- Isolated remnant Vector Risk Areas larger than 400,000 ha
- Any large Vector Risk Area outliers more than 30km across

Vector control

Vector control costs begin to reduce immediately because there is little initiation of management in previously unmanaged areas. The decline plateaus at an in-perpetuity cost of \$21 million/year. Total vector control costs (\$1047m) to 2055 are materially more than those for eradication over the same time frame (40 years) with total funding costs also significant greater at \$1,509 million assuming static testing and disease costs.

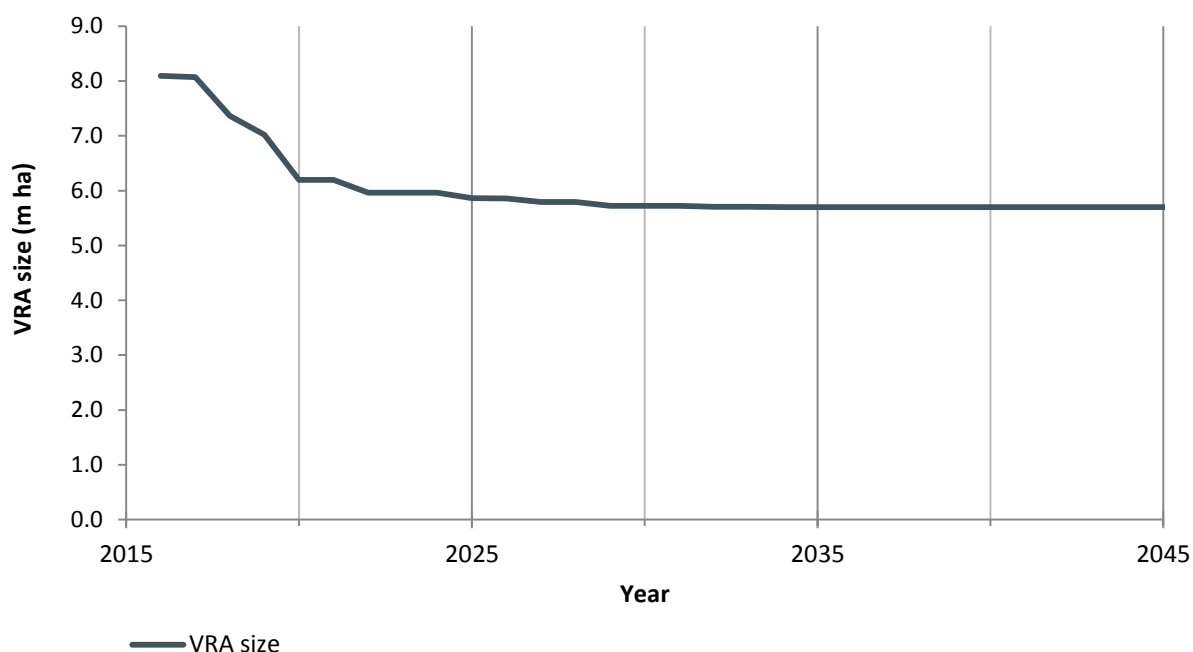
Annual costs after 30 years are \$31m per year ongoing.

The remaining Vector Risk Areas would be subject to buffer zone vector control operations in perpetuity, to prevent spread from the infected core regions. The core infected areas would be untreated.

Disease control

Disease control strategies (risk based testing) would be the same as for the eradication options.

Figure 4: TB Plan under 'Containment' objective from top to bottom: projected size of Vector Risk Areas nationally



COST BENEFIT ANALYSIS AND FUNDING

Table 1: Overview of the three options considered for the 2016 TB Plan

	Eradication	Faster Eradication	Containment
Attributes			
TB freedom in livestock	By 2026	By 2026	Contained @ ≤ 0.2% prevalence of infection
TB freedom in possums	By 2040	By 2035	TB in wildlife contained to 5.7 million ha by 2025 (down from 9 million ha) ⁴
Biological Eradication	By 2055	By 2050	
	Sporadic breakdowns potentially occurring for up to 15 years after TB freedom declared (mostly within first five years)		Never
Economics (\$billion except where otherwise noted)			
Initial average annual cost ⁵	\$60 million p.a.	\$70 million p.a.	\$51 million p.a.
Total plan cost	\$1.093	\$1.100	\$1.509 (over 40 years, same timeframe as proposal)
Present value (PV) of Plan Cost ⁶	\$0.559	\$0.595	\$0.486
PV of benefits that come from having the Plan ⁷	\$6,690	\$6,690	\$6,509
Benefit Cost Ratio	12:1	11:1	13:1
Use of a lowered probability of freedom stopping rule (0.9)	Results in a reduction in the overall costs of Plan (vector and total) by ~\$54m and shortens the time to freedom by 1-2 years.		
	Post- freedom ‘mop up’ costs triples from ~\$6m to \$18m	Post- freedom ‘mop up’ costs triples from ~\$7m total to \$21m	
Funding arrangements (first year)			
Beef	16.67% \$10.14 million / year CSL set at \$6.25	16.67% \$11.76 million / year CSL set at \$7.28	16.67% \$6.72 million / year CSL set at \$5.00
Crown	40% \$24 million / year	40% \$28 million / year	40% \$16 million / year
Dairy	40.83% \$24.34 million / year DNZ contribution of \$14.5 million/year and CSL of \$11.50	40.83% \$28.24 million / year DNZ contribution of \$18.6 million/year and CSL of \$11.50	40.83% \$16.13 million / year DNZ contribution of \$9.6 million/year and CSL of \$11.50
Deer	1.67% \$1.02 million / year DINZ contribution via existing Deer Industry Levy	1.67% \$1.17 million / year DINZ contribution via existing Deer Industry Levy	1.67% \$0.8 million / year DINZ contribution via existing Deer Industry Levy
Live animal exports	\$0.50 million / year Export levy @ \$11.50/head	\$0.58 million / year Export levy @ \$13.25/head	\$0.44 million / year Export levy @ \$10.00/head

4 This figure is in addition to current TB free areas. The aim is to capture eradication gains from previous investment by completing eradication in small areas, or areas where the probability of freedom is already high.

5 Annual costs for each option decline progressively through time (refer table 2).

6 Present Value figures are calculated using Treasury's recommended 8% discount rate and are summed over a 30 year period.

7 'No control' counterfactual used.

