Draft Regulatory Impact Statement: Stock Exclusion

Agency Disclosure Statement

This Draft Regulatory Impact Statement has been prepared by the Ministry for Primary Industries (MPI) and the Ministry for the Environment (MfE). It provides an analysis of options to exclude stock from waterbodies.

The analysis presented here is supported by the *National Stock Exclusion Study* undertaken by the MPI's Environmental Economics Unit (EEU), which will be published in conjunction with this Regulatory Impact Statement. For a range of stock exclusion policy options, the study estimated the financial costs of fencing and reticulation; reductions in *E. coli* loads from fencing; and New Zealander's willingness to pay for a reduced likelihood of getting sick from contact with freshwater. Each component of the research was contracted to an independent external provider; AgriBusiness Group, NIWA, and the Agribusiness and Economics Research Unit of Lincoln University respectively. MPI then used the results of each component to undertake a cost benefit analysis for each of the stock exclusion policy options.[1]

Results from the study are used throughout this paper to provide an impact assessment for the introduction of a stock exclusion regulation, and to compare the costs and benefits of different options for such a regulation. The study has some limitations. The impacts of stock exclusion practices on sediment in waterways and ecosystem health, and an assessment of the benefits and costs of introducing riparian planting and setback requirements, could not be included in the scope of the current study. Studies undertaken by the EEU in the Northland and Waikato regions show that these types of detailed analyses, particularly sediment modelling in freshwater bodies, are very time consuming and costly even at regional or catchment scales. However, work of this nature may be undertaken in future as part of the policy development process.

The survey methods used to determine non-market values and the current extent of stock exclusion have potential sources of error and bias, even though steps have been taken to reduce these uncertainties by applying robust design and analysis where possible. These include limitations around sample size; response rates; spatial distribution of responses, and self-selection or reporting bias. There are also limitations around the accuracy of land use data at a reach scale, especially when it is being aggregated to make inferences at a national scale. This is particularly related to the use of FarmsOnline, which was developed as a national biosecurity database, rather than for assessment of land use change. These limitations are described in detail in the *National Stock Exclusion Study* report.

The options presented here are constrained by Government's previous decision that a regulation would be introduced requiring exclusion of dairy cattle from waterways by 1 July 2017.

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[1] In alignment with the *Guide to Social Cost Benefit Analysis* recently updated by The Treasury (July 2015).

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Introduction

1. In October 2014, the Government announced its intention to make the exclusion of dairy cattle from water bodies mandatory by 1 July 2017, and to work with industry to exclude other cattle from waterways over time on intensively farmed lowland properties.
2. The Land and Water Forum (the Forum) was mandated to provide advice on the regulatory requirements to fence streams to exclude dairy cattle. The Forum brings together a range of stakeholders that have a stake in freshwater and land management. Their recommendations were published in the Forum's fourth report in November 2015. These recommendations included requirements to also exclude other types of stock.
3. In February 2016, the Government consulted on a proposal for a stock exclusion regulation as part of the *Next steps for fresh water* consultation.
4. We are now seeking to consult on a more detailed stock exclusion proposal. The proposal would require dairy cattle on milking platforms[2] and pigs to be excluded from specified types of water bodies across all terrains by 1 July 2017. Under the proposal, dairy support, beef cattle and deer would need to be excluded on flat and rolling land, and on steeper land where break-feeding, on a staggered timeline to 2030.

Status quo

5. Stock entering water bodies has negative effects on freshwater quality including direct contamination and damage to the banks of the river. Disease causing organisms and sediment are two types of contaminants that can enter water bodies from stock access. Contamination from disease causing organisms occurs from the direct deposition of animal waste into the water body and creates risks to human health. Sediment can enter water bodies from pugging and trampling of the stream banks which causes erosion, vegetation loss and soil loss. This reduces water clarity and decreases the water's ability to support a healthy ecosystem by impacting on habitat quality, spreading weeds and increasing algal blooms.
6. These impacts also have social, economic and cultural ramifications. New Zealanders value being able to use water bodies, for example for boating, swimming and mahinga kai (good gathering). This also creates a negative perception of the primary sector industry among the New Zealand public and our international markets.
7. Under the status quo, continued livestock access to waterways could mean that water quality and the natural character of water bodies degrades, or does not improve, in some areas.

Current stock exclusion

8. There is currently no national regulation requiring the exclusion of stock from water bodies. Stock exclusion requirements can be found in some council plans and in primary sector industry agreements. This means that stock exclusion requirements vary across regions and across primary sectors.

The dairy industry

9. The majority of dairy farmers (94 percent) are already excluding stock from all permanently flowing waterways over a certain size (Brown, 2015). A voluntary agreement, the *Sustainable Dairying Water Accord* (the Accord), aims to exclude 100 percent of dairy cattle (on milking platforms) from permanent waterways over 1 metre wide and 30 centimetres

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[2] The areas of a dairy farm where cattle are kept on a daily basis during the milking season.

deep, and regionally significant wetlands, by 2017 (DairyNZ, 2015). Most New Zealand dairy companies are signed up to the Accord so it applies to over 90 percent of dairy farms.

10. The Taranaki region sits outside the stock exclusion commitments of the Accord due to an existing agreement. The Taranaki Regional Council reported in 2014 that 80 percent of stream banks were fenced, and 65 percent vegetated. The Westland Milk dairy company (which has 330 supplier farms in Westland and Canterbury) has not signed up to the Accord, but promotes stock exclusion among its suppliers through other means.

11. Dairy support land, where dairy cattle are grazed off the milking platform, is not currently covered by the Accord. The Accord's stock exclusion requirements will extend to dairy cattle grazing on land owned or leased by the dairy farmer from 1 June 2017.

The beef, deer and pork industries

12. Beef+Lamb NZ and Deer Industry New Zealand promote stock exclusion through their voluntary Land Environment Plans, but these industries have a lower rate of stock exclusion than the dairy industry. The *Survey of Rural Decision Makers* (Brown, 2015) reported approximately 52 percent of sheep and beef farmers (who responded to the survey) had fenced all streams over 1 metre wide in 2015, with 77 percent having installed some fencing. Of deer farmers responding to the survey, around 54 percent had fenced all streams over 1 metre wide, with 89 per cent having fenced some streams over 1 metre wide. This is self-reported and not independently verified.

13. It is likely that pig farmers have already excluded most stock from waterways. Many pigs are housed, and farmers in Canterbury (where 65 percent of pig farms are located) are already required by the regional council, Environment Canterbury, to exclude intensively farmed stock from natural waterways.

Regional council plans

14. Regional councils (councils) vary in their approaches to addressing livestock access to water bodies (table 1). Of the sixteen regional councils, only nine have current or proposed stock exclusion rules (see Table 1). Where councils do have rules, often they only apply in certain situations e.g., to priority water bodies only.

15. Some councils take an effects-based approach, whereby stock access is allowed only if it does not have a specified impact on water bodies (for example, in Otago this includes a noticeable change in the clarity or colour of the water). In the West Coast, the regional council works closely with the local dairy company (Westland Milk Products) on environmental issues rather than regulating region-wide. Where councils are developing new Regional Plans, there is a general tightening of rules around stock exclusion.

16. Many councils provide some level of financial assistance for fencing and/or riparian planting. This is often limited to priority areas (for example, sites of significant biodiversity or cultural values). Monitoring and enforcement efforts between councils are highly variable. Some councils actively pursue offenders and have taken cases to court, while others monitor only when a complaint has been made.

Table 1: Summary of regional councils' current and proposed stock exclusion rules

Regional Council	Summary of where and when stock exclusion rules apply	Status
Councils WITH current, proposed or draft region-wide stock exclusion rules		
Waikato	Priority water bodies (in force)	Current
Bay of Plenty	Priority water bodies (in force)	Current
Canterbury	Intensively farmed stock and priority areas (in force)	Current
Horizons	New intensive farming or existing intensive farming in priority areas (in force)	Current
Southland	Current rules: Winter intensive grazing and priority water bodies (in force) Proposed rules: Where slope is less than 16 degrees; deer by 2020, other stock (except sheep) by 2018	Current Proposed
Marlborough	Intensively farmed stock, by 2022	Proposed
Gisborne	Winter intensive grazing by 2017 (riparian setbacks also required)	Proposed
Auckland	Intensive stock to be excluded by 2021 for lakes, wetlands and permanently flowing rivers/streams, and 2026 for intermittent rivers/streams.	Proposed
Wellington	Similar to proposed national rules but by 2022 (2018 for significant wetlands and priority water bodies)	Proposed
Northland*	Similar to proposed national rules	Draft
Taranaki	Intensively farmed stock, by 2020 (riparian planting also required)	Draft
Councils WITHOUT region-wide stock exclusion rules		
Westland	Stock access is a permitted activity (except for Lake Brunner catchment)	Current
Hawke's Bay	Stock access is a permitted activity (except for Tukituki catchment)	Current
Tasman	Stock access is a permitted activity (except at Te Waikoropupu Springs)	Current
Nelson	Stock access is a permitted activity	Current
Otago	Stock access is a permitted activity	Current

Problem definition

17. Freshwater quality is negatively affected by contaminants, including disease causing organisms and sediment, entering water bodies. This creates risks for human health and decreases the water's ability to support a healthy ecosystem.

