Economic Evaluation of the Government's Proposed "Action for Healthy Waterways" Policy Package

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Client Report

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EXECUTIVE SUMMARY

The true financial impact of the regulations proposed under the Action for Healthy Waterways discussion paper are considerably higher than those suggested by MfE. For a summary of these costs see Table 1 below.

On our calculations, and across a range of property types, the estimated capital costs of compliance per farm varies from $185,000 (mixed cropping farm) to $680,000 (hill country sheep & beef farm).

The annual costs of compliance range from $35,000 to $80,000. These annual costs comprise 5.4% to 30% of these properties' respective Earnings before Interest, Tax, Rent and Manager's Salary (EBITRm). We would consider that any annual cost greater than 10% of annual EBITRm is unsustainable.

Annual opportunity costs or "loss of future income" ranged from $85,000 to $184,000.

It is significant that three of the four case study farms already have very high levels of environmental compliance. They have won awards, been held up as industry models and recognised by their own district and regional councils. Yet all these businesses incur severe land use restrictions and significant costs in order to comply with the Action for Healthy Waterways regulations. These findings suggest that the Action for Healthy Waterways proposed regulations are out of step with the well-developed best practice standards of experienced and recognised land owners and of regional councils.

The most expensive impacts arise on hill country properties, largely through the cost of fencing for stock exclusion and providing alternate stock water supplies.

This is the area where MfE has grossly underestimated the economic impact. The cost of fencing to exclude stock from waterways and wetlands on hill country is substantially higher than on lowlands because (i) broken and steep contour accentuates the expense of fencing, (ii) four-wire electric construction is a minimum for practical purposes and (iii) the cost of reticulating alternative water supplies is substantially higher on hill country.

Direct access of stock to waterbodies is not the primary concern in the hill country. Rather, the potential impact to waterbodies is from the overland flow of pathogens and other contaminants to waterbodies. Therefore, a more appropriate approach to manage risk is through the identification and management of critical source areas. A fence does not stop an overland flow pathway. A 5m setback is also unlikely to stop overland flow through rainfall events.

A disturbing outcome of this analysis is that many of the proposed Action for Healthy Waterways regulations would have landowners divert time and capital into works that would have a dubious impact on the environmental health of receiving waterways. Many informed farmers are already addressing the "big ticket items" that are affecting water quality, such as critical source areas and sediment flows. There is a grave risk that this legislation would cause a misdirection of resources into capital expenditure and

policy shifts that have much less effect on freshwater quality, than do the mitigating actions that they are already employing.

The grandparenting (compliance rules based around historical performance) of farming enterprises and feed cropping programmes has a substantial impact on both lowland and non-lowland properties. This approach assumes negative effects unless proven otherwise (i.e. it is not effects-based). Under grandparenting rules, farms with the higher nutrient losses stand to sustain a higher level of productivity, have more flexibility, and will be valued more highly. Farms with a low level of loss and potentially better environmental footprint are effectively capped with a ceiling on stock numbers, production, land value and future income-earning potential. There is no recognition for the differential in nutrient losses between drystock and mixed cropping farms and other more intensive sectors. Grandparenting favours businesses that already have a high environmental impact. This runs counter to a "polluter pays" principle, because those farms with the lowest environmental footprint are bearing a much larger burden. This blunt, one-size-fits-all mechanism reinforces existing inefficiencies and rewards high-intensity farms.

There are a number of vagaries in the wording of the proposal that render it unworkable in its current form. For example, definitions of wetlands and definitions of carrying capacity. We have had no option but to take the most literal interpretation of these regulations to demonstrate the literal economic impact.

The proposed legislation would have the most comprehensive impact on property management and property rights that this industry has ever seen. It is unhelpful that the proposal makes little effort to differentiate between urgent and non-urgent action. A sensible approach would be to identify the “big ticket items”, i.e. the actions for each property that will deliver the greatest improvements to environmental impact. What is noticeably lacking in this legislation is a sense of “bespoke practice”, whereby priorities for individual farms are identified and prioritised, with incentive and encouragement to pursue those priorities. Instead, this is a “one size fits all” approach which is confronting and represents an insurmountable capital cost for many landowners, while not necessarily delivering the desired environmental outcomes.

Table 1: Summary* of the impacts of the "Action for Healthy Waterways" policy package on four case study farms											
Farm	**Effective Area (ha)**	**Description**	**Up-front capital costs ($/farm)**	**Length of fencing (km)**	**Costs ($/farm/yr)**	**Costs ($/ha/yr)**	**Increase in farm working expenditure per effective ha (%)**	**Nitrogen (N) leaching (kg N/ha/yr)**	**Phosphorus (P) loss (kg P/ha/yr)**	**Opportunity costs or "Loss of future income" ($/farm/yr)**	**Lost income from 5m stock exclusion set backs ($/farm/yr)**
A	**622**	Hill country sheep & beef breeding and finishing	$643,508	35	$79,514	$128	21%	11 (2019)	0.7 (2019)	NC	$18,389
B	**819**	Hill country sheep & beef breeding and finishing	$566,712	27	$72,468	$88	14%	18 (2018)	0.7 (2018)	$95,000	$12,318
C	**655**	Mixed cropping, bull and lamb finishing	$185,350	16	$35,337	$54	8%	17 (2018)	0.3 (2018)	$117,520	$17,415
D	**900**	Hill country sheep & beef breeding and finishing	$680,485	24	$80,304	$89	29%	7 (2016)	1.9 (2016)	$184,195	$6,408

* A full explanation and calculations are in the body of the report and in appendix 3 to 6.

NC : Not calculated

1. ACKNOWLEDGEMENTS

The authors would like to acknowledge and thank the case study farmers who gave up their time freely over a very busy period in the farming calendar. What was evident on the farm visits was the passion the farmers had for the land. The information supplied and input from the farmers was a key part of the analysis and we thank them for this.

2. INTRODUCTION

2.1 Action for healthy waterways

The Government has a vision to see a substantial improvement in freshwater quality in five years and to restore freshwater to a healthier state "within a generation". The Government has conducted a public consultation process on their proposed "Action for Healthy Waterways" policy package. This report looks at the management and economic impacts of the proposed policy package on four case study farms.

2.2 What is proposed?

There are three strategies proposed under the policy package to change the way land and freshwater are managed.

- The first is through amendments to the National Policy Statement for Freshwater Management (NPSFM). The NPSFM sits under the Resource Management Act (RMA) and directs local authorities to implement certain objectives and policies within their regional plans and regional policy statements over time. The first NPSFM was put in place in 2011 and this required regional authorities to implement water quality and quantity limits. In 2014, it was replaced and amended, and now includes national bottom lines for water quality and a national objectives framework.

- The second mechanism is the development of new National Environmental Standards (NES). NES are regulations issued under section 43 of the RMA and can apply regionally or nationally (although all current apply nationally). They can prescribe technical and non-technical standards, methods or other requirements for land use. Each regional, city or district council must enforce the same standard. In some circumstances where specified in the NES, councils can impose stricter or more lenient standards.

- Third are regulations under section 360 of the RMA that allow the government to regulate at a national level certain activities and aspects of environmental management.

2.3 New environmental bottom lines

The current NPSFM includes bottom lines for nine indicators, known as attributes, which mostly relate to measures of physical and chemical water quality[1]. The Science and Technical Advisory Group (STAG) has considered the available science and provided advice on updated, new attributes and bottom lines[1]. There are proposed new in-stream nitrogen attributes for ecosystem health. The new in-stream

[1] Ministry for the Environment. 2019. Action for healthy waterways – A discussion document on national direction for our essential freshwater. Wellington: Ministry for the Environment.

nitrogen or dissolved inorganic nitrogen (DIN) has changed from 6.9 to 1mg/L. There are also new instream sediment attributes and phosphate attributes being proposed in the NPSFM. STAG has proposed a bottom line for phosphorus in rivers at an annual median of 0.018 milligrams per litre of dissolved reactive phosphorus (DRP). As an example, see Appendix 1 for a table showing monitored streams in the Wellington region and whether they comply with the new bottom lines for nitrogen and phosphorus based on current levels.

Regional councils will be required to set rules to maintain or, where degraded, improve levels to achieve the new bottom lines. For sediment the proposals take into account natural erosion processes and recognise that natural levels of sediment in rivers vary across New Zealand. The implications for farmers however are that regional councils will identify catchments that have an erosion risk and they are likely to increase rules around land use activities. Farmers will need to have a Farm Environmental Plan which will specify activities that would need to be undertaken to reduce sediment loss.

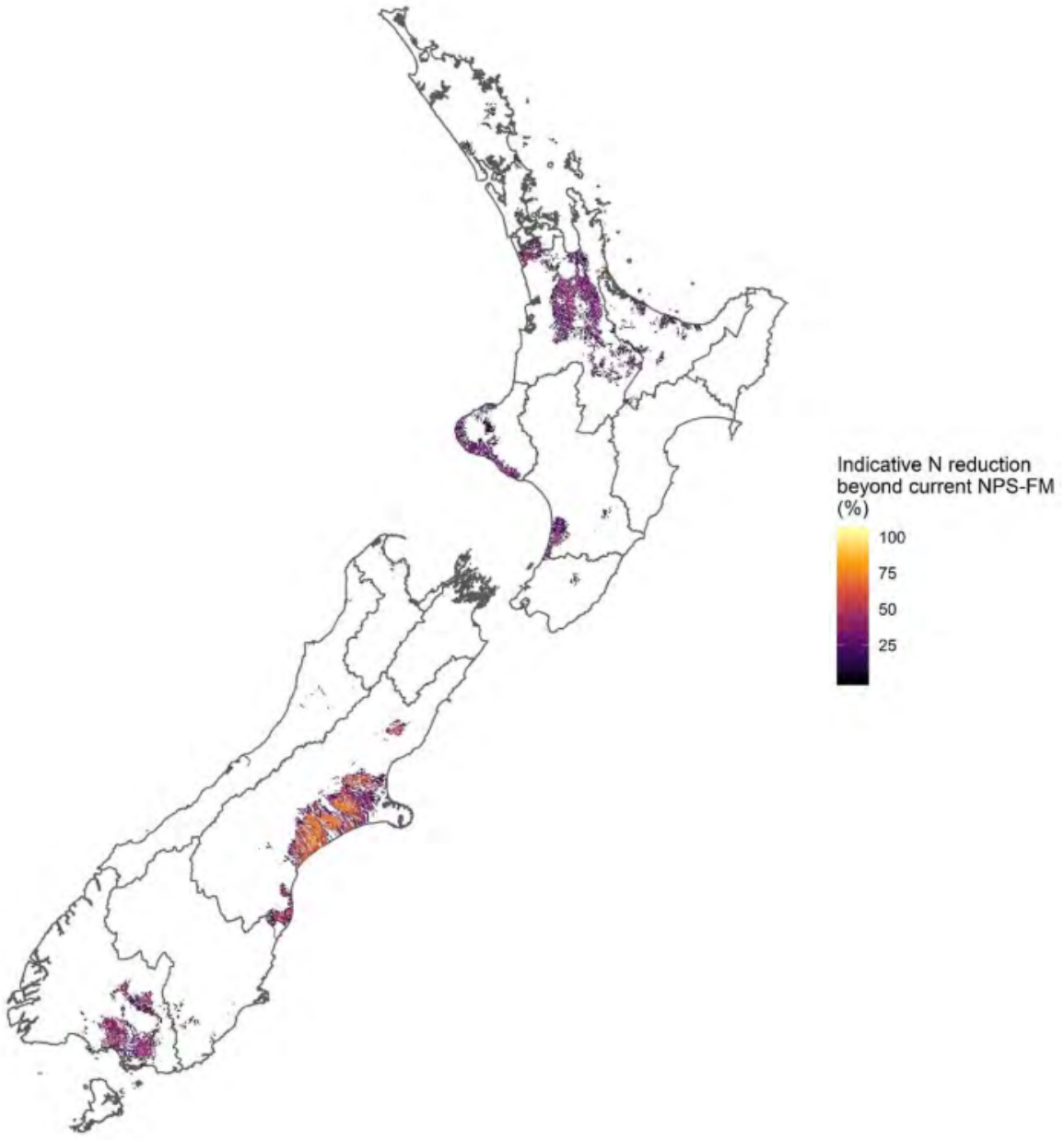
There will be substantial implications for land use where the bottom line is breached. Figure 1 below indicates major reductions in Nitrogen (N) needed in primarily Dairy intensive regions. From our calculations N leaching figures from Dairy systems are around 250% to 290% higher pe ha than sheep & beef dry stock farms. The average N use from Dairy Base owner operated dairy farms in the Waikato for the 2014-15, 2015-16, 2016-17 and 2017-18 seasons was 127, 132, 138 and 143 kgN/ha/yr. Contrast this with average N use on farms in the B+LNZ Sheep and Beef Farm Survey in Waikato-BOP which was around 9.2 kgN/ha/yr for 1990-91 to 2015-16. Recent B+LNZ analysis on 38 sheep and beef farms in Waikato showed that an average of 20 kgN/ha/yr was applied as fertiliser.

Reaching the proposed new bottom lines across the country would mean tighter restrictions on some lowland agriculturally dominated areas, beyond the existing limits, especially in parts of Waikato, Canterbury and Southland[1]. National scale modelling below (Figure 1) gives an indication of how much further nitrogen loads would have to be reduced under the proposed new bottom lines. The areas that are red/orange/yellow show where further reductions of more than 50 per cent may be required. It appears that the current allocation approach through the Action for Healthy Waterways policy package is a form of grandparenting. Grandparenting dry stock farms in these regions with a one-size-fits-all mechanism, risks supporting existing inefficiencies and rewarding high-intensity farms at the expense of low-intensity farms.

2.4 Giving effect to the NPSFM

The NPSFM directs regional councils to make or change regional plans to the extent needed to ensure the national bottom lines for water quality and national objectives are met. It is important to remember that these proposals require implementation at the regional level by councils. Depending on the water quality issues in different regions, the regional councils can set more stringent guidelines so they can meet the new national bottom lines. This has been evident in places such as Waikato where nitrogen was 'grandparented' under the proposed Plan Change 1.

Figure 1. Indication of impact of proposed new nutrient bottom lines[1]



3. PROPOSED POLICIES

3.1 Interpretation of the policies

B+LNZ and the author have interpreted to the best of their abilities the proposed policies. Where the Ministry for the Environment (MfE) could not give any further clarification, assumptions had to be made about the interpretation of the policy and what it meant on the case study farms. Some of the policies were unclear or silent on the exact mechanisms of implementing the policy and what methodology needed to be used.

3.2 Interpretation: excluding stock from waterways

The following is from MfE's policy proposals:

"We propose new standards for when stock must be excluded from wetlands, lakes and rivers more than one metre wide".[1]

"We also propose that farmers are required to have a freshwater module in their farm plan setting out how and when they will exclude stock from rivers and streams less than a metre wide and drains[1].

- "Through tailored Freshwater Modules in the Farm Plan (FM-FP) develop bespoke approaches for excluding stock [includes sheep?] from waterbodies, including smaller than 1m wide, and wetlands"[1],
- "For streams less than one metre wide and drains, farmers would be required to set out a plan for fencing and setbacks in the freshwater module of their farm plan. The timetable, type of fencing and setbacks would be tailored to the individual circumstances of the farm"[1].

"Dairy and beef cattle, and pigs, are not permitted to cross water bodies except by a dedicated culverted or bridged cross point (unless that crossing is no more than twice per month)"[2].

We interpret from these definitions that the ultimate intention is for all stock (including sheep), to be excluded from all waterways (including those <1 m).

3.3 Stock exclusion - no further loss of wetlands

As part of the proposals stock need to be excluded from all wetlands and MfE is proposing to require a setback of five metres, on average, across a farm.

"The RMA defines a 'wetland' as including permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to

[2] Draft Stock Exclusion Section 360 Regulations. Retrieved from: https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/draft-stock-exclusion-regulations.pdf

wet conditions. This does not include wet pasture or paddocks where water temporarily ponds after rain, or that contain patches of exotic sedge or rush species, or constructed wetlands."[1]

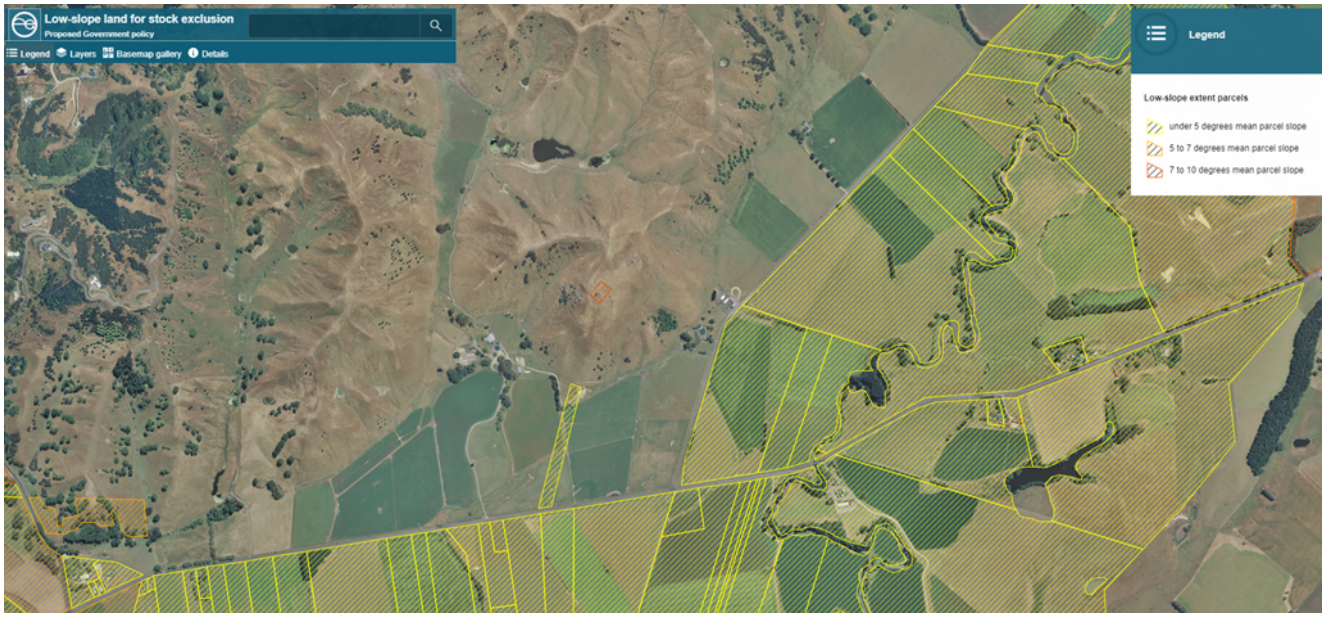
3.4 Interpretation: Low-slope land for stock exclusion

All cattle, deer, and pigs are to be excluded from permanently or intermittently flowing waterbodies that are greater than 1m wide in areas mapped as low slope by 1 July 2021.