Table 2: Projected annual costs of different Plan options over their lifetime (\$ million)

Average annual costs per funding period							
Option	2016-25	2026-30	2031-35	2036-40	2041-45	2046-50	2051-55
Option 1 Eradication	60	60	33	4	0.9	0.9	0.3
Option 2 Faster eradication	70	64	13	2	1	0.7	
Option 3 Containment	51	38	37	32	31	\$31 million p.a. ongoing	

	<i>TB freedom in livestock</i>
	<i>TB freedom in possums</i>
	<i>Biological eradication of TB from New Zealand</i>

COMPARISON OF OPTIONS

CRITERIA FOR ASSESSMENT OF OPTIONS

Strategic Fit	How well does it meet the objectives of TB management in New Zealand?
Benefit: Cost	What is the ratio of benefits to costs of each option?
Affordability and funding arrangements	Is the option affordable and are the necessary funding arrangements acceptable?
Feasibility	Is the option feasible (technically, politically and considering compliance) and what is the likelihood of success?
Resources	What are the resources and/or skills required to implement the option and are they available? Does the option impact resources in any other way?

ASSESSMENT AGAINST CRITERIA

Strategic fit

The eradication options best fulfil the objectives of TB management as they will result in the permanent removal of animal welfare and production impacts, completely satisfy TB related market access requirements, and best optimise value from previous investments and programme efficiencies gained from national management.

The containment option, however, also meets all the objectives of TB management by maintaining TB at a low prevalence, which protects the previous investments made and satisfies market access requirements. Due to the ongoing funding required, however, it does not fully leverage the benefits available from national management or previous investments.

Ratio of benefits to costs

The net present value of the benefits and costs of the options were calculated using a 30 year time frame and an 8% discount rate (to be consistent with Treasury guidelines). This has resulted in very similar benefit to cost ratios (11:1, 12:1, 13:1), with the faster eradication option producing the lowest ratio and containment the highest.

This similarity in benefit to cost ratios between the options indicates that much the same level of benefit from eradication can be achieved with a lower annual investment, and also reflects that the proposed containment option does maintain a low TB prevalence, with all the benefits that brings. It does not reflect, however, the ongoing costs of the containment option (as the analysis stops at year 30), compared to zero ongoing costs for the eradication options – this is a key factor to consider, particularly that the ongoing costs of containment (\$29m) are significant and that those funds could usefully be diverted to a number of other industry and public good activities once TB freedom, and then full eradication, is achieved.

Affordability and funding arrangements

The containment option is the most affordable on an annual basis, but as it requires funding in perpetuity, is the least affordable in the long term, particularly when the ongoing costs of disease impacts on farmers are considered.

The eradication options require higher funding levels in the medium term compared to containment, but both are more affordable than the current programme (by \$10-20 million/year). The faster eradication option would require an increase of the levy on dairy cattle slaughtered to \$16.36 (or increased funding from some other mechanism), whereas the levy on dairy cattle under the slower eradication option would rise moderately to \$14.05 over the next 5 years. With financial pressures being felt by all funders, the slower eradication option is the most attractive from an affordability perspective.

Feasibility

All of the options are technically feasible. Containment presents some risks of TB prevalence increasing due to the residual infection in the remaining Vector Risk Areas, but the operational and scientific knowledge of how to achieve both eradication and containment have been validated and improved over the recent years.

Other issues that may affect the feasibility of the options include compliance risks and public or political concerns. While there are always compliance issues with any management regime, compliance is likely to become a greater issue as TB prevalence drops and fewer people are affected directly by the disease, but continue to be affected by the management

programme e.g. testing, culling, and movement controls. Compliance, therefore, could be an issue for all options, but perhaps more of an issue for the containment option as TB prevalence remains low but management activities continue in perpetuity. No additional significant public or political risks have been identified between the options.

Resources

All of the proposed options reduce annual funding available for vector control operations. While cost savings are expected to accrue from other modifications to the programme (e.g. reduced testing costs and removal of cost buckets), a short term drop in vector control would slow down progress on the eradication options. This would cause a reduction in vector control capacity which may hinder the ability to scale up vector control operations when additional funds do become available. For this reason, for the eradication options, it is proposed to bring forward policy changes that will generate savings, to allow the maintenance of vector control operations and manage the risk of insufficient capacity in the sector as much as possible.

Reduction in vector control and disease testing operations will ultimately result in reduced national capability and capacity in those fields. This may adversely affect the ability to respond to future outbreaks of TB or other pests/diseases that would otherwise benefit from a 'standing army' of skilled possum control and animal disease testing specialists. These impacts could eventuate under all the options but do not outweigh the benefits of the successful eradication or containment of TB.

A key resource for vector control operations is the aerial application of 1080. While 1080 is only aerially applied over around 10% of the Vector Control Zones, it is an essential tool for the TB Plan. In the absence of aerial 1080 both programme costs and eradication timelines (if relevant) would increase significantly. While the use of this product has been endorsed by both the Parliamentary Commissioner for the Environment and the Environmental Protection Agency, there is some level of public concern around the use of 1080 and the use of this product may come under scrutiny again in the future.

In this light, the eradication options make the best use of the current availability of 1080. While the use of aerial 1080 would increase in the first five years of eradication, it would actually fall to near zero by 2030/35, whereas the containment option relies on the ongoing use of aerial 1080 to prevent resurgence in TB.

SUMMARY OF THE COMPARATIVE ADVANTAGES OF EACH OPTION

Table 3

	Strategic Fit	Benefit: Cost	Affordability and funding arrangements	Feasibility	Resources
Option 1 Eradication	•	•	•	•	•
Option 2 Faster Eradication	•	•		•	•
Option 3 Containment	•		•	•	•

• indicates the options meet the criterion more or less equally

Discussion

Both eradication options make the most of existing vector control tools and get the most out of the significant previous investment in TB control by taking the opportunity to rid New Zealand of bovine TB forever. The faster eradication option provides the most rapid achievement of full eradication from New Zealand and therefore the fastest delivery of the benefits that eradication brings. However, the slower eradication option provides similar benefits to the faster option, but at a more affordable annual cost. In fact, annual contributions are lowered for both the beef sector and the Crown, while the dairy and deer sectors maintain their current levels of funding.

Ultimately, both eradication options result in livestock being almost completely TB free in 10 years, arguably the most significant and immediate impact that farmers are seeking from the TB Plan. Increasing the funding by 10 million dollars per annum in the first 10 years of the new Plan will bring forward the eradication of TB by three years and cost \$3 million less overall (over a 30 year period) but it will not impact on this key measure.

It is therefore considered that as the cost of TB eradication by 2055 is marginally more over 30 years (less than 0.5%), this additional cost to farmers is outweighed by the benefits of:

- a. TB freedom in livestock achieved in same timeframe and lower upfront cost
- b. lower annual cost to farmers, and
- c. likely material efficiency improvements over the lifetime of the Plan allowing out year costs to be less than currently estimated.

