Section 32 Evaluation Report

Lake Rotorua Nutrient Management Rules Plan Change 10

December 2015

Bay of Plenty Regional Council
5 Quay Street
PO Box 364
Whakatane 3158
NEW ZEALAND

Contents

1 Introduction

1.1 Purpose of the report

This Section 32 report provides a summary of the process of evaluating the Lake Rotorua Nutrient Rules Plan Change ('Plan Change'), including why the Plan Change is needed and how it was developed. The report records the thinking and option analysis over the life of the project to create nutrient rules for Lake Rotorua. The key background reports that underpin this Section 32 report form part of the Section 32 evaluation undertaken. The contents of these reports formed an essential part of the policy process, and are merely summarised in this report.

The Purpose of this Plan Change is to reduce nitrogen losses from rural land within the Lake Rotorua Catchment to meet the nitrogen limit set by the Regional Policy Statement. This will be achieved primarily through an Integrated Framework comprising new policies and rules in the Regional Water and Land Plan ('RWLP'), financial incentives and gorse conversion (section 1.2).

The options considered and decisions made in developing the Plan Change include:

- Evaluating the overall approach to nutrient reduction (section 9)
- Evaluating new policies and methods, including rules, as they relate to specific topics, for example nutrient allocation and trading (section 10)
- Considering special topics that influence or are affected by the policy and rule framework (section 11).

Section 32 evaluation requirements

During the process of making changes to a regional plan Council is required by Section 32 of the Resource Management Act ('RMA') to evaluate the purpose of the proposal, along with the proposed policies and methods (including rules). The evaluation must:

- Examine whether the Objective (or Plan Change Proposal) is the most appropriate way to achieve the purpose of the RMA;
- Examine whether the proposed approach is the most appropriate way of achieving the objective;
- Assess and identify the benefits and costs, and risks of the new policies and rules on the community, the economy and the environment.

This report, which summarises the Section 32 evaluation, must be made available for public inspection at the same time the Plan Change is notified.

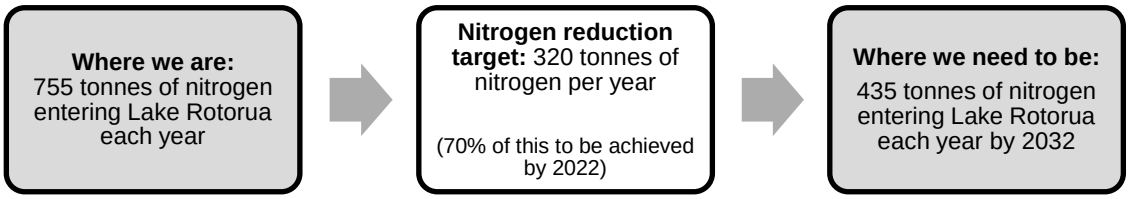
Refer to Appendix 1 for the full wording of Section 32 of the RMA.

1.2 What is the Plan Change designed to achieve?

Bay of Plenty Regional Council ('Council') is responsible for managing water quality in the region. A water quality target or Trophic Level Index[1] (TLI) of 4.2 for Lake Rotorua was set in consultation with the community. To reach the water quality target we must reduce the quantity of nutrients (i.e. nitrogen and phosphorus) entering Lake Rotorua.

The Bay of Plenty Regional Policy Statement ('RPS') sets an annual limit of 435 tonnes of nitrogen entering Lake Rotorua to meet the desired TLI of 4.2. This is to be achieved by 2032. The RPS sets the primary policy outcome that this Plan Change "must give effect to" (RMA section 67(3)(c)). That obligation is mandatory. Therefore the S32 evaluation necessarily focuses on the "how" and not the "why". The "why" has already been worked through at the RPS level.

The best available science indicates that the steady state nitrogen loss to the lake from within this catchment is approximately 755 tonnes per year[2], mostly from pastoral sources which include dairy, sheep, beef, deer and grazed lifestyle blocks.



Existing policies and rules in the RWLP set a discharge limit or nutrient benchmark, based on the discharges of each property from 2001-2004. However, nitrogen reduction is not a requirement of existing policies and rules. New rules are needed to achieve the sustainable nitrogen limit by 2032.

The Plan Change Objective is summarised in section 5 of this report.

Box 1 – The position on phosphorus

Both nitrogen (N) and phosphorus (P) contribute to eutrophication and degraded water quality. For Lake Rotorua both nitrogen and phosphorus management are important. The target load for phosphorus is 37 tonnes per year[3]. This is a non-statutory target and so is not addressed in this Plan Change. However, phosphorus management remains part of the Bay of Plenty Regional Council's lake restoration programme. Mitigation actions to reduce nitrogen losses from pastoral land will often – but not always -provide associated phosphorus reductions. Examples of actions that reduce both nitrogen and phosphorus loss include reduced fodder cropping, lower stocking rates - especially during winter - and conversion of pastoral land to trees.

[1] Trophic Level Index is a number used to indicate the health of lakes, calculated from measurements of concentrations of nitrogen and phosphorous, chlorophyll-a, and water clarity. As a general rule of thumb, a higher number indicates worse water quality. A trophic level of 4-5 indicates poor water quality (eutrophic) www.rotorualakes.co.nz/vdb/document/139

[2] Rutherford, K.C., Palliser, C., Wadhwa, S. (2011).
Note: RPS Policy WL 6B indicated a current state of 746 tonnes of nitrogen per year based on the estimates provided in the 2009 draft Lake Rotorua and Rotoiti Action Plan.

[3] Bay of Plenty Regional Council (2009), Lakes Rotorua and Rotoiti Action Plan.

1.3 Key background reports

A large body of research and analysis underpins the s32 report and forms part of the s32 evaluation. The outputs of this work and their impact on the policy process are summarised in the section 32 report. Executive summaries to the following key reports are included in Appendix 12:

Science reports

- Bay of Plenty Regional Council (2013). *Trends and state of nutrients in Lake Rotorua streams*. Environment Publication 2013/08. (Link)
- Environmental Research Institute (2015). *Ecotoxicological review of alum applications to the Rotorua Lakes*. Report prepared for the Bay of Plenty Regional Council. (Link)
- Hamilton DP, McBride CG, Jones HFE (2015). *Assessing the effects of alum dosing to two inflows to Lake Rotorua against external nutrient load reductions: Model simulations for 2001-2012.* (Link)
- Rutherford KC, Palliser C, Wadhwa S (2011)(1). *Prediction of nitrogen loads to Lake Rotorua using the ROTAN model*. NIWA client report HAM 2010-134. Report prepared for the Bay of Plenty Regional Council. (Link)

Overall approach

- Greenhalgh S (2013b). *Costs and benefits for achieving a clean lake: Rotorua Lakes*. Prepared for Bay of Plenty Regional Council.
- Kingi T, Sprosen M, Ledgard S, Morrell S, Matheson L, Park S (2015). *Meeting nutrient loss targets on dairy farms in the Lake Rotorua catchment*. Sustainable Farming Fund Project 11/023: Final Report. (Link)
- Land Connect Ltd (2015). *Lake Rotorua Catchment: Small block sector review*. Report prepared for the Bay of Plenty Regional Council.
- Market Economics Limited (2015). *Economic impacts of Rotorua nitrogen reduction: District, regional and national evaluation*. Report prepared for the Bay of Plenty Regional Council. (Link)
- Parsons O, Doole G, Romera A (2015)(1). *On-farm effects of diverse allocation mechanisms in the Lake Rotorua catchment*. Report prepared for the Lake Rotorua Stakeholder Advisory Group. (Link)
- Perrin Ag Consultants Ltd (2014). *Rotorua NDA impact analysis: Phase I Project, Rotorua*. Report prepared for the Bay of Plenty Regional Council. (Link)
- Telfer Young (2014). *Land values in the Rotorua area and the Lake Rotorua catchment*. Report prepared for the Bay of Plenty Regional Council. (Link)

The Rotorua Te Arawa Lakes Programme Vision and Strategy for the Lakes of the Rotorua District (Link) has also been important to developing the policy approach.

1.4 Lake Rotorua water quality: Rules as part of the solution

The Integrated Framework comprises new policies and rules in the RWLP, as well as financial incentives and gorse conversion. The Integrated Framework came about after the results of analysis of a 'Rules Only' approach. This and subsequent discussions about the continuing viability of pastoral farming in the catchment prompted the Lake Rotorua Primary Producers Collective[4] to develop an alternative approach to the rules. The alternative approach[5] was presented to StAG on 18 June 2013. The core aspect of the proposed approach can be shown in the following diagram:

Reductions to NDA levels			
	Area, ha	NDA, kgN/ha/yr	N load, tN/yr
dairy	5050	35 (or 30-40)[6]	177
drystock	16125	13 (or 10-16)[6]	210
totals	**21175**		**386**
gorse			-30
net load			**356**

From this position it was proposed that 100 tonnes N/yr would be allocated to an incentives scheme leaving a balance of 286 tonnes N/yr as the 2032 level within the pastoral sector. The key aspect of the framework is that there are agreed responsibilities established for components of what is required.

ROTAN Loads and agreed reductions

Sector	Catchment load tN/yr	2032 sector allocation KgN/ha/y	2032 sector allocation tN/y	Reduction from sector tN/y	Reduction from sector as % of sector load
Dairy	273.2	35	176.8	96.4	35.5%
Drystock	253.2	13	209.6	43.6	17.2%
Incentives			*-100*	100	*71% (100tN/140tN)*
Total	**526.4**		**386.4**	**240**	

[4] The Lake Rotorua Primary Producers Collective was formed in 2011 "To influence policy and farm practice that enables profitable farming, a prosperous community and a healthy lake". The group is represented in StAG and seeks to advance the interests of rural landowners facing major reductions in nutrient losses from their farms.

[5] Lake Rotorua Primary Producers Collective *Draft Alternative Lake Rotorua Catchment Nitrogen Policy* 11 July 2013

Subsequently StAG considered the matter further on 16 July 2013 (and at Subcommittee meetings on 30 July 2013 and 13 August 2013). On the 16 July 2013 the Collective's proposal was accepted by StAG as a framework around which a StAG Position paper could be developed. As part of StAG's considerations the proportion of funding for the incentives scheme was adjusted from $30 million to $40 million. The StAG position paper summarised the position as follows:

Programme	tN	Actions and Accountability
1. Rules Programme	140tN	- Approved Farm Nutrient Plans (FNPs) - which will include specific plans for N reduction - implemented for individual farmers over 40ha in size by 01 December 2015 - Staged reductions via Farm Nutrient Plans (FNPs) mandated through Resource Consents - Individual farmer resource consents applied for by 01 December 2017 - Farmer accountability, obligatory by 01 December 2032
2. Incentives Programme	100tN	- Regional Council accountability, to be achieved by 01 December 2022 through the proposed Incentives Programme
3. Gorse Re-vegetation Programme	30tN	- Regional Council responsibility through a catchment gorse elimination programme to be achieved, in collaboration with farmers and landowners, by 01 December 2022 using separate funding

The proposed approach[6] was presented to the Strategic Policy and Planning Committee on 17 September 2013 where it was adopted. It became known as the Integrated Framework[7].

The understanding of the agreed Integrated Framework is that the proportions of Nitrogen load reduction are to remain consistent through time. These percentages have been taken through into the allocation discussions as an important principle that needed to be met within the process of defining sector averages and ranges.

The Framework is a sharing of the required reductions between landowners through rules and the community through the incentives and gorse programmes. The Integrated Framework describes the core features of the approach to achieving the nitrogen target. While the nitrogen reduction figures may need to be updated due to developments since 2014, the key elements of the framework remain. The Integrated Framework is supported by engineering solutions that are designed to reduce 50 tonnes of nitrogen/year entering the lake.

[6] Lake Rotorua Stakeholder Advisory Group (StAG) *Position Paper - Allocation Rules and Incentives* 17 September 2013

[7] See recommendation 2 of Strategic Policy and Planning Committee 17 September 2013.

Table 1 Integrated Framework for Lake Rotorua catchment.[8]

Rules Programme – 140 tonne reduction		
By 2015	Farm Nutrient Plans	Plans will be put in place for every farm, setting out a practical pathway of staged nitrogen reductions.
By 2017	Resource Consents	Farms will be consented, with a Farm Nutrient plan as a consent condition.
By 2032	Nitrogen Discharge Allowances	Average of 35 kgN/ha/yr for dairy and 13kgN/ha/yr for drystock, with adjustments made for geographical and farm systems characteristics.
$5.5m available to support meeting the requirements of the rules and to engage with the incentives fund.		
Incentives Programme – 100 tonne reduction		
By 2022	Incentives Fund	$40m "below the line"[9] to remove 100 tonnes of nitrogen.
Gorse Programme – 30 tonne reduction		
By 2022	Gorse Fund	Separate funding to remove 30 tonnes nitrogen from gorse conversion.

1.4.1 Incentives and Gorse Programmes

The Integrated Framework includes the Incentives and Gorse Programmes which will together reduce 130 tonnes of annual nitrogen leaching. While the section 32 report evaluates the impacts of the new RWLP policies and rules, the following provides an overview of the other components of the Integrated Framework: the Incentives and Gorse Programmes.

The Incentives Programme

A $40 million incentive scheme has been established to permanently remove 100 tonnes of nitrogen from the Lake Rotorua catchment.

The Incentives Programme is an integral part of the framework for achieving the nitrogen reduction targets for Lake Rotorua, and a key part of the cost sharing between farmers and the community. The Crown and the Regional Council have contributed equally to the $40 million incentives fund.

The incentives scheme is available for landowners who want to permanently reduce their nitrogen losses below their Nitrogen Discharge Allowance (NDA). The scheme enables landowners to "sell" some or most of their property's NDA to permanently remove this nitrogen from the catchment. Involvement in the incentive scheme is voluntary. For most landowners participating in the scheme is likely to mean changing the type of activity they are doing on part or all of their land: for example converting pasture to forestry, or changing to some other low nitrogen loss land use. Experience in the Lake Taupō cap and trade scheme suggests that $40m is likely to

[8] The average discharge figures are OVERSEER® 5.4 numbers, and the incentives and gorse targets are now described as "post-attenuation" numbers.
[9] "Below the line" refers to the nitrogen below landowner individual 2032 target, i.e. purchasing nitrogen discharges beyond the landowner reductions required by the rules.

be a sufficient budget to buy the nitrogen reductions required[10], and this is confirmed by the results of catchment modelling.[11]

Selling nitrogen allowances to the scheme is about permanent reductions. Landowners will sign an agreement which:

- Includes a deed that survives in perpetuity,
- Records the land use change; and
- Secures the nitrogen reductions.

The Gorse Programme

Gorse conversion to forestry in the Lake Rotorua groundwater catchment is expected to remove 30 tonnes of nitrogen per year.

To meet the nitrogen limit for Lake Rotorua, all manageable sources of nitrogen need to be targeted. Gorse is a legume, or nitrogen-fixing plant, and research has shown it is capable of leaching significant amounts of nitrogen to groundwater which flows into the lake. Early estimates based on work by SCION[12] were that this nitrogen leaching rate was approximately 50 kg/ha/yr.[13] This figure has since been revised as a result of peer review to 38kg/ha/yr. It is estimated that 870 hectares of gorse in the Rotorua catchment[14] contributes 30 tonnes of nitrogen to the lake every year. This figure was included in the Integrated Framework as a target to be achieved through incentives funding.