18. Stock exclusion rules can be found in council plan or industry agreements. However, only nine of the sixteen regional councils have current or proposed stock exclusion rules and these rules only apply in certain situations. Over time, remaining councils are likely to progressively require stock exclusion for various stock types and water bodies, but this will take many years and provide incomplete protection.

19. Achieving a high uptake of stock exclusion voluntarily is difficult because the costs and benefits are borne by different parties; farmers bear the costs (for example, of installing fences) while the benefits are mostly public goods (that is, benefit all water users).

20. In areas where there are no stock exclusion rules, or rules do not apply to their farm, many farmers are choosing not to exclude stock. The Survey of Rural Decision Makers (Brown, 2015) asked farmers for their reasons for not excluding stock from waterways. Common reasons included lack of finances; not perceiving that there are environmental benefits; and perceiving that the costs are greater than the benefits.

21. This means there is low uptake of stock exclusion practices and stock entering water bodies continues to be a pressure on water quality. The costs of stock entering water bodies is borne by the public in terms of increased health risks, and the ecosystem in terms of degraded water bodies.

Objectives

22. The objective of this intervention is to better protect freshwater quality and ecosystems by decreasing contaminants, including disease causing organisms and sediment, entering water bodies.

Criteria

23. There are a series of criteria against which each option will be assessed:

    A. **Effectiveness (environmental benefit):** the option should be effective at stopping the entry of disease causing organisms and sediment on waterways;

    B. **Cost:** the option should be cost effective, including costs of compliance and enforcement, and transactional costs;

    C. **Feasibility:** the option should be feasible to comply with and enforce; and

    D. **Treaty of Waitangi:** the option should take into account the principles of the Treaty of Waitangi (as required by section 8 of the Resource Management Act 1991).

Consultation

24. In February 2016, the Government released a discussion document, *Next steps for fresh water* (*Next steps*). *Next steps* contained a proposal to develop a national regulation that requires exclusion of dairy cattle (on milking platforms) from water bodies by 1 July 2017, and other stock types at later dates.

25. Public consultation on the discussion document took place over two months. The Ministry received 3,966 submissions in total, representing the views of 6,342 people. A series of meetings and hui were also held during the two month consultation period, attended by approximately 1,050 people.

26. Nearly 20 percent of all written submissions commented on the stock exclusion proposal. Most respondents were supportive in principle but many had concerns over the details of implementation. Most unease came from the primary industry (83 percent had concerns or were opposed) and regional councils (54 percent had concerns or were opposed).

Greater stringency

27. Individuals, Māori, territorial authorities, NGOs, science providers and others largely agreed with the proposal or wanted the regulation more stringent and/or earlier deadlines for compliance. Many respondents saw the deadlines as too far away, allowing further degradation of fresh water.

Practicality issues

28. Regional council and primary industry concerns related to the lack of flexibility of a national regulation. Respondents commented that the cost of stock exclusion can be high (financial costs but also environmental problems such as weed invasion and erosion) and this may not be justified by the environmental benefit in all cases, particularly where:

    a. farming is extensive (low stocking densities)

    b. water quality is good and not declining

    c. costs of stock exclusion are particularly high (e.g., due to the topography or where regular flooding events would damage fences).

29. Some respondents agreed with the proposal in principle, as long as the regulation is able to take into account variation in circumstances (e.g., an exemptions regime is put in place). Respondents from the West Coast in particular were concerned it would be difficult for farmers to comply with the proposed regulation, especially by the 2017 deadline for dairy, due to the unique topography of the area. For example, Environment Southland commented:

    > "*There needs to be a process to allow a regional council to exempt land if considered appropriate*"

30. Respondents also showed a clear preference for stock exclusion to be required by any "effective method" rather than specifying that this must be achieved by fencing. For example, Federated Farmers noted that:

    > "*Federated Farmers seeks for a proposal around stock exclusion, which can be achieved by a variety of means, such as physical barriers (e.g. large banks, hedges, cliffs etc.) or through other such measures such as water troughs, hot wires, etc*"

Riparian issues

31. Many respondents pointed out the benefits of planted riparian buffers for water quality and the local environment. There is general agreement amongst primary industry groups and scientific organisations that it is not appropriate to have a national standard or requirement for riparian management. However, there is still a desire for the establishment of planted riparian buffers to be encouraged in some way.

Options analysis

32. One way to achieve the desired objective would be to remedy the effects of contaminants once in water bodies. However, there is no known means to do this that is acceptable to ecosystem health, so this option has not been considered any further.

33. The best way to achieve the desired objective is to exclude stock from waterways. Stock exclusion can be effective in reducing pathogen concentrations in catchments. A literature review of 'removal efficiencies' (the effectiveness of stock exclusion at reducing *E. coli* levels in freshwater) was carried out by AgResearch as part of the National Stock Exclusion study. This found that the most likely removal efficiencies for *E. coli* due to stock exclusion were around 60 percent for dairy cattle and deer, and around 40 to 50 percent for beef cattle.

34. Stock exclusion can also reduce bank erosion and sediment loads to water bodies. Excluding stock was found to improve the ecological health of streams (measured using the Macroinvertebrate Community Index) in several different regions of New Zealand, probably

through reduced suspended sediment. In Alberta, Canada, it was found that the overall health of the riparian area (vegetation, soils and hydrologic features) was improved through stream bank fencing (Miller et al, 2010).

Regulatory and non-regulatory options

35. There are a number of options, both regulatory and non-regulatory, to keep stock out of water ways. The following sections assess these options and their impacts, and Table A provides a summary of how these options compare against the criteria.

Option 1. Allow continuation of status quo (do nothing further to the initiatives already underway)

Option 2. Non-regulatory approaches, which could involve one or more of:

- **Financial incentives / grants for stock exclusion.**

  Incentives or subsidies can increase uptake of stock exclusion by reducing the cost burden on farmers. Small seed funding can initiate a wider community-led programme of environmental improvement, for example, voluntary riparian fencing and planting was undertaken in the Aorere catchment following Sustainable Farming Fund-subsidised investigations.

- **Guidance for landowners**

  This could cover the reasons for excluding stock (benefits to the farmer as well as the environment); where to prioritise stock exclusion; and how to plan and carry out stock exclusion.

- **Working with regional councils that do not have stock exclusion rules to encourage and help them to develop such rules.**

  Four councils do not currently have stock exclusion rules, either in force or in draft. These councils have deliberately not introduced such rules, and some have designed region-specific alternative approaches. Otago Regional Council has an effects-based approach focusing on water quality monitoring; while West Coast Regional Council has specific geophysical issues and works closely with the local dairy company and its farmers.

Option 3. Regulation. National regulation requiring landowners to exclude stock from water bodies, with instant fine for non-compliance. Could have broad coverage or only apply to certain stock types, areas and water bodies.

Analysis of the options

Option 1 – continuation of the status quo

36. If no action is taken, it is expected that there will be some increase in the level of stock exclusion, but this would be limited and patchy across the country. Over time, remaining councils are likely to progressively require stock exclusion for various stock types and water bodies, but this will take many years, and provide incomplete protection. Achieving a high uptake of stock exclusion voluntarily is difficult because the costs and benefits are borne by different parties; farmers bear the costs (for example, of installing fencing) while the benefits are mostly public goods (that is, benefit all water users). Of surveyed farmers with unfenced streams, only 12% were planning to fence in the next two years (Brown, 2015). The rest

were not planning to fence as they did not perceive a benefit, or perceived that the costs outweighed the benefits.

37. There will be costs to farmers needing to comply with new regional council rules. There will also be regulation and enforcement costs to regional councils. There would be no direct costs to central government.

38. There are no major practical feasibility issues, although this option will not protect freshwater quality and effectively prevent contaminants from entering waterbodies.

