BAY OF PLENTY REGIONAL COUNCIL TOI MOANA

Economic Impact Assessment of selected Essential Freshwater proposals for the Bay of Plenty region

Bay of Plenty Regional Council
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Contents

Part 1: **Introduction**

Purpose

The purpose of this document is to provide a preliminary high level assessment of the economic impacts of five of the proposals set out in the *Essential Freshwater* package[1] (as of 5 September 2019) for the Bay of Plenty region. These five proposals potentially have the greatest impact on the Bay of Plenty region, and are sufficiently developed to enable a reasonable assessment of implications. Some general commentary about a couple of the other proposals is also provided in Appendix 1.

The focus of this assessment is on the costs to the agriculture sector. A separate work stream focused on implementation of the proposals is considering the costs and resourcing implications for the Bay of Plenty Regional Council (BOPRC), and therefore ratepayers, in more detail.

The aim of this assessment is to inform the Regional Sector's response to, and BOPRC's submission on, the proposals. It is expected that this assessment will also contribute to the national understanding of the proposals' impacts, and help to inform final decisions.

Scope

The proposals considered in this report are:

National Policy Statement for Freshwater Management (NPS-FM):

(a) Dissolved Inorganic Nitrogen (DIN) and Dissolved Reactive Phosphorus (DRP) attributes

National Environmental Standards for Freshwater (NES-FW):

(b) Restrictions on further intensification of rural land use

(c) Farm planning

(d) Management of nitrogen in high nitrate-nitrogen catchments (specifically for Upper Rangitāiki)

S. 360 Regulations:

(e) Stock exclusion requirements

The regional context for these policies is described in Part 2. Part 3 explains each of the proposals, and assesses their impacts. Part 4 provides a summary table, discussion and overall conclusions.

[1] The package includes the *Action for healthy waterways* discussion document, draft National Policy Statement for Freshwater Management, proposed National Environmental Standards for Freshwater, and draft regulations under s. 360 of the Resource Management Act 1991 for stock exclusion.

Part 2: **Regional context**

Current approach to implementing the NPS-FM

Bay of Plenty Regional Council has established nine Water Management Areas (WMAs) across the region (Figure 1). The current two-stage approach to implementing the NPS-FM 2014 (amended 2017) is through an initial region-wide Water Quantity Plan Change (PC9, stage one), currently in mediation prior to Environment Court hearings, followed by WMA-specific Plan Changes covering both quality and quantity (stage two). The first of these WMA-specific Plan Change processes (PC12) has been progressing since 2016, and covers the Kaituna-Pongakawa-Waitahanui and Rangitāiki WMAs. Plan Change 12 is currently in a pre-draft phase, with management options being defined. It is highly likely that the current approach will need to be reviewed in light of any changes to the NPS-FM.

A process to improve water quality in the Rotorua Lakes pre-dates the NPS-FM and has resulted in a range of measures. These include rules for managing nitrogen in the Lake Rotorua catchment (PC10), restrictions on intensification in the catchments of several other lakes and an extensive non-statutory land management programme. Under the current approach, these initiatives will eventually be integrated into NPS-FM implementation in the Rotorua Lakes WMA.

Bay of Plenty Regional Council has had a non-statutory land management programme for a long time, which more recently has been targeted to prioritise interventions in 11 catchments with water quality issues. This programme involves funding assistance, advice and support for landowners to improve land management practices, reduce contaminant losses and protect local waterways.

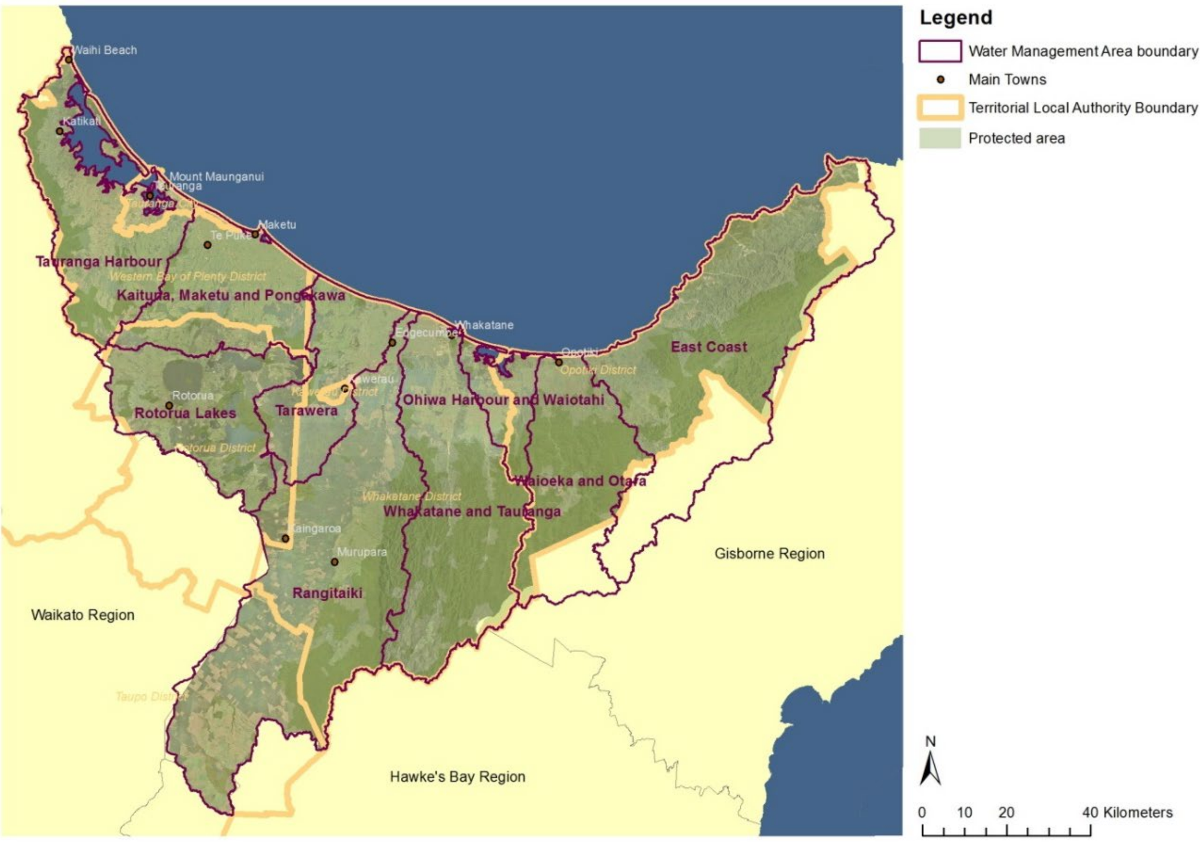

Figure 1 Bay of Plenty: Water Management Areas

Water quality

Water quality in the Bay of Plenty is generally good, relative to other regions, due largely to the significant extent of native and exotic forestry, which make up 69% of the region's land area.

Carter et al. (2018) describe in detail the results of water quality assessments across the region. In summary, no river and stream monitoring sites breach the current NPS-FM or regionally-recommended (Carter, Suren, & Scholes, 2017) bottom lines for ecosystem health attributes (nitrate and ammonia toxicity, dissolved oxygen, periphyton, benthic cyanobacteria, invertebrate communities). However, while nutrient toxicity thresholds are not breached, elevated nutrient levels around the region contribute to degradation in sensitive receiving environments.

Thirty-one out of 42 monitored freshwater swimming sites across the region (or 74%) are considered to be suitable for swimming under the current *E. coli* attribute table, while 11 sites (or 26%) are considered not suitable for swimming (Dare, 2019 in prep). This assessment would be quite different under the proposed *E. coli* attribute table for swimming sites during the bathing season in the proposed new NPS-FM; a lot more sites would fail the proposed national bottom line (Appendix 1).

Lakes, as receiving environments, are sentinels of change, reflecting integrated signals of climatic and catchment processes. In the Rotorua Lakes, water quality and trends vary by attribute and site, with several lake sites failing current NPS-FM or regionally-recommended bottom lines. Five of the twelve Rotorua Lakes do not currently meet their Trophic Level Index (TLI) targets set in the operative Regional Natural Resources Plan. Tropic Level Index scores will vary from year to year reflecting natural processes (e.g. climate) and the ongoing management of anthropogenic impacts.

Like lakes, harbours and estuaries in the region (e.g. Tauranga, Ōhiwa, Maketū, Waihī and Waiōtahe) are also particularly sensitive receiving environments, and in some cases are severely degraded. These receiving environments are expected to be the main drivers of land and freshwater management in their respective WMAs in the future, regardless of the proposed changes.

Land use and the agriculture sector

The Bay of Plenty region covers an area of 1.2 million ha. Nearly half of this area is in native bush and scrub (mostly within protected areas), and nearly one-quarter is in exotic forestry (Figure 2). The next most common land uses are dairy, drystock and horticulture. As described in Part 3C, there is currently a strong trend of conversion from pasture and arable to horticulture (kiwifruit and avocado in particular).

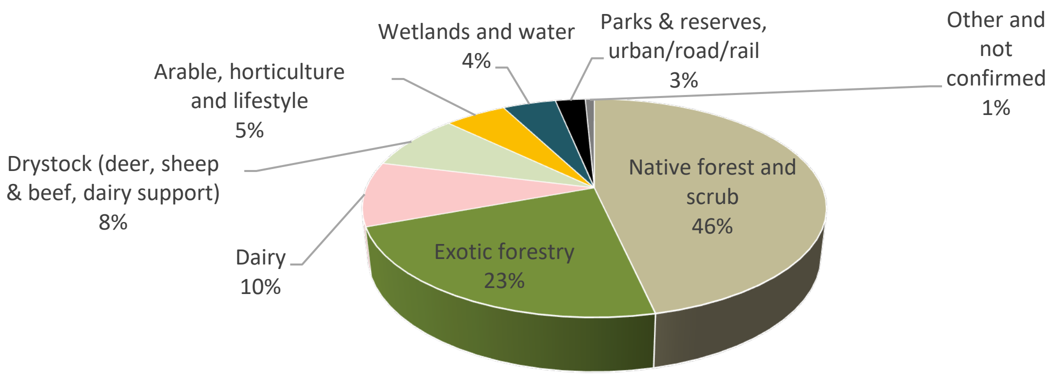

Figure 2 Current land use in the Bay of Plenty

About a third of the region's land is Māori-owned[2], under a range of tenure forms. The majority of Māori-owned land is in exotic or native forest. Appendix 3 contains more information about Māori land in the Bay of Plenty, and the impacts of the proposals on that land.

Small farms are a feature of the Bay of Plenty; most of these are dedicated to horticulture (mainly kiwifruit and avocado). This is significant because the farming regulations of the proposed NES-FW apply only to pastoral and arable properties over 20 ha, and horticultural farms over 5 ha (Clause 26). Figure 3 shows the number of farms by farm type and Figure 4 shows the number of farms by total size, as reported in the 2017 Agricultural Production Census (APC) (StatsNZ, 2018)[3].

A breakdown of the number of farms by size and farm type is only available for the Tauranga Moana, Kaituna-Pongakawa-Waitahanui, Rangitāiki and Rotorua Lakes WMAs (Figure 5). These four WMAs cover 80% of all Bay of Plenty farming businesses that responded to the 2017 APC, and 48% of the region's land area. Across these four WMAs, 48% of horticultural farms, 38% of pastoral farms and 69% of arable farms would be exempt from the farming proposals of the NES-FW based on total size thresholds. In terms of area across the region, an estimated 20% of land in horticulture, 10% of land in pasture and 50% of land in arable land uses would be below their respective thresholds. This would limit the impact and effectiveness of the proposed NES-FW in the Bay of Plenty.

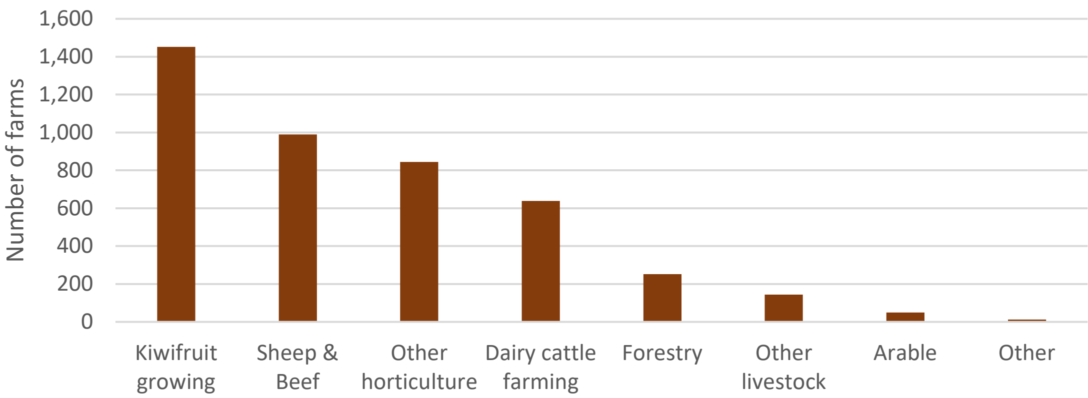

Figure 3 Number of farms by farm type in the Bay of Plenty (Source: APC 2017, StatsNZ)

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[2] Māori-owned land is defined in this case as land included in the Māori Land Online Database as at December 2015, with various corrections and amendments from other sources, including some land returned under Treaty Settlements. Māori land included here should be considered indicative only as not all Māori land in the Bay of Plenty is necessarily identified as such.

[3] The APC is sent to all GST-registered farming businesses and completion is compulsory. However, registration for GST is not compulsory for businesses with a turnover of less than $40,000 per year, but those businesses can choose to register voluntarily. There is therefore a partial and unquantifiable coverage of farming businesses below this turnover level.

For the purpose of the APC, a farm is defined as *one or more blocks of land, managed as a single operation, which is engaged in agricultural activity. This includes farming of livestock, horticulture, viticulture, nurseries, forestry, growing grain and seed crops, and land that could be used for these purposes.*

The proportion of eligible businesses that responded to the 2017 APC was 85.5% nationally. These businesses represented 88.3% of the total estimated value of agricultural operations. Values are imputed for farmers who do not return a completed questionnaire. Imputation involves replacing missing items with values based on other information available.

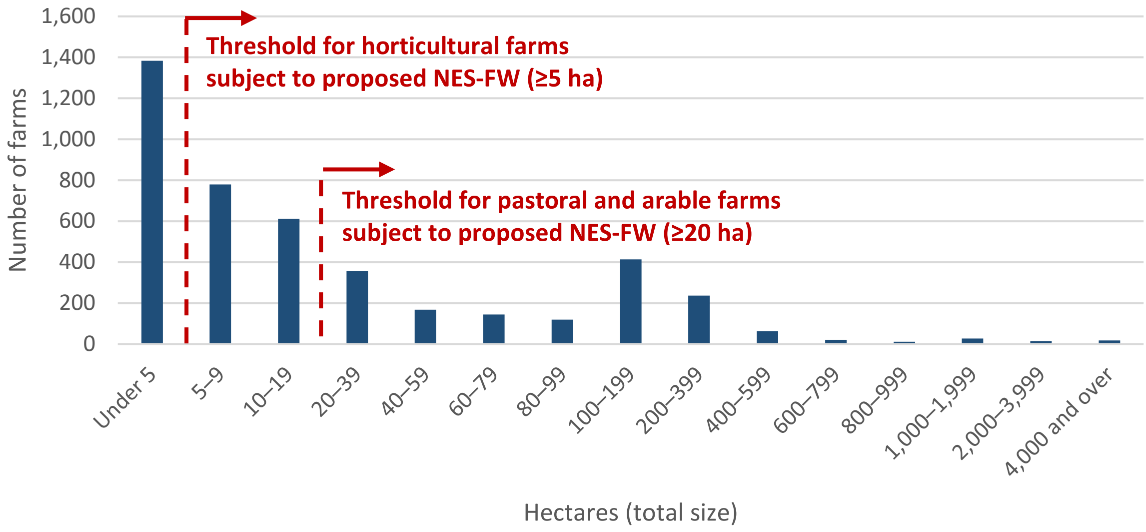

Figure 4 Number of farms by farm size in the Bay of Plenty (Source: APC 2017, StatsNZ)

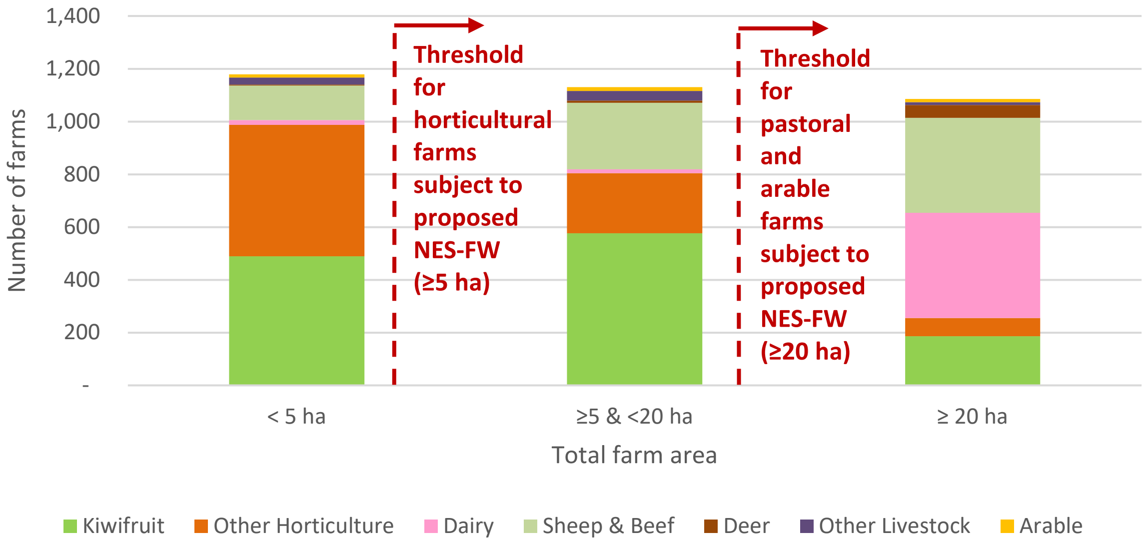

Figure 5 Number of farms by farm size and farm type in the Tauranga Moana, Kaituna-Pongakawa-Waitahanui, Rangitāiki and Rotorua Lakes WMAs (Source: APC 2017, StatsNZ)

Regional economy, importance of agriculture sector and population

The regional GDP in 2017/18 was $15.8b, or $52,254 per capita, 5.6% of New Zealand's GDP (StatsNZ, 2019). The Bay of Plenty economy is fairly diverse (Figure 6), and between 2000 and 2017 it grew by 155%. In 2017, agriculture (including horticulture) was the third largest direct contributor to the region's GDP (7.2%), on a par with construction (7.3%) and rental/hiring/ real estate (7.6%). Primary manufacturing, which includes the manufacturing of meat, dairy, fruit and cereal products, was the sixth largest contributor (6.1%)[4].