Containment delivers on all TB management objectives at the lowest annual cost, while maintaining recent gains in TB control, but at a significant and unacceptable ongoing cost.

CONCLUSION

THE CASE FOR ERADICATION

Significant progress has been made in the understanding of what is needed, and whether it is technically feasible to eradicate TB from New Zealand. What is readily accepted as achievable in 2015 was only thought a possibility seven years ago when the last review of the TB plan started. With considerable confidence, it can now be stated that TB can be eradicated and that eradication can be achieved cost effectively and deliver real economic benefits to farmers and the New Zealand economy.

Eradication is now clearly a more appropriate and cost effective approach to managing TB than containment. To only contain TB will cost more than an eradication programme in the medium to long term, committing farmers and the Crown to ongoing funding obligations well beyond the life of an eradication programme. Although the containment option has a lower average annual cost than either eradication option for the first 10 years, the situation quickly reverses from then on (Table 2). This is because considerable investment will continue to be required for vector control in the buffer and near forest programmes after eradication activity is completed in the smaller Vector Risk Areas.

RECOMMENDED OPTION

It has become clear through the Plan review process that eradication, provided it is feasible, is the most desirable option, and that affordability is the key factor determining how fast it should go. In this light, the slower eradication option provides good long term benefits relative to cost and passes the affordability test. Plan costs will be significantly lower than the current programme, and lower than the faster eradication option, and will not require significant increases to levies on existing funders.

DEFINITION OF TERMS

Biological eradication	The complete absence of TB in wildlife and livestock (but not humans) from a particular management unit, such as a Vector Control Zone, with a near zero chance of disease reinvasion. A declaration of biological eradication follows a declaration of TB freedom.
Breakdown	Refers to TB being diagnosed in a Clear or Suspended status cattle or deer herd.
Infected herd annual period prevalence (also herd infection rate)	Is the number of cattle and deer herds classified as infected at the start of the financial year, together with the number of cattle and deer herds found infected during the financial year, divided by total cattle and deer herds, expressed as a percentage.
False positive reactor	Is an animal that subsequently is negative to one of the diagnostic tests for TB. This means that one of the tests it had (usually the skin TB test) was a false positive.
Livestock TB freedom	A TB Plan milestone where cattle and deer herds are largely free of TB infection, with the exception of a very small number of isolated breakdowns which would require mopping up.
Management agency	Is defined in the Biosecurity Act as “a management agency responsible for implementing a national pest management plan”. The management agency for the TB Plan is TBfree NZ (OSPRI), a subsidiary of OSPRI New Zealand (TBfree NZ, OSPRI).
Movement Control Areas (MCA)	Defined geographical areas used under the current Plan to control the risk of TB transmission through cattle or deer movements from areas with the highest wildlife infection risk, being those areas where infected herd annual period prevalence (as a proxy for wildlife infection risk) is greater than one per cent.
National Animal Identification and Tracing Scheme (NAIT).	The National Animal Identification and Tracing scheme (NAIT) is a mandatory New Zealand scheme which has been established to create an electronic identification system for animal identification and lifetime traceability. The scheme requires all cattle and deer to be identified with an approved permanent NAIT device within 180 days of birth or prior to movement.
National Operational Plan (NOP)	The set of operational measures and policies developed by the management agency to give effect to the Minister’s decision and the TB Plan Order. The NOP is required under s100B of the Biosecurity Act 1993 to be produced by the management agency within 3 months of the TB Plan Order (or amended Order) coming into effect. It must be reviewed by the management agency annually, with a report on performance and any amendments provided to the Minister. The NOP cannot place any statutory obligations on farmers or other stakeholders.
Passive surveillance	The use of data from different sources to provide inference about the likelihood of presence or absence of TB. These data may come from unplanned incidental observations (such as the detection of TB in pigs or deer by recreational and commercial hunters or possum fur trappers) or from information collected for other primary purposes (such as the use of slaughterhouse inspection of cattle and deer for TB, and the use of livestock testing data collected to determine TB presence in livestock, not wildlife <i>per se</i>).
Plan Governance Group (PGG)	Established by funding parties to lead the TB Plan Review. Is responsible for preparing and submitting the Proposal to the Minister.
Proof of concept	Proof of concept is a realisation of a certain method or idea to demonstrate its feasibility.
Probability of freedom	The probability that TB has been eradicated from the possum population in a defined area.
Proposal	Means a proposal to create, amend, revoke, replace, or leave unchanged a National Pest Management Plan under the Biosecurity Act 1993. The contents and other requirements of a proposal on review of a national pest management plan are outlined in sections 105D and 59-67 of the Biosecurity Act 1993.
Residual Trap Catch Index	A measure used to determine the density of possum populations in a given area based on the number of possums captured per 100 traps laid (according to a specific design), expressed as a percentage.
Reactor	Means an animal that is positive to an approved TB test or tests and which is directed to slaughter. Such animals are to be identified with official Reactor ear tags up to the time of slaughter.
Spillover host	A spillover host cannot independently and indefinitely maintain TB within a population solely by transmission within the species concerned. Spillover hosts typically (in New Zealand) become infected by interacting with infected possums or some other host, but only very occasionally pass on the disease to another animal of the same species as itself. Some species can be true maintenance hosts at very high density (when there is lots of opportunity for transmission between individuals) but not at the low densities at which they usually occur in the wild. That is believed to be the case for wild deer, feral pigs, and ferrets, the three main spillover hosts in New Zealand.
Stopping rule	Means the level at which possum control stops in an area because the possum population is considered to be TB free. The level is currently set at a probability of TB freedom of 0.95. At that level, it is expected that one in 20 areas declared TB free will still contain TB possums and herds in such areas would be vulnerable