New Zealand farm land has been mapped into two broad categories by MfE. These are low-slope (LS) land and non-low-slope (NLS) land. Slope is determined across a land parcel (title?), e.g. it is an average slope across a land title.

The map on the MfE website shows the extent of area considered to be LS, which is defined as land parcels with an average slope of less than 5 degrees (yellow), 5 to 7 degrees (orange) or 7 to 10 degrees (red) (see Figure 2). These areas are under consideration for mandatory stock exclusion from all wetlands and lakes, and all rivers over 1 metre wide. It must be noted that land is mapped at 1:50,000 nationally to identify low slope. Slope is determined across a land parcel, which while making it simpler to apply, fails to identify variable slope within a farm.

Figure 2: MfE Mapping Low-slope land for stock exclusion



The MfE is consulting on setback distances. "For large rivers and streams (more than one metre across), lakes and wetlands, MfE are proposing to require a setback of five metres, on average across a farm"[1]. Setback requirements are 5m on average across a property with a minimum width of 1m. Where an existing fence does not comply with setback requirements, it shall be allowed to remain in its current position until 2025, unless the existing setback has a minimum 2 metre average width and is not less than 1 metre at any point, in which case the setback requirements do not apply until 2035.

Table 2: Stock exclusion on "Low-slope" land (MfE - Draft Stock Exclusion Section 360 Regulations)

Waterbody	Stock	Setback	Timeframe
Wetland	Dairy and dairy support cattle, pigs, beef cattle and deer	5 metres on average across a property (with a minimum width of 1m)	1 July 2021 for wetlands identified in regional or district plans. 1 July 2023 for all other wetlands
Wetland	Any new pastoral system for all cattle, pigs or deer establishing after gazettal	5 metres on average across a property (with a minimum width of 1m)	Immediately
Rivers (> 1 m wide), and lakes	Dairy and dairy support cattle and pigs	5 metres on average across a property (with a minimum width of 1m)	1 July 2021
Rivers (> 1 m wide), and lakes	Beef cattle and deer	5 metres on average across a property (with a minimum width of 1m)	1 July 2023
Rivers (> 1 m wide), and lakes	Any new pastoral system for all cattle, pigs or deer establishing after gazettal	5 metres on average across a property (with a minimum width of 1m)	Immediately
Rivers (> 1 m wide), and lakes	Land where any cattle or deer are feeding on fodder crops, or break feeding, or where pasture is being irrigated, or has been irrigated in the previous 12 months.	5 metres on average across a property (with a minimum width of 1m)	1 July 2021 Unless it is a new pastoral system established after gazettal, in which case, immediately

3.5 Interpreting land outside the low-slope category

Non-low-slope land is land that is not classified as low land on the MfE mapping tool and where the average slope at the land parcel scale is greater than 5 [or 7, 10] degrees. (TBC)

"In areas that are not mapped as low-slope, stock exclusion is still important, particularly where the land can sustain reasonably intensive uses. The stock exclusion requirements (that is to exclude cattle, pigs and deer) will therefore also apply to areas where:

- at the farm scale, the land has an average carrying capacity equal to or greater than 14 stock units per hectare
- at the paddock scale, the land has a carrying capacity equal to or greater than 18 stock units per hectare (regardless of the average carrying capacity of the farm)
- at the paddock scale, the land is or has previously been irrigated

- at the paddock scale, the land is used for fodder crops when cattle, pigs or deer are on that land[1]".

MfE has said it will be necessary to develop a methodology (or identify an existing methodology) to calculate carrying capacity.

Table 3: Stock exclusion from waterways on "Non-low-slope" land (MfE - Draft Stock Exclusion Section 360 Regulations)

Waterbody	Stock or land use	Setback	Timeframe
Wetland	Dairy and dairy support cattle, pigs, beef cattle and deer	5 metres on average across a property (with a minimum width of 1m)	1 July 2021 for wetlands identified in regional or district plans. 1 July 2023 for all other wetlands
Wetland	Any new pastoral system for all cattle, pigs or deer establishing after gazettal	5 metres on average across a property (with a minimum width of 1m)	Immediately
Rivers (> 1 m wide), and lakes	Dairy cattle, but not dairy support, and pigs (unless housed)	5 metres on average across a property (with a minimum width of 1m)	1 July 2021 Unless it is a new pastoral system established after gazettal, in which case, immediately
Rivers (> 1 m wide), and lakes	Beef cattle, dairy support cattle, and deer on land with a base carrying capacity • of 14SU/ha or more at the farm scale, or • 18 SU/ha or more at a paddock scale if the base carrying capacity is less than 14SU/ha at the farm scale	5 metres on average across a property (with a minimum width of 1m)	1 July 2023 Unless it is a new pastoral system established after gazettal, in which case, immediately
Rivers (> 1 m wide), and lakes	Land where any cattle or deer are feeding on fodder crops, or break feeding, or where pasture is being irrigated, or has been irrigated in the previous 12 months.	5 metres on average across a property (with a minimum width of 1m)	1 July 2021 Unless it is a new pastoral system established after gazettal, in which case, immediately

It appears that hill country or non-low slope land has been captured a number of ways in terms of stock exclusion in the policy. The freshwater module in the farm plan needs to set out how and when farmers will exclude stock from rivers and streams less than a metre wide and drains. If stock at any time are stocked at a rate of or exceeding 14SU/ha per farm or 18SU/ha per paddock, then they need

to meet the 360 regulations (note this includes exclusion from both permanent and intermittently flowing waterbodies greater than 1m wide). The way this is written, it captures all rotational grazing and mob stocking through individual paddocks. E.g. One mob of 50 R2 Steers @ 5 SU/hd equals 250 SU. If these were rotating through a 7ha hill country paddock with a stream, the stocking rate per ha would be 36 SU/ha so would trigger the stock exclusion rule and the fence set back requirements of 5m.

If the carrying capacity of the farm (carrying capacity is defined currently as the methodology used on Crown Pastoral Land) is greater than 14su per farm or 18su per paddock then irrespective of whether or not the actual stocking rate exceeds this, the stream needs to be fenced.

3.6 Certified farm plan with a freshwater module

MfE is proposing that all farmers be required to have a certified farm plan (FP) with a freshwater (FW) module by 2021 for schedule 1 catchments[3], and by 2025 for all other areas. The consultation document includes a range of options, but the Government's preferred approach is for a mandatory requirement in the draft Proposed National Environmental Standards for Freshwater (NES).

The freshwater module description in the draft NES is very prescriptive and includes needing to have a nutrient budget and demonstrating how a landowner will "reduce" all emissions of nitrogen, phosphorus, sediment and microbial pathogens. "The action points in a FW-FP must address the risk identified under subclause (3) and set out the actions that the person implementing the FW-FP is undertaking, or will undertake, to avoid, remedy, or mitigate the loss of contaminants, along with timeframes for those actions"[4]. This implies grandparenting a farm's current level of emissions, regardless of impact or whether there is any land use change.

The freshwater module requires stock exclusion, which implies excluding sheep from waterbodies (irrespective of size and permanent or intermittently flowing). It's important to note that a waterbody is the RMA definition of a waterbody, which includes intermittent and potentially ephemeral waterbodies and includes drains and ditches.

The freshwater module must identify environmental risks and set out time-bound auditable actions to address those risks and reduce losses. The farm plan must be certified by a farm environmental planner approved by the Minister for the Environment and Minister for Agriculture. The farm plan must also be audited by an approved auditor within 24 months.

[3] These catchments are presented on page 25 of the draft NES.
[4] Proposed National Environmental Standards for Freshwater, September 2019. Retrieved from: https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/proposed-nes-for-freshwater.pdf

3.7 Restricting further intensification of rural land use

By 2025 MfE anticipate that regional councils' implementation of the NPSFM will manage further intensification. In the meantime, the policy package looks to put a temporary restriction on further intensification. The proposal applies restrictions to the following activities:

- Increases in the area of land in irrigated pastoral, arable or horticultural production greater than 10 hectares
- Changes in land use above 10 hectares from:
    - arable, deer, sheep or beef to dairy-support
    - arable, deer, dairy-support, sheep, or beef to dairy
    - woody vegetation or forestry to any pastoral use
- Increases in forage cropping beyond the area in intensive winter grazing in the past five years; or if the applicant didn't previously carry out intensive winter grazing, then beyond a minimum threshold. MfE is seeking feedback on this minimum threshold – whether it should be 30 ha or 5 per cent of the property, or 50 ha or 10 per cent of the property, or somewhere between.

3.8 Increasing irrigation by more than 10 ha

An increase in irrigation is a discretionary activity if the increase since the commencement date is more than 10 ha. "Any resource consent granted for the discretionary activity must include at least the following conditions" [4]:

a) the applicant has a certified FW-FP

b) the FW-FP includes actions to avoid, remedy, or mitigate the adverse effects of the activity's contaminant discharges into freshwater, or onto land in circumstances that may result in the contamination entering water

c) the nitrogen, phosphorus, sediment, or microbial pathogen discharges of the farm that will result from the increased land used for irrigated production will not exceed the average discharges of those contaminants from the farm during the farm year 2017/2018.

3.9 Winter grazing on forage crops

The slope threshold being consulted on, permits winter grazing on forage crops if the slope is below a certain level. Thresholds of 10 degrees or 15 degrees are suggested in option one (see page 77 of the discussion document[1]) or 20 degrees in option 2 (see page 78 of the discussion document[1]). Therefore, a farmer will need a consent for winter crops above 10 or 15 degrees slope.

It is unclear how slope will be determined and if it is on a paddock by paddock basis or if it is determined across a land parcel via the MfE mapping tool. The mapping tool would make it simpler to apply but it fails to identify variation in slope across a farm. Using the mapping tool would mean that even if a farm contains a portion of land that is under 10 degrees in slope, and upon which the grazing of feed crops could be conducted with minimum emission risk, the farmer will still require a consent because the parcel of land has average slope exceeding 10 degrees. It is also unclear if farmers will need a consent each year for each paddock or if they will get a consent for certain areas over a certain timeframe.

3.9.1 Low-Lands (permitted)

The area of cropping needs to be considered alongside the slope of the land that farmers plan to grow and graze winter forage crops on. The proposal is that intensive grazing on winter forage crops is permitted activity as long as the size of the forage crop is less than:

a) 30 hectares or 5 % of the farm, or

b) Less than 50 hectares or 10% of the farm.

It is permitted if the farmer:

a) Provides a 5m (20m) vegetated setback from waterbodies

b) Follows strategic grazing principles

c) Protects critical source areas (no grazing)

d) The grazed paddock is re-sown within 1 month, or as soon as practicable, after the end of the grazing

e) And has no pugging above 20cm (10cm) for greater than 50% of the paddock.

3.9.2 Hill country & activities that do not meet standards (consent required)

The crop area is 'grandparented' to no greater than 2013/14 to 2018/19 years

"For the purpose of granting a resource consent for the restricted discretionary activity, discretion is reserved over the following:"[4]:

1. The area of annual forage crop
2. Methods of grazing management (such as requiring that grazing on sloping land occurs progressively downhill from the top to bottom of the slope)
3. Methods for protecting critical source areas
4. Provision for vegetated strips to protect waterbodies from stock grazing

5. Provisions for re-sowing the grazed paddock
6. Methods for preventing pugging
7. Applicant must have a certified FW-FP

4. OVERVIEW OF THE SHEEP & BEEF SECTOR

4.1 Overview

The sheep and beef industry is diverse, adaptable and to date has been resilient, continually making eco-efficient gains in how it produces red meat. Sheep and beef farmers have managed to increase meat production, while decreasing the total number of animals farmed, made significant progress in reducing their environmental footprint, while losing some of their most productive land to other land uses. In the drystock sector there is significant variation in topography, soil type, climate, stocking rates and livestock policies. No two sub-catchments are the same and often no two farms are the same. In terms of water quality in these catchments one farm might have a problem with P loss or sediment, while in more intensively farmed areas and in areas where soil may be coarse textured and free draining the main issue could be N. Given this large variation, a prescriptive "one size fits all" regulatory approach to managing contaminant losses is not a cost-effective or fair approach. Mitigation measures need to be implemented at a farm scale (matched to the farm system), be effects-based and be the most cost effective available.

4.2 Externalities of concern in the Sheep & Beef sector

In terms of water quality, the main contaminants of concern are sediment, nitrogen (N), phosphorus (P) and faecal bacteria. For sheep and beef farms the loss of P, sediment and faecal bacteria are the main concern. Sheep and beef farms are generally minor contributors to N loss. Nitrate leaching is the main pathway of nitrogen loss from soils. One of the major sources of nitrate leaching is from urine patches. Typically, the higher the stocking rate the more urine patches per unit area and the more N leaching. Intensive farming on vulnerable soils (coarse textured free draining) results in an increased amount of N making its way to our waterways[5]. High rainfall and irrigation on these free draining soils further increases the risk of N leaching. Nitrogen losses from sheep and beef farm systems are typically much lower than other pastoral land uses. Nitrogen leaching from dairy farms is higher than from sheep and beef farms.

This means that for sheep and beef farms, the main issues are in relation to contaminants which flow over the land (P, sediment, faecal bacteria), rather than those that flow through the soil profile such as N. The most efficient and effective approach to managing the impacts of sheep and beef farming on the environment is through tailored farm environment planning and the identification and management of critical source areas (CSA).

[5] Ms. Dewes, Evidence in Chief. Before the Board of Inquiry Tukituki Catchment Proposal. In the matter of the Resource Management Act. 1991. October 2013.Paragraph 21, page 6.

5. METHODOLOGY

5.1 Farm selection

With the tight time frame available to make submissions the authors chose farms located primarily on the East Coast of the North Island and one in Waikato. Farms were selected that had adequate existing data such as OVERSEER modelling, financial benchmarking, Farmax, and farm maps to make the data gathering exercise quicker and data analysis easier. Three out of the four farms have already made significant investments in environmental protection and are using technology to mitigate their environment imoacts as well as having Farm Plans. Ideally a farm would have been chosen in the South Island however time did not allow. The farms chosen gave a good representation of the B+LNZ farm classes in the North Island, including Farm Class 3, 4 and 5. The farms in table 4 were identified on the MfE web mapping tool to determine if they were classed as "low-slope" farms or if areas were classed as "low-slope" for stock exclusion.

Table 4. Case study farms

Farm	Effective Ha	Farm type	Location	B+LNZ Farm Class#	Classed as "low-slope" land for stock exclusion*
A	622	Hill country sheep & beef breeding and semi finishing	Eastern Wairarapa	3	N
B	819	Hill country sheep & beef breeding and finishing	Tararua	4	N (Only small parcels that are in separate titles)
C	655	Mixed cropping, bull and lamb finishing	Hawke's Bay	5	Y
D	900	Hill country sheep & beef breeding and finishing	Central Waikato	4	N (Only small parcels that are in separate titles)

 # BakerAg estimate of B+LNZ farm class

**Ministry for the Environment web map showing areas considered to be low-slope land for stock exclusion*

5.2 Farm visit and property inspection

Farms A, B and C were visited in October 2019. Farm D was visited in 2016 for another piece of work involving stock exclusion from water bodies and the data gathered was updated and used for this report. A full farm tour was undertaken on all farms, identifying and mapping all water bodies from which stock had to be excluded under the proposed policy package. The maps were not included in this report because all farmers wanted to be anonymous. There is a 5m setback requirement on average across the whole property, so an assessment was made if waterways that had existing fencing had a 5m set back.