Horticulture, particularly kiwifruit, is the most valuable industry within the agriculture sector, accounting for the largest proportion of the agriculture GDP contribution described above. In 2015/16, kiwifruit accounted for about 50% of the agriculture sector's direct contribution to regional GDP (Scrimgeour, Hughes, & Kumar, 2017; StatsNZ, 2019). The agriculture sector has a significant indirect (through industries supplying agriculture) and induced (through household spending) impact on the regional economy. In the Bay of Plenty, it is estimated that horticulture has a flow-on impact on the regional economy of about half its direct contribution to regional GDP, while the pastoral and arable sectors have a flow-on impact of about a third of their direct contribution[5].

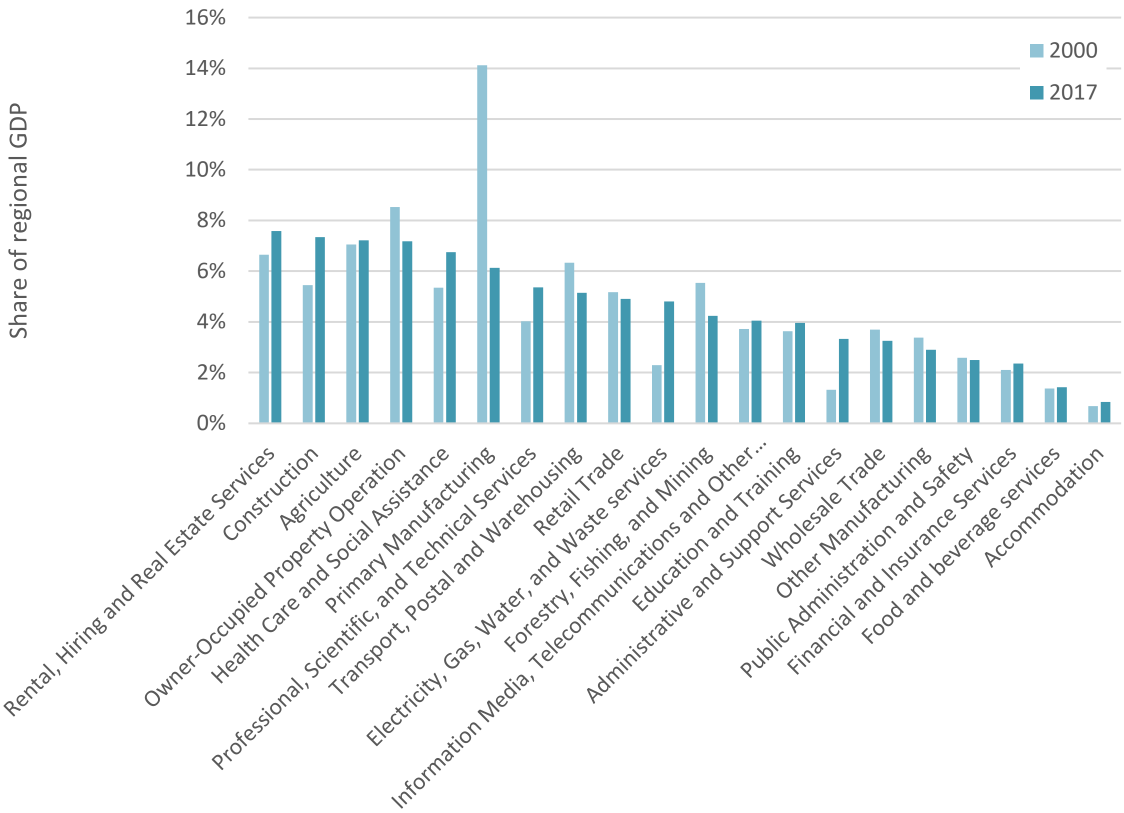

Figure 6 Share of Bay of Plenty regional GDP by industry (Source: StatsNZ)

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[4] While primary manufacturing has become smaller relative to other sectors since 2000, it has actually grown between 2000 and 2017, particularly in the 2014-2017 period.

[5] Bay of Plenty input-output tables generated by Butcher Partners Ltd., based on Statistics New Zealand 2013 input-output tables.

The estimated resident population of the Bay of Plenty in 2018 was 305,700, with just under half of that within Tauranga City (StatsNZ, n.d.). About 26% of the Bay of Plenty population identified themselves as Māori in 2013 (Statistics New Zealand, 2015).

In 2013, the primary sector was the fifth largest employer in the region behind retail trade, health/community services, property/business services and manufacturing, employing 10% (or 11,013) of usually resident workers (Statistics New Zealand, 2015). Unemployment in the Bay of Plenty was 3.5% in the second quarter of 2019 (StatsNZ, 2019). The primary sector also has significant indirect and induced impacts on regional employment.

Levels of socio-economic deprivation are generally higher in the eastern Bay of Plenty, although these vary significantly across the region, with some areas of the western Bay of Plenty also being highly deprived.

A balanced and considered approach to water quality improvements

Most people in the Bay of Plenty would probably agree with the objectives that the proposals seek to achieve, i.e. to stop degradation and improve water quality and ecosystem health. However, given the costs of these proposals and their potential socio-economic implications, it is important to consider:

- the extent of proposed water quality improvements and whether they are realistic;
- how they will be achieved (i.e. the effectiveness and efficiency of the proposals); and
- the timeframe for making the required changes.

It is anticipated that the preliminary assessment presented here will help with those considerations.

Part 3: **Assessment of proposals**

A) Dissolved Inorganic Nitrogen (DIN) and Dissolved Reactive Phosphorus (DRP) attributes

Proposal

The Science and Technical Advisory Group (STAG) has proposed two new attribute tables for DIN and DRP, and central government proposes to include these in the NPS-FM. The bottom lines for these two new attribute tables are proposed to be as set out below[6].

Attribute	Median bottom line (mg/L)	95^{th} percentile bottom line (mg/L)
DIN	1	2.05
DRP	0.018	0.054

As with all other attributes in the current NPS-FM, regional councils would be required to set objectives, limits and methods in regional plans (decision version by the end of 2025 (cl. 4.1)) which improve water quality where it is below these national bottom lines, and either maintain or improve where it is above national bottom lines (Subpart 2), unless the Council can demonstrate that the water quality state not meeting national bottom lines is due to naturally occurring processes (cl. 3.23). The timeframes to achieve these objectives are not provided in the NPS-FM; they are to be set in regional plans.

Approach

The implications of this proposal were analysed by identifying the monitoring sites that would fail the proposed new bottom lines. From the sites identified, we excluded sites for which:

- downstream sensitive receiving environments are assumed to be the main drivers of future nutrient reductions in the catchment, rather than the proposed new attributes (i.e. lakes, estuaries or hard-bottom streams likely to support conspicuous periphyton growth); and
- proposed bottom line breaches are likely due to natural conditions (e.g. geothermal activity, permeable volcanic soils, soft volcanic geology, and lack of productive land use or significant point source discharges upstream).

[6] In addition to this, STAG proposed removing the ‘productive class’ option from the current periphyton attribute table and requiring councils to use default nutrient-periphyton criteria, where no robust, locally-suitable and independently peer-reviewed criteria are available. Central Government is not proposing changes to the periphyton attribute table and is proposing to provide these default criteria as guidance only. There are no ‘productive class’ rivers or streams in the Bay of Plenty and BOPRC is developing its own nutrient-periphyton criteria so these proposals would have had no impact in the region.

Bay of Plenty Regional Council has a draft catchment model for the Kaituna-Pongakawa-Waitahanui and Rangitāiki WMAs (Williamson Water & Land Advisory, 2019; Mawer, Loft, Zhao, & Williamson, 2019), summarised by Carter et al. (2019 in prep). The draft catchment model estimates loads and concentration of total nitrogen (TN)[7] and total phosphorus (TP)[8]. These results were further analysed against historical monitoring data in these WMAs to estimate likely DIN and DRP concentrations under different land use and mitigation scenarios. This was achieved by calculating the proportions of DIN:TN and DRP:TP for each monitoring site, using measured data from the same data period as model estimates. Dissolved Inorganic Nitrogen and DRP time series were then created by using the 5th, 50th and 95th percentile proportions for each attribute at each site, and applying those proportions to the modelled TN and TP time series. This was intended to give an indication of the likely ranges of DIN and DRP under different model scenarios.

Assessment

Link between DIN/DRP and ecological health

Ecosystems are complex, there are multiple drivers that influence ecosystem health (e.g. river flow, nutrients, habitat availability/suitability, riparian vegetation degree of sedimentation, water temperature, dissolved oxygen). A range of management activities across different drivers is likely to be required to improve overall ecological health. Nutrients present in the water explain only a small amount of total variability in Macroinvertebrate Community Index scores (an indicator of ecosystem health). Factors such as habitat, land cover, sedimentation and riparian vegetation are also important determinants of ecosystem health (Snelder, Image, & Suren, 2019). Thus, targeting a single driver of ecosystem health (such as a defined nutrient concentration) could be considered over-simplistic and may not achieve the environmental results sought. Ideally, a case-by-case assessment of the key factors behind poor ecosystem health would be required, which may not necessarily be elevated nutrient levels in every case.

Measured data

An assessment of 45 long-term monitoring sites across the region found that 23 of those sites would fail the proposed DRP bottom line and eight sites would fail the proposed DIN bottom line. Twenty-five monitored sites would fail either one or both bottom lines overall, as six sites would fail both.

Bay of Plenty Regional Council has recently become aware of a potential issue with the methodology to assess DRP concentration in the laboratory. Dissolved Reactive Phosphorous results can be inflated if samples have high levels of silica or arsenate (both of volcanic origin) which interfere with the chemical reaction between the reagent and sample. The implication is that some of the elevated DRP results may actually be partly caused by elevated silica or arsenate, so there may actually be less bottom line exceedances than assessed here. The DRP assessment should therefore be considered indicative only and probably a worse-case scenario.

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[7] Total nitrogen (TN) is the total amount of nitrogen present in water and available for plant growth. It includes nitrogen released from decaying plants and animals as well as dissolved inorganic nitrogen (DIN). DIN includes nitrate, ammonia, and other forms of inorganic nitrogen (Parliamentary Commissioner for the Environment, 2012).

[8] TP is a measure of all types of phosphorus present [in water]. It includes the phosphate that is stuck to soil (sediment) [or particulate] as well as DRP which is more readily available for plants. Total Phosphorous is an important measure because most phosphate enters our rivers attached to sediment via run-off. Over time the phosphate that is bound to the sediment dissolves, and becomes available for aquatic plant and algae growth [, as DRP]. This is particularly an issue in slow flowing rivers where the phosphorus bound to sediment can gradually dissolve, feeding aquatic weeds and algae for many years. DRP concentrations are [one of several] indication[s] of a waterbody's ability to support algae and plant growth (LAWA, 2013).

Figure 7 and Figure 8 below show the location of the 45 monitoring sites mentioned above, their assessed DRP and DIN band (with sites that fail the proposed bottom lines highlighted in red) and land use. For the monitoring sites that fail the proposed bottom lines,
Figure 9 and Figure 10 show their assessed median and 95th percentile DRP and DIN concentrations respectively, relative to the proposed bottom lines.

Of the 25 sites that fail at least one of the two proposed bottom lines, five may be affected by the DRP attribute proposal only:

- Rangitāiki WMA:
  - (i) Otamatea at Wairere Road
  - (ii) Rangitāiki at Matahina Dam
  - (iii) Rangitāiki at Inlet to Aniwhenua Canal
- Tarawera WMA:
  - (i) Tarawera at Boyce Park
  - (ii) Tarawera at Awakaponga

The remaining 20 sites are not considered to be affected by the DRP and DIN proposals. At these sites, elevated nutrient levels are most likely due to natural conditions and/or it is assumed that sensitive downstream receiving environments will drive nutrient reductions in the future, to a greater extent (and at a greater cost) than would be required by the proposed attributes. The requirement to take into account receiving environments is already in place under the current NPS-FM so these are not considered costs of the proposal.

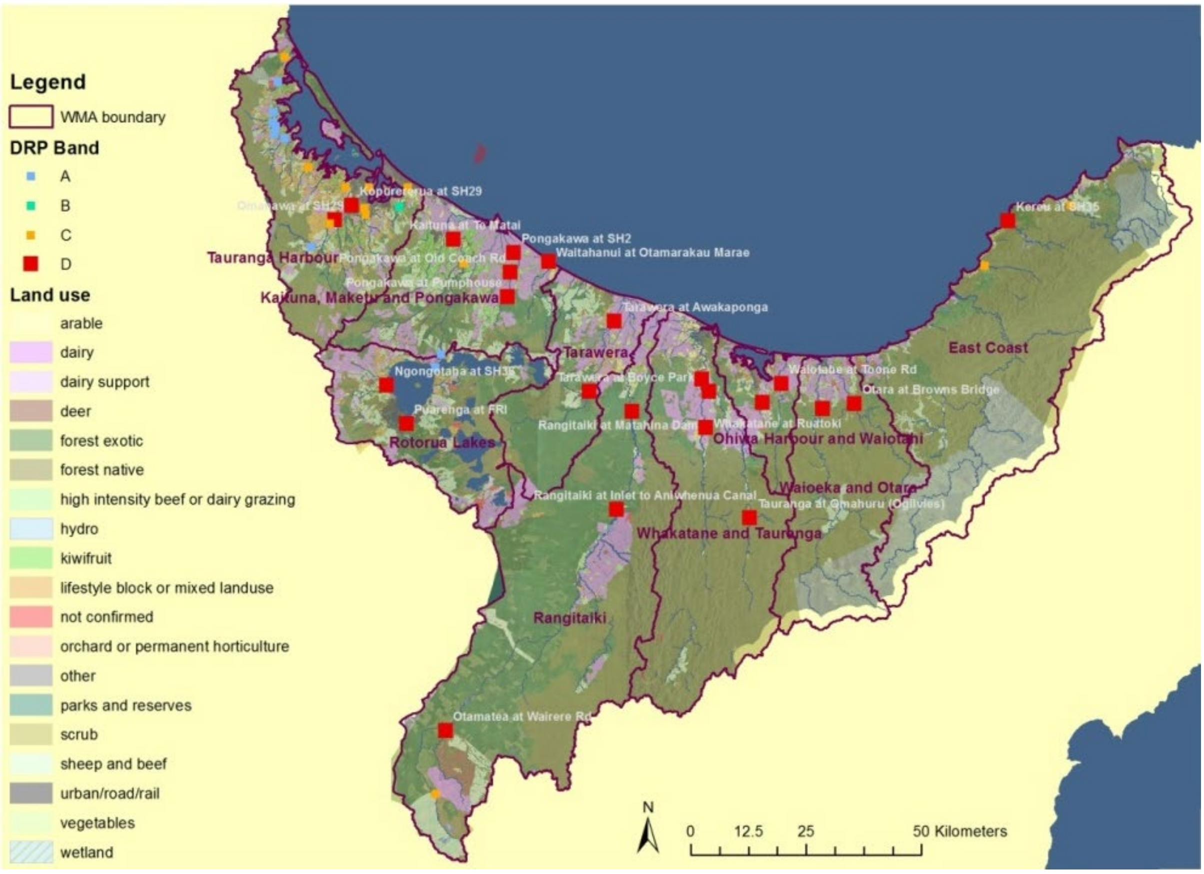

Figure 7 Assessment of monitoring sites against proposed DRP attribute and land use