Option 2 – non-regulatory approaches

39. This is unlikely to be much more effective than option 1, that is, it will not result in much more stock being excluded from waterways, unless very large financial incentives are brought in. The same reasons as described for option 1 still apply: the costs and benefits fall on different parties. Also, many non-regulatory approaches are already in use and most farmers are aware of the benefits of excluding stock, so this option is unlikely to have a large impact.

40. Many councils already offer funding for riparian management (including stock exclusion fencing) under certain circumstances. In addition, materials for fencing and water reticulation are tax deductible. There is a large amount of guidance material already in existence.[3] Regional councils not already regulating stock access to water bodies are unlikely to regulate unless required to, as they have actively chosen not to. Financial incentives would need to be large to make the benefits outweigh the costs for farmers who have not already excluded stock.

41. The cost of this option could be fairly low (for example, if the only action taken is development of guidance), but if financial incentives were offered, this could become very expensive and offering financial incentives penalises the early adopters of stock exclusion.

42. This option will also not protect freshwater quality and is not likely to effectively prevent contaminants from entering waterbodies.

Option 3 - regulation

43. A regulation would create greater incentives to exclude stock that options 1 and 2. This option therefore has the highest likely effectiveness. Giving regional councils the ability to issue instant fines for breaches of the regulation could improve compliance by making enforcement less onerous for councils. A regulation would not necessarily remove councils' discretion to apply more stringent rules where necessary.

44. The costs are higher than the other options, as there is a cost to introducing and enforcing a regulation. Regional councils would bear the enforcement costs. The costs to farmers overall would be higher due to greater uptake.

45. There is the potential for feasibility issues for landowners, as a blanket requirement does not take into account the variation in circumstances between farms. For example challenging topography may make compliance difficult or very expensive, or fencing streams could split paddocks into small, unusable sections. Enforcement by regional councils could be difficult due to the number of farms the regulation would apply to.

46. National regulation would ensure that a minimum standard is applied to farmers. This would better protect freshwater quality and ecosystems on a national level and ensure that give greater certainty to farmers and water users.

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[3] For example,, from DairyNZ (www.dairynz.co.nz/environment/waterways/fencing-waterways/), Beef+Lamb NZ (http://www.beeflambnz.com/PageFiles/1206/LEP%20stock%20exclusion.pdf), and Greater Wellington Regional Council (http://www.gw.govt.nz/assets/Our-Environment/Land%20and%20soil/WGNDOCS-962755-v1-ManagingStockAccesstoWaterwaysintheWellingtonregion-FINAL.PDF)

Recommended option: Regulation

47. In summary, the recommended option is a stock exclusion regulation, as this is the most effective option to protect freshwater quality and ecosystems from the impact of stock access. Regulation would provide reassurance to the public and our international markets that action is being taken to protect freshwater quality and ecosystem health. The following section provides an assessment of the costs and benefits of a mandatory national stock exclusion regulation, and how some of the costs and risks can be addressed.

Design of a stock exclusion regulation

48. There are five main aspects to the design of a national stock exclusion regulation that are discussed below:

    A. **Farm types.** Which stock types and what terrain should be included in a stock exclusion regulation?

    B. **Deadlines.** When would the requirements apply to different farm types?

    C. **Methods of exclusion.** Should permanent fencing be required, or should other methods be allowed?

    D. **Types of water bodies.** What types of water bodies (for example, what size of streams) should the regulation apply to?

    E. **Riparian management.** Should riparian buffers between fences and water bodies be required to be implemented and managed?

A. Farm types

Stock

49. The stock types being considered for a stock exclusion regulation are dairy cattle, beef cattle, deer and pigs. These stock types have an affinity for water and have the potential to directly deposit excreta into water bodies. They are also large animals with the potential to damage stream banks through trampling.

50. Sheep and goats are not included in the regulation. These animals are smaller and prefer not to enter water bodies, so do not have the same negative impact on water bodies and riparian environments through trampling or direct deposition. For sheep and goats, contribution to pathogen levels in water bodies is mainly due to surface runoff. In addition, these animals can be useful in controlling weeds where they are able to graze riparian margins.

51. Four options are considered for the application of a stock exclusion regulation, which progressively expand the application of the regulation to include more stock types. All four options provide greater environmental benefits than the status quo, but at a cost to farmers and regulators (central and local government). From option 1 through to option 4, the value of the environmental benefits increases, but so does the magnitude of the costs. All options have potential feasibility issues (for landowners) as blanket requirements do not take into account local circumstances where stock exclusion may be problematic or prohibitively expensive. However these issues are addressed through the implementation proposals.

52. The following section assesses these options and their impacts based on data from the National Stock Exclusion study (a summary of the study's methods and results is given in Appendix B). The figures given below for the benefits should be interpreted as a relative comparison between options rather than absolute figures, due to the limitations of the methods. Table B provides a summary of how these options compare against the criteria.

***Option 1**: Regulation applies to dairy cattle on milking platforms and pigs.*

53. The exclusion of dairy cattle on milking platforms has relatively low additional benefits compared to the status quo (valued at $65 million), as most dairy farmers are already excluding their stock from water bodies under the Sustainable Dairying: Water Accord. The costs for excluding dairy cattle on milking platforms are also relatively low ($20 million, comprising $10 million for each of fencing and water reticulation). This option is relatively feasible as fencing on milking platforms (which tend to be small and on flat land) is relatively straightforward and low cost; cattle fencing (two-wire electric) is the cheapest type of fencing at around $9,000 to fence 1 km of stream on both sides. The greatest potential issues will be felt in the West Coast where there is the most work left to do. The cost benefit ratio for this option is 3.2. The costs and benefits of excluding pigs were not estimated as nearly all pigs are already excluded from water bodies.

***Option 2**: Option 1 + dairy support cattle (both on land owned/leased by the dairy farmer and on third party land)*

54. Dairy cattle have a negative impact on water bodies both on and off the milking platform, and are sometimes grazed at high stocking densities while not being milked. This is the most cost efficient option, with the highest benefit-cost ratio (8.1). The estimated benefits are $258 million, with costs of $32 million (only slightly higher than option 1). This may be partly because dairy support is likely to use a greater proportion of temporary fencing than other farm types, and this is much cheaper than permanent fencing.

55. This option may present some feasibility challenges as dairy support is often a temporary land use. However using temporary fencing may mitigate this problem, as it is easily moved. This option creates an inconsistency as the requirements do not apply to beef farmers, while the impacts of beef cattle on water bodies are comparable to the impacts of dairy cattle.

***Option 3**: Option 2 + beef cattle*

56. This option has significantly higher environmental benefits than option 2, with an extra 18,000 km of the banks of waterways protected from livestock incursions, compared to the status quo (valued at $974 million).

57. The costs are also significantly higher ($358 million, of which around two thirds is for water reticulation) as this option applies to much more land (therefore protects more water bodies). There are 2.9 million beef cattle on flat and rolling country. The benefit-cost ratio is lower than option 2 (2.7). This is probably because beef cattle tend to be kept at lower stocking rates than dairy cattle, so have less of an environmental impact in the first place. Also, costs per kilometre of stream are likely to be higher as beef cattle are more likely to be on rolling than flat land.

***Option 4**: Option 3 + deer (proposed option)*

58. Deer are large animals capable of damaging water bodies, although they do not tend to stand in large groups in water bodies as cattle do. Some deer wallow, however, and these wallows can be major sources of sediment and pathogens when connected to other water bodies. In addition, young deer may play in water.

59. The total benefits of this option are estimated at $983 million and the costs are $367 million. This is only slightly higher than option 3. This is because the deer industry is relatively very small, occupying 287,000 hectares of land (Statistics New Zealand, 2015). The benefit-cost ratio is the same as option 3 (2.7), partly because deer fencing (or netting) is very expensive, averaging about $20 per metre.

60. Although this option has a lower benefit-cost ration than options 1 and 2, it would have the greatest environmental effectiveness as it would exclude the most stock. This option has

the greatest feasibility issues as deer farmers face much higher costs than cattle farmers to exclude stock due to the high cost of deer netting which may be prohibitively expensive for farms with an extensive drainage network (many water bodies on the farm).

Recommended option

61. The recommended option is option 4 (stock exclusion requirements apply to pigs, milking platforms, dairy support, beef cattle and deer). This option results in the greatest environmental benefits by excluding the most stock so will be the most effective at stopping contaminants entering water ways. This option is the most costly particularly for deer farmers.

62. Fencing and water reticulation materials are tax deductible, which reduces costs. Around half the regional councils offer funding to cover part of the cost of streamside fencing (between 25 percent and 50 percent of the cost), although this is often only available for priority areas. There are also transaction and enforcement costs associated with introducing a stock exclusion regulation, and these costs would fall on local and central government.