The Gorse Conversion Project will fund the conversion of mature gorse to production forestry, native bush, or other low nitrogen leaching activities. The funding covers the initial gorse control, site preparation, fencing, planting, and weed and pest control.

Nitrogen reductions from gorse conversion will be calculated on a catchment basis. Gorse removal will not contribute to individual property reductions because nitrogen loss from gorse is not included in Rule 11 benchmarks. Instead it is captured as "bush and shrub" with an average nitrogen loss of 3kg/ha/yr. This is significantly lower than the potential nitrogen loss from gorse which could be as high as 38kg/ha/yr.

Under the Plan Change, any parts of a property in gorse will be calculated using the forestry sector allowance of 3kg/ha to calculate a property's Nitrogen Discharge Allowance. This approach has been taken as re-assessing benchmarks to account for gorse would result in windfall gains for landowners. The gorse conversion funding recognises that there is no benefit to be obtained in an allocation sense from managing (removing) gorse.

[10] Kerr, Greenhalgh and Simmons (2015, p.5). The authors note that the trading price for nitrogen discharge allowances in 2012 was around $300/kg, although the price was 'largely determined by the [Lake Taupō Protection] Trust's trades, so does not necessarily reflect the long-run value of nitrogen in the [Taupō] catchment.
[11] Parsons, Doole, Romera (2015).
[12] Magesan G & Wang H (2008).
[13] Environment Bay of Plenty (2010).
[14] Boffa Miskell Limited (2011).

Key reference documents
Fact Sheets http://www.rotorualakes.co.nz/fact_sheets • Fact Sheet 5 – Gorse Conversion • Fact Sheet 3 – Draft Rules – Q&A

1.5 An underpinning methodology

Effective regulation requires a robust platform of information. The development of the Lake Rotorua Nutrient Rules has included extensive investigation and analysis, but it is not possible to provide absolute certainty. Fixing the rules to information at one point in time would introduce risks and potentially increase costs of achieving the nitrogen reduction target. To avoid these risks, a methodology has been designed to take advantage of the benefits of changing information in the context of the Lake Rotorua Nutrient Rules.

The methodological approach uses modelled numbers, and specifies the start (current load) and end (target load) points for nitrogen to the Lake. These choices are informed by robust science and analysis. Scientific research will continue to contribute to our knowledge base over time, and while numbers will change, the methodology will remain constant. The methodology incorporates numbers and narrative, and is designed to adapt to new information.

The key aspects of the methodology are:

- Accepting the sustainable lake load of 435 tonnes per year of nitrogen entering the lake (RPS)
- Accepting the steady state nutrient load to Lake Rotorua of 755 tonnes (ROTAN 2011[15])
- Requiring reductions in sector discharges of 35% from Dairy and 17% from Drystock (from the Integrated Framework)
- Allocating Nitrogen Discharge Allowances ('NDA') based on the Integrated Framework
- Ensuring that NDAs retain proportionality to OVERSEER® reference files into the future[16]
- Balancing adaptive management, using best science and good data, and providing certainty for the pastoral sector.

This approach balances certainty with the ability to respond to the best available science. The rules are designed to align with this methodology. A purely scientific approach would see a fluid environment in which shifts in modelling and science would cause shifts in the implementation of the rules. While this may create less risk for the achievement of the outcome, it would create significant uncertainty for landowners and Council.

[15] Rutherford K.C., Palliser C., Wadhwa S. (2011)(1).
[16] See section 10.6.2 for a discussion on reference files.

Research and science continue to influence our understanding of the lake and nutrient dynamics. This means that in cases the numbers underpinning aspects of the rules will change. In particular the numbers relating to nitrogen loss from pastoral land use are generated from OVERSEER® which undergoes regular version change. This presents a challenge to developing and implementing rules and in communicating with the community. Every number needs to be placed specifically in its relevant context to prevent misunderstanding. The rules therefore use a combination of dates and versions to do this.

1.6 What will the Plan Change look like?

This Plan Change will be included as a new topic-based chapter to the RWLP, comprising 17 new policies, 5 new methods, 14 new rules, 23 new definitions and 7 new schedules.

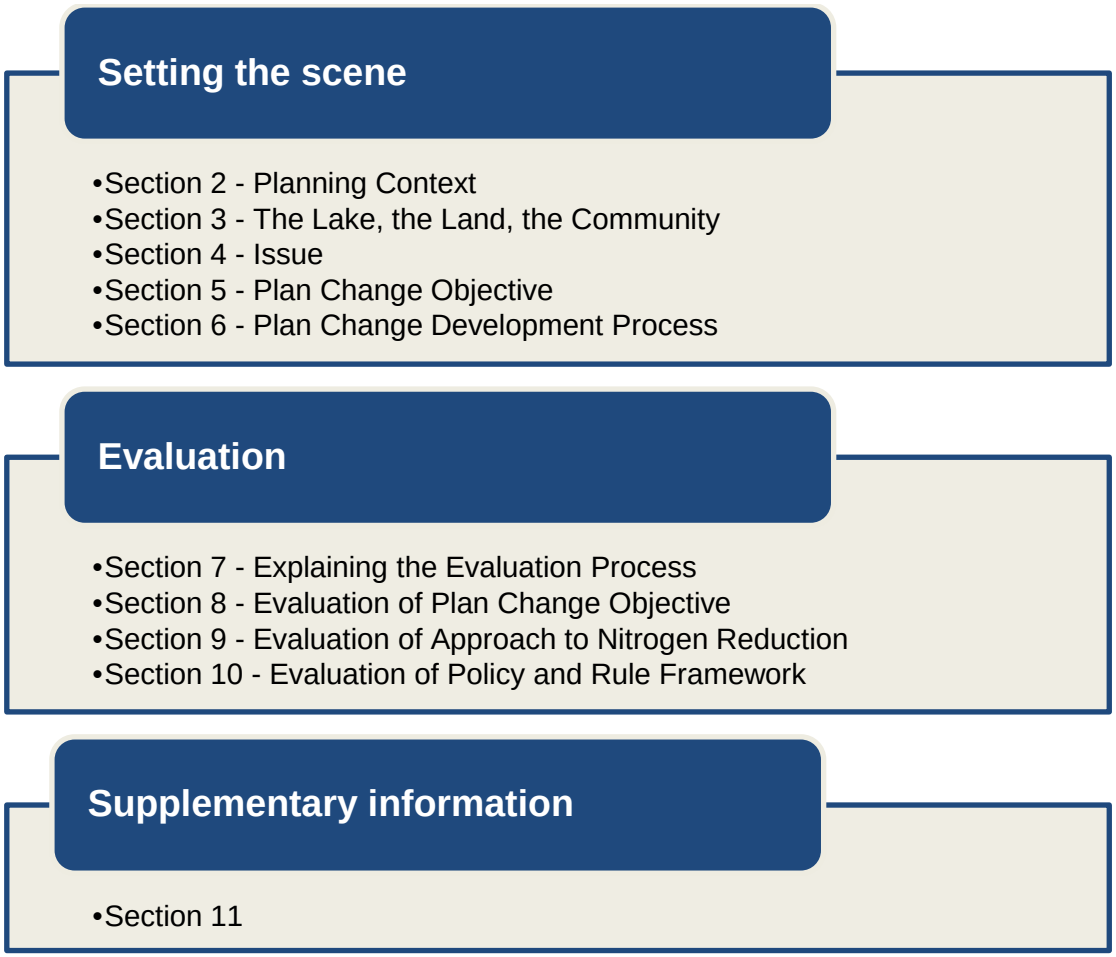
Key features of the Plan Change include:

- Managing farming activity land uses on the basis of property/farming enterprise size.
- Requiring resource consents for farming activities that have higher rates of nitrogen loss.
- Setting NDAs for all properties requiring resource consents.
- Allowing movement of NDAs between properties (i.e. trading).
- Requiring information reporting for all properties that have higher rates of nitrogen loss.
- Establishing staged nutrient reduction pathways by way of:
    - Nitrogen Management Plans, to show how landowners will make nutrient reductions over time towards their NDA.
    - Phasing in of rules between 2017 and 2022.
- Undertaking science reviews as specified in the rules framework.

The plan change does not include new objectives but relies on existing objectives within the RPS and RWLP.

1.7 Report structure

This report is structured as follows:



2 Planning context

The National Policy Statement for Freshwater Management (NPS-FW) requires robust management of effects on freshwater in New Zealand. This will be achieved through consultation with communities in Water Management Areas (WMA). The water quantity limits and quality targets for the Rotorua Lakes WMA will include the Compulsory National Values (NPS-FW) and will consider the Additional National Values (NPS-FW), as well as the values expressed by the community, including tāngata whenua. Objectives based on selected values and the attributes to achieve those values will be incorporated into the RWLP via future plan changes.

The Regional Policy Statement sets the strategic direction for environmental management, while the RWLP comprises the regulation (i.e. rules) to achieve that strategic direction. This Plan Change will accompany existing rules within the RWLP.

The Strategy for the Lakes of the Rotorua District provides an overall management strategy for the Rotorua Lakes. It is an overarching policy document that provides a future vision with practical steps for achieving that vision. The Strategy is supported by Action Plans for individual lakes.

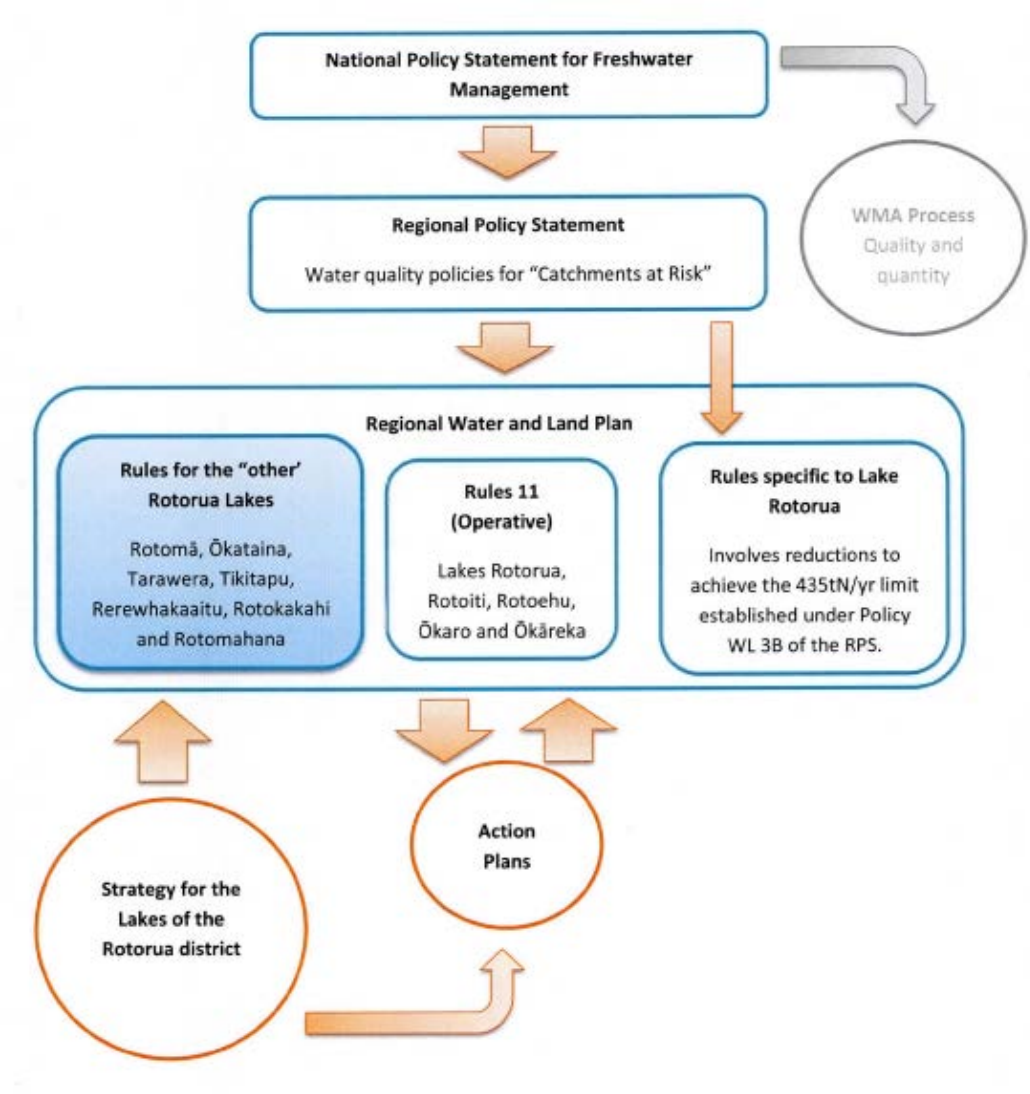


Figure 1 Rotorua Te Arawa Lakes planning and policy context.

This Plan Change sits in a wider policy environment and has been developed within a highly constrained policy context. The starting point for rule development is defined by the Regional Policy Statement. The full wording of the relevant provisions of the RPS and RWLP is in Appendix 2.

2.1 Regional Policy Statement

The RWLP establishes a water quality target of TLI 4.2 for Lake Rotorua. The RPS requires reduction of nitrogen entering the lake to meet the required future state for the Lake, and states that the total amount of nitrogen shall not exceed 435 tonnes per annum[17].

The policy context is constrained by the following RPS policies:

- The total amount of nitrogen entering the lake shall not exceed 435 tonnes per annum (Policy WL 3B)
- The capacity of the Lake to assimilate contaminants (nitrogen) must be allocated to land use activities (Policy WL 5B)
- Require, including by rules, the managed reduction of nutrient losses (Policy WL 6B)
- 70 percent of the required nitrogen loss reduction must be achieved by 2022 (Policy WL 6B)
- The nitrogen loss limit for the lake (425t per annum) must be reached by 2032 (Policy WL 6B)[18]

These policies provide the basis for the Plan Change development. In particular, Policy WL 5B has guided the approach for nitrogen allocation (refer to section 10.2.2 of this report).

Method 2 of the RPS directs the RWLP to give effect to these policies within two years from the date on which the Bay of Plenty Regional Policy Statement is made operative (October 2014).

2.2 Existing RWLP provisions

This Plan Change will be included as a new chapter within the RWLP. The new policies and methods (including rules) will integrate with existing RWLP issues, objectives, policies and methods as follows:

- Land use and management practices may cause adverse effects on water quality (Issue 10)
- The water quality of Lake Rotorua is maintained or improved to the Trophic Level Index of 4.2[19] (Objective 11)
- Manage land and water resources within an integrated catchment management framework (Policy 21)

[17] The sustainable lake load is defined as the amount of nitrogen annually entering the lake.
[18] In 2013 the Bay of Plenty Regional Council, Federated Farmers Rotorua, and the Primary Producers Collective signed the Oturoa agreement. This outlined the agreed timelines to achieve catchment nutrient reduction targets.
[19] Refer footnote 1.

- Develop equitable and workable provisions where land use restrictions or changes to land management practices are required to maintain or improve water quality (Policy 23)
- Develop Action Plans to maintain or improve lake water quality (Method 41)
- Support land use changes, and changes to land use rules (Method 43)
- Rules 11-11F ('Rule 11'), which relate to discharges of nitrogen or phosphorus from Land Use and Discharge Activities in the Rotorua Lakes Catchment.