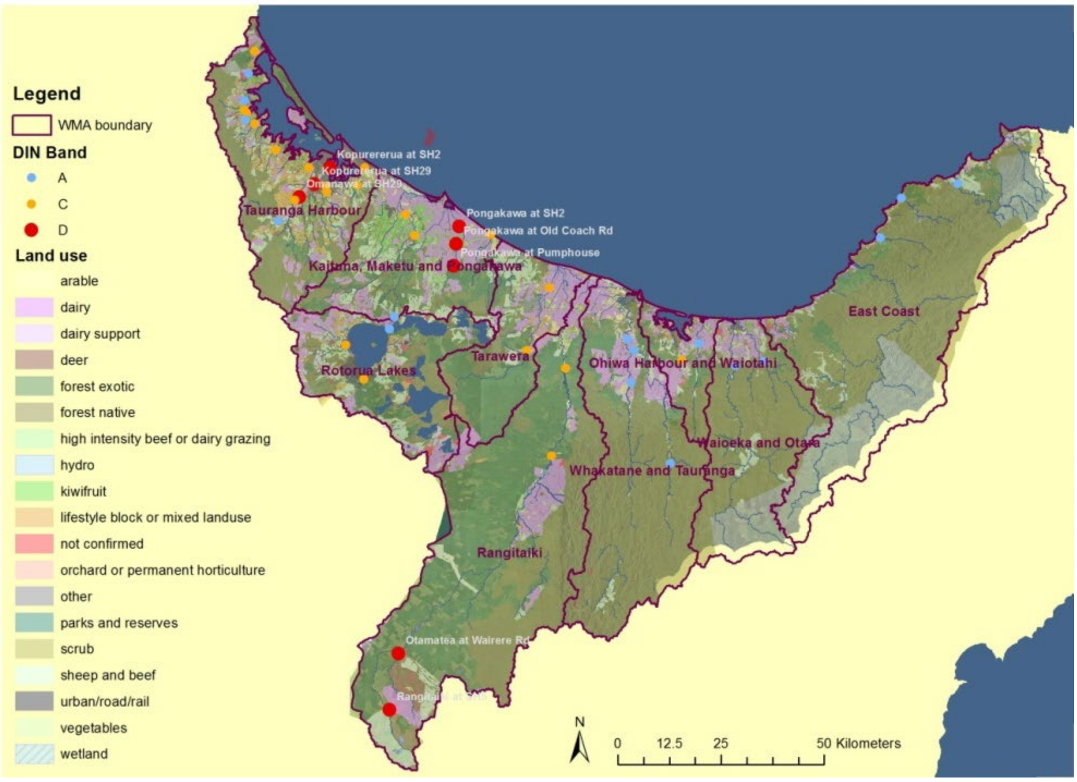

Figure 8 Assessment of monitoring sites against proposed DIN attribute and land use

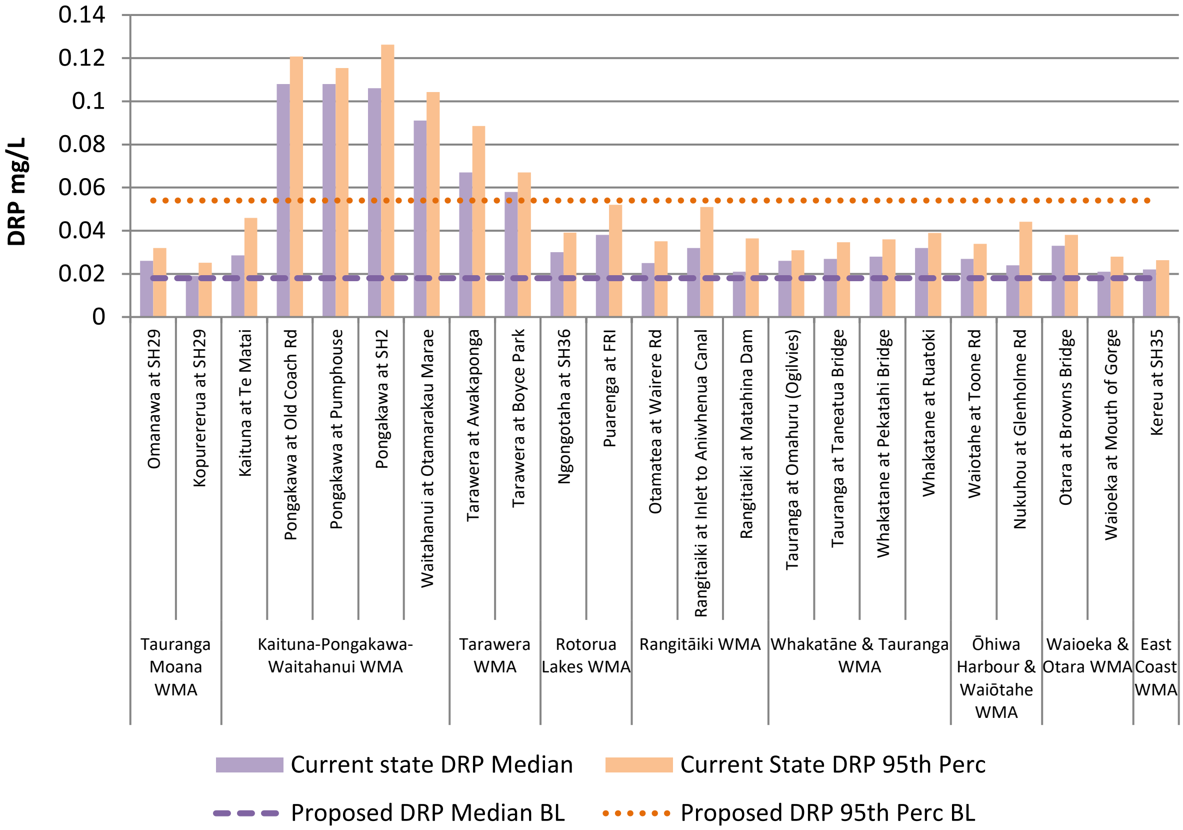

Figure 9 Assessed DRP concentration for sites that fail the proposed DRP bottom lines (BL)

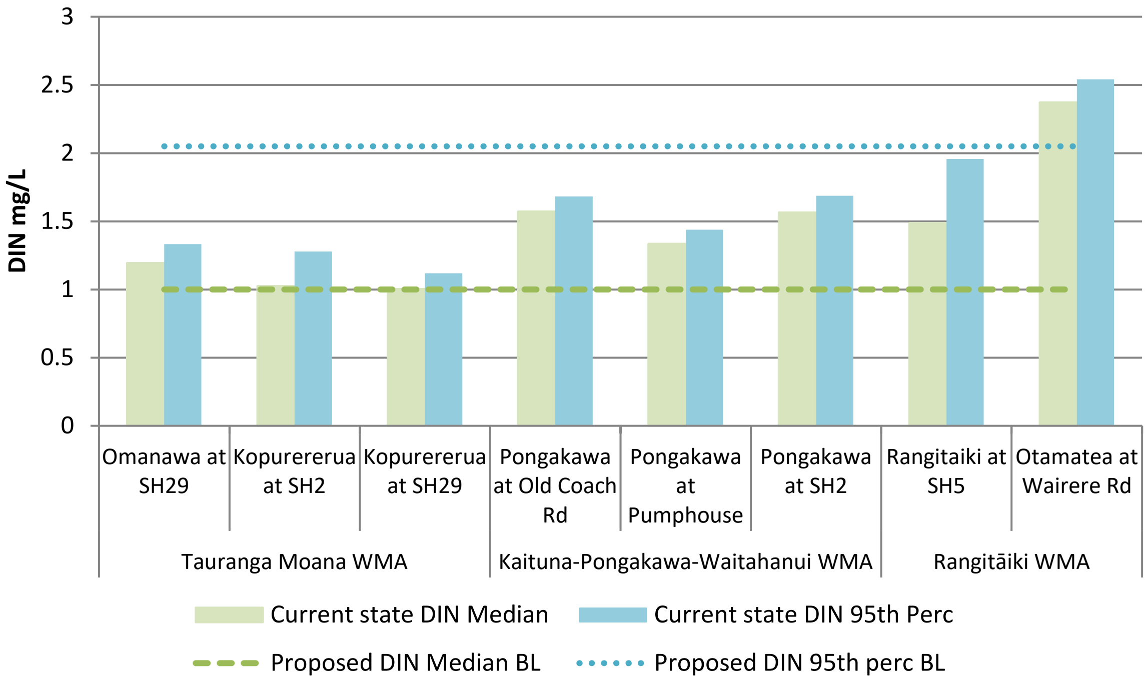

Figure 10 Assessed DIN concentration for sites that fail the proposed DIN bottom lines (BL)

Rangitāiki WMA

The draft catchment model results show that an estimated 94% and 63% of the current TN load at the Rangitāiki State Highway 5 and Otamatea sites, respectively, is from natural processes (Carter, Tingey, & Scholes, 2019 in prep). It is tentatively estimated that even if the entire anthropogenic TN load at these sites is removed (6% and 37% respectively), the sites would be unlikely to meet the proposed DIN bottom line[9].

In contrast, only an estimated 23% of the TP load at the Otamatea site is natural, while an estimated 64% and 67% of the TP load at Aniwhenua and Matahina respectively is natural (Carter, Tingey, & Scholes, 2019 in prep). Nonetheless, it is not possible to categorically say if these sites would meet the proposed DRP bottom line under natural conditions; conservative estimates place these sites in either the C or D bands under natural conditions. It is also tentatively estimated that the land use and mitigation practice changes tested in the draft Rangitāiki WMA catchment model, would be insufficient to meet the proposed DRP bottom lines at the Otamatea and Aniwhenua sites. It is particularly uncertain if those changes would be sufficient to meet the proposed DRP bottom line at the Matahina site, because conservative estimates also place these sites either in the C or D bands under natural conditions.

The cost of mitigation practices for the Rangitāiki WMA evaluated in the catchment model ranged from minimal impact on baseline operating profit for dairy, to about a 10% reduction in baseline operating for drystock (Matheson, Djanibekov, Bird, & Greenhalgh, 2018). The land use change scenarios modelled included conversion to horticulture and additional pastoral land uses in the Kāingaroa Forest, upstream of the affected sites. If meeting the proposed DRP bottom lines were possible, given the contribution of natural processes, the cost and degree of change required by landowners would be greater than the adoption of good management practice (GMP). It would likely require large-scale land use change and it is unlikely that development of the

[9] Estimated from modelled TN from natural state scenario – the likely water quality that would have occurred if the catchment was solely under native vegetation, and deriving DIN using 5th, 50th and 95th proportions of DIN:TN based on nearby measured data.

Kāingaroa Forest (Māori-owned land) would be possible. Further analysis will be required to fully understand the implications of the proposal in the Rangitāiki WMA.

Tarawera WMA

The extent to which natural processes are responsible for the failure of the Tarawera WMA sites to meet the proposed DRP bottom line is unclear. The catchment has a large proportion of permeable soils, volcanic geology and some geothermal activity, and there are also industrial point source discharges (including of geothermal fluid) and areas of productive land use (including dairy, sheep and beef, and exotic forestry) upstream of the monitoring sites. Without a clear understanding of the exact sources of phosphorus in the absence of a catchment model, it is not possible to further assess the implications of the proposed DRP attribute in this WMA.

Other sites

As illustrated in Figure 7 and Figure 8, several sites fail the proposed DRP and DIN bottom lines in the Tauranga Moana, Kaituna-Pongakawa-Waitahanui, Rotorua Lakes and Ōhiwa Harbour and Waiōtahe WMAs. All of these WMAs have downstream sensitive receiving environments, i.e. Tauranga Harbour/Waikareao Estuary, Maketū and Waihī Estuaries, Lake Rotorua, Ōhiwa Harbour and Waiōtahe Estuary. Furthermore, the sites in the Whakatāne and Waiōtahe catchment also have downstream environments that are susceptible to conspicuous periphyton growth. It is assumed that these sensitive receiving environments will be the main drivers of nutrient reductions in the future in these WMAs as the NPS-FM is implemented, and that these reductions will be more significant than those required to meet the proposed DIN and DRP bottom lines.

The Lake Rotorua catchment has rules in place to reduce nitrogen discharges from farming activities into the lake (PC10). It is expected that actions to reduce nitrogen will also have some impact on phosphorus reduction, although this is unlikely to be sufficient on its own to achieve phosphorus objectives for the lake (Donald, Bruere, & Park, 2019). It is assumed that phosphorus limits for the lake under the NPS-FM will eventually create stronger drivers of phosphorus reduction for the river monitoring sites in the lake catchment that were assessed to fail the proposed DRP bottom line.

Under the existing draft catchment model and subsequent analysis, it is anticipated that even if the entire anthropogenic TP load upstream of the Kaituna-Pongakawa-Waitahanui WMA monitoring sites was removed, those sites would still fail the proposed DRP bottom lines. In other words, the DRP bottom line failures in that WMA are due to natural processes. As summarised by Carter et al. (2019 in prep), an estimated 67% of the current TP load at both the Kaituna at Te Matai site and to Waihī Estuary (downstream of the Pongakawa Stream sites) is from natural sources (as opposed to anthropogenic sources, e.g. point source discharges or productive land use). Likewise, an estimated 84% of the current TP load at the lower Waitahanui site is from natural sources.

In terms of nitrogen, the TN load to the Waihī Estuary has to reduce by an estimated 66% to achieve a moderate state of ecological health (Park, 2018; Carter, Tingey, & Scholes, 2019 in prep). The changes required to achieve this reduction are also likely to result in the proposed DIN bottom line being met at the Pongakawa Stream sites. In contrast to TP, only an estimated 17% of the TN load to Waihī Estuary is from natural sources. It is tentatively estimated that a combination of land use change and improved farming practices (or mitigation) would result in the proposed DIN bottom line being met at the Pongakawa catchment sites. However, these changes would be insufficient to achieve a moderate state of ecological health in the estuaries, meaning more stringent nutrient limits would need to be applied to meet estuarine ecological health objectives.

Several of the sites in the eastern part of the region that fail the proposed DRP bottom line have very little productive land use upstream, are mostly downstream of native bush and have no significant upstream point source discharges (Figure 7). This suggests that the current state and DRP bottom line failure is mostly due to natural processes.

Summary and conclusions

The proposed DIN and DRP attributes are unlikely to have a substantial impact in the Bay of Plenty due to many sites having elevated nutrients due to natural causes (and would therefore be exempt from the proposed bottom lines), or downstream sensitive receiving environments driving more significant nutrient reductions. Furthermore, the DIN and DRP proposals may generally not be effective in achieving the ecological benefits sought, because of the range of environmental drivers (i.e. water quantity, habitat, ecological processes and aquatic life) that influence ecological attributes such as macroinvertebrates and fish. This is likely to be the case in other regions too.

Although several monitored sites would fail to meet the proposed bottom lines, relatively stringent nutrient limits are likely to be necessary in many catchments in the region, even in the absence of the DIN and DRP attributes. This is because the ecological health needs of lakes and estuaries will be key determinants of required nutrient reductions.

The proposed DRP attribute may have implications for five monitored sites across the Tarawera and Rangitāiki WMAs, out of 45 monitored sites across the whole region. However, it is possible that these sites would fail the proposed DRP bottom lines even under natural conditions. Further assessment would be required to fully understand the implications of the proposed DRP attribute in these two WMAs.

B) Restrictions on land use intensification

Proposal

Until the NPS-FM has been fully implemented (by the end of 2025 as proposed), the proposal (NES-FW Part 3, Subpart 2) seeks to restrict:

- increases in area of land in irrigated pastoral, arable or horticultural production above 10 ha;
- changes in land use above 10 ha from:
  - (i) arable, deer, sheep or beef to dairy-support
  - (ii) arable, deer, dairy-support, sheep or beef to dairy
  - (iii) 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 did not previously carry out intensive winter grazing, then beyond a minimum threshold.

For any of these activities, a resource consent will only be granted if the activity does not increase nitrogen, phosphorus, sediment or microbial pathogen discharges above the enterprise or property's 2013-18 baseline (average for this period). Consents will also be subject to the applicant supplying a farm plan (as described in Part 3C) for the proposed activity.

Furthermore, the proposal seeks to restrict any land use change to commercial vegetable growing that would increase the applicant's net area of that activity in the freshwater management unit, above their highest extent in 2013-18. The restriction would require either:

- no increase in contaminant (N, P, sediment and microbial pathogen) discharges above the enterprise's 2013-18 baseline (average for this period), to be achieved through a freshwater module in a farm plan; or
- the applicant to operate above GMP, as set out in a freshwater module in a farm plan.

As per all farming proposals in the NES-FW, the proposal would not apply to pastoral and arable farms of less than 20 ha and to horticultural farms of less than 5 ha. It is assumed these thresholds relate to the total area, as opposed to the effective area, of a farm. As described under regional context above, a large proportion of farming properties in the Bay of Plenty would be below these thresholds. Furthermore, it appears the proposal may (inadvertently?) not apply to properties which are currently in exotic forestry either, given the definition of "farm" in Part 3 of the proposed NES-FW. If the proposal did apply to such properties, the requirement would effectively be a moratorium on conversions from forestry to pasture as it is highly unlikely that contaminant losses from pasture would be lower than from forestry.

Approach

In 2017, BOPRC engaged with industry groups, major landowners and community groups to identify major rural land use change patterns in the Kaituna-Pongakawa-Waitahanui and Rangitāiki WMAs (in the context of the current Plan Change for those WMAs). These trends were applied generally across the region in a case study of future water supply and demand (McIndoe & Kashima, 2018). The main rural land use change trend expected in the Bay of Plenty (excluding subdivision into lifestyle blocks and urban growth, and impacts from sea level rise) is conversion to horticulture, mainly kiwifruit and avocado, in suitable areas[10]. In the upper parts of the region's

[10] Suitable areas were generally defined as not overly wet areas, LUC 1-4, less than 15 degree slope, allophanic or pumice soils only, below 250 m above sea level, where current land use is anything other than

catchments, conversions to forestry are also anticipated, but these are not captured by the proposal. Furthermore, in the Rangitāiki WMA, some conversion to horticulture or grazing was expected in a relatively small part of the Kāingaroa Forest, which is currently held in trust by CNI Iwi Land Holdings. However, properties dedicated exclusively to exotic forestry may be excluded from the proposal too, as described above.

To identify the number of properties and areas likely to be captured by the proposal, we have used the same future land use scenarios described above, focusing on likely conversions to horticulture (kiwifruit or avocado) by 2025. Based on that, a broad estimation of likely implications of the proposal by WMA is presented. Costs would include administration (i.e. obtaining a resource consent, including developing a farm plan for the proposed conversion and establishing baseline losses for the property) and assessing yearly contaminant losses (e.g. through an OVERSEER file).