Intensive vs. extensive farming

63. The costs of stock exclusion tend to be higher in the hill country than on flatter land. This is due to higher costs of transporting materials and installing fencing on challenging terrain (for example, fence lines may need to be bulldozed).

64. Dairy and pig farming are usually intensive farm systems, and therefore the environmental risks associated with stock access to water bodies are higher (due to the higher stocking rate). Stock exclusion on these farms is usually relatively low cost and straightforward compared to other farm types, as fencing is cheaper on flatter land, and the farms are usually smaller in size. It is proposed to apply stock exclusion requirements to these farm types regardless of terrain.

65. It is less clear cut for dairy support, beef cattle and deer as these stock types are both intensively and extensively farmed in New Zealand. The following options for how to apply stock exclusion requirements to dairy support, beef cattle and deer are considered. The following section assesses these options, and Table C provides a summary of how they compare against the criteria.

***Option 1**: Apply stock exclusion regardless of terrain or intensity*

66. There is a strong relationship between slope and intensity of farming; farming tends to get more extensive as you move from the plains up into the hill country of New Zealand. Environmental risks associated with stock access to water bodies are lower in the hill country due to lower stocking rates. On the plains, farming is more intensive (stocking densities are higher), so the negative environmental impacts of stock in water bodies are greater.

67. Applying the requirements to hill country as well as plains and lowland hills would require an additional $1,069 million to be spent by farmers (with additional benefits of $2286 million). Extensive farms are usually much larger than intensive farms and therefore farmers may have to install a large amount of fencing and stock water reticulation systems. The benefit-cost ratio for stock exclusion on plains and lowland hills is 2.7, and this drops to 2.3 if the requirements also apply in the hill country.

68. As extensive farming tends to gain lower profit margins per hectare, stock exclusion will be less affordable for these farmers. Practical constraints may render stock exclusion impossible or prohibitively expensive in some areas (for example, very steep and rocky areas). For these reasons, option 1 has been rejected.

***Option 2**: Apply stock exclusion using a stocking density threshold.*

69. While stocking density is a good proxy for environmental risk, it would be challenging to define and enforce as will vary across the farm and over the year. Paddock-level stocking density is more relevant for stock exclusion than farm-level stocking density: a farm with a moderate stocking density overall may still have locally high stocking densities near waterways. In addition, this option may apply to farms on steeper land where stock exclusion is less feasible.

***Option 3:** Apply stock exclusion on plains and rolling land only (defined as land with a slope of 0 to 15 degrees) (proposed option).*

70. Using a slope threshold is also a proxy for environmental risk, but applies more broadly so offers greater protection. It is more straightforward to define and enforce as it does not change over time. Slope also reflects the increasing costs and greater practical constraints of stock exclusion on steeper land. It is proposed that dairy support, beef cattle and deer are required to be excluded from water bodies on flat and rolling land (that is, land with a slope of between 0 and 15 degrees). On steeper land, it is proposed these stock types are only excluded where break-feeding due to the very high costs involved on steeper land (an additional $1069 million).

Recommended option: Slope-based approach

71. The recommended option is option 3, that is, to use a slope-based approach to distinguish between more intensive farm systems on flat and rolling land and more extensive farming in the hill country. It is proposed that dairy support, beef cattle and deer are required to be excluded from water bodies on flat and rolling land (that is, land with a slope of between 0 and 15 degrees). On steeper land, it is proposed these stock types are only excluded where break-feeding due to the very high costs involved on steeper land (an additional $1069 million).

Defining slope

72. The proposed method for defining slope is to use the Land Resource Inventory spatial dataset, developed by Landcare Research. The advantage of this approach is that it provides a high level of clarity to landowners and regional council compliance officers on where the requirements apply. The disadvantage is that the data is fairly coarse scale, and therefore will not take account of local (within paddock) variation in terrain. However it is suitable for broadly distinguishing between flat/rolling land and hill country.

73. The other option considered was requiring landowners and councils to identify the water bodies on their farm where the slope is under 15 degrees (for example, with an average slope 20 metres perpendicular to the water body). This option was rejected as it would be very resource intensive for landowners and councils, and open to interpretation.

B. Deadlines

74. It is proposed that there be some flexibility in timeframes for different stock types to comply with the stock exclusion requirements. The proposed dates by which landowners would need to comply are shown below in Table 2. These have been chosen as feasible dates for each sector, reflecting the amount of work left to do and the costs and practical constraints for different farm types. The chosen timeframes also aim to prioritise the higher risk activities in relation to water quality (for example, dairy farming which is generally more intensive than beef, and break-feeding[4]).

[4] Break-feeding is when stock are kept behind a temporary fence which is moved regularly to allow access to sections of the paddock at a time.

75. The dairy industry has been working towards stock exclusion targets since 2003 through the Sustainable Dairying: Water Accord and its predecessor, the Dairying and Clean Streams Accord, and the 1 July 2017 deadline for dairy cattle aligns with the Accord's target. The pork industry is similarly well progressed with regards to stock exclusion, so a deadline of 1 July 2017 has been assessed as achievable. However, there is a lot of work left to do for dairy support, beef cattle and deer, and the costs for individual farmers are likely to be higher due to the generally larger size of these farm types.

76. These deadlines would mean that the objectives were achieved but in a way that is feasible and cost effective. Later deadlines give farmers time to budget and plan for stock exclusion work, and the ability to spread the costs over time. Giving achievable timeframes has the benefits of being more feasible and being likely to achieve a higher rate of compliance. Some dairy support land will be included in the Accord from 2017, so a deadline of 2022 for all dairy support is considered achievable. Dairy support, beef and deer would require more time to comply due to the amount of work left to do and the costs involved. Where break-feeding is used, the timeframe is shorter as it is a higher risk activity in relation to water quality (due to the locally high stock densities. This is seen as achievable as break-feeding already involves the use of electric fencing.

Recommended option

77. The deadlines in Table 2 are the recommended option, as they balance environmental protection with feasibility.

Table 2: Proposed deadlines for compliance with a national stock exclusion regulation.

Farm/stock type	Plains (0-3°)	Undulating / rolling land (4-15°)	Steeper land (16° and over)
Dairy cattle (on milking platform) / Pigs	1 July 2017 (across all terrain)		
Dairy support (on either land owned/leased by the dairy farmer or third party land)[2]	1 July 2022		Only where break-feeding, by 1 July 2022
Beef cattle / Deer	1 July 2025 (1 July 2022 for break-feeding)	1 July 2030 (1 July 2022 for break-feeding)	Only where break-feeding, by 1 July 2022

C. Methods of exclusion

78. Three options for the allowed methods of stock exclusion were considered. The following section provides an assessment of these options and table D summarises how these options compare against the criteria. These options are assessed on the assumption that the recommended options stated previously are taken up.

Option 1: *Stock are required to be excluded by* ***permanent fencing*** *(unless a natural barrier is present that is 100 percent effective at excluding stock)*

79. The advantages of this option is that permanent fencing is highly effective at excluding stock (if maintained properly), and it would be straightforward to monitor (it is easy to tell if a fence has been installed or not). However it is also the highest cost option, and the least cost efficient. This is because permanent fencing is more expensive than temporary fencing (for example, for cattle fencing on flat land: $4.50 per metre for permanent fencing and $1.27 per metre for temporary fencing). Also permanent fencing cannot be repositioned easily. This will have the most impact on farmers that graze animals temporarily (for example, sheep and beef farmers undertaking contract grazing of dairy cattle). There may

also be issues of feasibility, such as flooding washing away fencing, which may result in high costs for farmers in flood prone areas.

Option 2: *Exclusion of* ***cattle*** *may be achieved by* ***temporary fencing*** *(unless a natural barrier is present that is 100 percent effective at excluding stock). All other stock must be excluded by permanent fencing*

80. This option is just as effective as option 1. It is also cheaper and more cost-efficient, as temporary fencing is cheaper and can be easily repositioned. Temporary fencing is a good option where frequent flooding poses a risk to permanent fencing. This option has a higher level of feasibility for farmers. The disadvantage of this option is that it is slightly less straightforward to monitor (for enforcement), but this is not insurmountable. For a regulation, prescribing fencing standards that include temporary fencing may be difficult.

Option 3: No method specified*, stock must be 100 percent excluded from water bodies*

81. This is very similar to option 2, given that permanent and temporary fencing are the main effective methods for excluding stock from water bodies. However this option gives farmers the flexibility to use new methods as new technologies are developed (for example, 'virtual' GPS fences). It also means that where natural barriers (for example, cliffs) prevent stock from accessing water bodies, landowners would not also need to fence. This option also avoids needing to prescribe fencing standards, and puts the onus on farmers to ensure their method is effective. This option also reflects the feedback received from consultation, which showed a clear preference for exclusion by any effective method rather than specifying that this must be achieved by fencing. The disadvantage of this option is that it may be more difficult to monitor and enforce.