	to becoming infected. These areas would receive additional possum control to eradicate the identified infection.
Surveillance	The process of conducting formal field surveys to try to detect the continued presence of TB in possums. It includes direct necropsy surveys of possums (usually by trapping) and/or necropsy of sentinel species such as pigs, ferrets, and deer, which are known to largely be spillover hosts in which the presence of TB indicates the probable presence of TB in possums.
TB	Used as an abbreviation for bovine tuberculosis. <i>Mycobacterium bovis</i> , is the bacterium that causes the disease of bovine tuberculosis (and is the 'pest' managed by the proposed TB Plan).
TB Plan	The set of objectives, measures and operational policies established to manage bovine TB in New Zealand. It is given effect to through the TB Plan Order and operationalised through the National Operational Plan (a requirement under s100B of the Biosecurity Act. References to the 'current Plan' mean the TB Plan as currently enacted and implemented through the TB Plan Order and the National Operational Plan. References to the 'proposed Plan' mean the TB Plan as amended if the changes set out in this proposal were to be approved.
TB Plan order	Is the Biosecurity (National Bovine Tuberculosis Pest Management Plan) Order 1998 that gives effect to the regulatory elements of the TB Plan.
TB freedom	A defined geographic area (e.g. a Vector Risk Area or New Zealand) is considered to become free of bovine TB when it becomes free of unacceptable risk of infection in wildlife. The level of acceptable risk is specified by the calculated probability that TB is no longer present – the 'Stopping rule' set by the Board of TBfree on the advice of technical and scientific experts (currently 0.95). At that level, one in 20 Vector Risk Areas could potentially be declared free but still contain TB. There would therefore be some residual outbreaks in areas declared free that would require a low level of 'mop up' activity after the declaration of freedom and revocation of Vector Risk Area status. Can also be known as 'statistical freedom' of TB in possums.
Vector Control Zone (VCZ)	A defined geographical area in which activities are undertaken to control the populations of wild animals that are known vectors for bovine tuberculosis.
Vector Free Area (VFA)	A defined geographical area where bovine tuberculosis is not maintained in the wildlife populations.
Vector Risk Area (VRA)	A defined geographical area where bovine tuberculosis is being maintained in the wildlife population as indicated by either epidemiological information from infected cattle and deer herds, or the finding of tuberculosis in wildlife animals that are classed as bovine tuberculosis maintenance hosts.
Works surveillance	Refers to inspection of carcasses for TB at cattle and deer slaughter premises.

APPENDIX A: BENEFITS OF CONTAINMENT VS ERADICATION

Impact	Containment at 0.2% v No Control	NPV (\$m)	%	Eradiation v No Control	NPV (\$m)	%
Biodiversity and flora and fauna impacts; the level and geographic focus of possum control and, in some situations, rodent and mustelid control, impacts the number and distribution of possums and other vector pests. These in turn impact the extent and location of damage to the flora and fauna eco-systems and indigenous biodiversity.	<p>Under Containment, expenditure on vector control falls from the current level of around \$50 million per year to around \$26 million per year in 2022 and then slowly declines to be around \$24 million from 2035 onwards.</p> <p>The number of possums in the environment will, therefore, rise from current levels under Containment but remain at a level materially below what they would be at without any vector control.</p> <p>Under No Control, there will be no vector control and the numbers of possums etc. in the environment will increase from current levels until they reach the maximum level able to be sustained by the environment.</p> <p>There is, therefore, a benefit from Containment compared with No Control in terms of improved flora and fauna eco-systems and greater biodiversity. This benefit endures as vector control continues under Containment.</p>	670.00	10.29%	<p>Initially, under Eradication, the number and spread of possums in the environment will remain around current levels as expenditure on vector control will be held at close to the current level of \$50 million per year until around 2027.</p> <p>Subsequently, under Eradication as TB is eradicated expenditure on vector control will decline sharply so that by 2037 it is minimal. Ultimately, expenditure on vector control ceases under Eradication.</p> <p>The number of possums in the environment will initially be relatively stable but as vector control is sharply reduced it will begin to increase. The number and spread of possums will trend back to the biological maximum as under No Control.</p> <p>Under No Control there will be no vector control and the numbers of possums in the environment will increase until they reach the maximum level able to be sustained by the environment.</p> <p>There is, therefore, initially a benefit from Eradication compared with No Control in terms of improved flora and fauna eco-systems and greater biodiversity but, overtime, this benefit attenuates and eventually disappears.</p>	670.00	10.01%
Trade preference shock; the prevalence of bovine TB affects the risks of a short-term adverse impact on consumers preferences for New Zealand beef, dairy and deer product exports in response to reports of outbreaks of bovine TB in New Zealand. Any preference shocks impact for a short period of time on the value of New Zealand's exports of these products.	Containment provides a benefit of a reduced risk of an adverse trade preference shock compared with No Control as there would be a lower level of bovine TB infection among herds.	47.49	0.73%	<p>Eradiation provides a benefit of a reduced risk of an adverse trade preference shock compared with No Control as there would be a lower level of bovine TB infection among herds.</p> <p>The benefit will tend to increase over time until bovine TB is eradicated under Eradication and the level of bovine TB reaches its maximum under No Control.</p>	53.67	0.80%
Trade access shock; the prevalence of bovine TB affects the risks of short-term informal trade access restrictions on beef, dairy and deer exports in response	Containment provides a benefit of a reduced risk of an adverse trade access shock compared with No Control as there would be a lower level of bovine TB infection among herds.	0.71	0.01%	Eradiation provides a benefit of a reduced risk of an adverse trade access shock compared with No Control as there would be a lower level of bovine TB infection among herds.	1.42	0.02%