While there could also be some conversions to dairy, dairy support or other pastoral land uses (some have occurred in the region recently), and increases in other irrigated land uses, vegetable growing and forage cropping, these are expected to be rare over the next five years. Agricultural Production Census data indicates that the number of farms engaged in, and area devoted to, commercial vegetable growing in the Bay of Plenty decreased between 2007 and 2017. Likewise, the area of forage cropping harvested in the region decreased between 2012 and 2017. Therefore, no such conversions and other forms of intensification included by the proposal are assumed.

A key element of uncertainty in relation to this proposal is the baseline contaminant losses. Not all properties would have evidence of their contaminant losses over the 2013-18 period. Furthermore, while OVERSEER can estimate base flow losses for nitrogen and phosphorus, there are currently no equivalent tools to accurately estimate sediment and microbial pathogen discharges at a property level, or surface flow losses generally. Likewise, even if there are accurate OVERSEER files (for N and P) for existing pastoral land, there currently are no robust tools to predict nutrient losses from fruit crops, the main expected 'new' rural land use in the Bay of Plenty. This will present significant challenges to the effective implementation of this proposal and may prevent large conversions to irrigated horticulture.

Assessment

Across the whole region, an estimated 44,100 ha (or about 3.7% of the region) and more than 2,000 properties would be viable for conversion, mainly from pasture, to horticulture, as described above. When the NES-FW size thresholds (i.e. >20 ha pastoral and arable properties, and >10 ha conversions) are applied, the extent of potential land use change covered by the proposal is reduced to 37,235 ha across 765 properties. It is assumed only a quarter of that growth would occur over the next five years, or would actually be irrigated. Based on that assumption, the estimated distribution of conversions to irrigated horticulture by WMA potentially affected by the proposal is summarised in Table 1 below.

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lifestyle block, orchard or permanent horticulture, kiwifruit, native forest, exotic forest, water, parks and reserves, urban/road/rail, wetland and outside of DOC land, QEII covenant areas and urban growth limits. Viable conversions are assumed to be those of at least 1 ha per property.

Table 1 Estimate of irrigated horticulture conversions by 2025 within proposed NES-FW size thresholds by WMA (assuming 25% of convertible area within size thresholds would actually convert by 2025)

Water Management Area	Number of properties with suitable land above size threshold	Convertible area above size threshold (ha)
Tauranga Moana	26	985
Kaituna-Pongakawa-Waitahanui	46	2,142
Tarawera	10	390
Rangitāiki	46	2,907
Waioeka and Otara	8	263
Whakatāne & Tauranga	27	1,414
Ōhiwa Harbour and Waiōtahe	12	549
East Coast	17	659
Total	**192**	**9,309**

Assuming an administrative cost of $7,000 per property to obtain a resource consent[11], total administrative costs of the proposal could add up to $1.3m by 2025.

If the proposal would in fact prevent those conversions from occurring due to the lack of evidence of baseline and expected future contaminant losses, there would be significant short term costs in lost employment opportunities and economic growth for the region. As reported by Matheson et al. (2018), the estimated annual per hectare baseline operating profit for kiwifruit was assessed to be $19,500 for green and $78,400 for gold, much higher than for pastoral and arable land uses. For dairy the estimate ranged from $1,115 to $2,582, for drystock from $133 to $421 and for arable it was $2,345[12]. Most of the area expected to convert to horticulture is currently in these land uses.

In the short term, the proposal could also affect land values by making smaller properties, which would be exempt from the proposal, more attractive to potential investors and larger properties less attractive.

It is assumed that no intensification, as defined in the proposal, would occur in the Rotorua Lakes WMA. McIndoe & Kashima (2018) describe why there is a low likelihood of intensification occurring in most of the Rotorua Lakes WMA:

Under (…) the [Bay of Plenty Natural Resource Plan], development in the catchments of Lakes Ōkāreka, Rotoehu, Ōkaro, Rotorua and Rotoiti is restricted to activities that do not increase the annual average export of nitrogen or phosphorus from the property compared to the property benchmark. In practice this restricts the conversion of land from forestry to pastoral farming or horticulture, from sheep and beef farming to dairying, or intensification of dairying.

Plan Change 10 further restricts development in the Lake Rotorua groundwater catchment by requiring a reduction in the catchment load to 435 t of nitrogen per annum (tN/yr) from 755 tN/yr (values based on OVERSEER 5.4). Generally, under the rules, existing activities will need to reduce in intensity and there is limited ability to develop underutilised land unless nitrogen discharge allocations are purchased.

Furthermore, the water quality policies in the Regional Policy Statement (RPS) identify the above 12 lakes as catchments at risk and require the establishment of contaminant limits within those catchments. It is

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[11] Including consent processing, development of farm plan and assessment of baseline and future contaminant losses.

[12] Currently, dry stock and kiwifruit profits would be higher, but the overall relativities remain unchanged (L. Matheson, pers. comm.).

anticipated, at this time, that the RPS water quality policies will be included in the Rotorua Lakes WMA limit-setting process.

Land use intensification in [this part of] the Rotorua Lakes area would be significantly restricted by all of these water quality provisions.

While intensification and land use change could theoretically occur under existing regional rules in the catchments of other Rotorua Lakes (i.e. Rerewhakaaitu, Rotomahana, Tarawera, Rotokakahi, Tikitapu, Tarawera, Ōkataina and Rotomā), the area available for land use change in these catchments is limited. Furthermore, conversions from forestry to any pastoral land use in the Lake Rotorua catchment are not currently considered to be financially viable[13], therefore it is likely they would not be financially viable in the catchments of other Rotorua Lakes either.

Summary and conclusions

There are likely to be few, if any, high risk land use change conversions in the Bay of Plenty by 2025. On the other hand, the predominant type of land use change occurring in the Bay of Plenty, and likely to be affected by the proposal by 2025, are conversions from pasture and arable to irrigated horticulture (particularly kiwifruit and avocado). The lack of available tools to determine contaminant losses for horticulture at a property scale could present significant impediments to this land use change trend. Despite the lack of these tools, it is generally expected that contaminant losses from fruit crops would be lower than from alternative land uses, if operating under GMP. Possible exceptions to this are sediment losses from contouring during the early stages of kiwifruit development, and other contaminants not included in the proposal (e.g. heavy metals, agri-chemicals). While unirrigated and smaller irrigated horticulture conversions would still be able to occur, the proposal could compromise significant environmental and socio-economic benefits associated with larger irrigated horticulture conversions in the short term, if these would be prevented. The scale of these would be much larger than any administrative costs (estimated at $1.3m by 2025) associated with the proposal.

[13] CNI Iwi Land Management Ltd, Māori Trustee, Federated Farmers of New Zealand v BOPRC [2019] NZEnv C 136, paragraphs 225 and 318(f)

C) Farm planning

Proposal

The proposal (NES-FW, Part 3, Subpart 3) would require farmers to have a farm plan with a freshwater module by 2025 (and by 2022 in the Upper Rangitāiki sub-catchment or if engaged in commercial vegetable production). Importantly, the actions a farmer commits to in the farm plan are not subject to the same timelines. These can be reasonably spread over time. Timing is likely to be revisited as measurable objectives, targets and timeframes are set in regional plans.

The farm plan would identify waterbodies, critical source areas, erosion-prone areas, and other risks (e.g. irrigation, fertiliser application, effluent, winter grazing, stock holding, etc.) to waterbodies. For these areas and risks, it would set out a schedule of actions to manage risk. Plans would need to be developed by a qualified farm planner, independently audited and progress reports submitted to the Regional Council. It is envisaged that the requirement for farm plans would be phased in, with higher risk activities and catchments under more pressure being prioritised. It is also assumed that farm plans will at least identify and require GMP, with implementation being enforceable by the Regional Council.

Like all farming proposals under the proposed NES-FW, this proposal would only apply to pastoral and arable farms of 20 ha or more and horticultural farms of 5 ha or more. It is assumed these thresholds relate to the total area, as opposed to the effective area, of a farm. As described under regional context above, a large proportion of farming properties in the Bay of Plenty would be below these thresholds, and therefore exempt from this requirement.

Approach

The assessment is based on 2017 APC data (for number of farms by farm type and size) for the region (StatsNZ, 2018), and GIS datasets of land use and property boundaries. The APC also has information about the number of existing nutrient planning documents (i.e. nutrient budgets, Good Agricultural Practice, Nutrient Management Plans and other nutrient planning documents), which are assumed to partially fulfil the requirements of a farm plan under this proposal.

We have estimated the number of new farm plans required by land use. The estimated costs of developing, certifying, auditing and implementing farms plans are expressed in terms of changes to operating profit. This includes the cost of extending any existing or expected currently required farm nutrient planning documents to fulfil the requirements of the proposal.

Development/certification and auditing costs are assumed to be $3,500 (one-off) and $1,750 every year per farm plan respectively[14]. The costs are assumed to be 50% less when a farmer already has an existing nutrient management document.

It is assumed that farm plans will require "Good Management Practice", defined as the M1 mitigation bundle in Matheson et al. (2018) and summarised in Appendix 2, except for stock exclusion and riparian buffers/setbacks as those are evaluated separately under Part 3E. Furthermore, for drystock (deer, sheep and beef, and dairy support), practices only up to M1.9 are considered given the relatively high cost of other practices within that mitigation bundle. Most mitigation practices require a more efficient use of inputs, less intensity and could generally be considered expected levels of practice.

The characterisation of mitigation costs was assessed for 13 different "average" farming and growing systems across the Kaituna-Pongakawa-Waitahanui and Rangitāiki WMAs (Matheson,

[14] A cost of between $5,000 and $7,000 is realistic to develop a farm plan from scratch (L. Matheson, pers. comm.). The lower cost of $3,500 is assumed on the basis that industry groups and/or the Regional Council would be expected to provide support for plan development (e.g. through a template and guidance).

Djanibekov, Bird, & Greenhalgh, 2018). In the absence of a similar characterisation for other parts of the region, this analysis was used for the rest of the region in the following assessment. The analysis should therefore be considered only indicative.

Assessment

Overall, the cost of farm plans (including development, auditing and GMP implementation) is estimated to result in a 5% reduction in annual operating profit across all affected land uses in the region, from $764m to $726m (Table 2). The biggest impact would be on drystock farmers (18% drop in overall operating profit, ranging from 8% to 24% for different farm systems). The least impact would be on kiwifruit growers (4% overall drop, 2% for gold, 8% for green) due largely to their much larger baseline profits relative to other land uses. Dairy farming would see an overall 5% drop in operating profit, although this would range from virtually no impact for more intensive farming systems to an 18% reduction for less intensive systems. These estimates do not take into account the costs of servicing debt, which would vary for individual landowners and would exacerbate impacts.

Impacts will vary by land use and for individual landowners, although the main cost to implement GMPs can be spread across a reasonable timeframe. The impact would potentially be significant for drystock farmers and less intensive dairy farmers.

In reality, farm plans will tailor mitigation practices to individual properties, taking into account specific property characteristics, circumstances and risks. They will encourage farmers to actively consider and manage risks, promoting voluntary behaviour change. If linked to a requirement to prepare and report an audited OVERSEER file (or other assessment of contaminant losses), farm plans will generate important baseline information. This information is currently either unavailable (e.g. nutrient losses from horticulture, baseline farming practices) or inaccessible (e.g. Fonterra-managed OVERSEER files for dairy farms). The main exception to this is properties in most of the Rotorua Lakes catchments, which are currently required to maintain accessible OVERSEER files. By tailoring mitigation practices, farm plans are also likely to maximise environmental benefits and minimise costs. The cost estimate presented here is therefore likely an overestimate.

Figure 11 illustrates the impact of the mitigation practices (listed in Appendix 2) on nitrogen and phosphorus base flow losses (Matheson, Djanibekov, Bird, & Greenhalgh, 2018). This scale of change in contaminant losses, plus reductions in sediment and pathogens which were not assessed, is likely to be achievable through the adoption of GMPs, through farm plans. When applied in the Kaituna-Pongakawa-Waitahanui and Rangitāiki WMA draft catchment model (Carter, Tingey, & Scholes, 2019 in prep), these mitigation practices led to reductions in contaminant loads to receiving environments, as summarised in Table 3, and a general improvement in water quality in relation to *E. coli* concentrations. The draft model results also showed that these reductions would be insufficient to achieve moderate states of ecological health in the Maketū and Waihī estuaries, suggesting that either more stringent mitigation and/or land use change would be required.

Table 2 Summary assessment of implications of developing, auditing and implementing Farms Plans in the Bay of Plenty region

Land use	Total number of farming businesses	Total area (ha)	Estimated number of farming businesses within size thresholds	Estimated total area within size thresholds (ha)	Estimated total effective area within size thresholds (ha)	Assumed number of existing nutrient management documents	Baseline EBIT/ha/year	Post-mitigation EBIT/ha	Mitigation cost/ha/year	Estimated Baseline profit/year	Farm Plan development/auditing costs per year	Estimated Farm Plan implementation costs/year	Estimated profit after mitigation/year
Kiwifruit	1,452	16,057	884	13,595	10,876	884				$ 500.1m	-$ 0.77m	-$ 19m	$ 481m
Green		*10,745*	*592*	*9,097*	*7,278*	*592*	*$19,500*	*$ 17,608*	*-$ 1,892*	*$ 167.6m*	*-$ 0.52m*	*-$ 13m*	*$ 154.2m*
Gold & other		*5,312*	*292*	*4,498*	*3,598*	*292*	*$78,400*	*$ 76,533*	*-$ 1,867*	*$ 333.2m*	*-$ 0.26m*	*-$ 6m*	*$ 326.7m*
Other horticulture	845	3,735	316	2,338	1,871	313	$19,500	$ 17,608	-$ 1,892	$ 58.2m	-$ 1.2m	-$ 5m	$ 51,7m
Sheep & beef	990	96,508	479	85,621	68,497	120	$133-$421	$109-$396	-$20 - -$25	$ 13.9m	-$ 0.7m	-$1.7m	$ 11.4m
Arable/grain growing	50	8,037	50	4,192	3,354	12	$ 2,345	$2,192	-$ 153	$ 15.1m	-$ 76,125	-$ 0.95m	$ 14m
Dairy	639	119,426	605	111,856	89,485	303	$1,115-$2,582	$955-$2,532	-$418 - $20	$ 175m	-$ 0.79m	-$ 7.83m	$ 166.4m
Deer	48	6,801	46	6,554	5,243	12	$ 229	$ 206	-$ 23	$ 1.2m	-$ 70,000	-$ 0.1m	$ 1m
Total	**4,024**	**250,565**	**2,379**	**224,157**	**179,326**	**1,632**				**$ 764.3m**	**-$ 3.6m**	**-$ 35m**	**$ 725.6m**

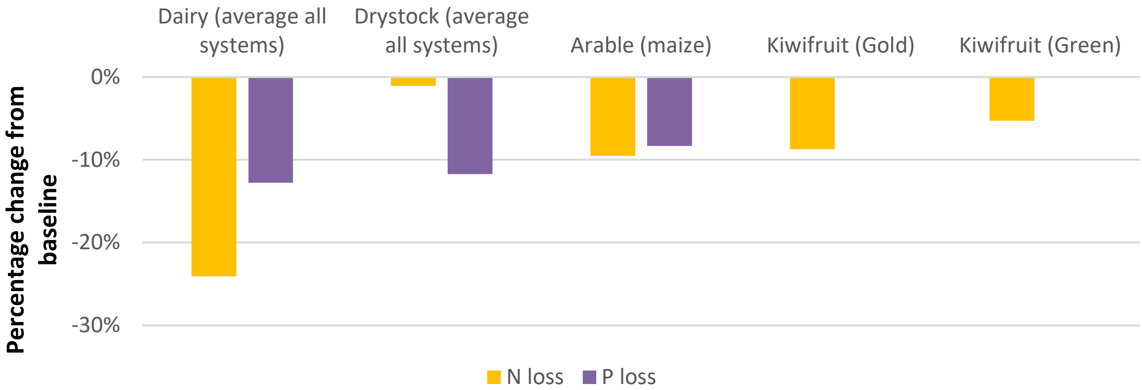

Figure 11 Impact on N and P losses from mitigation practices likely to be required under farm plans (Source: Matheson et al 2018)

Table 3 Estimated change in contaminant load to receiving environments in the Kaituna-Pongakawa-Waitahanui and Rangitāiki WMAs draft catchment model from application of mitigation practices (Source: Carter et al, 2019 in prep)

	Total nitrogen	Total phosphorus	Total Suspended Solids
Maketū Estuary	-8%	-7%	-1%
Waihī Estuary	-11%	-9%	-2%
Lake Matahina	-4%	-2%	0%

Based on BOPRC's experience with Plan Change 10 (Lake Rotorua), it is assumed that a qualified farm planner (FTE) could deliver about 40 farm plans per year, if that is the only thing they did. It would therefore take about 12 qualified full-time farm planners to deliver the estimated 2,379 farm plans required across the region by 2025. This assumes that less work would be required where nutrient management documents are already in place, that all necessary information would be readily available and that farm planners will also undertake some certification and auditing roles. However, most farm planners also undertake other activities and are unlikely to be dedicated only to developing, certifying and auditing farm plans. It is also unlikely that all necessary information would be readily available.

Capacity constraints have already been identified in relation to delivering Nutrient Management Plans under Plan Change 10 for Lake Rotorua, and in relation to delivering farm plans under Waikato's Plan Change 1[15]. Therefore, it is uncertain if it would be possible to deliver this number of farm plans by 2025 with currently available capacity. An increase in the availability of qualified Farm Planners, prioritisation of land uses, contaminants or areas, and possibly an extension of the timeframe, will be required.