Recommended option

82. All these options would deliver the same environmental effectiveness. The recommended option is option 3, not to specify a required method of stock exclusion. This is the most cost efficient option, and gives the highest level of flexibility to landowners and allows for advances in technology. This option also reflects the feedback received from consultation

D. Types of water bodies

83. A stock exclusion regulation could apply to any or all of the types of water bodies listed below. The following section assesses each of these water body types for inclusion in a regulation. These options are assessed on the assumption that the recommended options stated previously are taken up.

    A. **Lakes**
    B. **Wetlands**
    C. **Large permanently flowing rivers and streams** i.e. those over 1 metre wide
    D. **Small permanently flowing rivers and streams** i.e. those less than 1 metre wide
    E. **Intermittently flowing waterways.**

Lakes and wetlands

84. Lakes and wetlands play an important role in supporting biodiversity, filtering contaminants, adding oxygen to water and protecting against the effects of flooding. Livestock incursions can trample vegetation, as well as inputting nutrients and pathogens through direct deposition.

85. Stock exclusion from lakes and wetlands was assessed as achievable by the Land and Water Forum.

Large permanently flowing rivers and streams

86. Larger waterways (over 1 metre wide) are more likely to be used for recreation (fishing, food gathering, swimming, boating and wading) so are important to protect from stock access. Many larger rivers/streams are already fenced. Requiring stock exclusion from large streams is in line with the Sustainable Dairying: Water Accord, so is likely to be achievable for farmers.

Small permanently flowing rivers and streams

87. Small streams can have very high biodiversity values, often greater than in larger streams. In addition, they are often the first order streams and therefore have an impact on water quality in the rest of the catchment. What happens in these smaller rivers can have impacts further down the catchment, although *E. coli* peaks from stock access tend to be localised.

88. Requiring stock to be excluded from small streams increases the overall costs to farmers and potentially poses practical difficulties. The costs of including small streams could be very high for some farms, where they have networks of small branching streams. Fencing these would also result in the loss of productive land and segmentation of paddocks into small sections, which may impede the ability of the farmer to graze the land. This is particularly likely on rolling land.

89. Spring-fed streams on the plains can have a high diversity of aquatic species and good water quality, so it would be beneficial to protect these. This is more feasible on flatter land than on rolling land.

Intermittently flowing rivers/streams

90. Intermittent streams can have high ecological value, and their management has effects further downstream. However, stock access has less of an impact when water is not flowing.

91. In addition, including these streams in a regulation would increase the cost to farmers as there are a significant number of these types of streams. For example, Auckland council estimates there are 16,500 km of permanent rivers in the Auckland region, and a further 11,590 km of intermittent and ephemeral rivers.

Recommended option

92. The recommended option is to apply the requirements to wetlands, lakes and large permanently flowing rivers and streams over 1 metre wide on the rolling and steep land and all permanently flowing rivers and streams, regardless of size, on the plains as this will have significant environmental effects while being cost effective and feasible. The requirement should not apply to intermittent or ephemeral water bodies as the environmental impacts of stock access are less severe and the costs to farmers would be high.

E. Riparian management

93. When installing a fence to exclude stock, the fence can be positioned a distance of several metres or more back from the waterway (a 'setback'), thus creating a 'riparian buffer'. This buffer can be planted (for example, with native shrubs or trees), or left as grass. The following section assesses whether a stock exclusion regulation should include a requirement to manage and plant a riparian buffer. These options are assessed on the assumption that the recommended options stated previously are taken up.

94. There are multiple potential benefits of maintaining a riparian buffer, such as:

    d. Filtration of overland flows, reducing inputs of sediment and contaminants. Even a dense grass sward is an effective filter.

    e. Uptake of excess nutrients from surface and subsurface flows.

    f. Additional protection of stream banks compared to fencing alone, reducing erosion.

g. Prevention of trampling and pugging near the river, thus further reducing soil loss and sediment inputs compared to fencing alone.

h. Fences less likely to be damaged by flooding.

i. Increased organic matter inputs to streams (via leaves and woody debris), increasing the diversity of both food resources and habitats/refuges for aquatic life.

j. Vegetation providing shade, which keeps water temperatures more stable, providing a more suitable environment for aquatic species, including fish and invertebrates.

k. Shade also reduces growth of algae in water bodies. Some freshwater algae (cyanobacteria) can be toxic to humans, pets, livestock and wildlife. Algal mats also reduce light penetration and oxygen concentrations, reducing the life-supporting capability of fresh water.

l. Potential for additional uptake of nutrients from flows.

m. Habitat and refuges for aquatic life (invertebrates and fish). Stable, vegetated banks offer a greater range and quality of habitats (and refuges) for aquatic life.

n. Habitat and food for terrestrial life (birds and invertebrates). The presence of terrestrial invertebrates provides another source of food for aquatic species.

o. Improved aesthetics and enjoyment by people.

95. The realisation of these benefits, however, is highly dependent on the local circumstances, the width of the buffer and the types of plants used. The best environmental outcome will be achieved by undertaking a farm assessment and taking into account the local water quality issues and desired outcomes for the water body.

96. The initial costs of riparian planting can be very high. Typical native planting costs around $3.70 per metre for a single row of plants. For a 1 km length of stream, where just two rows of native planting are required on each side, the cost is estimated to be around $14,700. However, riparian planting is tax deductible under the Income Tax Act 2007.

97. The riparian buffer will also require ongoing maintenance (weed control and replacement of lost plants) at least until the plants are established. Buffers up to approximately 10 to 15 metres wide are likely to need ongoing weed control. This adds up to a high time and cost burden on farmers, which might not be justified by the benefits depending on the circumstances. Larger buffers may be needed to achieve desired outcomes but these will be very expensive to establish and has an opportunity cost as land cannot be used for other purposes.

98. Requiring a setback now would penalise early adopters, who would need to move their fences, which could be costly.

Recommended option

99. For the reasons outlined above, the recommended option is not to include riparian setback requirements in a stock exclusion regulation. The optimum riparian management strategy varies so much, that a blanket national requirement is not appropriate. A non-regulatory approach where riparian management may be able to be tailored to the individual situation is more appropriate, fair, and cost-effective. This option is also in line with the feedback received from consultation that a national requirement is not appropriate, but that riparian planting could be encouraged in other ways.

Table A. Comparison of non-regulatory and regulatory approaches against the status quo

Option 1: Status quo (do nothing, allow regional councils to continue to choose whether they regulate or not)	**Option 2: Non-regulatory approach** (e.g., incentives, guidance, working with councils to encourage them to include stock exclusion provisions in Plans)	**Option 3: Regulation** (with instant fine for non-compliance) - *preferred option*
Key:		
Effectiveness (Environmental)		
0 Increasing number of council rules will come into force over the next 10 years. Voluntary stock exclusion likely to progress slowly as costs and benefits fall on different parties	**+** No guarantee of increased uptake compared to status quo, for same reasons as option 1. Also non-regulatory tools are already in use.	**+** Guarantees close to 100% uptake.
Cost		
0 Lowest costs for central and local government. In some regions, farmers will face costs as new regional rules are implemented.	**-** Variable costs – guidance would be low cost, financial incentives would be high cost.	**-** Costs to central and local government of introducing and enforcing a regulation. Highest costs to farmers as stock exclusion requirements will be mandatory in all regions.
Feasibility		
0 Won't satisfy public desire for stock to be kept out of water bodies.	**0** Same as status quo	**-** Potential for feasibility issues for landowners and regional councils.
Treaty of Waitangi		
All options are consistent with the principles of the Treaty of Waitangi		

Table B: Assessment of options for stock types to include in a national stock exclusion regulation compared to the status quo. The status quo is current stock exclusion practice plus what will be required by 1 July 2017 under the Accord and Regional Plans.