to reports of outbreaks of bovine TB in New Zealand and hence the values of New Zealand's exports of these products.				The benefit will tend to increase over time until bovine TB is eradicated under Eradication and the level of bovine TB reaches its maximum under No Control.		
Reputation trade impact – food exports; the prevalence of bovine TB affects New Zealand's reputation for operating sound biosecurity, disease control and food hygiene systems. A loss of New Zealand's reputation in this regard gradually lowers the real prices achieved and/or increases the real costs of marketing New Zealand's food exports.	Containment provides a material benefit of reduced adverse reputational impact on food exports compared with No Control as the prevalence of bovine TB would be very much lower. There is a strong argument that, under No Control, the adverse impact on food exports of the loss of reputation would start earlier and grow faster and to a higher level than assumed under the Ad Hoc scenario evaluated in the 2014 analysis for funding purposes.	539.83	8.29%	Eradication provides a material benefit of reduced adverse reputational impact on food exports compared with No Control as the prevalence of bovine TB would be very much lower, and would on eradication disappear. There is a strong argument that, under No Control, the adverse impact on food exports of the loss of reputation would start earlier and grow faster and to a higher level than assumed under the Ad Hoc scenario evaluated in the 2014 analysis for funding purposes.	550.37	8.23%
Reputation trade impact – non-food exports; New Zealand tourism and non-food export sectors rely significantly on the country's 'clean-green' brand image which would be affected by the prevalence of bovine TB. A loss of New Zealand's reputation in this regard would gradually lower the real prices achieved and/or increase the real costs of marketing New Zealand's non-food exports.	Containment provides a material benefit of reduced adverse reputational impact on non-food exports compared with No Control as the prevalence of bovine TB would be very much lower. There is a strong argument that, under No Control, the adverse impact on non-food exports of the loss of reputation would start earlier and grow faster and to a higher level than assumed under the Ad Hoc scenario evaluated in the 2014 analysis for funding purposes.	48.66	0.75%	Eradication provides a material benefit of reduced adverse reputational impact on non-food exports compared with No Control as the prevalence of bovine TB would be very much lower, and would on eradication disappear. There is a strong argument that, under No Control, the adverse impact on non-food exports of the loss of reputation would start earlier and grow faster and to a higher level than assumed under the Ad Hoc scenario evaluated in the 2014 analysis for funding purposes.	97.33	1.45%
Production impact; the prevalence of bovine TB impacts the numbers of infected cows and hinds on farms and, as a result, affect the numbers of cows not producing calves and hinds not producing fawns because they are infected. The numbers of infected dairy cows on farms will also affect milk production and the numbers of diseased cows requiring replacement to maintain the capital stock.	Containment provides a material benefit of reduced production impacts compared with No Control as the prevalence of bovine TB would be very much lower. There is a strong argument that, under No Control, the adverse impacts on production would grow faster and to a higher level than assumed under the Ad Hoc scenario evaluated in the 2014 analysis for funding purposes.	2876.20	44.18%	Eradication provides a very material benefit of reduced production impacts compared with No Control as the prevalence of bovine TB would be very much lower, and would disappear on eradication of the disease. There is a strong argument that, under No Control, the adverse impacts on production would grow faster and to a higher level than assumed under the Ad Hoc scenario evaluated in the 2014 analysis for funding purposes.	2876.45	42.99%
Human mental health impacts; the	Under Containment, the number of people	342.71	5.26%	Under Eradication, the number of people suffering mental health	348.42	5.21%

prevalence of bovine TB impacts on the number of farmers, members of farming families, close associates and others in the community who suffer serious stress due to financial uncertainty, strains and the social stigma attached to the disease.	<p>suffering mental health impacts will decline as the level of bovine TB among herds declines.</p> <p>Under No Control, the number suffering mental health impacts is likely to rise up to some point as the level of bovine TB among herds increases.</p> <p>However, at some point under No Control the level of stress is likely to fall as bovine TB becomes so widespread that it is no longer seen to be something that brings stigma and resulting stress.</p>			<p>impacts will decline as the level of bovine TB among herds declines. Eventually the number will fall to zero as when eradication is achieved.</p> <p>Under No Control, the number suffering mental health impacts is likely to rise up to some point as the level of bovine TB among herds increases.</p> <p>However, at some point under No Control the level of stress is likely to fall as bovine TB becomes so widespread that it is no longer seen to be something that brings stigma and resulting stress.</p>		
Real option value impacts; the prevalence of bovine TB impacts on the value to landowners of the real options they have to change land use in the future.	<p>Under Containment, the value of the real options available to landowners through the ability to change land use in the future will increase as the level of bovine TB among herds declines until containment is achieved.</p> <p>Under No Control, the value of the real options available to landowners through the ability to change land use in the future will decrease as the level of bovine TB among herds increases exponentially.</p> <p>There is, therefore, a benefit from Containment compared with No Control in terms of real options values.</p>	888.41	13.65%	<p>Under Eradication, the value of the real options available to landowners through the ability to change land use in the future will increase as the level of bovine TB among herds declines, until bovine TC is eradicated.</p> <p>Under No Control, the value of the real options available to landowners through the ability to change land use in the future will decrease as the level of bovine TB among herds increases exponentially.</p> <p>There is, therefore, a benefit from Eradication compared with No Control in terms of real options values.</p>	941.47	14.07%
Carcass value losses - TB detected at slaughter; the prevalence of bovine TB impacts on the number of animals diagnosed as having bovine TB at slaughterhouses and, as a result, on the number of animals condemned at slaughterhouses for this reason.	<p>Under Containment, the level of bovine TB will decline until it reaches the containment level. The number of animals detected as having TB at slaughter and condemned will follow the same pattern. Once containment is achieved, the number of animals condemned at slaughter because of TB will stabilise, but at a low level.</p> <p>Under No Control, the level of bovine TB will increase exponentially from current levels and the number of animals detected as having TB at slaughter and condemned will follow the same pattern.</p> <p>There is, therefore, a benefit from Containment compared with No Control in the form of lower</p>	1031.85	15.85%	<p>Under Eradication, the level of bovine TB will decline until there is no bovine TB when eradication is achieved. The number of animals detected as having TB at slaughter and condemned will follow the same pattern. Once eradication is achieved, there will be no animals condemned at slaughter because of TB.</p> <p>Under No Control, the level of bovine TB will increase exponentially from current levels and the number of animals detected as having TB at slaughter and condemned will follow the same pattern.</p> <p>There is, therefore, a benefit from Eradication compared with No Control in the form of lower losses of carcass values.</p>	1031.93	15.42%