An increasing demand for Farm Planners around the country as a result of this proposal could lead to increased costs for landowners, if that increased demand is not matched by increased supply, particularly if timeframes are tight. Likewise, there is a risk that the quality of farms plans and audits may be compromised if Farm Planners are under pressure to complete large backlogs of farm plans and audits in a short timeframe.

[15] Statement of primary evidence of Lee Antony Matheson, on behalf of NZIPIM – Waikato Branch, to the hearing on Waikato Regional Council's proposed Plan Change 1 (Waikato and Waipa catchments – Healthy Rivers).

Summary and conclusions

Significant benefits are expected to be achieved from farm plans including tailored mitigation practices which will result in better environmental outcomes, and in some cases also improved farm financial performance. They will also generate important baseline information in terms of contaminant losses and farming practices. The costs of developing farm plans by 2025, and auditing them once in place, are generally not major, relative to baseline operating profits of affected land uses and expected benefits (although this will vary for individuals). The main cost will be in implementing plans, which are assumed to require GMPs. However, these costs can be spread over a longer timeframe. The capacity of qualified Farm Planners to deliver farm plans by 2025 could be an issue.

Despite the capacity issue, consideration should be given to extending the farm planning proposal to farms below the NES-FW size thresholds, even if it is under a longer timeframe.

D) Management of nitrogen in catchments with high nitrate-nitrogen levels: Upper Rangitāiki, upstream of confluence with Otangimoana Stream

Proposal

Three options are proposed (NES-FW, Part 3, Subpart 4):

1) a percentile-based nitrogen cap in identified catchments, taking into account land use, soil type and climate differences;
2) a national nitrogen fertiliser cap, with more stringent provisions for identified catchments; or
3) a requirement for farmers in identified catchments to show how they will reduce nitrogen leaching and auditing their progress through farm plans.

Like all farming-related proposals in the proposed NES-FW, this proposal applies only to pastoral and arable farms of 20 ha or more and horticultural farms of 5 ha or more. It is assumed these thresholds relate to the total area as opposed to the effective area of a farm.

Option 1 would apply only to low-slope (average slope of less than 5 degrees, 7 degrees or 10 degrees at parcel level) pastoral farms. All relevant farms would be required to submit an audited OVERSEER nitrogen loss figure to the Regional Council. The threshold will be set at the 70^{th}, 75^{th} or 90^{th} percentile of nitrogen loss for each land use, taking into account soil and climatic differences.

Identified catchments are those in the highest 10% of nitrate-nitrogen concentration of monitored sites nationally and where no NPS-FM rules currently apply. The Upper Rangitāiki, upstream of the confluence with the Otangimoana Stream, is the only identified catchment in the Bay of Plenty. However, based on the draft Rangitāiki WMA catchment model, 77% of the cumulative TN load of the Rangitāiki River at the confluence with the Otangimoana Stream is estimated to be due to natural causes (Carter, Tingey, & Scholes, 2019 in prep). This is likely due largely to the prevalence of pumice soils in the sub-catchment. It is unclear whether natural background nitrogen loads were considered in the selection of proposed identified catchments[16].

Approach

The assessment focuses on Options 1 and 3. Option 2 is not specific enough to assess (e.g. what would the cap be?) and we have no baseline information on fertiliser use in the identified catchment, or means of assessing the impact of reduced fertiliser use. However, efficient fertiliser use practices are considered within the GMP mitigation measures described below.

The identified catchment was mapped and affected properties identified. In the context of PC12, BOPRC previously commissioned Perrin Ag Consultants and Landcare Research to characterise farming systems and mitigation practices in the Rangitāiki WMA (Matheson, Djanibekov, Bird, & Greenhalgh, 2018). For sheep and beef, and deer, these characterisations were mainly based on current farming practices in the identified sub-catchment[17].

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[16] The upper Rangitāiki is also one of BOPRC's focus catchments, prioritised for land management intervention due to a trend of increasing nitrogen levels in recent years.

[17] There is no available characterisation for dairy or dairy support farms for this sub-catchment. Consequently, the characterisations for a Galatea unirrigated dairy farm and a Kaituna-Pongakawa-

In the absence of baseline nitrogen leaching information by property (to assess Option 1) or an indication of the extent of nutrient loss required (to assess Option 3), we describe the mitigation practices characterised by Matheson et al. (2018) and the implications these would have on nitrogen losses and sub-catchment profit. For Option 3, it is assumed that the cost of developing, auditing and implementing farm plans is already covered under the farm planning proposal discussed in Part 3C, if affected properties did not already have a farm plan. An additional cost under either option would be developing and auditing an OVERSEER file every year, again if affected properties were not already doing this.

Assessment

Sub-catchment and affected landowners

The identified sub-catchment (Figure 12) covers an area of 42,911 ha (equivalent to about 14.5% of the Rangitāiki WMA or 3.2% of the Bay of Plenty region). As summarised in Figure 13, 47% of the sub-catchment is in pasture (26% sheep and beef, 11% deer, 7% dairy support and 3% dairy), with the remainder in exotic forestry (38%), native forestry (13%) and a range of other land uses (3%). The predominant soil types in the identified sub-catchment, as in the wider Rangitāiki WMA, are pumice soils.

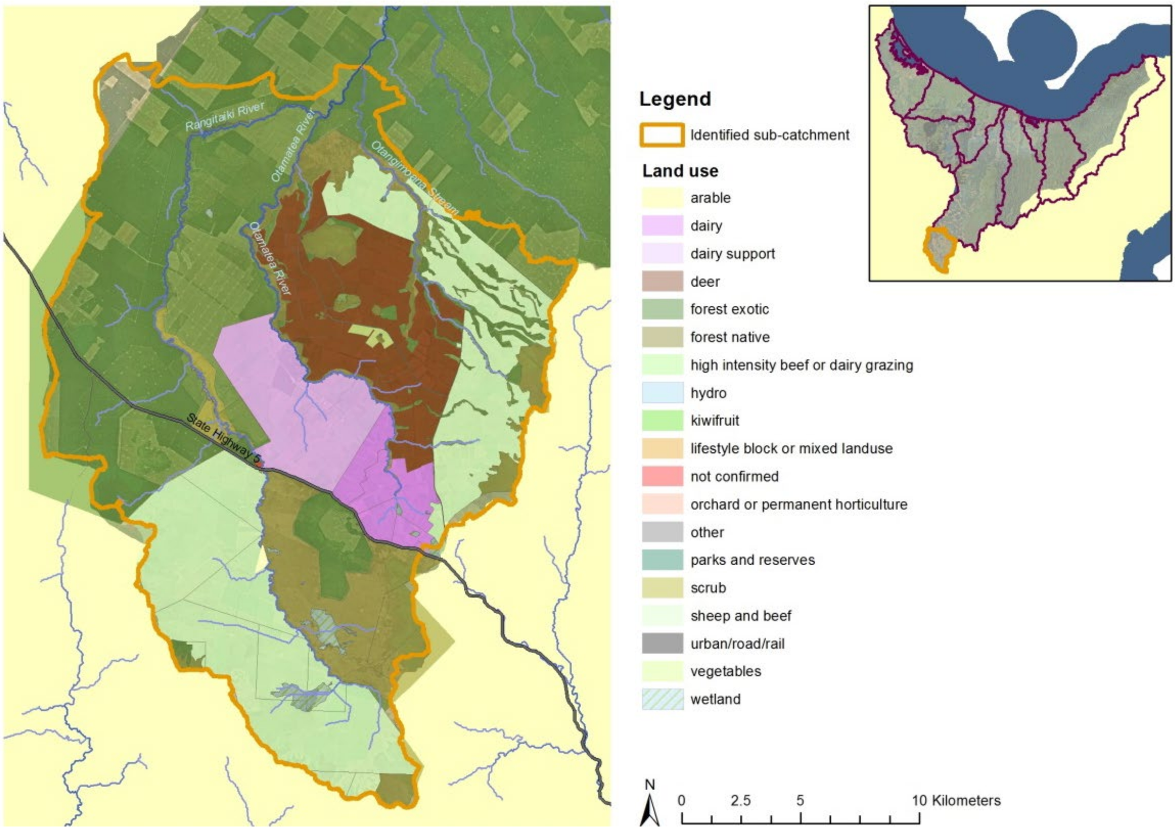

Figure 12 Identified sub-catchment: Upper Rangitāiki, upstream of confluence with Otangimoana Stream

Waitahanui WMA dairy support farm were used for this analysis. Dairy farms in this sub-catchment are quite different to those in Galatea so the analysis should be considered indicative only.

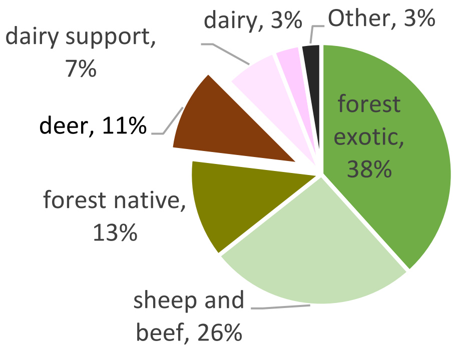

Figure 13 Identified sub-catchment, land use distribution

Options 1 and 3 would affect up to five landowners. The largest of these are Landcorp Farming (Rangitāiki Station, 9,674 ha) and Lochinver Farms (Lochinver Station, 13,726 ha, of which only 10,456 ha are in the identified sub-catchment and Bay of Plenty region) (Figure 14). Rangitāiki Station has deer, sheep and high intensity beef finishing, with a small area dedicated to potatoes and some forestry (exotic and native). Bay of Plenty Regional Council understands that there has been some intensification at Rangitāiki Station in recent years. Lochinver Station runs sheep and beef south of State Highway 5, and dairy support (including grazing for dairy heifers for export) and some exotic forestry north of State Highway 5. Bay of Plenty Regional Council understands that planned changes to farming operations at Lochinver Station will not result in intensification (M. Kapa, pers. comm.). The ecologically significant wetland complex around Lake Pouarua is in the middle of the sheep and beef section of Lochinver Station.

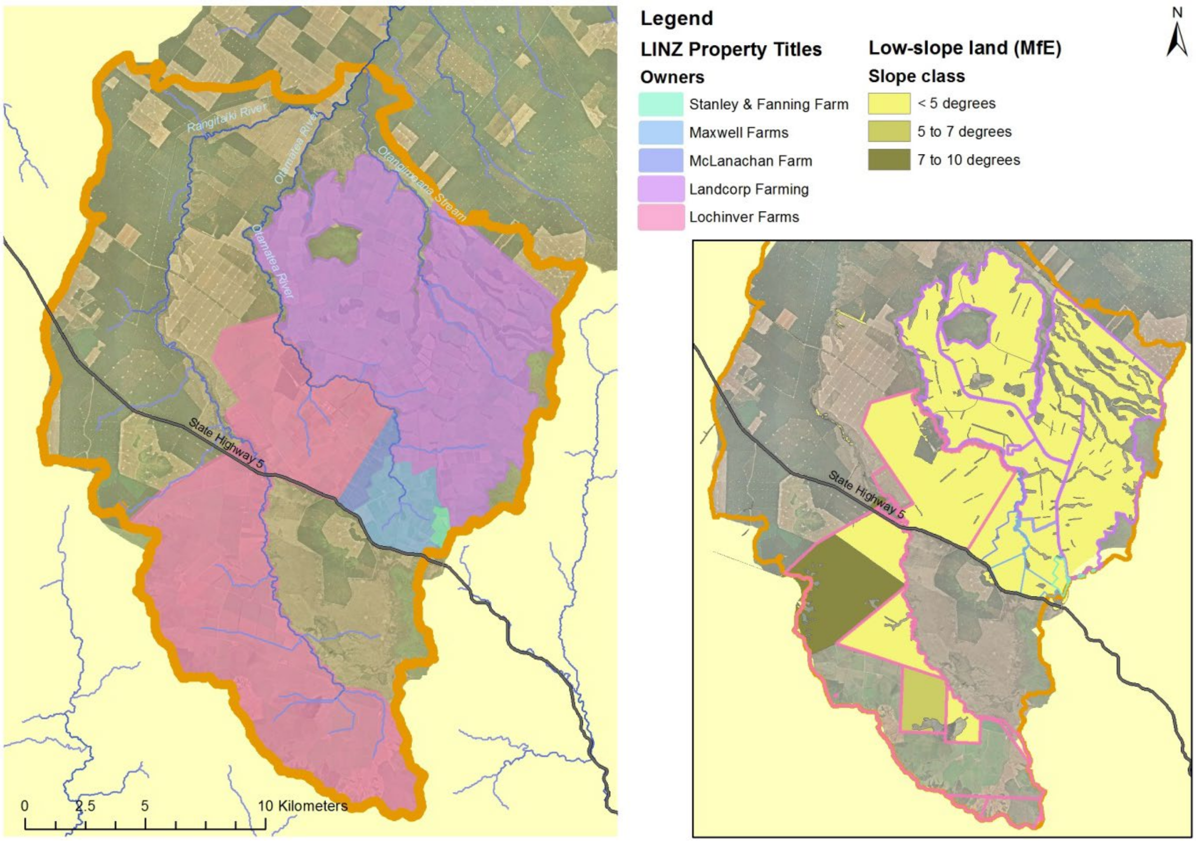

Figure 14 Identified sub-catchment, land ownership and slope class

Three other much smaller farms (1,481 ha in total) north of State Highway 5 would also be affected by Options 1 and 3; two of these are dairy farms and one is a sheep and beef farm. One of these farms (Stanley & Fanning) is only partially within the identified sub-catchment (and the Bay of Plenty region). There is also an additional smaller sheep and beef farm north of State Highway 5 but it is below the 20 ha threshold, therefore it is assumed to not be affected by the proposal.

The map on the right in Figure 14 shows the Ministry for the Environment's low-slope land classification for the sub-catchment. This shows that all properties north of State Highway 5 (Rangitāiki Station, northern part of Lochinver Station and the three smaller farms) are in the <5 degrees slope class, and are therefore captured by Option 1. The southern part of Lochinver Station (south of State Highway 5) has parcels that fall within each of the three different low-slope classes, and outside of the low-slope category. Therefore, it is unclear from the proposal whether Lochinver Station overall would be captured by Option 1, given that farms operate as entire units rather than by parcel. For the purpose of this assessment, it is assumed all five properties are captured by the proposal.

Aside from this ambiguity regarding the application of Option 1, it is worth considering some other practical challenges with implementation of Option 1 in particular. One aspect is the small number of landowners affected, and the difference between the large stations and the smaller farms. This means that for some of the pastoral land uses (i.e. deer, dairy support, and high intensity beef) there is only one landowner for each so it would not be possible to calculate a percentile of nitrogen leaching (at least not one that would be different to their own). There are two landowners in dairy, and three in sheep and beef (assuming Lochinver Station is indeed captured by Option 1). While it is theoretically possible to calculate a percentile across these, the impact of one property's leaching on the others will be significant. Although the Upper Rangitāiki is the sixth largest identified catchment (in terms of overall area), it has significantly fewer landowners than most other identified catchments and is less than a third of the size of the next largest identified catchment. Furthermore, the fact that two properties are partly outside the sub-catchment and the region may also present some implementation challenges.

Cost of reducing nitrogen losses

Figure 15 summarises the outputs of the characterisation of farming systems and mitigation practices relevant to this sub-catchment (Matheson, Djanibekov, Bird, & Greenhalgh, 2018). The mitigation practices modelled are listed in Appendix 2. As noted above, the characterisation of sheep and beef, and deer farming systems is based mainly on the operation of farming systems in this sub-catchment. The analysis assumes no baseline adoption of mitigation practices. In reality, it is likely that all landowners have already adopted at least some of the mitigation practices modelled. For example, feedback from Landcorp indicates that many of the mitigation practices modelled are already adopted within Rangitāiki Station (C. Bunny, pers. comm., 18 February 2019). The implication is that costs and nitrogen reductions are likely to be lower than shown here.

Figure 15 shows that the gains able to be achieved in terms of N loss reductions for drystock are marginal and come at a relatively significant cost. Although there is no available characterisation for dairy farms in this sub-catchment, they are likely to be less profitable than other dairy systems described in Matheson et al (2018) and the cost of N reductions are likely to be higher, although baseline N losses are likely to be lower. If we extrapolate these mitigation costs across the sub-catchment, the baseline sub-catchment profit for the affected land uses would decrease by 23% from $5.5m to $4.3m per year. These costs would be included within those described in Part 3C, for which the same mitigation practices are assumed.

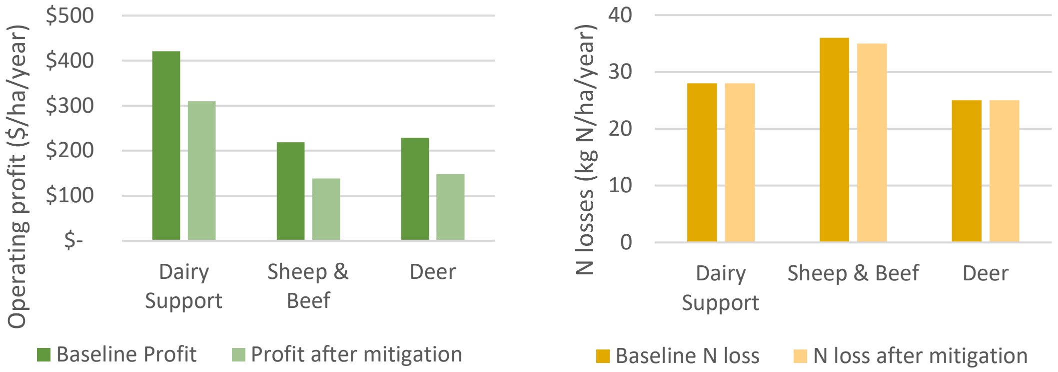

Figure 15 Profit and N losses under before and after mitigation practices for drystock (Source: Matheson et al 2018)

These mitigation practices were evaluated through the draft Rangitāiki WMA catchment model, taking into account assumptions about baseline mitigation uptake (Carter, Tingey, & Scholes, 2019 in prep). The preliminary results of the model indicate that the total cumulative TN load at the confluence of the Rangitāiki River and Otangimoana Stream can reduce by 4%, from 483 to 463 t per year. It is important to bear in mind that, as noted above, 77% of the current TN load at that point is estimated to be natural.