3 The Lake, the Land, the Community

Lake Rotorua was named by Ihenga, grandson of Tamatekapua who was the captain of the Arawa canoe.
Ihenga named the largest lake, Rotorua nui ā Kahu-matamomoe, in honour of his father-in-law and uncle, Kahumatamomoe.
"Rotorua nui" refers to the large basin-like lake.[20]

Lake Rotorua is well-known for the love story of Hinemoa and Tutanekai. According to the Māori legend, Hinemoa swam across the lake to her lover Tutanekai who lived on Mokoia Island, guided by the sound of Tutanekai's flute.

At 8,060 hectares, Lake Rotorua is the largest lake in the Rotorua district. It was formed from the crater of a large volcano in the Taupo Volcanic Zone some 220,000 years ago.[21] It is a relatively shallow lake, with an average depth of just 11 metres.

The city of Rotorua is on the south-western shore of the lake and covers about eight percent of the 50,060 hectare lake catchment. The Rotorua District has a population of around 65,300, with 38 percent of residents of Māori ethnicity – two and a half times higher than the national level. Sixty-eight percent of residents are of European ethnicity, five percent Pacific peoples and six percent Asian. In comparison with national statistics, the median income in Rotorua is slightly lower, people are less likely to hold a formal qualification, and are more likely to have been born in New Zealand.[22]

The lake and its surrounds contribute to the economic, cultural, social and environmental wellbeing of local people and people of New Zealand. Tourism, pastoral farming and forestry are the mainstays of the Rotorua district economy.

[20] Rotorua Te Arawa Lakes Programme (2015).
[21] Lake Ecosystem Restoration New Zealand (2015).
[22] Statistics New Zealand (2013)

This Plan Change relates to all land surrounding Lake Rotorua. The boundary is based around the groundwater catchment shown on the map (Figure 2).

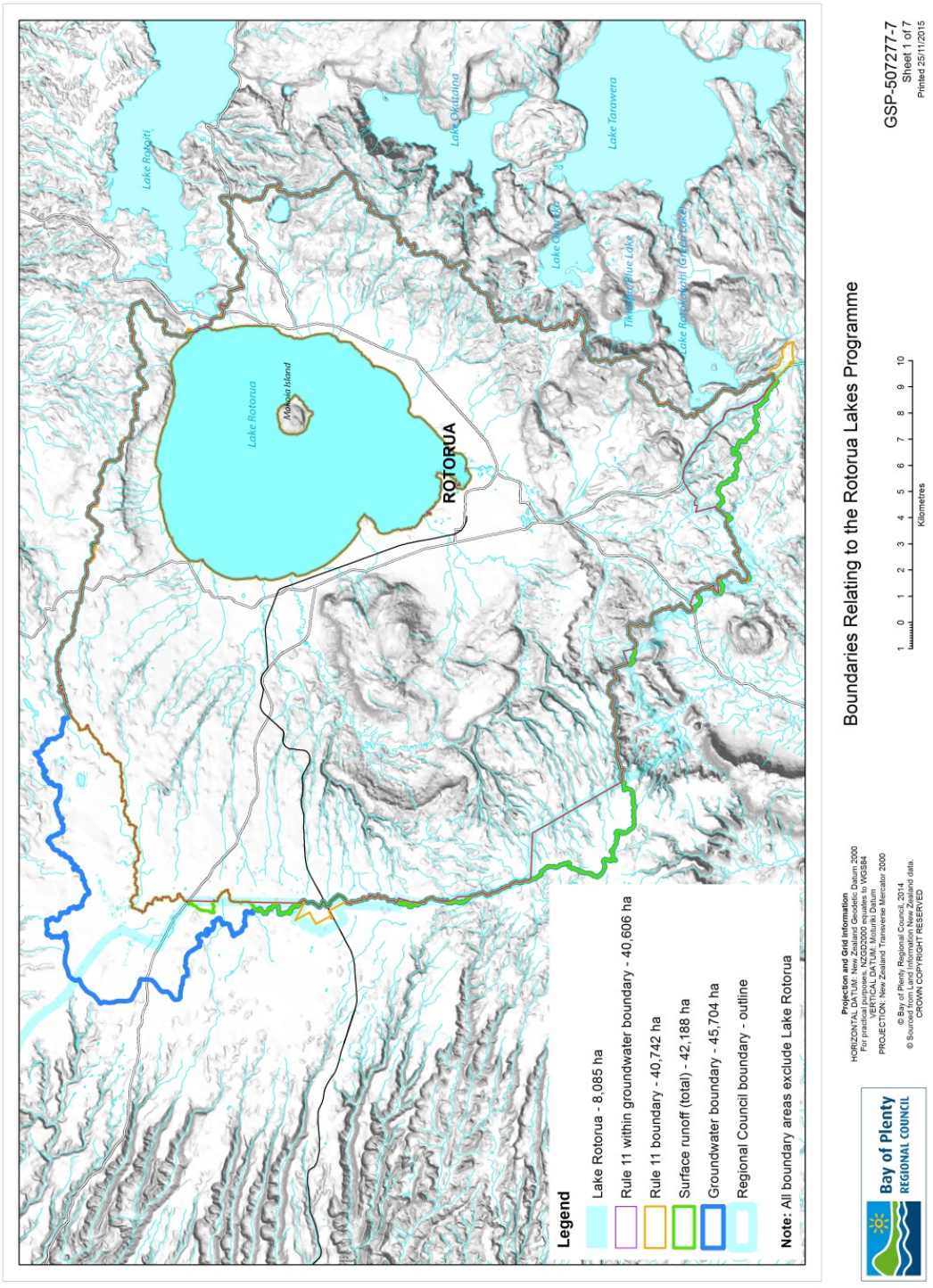


Figure 2 *Lake Rotorua groundwater catchment map with groundwater boundaries.*

Refer to section 11.2 for further details about the determination of the catchment boundary.

3.1 Catchment land use

The Lake Rotorua catchment is some 50,060 hectares, dominated by pastoral farming and forestry. The catchment includes around 9,000 hectares of indigenous vegetation on public and private land, and the Department of Conservation manages 3,250 hectares of public conservation land in the catchment, which includes Mount Ngongotahā.

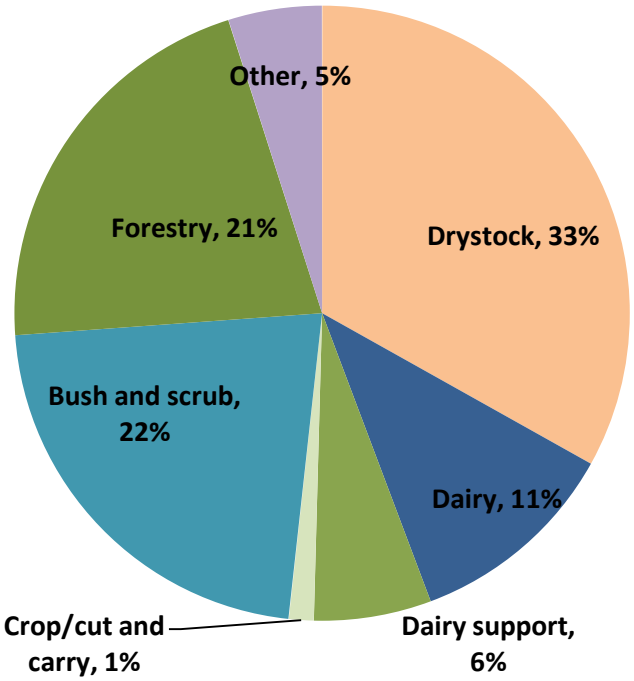


Figure 3 Land use within the Lake Rotorua groundwater catchment (excl. public land).[23]

Under the RWLP, Rule 11 applies to the Lake Rotorua surface water catchment. Rule 11 seeks to cap nitrogen and phosphorus loss from land at the 2001-2004 levels, but does not seek to reduce nutrient loss from land use.

The new rules in this Plan Change apply to properties in the groundwater catchment and seek nitrogen loss reductions.

Māori Land

Māori Land is land held in multiple ownership under the Te Ture Whenua Māori Land Act 1993. About 11,000 hectares (25 percent) of the Lake Rotorua catchment is Māori Land. Land use on this land is predominantly drystock farming (40 percent), and sixteen percent is used for dairy farming or dairy support. Around one-fifth (22 percent) of Māori Land is in bush and scrub, and 16 percent in forest. Māori Land makes up 11 percent of the total area of small properties (less than 40 hectares) in the catchment.[24]

[23] Bay of Plenty Regional Council GIS files. Objective reference: A1969765.
[24] Land Connect Ltd (2015). The figure here is based on Rotorua Lakes Council Land Valuation Reference data.

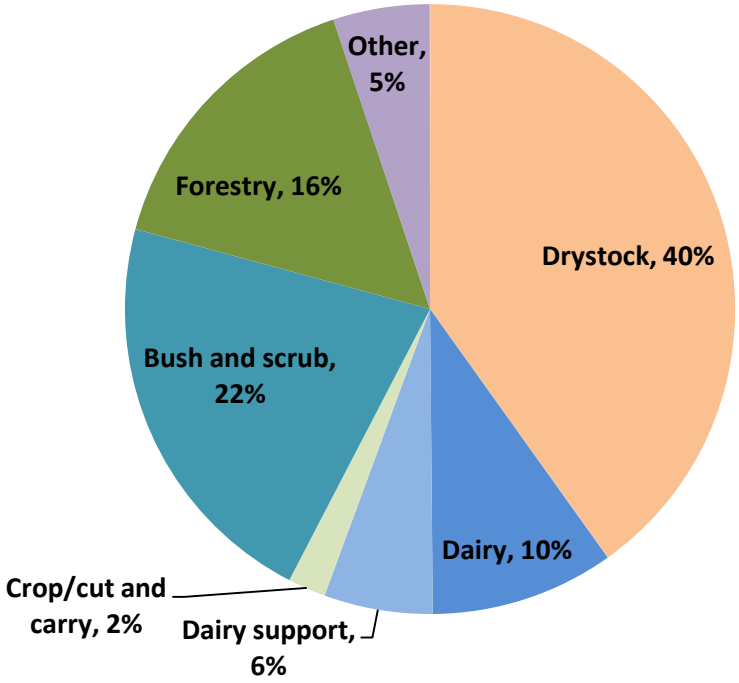


Figure 4 *Land use on Māori Land in the Lake Rotorua groundwater catchment.*[25]

Most (40 percent) of the Māori land in the catchment is classified as flat. The balance is split fairly evenly between rolling, easy and steep land.

Te Tumu Paeroa has an administrative role for 81 entities in the catchment, making up 3,436 hectares. It is the Responsible Trustee for 24 entities, the Custodian Trustee for 37 entities, and the Agency Trustee for 23 entities.

Māori Land in the catchment sits under a separate legislative and cultural structure to general land. It cannot be sold on the open market, it can be difficult to raise funds to develop, and historical factors mean that much Māori land in the catchment has not been developed.

Forestry

The 16 forestry blocks (any block with over 90 percent of the property in forestry) in the Lake Rotorua catchment cover over 8,000 hectares. In addition to the large blocks of forest, the area in exotic forest intended for harvest makes up around four percent of the land on pastoral farms, and native scrub and bush made up around seven percent.[26]

[25] Bay of Plenty Regional Council GIS files. Objective reference: A1969765.
[26] Statistics New Zealand: *Agricultural Production Census 2012*.

Pastoral farming

Dairy farming occurs on about a quarter of the pastoral farming land in the catchment. In 2012, 30 properties in the Lake Rotorua catchment identified as dairy farms, with 27 (90 percent) of these being greater than 40 hectares.[27] The total number of dairy cattle in the catchment reduced by ten percent between 2007 and 2012, to 20,200 (Figure 5). This change was made up of an increase of 1,800 dairy cattle on dairy farms and a decrease of 4,000 dairy cattle on drystock farms. During the same period the total number of dairy cattle in the region increased by 13,000 (four percent). Intensification of pastoral farming in the lake catchment has been constrained by benchmarking under Rule 11.

In 2012, 114 farms in the catchment identified as drystock farms, most of these farming sheep and beef. Seventy-five percent of these were 40 hectares or more, and 27 of those farms were larger than 80 hectares.[28] In 2012 there were around 11,000 beef cattle in the catchment and 16,000 sheep. Beef cattle numbers were fairly steady for the five years to 2012, while sheep numbers reduced by one-fifth.

Compared with dairy and sheep and beef farming, deer farming is relatively uncommon in the Lake Rotorua catchment area. In late 2015 there were about 18 properties in the catchment with deer, although deer farming was not necessarily their main business. Eleven of these were properties of greater than 10 hectares, and seven of those were exclusively deer. Deer farming in the catchment comprises velvet operations, studs, and venison production.

Deer farming has declined in the catchment and across New Zealand in recent years. The national herd reduced by around 24 percent in the five years to 2012, and has continued to reduce since then. Over the same period the number of deer in the Lake Rotorua catchment halved (Figure 5). Deer farming infrastructure (such as fencing and handling facilities) remain on farms allowing them to readily revert back to deer in the future.

Livestock in the catchment are not restricted to these four livestock types, but these are the largest groups.

[27] Statistics New Zealand: *Agricultural Production Census 2012*. The Census is sent to all GST-registered agricultural businesses. GST registration is compulsory for businesses with a turnover greater than $60,000/year, and voluntary below that level. There is therefore partial and unquantifiable coverage of units below this turnover level. Census data is rounded up or down to multiples of three.

[28] Statistics New Zealand: *Agricultural Production Census 2012*.

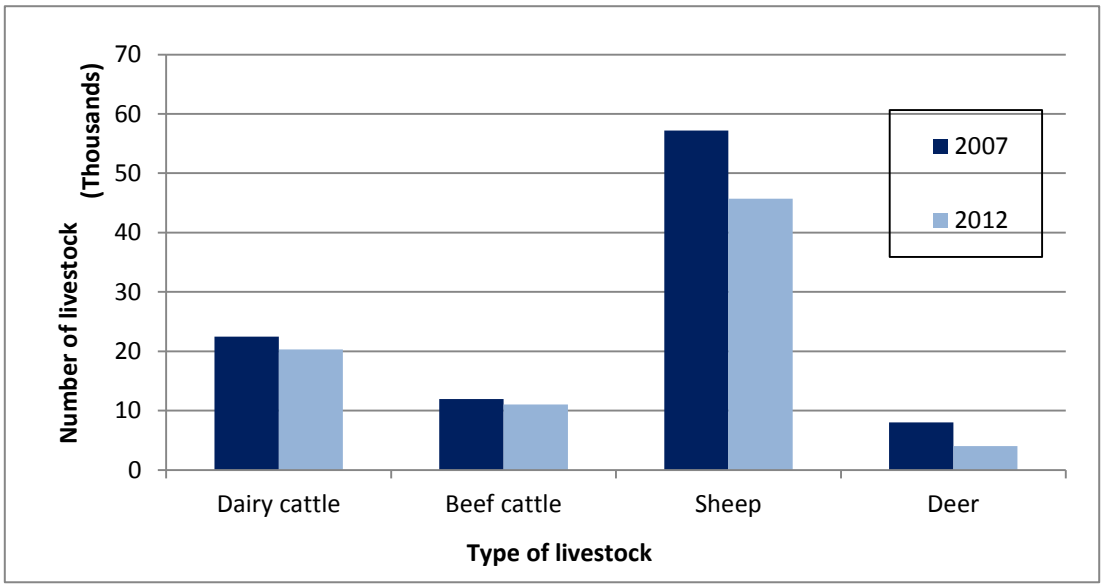


Figure 5 Number and type of livestock in Lake Rotorua Catchment.