	losses of carcass values.					
Impact on opportunities to export live cattle and deer; the prevalence of bovine TB will impact on the number of live cattle and deer exports and the price premiums these exports will achieve.	<p>Under Containment, the level of bovine TB will decline until it reaches the containment level. The impact of this decline in morbidity on the number of live cattle and deer exports and the price premiums they will achieve will be modest, as the reduction in morbidity from current levels will be modest and unlikely to have a major effect on live animal exports.</p> <p>Under No Control, the level of bovine TB will increase exponentially from current levels and the prevalence is likely to lead to a cessation in live deer and cattle exports in a few years.</p> <p>There is, therefore, a benefit from Containment compared with No Control in the form of higher numbers of live cattle and deer exports and the achievement of higher price premiums.</p>	6.83	0.10%	<p>Under Eradication, the level of bovine TB will decline until it reaches zero when eradication is achieved. The impact of this decline in morbidity on the number of live cattle and deer exports and the price premiums they will achieve will be modest, as the reduction in morbidity from current levels will be modest and unlikely to have a major effect on live animal exports.</p> <p>Under No Control, the level of bovine TB will increase exponentially from current levels and the prevalence is likely to lead to a cessation in live deer and cattle exports in a few years.</p> <p>There is, therefore, a benefit from Eradication compared with No Control in the form of higher numbers of live cattle and deer exports and the achievement of higher price premiums.</p>	20.50	0.31%
Impact of possum grazing on pasture and other feed; the level and geographic focus of possum control for bovine TB control impacts the number and distribution of possums, which in turn impacts the extent and location of damage to pasture and other feed inflicted by possums. Possum consumption of grass and other feed increases the costs of production for farmers.	<p>Under Containment, expenditure on vector control falls from the current level of around \$50 million per year to around \$26 million per year in 2022 and then slowly declines to be around \$24 million from 2035 onwards.</p> <p>The number of possums in the environment will, therefore, rise from current levels under Containment but remain at a level materially below what they would be at without any vector control.</p> <p>Under No Control, there will be no vector control and the numbers of possums in the environment will increase until they reach the maximum level able to be sustained by the environment.</p> <p>There is, therefore, a benefit from Containment compared with No Control in terms of the impact of possums grazing on pasture and other feed.</p>	46.19	0.71%	<p>Initially, under Eradication, the number and spread of possums in the environment will remain around current levels as expenditure on vector control will be held at close to the current level of \$50 million per year until around 2027.</p> <p>Subsequently, under Eradication as TB is eradicated expenditure on vector control will decline sharply so that by 2037 it is minimal. Ultimately, expenditure on vector control ceases under Eradication.</p> <p>The number of possums in the environment will initially be relatively stable under Eradication but as vector control is sharply reduced it will begin to increase. The number and spread of possums will trend back to the biological maximum as under No Control.</p> <p>Under No Control, there will be no vector control and the numbers of possums in the environment will increase until they reach the maximum level able to be sustained by the environment.</p> <p>There is, therefore, a benefit from Eradication compared with No Control in terms of the impact of possums grazing on pasture and other feed.</p>	62.69	0.94%
Impact of possums on other activities; the level and geographic focus of possum control for bovine TB control	Ditto benefit B12 above	11.99	0.18%	Ditto benefit B12 above	16.28	0.24%

impacts the number and distribution of possums, which in turn impacts the extent and location of damage inflicted by possums to fruit and ornamental trees, buildings, electrical transmission and distribution systems, etc. Possum damage increases the costs of production to suppliers.						
Risks of liability to eradicate or manage possums and possum habitats; if there is no NPMP, it is still possible for landowners and occupiers to have imposed on them under the Biosecurity Act an obligation to control vectors, like possums, and vector habitats. The risks of this occurring will be determined, in part, by how widespread vectors like possums and bovine TB are in the environment. If there is an NPMP in place there is unlikely to be additional obligations imposed on landowners and occupiers to control vectors and vector habitats.	Under Containment, there is by definition an NPMP in place, so there is unlikely to be any material risk of additional obligations being imposed on landowners and occupiers to control vectors and vector habitats.	12.88	0.20%	Under Eradication, there is by definition an NPMP in place, so there is unlikely to be any material risk of additional obligations being imposed on landowners and occupiers to control vectors and vector habitats.	12.88	0.19%
	Under No Control, initially the numbers of possums and the prevalence of TB would be similar to what they are currently. Over time, however, both would increase, particularly the prevalence of bovine TB, which would grow exponentially. The risks of obligations being placed on landowners and occupiers to control or eradicate possums and possum habitats will rise along with the prevalence of bovine TB.			Under No Control, initially as the numbers of possums and the prevalence of TB would be similar to what they are currently. Over time, however, both would increase, particularly the prevalence of bovine TB, which would grow exponentially. The risks of obligations being placed on landowners and occupiers to control or eradicate possums and possum habitats will rise along with the prevalence of bovine TB.		
	There is, therefore, a benefit under Containment compared with under No Control of a reduced risk to landowners of having obligations placed on them to control vectors, like possums, and vector habitats.			There is, therefore, a benefit under Eradication compared with under No Control of a reduced risk to landowners of having obligations placed on them to control vectors, like possums, and vector habitats.		
Benefits from future research and development; if there is a NPMP there will be funding for public good research into the management and control of bovine TB and the vectors that carry it. Any benefits from this research are benefits of the NPMP. If there is no NPMP there will be no funding for public good research and no benefits from such research.	Under Containment, there will be public good research and benefits from this research will accrue. The level of expenditure is assumed to be around \$2 million per year until 2030 but to decline to be \$1 million per year from 2033 onwards.	8.34	0.13%	Under Eradication, there will initially be public good research and benefits from this research will accrue. The level of expenditure is assumed to be around \$2 million per year until 2030 before declining to be \$1 million per year in 2033 and continuing to decline thereafter so there is no expenditure from 2040 onwards.	7.86	0.12%
	Under No Control there will be no public good research and no benefits from this research will accrue.			Under No Control there will be no public good research and no benefits from this research will accrue.		
	There is, therefore, a benefit under Containment compared with under No Control in the form of benefits of public good research.			There is, therefore, a benefit under Eradication compared with under No Control in the form of benefits of public good research.		

Efficiency effects of TB livestock compensation; if there is an NPMP, there will be compensation payments to farmers for at least some of the stock slaughtered as a result of the NPMP. The compensation payments to farmers in themselves will be a wealth transfer and so neither a benefit nor a cost of the NPMP overall. The payment of compensation will, however, reduce compliance costs of enforcement of the scheme but may encourage more risky behaviour and so have impacts on the efficiency of the schemes. If there is no NPMP there will be no compensation payments to farmers and no impact on compliance costs of enforcement of the scheme, as there will be no scheme.	Under Containment, there will two offsetting effects of compensation payments on efficiency compared with what would occur under No Control: improved efficiency through reducing the costs of ensuring parties comply with the NPMP in terms of testing, herd movement control, and vector control; and reduced efficiency through encouraging more risky behaviour. The judgement of PPG is that these two effects will offset one another and that there is no net benefit under Containment compared with under No Control.	0.00	0.00%	Under Eradication, there will two offsetting effects of compensation payments on efficiency compared with what would occur under No Control: improved efficiency through reducing the costs of ensuring parties comply with the NPMP in terms of testing, herd movement control, and vector control; and reduced efficiency through encouraging more risky behaviour. The judgement of PPG is that these two effects will offset one another and that there is no net benefit under Eradication compared with under No Control.	0.00	0.00%
Impact on resources required to respond to bovine TB; if there is no NPMP, considerable resources could be used negotiating, administering and managing the response to bovine TB and whether a TB NPMP should be introduced and, if so, what activities and priorities should it take on. This is supported by past experience. If there is an NPMP more limited resources would be used on such activities.	Ditto benefit B14 above	6.38	0.10%	Ditto benefit B14 above	6.38	0.10%
Other environmental impacts from ground cover effects of pests; the level and geographic focus of possum control for bovine TB control impacts the number and distribution of possums, which in turn impacts the extent and location of damage from run-off and erosion as a result of damage to erosion control planting by possums.	Ditto benefit B12 above	2.14	0.03%	Ditto benefit B12 above	3.45	0.05%
Clinical diagnosis costs on-farm; the prevalence of bovine TB, and whether there is an NPMP, will affect the number of clinical diagnosis tests on farms and vet visits to farms to conduct them.	Under Containment, no animals will reach the stage of having clinical bovine TB while on-farm and there will, therefore, be no on-farm clinical diagnosis tests or associated costs.	3.41	0.05%	Under Eradication, no animals will reach the stage of having clinical bovine TB while on-farm and there will, therefore, be no on-farm clinical diagnosis tests or associated costs. Under No Control, some animals will develop clinical bovine TB on-	3.41	0.05%