There will also be some smaller administration costs for landowners (relative to mitigation costs) to get farm plans (under Option 3, but as noted above these are the same as those required under the farm planning proposal discussed in Part 3C) and audited OVERSEER files if they don't already have these[18]. Bay of Plenty Regional Council understands that Rangitāiki Station, Lochinver Station and at least one of the smaller dairy farms already have farm plans, although it is uncertain if these would meet the requirements of the farm planning proposal. Dairy farmers also generally have OVERSEER files as part of their Fonterra supply requirements. However, it is unlikely that these would fully meet the requirements of the proposal.

Summary and conclusions

The basis for selecting the Upper Rangitāiki as a national priority catchment seems questionable. There are other catchments in the Bay of Plenty that would have been considered more heavily impacted by nitrogen, if natural nitrogen levels and receiving environments were taken into account. Because of the very few landowners affected in the Upper Rangitāiki sub-catchment, practical implementation of Option 1 could be challenging.

It is estimated that TN load in the sub-catchment could reduce by 4% through application of GMPs. However, this would lead to an estimated 23% reduction in sub-catchment operating profit per annum.

[18] The discussion document assumes a cost of $3,500 per farm for developing a Farm Plan, plus $1,500 every two years for auditing. Cost of developing and auditing an OVERSEER file would be between $500 and $3,000 per year, depending on the quality and completeness of source information (L. Matheson, pers. comm.).

E) Stock exclusion

Proposal

The proposal (s. 360 regulations), summarised in Table 4Table 4 below, would require general exclusion from waterbodies over a metre wide on 'low-slope land' and on steeper areas with a high stocking rate carrying capacity. 'Low-slope land' has been mapped at a parcel level, where the average slope is <5°, <7° or <10°. The proposal would also require stock exclusion practices from smaller waterbodies and drains to be specified within farm plans. The proposal only applies to dairy cattle, dairy support cattle, beef cattle, pigs and deer. Sheep, horses, goats and other livestock are not subject to the proposal.

Timeframes vary by stock and waterbody type, as described in Table 4. Where an existing fence does not comply with setback requirements, it would be allowed to remain in place until 2025. If an existing fence has an average setback of at least 2 m, and not less than 1 m at any point, it could remain in place until 2035.

For waterbodies over a metre wide, the proposal requires a setback width of 5 m on average across the farm, and at least 1 m. Setbacks for smaller waterbodies and drains would be determined through farm plans.

Exemptions and extensions could be sought, presumably from the Regional Council.

Table 4 Proposed stock exclusion requirements for wetlands and large waterbodies

Stock exclusion on "Low-slope" land

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

Stock exclusion from waterways on Non-low-slope land

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

Approach

The assessment focuses on rivers and streams over 1 m wide, lakes and wetlands only. Wetlands and lakes are those identified in the BOPRC land use dataset, Price & Fitzgerald (2018) and a LINZ lake dataset, acknowledging this may not be a comprehensive list. For rivers and streams, wetted widths at MALF, estimated by Booker (2015), are used to identify rivers and streams over 1 m wide using the River Environment Classification (REC) dataset. GIS analysis was used to estimate the length of fencing required and area of pastoral land that would need to be retired in setbacks.

For non-low-slope land, the methodology to estimate carrying capacity in relation to beef, dairy support and deer, and therefore to identify where the requirement would apply, is highly complex and BOPRC understands that necessary data for the North Island is not available. Furthermore, it is not possible to accurately identify areas where cattle or deer would regularly feed on fodder crops, that operate break-feeding, or where there is current or historical irrigation. Therefore, the analysis assumes that the requirement would apply to all of these land uses in non-low-slope land, for rivers over 1 m wide, wetlands and lakes. In addition, BOPRC's land use dataset does not distinguish between sheep and beef. These limitations may result in an over-estimation of the impact of the proposal for these land uses in these areas, although it is unclear by how much.

Another area of uncertainty is the extent of current stock exclusion and setbacks, and whether existing setbacks comply with the proposal. The vast majority of dairy farmers would have already fenced waterbodies subject to the proposal under the Sustainable Dairying Water Accord (DCANZ & DairyNZ, 2019). However, it is assumed that for most dairy farms, setbacks would not meet the setback requirements of the proposal, so fence shifting will be required. For drystock, it is assumed that the extent of current stock exclusion is much lower, and again there is uncertainty about whether setbacks, where they exist, would meet the requirements of the proposal.

Relevant costs assumed in the analysis are summarised in Table 5 below[19]:

Table 5 Assumed stock exclusion costs

Land Use	Fencing costs ($/km)	Setback weed control ($/ha/year)	Lost profit in setbacks ($/ha/year)
Dairy	$5,000	$130	$1,115-$2,582
Sheep and beef	$14,000		$133-$421
Deer	$26,000		$229

It is assumed that farm systems would remain viable under the proposed setbacks, i.e. that the same stocking rates are able to be maintained, although this would likely vary between farms. The riparian practices modelled in Matheson et al. (2018) were different than those set out in the proposal. The proposal requires more pasture to be retired into setbacks.

Assessment

Table 6 shows the total area of the affected land uses in the region, the area that would need to be retired from grazing into setbacks and the length of fencing required, for each one of the slope categories proposed. This ignores any existing riparian fencing or setbacks that meet the proposal's conditions so presents a worse-case scenario.

Table 6 Estimates of grazing area to be retired in setbacks and length of fence lines required

	Area (ha)			Setbacks (ha)			Fence lines (km)		
Land use	**Low-slope land[20]**	**Steeper land**	**Total**	**Low-slope land**	**Steeper land**	**Total**	**Low-slope land**	**Steeper land**	**Total**
Dairy	56,308-76,091	46,738	122,829	518-738	567	1,305	887-1,241	893	2,134
High intensity beef grazing & dairy support	3,195-5,178	6,042	11,220	32-46	94	140	50-77	154	231
Sheep and beef	12,892-21,020	79,378	100,398	222-298	772	1,070	195-307	1,299	1,606
Deer	4,438-5,242	5,076	10,318	17-21	35	56	33-42	65	107
Total	**76,834-107,531**	**137,234**	**244,765**	**788-1,103**	**1,467**	**2,571**	**1,165-1,667**	**2,411**	**4,078**

[19] From Matheson et al. 2018. Fencing costs are broadly consistent with those quoted in the *Essential Freshwater* discussion document. They do not include setback planting and maintenance costs, other than weed control, or any subsidies. As described in Matheson et al. 2018, in situations where fences need to be relocated to comply with the proposed setback requirements (i.e. assumed to be most dairy farms and some drystock farms), it is assumed some materials could be reused. However, labour costs would be greater than for new fencing. Therefore, it is assumed that relocation costs would be the same as the cost of new fencing.

[20] In the discussion document, there are three options for how to define 'low-slope' land, i.e. <5°, <7° and <10° on average at parcel level. In this table, when referring to low-slope land, the first number refers to the first option and the second number refers to the third option. Total values are based only on the third option.

It is estimated that across the region, about 1.1% of total grazing area (or 2,571 ha) for the affected land uses will need to be retired into setbacks. Furthermore, an estimated 4,078 km of fence lines (or other exclusion method if available) would be required. The majority of this area and fence line length will be on dairy, and sheep and beef land, due to the greater proportion of those land uses in the region.

As noted above, although virtually all dairy farmers have already fenced waterbodies subject to the proposal, it is assumed the vast majority of them will need to shift fence lines to comply with the proposed setback requirements. It is assumed most drystock farmers would either have to provide stock exclusion for the first time, or shift existing fence lines to comply with setback requirements.

Based on the assumed costs described above and the highest estimates of setbacks and fence lines identified in Table 6, total costs of fencing required across the region would be up to $39.2m. As capital costs, these could be spread over several years. For example, if this cost is annualised over 25 years (the typical life of a fence) at a 6% interest rate, the cost would be $3m per year. Lost profit in setbacks is estimated to be $2.9m per year. The distribution of these costs across different land uses is detailed in Table 7 below. To put these costs in context, the estimated baseline profit per hectare for these land uses across the region is estimated to be about $190m per year.

Table 7 Estimated fencing costs and lost profit from proposed stock exclusion requirements

Land use	Total fencing costs	Lost profit in setback (including weed control costs) per year
Dairy	$10.7m	$2.5m
Sheep & beef (including high intensity grazing and dairy support)	$25.7m	$0.4m
Deer	$2.8m	$20,000
Total	**$39.2m**	**$2.9m**

Increased demand for fencing contractors will potentially create new employment opportunities, although it could also increase the costs of fencing if not matched by increased supply. Likewise, increased demand for fencing materials could also increase fencing costs.

Summary and conclusions

Significant benefits are expected from stock exclusion including reduced contaminant losses, reduced risk from swimming and creating opportunities for habitat and aesthetic improvements through riparian planting (although riparian planting per se is not part of the proposal).

Although stock exclusion and setbacks will reduce contaminant losses into waterways, there is uncertainty about the level of effectiveness of different setback widths to mitigate against different contaminants in different circumstances and locations (e.g. Valkama et al. (2018), Zhang et al. (2010)). Therefore, it is not possible to determine what would be an ‘optimal’ setback width.

The costs include fencing, whether new fences or re-locating fences that do not meet setback requirements, and lost profit from setbacks. Timeframes for the proposal vary by waterbody type and land use. As capital costs, fencing costs could also be spread over several years, which would make the cost more manageable for landowners. However, this is subject to landowners being able to access the necessary funds either from available cash flow or additional debt.

Farmers that have recently completed fencing their waterways (e.g. under the Sustainable Dairying – Water Accord) would likely be highly frustrated at having to relocate their fences under the proposal. This will also divert resources from other initiatives (e.g. implementation of other GMPs through farm plans). To mitigate this impact and cost, consideration should be given to extending required timeframes to more closely align with the typical lifetime of a fence, when stock exclusion is already in place.

Part 4: **Summary, discussion and conclusions**

Table 8 summarises the assessed impacts of all five proposals, their timeframes and a high level description of the benefits expected. For farm plans and stock exclusion, which are expected to have the most significant long term impacts across the whole region, this information is also presented in comparison to baseline operating profit for the Kaituna-Pongakawa-Waitahanui and Rangitāiki WMA farm systems modelled by Matheson et al (2018) (Figure 16).

Table 8 Summary of estimated costs, timeframes and expected benefits

Proposal	Estimated costs	Timeframe	2020-25	2025-35	2035+	Expected benefits
DIN/DRP attributes	? – Proposal is likely to not apply across all or most of the region due to naturally elevated nutrient levels and/or sensitive downstream receiving environments requiring higher levels of nutrient reduction. Tarawera and Rangitāiki WMAs could possibly be affected. If so, cost could be significant (e.g. large scale land use change required, no opportunity for intensification).	To be determined within Regional Plan				Nil – except perhaps reduced macrophytes in catchments where the proposal would actually apply (e.g. possibly Tarawera WMA?)
Restriction on land use intensification	Assumed to affect ~200 large properties across the region (~9,300ha) that would be converting to irrigated horticulture by 2025. Assumed $7,000 administration costs per property (or $1.3m overall). Delays in economic and environmental gains from conversions from arable and pasture to irrigated horticulture (kiwifruit and avocado). High risk land use changes are expected to be rare by 2025 but administration cost per property is assumed to be the same. Potential short term impact on land values.	2020 – 2025, regulation would cease to apply once the Regional Plan has fully implemented the proposed NPS-FM.				• Potential short term increase in land values of smaller properties not subject to the proposal. • Strong protection against high risk land use changes to ensure no increase in contaminant losses. • Questionable benefits in relation to irrigated fruit crops.
Farm plans	Farm plan development and auditing costs assumed to be $3,500 (one-off) and $1,750 (every year) respectively per property, adding up to $3.6m/year across the region. Farm plan implementation costs up to $35m per year across the region, but spreadable over a longer	Farm plan development by 2025, with high risk activities or areas prioritised. Farm planner capacity				• Generating baseline contaminant loss and farming practice information • Potentially improved financial performance and resilience of

Proposal	Estimated costs	Timeframe	2020-25	2025-35	2035+	Expected benefits
	timeframe.	is likely to be a significant constraint to achieve the 2025 timeframe. Farm plan implementation to be determined within each plan, presumably informed by risk and regional priorities.				individual farms, subject to complementary education and support services • Tailored adjustments to farming practices lead to reduction in contaminant losses (including greenhouse gases) and improved ecosystem health • Platform for other modules (e.g. greenhouse gases, biodiversity, animal welfare, etc.)
High N catchments (Upper Rangitāiki, upstream of confluence with Otangimoana Stream)	Five landowners affected. Administration costs. It is estimated the sub-catchment annual profit would fall by about 23% if all landowners applied GMPs. Potential implementation challenges.	2020 – 2025, regulation would cease to apply once the Regional Plan has fully implemented the proposed NPS-FM.				Questionable given high natural N load (significant cost in GMP uptake for 4% reduction in N load).
Stock exclusion	Fencing costs (including fence re-location where setbacks are less than requirement): $39.2m across the region, or $3m per year annualised over 25 years at a 6% interest rate. Lost profit in retired setbacks $2.9m per year across the region (including weed control but not riparian planting).	2035 at the latest. Timeframe varies by land use and waterbody type, and whether existing fences meet setback requirements.				• Reduced streambank erosion and contaminant losses through filtering • Opportunity for riparian planting which in turn increases shading, improves habitat, sequesters carbon, improves aesthetic values and biodiversity. • Increased amenity and recreational opportunities, lower risk of sickness from swimming. • Increased employment opportunities for fencing contractors.

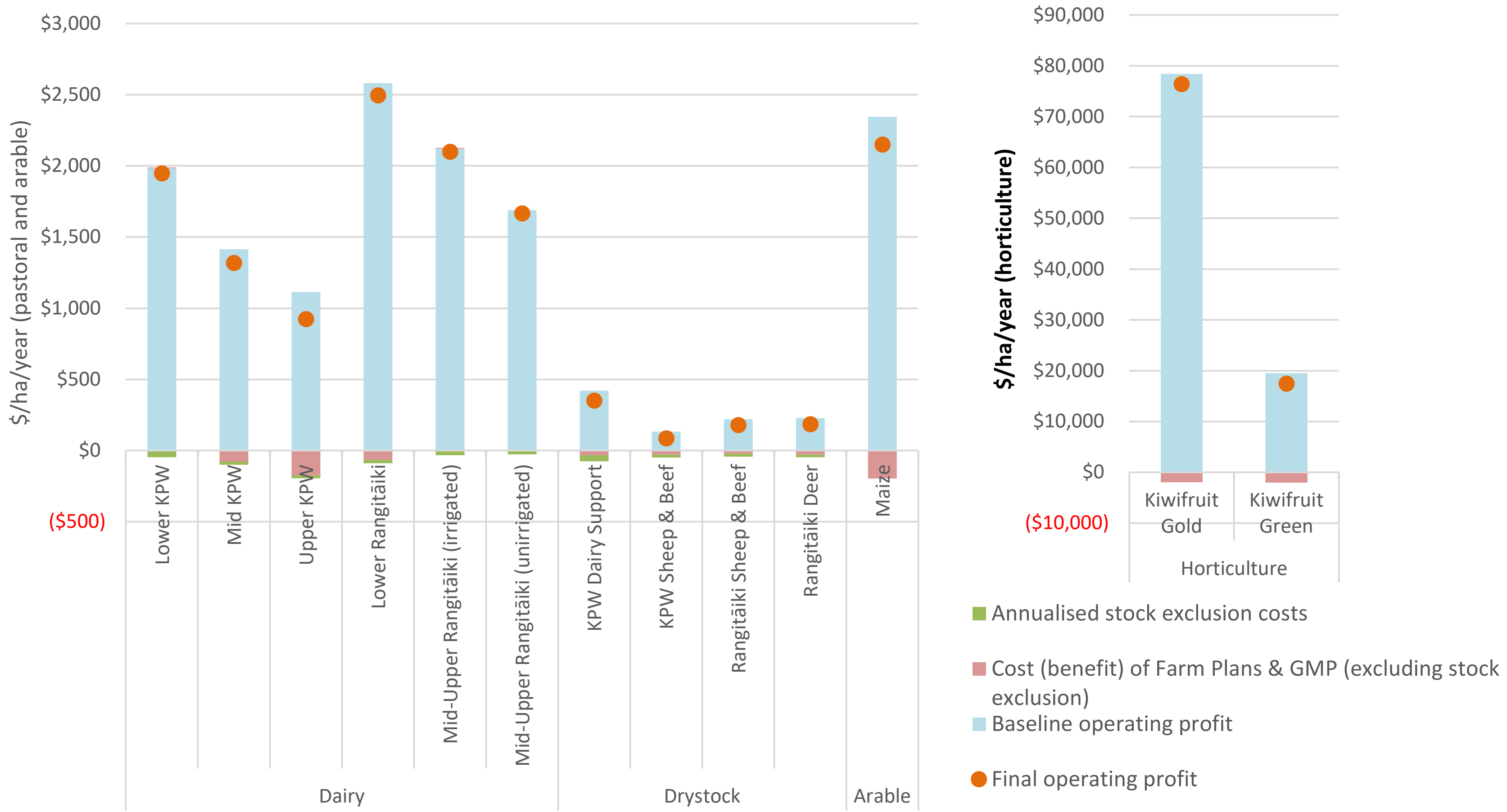

Figure 16 *Estimated impact of farm plan and stock exclusion proposal on Kaituna-Pongakawa-Waitahanui and Rangitāiki WMA farms (based on Matheson et al. 201821)*

[21] Annualised stock exclusion costs assume costs are spread over 25 years at a 6% interest rate, and that exclusion from large waterbodies is required for all drystock on steeper land, regardless of base carrying capacity. This includes fencing, lost profit and weed control in setbacks but excludes riparian planting and any subsidies. This also assumes that all farm systems will remain viable with the proposed setbacks, i.e. that no reduction in stocking rates is necessary. It is assumed effective area is 90% of total area on average.