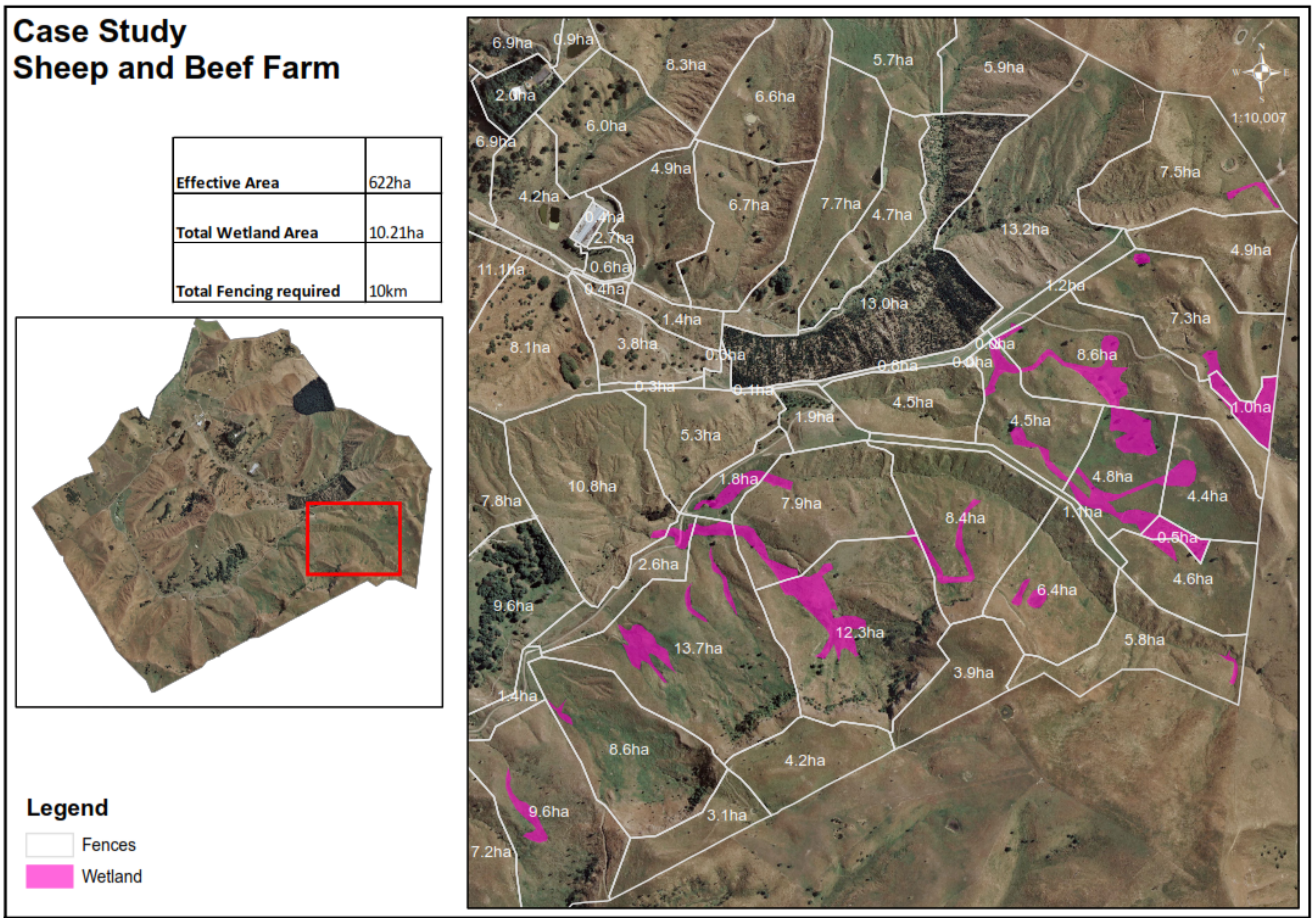
Figure 3: Waterways fenced with riparian planting on farm C. The fence setback on these do not meet the proposed 5m requirements.

5.3 Identifying wetlands for stock exclusion

Wetlands were identified on farms A, B and C. The consultant was not an expert in the area of wetland classification and found it difficult to apply the RMA wetland definition in the field so engaged a Senior Environmental Monitoring Officer from Greater Wellington Regional Council (GWRC). The officer identified all the wetlands that needed stock exclusion on Farm A (see figure 5). The consultant then made their best judgement on the other farms in terms of what comprised a wetland. Farm D has many wetlands but unfortunately due to time constraints these were not identified, and stock exclusion was not costed as part of this report on this farm.

Figure 4: Examples of a fenced wetland and an unfenced wetland on case study Farm A

Figure 5: Farm map showing wetlands that will need stock exclusion on case study Farm A



5.4 Estimate of fencing costs

QGIS mapping software was used to measure waterways, wetlands and fence lines needed to exclude stock. Where an existing fence was in place on one side this was kept, and the opposite side of the waterway was measured. A four-wire electric fence was chosen (explained below) to fence on both sides. No allowance was made in the costs for removing existing fences that don't comply with the setback rules. Fencing labour and material on flat land was priced a $10/linear metre, for hill country $16.50. These figures were based on pricing from BakerAg records and the Ministry for Primary Industries (MPI) Stock Exclusion Costs Report[6]. It's important to note that fencing materials and labour costs have risen significantly since the 2016 MPI report and this was considered when determining the per-metre rates. Several other sources and methods were used to estimate fencing costs on a per-metre rate:

- Recent on-farm fencing project costs were gathered from farms.
- The consultant made an independent assessment based on his own practical experience with fencing and the costs associated.

[6] Ministry for Primary Industries Stock Exclusion Costs Report. MPI Technical Paper No: 2017/11, January 2016

- Evidence was gathered on each property as to the current fencing and what was required to fit their stock policies.

5.4.1 Why haven't one-wire or two-wire fences been used?

All of the farmers mentioned if they were going to exclude stock from waterways it would not be with one or two wires, the minimum would be a four-wire electric and a number of the case studies preferred permanent eight-wire post and batten fences for a number of reasons:

- The stock policy and type of animal farmed, and contour played an important role in determining the type of fence.
- Single or double wire fencing is unsuited for stock exclusion when sheep are part of the policy due to the damage caused by sheep continually pushing through fences to feed and during mustering. This is especially relevant in a drought year or when power is down. All four of the farms run sheep as part of their stock policy.
- Three of the farms had cows which were set stocked for calving and there are issues with newborn calves slipping under one or two wires and getting shocked and not coming back to the cow for milk which is an animal welfare issue.
- If power is down due to a short and the one wire is low and sheep run under, they can catch the wire and get entangled in it which is an animal welfare issue.
- A single wire (no matter how much power) would not provide enough of a barrier to freshly weaned mobs of beef weaners that some of the properties farm.
- Riparian planting cannot be undertaken with one wire as sheep can access newly planted plants
- There are also issues with getting power to isolated parts of the farm.
- The dairy industry often uses one or two wires to fence waterways. Dairy farms are typically flat to rolling so the contour means fewer dips in the fence line. Dairy farms don't run sheep. Cows are large (no chance to fit under high points in the wire), hand-reared and quiet (handled in the shed each day). They are shifted twice daily for milking and often never push under fences to get extra feed. Grazing residuals are higher, so cattle don't go looking for feed. Power in the fence lines is typically easier to manage on a smaller property with less chance for shorts and often because of the shorter distance the voltage is significantly higher than large extensive properties with electric fences.
- It therefore cannot be assumed that a one-wire or two-wire fence is suitable in many situations and the consultant has used his professional judgment in choosing a four-wire electric with post spacings at 5 m. Waterways that have been fenced off on the

farms were typically with permanent eight-wire post and batten fences or seven-wires with two electrified wires.

5.4.2 Are temporary fences the solution?

In cases where stock is intensively grazed, such as strip grazing saved grass or on forage crops, then fencing waterways is practical in most hill country situations with a temporary fence.

Temporary fences have been put forward as a solution to exclude stock from waterways in hill country in extensive all-grass situations. This is simply not practical unless significantly more staff are employed on these farms. The reason it is not practical is stock are often on rotation through paddocks so before stock are moved into a paddock a temporary fence would have to be erected each time and then taken down including moving a portable fence unit. Often winter stock rotations are on one-day or two-day shifts going through multiple paddocks with waterways in hill country therefore the time commitment is simply not feasible without a dedicated person to do this. In the spring animals are often set stocked (stay in the paddocks permanently) for lambing and calving. This would mean temporary fences across the whole farm in multiple paddocks with multiple portable fence units. This is all assuming a one wire temporary fence so if sheep are excluded it would need a four-wire temporary fence which would be extremely difficult and time consuming to erect in hill country on both sides of the streams.

5.4.3 Streams were not straight and the contour varied

Many of the waterways were not straight and the terrain varied. The cost of fencing on this type of terrain and hill country greatly increases for several reasons:

- Cost to get the material into the site. Often this must be walked in.
- Less opportunity to use a labour-saving post rammer, so that more manual labour is required.
- More 'benching' preparation by machinery needed to allow fence lines (see figures 8 & 9).
- A lot more angles needed and additional stays.
- Posts are much closer together.
- More foots needed in dips.
- More floodgates needed in dips.

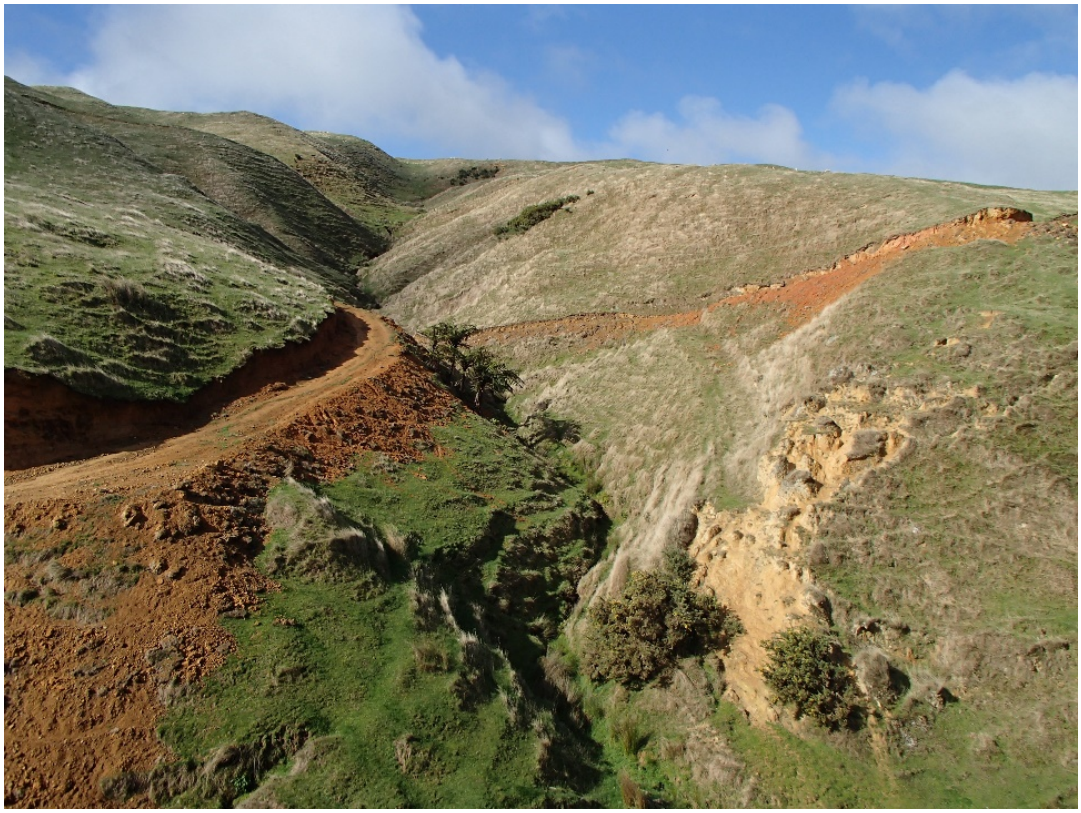
Figures 6 & 7: Water ways that will be expensive to fence in hill country

5.5 Unintended consequences of fencing hill country streams?

To create a suitable stock proof fence line with minimal dips, many hill country fence lines will be bulldozed. The hills will be "benched" to create the fence lines as well. Some of the hill country farms visited already have extensive erosion control measures in place with poplar and willow pole planting to stop sediment entering waterways. This benching of fence lines will create a huge amount of sediment for many years after the fencing project and these scars often don't fully recover adding more sediment to waterways. Benching the bottom of a hill is problematic as well as the 'toe' of the hill is removed, and the hill can erode into waterways. Slumping of the benched areas is also common adding further sediment. Another unintended consequence is that by fencing waterways you provide more subdivision and smaller paddocks which intensifies the stocking rate per ha. In rain events stock will track up and down fences opening the soil and creating risk areas for sediment, pathogen and nutrient run-off. If stock are concentrated in these smaller paddocks, then pugging can be a risk during

a rain event compared to larger paddocks where the stock can spread out and seek shelter. Below are a number of pictures of fence lines that have been bulldozed in hill country and the large quantities of sediment created. One of the pictures shows stock tracking along fence lines (figure 9) and cattle in a small paddock after a rain event (figure 10).

Figures 8 & 9: Bulldozed tracks for fence lines in hill country that are above streams



Figures 9 & 10: Stock tracking along a fence line and shallow pugging with surface mud caused after a rain event.

5.6 Erosion and sediment control

The action points in a FW-FP must set out the actions that the person implementing the FW-FP is undertaking, or will undertake, to avoid, remedy, or mitigate the loss of contaminants, along with timeframes for those actions. Some of the main critical source areas from which sediment, nitrogen, phosphorus and microbial pathogens could be lost have already been identified by the farmers. There wasn't time at the visit to identify all actively eroding areas, erosion prone areas, and areas of bare soil for erosion and sediment control and re-vegetation. The number of poplars needed for planting was estimated based on the size of the property and erosion status, however this would need more investigation to get an exact figure. Popular pole costings were calculated after talking with GWRC.

Figure 11: Extensive pole planting of a critical source area on one of the case study farms

5.7 Estimate of water reticulation costs

After excluding stock from waterways on farms A, B, and D, alternative water supplies (or water reticulation) would be required. Google Earth and QGIS mapping software were used to design the water reticulation system and estimate associated costs. Key reticulation costs such as additional pumps, power, header tanks, source dams and main lines were calculated for the properties. Costings were adapted from the report titled "Implications of the proposed Waikato Plan Change 1". [7]

5.8 OVERSEER modelling to determine nutrient losses

OVERSEER modelling for farms B and C was carried out by the Senior Environment Data Analyst from B+LNZ using best management input standards. The analyst is a certified nutrient management adviser with 14 years' experience using OVERSEER, and version 6.3.2. was used. OVERSEER results for farm A were obtained from Ballance Agri-nutrients and reviewed by a BakerAg consultant. OVERSEER results for farm D were obtained from the report "Implications of the proposed Waikato Plan Change 1".[7] Any OVERSEER data in the report should not be used for consenting or compliance purposes.

5.9 Estimated costs of livestock crossing structures

Environment Waikato's "Best Practice Guidelines for Waterway Crossings" was used to determine appropriate livestock crossing structures for each situation. For smaller culvert crossings not needing consent, prices were obtained from local rural supply firms and based on the consultant's practical experience of placing culverts on farm. It must be noted that farm B had a significant river running through the property that at peak stock movement times they would move stock through more than two times a month. Three large engineered bridges would be the only possible solution to exclude stock out of these streams otherwise stock would have to be mustered long distances on the main road.

5.10 Calculations of the potential loss of future income

For the three farms B, C and D on which the proposed policy package will have the biggest impact in terms of potential loss of future income, current financial performance was analysed using annual accounts, BakerAg Financial Analysis Benchmarking (FAB), and cash books such as Xero & Figured and Cash Manager. This was then used to develop the status quo level of financial performance. The key financial KPI used was Earnings before Interest, Tax, Rent and Manager's Salary (EBITRm).

For the properties that were compared and contrasted with B+LNZ sheep & beef farm survey data a judgment was also made on the potential of each property run under an average efficient operator and at top 20% performance. The status quo was then compared to similar properties in the farm class for those financial years to determine the opportunity costs.

[7] Implications of the proposed Waikato Plan Change 1 Report. BakerAg, R Beetham. C Garland. June 2018.

A change of policy on the property was then modelled in OVERSEER to see the impact this would have on the property's nutrient losses. Reduction in nutrient losses was also modelled and the resulting impact on stocking rate. The cost of the reduced stocking rate was then calculated.

6. CASE STUDY – FARM A

6.1 Introduction to Farm A

Farm System:	Hill country sheep & beef - breeding and semi finishing
Location:	Eastern Wairarapa
Altitude:	191m to 430m
Area:	646ha Total – 622ha effective.
Contour:	55ha flat to rolling, remainder hills. 20ha forestry and 3ha of QEII National Trust protected swampland.
Rainfall:	860mm average rainfall pa.
Soil tests taken in June 2017:	Averages: pH 5.9, Olsen P 16, Sulphate Sulphur 8
Subdivision:	95 main paddocks (6.7ha average size).
Water:	Bulk of farm fed by gravity from springs via troughs. Dams and spring fed creeks through others without troughs.
Stocking Rate:	9 SU/ha (4 year av)
Sheep System:	2800 mixed age (MA) and two tooth (2th) Ewes, 800 in-lamb hoggets. Lambing 145% 4-year average. A proportion of lambs are sent to the works at weaning and the rest are sold store or to the works through autumn season dependent.
Cattle System:	100 mixed age (MA) Angus cows. 20 in-calf R2 heifers. Weaner steers generally sold at the weaner fair, with weaner heifers taken through for replacements and finishing.
Cropping:	Circa 10-15ha of rape and some turnips. Main reason/purpose of these crops is to start growing out the ewe lambs. Fed out in summer-autumn. 6ha of red clover, 2.5ha annual clover and 20ha of plantain.