Small properties (less than 40 hectares)[29]

Small properties are a feature of the Lake Rotorua catchment, with around 1,480[30] properties making covering 5,600 hectares, including 4,150 hectares effective area.[31] Approximately 70 percent of small properties are less than four hectares, covering a total area of 1,100 hectares.

In 2012, 132 small holdings in the catchment were included in the Agricultural Production Census. Of these, 57 were less than 10 hectares and 24 were less than four hectares. The majority of GST-registered smallholdings (57 percent) identified themselves as sheep and beef businesses. Two percent identified as dairy farms, and two percent as deer farms. Drystock farming occurs on 90 percent of small properties, and dairy support occurs on at least six percent of small properties.[32]

The majority (80 percent) of small holdings are privately or company owned. Māori-owned small holdings make up 11 percent of the total land area in small holdings, and publicly owned land (e.g. Department of Conservation) make up 10 percent.

3.2 Cultural values and association

The traditional, historical, cultural and spiritual relationship and association of Te Arawa hapū and iwi with Lake Rotorua is evident through:

- The physical presence (or remnants) of historic settlements and places of significance (e.g. waahi tapu)
- Pakiwaitara (stories) and waiata (songs) featuring the Te Arawa Lakes
- The number of marae located on the shores of the Te Arawa Lakes.

[29] Land Connect Ltd (2015).
[30] One property may comprise several value references; as a result this figure overestimates the number of small properties, possibly by as much as 20 percent.
[31] Effective area is the combined area of pasture and all forage and cash crops (definition from Beef and Lamb NZ).
[32] Land Connect Ltd (2015).

The cultural values associated with Lake Rotorua are physical and metaphysical. To Te Arawa, the lakes are a taonga, and their relationship to the lakes and environs is the foundation of their identity, cultural integrity, wairua, tikanga and kawa. This was recognised by the vesting of the lakebed in Te Arawa, through the Te Arawa Lakes Trust as a result of Treaty Settlement.[33]

The guiding Te Arawa values:[34]

- Are based around wai (water) as central to life, symbolising the lifeblood of Papatuanuku (earth mother) and the tears of Ranginui (sky father). It is the element that binds the physical and spiritual realms.
- Are structured and layered like Whakapapa, encapsulating the Māori world views and acknowledging connection with the gods, the natural world and each other.
- Reflect the voice of Te Arawa.

[33] Te Arawa Lakes Settlement Act 2006 and Deed of Settlement 2004.
[34] Te Arawa Lakes Trust (2015a).

4 Issue

4.1 Issue statement

The best available science indicates that the sustainable limit for nitrogen entering the lake is 435 tonnes per year and the current amount of nitrogen entering Lake Rotorua is approximately 755 tonnes per year.[35]

Nitrate (NO_3) and ammonia (NH_3) are common forms of nitrogen in water, and both cause problems. Very high levels of nitrate can make groundwater unsafe to drink, and ammonia is highly toxic to fish and other creatures that live in water. High levels of nutrients (nitrogen and phosphorous) can cause excessive growth of aquatic plants, including algae.[36] This can lead to algal blooms, making the water unsafe for contact recreation such as swimming and boating. Poor water quality reduces the mauri (life force) of the lake and reduces mahinga kai habitat and survival.

Nitrogen arrives at the lake through natural and human-induced processes. Natural processes include rainfall, geothermal activity, and leaching from below forestry and native bush. These sources account for 18 percent of nitrogen to the lake. Human-induced sources contribute the majority of nitrogen to the lake, including 526 tonnes from pastoral sources (dairy, sheep, beef, deer and grazed lifestyle blocks), 60 tonnes from sewage and septic tanks, and 34 tonnes from the urban area. Nitrogen from natural processes cannot be reduced, so this policy focuses on those from human activities.

Box 2 – The position on alum dosing

Alum dosing (adding Aluminium Sulphate) has been used by Council since 2006 (Utuhina Stream) and 2010 (Puarenga Stream) to 'lock up' or reduce the amount of phosphorus in water.

Alum dosing within the Lake Rotorua Catchment has been piloted as a nutrient management intervention. It has proved to be a relatively cost effective mechanism. Monitoring indicates that alum dosing has had a beneficial effect on the quality of Lake Rotorua by reducing the phosphorus content of the lake water[37].

Alum dosing does not have a direct effect on nitrogen levels in the lake, but does appear to have a role in flocculating organic matter in the lake. This takes organic matter and its associated nitrogen to the bottom of the lake. Alum dosing will not achieve the sustainable lake load of 435 tonnes of nitrogen per year as required by the RPS. The decision-making framework for alum dosing under the RMA considers it as a temporary mechanism – not a long-term solution. Specifically, the current consents for alum dosing were on the basis that other land-based interventions would be undertaken to support the long-term nutrient reductions required.

Further information can be found in section 9.4 of this report.

[35] Rutherford, Palliser, Wadhwa (2011).
Note: RPS Policy WL 6B indicated a current state of 746 tonnes of nitrogen per year based on the estimates provided in the 2009 draft Lake Rotorua and Rotoiti Action Plan.
[36] Parliamentary Commissioner for the Environment (2013).
[37] MacIntosh (2012).

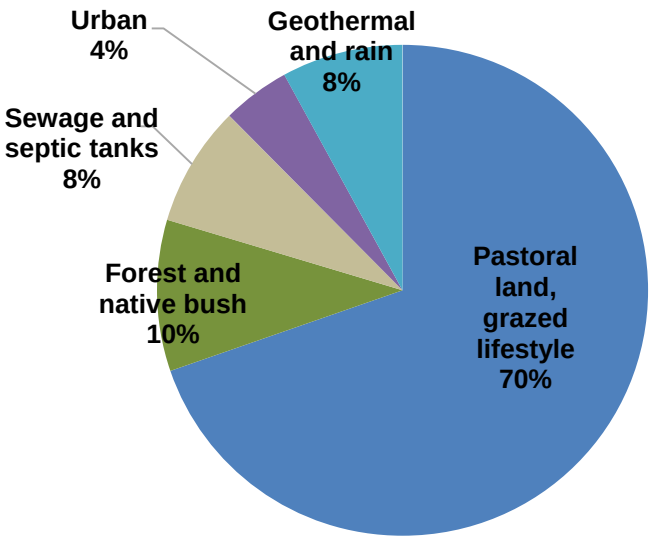


Figure 6 Percentage contribution of nitrogen load to Lake Rotorua, by source.

4.2 Why new policies and rules are needed

Rule 11 and existing lake improvement actions are not sufficient to achieve the sustainable level of nitrogen entering the lake, so new policies are required to achieve the reductions required by Policy WL 6B in the RPS. This is explained further below.

4.2.1 Current rules are ineffective for nitrogen reduction

Rule 11, introduced in 2005, set a discharge limit or nutrient benchmark based on the land use of each property based on nitrogen discharges for 2001-2004. The intention of Rule 11 was to stop further *increases* in nitrogen leaching into the lake, but nutrient *reduction* is not required by the Rule.

4.2.2 Current actions and engineering solutions alone provide limited benefit for water quality improvement

No single measure will be sufficient to improve Lake Rotorua water quality. The following initiatives have been completed:[38]

- Sewerage reticulation: Completed for Brunswick, Hinemoa Point, Tarawera Road and Paradise Valley.
- Floating wetland: Completed, though plants need to establish before nutrient removal occurs. Achieves a small amount of nitrogen reduction – considerably less than was anticipated in the design work.[39]
- Detainment bunds: Eight have been installed on farms on State Highway 36.
- Alum dosing (also known as phosphorus locking) in Utuhina and Puarenga Streams (refer Box 2 overleaf and section 9.4 of this report): this treatment has been very successful in Lake Rotorua, and has achieved greater than anticipated results – however it is not a permanent solution.

[38] http://www.rotorualakes.co.nz/lake_rotorua_achievements
[39] Bay of Plenty Regional Council. Objective reference: A2184465.

The following initiatives are planned or pending:

- Construction of the Tikitere Geothermal Treatment plant (deferred until 2018/2019)
- Alternative wastewater disposal options from the Rotorua Wastewater Treatment Plant into Whakarewarewa Forest.

For the past three years Lake Rotorua water quality has been at or very near to its TLI target. This is primarily due to alum dosing, which has been very effective but is not considered a long-term solution, and does not reduce nitrogen to the levels required (refer to section 9.4).

The actions above have contributed to the improvement in lake water quality but they can reduce annual nitrogen entering Lake Rotorua by, at most, 50 tonnes. This is insufficient to achieving the sustainable nitrogen limit by 2032.

4.2.3 The RPS directs managed reduction by way of rules

Policy WL 6B of the RPS specifically refers to the inclusion of rules as a method by which nutrient reduction is managed. Other than rules within a regional plan, there are no other effective options available to Council for meeting the direction of "requiring" within this policy.[40]

Key reference documents

- Bay of Plenty Regional Council (2013). *Trends and state of nutrients in Lake Rotorua streams*. Environmental Publication 2013/08. http://www.rotorualakes.co.nz/vdb/document/769
- Environmental Management Services Ltd (2009). *Regional Water & Land Plan Rule 11: Review of Efficiency and Effectiveness*. Report prepared for the Bay of Plenty Regional Council. www.rotorualakes.co.nz/vdb/document/162
- Environmental Research Institute (2012). *Predicting the effects of nutrient loads, management regimes and climate change on water quality of Lake Rotorua*. http://www.rotorualakes.co.nz/vdb/document/770
- Rutherford K.C., Palliser C., Wadhwa S. (2011)(1). *Prediction of nitrogen loads to Lake Rotorua using the ROTAN model*. NIWA client report HAM 2010-134. Report prepared for the Bay of Plenty Regional Council. www.rotorualakes.co.nz/vdb/document/768
- Bay of Plenty Regional Council (2014). *Operative Regional Policy Statement*. http://www.boprc.govt.nz/knowledge-centre/policies/operative-regional-policy-statement/
- Bay of Plenty Regional Council (2012). *Allocating Lake Rotorua's sustainable nitrogen limit amongst land use activities*. Draft paper prepared by Council staff. http://www.rotorualakes.co.nz/vdb/document/512

[40] Other legal frameworks for creating regulations include the Local Government Act 2002 (bylaws), Soil Conservation and Rivers Control Act 1941 (soil protection and river management). None of this legislation provides a basis for nutrient loss management.

5 Plan Change Objective

The Plan Change does not include new objectives. It relies on existing objectives within the RPS and RWLP. Section 32 of the RMA states that, where a Plan Change does not include stated objectives, then the 'Plan Change Objective' relates to the purpose of the proposal. The purpose of the proposal is:

To reduce nitrogen losses from rural land within the Lake Rotorua catchment to meet the nitrogen limit set by the Regional Policy Statement.

In other words, the purpose is to reduce the annual load of nitrogen to the lake from 755 tonnes to 435 tonnes by 2032.

To achieve the water quality target of TLI 4.2, the RPS sets an annual limit of 435 tonnes of nitrogen. This is to be achieved by 2032 (refer Figure 7 below).

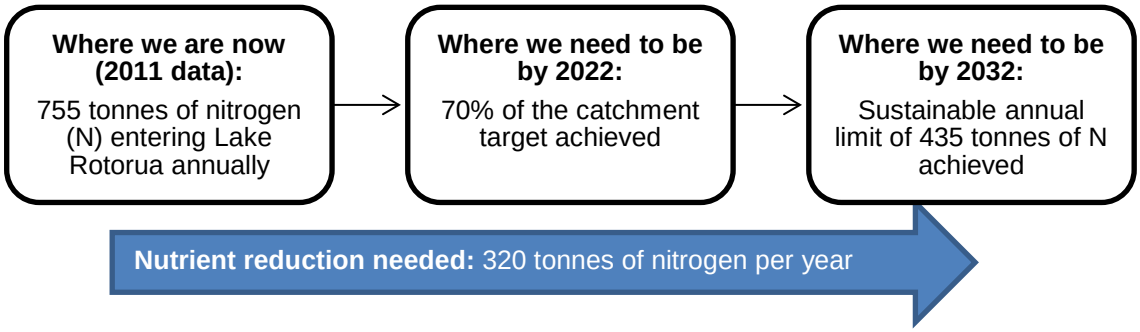


Figure 7 – Lake Rotorua nitrogen levels: where we are and where we need to be.

To meet this target, the annual amount of nitrogen entering the lake must be reduced by 320 tonnes. Of this, 50 tonnes can be reduced through urban and engineering solutions (refer section 4.2.2). The remaining 270 tonnes is to be achieved through reduced discharges from rural land.

Key reference documents

- Rutherford J.C., Pridmore R.D., White E. (1989), *Management of phosphorus and nitrogen inputs to Lake Rotorua, New Zealand*. Journal of Water Resources Planning & Management 115 (4): 431-439.
- Rutherford, K., (2003), *Lake Rotorua Nutrient Load Targets*. NIWA Client Report: HAM2003-155
- Rutherford, K. (2008), Nutrient load targets for Lake Rotorua - a revisit, NIWA Client Report: HAM2008-080.
- Rutherford, K.C., Palliser, C., Wadhwa, S. (2011)(1). *Prediction of nitrogen loads to Lake Rotorua using the ROTAN model*. NIWA client report HAM 2010-134. Report prepared for the Bay of Plenty Regional Council. www.rotorualakes.co.nz/vdb/document/768
- Bay of Plenty Regional Council (2014). *Operative Regional Policy Statement*. www.boprc.govt.nz/knowledge-centre/policies/operative-regional-policy-statement/

6 Plan Change development process

This Chapter outlines how the Plan Change was developed, including what consultation was undertaken and how feedback has shaped the Plan Change.

6.1 Overview of development process

The Plan Change has had a long development process, including more than two years of policy and rule development.

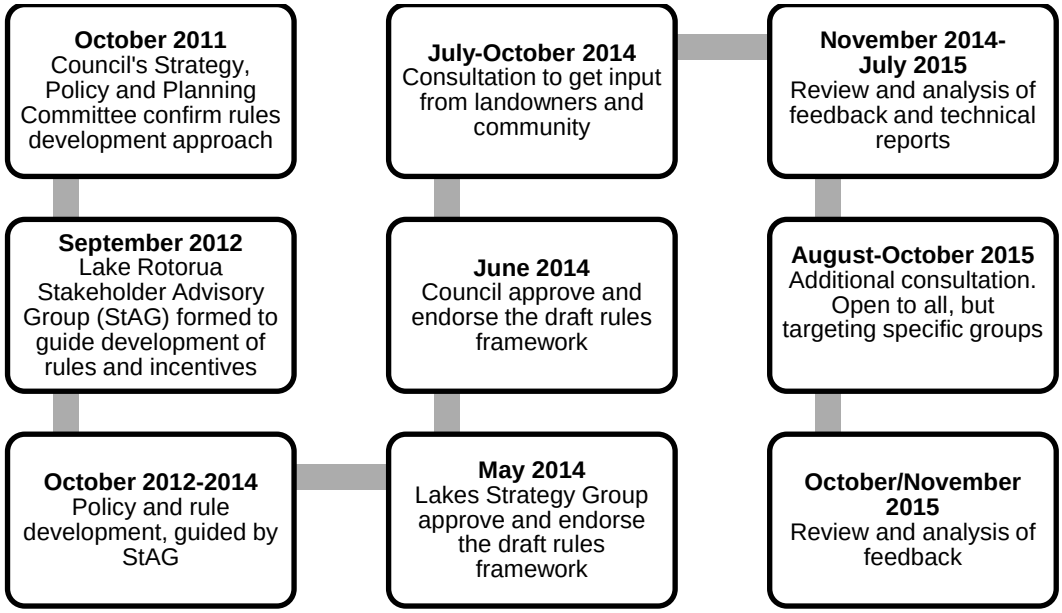


Figure 8 Plan Change development process.