	<p>Under No Control, some animals will develop clinical bovine TB on-farm and some of these will be subject to clinical diagnosis.</p> <p>There is, therefore, a benefit under Containment compared with under No Control in the form of on-farm clinical diagnosis tests avoided.</p>			<p>farm and some of these will be subject to clinical diagnosis.</p> <p>There is, therefore, a benefit under Eradication compared with under No Control in the form of on-farm clinical diagnosis tests avoided.</p>		
Impact on forestry production output and costs; the level and geographic focus of possum control for bovine TB control impacts the number and distribution of possums, which in turn impacts the extent and location of damage inflicted by possums to forest trees and seedlings. Possum damage increases the costs of production of forest growers.	Ditto benefit B12 above	0.80	0.01%	Ditto benefit B12 above	1.09	0.02%
Resources used in dealing with disputes and litigation; the prevalence of bovine TB, and whether there is a NPMP, will affect the number of disputes arising from the spread of bovine TB and infected vectors. The more disputes there are the greater the resources likely to be used in dealing with, managing and resolving these disputes and litigation flowing from them. If there is an NPMP, most disputes are likely to be avoided. If, and when, bovine TB among herds and TB-infected possums become very widespread the level of disputes is also likely to decline as there will be little that parties could do to effectively impose liability on others and receive compensation from them.	Ditto benefit B14 above	1.97	0.03%	Ditto benefit B14 above	1.97	0.03%
Impact on the ability to select and retain superior genetic animals; the prevalence of bovine TB impacts the level of culling of livestock and affects the scope to cull animals of lesser genetic value while maintaining normal herd size. This will impact on the ability to select and retain superior genetic animals and hence the pace of genetic improvement in herds.	<p>Under Containment, the level of bovine TB will decline until it reaches the containment level. The number of animals culled as a result of TB will follow the same pattern. After containment is achieved, the number of animals culled will stabilise at a low level.</p> <p>Under No Control, the level of bovine TB will increase exponentially from current levels and</p>	1.82	0.03%	<p>Under Eradication, the level of bovine TB will decline until there is no bovine TB when eradication is achieved. The number of animals culled as a result of TB will follow the same pattern. When eradication is achieved there will be no culling due to TB.</p> <p>Under No Control, the level of bovine TB will increase exponentially from current levels and the number of animals culled as a result of TB will follow the same pattern.</p>	2.55	0.04%

	<p>the number of animals culled as a result of TB will follow the same pattern.</p> <p>There is, therefore, a benefit from Containment compared with No Control in the form of lower culling due to TB and hence a higher potential pace of genetic improvement in the herd.</p>			There is, therefore, a benefit from Eradication compared with No Control in the form of lower culling due to TB and hence a higher potential pace of genetic improvement in the herd.		
Impact on the consent costs of disposing of clinically infected animals on-farm; the prevalence of bovine TB will impact on the number of farms that will dispose of clinically infected animals in on-farm pits. To dispose on-farm will require a resource consent and so there will be an impact on the number of farms requiring such consents and the costs of obtaining and maintaining these consents and pits.	<p>Under Containment, the level of bovine TB will decline until it reaches the containment level. The number of farms requiring an on-farm pit for the disposal of clinically infected animals will also gradually decline over time.</p> <p>Under No Control, the level of bovine TB will increase exponentially from current levels and the number of farms requiring an on-farm pit for the disposal of clinically infected animals will rise until a very significant proportion of all farms require a pit and an associated consent.</p> <p>There is, therefore, a benefit from Containment compared with No Control in the form of lower costs of the consents and pits for disposing of clinically infected animals on-farm.</p>	2.48	0.04%	<p>Under Eradication, the level of bovine TB will decline until there is no bovine TB when eradication is achieved. The number of farms requiring an on-farm pit for the disposal of clinically infected animals will also gradually decline over time and become zero once eradication is achieved.</p> <p>Under No Control, the level of bovine TB will increase exponentially from current levels and the number of farms requiring an on-farm pit for the disposal of clinically infected animals will rise until a very significant proportion of all farms require a pit and an associated consent.</p> <p>There is, therefore, a benefit from Eradication compared with No Control in the form of lower costs of the consents and pits for disposing of clinically infected animals on-farm.</p>	2.51	0.04%
Impact on the costs of bio-security activities due to being able to draw on a "standing army"; the extent of vector control and herd testing undertaken affects the size of the "standing army" of experienced herd testers and vector controllers available to assist with other bio-security activities, if required.	<p>Under Containment, initially there will be a significant level of herd testing and vector control and a reasonably sizeable "standing army" available to assist with other bio-security activities, if required. However, over time, the size of the standing army will be reduced and eventually, when containment is achieved, the numbers will be modest.</p> <p>Under No Control, there will be no herd testing and vector control and so no "standing army" of herd testers and vector controllers available to assist with other bio-security activities, if required.</p> <p>There is, therefore, a benefit from Containment compared with No Control in the form of there being a "standing army" available to assist with other bio-security activities, if required.</p>	0.30	0.00%	<p>Under Eradication, initially there will be a significant level of herd testing and vector control and a reasonably sizeable "standing army" available to assist with other bio-security activities, if required. However, over time, the size of the standing army will be reduced and eventually disappear, when eradication is achieved.</p> <p>Under No Control, there will be no herd testing and vector control and so no "standing army" of herd testers and vector controllers available to assist with other bio-security activities, if required.</p> <p>There is, therefore, a benefit from Eradication compared with No Control in the form of there being a "standing army" available until eradication is achieved to assist with other bio-security activities, if required.</p>	0.37	0.01%