Current Environmental Management:

- Winners of several Farm Environment Awards
- Regular soil testing along GPS transects
- Variable rate fertiliser technology
- Farm modelling using Ballance MitAgator including nutrient budgets

- Retired 12.5ha of highly erodible country in 2012 and planted pines, acacias, lusitania, redwood and eucalyptus through the Greater Wellington Regional Council's afforestation scheme.
- A sediment dam has been developed to help reduce the amount of sediment entering the waterways.
- Minimal use of winter forage crops
- Stock crossing structures across creeks for stock
- Retired two small blocks of limestone spring wetland areas into QEII National Trust covenants, which are the source of farm stock water, with a third smaller one in the process of being fenced.
- More than 2000 poplar and willow poles have been planted for erosion control, shade and fodder in drought.

6.2 Impacts of the "Action for Healthy Waterways" policy package on farm A.

6.2.1 Environmental Overview

Farm A is not only award-winning for its excellence in sustainable farm practices but also has a strong emphasis on innovation in order to create a sustainable, environmentally friendly and aesthetically pleasing farming system. As part of their forward-thinking, Farm A was modelled using Ballance's latest tool MitAgator - a spatial critical source area model for predicting nitrogen, phosphorus, sediment and bacteria loss and management within agricultural land. MitAgator highlights target areas that can then be prioritised based on their impact, cost and effectiveness in reducing environmental concerns. Having identified key areas which would benefit in reducing their environmental footprint, Farm A has been able to plan its approach to reducing losses by using their cashflow strategically to get the greatest environmental benefit.

Farm A has spent a considerable amount of money on environmental protection in the last 5 years. This has been enabled by lifting farm performance to create an operating profit, which has allowed them to spend more on protecting the environment for future generations. Profit is driven by a highly efficient farm system: increased reproductive efficiency, faster lamb growth rates and higher carcass weights. The feed cropping underpins Farm A's ability to efficiently grow and finish lambs/cattle quickly, which in turn reduces the amount of stock on the farm during winter months when the risk of nutrient and sediment losses is higher. The efficient system contributes to the operating profit, which gives Farm A the ability to direct funds into fencing and planting critical source areas. This is in contrast to some farmers who may be in the development phase and don't have funds available for environment projects.

More than 2000 poplars and willows have been planted on Farm A to reduce soil erosion, which can allow sediment and phosphorus into waterways. Furthermore, 12.5ha was retired to afforestation and other areas to QEII covenants. The covenant is an agreement between the QEII National Trust and the landowner to protect land forever. The landowner continues to own and manage the protected land, and the covenant and protection stays on the land, even when the property is sold to a new owner. A sediment trap was built in a main catchment to mitigate sediment and nutrient run-off. Several wetlands have been retired for their protection and to reduce stock losses in dry years. Farm A continually monitors work already done to protect the environment while allocating additional funds for future work required to manage nutrient and sediment losses. In terms of environmental management, we estimate Farm A would be in the top 5% of sheep and beef farms.

6.2.2 Nitrogen (N) loss and Phosphorus (P) Loss

Farm A has OVERSEER-modelled N losses in 2019 of 11kg/N/ha/yr and P losses of 0.7kgP/ha/yr. These are low levels of N and P loss and lines up with typical losses for sheep & beef farms in the studies in tables 12 & 13.

6.2.3 Up-front capital costs

The up-front capital cost of $643,508 (Table 5) is mainly for fencing up to 5515m of streams greater than 1m wide, 19,537m of streams less than 1m wide but accessible to stock, plus water reticulation, wetland fencing and planting, and the consenting/compliance cost. For a business that has already spent an immense amount of time and money on creating a sustainable farming system of their own volition, and which is already well recognised for their environmental efforts, these costs are hard to accept and are something of an insult. Given the size of the business, the capital costs required to meet environmental compliance are untenable and the effectiveness of the prescribed works is highly dubious.

Table 5: Costs associated with complying with the Essential Freshwater Policy Package.

Farm A	
Up-front capital costs	$643,508
Ongoing annual costs	$79,514
Ongoing annual costs per effective ha	$128
% Increase in farm working costs per effective ha	21%

6.2.4 Increased economic costs

Ongoing annual compliance costs were calculated at $79,514 p.a. for Farm A. This represents a 21% increase in farm working expenses. These annual costs represent 25% of Farm A's annual EBITRm which is unsustainable.

6.2.5 Loss of flexibility

Using MfE's low slope land stock exclusion mapping tool, Farm A would not be permitted to grow a winter crop without a resource consent under the proposed policy, as the farm falls into the non- low slope land category because the majority of the land is 10 degrees or greater. As the targeted crops are generally fed out in summer/autumn, some clarification would be necessary to see whether this was captured by the winter cropping regulation. Farm A would be unable to increase the area of crop grown under the land use change restrictions and grandparenting of nutrients. This could impede the business's ability to grow out their capital stock and performance/profitability could be impacted in the future.

The main permanent waterway that runs through the farm is just over 4km long. The fencing required to meet the MfE proposal not only requires fencing of both sides of the waterway but also disrupts the farm system, as paddock areas would need to be changed to reflect the change in paddock size, and water availability. This can have a flow-on effect as mob sizes are allocated to paddocks based on paddock size, shelter, and water. New fencing would take away much of the natural value of the paddock and would give less flexibility to the business and where they can put their stock.

6.2.6 Loss of Income ("Frozen Income")

Small farm management policy changes to Farm A to optimise the system and bring resilience in a changing climate will be stymied under the proposal which requires a reduction in all emissions regardless of current levels or environment effect. This is highly inequitable on a property such as Farm A which already has a low environmental footprint. This approach assumes negative effects unless proven otherwise (i.e. it is not effects-based), and it essentially locks-in land use options, limiting business growth and capital growth.

The annual lost income to Farm A from stock exclusion set-backs, as laid out in the MfE framework, can be found in table 6. Because of the numerous streams, drains, wetlands, and ditches stretching throughout Farm A and the requirements of a 5m set back, 37ha of current productive pasture would be lost and used as a buffer to capture nutrient losses. This represents a 5.9% loss of productive land.

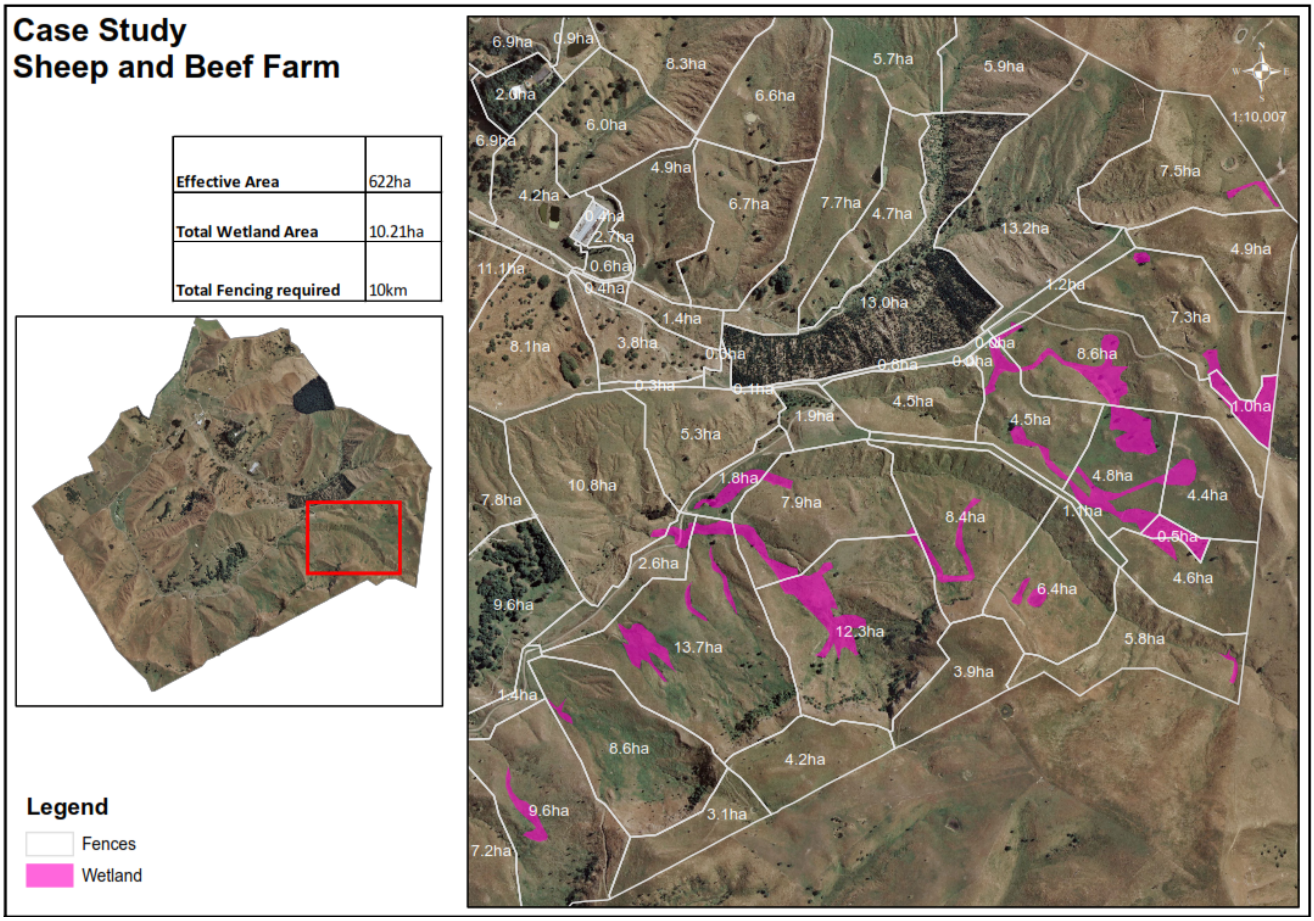
Table 6: Annual lost Income from stock exclusion set-backs

Annual lost Income from stock exclusion set-backs			
Land lost from production due to new set-back requirements	**Area ha loss**	**EBITRm/ha**	
5m set-back distance on waterways	22	$497	$10,934
Assumed half of the lost wetland area were grazable all year round	5	$497	$2,485
5m set-back distance around wetlands	10	$497	$4,970
	37		**$18,389**

6.2.7 Stock exclusion from Wetlands

Farm A has already retired three wetlands on the property and planted these areas. These wetlands were large and easier to retire due to the nature of the terrain and location. Due to the nature of the property with limestone soils there are more wetlands that would need stock excluded according to the wetland definition used. To the untrained eye, the additional wetlands identified in figure 12 by the wetland specialist look to be no more than wet 'seeps' on the hill side and natural springs which are common across many hill country properties in the Wairarapa. The author questions the biodiversity benefits or environmental outcomes that would be achieved from excluding stock from these areas based on his own personal experience of fencing areas like this where no natural regeneration has been evident. The practicalities and cost of fencing these minor wetlands across Farm A would mean a lot of land retired and funds diverted away from other biodiversity projects and environmental management such as erosion control. Once again, this one-sized fits all blanket approach is not effects-based and has dubious environmental value.

Figure 12: Wetlands on case study Farm A



7. CASE STUDY – FARM B

7.1 Introduction to Farm B

Farm System:	Hill country sheep & beef breeding/finishing. Summer dry winter wet.
Location:	Tararua
Altitude:	130m to 460m
Area:	970ha Total – 819ha effective.
Non effective:	22 ha in forestry, 41 ha in bush, 54 ha of regenerating scrub, 28 ha of unvegetated gorge slopes.
Contour:	Circa 18% of the property is flat to undulating, 36% is rolling to strongly rolling, 36% is moderately steep to steep hill country with the remaining 10% being steep to very steep hill country and gorges. Soils include banded mudstone and argillite and crushed argillite with some alluvial flats and colluvium on some of the lower slopes.
Rainfall:	1,000 to 1,250 mm annually
Soil Fertility:	Averages October 2017: pH 5.6, Olsen P 15, Sulphate Sulphur 7
Subdivision:	In 2015 there were 106 paddocks greater than 1 ha.
Water:	Stock water consists of reticulated water and troughs, or dams.
Stocking Rate:	6610 SU July 2019 = 8 SU/ha. Moved to more of a trade component and better per head performance with lower stocking so stocking rate not that relevant. 8144 SU (9.9SU/ha) in 2015.
Sheep System:	3700 MA & 2th Ewes, 700 Inlamb hoggets. Lambing 135% to 145%. Lambs killed prime to 17kg CCW season dependent.
Cattle System:	Changeable depending on margins. Now running circa 100 MA cows. Trading component of steers, heifers, and bulls sold store or prime depending on season and margins.
Cropping:	Extensive cropping program. Growing kale for tupping ewes on in March and also wintering in-lamb ewes. Growing rape, chicory and leafy turnip as lamb finishing feed. Growing greenfeed crops to winter cattle.

Current Environmental Management:

- Winners of a number of Farm Environment Awards

- Developed and implemented a Whole Farm Plan (WFP) as part of Horizons Regional Council's Sustainable Land Use Initiative (SLUI), that aims to identify farm-specific opportunities for sustainable resource management and sustained business development.
- Aim to plant at least 250 poplar or willow poles annually
- Retired many areas on the farm including riparian planting. Still riparian areas to be fenced off in line with the Whole Farm Plan (WFP).
- Lowered stock numbers to enhance stock performance
- Soils are tested annually for the main fertiliser application over the whole farm. The farm is divided into five main nutrient management blocks according to soil type, topography and production.
- Active Overseer nutrient budget file in place
- Nitrogen is used as a strategic tool on selected areas of the farm when required.
- Before any nitrogen is applied to crops, soil Available Nitrogen is tested to see how much (if any) nitrogen is needed before any applications occur. All efforts are made to mitigate the negative effects of nitrogen use.

7.2 Impacts of the "Action for Healthy Waterways" policy package on farm B.

7.2.1 Environmental Overview

Farm B is an award-winning farm for its environmental work to date. As part of Horizon's Sustainable Land Use Initiative (SLUI), Farm B has carried out Land Use Capability mapping and identified vulnerable and sensitive areas of the farm which need protecting. They also identified areas that had not reached their productive potential and it is these areas that drive the business and allow investment in environmental protection and enhancement on the other areas.

Farm B has spent an estimated $120,000 on environmental protection over the last four years but they have only been able to do this by lifting productivity. This has included growing 60ha of forage crops such as kale, which, along with genetics and ewe body condition scoring, Farm B credit for significantly lifting reproductive performance in their Romney ewes. The lift in reproductive performance has allowed the farm to drop ewe numbers and reduce the stocking rate.

These farm system changes are what the industry call "eco-efficiency gains" which result in increasing farm performance while reducing the environmental footprint of the business across soil health, greenhouse gas emissions, and freshwater health.

The SLUI plan is a work in progress each year, in consultation with Horizon's staff. Farm B allocates funds to environmental protection work on areas they consider a priority. Up-coming work includes fencing off a wet area to create a nutrient and sediment trap and more pole-planting.

7.2.2 Up-front capital costs

The up-front capital costs of $566,712 (Table 7) mainly for fencing and water reticulation is insurmountable for any landowners with a business of this scale. For a business that has already made significant environmental investments, won awards, made huge eco-efficiency gains, and has a small environmental footprint these costs are unjustifiable in relation to the environmental outcomes.

Table 7: Costs associated with complying with the Essential Freshwater Policy Package.

Farm B	
Up-front capital costs	$566,712
Ongoing annual costs	$72,468
Ongoing annual costs per effective ha	$88
% Increase in farm working costs per effective ha	14%

7.2.3 Increased economic costs

Ongoing annual compliance costs were calculated at $72,468 p.a. for farm B. This represents a 14% increase in farm working expenses. This level of increase in expenses is unsustainable especially as the policy does not allow flexibility to marginally intensify parts of the land to cover rising costs.

7.2.4 Loss of flexibility

Under MfE's proposed policy, the growing of feed crops on slopes of 10 degrees or greater – which is most of Farm B would be prohibited without a resource consent. Also, Farm B would be unable to increase the area of crop grown under the land use change restrictions and freshwater module of the farm plan. For Farm B this would impact on production and slow down investment in environmental work as it wouldn't be generating the income to enable it to invest in fencing, land retirement, erosion control or wetland development.

The FW-FP implies grandparenting a farm's current level of emissions, regardless of impact or whether there is any land use change. OVERSEER modelling (Tables 8 & 9) showed lifting Farm B's stocking rate from the 2018 OVERSEER level of 9.14/ha to the same as the B+LNZ farm class 4 Top 20% average of 9.43/ha lifted N leaching from 17,197kg total to 17,305kg total, although the stock unit lift is minor there is still a small increase in the nutrient output and under the proposed policy this would not be permissible.