6.2 Participants development of the Plan

6.2.1 Council's Regional Direction and Delivery Committee

The Regional Direction and Delivery Committee have a core function of policy formulation and implementation and monitoring Regional Council strategy and policy.

The Committee meet every six weeks and are the decision-makers for the Proposed Plan Change. Meeting agendas and minutes are publically available: www.boprc.govt.nz/council/committees-and-meetings/regional-direction-and-delivery/

6.2.2 Rotorua Te Arawa Lakes Strategy Group

The Rotorua Te Arawa Lakes Programme is managed by the Rotorua Te Arawa Lakes Strategy Group (RTALSG). This joint partnership of Rotorua Lakes Council, Bay of Plenty Regional Council and Te Arawa Lakes Trust, with funding from Ministry for the Environment, is established in law as part of the Te Arawa Lakes

Settlement.[41] The RTALSG meets four to five times a year to coordinate policy and actions to improve the Rotorua lakes. In relation to the Plan Change, this group:

1 Receives updates from the Lake Rotorua Stakeholder Advisory Group and council staff about rule development

2 Makes recommendations to the Regional Direction and Delivery Committee

Meeting agendas and minutes are publically available: www.boprc.govt.nz/council/committees-and-meetings/rotorua-te-arawa-lakes-strategy-group/

6.2.3 Lake Rotorua Catchment Stakeholder Advisory Group

The Regional Council directed that the development of rules must involve active engagement of stakeholders.[42] As a result, the Lake Rotorua Catchment Stakeholder Advisory Group (StAG) was established in July 2012 to:[43]

- Provide oversight, advice and recommendations on the policy and methods, including rules to achieve the nutrient reduction targets needed from rural land in order to meet the Lake Rotorua water quality target
- Facilitate engagement with all stakeholders

The StAG comprises 15 members from sectors that will be affected by the rules including:

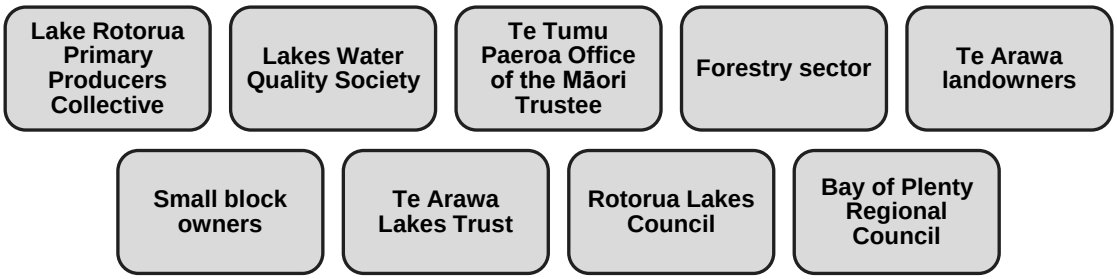


Figure 9 Composition of the Lake Rotorua Stakeholder Advisory Group (StAG).

StAG meets monthly. Meeting agendas and minutes are publically available at: www.rotorualakes.co.nz/stag

[41] Te Arawa Lakes Settlement Act 2006 and Deed of Settlement 2004. Roles and responsibilities are described in Appendix 3.
[42] Bay of Plenty Regional Council (2012). *Strategy Policy and Planning report, 31 July 2012*. This describes the process to deliver a package of rules and incentives for reaching the nitrogen limit for Lake Rotorua. Full URL available in bibliography.
[43] Lake Rotorua Catchment Stakeholder Advisory Group (2012). *Terms of Reference, December 2012*. Objective reference: A1969788.

6.2.4 Other stakeholder engagement

Other stakeholder engagement included:

- Meeting with Te Arawa Lakes Trust staff in August 2015
- Meeting with Waikato Regional Council staff in September 2015 to discuss cross boundary issues
- Responding to correspondence from Beef and Lamb NZ, Federated Farmers and Lake Rotorua Primary Producers Collective.
- Meeting with Rotorua Lakes Council planning staff in August 2015 to provide an overview and update on the draft rules. Draft rules were provided to Rotorua Lakes Council for feedback and response made to letters. There has been a focus on achieving a joined-up approach to economic analysis.
- Informing the Ministry for the Environment about consultation process
- Involving staff from partner organisations in the Workstream Leads and Programme Steering Group meetings within the Rotorua Lakes Programme.

6.3 Community consultation on Draft Rules

Given the scale of change and potential impact associated with introducing new rules within the Lake Rotorua catchment, extensive consultation was undertaken with the community. Every effort has been made to consult with all affected parties and groups. Two specific consultation exercises were undertaken through 2014-15, as well as offers of engagement and continuing engagement with the community, StAG, and other organisations.

6.3.1 July to October 2014 consultation period

Table 2 Overview of 2014 community consultation.

Consultation period	14 July 2014 to 31 October 2014. *In response to requests from iwi and the public for additional consultation time, the original consultation deadline was extended from 14 October to 31 October 2014.*
Consultation purpose	• To engage with the Lake Rotorua catchment community and provide an opportunity to respond to the draft rule structure before anything is formalised in a plan change. • To increase awareness about what the rules need to achieve, and how rules will impact land users once they have effect. Views also sought on possible alternatives to the draft rules.
Consultation focus	Consultation was not based around a detailed plan change document (i.e. policy wording). Instead it focused on the draft rule structure: in particular how the rules are intended to work, the changes that are likely for landowners and what that could mean. Staff were clear on the scope of consultation, especially which elements were not open for discussion: e.g. the Lake Rotorua catchment nitrogen limit of 435 tonnes and the target date of 2032.
Consultation materials	• Consultation brochure explaining the draft rule structure. • Eight topic-specific fact sheets made available at public meetings and mailed out as requested. • All supporting / technical documents were available on the Rotorua Te Arawa Lakes Programme website (www.rotorualakes.co.nz/).

Consultation method	• Drop-in days, public information sessions/open days, hui and sector meetings over the first three months. • Additional meetings were held focusing on the small landowner/lifestyle block sector and Māori landowners. • Public meetings.
How information was disseminated	Through Facebook, radio and press adverts, emails, and YouTube. Local, sector-specific and national media also covered the consultation through articles and news stories.
How feedback was collected	Feedback channels included telephone, in person, online, and post or email. The feedback form comprised seven specific questions relating to the draft rules.

6.3.2 August to October 2015 consultation period

Table 3 Overview of 2015 community consultation.

Consultation period	August 2015 to October 2015.
Consultation purpose	• To seek additional feedback from the community: in particular iwi, deer farmers, and small block holders. • To provide the general community further opportunity to give feedback.
Consultation focus	This stage of community consultation included targeted engagement, with a focus on supporting landowners to understand the impact of the rules on their property, and/or on their sector.
Consultation materials	• Groundwater catchment map, resource consenting information, summary of cost impacts for farmers, council report, guide for landowners and the latest version of draft rules were all available at public drop in sessions and posted to people if requested. • Draft rules and all supporting/technical documents were available on the Rotorua Te Arawa Lakes Programme website (www.rotorualakes.co.nz/). • Provision of detailed project information and responses to questions to Chen Palmer (representing Protect Rotorua), including five Local Government Official Information and Meetings Act responses.
Consultation method	• Two public drop-in sessions. • Online feedback forms. • Meetings with about 65 Protect Rotorua members (September, October 2015). • Phone calls to 65 small block owners and deer farmers to listen to ideas and issues, and explain draft rules. • Contacting every known deer farmer in the catchment. • Individual meetings with small block owners and deer farmers organised at landowner's request. • Provision of updates at meetings where iwi and hapū representatives were present. • Meeting with Te Arawa Māori Landowners Collective and staff from Te Tumu Paeroa. • Contacting all Te Arawa Iwi authorities with offer of engagement meetings with Council staff.

How information was disseminated	• Advertising in local newspapers. • Local, sector-specific media. • Letters to 1,200 rural properties and emails to 400+ stakeholders inviting recipients to drop in sessions. • Provision of a dedicated phone line for public enquiries. • Website information updated.
How feedback was collected	Feedback channels included telephone, in person, online (via website), post, and email. Several groups provided written feedback on behalf of their membership.

6.4 Engagement with Iwi Authorities/Māori Land owners

Māori Land is land held in multiple ownership under the Te Ture Whenua Māori Land Act 1993. Jointly-owned Māori land tends to have more obstacles to development than land in general title. This is recognised as an issue of significance in the RPS.

Targeted engagement occurred with Māori Land owners because a large proportion of the catchment that is Māori Land (around 25%). A significant area of undeveloped land (i.e. 'bush') in the Lake Rotorua catchment is Māori Land. There is a view that Māori Land in the catchment is, on average, less developed than non-Māori land (see also section 3.1).

In light of a lack of attendance at public meetings and submissions from Māori landowners, Glenn Hawkins and Associates (GHA)[44] was engaged to assist the Council in raising awareness and encouraging feedback from Māori landowners. Engagement included:

- Dairy and drystock meeting with Tokerau A14A2 Trust Board, Maraeroa Trust Board, and Takehe 8c (29 July 2014).
- Drop-in day for Māori landowners (20 October and 28 October 2014).
- Hui for Māori landowners (21, 22 and 28 October 2014).
- Development of a YouTube video for Māori Land block owners.
- Open invitation to public meetings.
- Meetings specifically with iwi – on request.
- All iwi authorities received updated project information and were offered the option of meetings if desired (September 2015).
- Offers to engage with iwi/hapū groups were made wherever possible: such as at StAG meetings, Hamurana Reserve open day, and RPSC Project Steering Group (21 October 2015).

Iwi groups were exposed to the project through the various forums that operate in the area, including the Regional Council's Komiti Māori, Rotorua Te Arawa Lakes Strategy Group, Lake Programme Steering Group, and StAG. Iwi groups have met to discuss the implications for the Draft rules independently of the Regional Council process.

[44] A Māori accounting and consulting firm.

Summary of feedback

Māori landowners were concerned that the proposed approach will result in inequity and effectively penalise them for their historically low contribution to the current levels of nitrogen. In particular the approach to allocate nitrogen was opposed on the grounds of fairness and equity; it was felt it contradicts the effects-based philosophy of the Resource Management Act 1991 (RMA). There was unease amongst Māori landowners that the measures do not promote incentives to replace high nitrogen emitting activities with low nitrogen emitting activities[45].

6.4.1 Ongoing engagement with iwi/Māori Land owners

Tāngata whenua engagement in the development of the rules has been ongoing:

- During August/September 2015 all Te Arawa iwi authorities received updated project information and were offered options of meeting if desired.
- The project was presented to the Regional Council's Komiti Māori in October 2015.
- As mentioned above, offers to engage with iwi/hapū are made wherever possible.

6.4.2 Taking into account iwi management plans

When a regional council is preparing a plan change it must take into account any relevant planning document recognised by an iwi authority[46].

A review of Iwi Management Plans was undertaken in early 2015. Three management plans contained provisions that were directly relevant to the Plan Change. These include:

- Recognition of declining water quality within the Rotorua Lakes and the downstream effect on the mauri of the Kaituna River.
  This is acknowledged in the option evaluations in section 9 of this report
- Aspirations for Lake Rotorua to be clean and restored to health. This includes the protection and restoration of the mauri of its tributaries).
  This is acknowledged in the option evaluations in section 9 of this report.
- Opposition of continued Alum dosing and sediment capping within the Lake Rotorua Catchment.
  This is acknowledged specifically in section 9.4.1 of this report.
- Support for reduced nitrogen leaching from land use activities along with the use of alternative methodologies to achieve the outcome of improved water quality within the Rotorua Lakes. This includes artificial floating wetlands and aeration/destratification.

It is considered that the Proposed Plan Change has taken into account relevant planning documents recognised by an iwi authority. The Proposed Plan Change represents a range of tools to reduce the level of nitrogen in Lake Rotorua and subsequently improve water quality in both Lake Rotorua and the Kaituna River.

[45] IScribe Ltd (2014).
[46] Section 66(2A)(a) of the Resource Management Act 1991.

Key reference documents

Technical reports

- GHA (2014) Summary Report. NDA Rules Presentations and Promotion amongst Māori Land Owners. Prepared by Arapeta Tahana (GHA), November 2014. Presented to Komiti Māori 1 October 2015 www.boprc.govt.nz/media/464678/komiti-Māori-agenda-01-october-2015.pdf

YouTube video

- A 5 minute video was uploaded to YouTube which detailed the project, the proposal and the draft rules. The video focused on Māori farmers, as 25% of landowners in the Rotorua Lakes catchment, and included Māori translation. www.youtube.com/watch?v=6NT0qcFU8pk&list=UUnIAqmkGz2sKgAuuau5wDBg

Iwi planning documents

- Te Maru O Ngāti Rangwewehi Iwi Authority (2012) *Ngāti Rangiwewehi Iwi Environmental Management Plan.* www.boprc.govt.nz/.../ngati_rangiwewehi_iwi_environmental_managment_plan_2012.pdf
- Ngāti Whakaue ki Maketū Hapū Iwi Resource Management Plan Phase 2 (2011) http://www.smartgrowthbop.org.nz/media/62465/323te_runanga_o_ngati_whakaue_ki_maketu-hapu_iwi_res.mgmnt_plan-phase_2-final_report-aug2011__read_only_.pdf
- Tapuika Environmental Management Plan 2014-2024 www.tapuika.iwi.nz/images/uploads/Tapuika_Environmental_Management_Plan_2014_-_Web_Version.pdf

6.5 Outcomes of consultation

Two consultation processes have been run to support the Plan Change development process:

- July to October 2014
- September and October 2015.

From the July to October 2014 consultation period more than 330 feedback forms, emails, or letters were received from the general public, sector organisations, large land block representatives, and Māori landowners.

An additional round of consultation was undertaken between September and October 2015. The majority of feedback from this second consultation came from drystock or deer farmers. A number of dairy farmers and horse owners also provided feedback. Over half of those providing feedback owned lifestyle properties in the catchment.

The following is a summary of the combined consultation feedback reported to Council's Regional Direction and Delivery Committee on 9 December 2014 and 17 November 2015. Links to source documents and reports are provided at the end of this report section.

The key themes of consultation feedback were:

- Science.
- Social and economic impacts.
- Managing small properties.
- Timeframes, managed reduction and the 2022 target.
- Nitrogen allocation.
- Regulatory focus.

6.5.1 Science

The science to support the sustainable nitrogen limit has been developed over a long period of time and on the basis of a large body of advice from a range of expertise a range of experts[47]. The sustainable nitrogen limit was first identified in 1986[48] and has been reassessed and reconfirmed since.[49]

Consultation feedback	What has changed as a result of feedback
• Uncertainty around the scientific evidence regarding the sustainable nitrogen limit and nitrogen reduction approaches	• New method included in the Plan Change to formalise Council's commitment to five yearly reviews of science underpinning the policy and rules. This includes: • Review timeframes • Key science themes considered in the reviews • Options if science advice changes

Figure 10 Consultation feedback and outcomes: Science.