It is clear from Figure 16 that drystock is likely to be more heavily impacted due to their lower baseline profit. Although the impact on dairy at farm level does not appear that significant, the operating profit figures do not take into account debt servicing. Farm debt in the drystock sector is not understood to be a systemic issue as it is in dairy, but some individual drystock farmers would also have high debt levels. The Reserve Bank (2019) has identified debt in the dairy sector in particular as one of the biggest risks to financial stability. Banks are taking a more conservative stance on dairy debt, which is likely to make financing of environmental expenses, such as those required by these proposals, more challenging. This situation leaves farmers, dairy in particular, vulnerable to increased costs (such as those required by these proposals) or price drops. The average debt level for dairy farms in the Bay of Plenty in 2017-18 was $24,638 per hectare (DairyNZ, 2019), although there would be wide variation on that figure for individual farmers.

There is a risk that the proposals would lead to some landowners going out of business and defaulting on their loans, particularly when considered alongside other upcoming requirements (e.g. Zero Carbon Bill, other aspects of *Essential Freshwater* proposals not evaluated here) or external shocks (e.g. price drops). If these impacts are widespread, there could potentially be significant social and economic implications for the region (and nationally). The analysis presented here does not look at ongoing viability of farming businesses, or the implications of widespread farm unviability.

Still focusing on the farm plans and stock exclusion proposals, Table 9 follows from Table 2 with the addition of annualised stock exclusion costs (subject to the same assumptions as in Figure 16). The overall impact of both proposals on the regional primary sector annual operating profit is estimated to be a 5.5% reduction, with drystock being more heavily impacted due to lower baseline profits and fewer farm systems 'levers' to pull. Annualised stock exclusion costs would obviously be sensitive to the period over which the costs are spread and the interest rate assumed.

Table 9 Estimated region-wide impact on operating profit by industry of farm plans and stock exclusion proposals

Land use	Total number of farming businesses	Total area (ha)	Estimated number of farming businesses within size thresholds	Estimated total area within size thresholds (ha)	Estimated Baseline operating profit/year	Estimated profit after Farm Plans & mitigation/year	Estimated operating profit after FPS, mitigation and stock exclusion (annualised)	Percentage change from baseline operating profit
Kiwifruit	1,452	16,057	884	13,595	$ 500.1m	$ 481m	$ 481m	-4%
Other horticulture	845	3,735	316	2,338	$ 58.2m	$ 51,7m	$ 51.7m	-11.2%
Sheep & beef	990	96,508	479	85,621	$ 13.9m	$ 11.4m	$9.4m	-32.1%
Arable/grain growing	50	8,037	50	4,192	$ 15.1m	$ 14m	$14m	-6.8%
Dairy	639	119,426	605	111,856	$ 175m	$ 166.4m	$165.6m	-5.4%
Deer	48	6,801	46	6,554	$ 1.2m	$ 1m	$0.84m	-32.5%
Total	**4,024**	**250,565**	**2,379**	**224,157**	**$ 764.3m**	**$ 725.6m**	**$722.6m**	**-5.5%**

A more detailed assessment will be required to confidently estimate the impact of the proposals on regional GDP. The total direct contribution of agriculture to regional GDP is about 7%. It is estimated that horticulture has a flow-on impact on other industries (indirect and induced) of about half its direct contribution to regional GDP, while the pastoral and arable sectors have a flow-on impact of about a third of their direct contribution[22]. While many of the proposals will affect direct and flow-on contributions to regional GDP, there are a number of factors that will determine the extent of this[23]. The extent of impacts on farm viability (as discussed above) and landowner responses (as discussed below) are two key factors. Furthermore, some of the flow-on impacts of the agricultural sector on the regional economy are likely to increase (e.g. through additional fencing and farm planning expenses). However, the agriculture sector contribution to regional GDP is likely to continue to increase, probably by more than the estimated impact of the proposals, due to ongoing conversions to horticulture, regardless of the intensification proposal.

The assessment presented here should be considered indicative and preliminary. There a number of uncertainties and assumptions, described in more detail within the assessment for each proposal, that must be noted. The analysis has relied on readily available information, able to be sourced and analysed in a limited timeframe.

Importantly, the analysis assumes no adjustment by landowners. In reality, landowners are likely to respond to any regulatory changes in a number of ways, which would reduce the overall impact of the proposals. For example, landowners may choose to change land use (e.g. from drystock to forestry, or dairy to horticulture) as a way to avoid some of the costs of the proposals (although acknowledging those choices will also carry other costs). Likewise, landowners may choose to leave the industry before these costs 'bite'. Equally, as described above, if the proposals (along with other shocks) lead to many landowners going out of business, the implications would be greater than assessed here.

It will be important for final decisions on these proposals to focus on those which will have the greatest expected benefits (e.g. farms plans, stock exclusion, intensification restriction for high risk land use changes) while ensuring that transition times do not compromise the ongoing viability of the primary sector.

[22] Bay of Plenty input-output tables generated by Butcher Partners Ltd., based on Statistics New Zealand 2013 input-output tables.

[23] By way of comparison, the estimated economic impacts of PC10 (Lake Rotorua nitrogen management) were estimated to be 0.09% and 0.03% of the Rotorua District's and Bay of Plenty's GDP respectively (Market Economics, 2015).

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Appendix 1 – Other proposals

This section presents a brief analysis of the implications of two other proposals not considered above.

E. coli attribute table for swimming sites during the bathing season

Under the proposed NPS-FM, a new attribute table for *E. coli* is included, applicable only to swimming sites during the bathing season (November to March), in addition to the existing *E. coli* attribute table. This attribute table is based on the 2003 Microbiological Water Quality Guidelines, which are acknowledged to be outdated and in need of review within the discussion document itself and also in Milne et al. (2017).

Under the current NPS-FM, only 11 of 42 monitored sites throughout the Bay of Plenty are considered not suitable for swimming (Dare, 2019 in prep). Under the proposed NPS-FM, 20 out of 42 monitored sites would fail the proposed *E. coli* bottom line for swimming sites during the bathing season (Figure 17).

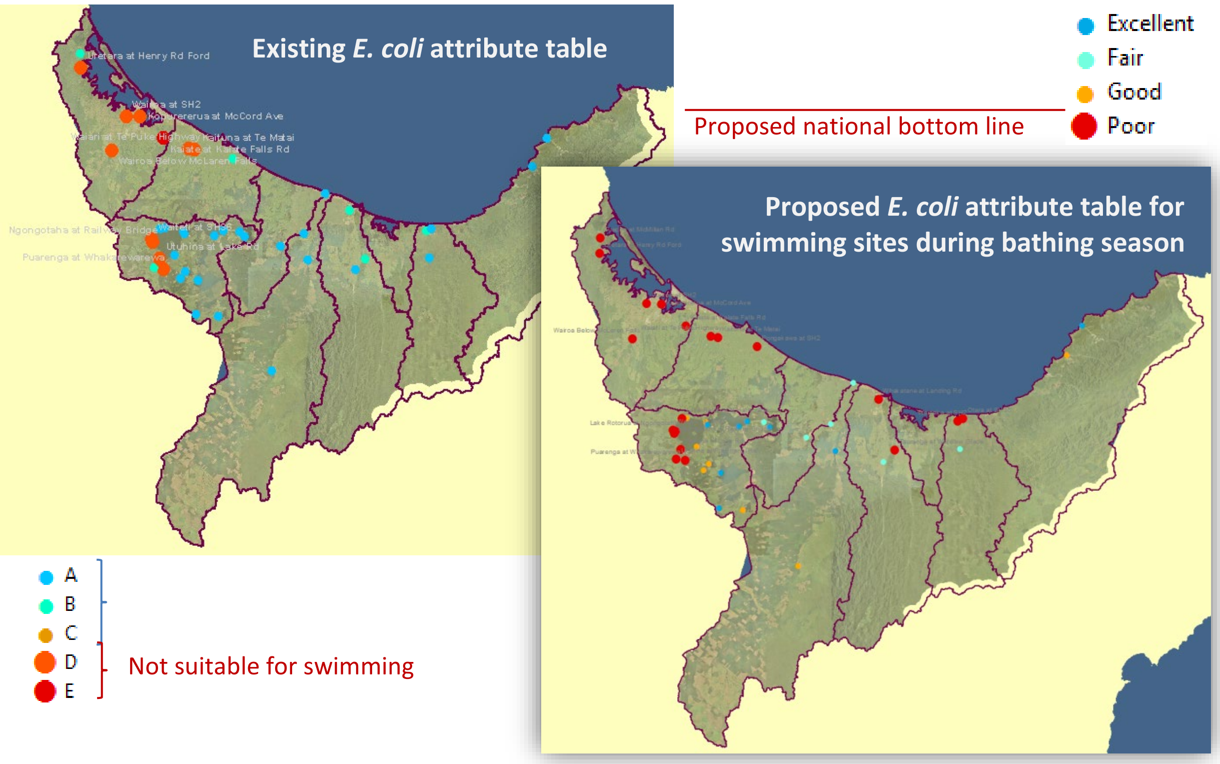

Figure 17 E. coli attribute bands under existing and proposed E. coli attribute tables

Figure 18 shows the assessed current state (95th percentile and median) relative to the proposed bottom line (95th percentile), for monitored sites that would fail the proposed bottom line. The large differences between 95th percentiles and medians suggest that the bottom line failures are likely to be driven mainly by rainfall events, when most people are unlikely to be swimming.

Even under the current attribute table, the process to achieve a suitable for swimming state is very complex and potentially costly. For example, the annualised cost of fully fencing the catchment upstream of the Kaiate Falls (one of the swimming sites considered not suitable for swimming under the current NPS-FM) is estimated to be nearly five times the estimated annual catchment profit, and it is uncertain whether that intervention will make the site suitable for swimming (Matthews, 2018). It would generally be reasonable to expect that the proposed bottom line could be achieved for sites where the difference between the current state and bottom line is relatively small (e.g. through GMP, stock exclusion, land use change). However, for sites where the difference is large (e.g. Kaiate Falls), it may not be possible to meet the proposed bottom line without more significant change and cost, if at all.

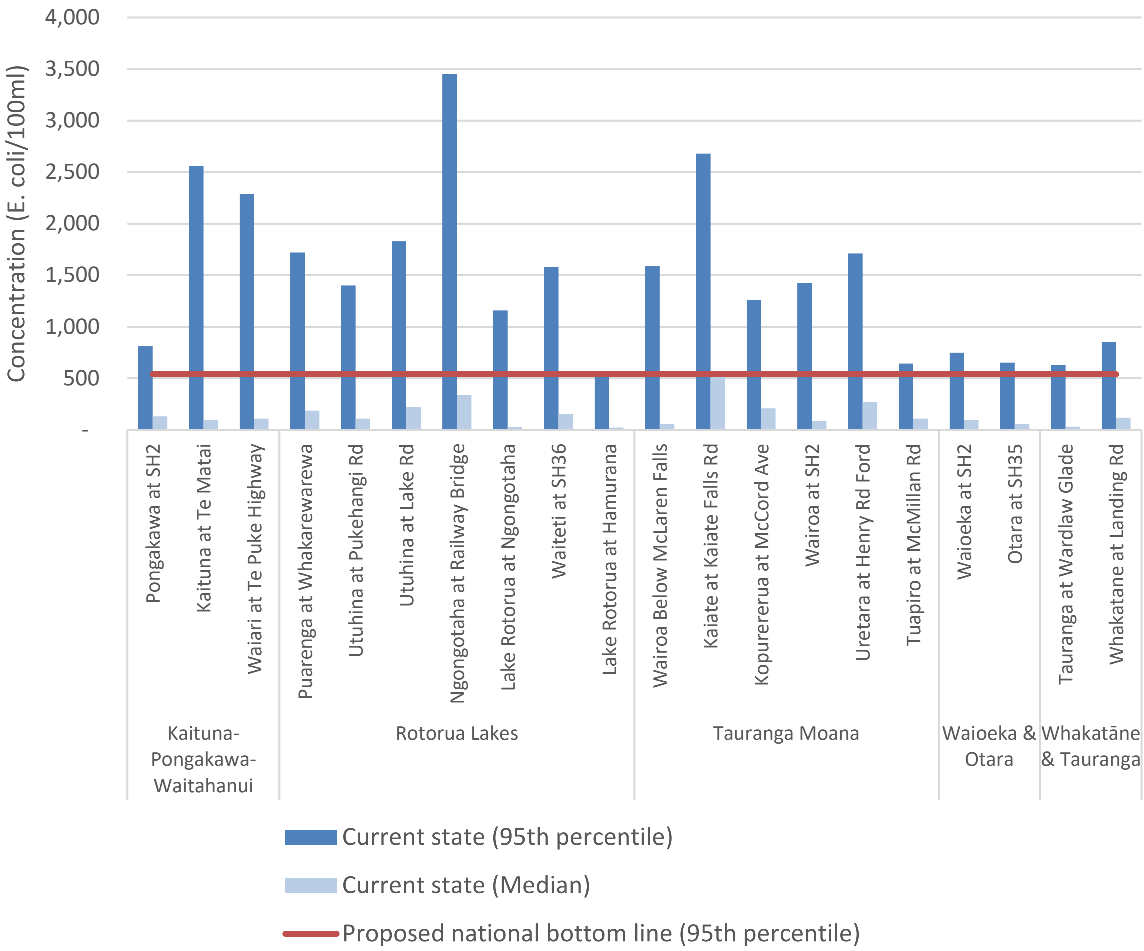

Figure 18 *Assessment of current state relative to proposed E. coli bottom line for sites that would fail it*

The 2017 NPS-FM amendments to the *E. coli* attribute table were found to be a sound approach to determine suitability for swimming (McBride & Soller, 2017). Given the likely expense and complexity that the proposed new attribute table is likely to require, for questionable benefit, the existing *E. coli* attribute table seems preferable, perhaps with the introduction of a national bottom line which is currently lacking.

Compulsory telemetry

The discussion document also proposes to require telemetry for water users, starting with consents taking more than 20 L/s. The discussion document quotes costs of between $600 and $1,800 for a telemetry unit, and transmission costs of between $20 and $99 per month, depending on location.

There are 1,379 consumptive freshwater take consents in the Bay of Plenty. Of these, 720 (52%) are for takes ≥ 5 L/s which are subject to the Water Metering Regulations. Of these, only 205 consents (or 15% of all consents) are currently using telemetry to submit water use records, either because they are required to do so under consent conditions or the regulations (149), or because they are doing it voluntarily (56) (A. Gilchrist, pers. comm.).

Accurate water use data is essential to assess compliance with individual consent conditions and overall allocation limits of a resource, and therefore to manage the resource.

Water use data quality for consents not using telemetry is generally so poor that it renders their information of very limited use for the purposes above. Given the cost of telemetry relative to water users' profit (as described above), and the limited quality and completeness of current water use data in the Bay of Plenty, this proposal is strongly supported. Consideration should be given to extending the coverage of the requirement to all (or more) permanent consumptive takes and bringing implementation timeframes forward.

Appendix 2 – Mitigation practices

Source: Matheson et al., 2018

Shaded practices were not considered in the analyses.

DAIRY	1	Placement of feeding equipment
	2	Timing of effluent application in line with soil moisture levels (assumes sufficient storage)
	3	Reduced tillage practices
	4	Improved nutrient budgeting and maintenance of optimal Olsen P
	5	Laneway run-off diversion
	6	Grow maize on effluent blocks (if already growing maize)
	7	Elimination of summer cropping
	8	Reductions in seasonal stocking rate
	9	Efficient fertiliser use technology
	10	Efficient irrigation practices (soil moisture monitoring)
	11	Use of plant growth regulators [to replace N]
	12	Adoption of low N leaching forages
	13	Relocation of troughs
	14	Slow release phosphorus fertiliser RPR
	15	Reduce autumn N application – replace with appropriate low(er) N feed
	16	3m average vegetated and managed buffer around rivers, streams, lakes and wetlands subject to the Dairy Accord; 1m around drains; 5m average buffer on slopes between 8 and 16 degrees, 10m average buffer on slopes above 16 degrees.
DRYSTOCK (sheep & beef, deer, dairy support)	1	Improved nutrient budgeting and maintenance of optimal Olsen P
	2	Efficient fertiliser use technology
	3	Stock class management within landscape
	4	Adopt M1 arable cultivation practices for winter cropping
	5	Laneway run-off diversion
	6	Relocation of troughs
	7	Appropriate gate, track and race placement, design (where possible)
	8	Targeted space planting of poles
	9	Slow release phosphorus fertiliser RPR
	10	Adoption of low N leaching forages
	11	Full stock exclusion from all waterbodies greater than 1m wide at any point adjacent to farm (including drains) and wetlands. 2m average vegetated and managed buffer around rivers, streams, lakes and wetlands; 1m around drains; 3m average buffer on slopes greater than 8 degrees (or mid catchment); 5m average buffer on slopes greater than 16 degrees (or upper catchment) with associated reticulation

ARABLE	1	Grass or planted buffer strips (1m)
	2	Complete protection of existing wetlands
	3	Maintain optimal Olsen P
	4	Efficient fertiliser use and technology
	5	Cover crops between cultivation cycles
	6	Manage risk from contouring
	7	Reduced tillage practices
HORTICULTURE	1	Complete protection of existing wetlands
	2	Maintain optimal Olsen P
	3	Laneway run-off diversion
	4	Efficient fertiliser use and technology
	5	Efficient irrigation practices (soil moisture monitoring, not following fertiliser application)
	6	Grass swards under canopy, minimise bare ground and vegetated buffers around waterways.