Table 8: Modelled stock unit changes in OVERSEER

Base, Revised Stock Units (RSU) (OVERSEER)			Alternative scenarios modelled in OVERSEER					
		2017/18	Reducing stock numbers to the average for Farm Class 4* in 2017/18	Increasing stock numbers to the top^ 20% for Farm Class 4* in 2017/18	Increasing beef numbers to the top 20% for Farm Class 4* in 2017/18	Decreasing stock numbers to achieve a 10% decrease in N loss (aim 15477 kg N)	Decreasing stock numbers to achieve a 5% decrease in N loss (aim 16337 kg N)	Increasing winter kale by 20%
Farm Name	**Description**	**Stocking rate (RSU/ha)**	**Stocking rate (RSU/ha)**	**Stocking rate (RSU/ha)**	**Stocking rate (RSU/ha)**	**Stocking rate (RSU/ha)**	**Stocking rate (RSU/ha)**	**Stocking rate (RSU/ha)**
Farm B	Revised stock units per effective hectare (cattle/sheep)	9.14 (1.29/7.85)	8.89 (1.25/7.64)	9.43 (1.29/8.14)	9.43 (1.58/7.85)	5.79 (1.05/4.75)	7.09 (1.17/5.93)	9.17 (1.30/7.88)

*B+LNZ Farm Survey East Coast NI, Farm Class 4

^The top 20% of the B+LNZ sample ranked by EBITRm/ha

Table 9: Modelled Nitrogen (N) leaching kg/ha/yr changes on case study farm B

			Alternative scenarios modelled in OVERSEER					
		2017/18	Reducing stock numbers to the average for Farm Class 4* in 2017/18	Increasing stock numbers to the top^ 20% for Farm Class 4* in 2017/18	Increasing beef numbers to the top 20% for Farm Class 4* in 2017/18	Decreasing stock numbers to achieve a 10% decrease in N loss (aim 15477 kg N)	Decreasing stock numbers to achieve a 5% decrease in N loss (aim 16337 kg N)	Increasing winter kale by 20%
Farm Name	**Description**	**N leaching kg/ha (kg total)**	**N leaching kg/ha (kg total)**	**N leaching kg/ha (kg total)**	**N leaching kg/ha (kg total)**	**N leaching kg/ha (kg total)**	**N leaching kg/ha (kg total)**	**N leaching kg/ha (kg total)**
Farm B	925 ha sheep and beef Class 4 farm	18 (17197)	18 (17099)	18 (17305)	18 (17358)	16 (15546)	17 (16332)	18 (17239)

*B+LNZ Farm Survey East Coast NI, Farm Class 4

^The top 20% of the B+LNZ sample ranked by EBITRm/ha

Note: N loss reported using Overseer v 6.3.2. The data above should not be used for consenting or compliance purposes. Overseer files were completed by a certified nutrient management advisor using best management input standards.

7.2.5 Loss of Income ("Frozen Income")

The freshwater module description in the draft NES is very prescriptive and includes needing to have a nutrient budget and demonstrating how a landowner will "reduce" all emissions of nitrogen, phosphorus, sediment and microbial pathogens. Modelling was undertaken on Farm B to reduce N leaching from the 2018 baseline by 5% and 10%. To do this stock numbers had to be reduced in OVERSEER (see Tables 8 & 9).

For a 5% reduction in N losses, stock units/ha had to reduce by 2.05 SU/ha. This would represent an annual lost income of $116/ha EBITRm based on B+LNZ class 4 average figures in 2018. Over Farm B's 819 effective ha this represents $95,000 EBITRm in lost income. At a 10% reduction in N losses, stock units had to reduce 3.35 SU/ha. Over the 819 ha this represented $155,153 EBITRm in lost income.

Table 10 shows the annual lost income from stock exclusion set-backs through loss of productive land on Farm B where a total of 26ha will be lost. Combining a 5% reduction in N losses and the lost production land to set-back requirements generates an annual loss of income of $107,318 EBITRm.

Table 10: Annual lost Income from stock exclusion set-backs

Land lost from production due to new set-back requirements.	**ha Loss**	**EBITRm/ha**	
5m set-back distance on waterways	22	$481	$10,582
Assumed half of the lost wetland area grazable all year round	1.7	$481	$813
5m set-back distance around wetlands	1.9	$481	$924
	26		**$12,318**

8. CASE STUDY – FARM C

8.1 Introduction to Farm C

Farm System:	Mixed cropping, bull and lamb finishing	
Location:	Central Hawke's Bay	
Altitude:	70m to 100m	
Area:	665 Total - 655ha effective	
Rainfall:	750 mm average pa.	
Soil Fertility:	pH	5.8 – 6.5 variable
	Olsen P	20 – 50 Peat high
	Potash	4 – 20 variable, peat generally low
	Sulphate Sulphur	5 – 20 variable
Irrigation:	275ha under precision irrigation system. Water is provided from water storage dams and bores. Planning on another storage dam this summer and have consent to take total irrigated area to 450ha.	
Drainage	Sub-surface tile drains. 400ha approx.	
Cash Crops:	Cropping 450-500ha pa. Barley (malting/feed), wheat, maize, oats, squash, sweet corn, processed peas and beans. Small seed crops (ryegrass, chicory, carrots, bunching onions, radish, choi-sum), hemp.	
Forage Crops:	15 – 40ha under irrigation after a cash crop. Planted mid-January grazing 60 days later at about 3500kgDM/ha.	
Water:	Water for stock is provided via water troughs through a reticulated water system.	
Stocking Rate:	This changes year to year depending on cropping rotations and trade stock numbers.	
Sheep System:	Trading circa 5000 male lambs. Target slaughter weights of 22kg CW July to October.	
Cattle System:	Trading circa 300 Bulls. R1yr and R2yr bulls 50:50 Autumn/Winter. Target slaughter above 300kgCW whether it be June or October.	

Current Environmental Management:

- Active Foundation for Arable Research (FAR) Farm Environmental Plan in place
- Detailed land use capability mapping

- 95% of open drains on property are fenced off. Approx 15km of fencing.
- Main creek has a 5-10m buffer fenced off along it.
- Uses precision agriculture technology (differential application) to ensure optimal use of nutrients and water, preserve soil structure and minimise the impact on the environment.
- Minimal tillage to preserve soil carbon, nitrogen and soil structure.
- Tractors and harvester are under real-time kinematic (RTK) positioning and GPS guidance (which is accurate to 2cm).
- Yield monitoring producing yield maps.
- 150ha mapped for soil conductivity (water holding capacity).
- Using variable rate precision irrigation
- Moisture probes used for irrigation scheduling. Monitoring soil moisture levels so that informed decisions for turning on irrigation can be made.
- Soil grid sampling 1 ha blocks.
- Variable rate drilling and spreading fertiliser from prescription maps. This helps match the timing and the amount of fertiliser inputs, to meet the crops requirements and minimise the risk of contaminate losses to the environment.
- Variable rate application of lime using prescription maps
- Controlled traffic farming (CTF), every tractor, harvester and machinery use the same wheel tram lines, which limits compaction.
- Active Overseer nutrient budget in place.
- Nitrogen is used as a strategic tool on selected areas of the farm when required.
- Before any nitrogen is applied to crops, soil Available Nitrogen is tested to see how much (if any) nitrogen is needed.
- Detailed nitrogen budgets are used based on crop requirements, predicted yields, and soil and weather conditions.

8.2 Impacts of the "Action for Healthy Waterways" policy package on farm C.

8.2.1 Overview

Farm C is situated in Hawke's Bay and falls under the Hawke's Bay Regional Council's Plan Change 6 (PC6) Tukituki Catchment which became operative on the 1 October 2015 following a Board of Inquiry and High Court statutory processes.

The Tukituki Catchment plan[8] establishes Freshwater Objectives which are implemented through numerical water quality limits and targets set out in Tables 5.9.1A and 5.9.1B[8]. These include zone-specific environmental bottom lines for Dissolved Inorganic Nitrogen (DIN) of 0.8mg/L. It is important to note that the proposed environmental bottom line for DIN in the Essential Freshwater Package changes to the NPSFWM is 1mg/L.

The Tukituki plan then establishes management frameworks for primary productive land uses through various rules which require among other conditions farms to have a Farm Environment Management Plan (FEMP) and to be operating in accordance with nitrogen leaching allocation/ authorisations based on the natural capital of their land, as provided by Land Use Capability framework in Table 5.9.1D[8]

Farm C has calculated its nitrogen leaching allowance (Table 11) which under PC6 provides flexibility up to 22.6kgN/ha/yr for the whole farm, given the farm's individual makeup of Land Use Capability classes. The approach provided in PC6 enables Farm C to optimise their land use and farming systems within the natural capital of their land and within environmental limits.

Table 11: Farm C, calculated nitrogen leaching allowance under PC6 based on LUC allocation rules. Note this was when the farm was 621 effective hectares.

LUC	Limit (Kg N/ha/yr)	Blk 1	Blk 2	Blk 3	Blk 4	Blk 5	Blk 6	Blk 7	Blk 8	Blk 9	Blk 10	Blk 11	Blk 12	Blk 13	Blk 14	Blk 15	Blk 16	Blk 17	Blk 18	Total area (ha	Total leaching
1	30.1					24.02	3.72	1												28.74	865.074
2	27.1																			0	0
3	24.8	12.58	39.39	30.05	17.6	5.94	12.88	1.66	17.39	23.09	30.63	0.37	33.46			2.75	1.46			229.25	5685.4
4	20.7				39.71		0.01	5.01	2.34	20.37	27.04		25.65	55.25	83.17	59.75	2.84	24.39	4.76	350.29	7251.003
5	20														0.45			0.17		0.62	12.4
6	17				11.57													0.64		12.21	207.57
7	11.6																			0	0
8	3																			0	0
Total		12.58	39.39	30.05	68.88	29.96	16.61	7.67	19.73	43.46	57.67	0.37	59.11	55.25	83.62	62.5	4.3	25.2	4.76	621.11	14021.447
																				Total Leaching / Total area =	**22.57 kg/N/ha/yr**

[8] October 2015. Hawke's Bay Regional Resource Management Plan, Plan Change 6 – Tukituki River Catchment

8.2.2 Environmental overview

Farm C's extensive use of technology and 'soils first' approach has led to an extremely efficient and highly productive mixed cropping and livestock system which is operating within current environmental limits. The farm has a detailed FAR Land Environmental Plan and has already fenced 95% of waterways on the property with approximately 15km of fencing. The business uses extensive technology to help protect the environment (see more details under farm summary) including precision agriculture technology (differential application) to ensure optimal use of nutrients and water, preserve soil structure and minimise the impact on the environment. Minimal tillage is used to preserve soil carbon, nitrogen and soil structure. Moisture probes are used for irrigation scheduling along with variable rate irrigation. For this class of country, the farm system has a very low environmental footprint and based on our assessment would be in the top 5% of farmers in terms of farm performance.

8.2.3 Nitrogen (N) loss

Nitrate leaching is the main pathway of nitrogen loss in soils. One of the major sources of nitrate leaching is from urine patches from animals. Typically, the higher the stocking rate the more urine patches per unit area and the more N leaching. Intensive farming on vulnerable soils (coarse-textured, free draining) results in an increased amount of N making its way to our waterways[9]. High rainfall and irrigation on these free draining soils further amplifies the risk of N leaching.

Farm C has calculated its nitrogen leaching allowance (Table 11), which under PC6 provides flexibility up to 22.6 kgN/ha/yr for the whole farm, given the farm's individual makeup of Land Use Capability classes. The approach provided in PC6 enables Farm C to optimise their land use and farming systems within the natural capital of their land and within environmental limits. Based on information provided by Farm C, the whole farm average N loss from the root zone in 2018 was 17 kgN/ha/yr, well within the allowance under PC6 see table 11. Comparing this with other data sets available to BakerAg on similar country, this would be considered average to low N loss especially on irrigated country and the property is still well within its environmental limits. A BakerAg data set of similar finishing farms (but with less cropping) was reviewed, and the average N loss was 19.9 kgN/ha/yr with a range of 13 to 31 kg.

To compare and contrast with other industries, more intensive systems such as dairying have N loss in the 30-50 kgN/ha/yr range depending on location, soil type and farm system (see Tables 12 & 13). There are dairy farms that sit higher than this range as evidenced in Appendix 2 where two advertised dairy farms had N losses of 72 and 85 kgN/ha/yr.

[9] Ms. Dewes, Evidence in Chief. Before the Board of Inquiry Tukituki Catchment Proposal. In the matter of the Resource Management Act. 1991. October 2013.Paragraph 21, page 6.

Nitrogen losses from sheep and beef and mixed cropping farm systems are typically much lower than other pastoral land uses. When we compare the modelled N losses from this business in 2018 of 17kg/N/ha/yr with the Dairy farm studies in Tables 12 & 13 and Appendix 2, Farm C has a very small environmental footprint in terms of N losses.

Table 12: Industry nutrient losses

Industry	N leaching (kg/ha)	P loss risk (kg/ha)	Gross margin, 2012 ($/ha)
Dairy	29-49	0.8-2.1	$3,000-$4,500
Sheep and beef	8-18	0.1-0.5	$50-$800
Forestry	2	0.1	$250

Source: AgResearch - (Kaye-Blake et al 2013**)**

Note: The gross margin figures are for 2012 data on prices, costs and productivity

Table 13: Nutrient losses across different land use

Study	Land use	Region	Average N leaching (kgN/ha/yr)	Range (kgN /ha/yr)	Average P loss risk (kgP/ha/yr)	Range (kgP/ha/yr)
[1]	Dairy	Southland	30	22-49	0.8	0.8-1.3
[1]	Wintering/Support	Southland	55	39-114	1.2	0.7-2.0
[1]	Sheep/Beef/Deer Intensive	Southland	12	8-23	0.6	Not available
[1]	Sheep/Beef/Deer Extensive	Southland	6	4-8	0.3	Not available
[2]	Dairy 1997/98	Waikato	32	26-39	0.8	0.7-0.9
[2]	Dairy 2007/08	Waikato	38	33-47	0.8	0.7-0.9
[2]	Sheep & Beef	Waikato	13	10-16	1.6	0.5-2.1

[1] 2014. George Ledgard, An Inventory of Nitrogen and Phosphorus Losses from Rural Landuses in the Southland Region

[2] 2009. Environment Waikato. Nutrient Budgets for Waikato Dairy and Sheep, Beef and Deer Farms

8.2.4 Phosphorus (P) loss

Average phosphorus (P) loss from Farm C in 2018 was 0.3 kg P/ha/yr. Comparing this with other data sets available on similar country this would be considered low P loss. A BakerAg data set of similar finishing farms was reviewed, and the average P loss was 0.9 kgP/ha/yr with a range of 0.3 to 1.9 kg. When Farm C is compared to dairy farms in Tables 12 & 13, a loss of 0.3 kg P/ha/yr is low.

8.2.5 Proposed 120 ha new irrigation

Currently farm C has 275 ha under centre pivot irrigation from water storage dams and bores. Storage dams capture 'flood flow water' from surrounding hill country. Storage dams provide approximately 120,000 cubic metres of water or circa 150mm/ha/yr. The regional council has

issued another consent to take and use water at high flow from a stream to fill 'off stream' water storage reservoirs for subsequent irrigation areas planned. This consent would take the total irrigated area to 450ha. The consent expires on 31 May 2034.

Farm C is currently preparing the farm to develop another 120ha of irrigation under a centre pivot. The Essential Freshwater Proposals prevents land use optimisation within the natural capital of the land through a number of key mechanisms:

1 Restrictions on land use change where emissions from the farm would increase from historic levels
2 FM-FP requires all emissions, irrespective of starting point or environmental impact on aquatic ecosystem health, to reduce over time.

Restrictions on irrigation development are proposed to apply from June 2020. A resource consent would be needed to irrigate more than 10 ha of unirrigated land, and this would only be granted if there is evidence that emissions (nitrogen, phosphorus, sediment, pathogens) from the new land use would not exceed the average discharges of contaminants from the old land use (farm) during the farm year 2017/18.

8.2.6 OVERSEER modelling new irrigation project

Farm C was modelled through OVERSEER for the 2017/18 year to determine the farm's nutrient losses. Table 14 shows N leaching in 2018 was 17 kgN/ha/yr. Irrigating a further 120 ha increased the N leaching by 5kgN/ha/yr to 22 kgN/ha/yr. Significantly, this is still within the allocation under the PC6. Phosphorus (P) loss also increased from 0.3 kgP/ha/yr to 0.4 kgP/ha/yr. Based on the scenario modelled, Farm C would not be able to implement the proposed 120 ha irrigation project because it would not get consent as the nutrient losses have increased from the baseline year of 2017/18.

For comparison a dairy farm system was modelled on the property. Based on the assumptions in the model, the dairy farm had higher N loses of 32kgN/ha/yr. P losses were also significantly higher at 1.1kgP/ha/yr vs 0.4 kgP/ha/yr. These losses are in line with other dairy data sets seen in Tables 12 & 13.

Mixed cropping farmers have long been suspicious of models such as OVERSEER and question whether the results truly represent losses from their farms and these concerns were raised by Farm C. To date, there has been little measurement of N losses from the root zone of cropping rotations and the industry is short of robust scientific data to calibrate the cropping components of the OVERSEER model. The "Rootzone Reality Project" is funded by the Ministry for Primary Industries' Sustainable Farming Fund and led by FAR. It aims to scientifically prove what is happening under cropping systems such as Farm C and ensure accurate reporting of nutrient losses from them.

Farm C's concerns over the OVERSEER model were backed up by the Senior Environment Data Analyst from B+LNZ who found the OVERSEER model did not accommodate for different aspects of the complex cropping system.

Table 14: Nitrogen (N) leaching kgN/ha/yr on case study farm C and alternative scenarios modelled in OVERSEER

Baseline 2018			Alternative scenarios modelled in OVERSEER			
		2018	Irrigating a further 120 ha from 2018. Increasing cropping area and yields and lambs finished. Decreasing bulls finished	Increased winter Kale by 20ha for the Bulls, buying bulls a month earlier	Increased Summer Rape by 20ha and buying and finishing lambs a month earlier	Dairy farm, 2.9 cows/ha, 505 ha irrigation, cows wintered on kale, young stock grazed off.
Farm Name	**Description**	**N leaching (kg/ha)**	**N leaching (kg/ha)**	**N leaching (kg/ha)**	**N leaching (kg/ha)**	**N leaching (kg/ha)**
Farm C	655ha Mixed cropping and livestock finishing.	17	**22**	**18**	**17**	**32**

Key: Red represents an increase in the farm's N leaching from 2018 based on modelled scenarios . A resource consent would be needed to irrigate an additional 10 ha of unirrigated land, and this would only be granted if there is evidence it would not increase nitrogen, phosphorus, sediment or microbial pathogen discharges above the property's baseline.