Option 1: Regulation applies to dairy cattle on milking platforms, and pigs	**Option 2:** As option 1 plus dairy support on plains and lowland hills	**Option 3:** As option 2 plus beef cattle on plains and lowland hills	**Option 4:** As option 3 plus deer on plains and lowland hills
Key: Scale of 0 to 4, where 0 = does not meet objective, and 4 = rates highly against objective. Preferred option is highlighted in green.			
Effectiveness (environmental)			
1 Relatively small environmental benefit, with willingness to pay for the benefits valued at **$65 million** (MPI, 2016).	**2** [↑] Greater environmental benefit than option 1, with around 1,400 km more stream bank protected than the status quo, valued at **$258 million**.	**3** [↑] Very large environmental benefit, with 18,000 additional km of stream length protected from livestock incursions, valued at **$974 million**.	**4** [↑] Slightly greater environmental benefit than option 3, valued at **$983 million** as the deer industry is relatively very small.
Costs			
4 [↑] This is the **lowest cost option** overall as it requires the least additional fencing: additional costs on top of the status quo estimated at **$20 million**. [↑] Estimated benefit-cost ratio is **3.2** (MPI, 2016).	**4** [↑] **Relatively low cost**: additional costs compared to the status quo estimated at **$32 million**. [↑] Most cost efficient option; has the highest benefit-cost ratio: **8.1**	**3** [↓] Significant additional costs compared to the status quo: estimated at **$358 million**) [-] Estimated benefit-cost ratio is **2.7**, lower than options 1 or 2	**3** Additional costs compared to the status quo estimated at **$367 million in total** (only slightly more than option 3 as the deer industry is small). [-]The marginal benefit-cost ratio for the exclusion of deer is **2.7**
Feasibility			
3 [↑] Ffencing on milking platforms is relatively straightforward and low cost. [↓] However West Coast farmers may face high costs and practical challenges due to the high rainfall and extensive drainage networks. This is exacerbated	**3** Same issues as option 1 It is estimated that fencing and installing stock water reticulation on remaining dairy farms will cost $44,593 per farm. This represents 7% of total expenses and could decrease profitability by 20%. [↑] Relatively **affordable** and feasible for	**2** [↓] More feasibility issues and less affordable due to the farm types captured by this option. [↑] However these costs would be able to be spread over at least 8–9 years. Phasing in the requirements over a number of years will reduce the financial	**1** [↓] This is the **least affordable** option for farmers as deer fencing is expensive. [↑] However costs would be able to be spread over 9-14 years.

Option 1: Regulation applies to dairy cattle on milking platforms, and pigs	**Option 2:** As option 1 plus dairy support on plains and lowland hills	**Option 3:** As option 2 plus beef cattle on plains and lowland hills	**Option 4:** As option 3 plus deer on plains and lowland hills
by the current low dairy payout.	dairy support farmers as it is likely that cheaper temporary fencing will be able to be used in many cases. Also farmers would have 5 years to comply	burden on these farmers. For example, phasing in fencing and reticulation requirements for beef cattle over 10 years will result in costs of $5,391 per year and represent around 9 percent of the industry's five-year average profit.	

Table C. Comparison of options for applying stock exclusion requirements to dairy support, beef cattle and deer

Option 1: Requirements apply to all beef cattle and deer (on all terrain types).	**Option 2:** Requirements based on intensity directly (stocking rate)	**Option 3:** Requirements based on terrain (slope)
Key: Scale of 0 to 4, where 0 = does not meet objective, and 4 = rates highly against objective. Preferred option is highlighted in green.		
Effectiveness (Environmental)		
4 Greatest environment benefit as applies to the greatest area. However, lower environmental benefit *per km fencing* (i.e. per $ spent).	**3** Targets highest risk activities only. Applies less broadly than option 3 so lower environmental benefits. Enforcement will be difficult which may reduce effectiveness.	**3** Targets highest risk activities by proxy. May exclude some intensive farming.
Cost		
1 Very high costs (additional costs of $1,069 million compared to option 1) as extensive farms tend to be large and will require a lot of fencing. Fencing can be much more expensive on hill country.	**3** Costs likely to be slightly lower than option 1 as applies to fewer farms. Applies to the farms most likely to be able to afford stock exclusion. May apply to farms on steeper land however	**3** Costs estimated at $336 million to exclude beef cattle and deer on plains and lowland hills Applies to farms where stock exclusion is the most cheap and straightforward.
Feasibility		
0 The least affordable option for farmers as extensive farming tends to have a lower profit margin per hectare. Practical difficulties of fencing on steep land. Large areas of land involved make enforcement more difficult.	**2** Hard to meaningfully define stocking density for these purposes as this will vary across the farm and over the year. Could be difficult to enforce for same reasons. May apply to some farms on steeper land	**3** Provides clarity for those complying with, and enforcing, the rules; not open to interpretation (if slope defined well e.g., using a slope map) Slope will not change over time.

Table D: Comparison of options for allowed methods of stock exclusion, under a national regulation

Option 1: Permanent fencing only	**Option 2:** Temporary fencing allowed for cattle	**Option 3:** Any method that achieves 100 per cent exclusion
Key: Scale of 0 to 4, where 0 = does not meet objective, and 4 = rates highly against objective. Preferred option is highlighted in green.		
Effectiveness		
4 [↑] Highly effective at excluding stock [↑] Monitoring would be straightforward which could lead to higher compliance.	**4** [↑] Highly effective at excluding stock.	**4** [↓] Effective but may be more difficult to monitor whether farmers are complying, and therefore overall effectiveness may be slightly lower.
Cost		
3 [↑] Permanent fencing won't be the most efficient option for all farmers as it is more expensive than temporary fencing and cannot be repositioned more easily. [↓] Would not allow for new cheaper or better methods (if developed in the future) to be used.	**4** [↑] More cost efficient than option 1 as temporary fencing is cheaper to erect and can be repositioned more easily. [↓] Would not allow for new cheaper or better methods (if developed in the future) to be used.	**4** [↑] Allows for most cost efficient option to be used [↑] Also allows any new (potentially cheaper) methods to be implemented by farmers as they become available. Promotes innovation. [↓] Monitoring may be more resource intensive.
Feasibility		
2 [↓] May be practical issues in some circumstances (where grazing is temporary or there is a high flooding risk). [↑] Most practical option for monitoring.	**4** [↑] More achievable for farmers due to more flexibility and lower cost of temporary fencing [↓] Slightly less straightforward to monitor than option 1.	**4** [↑] Most feasible for farmers to implement due to greater flexibility and potentially lower costs for some [↓] Monitoring and enforcement more problematic than the other options.

Conclusions and recommendations

100. It is recommended that a regulation is developed to exclude stock from particular water bodies. A regulation will create stronger incentives than non-regulatory options and is therefore more likely to protect freshwater quality and ecosystems from the impacts of stock access.

101. A stock exclusion regulation should apply to all stock types (pigs, dairy cattle on milking platforms, dairy support cattle, beef cattle and deer). While this option has a lower benefit-cost ratio compared to other options explored in the analysis, it would have the greatest environmental effectiveness as it would exclude the most stock. This is also in line with LAWF recommendations. It is important to note, however, that excluding all stock types has the greatest feasibility issues. This is because the high cost of deer netting means that deer farmers face much higher costs than cattle farmers. To address this issue, it is recommended that the regulation has a staggered timeframe for compliance, giving deer more time to budget and plan for stock exclusion work. The proposed deadlines (see Table 2) would mean that the objectives are achieved, but in a way that is feasible and cost effective.

102. On the plains, stocking densities are higher, so the negative environmental impacts of stock access to water bodies are greater. In the hill country, environmental risks associated with stock access are lower due to lower stocking rates. The costs of stock exclusion also tend to be higher in the hill country than on flatter land. It is recommended that a slope-based approach is used to distinguish between more intensive farm systems on flat and rolling land and more extensive farming in the hill country. Dairy support, beef cattle and deer are required to be excluded from water bodies on flat and rolling land (that is, land with a slope of between 0 and 15 degrees). On steeper land, it is proposed these stock types are only excluded where break-feeding due to the very high costs involved.

103. It is recommended that a method for excluding stock, such as fencing, is not prescribed. This recommendation reflects the feedback received from consultation, which showed a clear preference for exclusion by any effective method rather than specifying that this must be achieved by fencing. This option will be more difficult to monitor and enforce, however, it provides the greatest level of flexibility to utilise natural barriers (for example, cliffs) and new methods as technologies are developed (for example, 'virtual' GPS fences).

104. The recommended option is to apply stock exclusion requirements to wetlands, lakes and large permanently flowing rivers and streams over 1 metre wide on the rolling and steep land and all permanently flowing rivers and streams, regardless of size, on the plains as this will have significant environmental benefits while being cost effective and feasible.

105. It is recommended that riparian setback requirements are not included in a stock exclusion regulation. The optimum riparian management strategy varies so much, that a blanket national requirement is not appropriate. A non-regulatory approach where riparian management may be able to be tailored to the individual situation is more feasible and and cost-effective. This option is also in line with the feedback received from consultation that a national requirement is not appropriate, but that riparian planting could be encouraged in other ways.