Human physical health impacts; the prevalence of TB-infected possums, other wildlife and game animals in the environment; the level of TB-infected livestock being slaughtered; and the level of TB-infected unpasteurised milk available for consumption will affect the risk of infection among farmers and process workers, game and possum hunters, and to a very limited extent among consumers. The number of humans infected with bovine TB will impact on the human physical health of the population.	<p>Under Containment, the number of people suffering physical health effects will decline as the level of bovine TB among herds and wildlife declines. When containment is achieved, the level of human health effects from bovine TB will be minor.</p> <p>Under No Control, the number suffering physical health impacts is likely to rise as the level of bovine TB among herds increases.</p> <p>There is, therefore, a benefit under Containment compared with under No Control in the form of lower human physical health effects from bovine TB.</p>	0.07	0.00%	<p>Under Eradication, the number of people suffering physical health effects will decline as the level of bovine TB among herds and wildlife declines. Once eradication is achieved, there will be no on-going human health effects from New Zealand sourced bovine TB.</p> <p>Under No Control, the number suffering physical health impacts is likely to rise as the level of bovine TB among herds increases.</p> <p>There is, therefore, a benefit from Eradication compared with No Control in the form of lower human physical health effects from bovine TB.</p>	0.08	0.00%
Impact on costs of slaughtering cattle and deer and the need to segregate products in processing; the prevalence of bovine TB will affect the number of TB-infected animals being slaughtered at processing plants. This will affect the speed at which kill chains can operate and the extent to which infected stock or product has to be segregated from non-infected stock or product with implications for the costs of processors and returns to farmers.	PPG determined the difference in net benefits under the Containment and No Control scenarios not captured in the difference in payout for condemned stock account for under benefit B10 is immaterial.	0.00	0.00%	PPG determined the difference in net benefits under the Eradication and No Control scenarios not captured in the difference in payout for condemned stock account for under benefit B10 is immaterial.	0.00	0.00%
Impact on carbon credits; the level and geographic spread of possums browsing on trees may affect over time the level of carbon sequestration by New Zealand bush and forests.	PPG determined there is limited likelihood of any benefit from any effect of possums on sequestration within the period likely to impact the analysis.	0.00	0.00%	PPG determined there is limited likelihood of any benefit from any effect of possums on sequestration within the period likely to impact the analysis.	0.00	0.00%
Impact on opportunities for provision of raw milk; the prevalence of bovine TB will impact on the risks for raw milk producers and the market opportunities they face and prices they receive.	PPG determined that the likelihood is that the quantity of raw milk sales will remain small under any likely scenario. PPGs best estimate is that there will be no net benefit from increased opportunities to sell raw milk within the period likely to impact on the analysis.	0.00	0.00%	PPG determined that the likelihood is that the quantity of raw milk sales will remain small under any likely scenario. PPGs best estimate is that there will be no net benefit from increased opportunities to sell raw milk within the period likely to impact on the analysis.	0.00	0.00%
On-farm mustering costs; if there is a NPMP there will be a requirement on farmers to present stock for herd testing and the frequency and nature of the	Under Containment, farmers will be required to muster to present animals for TB herd testing and will incur incremental costs in doing this. As the prevalence of TB declines towards the	-0.23%	-14.90	Under Eradication, initially farmers will be required to muster to present animals for TB herd testing and will incur incremental costs in doing this. As the prevalence of TB declines towards eradication the level of herd testing will also decline. Testing and the costs of	-0.15%	-10.17

testing required under the NPMP will impact on the incremental costs to farmers of mustering stock for bovine TB tests.	<p>containment level the amount of herd testing will also decline but there will always be some level of herd testing and incremental mustering costs associated with it.</p> <p>Under No Control, there will be no TB herd testing and so no incremental costs for farmers mustering to present stock for TB testing.</p> <p>There is, therefore, a cost under containment compared with under No Control in the form of incremental on-farm mustering costs for presenting animals for TB herd testing.</p>			<p>mustering to present animals for herd testing will cease once eradication is achieved.</p> <p>Under No Control, there will be no TB herd testing and so no incremental costs for farmers mustering to present stock for TB herd testing.</p> <p>There is, therefore, a cost under Eradication compared with under No Control in the form of incremental on-farm mustering costs for presenting animals for TB herd testing.</p>		
Carcass value losses – test reactors slaughtered; the prevalence of bovine TB impacts the numbers of animals reacting to tests on-farm and hence on the number of animals slaughtered because they are reactors on-farm.	<p>Under Containment, there will be on-farm tests and so there will be on-farm test reactors to be slaughtered. The number will decline over time until the containment level of bovine TB is reached.</p> <p>It is assumed that under No Control there will be no testing and hence no on-farm test reactors to be slaughtered.</p> <p>Containment, therefore, imposes a cost compared with No Control.</p>	-9.07	-0.14%	<p>Under Eradication, there will be on-farm tests until eradication is achieved and so up to that point there will be on-farm test reactors to be slaughtered.</p> <p>It is assumed that under No Control there will be no testing and hence no on-farm test reactors to be slaughtered.</p> <p>Eradication, therefore, imposes a cost compared with No Control.</p>	-4.38	-0.07%
Herd management & livestock movement cost impacts; bovine TB cattle and deer herd infection controls incur significant costs and impact on farm management and profitability, mainly through reduced sale values and reduced opportunities for moving stock for grazing or herd relocation.	<p>Containment imposes a cost compared with No Control as under Containment there will be on-going herd control and livestock movement restrictions.</p> <p>It is assumed that under No Control there will be no herd management or livestock movement controls and hence no costs associated with such activities.</p>	-17.59	-0.27%	<p>Eradication initially imposes a cost compared with No Control as, until eradication is achieved, there will still be instances of herd control and livestock movement restrictions. Once eradication is achieved there will be no on-going herd management and livestock movement controls and so no associated cost.</p> <p>It is assumed that under No Control there will be no herd management or livestock movement controls and hence no costs associated with such activities.</p>	-8.08	-0.12%
Impact of testing on dairy production; not relevant as impact of bovine TB testing on dairy production is considered by SSG to be minimal.	Not relevant as the impact of bovine TB testing on dairy production is considered by PPG to be minimal.			Not relevant as the impact of bovine TB testing on dairy production is considered by PPG to be minimal.		
Impact on the possum pelt industry; the level and geographic focus of possum control for bovine TB control impacts the	It is standard practice in cost benefit analysis not to compensate parties for any negative externalities they incur as a result of a policy. For			It is standard practice in cost benefit analysis not to compensate parties for any negative externalities they incur as a result of a policy. For this reason, PPG determined any net cost on the pelt and fur		

number and distribution of possums, which, in turn, impacts the extent and location of possums available for the possum pelt and fur industry. This affects the costs of supply of possum pelts and fur.

this reason, PPG determined any net cost on the pelt and fur industry should be disregarded.

industry should be disregarded.