Note: N loss reported using Overseer v 6.3.2. The data above should not be used for consenting or compliance purposes. Overseer files were completed by a certified nutrient management adviser using best management input standards.

Table 15 : Average Phosphorus (P) loss kgP/ha/yr on case study farm C and alternative scenarios modelled in OVERSEER.

Baseline 2018		Alternative scenarios modelled in OVERSEER				
		2018	Irrigating a further 120 ha. Increasing cropping area and yields and lambs finished. Decreasing bulls finished	Increased winter Kale by 20ha for the Bulls buying bulls a month earlier	Increased Summer Rape by 20ha and buying and finishing lambs a month earlier	Dairy farm, 2.9 cows/ha, 505 ha irrigation, cows wintered on kale, young stock grazed off.
Farm Name	**Description**	**P loss (kg/ha)**	**P loss (kg/ha)**	**P loss (kg/ha)**	**P loss (kg/ha)**	**P loss (kg/ha)**
Farm C	655ha Mixed cropping and livestock finishing.	0.3	**0.4**	**0.3**	**0.3**	**1.1**

Key: Red represents an increase in the farm's P loss from 2018 based on modelled scenarios. A resource consent would be needed to irrigate an additional 10 ha of unirrigated land, and this would only be granted if there is evidence it would not increase nitrogen, phosphorus, sediment or microbial pathogen discharges above the property's baseline.

Note: P loss reported using Overseer v 6.3.2. The data above should not be used for consenting or compliance purposes. Overseer files were completed by a certified nutrient management adviser using best management input standards.

8.2.7 Loss of income ("Frozen income")

The Essential Freshwater proposals effectively grandparent extensive or environmentally responsible farms like Farm C to current or historic farming systems, removing their ability to innovate, adapt, or optimise their land uses and farming systems to meet a range of pressures including changing markets, changes in climate, personal aspirations, and individual life circumstances.

The risk of multiple crop failures in the Hawkes Bay climate is a real concern with climate change. Irrigation brings resilience in a changing climate with reliable yields. The income earning potential of the proposed 120 ha of dryland on Farm C has effectively been 'frozen'. Table 16 shows the gross margin of a dryland area versus the same land irrigated. The gross margin per ha difference is $979, over 120 ha this is an annual opportunity cost of not having irrigation of $117,520. This analysis is conservative and doesn't take into account options that open up to grow high value specialist crops that can return up to $10,000/ha. Contracts to grow these crops

can only be secured with irrigation and if the farmer can achieve consistent quality crop yields. Another element not factored into this gross margin is the improved livestock finishing system with better margins as a result of a more controlled system.

Table 16: Dryland gross margin vs irrigated

	$/ha
Annual cropping gross margin - irrigated	$1,871
Annual cropping gross margin - dry land	$892
Difference	$979
Annual opportunity cost on 120 ha	**$117,520**

Source: Farm C Gross Margin information. Rotation of Wheat, Peas and Moata grass seed. Crop gross margins do not include livestock trading revenue.
Irrigated gross margins include irrigation running costs and interest on the capital investment

8.2.8 Summary of compliance costs

Table 17: Costs associated with complying with the Essential Freshwater Policy Package

Farm C	
Up-front capital costs	$185,350
Ongoing annual costs	$35,337
Ongoing annual costs per effective ha	$54
% Increase in farm working costs per effective ha	8%

8.2.9 Up-front capital costs

Full detail on the capital costs can be seen in Appendix 5. The main cost is fencing to meet the stock exclusion rules and particularly the 5m set-back requirements. Farm C has already fenced 95% of the waterways (approx. 15km) on the property, however on average the set backs are not 5m. Photos in figure 3 (above) show existing waterways fenced but the set-back is not 5m. Spending $157,000 on more fencing on this property in the author's opinion would be of dubious value and not likely provide any additional environmental benefits. It must be noted that no costs were included to remove the existing fences when changing set-backs. On flat cropping land where the risk of overland flow is minimal the proposed 5m buffer seems excessive and there needs to be clear science showing better environmental outcomes from having this level of set-back distance. There is considerable loss of annual income by taking out this productive land (see Table 18).

Table 18: Annual lost Income from stock exclusion set-backs

Land lost from production due to new set back requirements.	**ha Loss**	**EBITRm/ha**	
5m set-back distance waterways	11	$1,625	**$17,415**

8.2.10 Increased economic costs

Ongoing annual compliance costs were calculated at $35,337 p.a. for Farm C. This represents an 8% increase in farm working expenses for a farm that already has a low environmental footprint. Farm C will not have the opportunity to marginally intensify to cover these additional costs.

8.2.11 Proposed irrigation development – 'Stranded assets'

The total cost of the 120ha irrigation project is estimated at $750,000. Farm C has already undertaken significant investment (see Table 19) in developing the 120ha irrigation area including construction of storage dams. The total costs to date have been $287,200. Under the proposal the irrigation development will become obsolete with $287,200 of 'stranded assets'.

Table 19. Irrigation development expenditure for 120ha

Expenditure to date	**$ GST excl**
Valves, pumps, pipes, welding	$262,200
Consulting fees	$10,000
Engineering fees	$15,000
	$287,200
Budgeted expenditure to complete project	
Dam engineering & detailed design for consent	$90,000
Dam construction (est. $100 to $150K)	$125,000
Main line pipe	$28,000
Electricity	$5,000
Pivot Irrigator for 120ha	$215,000
	$463,000
Total estimated investment cost	**$750,200**

9. CASE STUDY – FARM 'D'

9.1 Introduction to Farm 'D'

Farm System:	Hill country sheep & beef - breeding and finishing
Location:	Central Waikato
Altitude:	20m to 250m
Area:	1000ha total – 900ha effective
Contour:	150ha flat to rolling, 350ha rolling hills, 500 ha medium to steep hills.
Av Rainfall:	860mm pa.
Fertility 2016	Hill averages: pH 5.6, Olsen P 7, Sulphate Sulphur 6 Decommissioned dairy farm averages: pH 5.9, Olsen P 37, Sulphate Sulphur 5.
Water:	There is approximately 400ha of reticulated country fed from two separate bores. A number of stock water dams are also on the property. Most hill country stock water is from springs or dams.
Stocking Rate:	4.2 SU/ha at 1 July 2017 and 4.8 SU/ha 30 June 2018
Sheep System:	Small Coopworth breeding flock with 280 MA & 2th Ewes. All lambs killed prime.
Cattle System:	For ease of management farming a high cattle ratio of 90% cattle 10% sheep. Approximately 150 - 200 breeding cows. The cows calve in September with the calves weaned in April at around 200kgLW. Surplus heifers and own-bred steers are fattened, plus additional beef steers and Friesian bulls are bought in at 350-400kgLW and finished to heavy weights of around 700kgLW (350-360kg CW).
Cropping:	Minimal cropping with typically 8 ha white clover and plantain followed by permanent pasture.

Current Environmental Management:

- Some ponds are fenced to exclude stock
- Some drains are fenced
- The decommissioned dairy farm was fenced under the dairying and clean streams accord

- Willow stakes have been planted in drains and gullies

9.2 Impacts of the "Action for Healthy Waterways" policy package on farm D

9.2.1 Environmental overview

Due to a number of different circumstances, Farm D has not optimised the farm system. The hill country currently has low soil fertility and therefore a low stocking rate. Farm D has OVERSEER modelled N losses in 2016 of 7kgN/ha/yr and P losses of 1.9kgP/ha/yr. The stocking rate and farm policy is very similar in 2019.

In terms of Farm D's environmental footprint, it would be described as minimal compared with other more intensive land uses in the Waikato. The low stocking rate has driven a lower than average operating profit therefore the ability of the farm to sustain a high level of environmental expenditure has been limited. To date there has been expenditure on stock exclusion from waterways on the decommissioned dairy farm.

9.2.2 Up-front capital costs

The up-front capital costs of $680,485 (Table 20) mainly for fencing and water reticulation is insurmountable for a farm business of this scale. It's important to note that the waterways and measured lengths were mapped as part of another report[7] looking at the impacts of the proposed Waikato Plan Change 1. In this report the waterways on Farm D were only mapped up to 25˚ degrees in slope. Under this new proposed policy more streams would be captured in the hill country and the capital fencing costs would increase. Due to time constraints the Wetlands on Farm D were not identified and stock exclusion from these was not costed as part of these calculations.

Table 20: Costs associated with complying with the Essential Freshwater Policy Package.

Farm D	
Up-front capital costs	$680,485
Ongoing annual costs	$80,304
Ongoing annual costs per effective ha	$89
% Increase in farm working costs per effective ha	29%

9.2.3 Increased economic costs

Ongoing annual compliance costs were calculated at $80,304 p.a. for Farm D. This represents a 29% increase in farm working expenses. This level of increase in expenses is unsustainable, especially as the policy does not allow flexibility to marginally intensify parts of the land to cover rising costs.

9.2.4 Loss of flexibility

Grazing animals on winter forage crops in the hill country on Farm D will require a resource consent, irrespective of how it is managed or its proximity to a waterbody. The total area under forage crop must not exceed the highest annual amount of area in annual forage crop in any farm year between 2013/14 and 2018/19. This will impact Farm D as there has been very little use of these crops to date. Farm D will not have the chance to make eco-efficiency gains such as Farm B by using crops strategically on the property. The ability of Farm D to optimise the farm system and create resilience in a changing climate will be taken away.

9.2.5 Loss of income ("Frozen income")

The Essential Freshwater proposals effectively grandparent extensive farms like Farm D to current or historic farming systems, removing their ability to innovate, adapt, or optimise their land uses and farming systems to meet a range of pressures including changing markets, changes in climate, personal aspirations, and individual life circumstances.

Using OVERSEER the FW-FP implies grandparenting a farm's current level of emissions, regardless of impact or whether there is any land use change. Focussing on N, in the OVERSEER software, stocking rate is one of the key drivers of N leaching, so by grandparenting a farm's level of N leaching, in a rough sense, stocking rate is being capped. For farms that have been developed and are running at near optimum levels this may be seen as an appropriate course of action but it places unfair restrictions on farms that are not currently well developed.

An example of this is farm D. Soil fertility is well below optimum levels. Due to this, and the current maturity of the business, it is not being farmed to optimal levels. This is highlighted in Table 21 below that shows farm D was only carrying 4.6 SU/ha in 2015 compared to the B+LNZ class average of 9.3 SU/ha and the B+LNZ top 20% of 10.2 SU/ha. In June 2018 the farm was carrying 4.8 SU/ha.

This low stocking rate is driving a low N loss figure of 7kgN/ha/yr. Compare this to similar land classes that are optimised where the N loss would be in the 15-20kg/ha/yr range. The impact of the Essential Freshwater proposals is that farm D, which to this point has had very little N impact, would lose the opportunity to invest in improving soil fertility and improving the profitability of the business in the future.

Table 21: Farm D's stocking rate (SU/Ha) compared to the B+LNZ Class 4 Average.

	Farm D 2015	**B+LNZ 2015 Class 4 2015 Mean**	**B+LNZ 2015 Class 4 2015 Top 20%**
Effective Ha	900	334	341
Total SU	4150	3116	3488
SU/Ha	4.6	9.3	10.2

If property D were to lift performance to the average for the B+LNZ Class 4 and run a similar policy the increased annual income potential would be $184,195, or $205/ha. OVERSEER modelling was undertaken to see what impact this would have on Farm D's level of nutrient

losses particularly N loss. Table 22 shows N loss lifted to 8 kgN/ha/yr therefore under the proposed policy the farm would not be able to do this and capture the additional income.

Table 22: N loss results on Farm D and scenario modelling in OVERSEER

	Baseline			Alternative scenarios modelled in OVERSEER	
	2014-15	2015-16	Baseline	Stocking Rate & Cattle Ratio to B+LNZ Class 4 Mean	Stocking Rate & Cattle Ratio to B+LNZ Class 4 Top 20%
Farm Name	N leaching (kg/ha/yr)	N leaching (kg/ha/yr)	N leaching (kg/ha/yr)	N leaching (kg/ha/yr)	N leaching (kg/ha/yr)
Farm D	7	7	7	8	10

Key: Red represents an increase in the farms N loss from the baseline, based on modelled scenarios.
Note: N loss reported using Overseer v 6.2.3. The data as stated above should not be used for consenting or compliance purposes.

The annual lost income to Farm D from stock exclusion set-backs, can be found in Table 23. Because of the numerous streams, drains, wetlands, and ditches stretching throughout Farm D and the requirements of a 5m set back, 24ha of current productive pasture would be lost and used as a buffer to capture nutrient losses.

Table 23: Annual lost Income from stock exclusion set-backs

Annual lost Income from stock exclusion set-backs			
Land lost from production due to new set-back requirements	**ha Loss**	**EBITRm/ha**	
5m set-back distance on waterways	24	$267	**$6,408**

9.2.6 Impact on land value

Purchasers would assess the large up-front capital costs ($680,485) to comply with the proposals and factor this into what they are prepared to pay for the property.

The current very low nutrient losses particularly N of 7kgN/ha/yr 'grandparents' the future potential of the property and will have a big impact on the property's future value. Effectively the stocking rate is capped at a low level leaving few options for prospective purchasers.

Analysis was undertaken in the BakerAg "Implications of the proposed Waikato Regional Plan Change 1" report[7] to see what impact grandparenting of N would have on Farm D's land value.

Results found this could potentially drop the value of this property by $4,400/ha or $3,960,000, or a 44% drop in land value. A land value devaluation of this magnitude would have serious ramifications on the balance sheet position of farm D. This would impact the bankability of this business and ongoing viability.

10. IMPLICATIONS FOR THE SHEEP & BEEF SECTOR

The broad stock exclusion rules particularly on hill country will severely impact the on-going viability of the sector.

Requiring a reduction in all emissions regardless of current levels or environment effect is inequitable and will put further pressure on the viability of some land uses. This is inefficient and is likely to be ineffective at addressing specific freshwater issues relative to the farm and its contribution to those issues. For example, for an extensive farming operation in a catchment where sediment is an issue, it would be more effective and efficient to focus action on erosion control and mitigation rather than diluting efforts across all four potential contaminants e.g. phosphorus, nitrogen, and pathogens.

Under grandparenting rules, farms with higher nutrient losses stand to sustain a higher level of productivity, have more flexibility, and will be valued more highly. Farms with a low level of loss and potentially better environmental footprint are effectively capped with a ceiling on stock numbers, production, land value and future income-earning potential. There is no recognition for the differential in nutrient losses between drystock and mixed cropping farms and other more intensive sectors. Grandparenting favours businesses that already have a high environmental impact. This runs counter to a "polluter pays" principle, because those farms with the lowest environmental footprint are bearing a much larger burden. This blunt, one-size-fits-all mechanism reinforces existing inefficiencies and rewards high-intensity farms.

In the OVERSEER software, stocking rate is one of the key drivers of nitrogen leaching, so capping a farm's level of nitrogen leaching indirectly limits its stocking rate. This may be an appropriate course of action for sheep and beef farms that have been optimised, but it places unfair restrictions on farms that are not currently optimised or, are underdeveloped in relation to the natural capital of their land.