Appendix 3 – Implications for Māori land

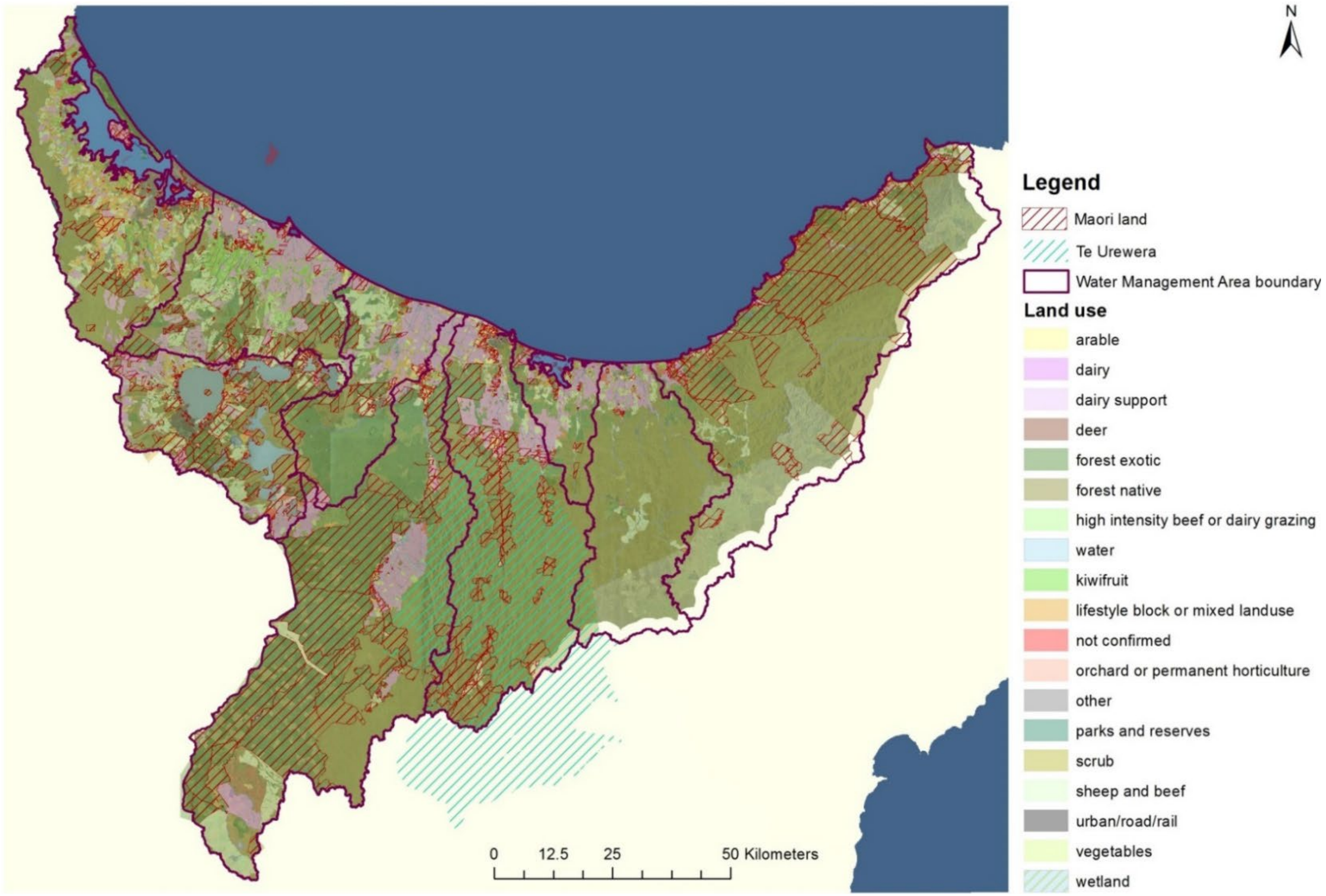

Figure 19 Māori land in the Bay of Plenty region

This Appendix replicates the assessment described in the body of the report, but focusing on Māori land in the Bay of Plenty (Figure 19). For the purpose of this assessment, Māori land is defined as land included in the Māori Land Online database[24] as at December 2015, with various additions, corrections and amendments from other sources. These include some land returned under Treaty Settlements since. Māori land included here should be considered indicative only as not all Māori land in the Bay of Plenty is necessarily identified as such. Furthermore, no distinction is made for Māori land under different forms of tenure, although this would be a key determinant of potential development opportunities.

Increasing the productivity of Māori land was a key opportunity identified in the Bay of Plenty Regional Growth Study (Schoefisch, et al., 2015). Historically, Māori land has faced a range of barriers to development.

As described by McIndoe & Kashima (2018), Māori land in the Bay of Plenty encompasses 415,000 ha, or about a third of the region's land area. The vast majority of this land is currently under exotic (47%) and native (39%) forestry. Of the proportion in exotic forestry, about 90,000 ha are within high capability land[25], which could theoretically be converted into other land uses. However, due to established lease arrangements, national policy direction/legislation and challenges involved in changing land use, it is unlikely that much of this land will convert into other land uses in the short to medium term. There are only 28,000 ha of high capability Māori land across the Bay of Plenty in other land uses, which could more realistically be further developed or converted in the short to medium term. Figure 20 shows the distribution of land use for Māori land in the Bay of Plenty.

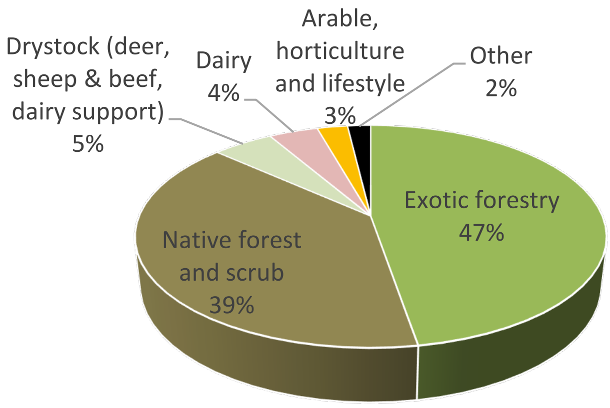

Figure 20 Land use distribution, Māori land in the Bay of Plenty

A third of all Māori land in the Bay of Plenty is held in trust by CNI Iwi Holdings Ltd., on behalf of Central North Island iwi. Most of this land is in exotic forestry within the Rangitāiki WMA.

[24] The database includes land that falls within the jurisdiction of the Māori Land Court under Te Ture Whenua Māori Act 1993 and other legislation – this is primarily Māori Customary and Māori Freehold Land, but also includes, General Land Owned by Māori, Crown Land Reserved for Māori and some Treaty Settlement reserves, mahingā kai and fishing rights areas.

[25] This is defined here as land classified in the Land Use Capability (LUC) categories 1 to 4, as identified in the New Zealand Land Resources Inventory database, for indicative purposes only. It is acknowledged that there can be productive land in other LUC categories.

DIN and DRP attributes

As described in Part 3A, only five monitoring sites across the Tarawera and Rangitāiki WMAs may be affected by the proposed DRP attribute. There is Māori land upstream of these sites. In the Tarawera WMA, Māori land is currently in forestry (native and exotic), sheep and beef, and dairy, although most is of low capability so is unlikely to develop. In the Rangitāiki WMA, Māori land is mostly in exotic forestry within the Kāingaroa Forest, a large proportion of which is of high capability so it could theoretically be developed. Should the DRP attribute actually apply in these WMAs (i.e. if after more detailed assessment elevated DRP levels are determined not to be due to natural causes), it is likely that any development of Māori land would be significantly constrained and existing pastoral land uses would either need to reduce in intensity or convert to forestry.

Restrictions on land use intensification

Of the 44,100 ha across the region that could be suitable for conversion, mainly from pasture, to horticulture, 11,000 of these are on Māori land across 1,267 properties, mostly in the Rangitāiki, Whakatāne/Tauranga and East Coast WMAs. When the proposed NES-FW size thresholds (i.e. >20ha pastoral and arable properties, and >10ha conversions) are applied, the extent of potential land use change on Māori land captured by the proposal is reduced to 7,542 ha across 183 properties. Assuming, as in Part 3B, that only a quarter of this growth would realistically occur by 2025 and that it would be irrigated, Table 10 shows the number of properties and area of Māori land that would be affected by the proposal. There are more than 1,000 properties on Māori land that would be suitable for conversion to horticulture but that, due to their small size, would be exempt from the proposal.

Relative to all other land, Māori land is dominated by a large number of small parcels with multiple owners. A notable exception to this is the CNI Iwi Holdings land described above. Property ownership has been used to determine the area and number of properties affected. However, for Māori land in particular, this approach may underestimate the impact as several small parcels below the proposed NES-FW size thresholds owned by different parties may in fact operate as a single larger farming business, which may in fact fall within the size thresholds.

As described in Part 3B, although there is a large proportion of Māori land in the Rotorua Lakes WMA, it is assumed no conversions in this area would be captured by the proposal. This is due to the WMA being generally unsuitable for irrigated horticulture, current planning restrictions and conversions from forestry to pasture currently being uneconomic.

Bearing in mind the per property administration costs described in Part 3B, the total cost of obtaining consents for conversion for the 47 properties identified below would add up to $329,000. As noted in Part 3B, the lack of an available tool to assess contaminant losses from irrigated horticulture at a property level could prevent conversions from occurring before 2025. This would have negative environmental and economic consequences, and would create another significant barrier to the development of Māori land in the short term.

Table 10 Estimate of irrigated horticulture conversions on Māori land by 2025 within proposed NES-FW size thresholds by WMA (assuming 25% of convertible area within size thresholds would actually convert by 2025)

Water Management Area	Number of properties with suitable land above size threshold	Convertible area above size threshold (ha)
Tauranga Moana	5	119
Kaituna-Pongakawa-Waitahanui	5	150
Tarawera	3	120
Rangitāiki	10	522
Waioeka & Otara	0	0
Whakatāne & Tauranga	9	386
Ōhiwa Harbour & Waiōtahe	1	55
East Coast	14	533
Total	**47**	**1885**

As described in Part 3B, it is ambiguous if the requirement would apply to properties that are exclusively in exotic forestry. If the proposal does apply, the requirement would effectively mean a moratorium on conversions from forestry to other land uses given that forestry would generally have the lowest contaminant losses. This would be particularly relevant for Māori-owned land given the predominance of that land use.

Farm planning

Overall, annual operating profit across all affected Māori land would drop by an estimated 3.4% from $70.3m to $67.8m, from the costs of developing, auditing and implementing farm plans (Table 11). In relative terms, this is slightly less than the equivalent impact across all land in the Bay of Plenty. As with all land, drystock properties are expected to be more significantly affected due to their lower baseline profit.

Relative to all other land, and except for the CNI Iwi Holdings land, Māori land is dominated by a large number of small parcels with multiple owners. Property ownership has been used to determine the number of properties affected. However, this approach may underestimate the impact as several small parcels likely to fall below the proposed NES-FW size thresholds owned by different parties may in fact operate as a single larger farming business. Furthermore, a relatively large proportion of Māori land may be leased. In this case, the costs are likely to fall on the lessee rather than on the landowners.

It is assumed that the performance of Māori land in each land use is on average comparable to that of all other land. As described in Part 3C, it is assumed that farmers who already hold, or are required to hold, nutrient management documents (e.g. Lake Rotorua) would already face a fraction of these costs.

Table 11 Summary assessment of implications of developing, auditing and implementing Farm Plans on Māori land in the Bay of Plenty region

Land use	Total area (ha)	Estimated number of farming businesses within size thresholds	Estimated total area within size thresholds (ha)	Estimated total effective area within size thresholds (ha)	Assumed number of existing nutrient management documents	Baseline EBIT/ha/year	Post-mitigation EBIT/ha	Mitigation cost/ha/year	Estimated Baseline profit/year	Farm Plan development/auditing costs per year	Estimated Farm Plan implementation costs/year	Estimated profit after mitigation/year
Kiwifruit	971	60	788	630	60				$30,7m	-$ 52,500	-$ 890,006	$29,8m
Green	*641*	*40*	*520*	*416*	*40*	*$19,500*	*$17,608*	*-$1,892*	*$10m*	*-$ 34,650*	*-$ 590,055*	*$9,4m*
Gold & other	*330*	*20*	*268*	*214*	*20*	*$78,400*	*$76,533*	*-$1,867*	*$20,7m*	*-$17,850*	*-$ 299,951*	*$20,4m*
Other horticulture	274	10	211	169	10	$19,500	$17,608	-$1,892	$4,3m	-$8,750	-$ 239,362	$4,0m
Sheep & beef	20,514	129	14,607	11,686	32	$133-$421	$109-$396	-$20 - -$25	$3,2m	-$197,531	-$ 264,327	$2,7m
Arable/grain growing	4,247	41	1,834	1,467	10	$2,345	$2,192	-$153	$8m	-$62,781	-$ 210,413	$7,7m
Dairy	16,700	133	13,663	10,930	67	$1,115-$2,582	$955-$2,532	-$418 - $20	$24,1m	-$174,563	-$ 312,285	$23,6m
Deer	127	2	127	102	1	$229	$206	-$23	$23,254	-$2,625	-$ 2,043	$ 18,586
Total	**42,835**	**375**	**31,229**	**24,983**	**180**				**$ 70,3m**	**-$498,750**	**-$ 1,9m**	**$ 67,8m**

Management of nitrogen in catchments with high nitrate-nitrogen levels: Upper Rangitāiki, upstream of confluence with Otangimoana Stream

None of the affected properties in the identified sub-catchment are Māori land. However, there are 14,350 ha of Māori land in exotic forestry and 880 ha in a range of other non-pastoral land uses, within the sub-catchment. It is unlikely that this land would convert to pasture, horticulture or arable land uses by 2025 (when the proposal will no longer apply). Therefore, Māori land in the sub-catchment is unlikely to be affected by the proposal.

Stock exclusion

Table 12 shows the total area of the affected Māori land in the region, the area that would need to be retired from grazing into setbacks and the length of fencing required, for each one of the slope categories proposed. This ignores any existing fencing or setbacks that meet the proposal's conditions so presents a worse-case scenario.

Table 12 Estimates of grazing area to be retired into setbacks and length of fence lines required, for Māori land

	Area (ha)			Setbacks (ha)			Fence lines (km)		
Land use	**Low-slope land**[26]	**Steeper land**	**Total**	**Low-slope land**	**Steeper land**	**Total**	**Low-slope land**	**Steeper land**	**Total**
Dairy	6,134-9,521	7,179	16,700	80-114	111	225	106-166	131	296
High intensity beef grazing & dairy support	1,365-1,977	2,220	4,196	15-20	33	53	20-30	49	79
Sheep and beef	1,348-2,246	14,073	16,318	37-61	171	232	35-52	267	302
Deer	7	120	127	0	1	1	0	1	1
Total	**8,853-13,750**	**23,592**	**37,342**	**131-196**	**316**	**511**	**161-248**	**449**	**696**

Under the same assumptions as described in Part 3E, Table 13 summarises the distribution of stock exclusion costs for Māori land by land use. Across the entire Bay of Plenty, fencing costs on Māori land are estimated to total $7.1m (or $0.5m per year if annualised over 25 years at a 6% interest rate). Lost profit from setbacks, including weed control costs, are estimated to be $0.54m per year.

[26] In the discussion document, there are three options for how to define 'low-slope' land, i.e. <5°, <7° and <10° on average at parcel level. In this table, when referring to low-slope land, the first number refers to the first option and the second number refers to the third option. Total values are based only on the third option.

Table 13 Estimated fencing costs and lost profit from proposed stock exclusion requirements

Land use	Total fencing costs	Lost profit in setback per year (including weed control costs)
Dairy	$1.5m	$0.4m
Sheep & beef (including high intensity grazing and dairy support)	$5.6m	$0.1m
Deer	$31,000	$360
Total	**$7.1m**	**$0.54m**

Summary and conclusions

When considered alongside the farm planning proposal, stock exclusion would result in an estimated 5% reduction to the baseline annual operating profit of Māori land across the Bay of Plenty. Costs fall more heavily on drystock and lower intensity dairy farming. Consequently, the impact on Māori land is generally comparable to the impact on all land, acknowledging that most Māori land is in forestry, which may not be subject to these proposals and most of which is unlikely to develop, at least in the short to medium term. Nonetheless, these proposals represent additional barriers to development of Māori land, on top of other existing historical and contemporary barriers.

The proposed DRP attribute (if applicable in the Rangitāiki WMA in particular) and the land use intensification restriction would create additional barriers to the development of Māori land, which is already constrained by a range of other factors. A mitigating factor is that Māori land is characterised by many small parcels which fall outside of the proposed NES-FW size thresholds. However, it is uncertain the extent to which these currently operate as larger farming businesses, that would fall within the size thresholds.