Refer to section 11.1 of this report for further information.

6.5.2 Social and economic impacts

In all decisions staff have been clear that there are costs, benefits, and risks of new rules to manage nitrogen loss in the Lake Rotorua catchment. Costs to the Council, community and landowners were communicated throughout the consultation period.[50,51]

[47] Fact Sheet 8: Science behind the nitrogen limit: Lake Rotorua (July 2014 consultation material)
[48] Rutherford, Pridmore and White (1989).
[49] Rutherford K. (2003); Rutherford K. (2008).
[50] Fact Sheet 7: Cost impacts of draft NDAs on farms (July 2014 consultation material)
[51] Fact Sheet 9: Cost of new rules (July 2014 consultation material)

Consultation feedback	What has changed as a result of feedback

• Potential social and economic impact that the draft rules may have on the Rotorua community. This includes:
  • Cost for landowners to get resource consent and achieve allocated NDA
  • Impact of the rules on property values, including small (lifestyle) properties
  • Development of rules without understanding the associated costs and impacts
  • Lack of assessment of effects on small property owners
	• Plan notification delayed from March 2015 to enable:
	  • the completion of economic impact analysis to be incorporated into the s32 evaluation report
	  • Council and Partners sufficient time to give feedback on the draft s32 evaluation report prior to Plan notification
	• Short term trading to be considered for addition to draft rules on the basis of assisting transition
	• Potential impact on property values has been analysed, including small properties.
	• A small property report has been commissioned to provide a greater understanding of impacts on that sector.

Figure 11 Consultation feedback and outcomes: Social and economic impacts.

Refer to section 9 of this report for further information.

6.5.3 Managing small properties

Under the draft rules, properties smaller than two hectares and properties between 2-40ha would have been permitted to discharge less than 10 kgN/ha/yr.

Consultation feedback	What has changed as a result of feedback
• Land use can vary hugely in the 2-40ha property size range. One rule will not fit all • Difficulty in knowing whether smaller properties would meet the 10 kgN/ha/yr (OVERSEER® 5.4) threshold, particularly under horse grazing • Unfair to exclude under 2ha properties, not efficient to include small properties • Impact on land values, especially given that many small properties do not generate an income • Stocking rates are too low in stocking rate tables • Stocking rate table penalises horse owners	• Permitted rule threshold changed from 2ha to 4ha provided there is no cropping, horticulture, or dairy on the property • Nitrogen loss from properties 4-10ha is permitted provided the property complies with the stocking rate table, and no cropping/horticulture • Regulatory requirements for properties 10-40ha delayed until 2022 • Review of stocking rate table, including rates for horses

Figure 12 Consultation feedback and outcomes: Managing small properties

Refer to section 10.3 of this report for further information.

6.5.4 Timeframes, managed reduction and the 2022 target

The development of the draft rules have been underpinned by the key elements of RPS Policy WL 6B: managed reduction, a 2022 Managed Reduction Target, and a 2032 limit to be achieved.

Consultation feedback	What has changed as a result of feedback

• Timeframes in which landowners are expected to make changes are unrealistic
• Significant progress has already made towards reaching the reduction target
• Allow landowners to make reductions voluntarily
• Look at options other than rules
• Nitrogen Management Plans should not be a part of the consenting process, or used as a compliance tool
• Support only the 2022 target to achieve the 70% reduction
	• No change to expectation that Nitrogen Management Plans are required that will show:
	  • a pathway of managed reduction
	  • specfic targets for 2022, 2027 and 2032
	  • Mitigation measures to achieve the Nitrogen Discharge Allowance
	• Consideration of 'opt in' and 'opt out' approaches

Figure 13 Consultation feedback and outcomes: Timeframes, managed reduction, and the 2022 target.

6.5.5 Nitrogen allocation

The chosen allocation approach is vitally important as it determines the distribution of nitrogen discharge allowances, i.e. who gets what. While allocation itself doesn't constrain how land can be used, landowners with low allocation will have to manage within the low NDA, or trade (purchase allowances) to intensify or change land use. More than three quarters of the respondents did not support the suggested approach to allocate nitrogen to land use.

Consultation feedback	What has changed as a result of feedback
• Those with high nitrogen losses tended to support grandparenting and/or sector ranges based on historic land use • Those with low nitrogen loss tended to support equal averaging or land use capability (natural capital) • Those with low nitrogen loss believe that sector-averaging allocation rewards the polluters • Pre-2001 mitigation, such as retiring land, needs to be recognised • Concern about the impact of the rules on ability to develop Māori Land • Unduly onerous nitrogen constraint on undeveloped land	• Completion of an NDA economic analysis report • Selection of preferred approach: sector averages with ranges based on Rule 11 benchmarking • Staff working with Te Tumu Paeroa and Te Arawa to increase understanding of the issues for undeveloped Māori land

Figure 14 Consultation feedback and outcomes: Nitrogen Allocation.

Staff have been clear during consultation that regardless of the method chosen, any allocation approach will have relative “winners” and “losers”. The best allocation system will be the one that is seen as being fair amongst those who are most affected.

Further information about the allocation approaches considered and evaluated is provided in sections 10.3.

6.5.6 Regulatory focus

An annual reduction of 320 tonnes of nitrogen discharges is required to reach the sustainable nitrogen load for Lake Rotorua.

The Integrated Framework proposes that a 270 tonne reduction is achieved through a programme of rules (140 tonnes, 44 percent), incentives (100 tonnes, 31 percent) and gorse removal (30 tonnes, 9 percent). The remaining 50 tonnes (16 percent) is to be achieved through engineering solutions.

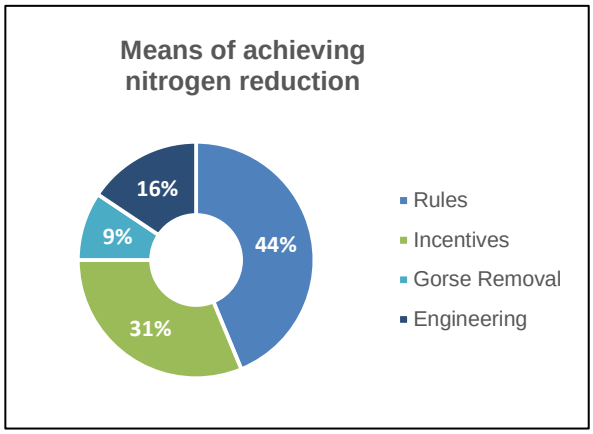


Figure 15 *Reductions in nitrogen through the Integrated Framework*

Consultation feedback from landowners indicated a perception or assumption that the Lake Rotorua water quality issue would be addressed through rules alone. This may have been due to the consultation focus on the draft rules (the regulatory component subject to the formal RMA process), rather than the whole Integrated Framework.

Consultation Feedback	What has changed as a result of feedback
• Rules are not the answer – explore other solutions • Focus on voluntary and collective action • Establish a Memorandum of Understanding with farmers • It is unfair for the rural landowners to pay for a clean lake	• All future communications will tell the whole story of what is and has been done for Lake Rotorua to put the regulatory component in context.

Figure 16 *Consultation feedback and outcomes: Regulatory focus.*

Key reference documents

Consultation fact sheets

- Fact sheet 1: Have Your Say brochure - A summary of the draft rules and what they mean for landowners
- Fact sheet 2: Nitrogen Discharge Allowances ('NDA') - Provides an explanation of the preferred allocation approach, why it was chosen and the different allocation options available
- Fact sheet 3: Rules – Q&As - Answers common questions on the draft rules to limit nitrogen loss from rural land
- Fact sheet 4: Support and incentives - Details the support available to landowners for advice to meet their NDA and the incentives scheme to reduce nitrogen to below their NDA
- Fact sheet 5: Gorse conversion fund - Explains why gorse conversion is being done, what the conversion options are and how it works
- Fact sheet 6: Resource consents - Provides an overview of what a resource consent is and the different consent types
- Fact sheet 7: Cost impacts of draft NDAs on farms - Is a high level summary of a report by Perrin Ag Consultants on the impact that NDAs may have on farm profitability
- Fact sheet 8: Science behind the nitrogen limit for Lake Rotorua - Provides an overview of the science that supports the nitrogen limit of 435 tonnes for Lake Rotorua
- Fact sheet 9: Cost of new rules - Provides an overview of the cost implications of the draft rules for landowners, the community and the Regional Council

Supporting information

http://www.rotorualakes.co.nz/supporting_information

- Lake Rotorua Groundwater catchment map - An indicative map of the Lake Rotorua groundwater catchment area with the ability to zoom in on the catchment line and see property boundaries
- Stocking intensity fact sheet - An indicative guide for landowners to check if their property is likely to be below the nitrogen limit set out in the draft permitted rule

Technical reports

- IScribe Ltd (2014). *Lake Rotorua Draft Nitrogen Rules – Consultation Report*. Report prepared for the Bay of Plenty Regional Council. http://www.rotorualakes.co.nz/vdb/document/891
- IScribe Ltd (2015). *Lake Rotorua Draft Nitrogen Rules: Summary of additional consultation*. Report prepared for the Bay of Plenty Regional Council.

Council reports

https://www.boprc.govt.nz/council/committees-and-meetings/regional-direction-and-delivery/

- Regional Direction and Delivery Committee meeting 24 June 2014 to approve the draft rules for consultation
- Report to Regional Direction and Delivery Committee meeting 9 December 2014 presenting the feedback from consultation
- Report to Regional Direction and Delivery Committee meeting held 17 November 2015 presenting the feedback from additional consultation

Key reference documents
• Report to Rotorua Te Arawa Lakes Strategy Group 10 December 2014 presenting the feedback from consultation www.boprc.govt.nz/media/395629/2014-12-10-rotorua_te_arawa_lakes_strategy_group-pt1.pdf

7 Explaining the evaluation process

Section 32 of the RMA seeks to ensure transparent and robust decision-making on Council RMA plans and policy statements.

For this reason, section 32 of the RMA requires:

- An evaluation of the appropriateness of the Plan Change in achieving the purpose of the RMA
- An evaluation of the benefits and costs of the Plan Change, and risks of new policies and rules to the community, the economy, and the environment
- The evaluation to be documented, so that stakeholders and decision-makers can understand the rationale for policy choices.

7.1 Appropriateness

Appropriateness means 'suitable, but not necessarily superior'. This means that the most appropriate option must demonstrate that it will meet the objectives in an efficient and effective way[52].

7.2 Efficiency and effectiveness

Determining the most appropriate policies and methods is based on an assessment of the *effectiveness* and *efficiency* of the policy and rule options, and the risks of acting or not acting where is uncertain or insufficient information.

Efficiency and effectiveness are not defined in the RMA. However, the Ministry for the Environment Guide for Section 32 of the RMA[53] provides the following guidance:

Effectiveness:
The contribution new provisions make towards achieving the objective and how successful the new provisions are likely to be in solving the identified problem.

Efficiency:
Whether the provisions will achieve the objectives at the lowest total cost to all members of society, or achieves the highest net benefit to all of society.

Figure 17 Efficiency and effectiveness.

7.3 Scale and significance

Section 32(1)(c) of the RMA states that the evaluation report *"must contain a level of detail that corresponds to the scale and significance of the environmental, economic, social and cultural effects that are anticipated from the implementation of the proposal."*

[52] Ministry for the Environment (2014). *A guide to section 32 of the Resource Management Act*.
[53] Ibid.

Scale refers to the anticipated size or magnitude of the effects anticipated from the proposal, while significance refers to the importance or impact of the issue (in this case, Lake Rotorua water quality), or the significance of the policy response to the issue.[54]

The current policy baseline for this Plan Change is:

- The Operative RPS. As outlined in Chapter 2, there is a constrained policy context (e.g. sustainable lake load and associated timeframes).
- The RWLP – Rule 11. Most of the Lake Rotorua catchment is subject to Rule 11, which set a discharge limit or nutrient benchmark based on the average annual export of nitrogen for each property for the period 1 July 2001 to 30 June 2004.

Council is not proposing to change the operative objectives within the RWLP or the RPS as part of the plan change. The targets set in these planning documents have been through a public process and s32 evaluation within their respective RMA processes.

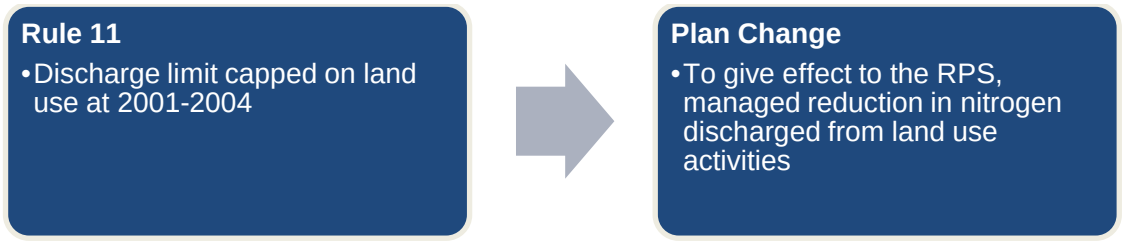


Figure 18 Plan Change baseline: Degree of shift from Rule 11.

Although landowners in the catchment are currently subject to the nitrogen limits established under Rule 11, the proposed rules will reduce those benchmarks, and will have the potential to impact on the profitability farming businesses. Impacts will vary depending on the farming type, the farm characteristics (e.g. soil type), and the ability of the landowner to make changes and meet financial commitments. It is inevitable that these potential impacts would also have a flow-on effect to the wider community. This was confirmed by the complex competing demands on the Lake resource by users, which includes pastoral farmers, iwi, the local community, and domestic and international tourists.

The Plan Change evaluation has been extensive, and has been based around the scale of impact of new provisions. The baseline situation is Rule 11. Council has been clear that these impacts are high and therefore a full analysis is appropriate.

[54] Ministry for the Environment (2013). Interim guidance on incorporation of changes resulting from the Resource Management Amendment Act 2013.

7.4 Evaluation structure

This report does not document the evaluation of individual policies and methods. Instead, this report outlines the evaluation of Plan Change provisions as a whole (section 9) and as clustered topics (section 10). This is to take a more holistic and integrated approach to evaluation.

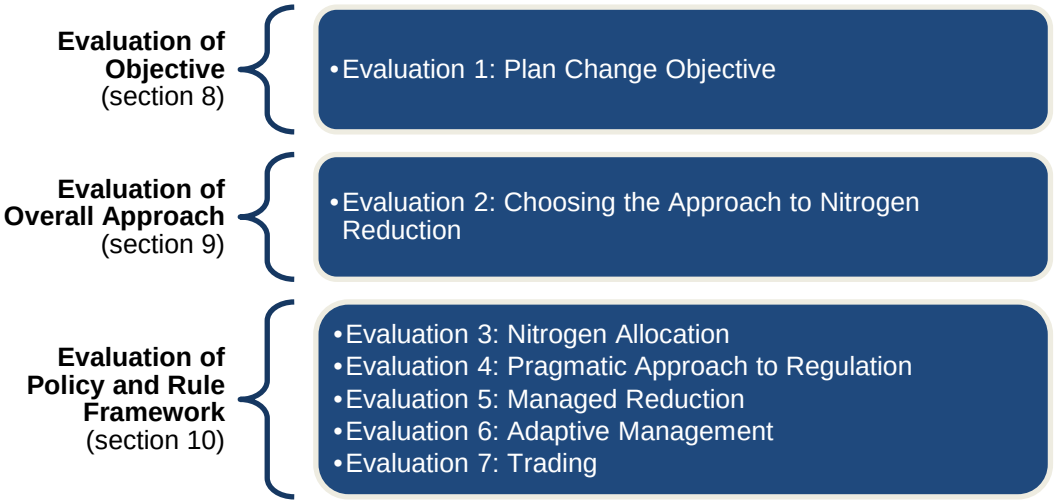


Figure 19 – Structure of Plan Change evaluation

8 Evaluation of Plan Change Objective

The Objective of this Plan Change is to reduce nitrogen losses from rural land within the Lake Rotorua catchment to meet the nitrogen limit set by the Regional Policy Statement. This will reduce the annual nitrogen load to Lake Rotorua from 755 tonnes to 435 tonnes by 2032.