Implementation and review

106. Successful implementation will require working closely with regional councils and industry groups. MfE will work with regional councils and industry groups on the development of guidance information on the new regulation to ensure farmers are aware of the requirements and compliance deadlines. If required, MfE officials will be available to meet with these groups to discuss the details of the regulation.

107. In order to communicate the requirements, information will be prepared that can be distributed by industry groups to their networks and available on our website. This will include best practice guidance and identifying support available for affected parties for example, potential funding sources available.

108. It will be particularly important to work with farmers of dairy cattle on milking platforms and pigs, as these groups will have the earliest compliance deadlines. The number of farms that would have to exclude stock by the first deadline is low (but the implications to these farms would be high) because:

    A. 94 percent of dairy cattle on milking platforms are excluded from waterbodies due to the Sustainable Dairying Accord. The greatest potential impact would be felt in the West Coast where the Sustainable Dairying Water Accord does not apply.

    B. Pig farmers have already excluded most stock from waterways. Many pigs are housed, and farmers in Canterbury (where 65 percent of pig farms are located) are already required by the regional council, Environment Canterbury, to exclude intensively farmed stock from natural waterways.

109. It will also be important to work closely with regional councils to ensure that they are aware of the requirements and their enforcement role. This information will be provided to councils and MfE officials will be available to meet with councils to discuss the details of the new regulation.

110. Under the new regulation, councils would be responsible for the compliance and enforcement of the requirements. This would introduce a compliance cost to councils. This cost could be minimised if the results of third party audits, as Fonterra uses under the Accord, can be used by councils.

111. The requirements outlined in the regulation would be a minimum standard. Regional councils would be able to, and already do, set more stringent requirements in their regional plans. For example, councils may wish to protect sensitive and high value water bodies and address critical source areas where these are not covered by this proposed regulation, such as smaller waterways or those in hill country areas.

Exceptions

112. In limited cases, stock exclusion may be impractical and not justified by the environmental benefits (for example, where paddocks are intersected by many waterways and stocking density is very low, as on some West Coast farms). In some cases, there may be mitigations other than fencing that would be a more cost effective way to achieve water quality aims, such as the creation of artificial wetlands.

113. The LAWF recommended that councils be allowed to grant exceptions in limited circumstances where large costs and significant impracticalities relative to the environmental benefit can be demonstrated. The results of public consultation and officials' analysis support the idea that there are some circumstances where stock exclusion from all waterways will not be achievable, or justified by the magnitude of the environmental benefit. Some concerns have been raised by primary industry bodies, farmers and councils about the lack of flexibility of a national regulation in dealing with the local variation in the cost and benefits of stock exclusion.

114. It is proposed that the regulation provides that a landowner may apply to their regional council for permission to develop a Farm Environment Plan, as an alternative to fully meeting the stock exclusion requirements by the deadlines. The Plan would need to set out how, where and when stock will be excluded from water bodies on their land, and where stock exclusion is not feasible or cost-effective, alternative mitigations that will be undertaken to manage the environmental impacts of stock access to water bodies. The Farm Environment Plan would have to be approved in writing by the regional council.

Enforcement provision

115. In order to ensure that this regulation is complied with, it is recommended that it includes an enforcement provision. The provision would provide that if a landowner (and/or lessee) does not meet the requirements of the regulation, they would be required to pay a fine. Failing to provide effective exclusion, regardless of whether stock actually gain access to the waterbody, would be an offence under the regulation. Failure to comply with the conditions of a Farm Environment Plan would also be an offence incurring penalties.

116. Some councils already have stock exclusion requirement in their regional plans. There are currently problems of enforcement because of the cost to councils in taking a Court prosecution. The Resource Legislation Amendment Bill (RLAB) amends the Resource Management Act to provide for a nationally standardised infringement regime with instant fines that can be prescribed through the stock exclusion regulations, up to $2000. The regulation will prescribe a maximum fee of $2,000 for each observed event of stock in a water body.

117. This enforcement provision will ensure that the stock exclusion regulation will achieves its public policy objectives as it will provide incentives to farmers to comply with the regulation and a way for councils to encourage farmers that are not complying.

Monitoring, evaluation and review

118. The regulation will be successful if all relevant stock types are excluded from the defined water bodies by 2030 and the water quality in previously unfenced areas improves. The success of exclusion of each stock type against their respective deadlines can be monitored by local authorities. Data can also be collected by local authorities on the number of farmers that are given permission to carry our Farm Environment Plans instead. This policy can also be measured against the number of fines that are given out by local authorities.

Glossary

Dairy grazier	A farmer who grazes dairy cattle while they are not being milked (see dairy support).
Dairy support	Where dairy cattle are grazed while not being milked, either on land owned or leased by the dairy farmer, or on land owned by a third party.
Milking platform	The areas of a dairy farm where cattle are kept on a daily basis during the milking season.
Hill country	For the purpose of this analysis, hill country is defined as terrain characterised by steep slopes (slopes of over 15 degrees) and usually V-shaped valleys.
Intermittently flowing water body	A water body that does not flow (does not contain water) for the entire year (e.g., dries up in summer).
Livestock unit	Livestock units are a way to compare stocking densities across different stock types. One livestock unit equals one 40 kilogram breeding ewe with a suckling lamb. A single dairy cow would be around 6–8 livestock units, a grazing cow 4.5 units, and beef cattle around 3–6 units per individual, depending on weight, gender and age. See http://portal.beeflambnz.com/tools/benchmarking-tool/definitions for more information on livestock units.
Lowland/rolling hills	For the purpose of this analysis, lowland/rolling hills are defined as terrain characterised by gentle slopes (slopes of 4 to 15 degrees) and usually U-shaped valleys.
Natural wetland	As per the Resource Management Act definition (permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions), but not including wet pasture, damp gully heads, or where water temporarily ponds after rain or pasture containing patches of rushes
Permanently flowing water body	A water body that flows (contains water) continuously for the majority of the year.
Plains (also 'Alluvial Plains' or 'Flats')	For the purpose of this analysis, plains or flats are defined as terrain characterised by flat land (slopes of 0 to 3 degrees).
Riparian margin	The strip of land adjacent to the bank of a water body, of no specific width. It is the interface between land and water.
Significant wetland	An area that has a vegetative cover dominated by indigenous wetland plant species and is identified as significant in a regional policy statement or regional plan.
Stock exclusion	The practice of excluding farmed livestock from water bodies, e.g., by fencing, to reduce impacts on water quality and damage to the banks of the water bodies.

Water body	A river, lake, stream, pond, wetland, or aquifer, or any part thereof, containing fresh water or geothermal water, and which is not located within the coastal marine area.
Wetland	See 'Natural wetland'.

Appendix A: Land and Water Forum recommendations on stock exclusion

In 2015, the Land and Water Forum (LAWF) was asked to provide recommendations to the Government on the design of a stock exclusion regulation. Its recommendations were published as part of its Fourth Report in November 2015 (Land and Water Forum, 2015) and are summarised below.

Farm types and dates

- A national stock exclusion regulation should apply to all those livestock types that can cause significant damage from incursions into waterways, on the plains and lowland hills by the dates in table A1.

Table A1: LAWF recommendations for when a national stock exclusion regulation should apply to different farm types.

Farm type	Plains (0–3°)	Lowland/rolling hills (4–15°)
Dairy cattle on milking platforms	1 July 2017	
Dairy support (owned/leased by dairy farmers)	2020	
Dairy support (third party grazing)	2025	
Beef cattle	2025	2030
Deer	2025	2030*
Pigs	1 July 2017	

*Intensive farms only

- Whether the classification of terrain should occur at a sub-catchment, property or intra-property level should be determined by public consultation.

Methods of exclusion

- "Excluded" should mean effectively barred from access to water: for milking platforms a fence must be permanent; temporary fencing may be used for intermittent, concentrated and short-term grazing near waterways; permanent deer fencing will be expensive and impractical in certain landscapes, so other approved measures can be used.

Types of water bodies

- A regulation should apply to:
  - permanently flowing waterways and drains greater than one metre in width and deeper than 30 centimetres
  - permanently flowing waterways smaller than those outlined above on the plains. Landowners should be given until at least 2020 to achieve this (i.e., any exclusion dates before 2020 in table 3 should not apply for smaller waterways)
  - Natural wetlands.

Implementation

- Stock exclusion requirements should be able to be applied more widely/stringently than the above recommendations to protect particular values of water bodies or where specific management practices are being used that could result in significant damage to waterways (e.g., strip grazing).