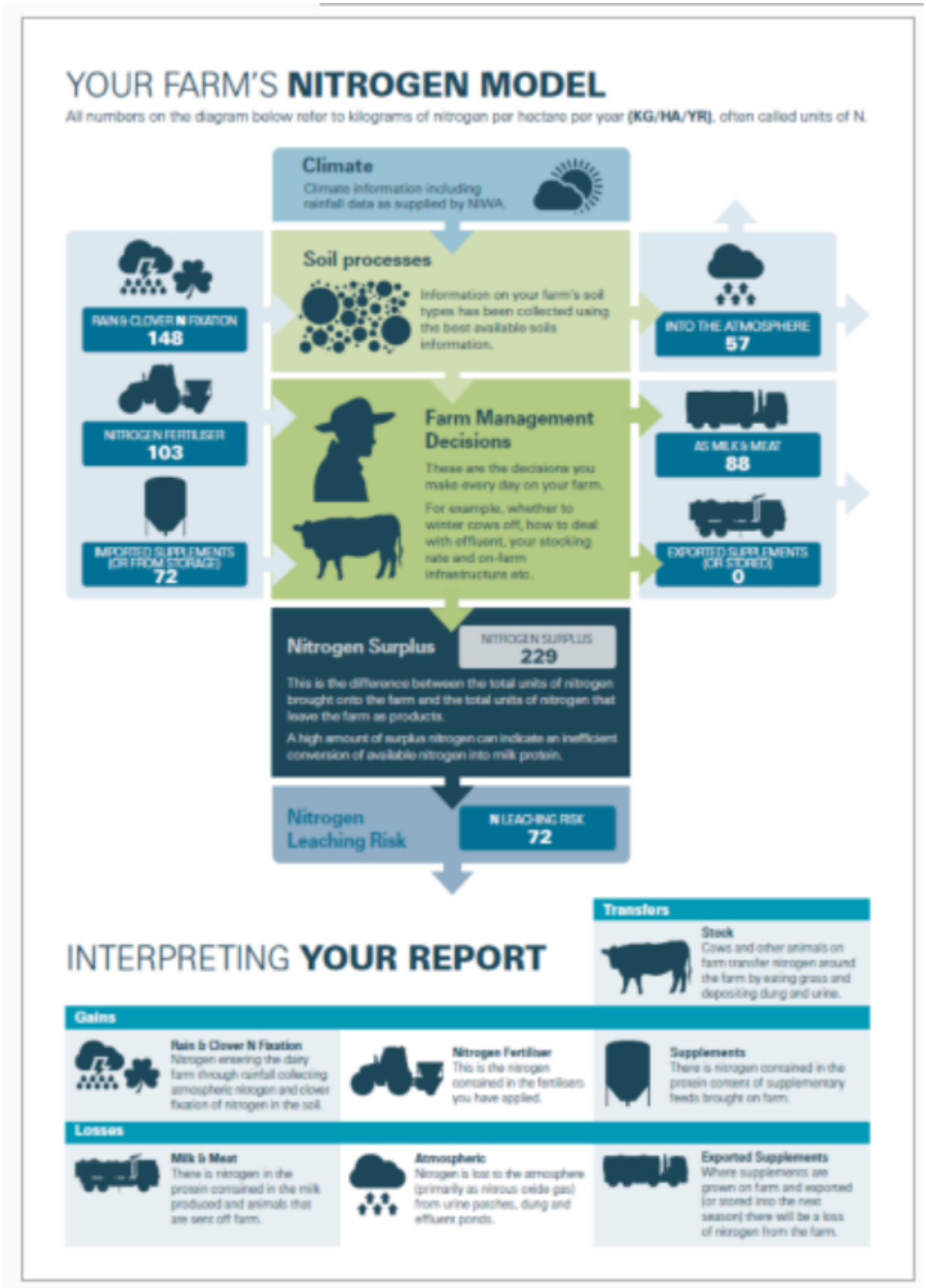
11. APPENDICES

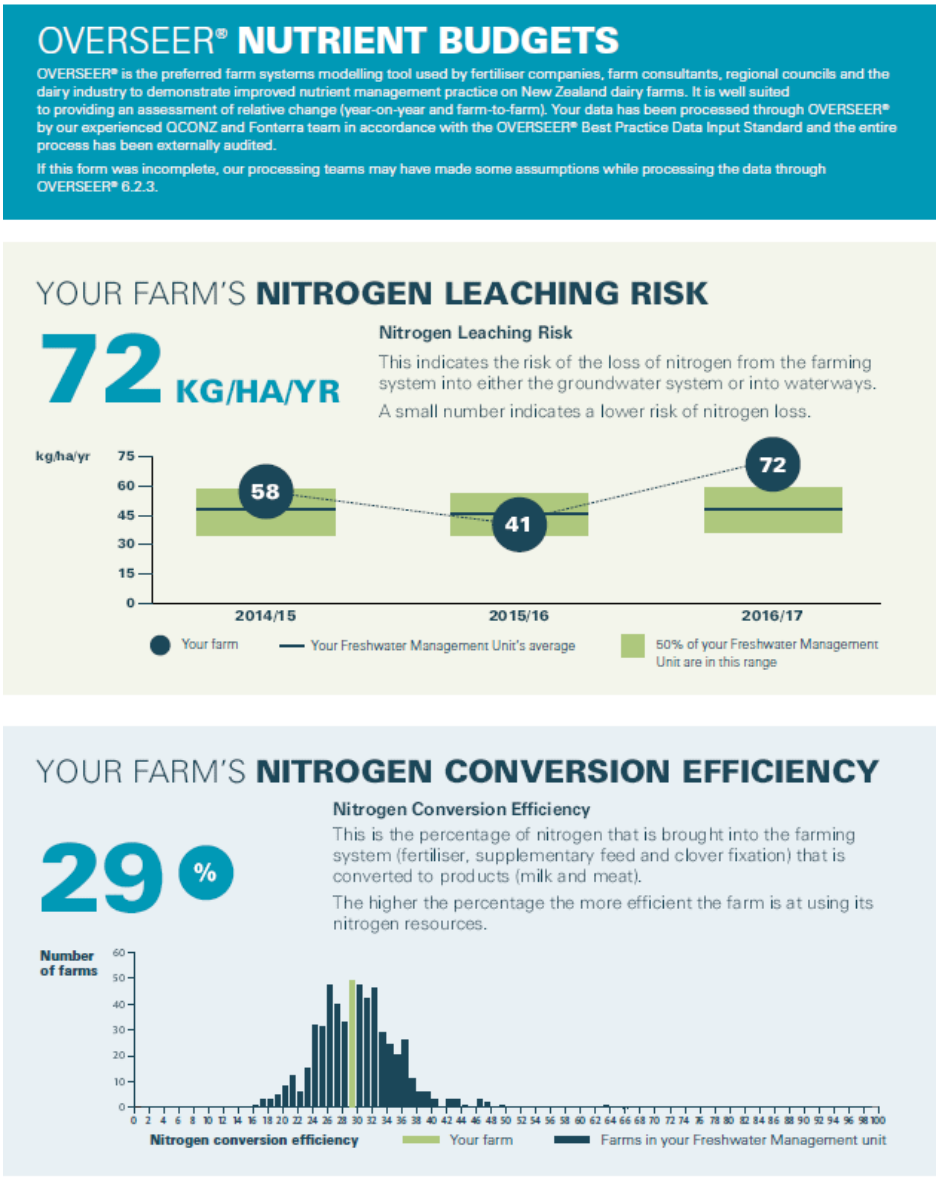
11.1 Appendix 1.

Site Name	TON 5 year median	Ammoniaca l N 5 year median	DIN	Comply NPS? 1.0		DRP 5 year median	Comply NPS? 0.018
Ruamāhanga River catchment							
Huangarua River at Ponatahi Bridge	0.23	0.005	0.235	YES		0.0058	YES
Kopuaranga River at Stuarts	0.96	0.005	0.965	YES		0.014	YES
Mangatarere River at State Highway 2	1.06	0.034	1.094	NO		0.029	NO
Parkvale Stream at Weir	1.6	0.01	1.61	NO		0.022	NO
Parkvale tributary at Lowes Reserve	4.45	0.005	4.455	NO		0.01125	YES
Ruamāhanga at State Highway 2		0.003				0.00245	YES
Ruamāhanga River at Gladstone Bridge	0.395	0.005	0.4	YES		0.0089	YES
Ruamāhanga River at McLays	0.021	0.005	0.026	YES		0.00205	YES
Ruamāhanga River at Pukio	0.37	0.007	0.377	YES		0.0133	YES
Ruamahānga River at Te Ore Ore	0.35	0.005	0.355	YES		0.0053	YES
Ruamāhanga River at Waihenga Bridge	0.485	0.006625	0.491625	YES		0.011625	YES
Taueru River at Gladstone	0.73	0.006	0.736	YES		0.01785	YES
Waingawa River at South Road	0.0625	0.005	0.0675	YES		0.0031	YES
Waiohine River at Bicknells	0.365	0.006	0.371	YES		0.0109	YES
Waipoua River at Colombo Road Bridge	0.75	0.005	0.755	YES		0.00375	YES
Whangaehu River at 250 m from Confluence	0.59	0.005	0.595	YES		0.033	NO
Whareama River catchment							
Whareama River at Gauge	0.01	0.005	0.015	YES		0.0036	YES

Source Irrigation NZ 2019: Data has been obtained from Land Air Water Aotearoa website (LAWA), as at 10 October 2019.

11.2 Appendix 2.





Source: 2017. Property Information Memorandum, Farmlands Real-Estate. Te Awamutu Dairy Farm

Source: Property Information Memorandum, Bayleys.

11.3 Appendix 3 .Farm A – Detailed Calculations

Ongoing annual costs to comply with the Action for Healthy Waterways policy package

Yearly OVERSEER file			
OVERSEER file to test any farm policy changes, and track reduction in emissions overtime as per the FW-FP	**Hrs.**	**$/Hr.**	
Farm visit and OVERSEER file	8	160	$1,280
Travel 100Km @ 80c km			$80
OVERSEER FM Charge			$200
			$1,560
Compliance with the FW-FP audited by an approved auditor			
An audit must be conducted every 2-years, unless the approved auditor is satisfied the environmental performance of the farm is at a level that means the audit can take place every 3-years.			
Assumed farm needs audit every 2-years ($1280 for audit/2 years = $640/pa)			**$640**
Water reticulation ongoing annual costs			
*Additional R&M with new system $20/Trough			$340
Annual depreciation 40 Yr lifespan			$850
Interest @ 5%			$1,700
			$2,890
* Fixing water leaks, replacing trough fittings, maintenance of pumps, maintenance of trough surrounds with metal etc.			
Winter grazing on forage crop			
Resource consent for winter crops above 10 or 15 degrees slope. Slope is determined across a land parcel. Consent estimated at $5,000, analysis of impacts in line with FW-FP. Assumed consent in place for 5-years ($1,000/yr)			
			$1,000
Fencing ongoing annual costs			
*Additional R&M required on new fences			$9,647
Annual depreciation 40 Yr. lifespan			$14,459
Interest @ 5%			$28,918
		Total Costs	**$53,024**
*1.5% of capital cost, inflated at 1% per year for 20-years. More fences to look after, more flood damage, erosion damage, bank slumping, stock pushing wires. Keeping electrics going, finding faults, spraying lines to keep power up.			
Freshwater module , schedule of actions to mitigate contaminant losses			
Erosion control, poles planted to control erosion and critical source areas (CSAs)		**Poles/Yr.**	
Poles cost $25 per pole with 50% subsidy reimbursed		200	**$2,500**
Riparian planting assumed 1km per year planted (Owners choice)	**Meters**	**$/M***	
Costs 2 rows planted both sides (if 5m Buffer)	1000	$14.8	**$14,800**
Weed and pest control in riparian areas. Assumed 16-hours plus chemical			**$2,300**
Additional administration			
Monitoring, record keeping, reporting and gathering information to demonstrate compliance with the farm environment plan including the freshwater module	**Hrs**	**$/Hr**	
	20	$40	**$800**
***Total annual costs**			**$79,514**
Effective Ha	**622**	**$/Ha**	**$127.84**
% increase in farm working costs/Ha/Yr			**21%**

* Assumes 1km of riparian planting with a 5m buffer (owners choice)

Upfront capital costs to comply with the Action for Healthy Waterways policy package

Certified farm plan (FP) with a freshwater (FW) module (FW-FP)			
	Hrs	**$/Hr**	
Farm A does not have a current farm plan. Develop a certified farm plan including a freshwater module (FW-FP)	0	$0	$5,000
FW-FP to be signed off by a credited farm environment planner and the council notified	5	$160	$800
Audited within 24-months of completion (audited by an approved auditor). Report to council	9	$160	$1,440
			$7,240
Note: The estimated cost of preparing a certified farm plan depended on if the farmer had a base plan, the farm size, farm system and local rules. The cost also depended on soil information available and if the farm had farm maps. AgFirst NZ, EnviroPlan Canterbury, AgriMagic and BakerAg were all canvassed regarding the cost of farm plans and the costs ranged from $2,000 to $8,000. With the requirements under the proposed NES and addition of the freshwater module the minimum cost was estimated at $5,000 per plan if the farmer had no plan already in place.			
Soil tests to determine current soil fertility			
	Tests	**$/Test**	
Five tests to develop nutrient budget	5	$75	**$375**
Develop base OVERSEER nutrient budgets for FW-FP			
As part of the FW-FP farmers need to have a base nutrient budget and demonstrate how they are "reducing" nitrogen, phosphorus, sediment and microbial pathogens.	**Hrs**	**$/Hr**	
Develop base file for farm A	8	$160	$1,280
Travel 100Km @ 80c km			$80
OVERSEER FM charge			$200
Note: Ballance environmental team Est range for one year $800-$2,880 for sheep & beef , for 2 files they have indicated $3,000. More for cropping farms			**$1,560**
Excluding stock from waterways			
[1] Fencing waterways and wetlands.			**$578,358**
[2] Additional water reticulation needed after fencing waterways off.			**$34,000**
[3]Livestock crossing structures including engineering & consents ($935/culvert)			**$4,675**
Note: Farm A already has provision for stock crossing in most places. No provision for fish passages was priced.			
Freshwater module, schedule of actions to mitigate contaminant losses			
Erosion control, poles planted to control erosion and critical source areas (CSAs)		**Poles/Yr.**	
Poles cost $25 per pole with 50% subsidy reimbursed		200	**$2,500**
Riparian planting assumed 1km of streams at outset planted (Owners choice). No subsides included.	**Meters**	**$/M***	
Costs 2 rows planted both sides (if 5m Buffer)	1000	$14.8	**$14,800**
Total Costs^			**$643,508**

[1]Assuming a four wire electric fence on both sides if no existing fence was in place. No allowance for removing existing fences that don't comply with the set back rules. Fencing labour and material on flat land of $10/linear metre, for hill country $16.50. These figures are based on pricing from BakerAg records and the *Ministry for Primary Industries Stock Exclusion Costs Report. MPI Technical Paper No: 2017/11, January 2016.* Note fencing materials and labour costs have risen significatly since the 2016 MPI report.

[2]Additional troughs on current reticulated system. Reticulated system formula of $2,000/trough used from *Implications of the proposed Waikato Plan Change 1 Report. BakerAg, R Beetham. C Garland. June 2018.*

[3]Installing Nexus Culvert 400mm x 6m, includes retaining posts, rails, labour and digger.

*Ministry for Primary Industries Stock Exclusion Costs Report. MPI Technical Paper No: 2017/11, January 2016

^Assumes 1km of riparian planting at a 5m buffer

Fencing - Stock exclusion

Description	Fence Type	Meters	$/m	Total	Comments
Excluding stock from permanent and intermittent waterways more than one metre wide	4 Wire electric, posts at 5m spacings	5515	$16.50	$90,998	One wire fence not suitable. Fences to keep sheep and young cattle out
Farm plan freshwater module. Excluding stock from streams, drains, and ditches less than a metre wide	4 Wire electric, posts at 5m spacings	19537	$16.50	$322,361	One wire fence not suitable. Fences to keep sheep and young cattle out
Excluding stock from wetlands	4 Wire electric, posts at 5m spacings	10000	$16.50	$165,000	One wire fence not suitable. Fences to keep sheep and young cattle out
Total Fencing Costs				**$578,358**	

11.4 Appendix 4 .Farm B – Detailed Calculations

Ongoing annual costs to comply with the Action for Healthy Waterways policy package

Yearly OVERSEER file			
OVERSEER file to test any farm policy changes, and track reduction in emissions overtime as per the FW-FP	**Hrs.**	**$/Hr.**	
Farm visit and OVERSEER file	8	160	$1,280
Travel 100Km @ 80c km			$80
OVERSEER FM Charge			$200
			$1,560
Compliance with the FW-FP audited by an approved auditor			
An audit must be conducted every 2-years, unless the approved auditor is satisfied the environmental performance of the farm is at a level that means the audit can take place every 3-years.			
Assumed farm needs audit every 2-years ($1280 for audit/2 years = $640/pa)			**$640**
Water reticulation ongoing annual costs			
*Additional R&M with new system $20/Trough			$540
Annual depreciation 40 Yr lifespan			$2,063
Interest @ 5%			$4,125
			$6,728
* Fixing water leaks, replacing trough fittings, maintenance of pumps, maintenance of trough surrounds with metal etc.			
Winter grazing on forage crop			
Resource consent for winter crops above 10 or 15 degrees slope. Slope is determined across a land parcel. Consent estimated at $5,000, analysis of impacts in line with FW-FP. Assumed consent in place for 5-years ($1,000/yr)			
			$1,000
Fencing ongoing annual costs			
*Additional R&M required on new fences			$7,524
Annual depreciation 40 Yr. lifespan			$11,277
Interest @ 5%			$22,554
		Total Costs	**$41,355**
*1.5% of capital cost, inflated at 1% per year for 20-years. More fences to look after, more flood damage, erosion damage, bank slumping, stock pushing wires. Keeping electrics going, finding faults, spraying lines to keep power up.			
Freshwater module , schedule of actions to mitigate contaminant losses			
Erosion control, poles planted to control erosion and critical source areas (CSAs)		**Poles/Yr.**	
Poles cost $25 per pole with 50% subsidy reimbursed		250	**$3,125**
Riparian planting assumed 1km per year planted (Owners choice)	**Meters**	**$/M***	
Costs 2 rows planted both sides (if 5m Buffer)	1000	$14.8	**$14,800**
Weed and pest control in riparian areas. Assumed 16-hours plus chemical			**$2,300**
Additional administration			
Monitoring, record keeping, reporting and gathering information to demonstrate compliance with the farm environment plan including the freshwater module			
	Hrs	**$/Hr**	
	24	$40	**$960**
***Total annual costs**			**$72,468**
Effective Ha	**819**	**$/Ha**	**$88.48**
% increase in farm working costs/Ha/Yr			**14%**

* Assumes 1km of riparian planting with a 5m buffer (owners choice)

Upfront capital costs to comply with the Action for Healthy Waterways policy package

Certified farm plan (FP) with a freshwater (FW) module (FW-FP)			
	Hrs	**$/Hr**	
Farm B has a current Sustainable Land Use Initiative plan(SLUI). Likely need updating in line with a certified farm plan and to include a freshwater module.	10	$160	$1,600
FW-FP to be signed off by a credited farm environment planner and the council notified	5	$160	$800
Audited within 24-months of completion (audited by an approved auditor). Report to council	9	$160	$1,440
			$3,840
Note: The estimated cost of preparing a certified farm plan depended on if the farmer had a base plan, the farm size, farm system and local rules. The cost also depended on soil information available and if the farm had farm maps. AgFirst NZ, EnviroPlan Canterbury, AgriMagic and BakerAg were all canvassed regarding the cost of farm plans and the costs ranged from $2,000 to $8,000. With the requirements under the proposed NES and addition of the freshwater module the minimum cost was estimated at $5,000 per plan if the farmer had no plan already in place.			
Soil tests to determine current soil fertility			
	Tests	**$/Test**	
Six tests to develop nutrient budget	6	75	**$450**
Develop base OVERSEER nutrient budgets for FW-FP			
As part of the FW-FP farmers need to have a base nutrient budget and demonstrate how they are "reducing" nitrogen, phosphorus, sediment and microbial pathogens.	**Hrs**	**$/Hr**	
Develop base file for farm B	8	160	$1,280
Travel 100Km @ 80c km			$80
OVERSEER FM charge			$200
Note: Ballance environmental team Est range for one year $800-$2,880 for sheep & beef , for 2 files they have indicated $3,000. More for cropping farms			**$1,560**
Excluding stock from waterways			
[1] Fencing waterways and wetlands.			**$451,087**
Water reticulation needed after fencing waterways off.			**$82,500**
[2]Livestock crossing structures including engineering & consents ($935/culvert)			**$9,350**
Note: No provision for fish pasages was priced. Three engineered bridges would be needed over large streams and rivers on farm B. These would be a significant cost, estimated at $100,000 plus per bridge. They are not included in the livestock crossing costings.			
Freshwater module, schedule of actions to mitigate contaminant losses			
Erosion control, poles planted to control erosion and critical source areas (CSAs)		**Poles/Yr.**	
Poles cost $25 per pole with 50% subsidy reimbursed		250	**$3,125**
Riparian planting assumed 1km of streams at outset planted (Owners choice). No subsides included.	**Meters**	**$/M***	
Costs 2 rows planted both sides (if 5m Buffer)	1000	$14.8	**$14,800**
Total Costs^			**$566,712**

[1]Assuming a four wire electric fence on both sides if no existing fence was in place. No allowance for removing existing fences that dont comply with the set back rules. Fencing labour and material on flat land of $10/linear metre, for hill country $16.50. These figures are based on pricing from BakerAg records and the *Ministry for Primary Industries Stock Exclusion Costs Report. MPI Technical Paper No: 2017/11, January 2016.* Note fencing materials and labour costs have risen significatly since the 2016 MPI report.