Section 32 of the RMA states that an objective means:

(a) For a proposal that contains or states objectives, those objectives:

(b) For all other proposals, the purpose of the proposal.

No new Objectives will be added to the RWLP as a result of this Plan Change. The Objective to be assessed relates to the purpose of this Plan Change, as outlined in section 5 of this report and directed by the policies WL 3B and WL 6B of the RPS. The purpose is therefore:

To reduce nitrogen losses from rural land within the Lake Rotorua catchment to meet the nitrogen limit set by the Regional Policy Statement.

The 'numbers' associated with the Plan Change Objective (e.g. 435 tonnes of nitrogen per year) and the directive for nitrogen reduction were established by the RPS process and are therefore beyond the scope of this evaluation.

The 'purpose' of Plan Change is the most appropriate way to achieve the purpose of the RMA. Sustainable management of the lake requires that nitrogen discharges from pastoral farming within the Lake Rotorua catchment be reduced. This Plan Change will:

- Sustain the potential of Lake Rotorua to meet the reasonably foreseeable needs of future generations (section (5)(2)(a) of the RMA). The uses and values the lake provides include recreational, mahinga kai, economic development and cultural identity
- Safeguard the life-supporting capacity of the waters of Lake Rotorua (section (5)(2)(b) of the RMA)
- Remedy and mitigate adverse effects from surrounding land use (section (5)(2)(c) of the RMA).

The Integrated Framework ensures that the use and development of land can continue, provided that the sustainable lake load is achieved by 2032. The evaluation of the Integrated Framework, as the primary mechanism to achieve the Plan Change Objective, is provided in section 9 of this report.

Key reference documents

- Bay of Plenty Regional Council (2014). Operative Regional Policy Statement. www.boprc.govt.nz/knowledge-centre/policies/operative-regional-policy-statement/
- Bay of Plenty Regional Council (2010). Proposed Bay of Plenty Regional Policy Statement. Section 32 report Water quality and land use. Strategic Policy Publication 2010/07 www.boprc.govt.nz/media/78773/strategicpolicypublication201007-waterqualityandlanduse.pdf

9 Evaluation of approach to nitrogen reduction

This section provides a summary of the evaluation of the overall approach to reducing the amount of nitrogen entering Lake Rotorua to 435 tonnes per year. The key steps were:

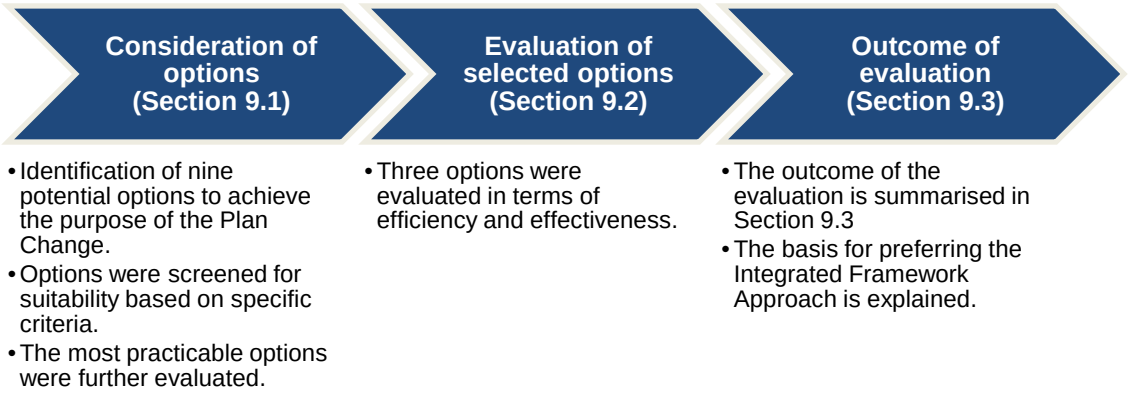


Figure 20 Evaluation process.

9.1 Consideration of options

The following options were considered:

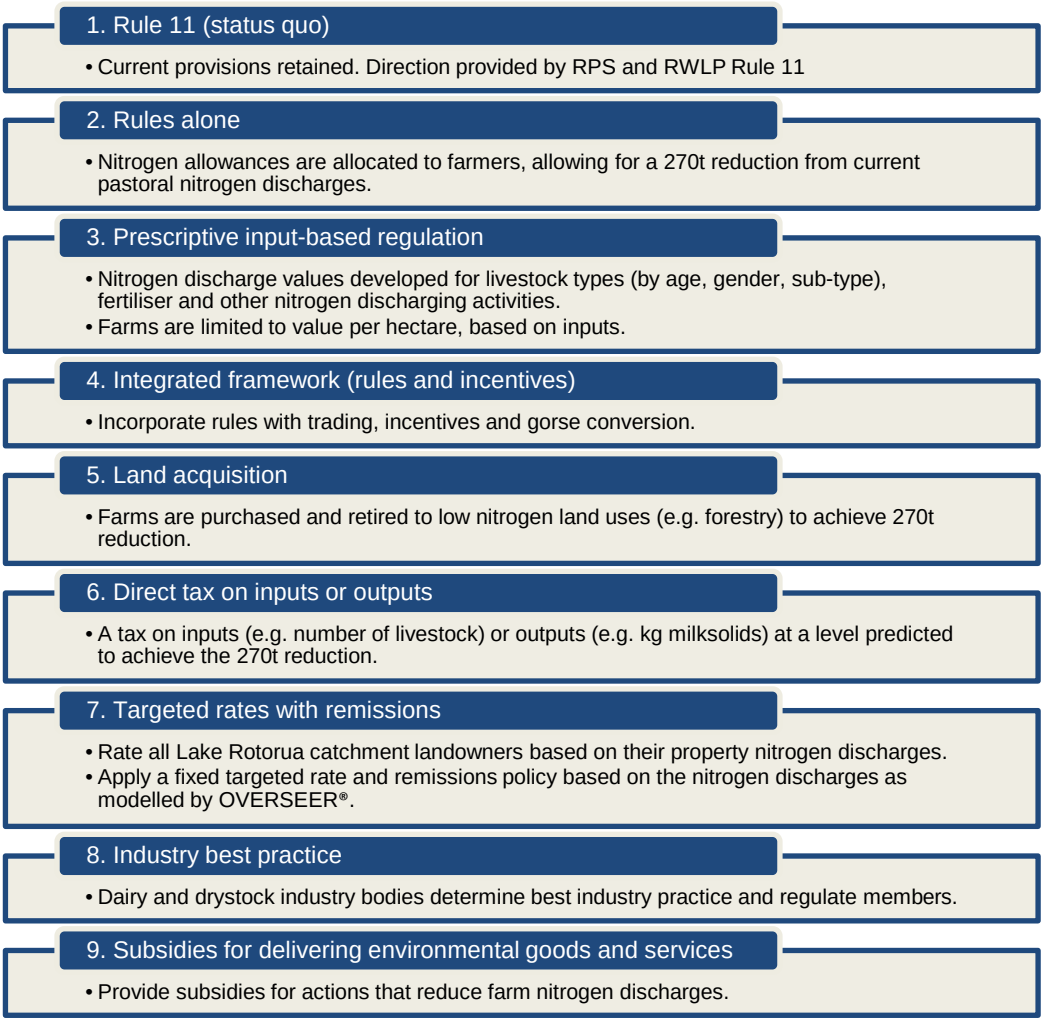


Figure 21 Options considered for overall approach to nitrogen reduction.

Evaluation criteria were developed to provide a consistent approach for a rapid assessment to identify which options were suitable for further evaluation. The criteria used were: alignment with objective, within Council power and function, effectiveness, and efficiency (Table 4).

Table 4 Application of criteria to screen options for evaluation

Options	CRITERIA			
	Aligned with purpose of Plan Change	**Within Council power and function**	**Effective: Certainty in achieving environmental target**	**Efficient: Incentivises efficient resource use**
1. Rule 11 (status quo)	×	✓	×	✓
2. Rules alone	✓	✓	✓	✓
3. Prescriptive input-based regulation	✓	✓	×	×
4. Integrated framework (rules and incentives)	✓	✓	✓	✓
5. Land acquisition	✓	✓	✓	×
6. Direct tax on inputs or outputs	✓	×	×	✓
7. Targeted rates with remissions	✓	✓	×	✓
8. Industry best practice	✓	✓	×	✓
9. Subsidies for delivering environmental goods and services	✓	✓	×	×

Based on the evaluation criteria, the Rules Alone (Option 2) and the Integrated Framework (Option 4) were evaluated further. The Status Quo (Option 1) was also evaluated, for completeness. The evaluation of the Status Quo is included in the appendices.

Refer to section 11.7 for a summary of the assessment of the options not progressed.

9.2 Evaluation of selected options

The following options were selected for evaluation:

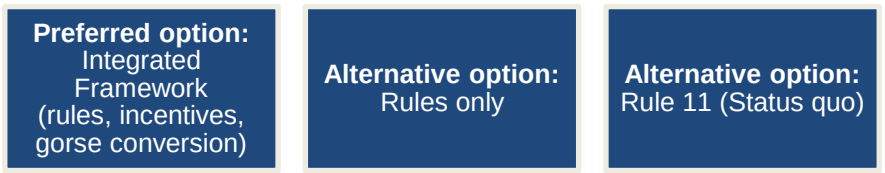


Figure 22 Options selected for evaluation.

This section provides a summary of the efficiency and effectiveness evaluation undertaken for the "rules only" and the Integrated Framework. Options were assessed using quantitative and qualitative methods as appropriate. The full evaluation tables, including the quantitative assessment, are provided in Appendices 5-7.

9.2.1 Summary of effectiveness and efficiency of 'rules only' and 'integrated framework' options

Efficiency	Rules only	Integrated framework
Benefits		
Social benefits		
The health and mauri of the people *(NPS-FW Compulsory Value)*	Potentially meets this value, which requires no more than a moderate risk of infection to people when involved in activities that involve only occasional immersion in the water. The value requires toxins and toxic algae not to be present in quantities that would harm human health.	As per Rules Only option.
Aligns with the Vision and Strategy for the Lakes of the Rotorua district	Potentially meets the preserving and protecting the lake, but it does not connect the community in achieving that.	A lasting solution with the local community working together to preserve and protect the lake aligns with the Vision and Strategy for the Lakes of the Rotorua district.
Future generations	Ensures a lasting solution. Future generations will not have to address the issue of an unsustainable load of nitrogen.	As per Rules Only option.
Shared community responsibility	Responsibility rests with pastoral farmers/landowners in the lake catchment.	Shares responsibility for water quality improvement across the local and regional and national community for improving the health of Lake Rotorua. The shared responsibility recognises that the benefits of a clean lake accrue to the wider NZ community.
Recreational use of lake and surrounds	The safety of activities including boating, swimming, waka ama, and harvesting food is ensured.	As per Rules Only option.

Efficiency	Rules only	Integrated framework
Tourism – domestic and international	Tourism is a key component of Rotorua's economy. Good water quality contributes positively to domestic and international tourism, including jobs in the tourism and associated sectors. Willingness-to-pay studies indicate that people value good water quality in Lake Rotorua.	As per Rules Only option.
The health and mauri of the environment *(NPS-FW Additional Value)*	Protects and enhances the amenity values associated with good water quality and valued by the community.	As per Rules Only option.
Cultural Benefits		
The health and mauri of the water – ecosystem health *(NPS-FW Compulsory Value)* Cultural wellbeing of people and communities	This value covered under environmental benefits.	This value covered under environmental benefits.
Relationship of Māori and their cultures and traditions with their ancestral lands, water, sites, wahi tapu and other taonga; kaitiakitanga	Bringing the mauri of the lake back is the imperative of the Te Arawa people. This approach will contribute to achieving this.	As per Rules Only option.
Food gathering, places for food *(NPS-FW Additional Value)*	Achieves protection of food species that are vulnerable to the conditions brought on by high levels of nutrients.	As per Rules Only option
Alum dosing and taonga species	Some iwi view alum dosing as a short term intervention or not as being appropriate technology for use in the lake. Concerns have been expressed about the unknown cumulative effects of alum on taonga species. Under this option alum dosing can be phased out.	As per Rules Only option

Efficiency	Rules only	Integrated framework
Environmental benefits		
The health and mauri of the water – ecosystem health *(NPS-FW Compulsory Value)*	The ecosystem services provided by Lake Rotorua include nutrient processing, biodiversity, provision of food, science and education, and amenity and recreation. Deterioration of the lake reduces the value these ecosystem services provide.	As per Rules Only option.
Ecosystem services from forestry	Additional planting of exotic forest in the catchment. Ecosystem services include provisioning services of wood and fiber and biofuel, regulating carbon sequestration, avoiding erosion, improving water quality, flood mitigation and biodiversity, and cultural services including recreation and native species conservation.[55]	As per Rules Only option.
Alum dosing: Risks	While alum dosing improves lake water quality by locking up phosphorus, limiting the availability of this nutrient and reducing the incidence of algal blooms, this option avoids the possible but unknown cumulative effects and environmental risks[56] of the treatment by phasing it out.	As per Rules Only option.
Economic benefits		
New Zealand 'branding'	Good water quality contributes to New Zealand's brand. Conversely, poor water reduces that benefit and threatens the wider economy.	As per Rules Only option.

[55] Yao et al. (2013).
[56] Tempero G (2015).

Efficiency	Rules only	Integrated framework
Incentives fund	NA.	The Incentives Fund is designed to help retain a viable low nitrogen pastoral economy – especially retention of the dairy sector. Provides opportunities to utilise incentives and gorse conversion packages to: o Fund moving to different low nitrogen land uses and/or o For some owners this may offset cost of lost development potential e.g. on Māori Land
Opportunities for employment	An increase in forestry in the catchment contributes positively to the local economy and jobs. This could be in production forest, or in wood and wood product manufacturing.	As per Rules Only option.
Opportunities for economic growth	An increase in forestry and wood products contribution to local GDP. Increases in forestry bring other opportunities, such as producing bioenergy from the non-utilised in-forest residues.[57] Forestry also has potential for other benefits related to recreation and tourism, for example, Whakarewarewa forest mountain biking and walking recreation activities. Poor lake water quality is a threat to tourism income and jobs in the Rotorua district. Tourism is a key contributor to the Rotorua district economy. Further, poor water quality in Lake Rotorua is a threat to New Zealand branding for exports and tourism.	As per Rules only option, plus: Potential for significant opportunities to explore innovative land use supported by the gorse conversion and incentives programmes. For example afforestation, growing hazelnuts, ginseng, truffles and mānuka (for honey and oil). Beneficial to the Rotorua forestry sector (refer to commentary under economic costs).