- Fencing of waterways should be required during significant land use changes to a farm type and on terrain that the proposed national stock exclusion regulation will eventually apply to.
- Exceptions should be able to be given where large costs and significant impracticalities relative to the environmental benefit can be demonstrated.
- There should be interim milestones for excluding stock from waterways.

Riparian management

- Permanent fences should be placed at an appropriate distance from the waterway, as determined by an on-farm assessment.
- There should be more stringent requirements for riparian management where specific water quality issues exist that can be improved by suitable riparian management.
- Existing riparian management assessment tools should be reviewed, updated, and potentially consolidated if necessary.

Appendix B. The National Stock Exclusion study: methods and results

1. Costs of stock exclusion

Methods

The costs of stock exclusion were estimated by the Agribusiness Group (Lincoln University) from observed market transactions. Costs include the cost to erect a finished fence (labour and materials), maintenance costs, and costs to install a reticulated water supply (piped network of water) as an alternate source of drinking water for stock. They were discounted at 8 per cent over 25 years. The cost per metre of fencing was multiplied by the length of waterways where fencing was required to exclude stock under each of the policy scenarios. This gave the total estimated cost of fencing to exclude stock for each policy scenario. Typical costs of riparian planting (per row of plants) were separately calculated.

Different types of fencing (including temporary fencing) were applied to each of the land uses within the policy scenarios, with low-, medium- and high-cost options assessed for each. For example, it was assumed that two-wire electric cattle fences would be used to exclude dairy cattle from waterways flowing through dairy platforms, however on steeper land (slope greater than 16 degrees), a non-electric 8-wire sheep and cattle fence would be required. Lower cost options for fencing typically involved a higher proportion of temporary electric fencing.

Results

The most likely costs for the five stock exclusion options are given in table 3. Fencing is not the most expensive aspect of stock exclusion; the cost of water reticulation makes up between 58 per cent and 77 per cent of the total costs in table 3. These costs could be much lower if farmers already have some reticulation infrastructure. Deer netting (non-electric, to boundary fence specifications) was the most expensive type of fencing, with unit costs ranging between $13.70 and $28.90 per metre. Electric, two-wire cattle fencing was the cheapest type of fence, costing between $2.91 and $8.58 per metre. Costs are regionally variable, for example the cost of labour to install fencing was typically cheaper in the South Island, while materials for wooden fencing (e.g., posts and battens) were cheaper in the North Island. On average, the total cost to install fencing was 120 per cent higher in steep country compared with costs to install fencing on rolling land. It is important to note fencing materials are tax deductible for farmers, so the costs are likely to be lower than those given in table 3.

Table 3: Estimated most likely costs (NZ$, additional to the status quo) for the five stock exclusion options

Scenario:	Option 1 (dairy cattle on milking platforms)**	Option 2 (dairy cattle plus dairy support)**	Option 3 (dairy cattle and dairy support plus beef cattle)**	Option 4 (dairy cattle, dairy support and beef cattle plus deer)**	Option 5 (dairy cattle, dairy support, beef cattle and deer on all waterways on all land up to 28°)
Estimated total nationwide cost of stock exclusion	$20 million	$32 million***	$358 million	$367 million	$1,436 million
Cost of fencing	$10 million	$12 million	$103 million	$108 million	$451 million
Cost of water reticulation	$10 million	$19 million	$256 million	$259 million	$985 million

*Discounted at 8% over 25 years.

**On plains and lowland hills only, as described on page 8. Exclusion of stock from permanently flowing waterways (streams, rivers and lakes) over 1 metre wide.

***Totals may not equal sum of fencing and reticulation costs due to rounding

2. Water quality benefits from stock exclusion

Methods

The effects of the stock exclusion scenarios on *E. coli* concentrations in water bodies was modelled by NIWA using a modified version of the Catchment Land Use for Environmental Sustainability (CLUES) model. Effects on sediment loads were not considered due to difficulties of accurately modelling sediment. The model looked at the impacts on permanently flowing waterways (stream, rivers and lakes) over 1 metre wide, but not wetlands, due to lack of available data. 'Low', 'most likely' and 'high' scenarios were run.

Results

The stock exclusion policy options are all expected to achieve a slight improvement in water quality in streams and rivers compared to what will be achieved with current fencing levels and industry and regional council requirements. Option 1 has only a small impact, and option 5 the greatest improvement. Northern areas of the North Island showed the greatest improvements in freshwater quality (for options 3, 4 and 5).

3. Willingness to pay by the public for water quality benefits ('non-market valuation')

Methods

A survey of 2,032 New Zealand residents was undertaken by the Agribusiness and Economics Research Unit (AERU) at Lincoln University in September 2015 to determine the value that people place on improvements in water quality. Values were derived for respondents' stated willingness to pay for changes in human health risk, ecological quality and water clarity, based on econometric analysis of the survey results. More information is available in Grinter and White (2016).

Results

The results indicate that people prefer to have stock exclusion management over its absence, and value water quality improvements close to their home over improvements further away. The analysis suggests that passive-use values (such as visual amenity) are as important to New Zealand residents as direct-use activities (e.g., swimming and boating). Respondents to the survey were willing to pay more for water clarity and ecological quality than for improvements in human health risk.

4. Cost-benefit ratios for stock exclusion: synthesising costs and benefits

Methods

The cost-benefit analysis concentrated solely on the benefits of the reduced human health risk associated with lower *E. coli* concentrations in water bodies, and did not take into account the other benefits of stock exclusion. This is because other benefits were not able to be quantified. Benefits of each policy scenario were calculated by combining the modelled *E. coli* reductions with willingness to pay estimations from the non-market valuation study.

Net benefits or costs were calculated as the difference between these quantified benefits and the total costs of stock exclusion (costs of fencing and water reticulation but not riparian planting). A range of potential costs and benefits was estimated for each scenario, and the 'medium' (or 'most likely') values were used. The ratio of benefits to costs was calculated.

The study compares the real financial costs of stock exclusion with the willingness of the public to pay for the benefits of stock exclusion. The benefits (in dollar value) represent a value placed on something that does not have a market value, rather than money that will be saved or received through implementing the policy (e.g., economic returns on building a road). Non-market valuation is a common approach to estimating benefits of something that does not have an observable market value, like improvements in water quality. The approach used is the standard method for non-market valuation advocated by Treasury. It has been used extensively in New Zealand and overseas,

including in other projects to inform freshwater management in New Zealand, such as in MPI's previous work in the Waikato and Southland.

Results

The magnitude of potential total benefits increases from option 1 to option 5, as each option would offer a greater level of environmental protection than the previous one. The total costs also increase from option 1 through to option 5, as each successive option would require more stock exclusion fencing than the preceding one. The option with the highest ratio of benefits to costs is option 2 (all dairy cattle including dairy support), followed by option 1 (dairy cattle on milking platforms only).

Table 4: The estimated benefits and costs of each scenario (additional to the status quo), net benefits and cost-benefit ratios. A cost-benefit ratio of 1.5 means that for each $1 spent, $1.50 worth of benefits is gained

Scenario:	Option 1 (dairy cattle on milking platforms)*	Option 2 (dairy cattle plus dairy support)*	Option 3 (dairy cattle and dairy support plus beef cattle)*	Option 4 (dairy cattle, dairy support and beef cattle plus deer)*	Option 5 (dairy cattle, dairy support, beef cattle and deer on all waterways on all land up to 28°)
'Willingness to pay' value for the benefits of reduced *E. coli* levels**	$65 million	$258 million	$974 million	$983 million	$3,370 million
Estimated costs (fencing and stock water reticulation)	$20 million	$32 million	$358 million	$367 million	$1,436 million
Estimated value of net benefits (NZ$)	$45 million	$226 million	$616 million	$617 million	$1,934 million
Cost-benefit ratio**	3.2	8.1	2.7	2.7	2.3

*On plains and lowland hills only, as described on page 8. Exclusion of stock from permanently flowing waterways (streams, rivers and lakes) over 1 metre wide.

**This is based on the estimated *most likely* values for the effectiveness of stock exclusion at reducing *E. coli* levels in water bodies.

There is some uncertainty around the value of the benefits in table 4. This is partly due to variation in the effectiveness of stock exclusion at reducing *E. coli* levels, and partly due to the inherent uncertainties associated with non-market valuation studies. Nonetheless, these results suggest that the value of the benefits is higher than the costs for each scenario. Furthermore, there are other benefits to the stock exclusion policies that could not be quantified. The cost-benefit ratio provides a useful comparison between the options. This is only one way in which the options can be compared, however; equity and feasibility are also important considerations.

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