[2]Installing Nexus Culvert 400mm x 6m, includes retaining posts, rails, labour and digger.

*Ministry for Primary Industries Stock Exclusion Costs Report. MPI Technical Paper No: 2017/11, January 2016

^Assumes 1km of riparian planting at a 5m buffer

Fencing - Stock exclusion

Description	Fence Type	Meters	$/m	Total	Comments
Excluding stock from permanent and intermittent waterways more than one metre wide	4 Wire electric, posts at 5m spacings	7792	$16.50	$128,568	One wire fence not suitable. Fences to keep sheep and young cattle out
Farm plan freshwater module. Excluding stock from streams, drains, and ditches less than a metre wide	4 Wire electric, posts at 5m spacings	17625.8	$16.50	$290,826	One wire fence not suitable. Fences to keep sheep and young cattle out
Excluding stock from wetlands	4 Wire electric, posts at 5m spacings	1920.8	$16.50	$31,693	One wire fence not suitable. Fences to keep sheep and young cattle out
Total Fencing Costs				**$451,087**	

Reticulation costings	
Main System Details	
Hill block	
2 X Tank @ 454m asl	
Spring with diesel pump @ 215m asl	
780m main line pump to tank	
Details & Costs	
System design	$2,500
2 X 30,000 L tank (Range $3500 - 3900)	$7,000
Excavation of site, level, base	$2,500
Deliver tank to site -helicopter ($1600/Hr)	$3,200
Spring works, well liner, tap	$3,400
Pump diesel ($3500-5000)	$5,000
Startomatic for pump	$900
Tank level meter	$500
Pump shed with concrete Base	$3,500
	$28,500
Costs for Main System & Troughs	
Total troughs	27
System formula $2000/Trough	**$54,000**
Total Costs	**$82,500**
Final Costs	**$82,500**
Ongoing annaul costs post instalalation	
Additional R&M with new system $20/Trough	$540
Annual depreciation 40 Yr lifespan	$2,062.50
Interest 5%	$4,125
Total Costs	**$6,728**

11.5 Appendix 5. Farm C – Detailed Calculations

Ongoing annual costs to comply with the Action for healthy waterways policy package

Yearly OVERSEER file			
OVERSEER file to test any farm policy changes, and track reduction in emissions overtime as per the FW-FP	**Hrs.**	**$/Hr.**	
Farm visit and OVERSEER file (More time because of detailed cropping)	12	160	$1,920
Travel 100Km @ 80c km			$80
OVERSEER FM Charge			$200
			$2,200
Compliance with the FW-FP audited by an approved auditor			
An audit must be conducted every 2-years, unless the approved auditor is satisfied the environmental performance of the farm is at a level that means the audit can take place every 3-years.			
Assumed farm needs audit every 2-Years ($1,280 for audit/2-years = $640/pa)			**$640**
Water Reticulation - Ongoing annual costs			
			NA
Fencing ongoing annual costs			
*Additional R&M required on new fences			$2,627
Annual depreciation 40 Yr. lifespan			$3,937
Interest @ 5%			$7,874
		Total Costs	**$14,437**
*1.5% of capital cost, inflated at 1% per year for 20-years. More fences to look after, more flood damage, erosion damage, bank slumping, stock pushing wires. Keeping electrics going, finding faults, spraying lines to keep power up.			
Freshwater module , schedule of actions to mitigate contaminant losses			
Riparian planting assumed 1km per year planted (Owners choice)	**Meters**	**$/M***	
Costs 2 rows planted both sides (if 5m Buffer)	1000	$14.8	**$14,800**
Weed and pest control in riparian areas. Assumed 16-hours plus chemical			**$2,300**
Additional administration			
Monitoring, record keeping, reporting and gathering information to demonstrate compliance with the farm environment plan including the freshwater module	**Hrs**	**$/Hr**	
	24	$40	**$960**
***Total annual costs**			**$35,337**
Effective Ha	**655**	**$/Ha**	**$53.95**
% increase in farm working costs/Ha/Yr			**8%**

* Assumes 1km of riparian planting with a 5m buffer (owners choice)

Upfront capital costs to comply with the Action for Healthy Waterways policy package

Certified farm plan (FP) with a freshwater (FW) module (FW-FP)			
	Hrs	**$/Hr**	
Farm C has a current Foundation for Arable Research (FAR) farm plan. Likely need updating in line with certified farm plan and to include a freshwater module.	10	$160	$1,600
FW-FP to be signed off by a credited farm environment planner and council notified	5	$160	$800
Audited within 24-months of completion (audited by an approved auditor). Report to council	9	$160	$1,440
			$3,840
Note: The estimated cost of preparing a certified farm plan depended on if the farmer had a base plan, the farm size, farm system and local rules. The cost also depended on soil information available and if the farm had farm maps. AgFirst NZ, EnviroPlan Canterbury, AgriMagic and BakerAg were all canvassed regarding the cost of farm plans and the costs ranged from $2,000 to $8,000. With the requirements under the proposed NES and addition of the freshwater module the minimum cost was estimated at $5,000 per plan if the farmer had no plan already in place.			
Soil tests to determine current soil fertility			
	Tests	**$/Test**	
Farm C has detailed tests already	0	75	**$0**
Develop base OVERSEER nutrient budgets			
Must show emissions (nitrogen, phosphorus, sediment, pathogens) from the new land use does not exceed the average discharges of contaminants from the old land use (farm) during the farm year 2017/18	**Hrs**	**$/Hr**	
Complex file with multiple crop rotations and many blocks (7-days to develop base)	56	160	$8,960
Travel 100Km @ 80c km			$80
OVERSEER FM charge			$200
Note: Ballance environmental team Est range for one year $800-$2,880 for sheep & beef , for 2 files they have indicated $3,000. More for cropping farms			**$9,240**
Excluding stock from waterways			
#Fencing waterways. Moving existing fences to comply with set back requirements			**$157,470**
Water reticulation needed after fencing waterways off			NA
Livestock crossing structures including engineering & consents			NA
Freshwater module , schedule of actions to mitigate contaminant losses			
		Poles/Yr.	
Erosion control, poles planted to control erosion and critical source areas (CSAs)			**$0**
Riparian planting assumed 1km of streams at outset planted (Owners choice). No subsides included.	**Meters**	**$/M***	
Costs 2 rows planted both sides (if 5m Buffer)	1000	$14.8	**$14,800**
Total Costs^			**$185,350**

#Assuming a four wire electric fence on both sides if no existing fence was in place. No allowance for removing existing fences that dont comply with the set back rules. Fencing labour and material on flat land of $10/linear metre, for hill country $16.50. These figures are based on pricing from BakerAg records and the *Ministry for Primary Industries Stock Exclusion Costs Report. MPI Technical Paper No: 2017/11, January 2016.* Note fencing materials and labour costs have risen significatly since the 2016 MPI report.

*Ministry for Primary Industries Stock Exclusion Costs Report. MPI Technical Paper No: 2017/11, January 2016
^Assumes 1km of riparian planting at a 5m buffer

Fencing - Stock exclusion

Description	Fence Type	Meters	$/m	Total	Commnets
Excluding stock from rivers and streams more than one metre wide	4 Wire electric, posts at 5m spacings	13101	$10.00	$131,010	Fences to keep weaner bulls out and sheep out of riparian areas.
Farm plan freshwater module. Excluding stock from streams, drains, ditches less than a metre wide	4 Wire electric, posts at 5m spacings	2646	$10.00	$26,460	Fences to keep weaner bulls out and sheep out of riparian areas.
Total Fencing Costs				**$157,470**	

11.6 Appendix 6. Farm D – Detailed Calculations

Ongoing annual costs to comply with the Action for Healthy Waterways policy package

Yearly OVERSEER file			
OVERSEER file to test any farm policy changes, and track reduction in emissions overtime as per the FW-FP	**Hrs.**	**$/Hr.**	
Farm visit and OVERSEER file	8	160	$1,280
Travel 100Km @ 80c km			$80
OVERSEER FM Charge			$200
			$1,560
Compliance with the FW-FP audited by an approved auditor			
An audit must be conducted every 2-years, unless the approved auditor is satisfied the environmental performance of the farm is at a level that means the audit can take place every 3-years.			
Assumed farm needs audit every 2-years ($1280 for audit/2 years = $640/pa)			**$640**
Water reticulation ongoing annual costs			
*Additional R&M with new system $20/Trough			$2,000
Annual depreciation 40 Yr lifespan			$6,244
Interest @ 5%			$12,488
			$20,732
* Fixing water leaks, replacing trough fittings, maintenance of pumps, maintenance of trough surrounds with metal etc.			
Winter grazing on forage crop			
Resource consent for winter crops above 10 or 15 degrees slope. Slope is determined across a land parcel. Consent estimated at $5,000, analysis of impacts in line with FW-FP. Assumed consent in place for 5-years ($1,000/yr)			
			$1,000
Fencing ongoing annual costs			
*Additional R&M required on new fences			$6,658
Annual depreciation 40 Yr. lifespan			$9,980
Interest @ 5%			$19,959
		Total Costs	**$36,597**
*1.5% of capital cost, inflated at 1% per year for 20-years. More fences to look after, more flood damage, erosion damage, bank slumping, stock pushing wires. Keeping electrics going, finding faults, spraying lines to keep power up.			
Freshwater module , schedule of actions to mitigate contaminant losses			
Erosion control, poles planted to control erosion and critical source areas (CSAs)		**Poles/Yr.**	
Poles cost $25 per pole with 50% subsidy reimbursed		150	**$1,875**
Riparian planting assumed 1km per year planted (Owners choice)	**Meters**	**$/M***	
Costs 2 rows planted both sides (if 5m Buffer)	1000	$14.8	**$14,800**
Weed and pest control in riparian areas. Assumed 16-hours plus chemical			**$2,300**
Additional administration			
Monitoring, record keeping, reporting and gathering information to demonstrate compliance with the farm environment plan including the freshwater module	**Hrs**	**$/Hr**	
	20	$40	**$800**
***Total annual costs**			**$80,304**
Effective Ha	**900**	**$/Ha**	**$89**
% increase in farm working costs/Ha/Yr			**29%**

* Assumes 1km of riparian planting with a 5m buffer (owners choice)

Upfront capital costs to comply with the Action for Healthy Waterways policy package

Certified farm plan (FP) with a freshwater (FW) module (FW-FP)			
	Hrs	**$/Hr**	
Farm D does not have a current farm plan. Develop a certified farm plan including a freshwater module (FW-FP)	0	$0	$5,000
FW-FP to be signed off by a credited farm environment planner and the council notified	5	$160	$800
Audited within 24-months of completion (audited by an approved auditor). Report to council	9	$160	$1,440
			$7,240
Note: The estimated cost of preparing a certified farm plan depended on if the farmer had a base plan, the farm size, farm system and local rules. The cost also depended on soil information available and if the farm had farm maps. AgFirst NZ, EnviroPlan Canterbury, AgriMagic and BakerAg were all canvassed regarding the cost of farm plans and the costs ranged from $2,000 to $8,000. With the requirements under the proposed NES and addition of the freshwater module the minimum cost was estimated at $5,000 per plan if the farmer had no plan already in place.			
Soil tests to determine current soil fertility			
	Tests	**$/Test**	
Ten tests to develop nutrient budget	10	$75	**$750**
Develop base OVERSEER nutrient budgets for FW-FP			
As part of the FW-FP farmers need to have a base nutrient budget and demonstrate how they are "reducing" nitrogen, phosphorus, sediment and microbial pathogens.	**Hrs**	**$/Hr**	
Develop base file for farm D	12	$160	$1,920
Travel 100Km @ 80c km			$80
OVERSEER FM charge			$200
Note: Ballance environmental team Est range for one year $800-$2,880 for sheep & beef , for 2 files they have indicated $3,000. More for cropping farms			**$2,200**
Excluding stock from waterways			
[1] Fencing waterways (Wetlands not mapped or measured)			**$399,185**
Water reticulation needed after fencing waterways off.			**$249,760**
[2]Livestock crossing structures including engineering & consents ($935/culvert)			**$4,675**
Note: No provision for fish passages was priced.			
Freshwater module, schedule of actions to mitigate contaminant losses			
Erosion control, poles planted to control erosion and critical source areas (CSAs)		**Poles/Yr.**	
Poles cost $25 per pole with 50% subsidy reimbursed		150	**$1,875**
Riparian planting assumed 1km of streams at outset planted (Owners choice). No subsides included.	**Meters**	**$/M***	
Costs 2 rows planted both sides (if 5m Buffer)	1000	$14.8	**$14,800**
Total Costs^			**$680,485**

[1]Assuming a four wire electric fence on both sides if no existing fence was in place. No allowance for removing existing fences that don't comply with the set back rules. Fencing labour and material on flat land of $10/linear metre, for hill country $16.50. These figures are based on pricing from BakerAg records and the *Ministry for Primary Industries Stock Exclusion Costs Report. MPI Technical Paper No: 2017/11, January 2016.* Note fencing materials and labour costs have risen significatly since the 2016 MPI report.

[2]Installing Nexus Culvert 400mm x 6m, includes retaining posts, rails, labour and digger.

*Ministry for Primary Industries Stock Exclusion Costs Report. MPI Technical Paper No: 2017/11, January 2016

^Assumes 1km of riparian planting at a 5m buffer

Reticulation costings

Main System Details	
Block 1	
Tanks @ 245m asl (Sheep & Cattle Yards)	
Spring 235m asl - 190m main line spring to tank	
Details & Costs	
System Design	$2,500
3 X 30,000 L tank (Range $3500 - 3900)	$10,500
Excavation of tank sites, level, base x 3	$1,800
*Helicopter Tanks to Site -($1200 Ferry, $320 Tank)	$2,160
Tapping Spring Source + Materials	$2,500
Pump diesel ($3500-5000)	$4,000
Startomatic for pump	$800
Tank Level Meter	$500
Pump Shed - Concrete Base	$2,500
	$27,260
Costs for Main System & Troughs	
Ha	500
Ha/Trough	5
Total Troughs	100
System Formula $2000/Trough	**$200,000**
Total Costs	**$227,260**

* Helicopter $1600/Hour

Additional troughs on reticulated country	
$1,250 including 100m pipe x 18	**$22,500**
Final Costs	**$249,760**

Ongoing annaul costs post instalalation	
Additional R&M with new system $20/Trough	$2,000
Annual Depreciation 40 Yr Lifespan	$6,244
Interest 5%	$12,488
Total Costs	**$20,732**

Fencing - Stock exclusion

Description	Fence Type	Meters	$/m	Total	Comments
Excluding stock from streams >1m. Farm plan freshwater module. Excluding stock from streams, drains, and ditches less than a metre wide	4 Wire electric, posts at 5m spacings	24193	$16.50	$399,185	One wire fence not suitable. Fences to keep sheep and young cattle out
Excluding stock from wetlands	4 Wire electric, posts at 5m spacings	0	$16.50	$0	One wire fence not suitable. Fences to keep sheep and young cattle out
Total Fencing Costs				**$399,185**	