[57] Yao et al. (2013).

Efficiency	Rules only	Integrated framework
	Potential for positive changes within the pastoral farming industry including establishing niche markets, such as high quality beef from a sustainably managed catchment.[58] Potential for contributing to NZ meeting greenhouse gas reductions. Carbon credits may become a future opportunity (recognising that current market prices are low)	
Alum dosing	In the medium to long-term alum dosing would be discontinued, and the current spending on that can be used elsewhere.	As per Rules Only option.
Costs		
Social costs		
Social disruption	Social disruption – the alteration in the social make-up of the catchment – is unavoidable where a sufficiently large sector is required to change their land use practices. The high economic costs for farmers will result in high levels of stress, which may impact on the wellbeing of families and the community. Mitigations include the sector range allocation which reflects existing nitrogen use; the 15 year timeframe and staged reduction; and the ability to trade providing farmers with some flexibility.	As per Rules Only option, plus: The incentives and gorse programmes spread the costs across the community and provide farmers with assistance and incentives to make changes. The advice and support funding provides support to farmers to find new ways in their current farm systems, or to change to another farming type.

[58] For example Taupō Beef http://www.nzfeatrust.org.nz/vdb/document/269

Efficiency	Rules only	Integrated framework
Small property owners	Small block properties/farming enterprises are unlikely to be significantly affected by rules as they tend to be operated as lifestyle properties and therefore are lower nitrogen loss activity types. The exception is where larger animals (such as horses) are kept and fed supplementary feed. To recognise the low risk to nitrogen loss from the smaller sized properties and to increase administrative efficiency a property size threshold has been introduced. However, without the Integrated Framework tighter controls may have been required on small blocks due to the need for a different allocation system. This would increase the level of any social disruption.	The integrated framework has developed activity categories to increase the efficiency of the policy. These categories reduce the impact of the rules on small block owners in particular. Those under 4 hectares are not subject to livestock restrictions, and those below 10 hectares can be permitted provided they are low intensity. This flexibility will reduce or eliminate the level of change needed for these landowners.
Amenity values	Changes in the physical landscape that may impact on amenity values e.g. increased area of exotic forest	As per Rules Only option
Community structure	There may be changes in community structure, such as the number and location of schools. In a community such as Rotorua, with a large number of lifestyle blocks, this is probably a small risk.	As per Rules Only option, although risk reduced because many small property owners will be largely unaffected.
Cultural costs		
Land development	Undeveloped Māori land: No significant change for undeveloped Māori Land in terms of the inability to intensify or change the use of land. Development of Māori Land blocks has already been restricted as a result of Rule 11, which has been in place since 2005.	The same issues as the Rules only option, however this approach is preferable because reductions from the status quo are not so severe due to the community share (incentives and gorse funds). The preferred allocation approach provides some increases in NDA to low benchmarked properties.

Efficiency	Rules only	Integrated framework
	Opportunities to sell land and utilise capital elsewhere are limited for owners of Māori land. Trading may provide opportunities for future development or for selling NDA to fund other ventures. It is not clear that the presence of undeveloped Māori land is an issue that will affect allocation to Māori more than any other group in the catchment.	
Environmental costs		
Sediments and phosphorus	The increased forestry expected will potentially contribute to sediment and release of phosphorus into the lake at harvest time. These effects could be managed through appropriate policy.	As per Rules Only option.
Long timeframe for improvement	The long period of implementation of this policy will delay the improvement in water quality.	As per Rules Only option.
Economic costs		
Economic or commercial development *(NPS-FW Additional Value)*	This approach will have economic costs for high nitrogen intensity activities such as pastoral farming, and benefits to low nitrogen activities, such as forestry. It is not known what the balance will be over the 15 year implementation period and beyond.	As per Rules Only option.

Efficiency	Rules only	Integrated framework
Impacts on pastoral farmers	Farm level impacts will vary depending on sector, geophysical characteristics, historical nitrogen use, farmer preferences and management ability. It is likely that all farmers will have to make changes to how they currently farm and some farmers will have to change their land use. A range of mitigation options are available to farmers, but under the rules only approach farmers are likely to have to undertake move to some of the more expensive mitigations to achieve their individual nitrogen discharge allowance targets. The requirement in the RPS to achieve 70 percent of the total reduction by 2022 will put additional pressure on farmers, and the inability to delay is likely to increase the costs to farmers and to the catchment.	Under this option, the community's commitment to achieving 130+ tonnes of the required reduction allows farmers a greater allocation of nitrogen allowances. Case studies of farms in the catchment suggest that many farmers will be able to achieve the reductions required with changes in farm management within the same farm system. The ability to do this will relate to factors including historical nitrogen use (allocation), geophysical characteristics of farm and farmer ability. For some farmers these changes may result in increased profitability. Where conditions are not so favourable (lower allocation of N, leakier soils, more rainfall), on farm changes will be more dramatic, may involve partial or total changes in land use, and will be expensive for farmers. The negative impacts on income are lessened by the commitment from the community to the incentives funding, the gorse funding, and the engineering options (such as the proposed Tikitere denitrification plant). Under the integrated framework, modelling results suggest that average profit per hectare increases for all farm types. This is a result of (a) less productive farms moving to lower nitrogen land uses and selling assets such as Fonterra shares, livestock and nitrogen discharge allowances (converted to annualised income in the model); and (b) the average income of those remaining in the original sector being higher. Modelling suggests that the dairying area is likely to reduce by half, the sheep and dairy by a third, sheep and beef by around 14 percent, and forestry increase by around 60 percent. This will impact on produce from the catchment, particularly dairy.

Efficiency	Rules only	Integrated framework
Impacts on small block owners	There are approximately 1400 blocks of less than 40 hectares in the catchment. Based on GST registration, relatively few of these (less than 9 percent) are operating an agricultural business. For businesses, the impacts of reduced nitrogen leaching may be similar to larger blocks, and will depend on the type of business, the benchmark and the allocation system chosen under a rules only approach. Under "Rules Only" the impact would be proportionally higher. For non-business small blocks, the rules will limit the number of livestock. Properties being run for lifestyle purposes will be unlikely to suffer any significant economic costs; however there could be reductions in the number of stock that could be kept under a rules-only approach. If a 4ha threshold was introduced there would not be an economic impact of this band of properties.	As with Rules Only option.
Impacts on forestry block owners	No significant change for forest owners in terms of the inability to intensify or change the use of land. Inclusion of a trading scheme will make land use change more accessible.	As per Rules Only option.
Impacts on Māori land owners (also see cultural costs)	Developed Māori land: Owners of Māori Land would experience reduced lease income as a result of reduced economic returns. Underdeveloped land: Land with low nitrogen benchmarks may attract a higher allocation under the allocation methodology.	As per Rules Only option. The income losses associated with the integrated framework are less because the reductions required by landowners are significantly less than under the Rules Only option.
Reduction in employment in pastoral farming sector	There are likely to be a modest reduction in employment in pastoral farming sectors, although this is partially offset by increases in other sectors.	As per Rules Only option.

Efficiency	Rules only	Integrated framework
Reduction in GDP from pastoral farming sector	Modelling of the regional economy under a Rules Only approach indicates a modest reduction in GDP, partially offset by increases in forestry and potential for tourism. There are reductions in district income from the farming sector. At least in the short term, the changes are expected to have a small negative impact on GDP. The impact of on the regional economy is around 0.1 – 0.2 percent.	Modelling of the integrated framework approach in the district, regional and national economy, (a scenario of 50 percent trading efficiency and optimal land use change), indicated modest reductions in the district, regional and national economies. The net loss to GDP is $14.4m nationally, which includes $4.3m to the Bay of Plenty economy, and $3.5m in the Rotorua District economy. Most of the loss ($3.2m) is within the Lake Rotorua catchment. For Bay of Plenty, the $3.4m represents 0.03 percent of the $11b GDP in 2014. For Rotorua District, the $2.5m is 0.1 percent of district GDP. Much of the loss is in the pastoral farming sector, however this is partially offset by gains in the forestry sector.
Employment	Losses in employment in the pastoral sector	As per Rules Only option. Modelling (scenario of 50 percent trading efficiency and optimal land use change) suggests that employment in the Rotorua District could be reduced by 76 full- or part-time jobs (net).
Property values in the catchment	Variable costs in relation to property values. Property values in the catchment will be impacted, with prices reflecting the best economic use for the land. This will depend on characteristics of the land such as slope, soil type and rainfall, and also on options for other uses such as subdivision for lifestyle. How current farm systems are positioned in relation to benchmarks and NDA levels will also contribute to a property's value. Where farm system changes have already occurred there is less impact associated with nitrogen reduction.	As per Rules Only option. However, compared with the rules only option, the Integrated Framework lessens the likely impact on property values because the higher nitrogen allocations to landowners under this approach expand the potential economic uses of the properties.

Efficiency	Rules only	Integrated framework
Compliance costs to farmers	Low compliance costs to farmers. Future costs associated with consenting, monitoring, reporting and administration will be incurred.	As per Rules Only option.
Fiscal costs to Council (ratepayers)	Moderate fiscal costs to the Council. Costs relate to provision of technical support for farm advisors; administration, including recording annual returns and processing transactions; monitoring; compliance and consenting. Monitoring and compliance costs may be high because of the potential difficulties for farmers in reaching the targets under a rules only approach. The estimated full costs are available in Appendix 10.	As per Rules Only option. Costs of funding the incentives and gorse funding fall to the local, regional and national communities. Similarly, costs associated with running the incentives scheme, such as establishing the Board to manage the fund and undertake purchases of nitrogen discharge allowances.
Relevance and transparency		
Directed towards achieving the objective	Yes	Yes
Will clearly achieve, or partly achieve, the objective	May only partly achieve because of difficulties for farmers to achieve the reductions required.	Yes
Usefulness		
Will effectively guide decision-making	Yes, provides clear direction for decision making	Yes, provides clear direction for decision making
Meets sound principles for writing policies and rules	Yes	Yes

Efficiency	Rules only	Integrated framework
Assumptions made	Farmers will be able to achieve the 270 tonne of on-farm nitrogen discharges throughout the 2017-2032 period in a way that will allow them to remain viable, although not necessarily in the same form of farm business as currently. OVERSEER® will continue to be adequate for the purpose of monitoring and managing. The Council will adequately resource the monitoring and compliance to achieve the objective and support the trading market.	As per Rules Only option, however – The inclusion of the community contributions for the 100tN reduction incentives fund and the 30tN reduction gorse fund now require farmers to achieve the lesser 140 tonne reduction in on-farm nitrogen discharges. Assumes that this shift to a low nitrogen farming economy is economically viable. Assumes that the Incentives Programme will be successful in purchasing the 100t annual reductions in nitrogen entering the lake. Assumes the Gorse Programme will be successful in converting sufficient area of gorse to forestry to achieve a 30t annual reduction in nitrogen leaching.
Achievability		
Within Council's functions and powers	Yes	Yes
Within the scope of Council's available tools and resources	Yes	Yes
Rules can be complied with and enforced	Uncertain	Yes
Degree of uncertainty in the ability to achieve the objective	High	Low-medium

Overall assessment		
Risk of acting or not acting	**Rules only**	**Integrated framework**
Is there uncertain or insufficient information on the topic?	The Lake Rotorua water quality issue with respect to nitrogen discussed throughout this report has been considered extensively and is well understood. Stakeholders and technical experts have provided guidance to ensure the issues are entirely understood. The many evaluations undertaken as part of this policy process have contributed to the Council's understanding of the economic, scientific, social, cultural and environmental issues surrounding the Lake Rotorua water quality issue. The Council considers that there is sufficient information on the proposed provisions.	
Is the topic of high significance or complexity?	The topic is highly significant. Reducing nitrogen levels and improving water quality in Lake Rotorua is of high significance to iwi and hapu, recreational users, and the wider community who live close to or visit Lake Rotorua. It is also highly complex topic, relying on scientific and modelling expertise, and a body of knowledge about the role of nutrients in ground and surface water that continues to grow.	
Risk of acting or not acting (risk is a factor of potential consequence and the likelihood of a consequence occurring).	The risks of acting relate to the availability of robust science information to inform OVERSEER® and the dependency on OVERSEER® as a tool for modelling nitrogen discharges. Methods to manage this risk have been incorporated into the rules framework. There is also a risk associated with the level of complexity within the rules framework. The risk of not acting is that nitrogen discharges into the lake will remain at unsustainable levels, and water quality: a) Continues to be addressed by alum dosing. If this occurs, future generations will be faced with addressing a greater water quality problem, which may include dealing with toxicity effects from alum dosing, or b) Alum dosing is unable to continue (consent is not guaranteed and there would be no replacement strategy to support and application) and the lake water quality rapidly declines. Current generations would then be faced with a polluted lake.	

Options assessed	Efficiency	Effectiveness	Most appropriate option?	Summary of reasons for selection
Rules only	Medium	Low to medium	No	NA
Integrated framework	Medium to high	Medium to high	Yes	• Although farmers will have to make changes to their practices and some will have to change land use, pastoral farming will remain a viable activity in the catchment. The incentives funding is crucial to achieving this. The advice and support funding also contributes to this outcome. • Local, regional and national benefits: The integrated framework recognises the wider benefits of farming and a clean lake to the wider community, and shares the costs across those communities. This shared responsibility aligns with the Te Arawa Vision and Strategy for the Rotorua Lakes. • Expected to be effective – that farmers will be able to make the changes needed, therefore providing a lasting solution. • Supports opportunities to explore innovative land use through the gorse conversion fund and incentives fund. • Gives effect to the Regional Policy Statement. • Is aligned with the National Policy Statement – Freshwater and will be effective in achieving the values set out in the NPS-FW.

9.2.2 Alternative option: Rule 11 (status quo)

The consideration of the status quo is a normal part of a section 32 process. The status quo provides a baseline for options to be evaluated against. In the case of nutrient management options for Lake Rotorua, the status quo is the regulatory environment created by Rule 11 in the RWLP. Rule 11 capped the existing nitrogen and phosphorus loss from properties within the Lake Rotorua catchment benchmarked for the average annual export of nutrients for the period 1 July 2001 to 30 June 2004.

Nitrogen reduction is not required under Rule 11 and therefore it will not "give effect to" the RPS. As a result, this option is neither effective nor appropriate.

9.3 Outcome of evaluation

Rule 11 – the status quo is inconsistent with Part 2 of the RMA and will not "give effect to" the RPS because it does not require reductions in nitrogen loss.

The **Rules Only** option would result in the sustainable pastoral load of nitrogen being fully allocated to land uses in the catchment. Landowners would be required to undertake a significantly higher level of land management and land use change. The economic impact of the rules-only approach is significant and would threaten farming viability in the catchment. This option is not effective, efficient or appropriate.

The preferred approach is the Integrated Framework as it is most appropriate, efficient and effective in achieving the Plan Change Objective. Evaluation has shown this to be the best way to achieve the community values for Lake Rotorua water quality required by the RPS and RWLP. The Integrated Framework is based on the collective efforts of farmers and the community. This approach recognises the joint benefits of the values for the lake, such as recreation, amenity, and human health. It has evolved through a collaborative development process, including community engagement. This increases the likelihood of success as it has been extensively tested, making it more robust. The Integrated Framework is dependent on other programmes (incentives scheme, gorse removal and engineering solutions) to achieve the nitrogen reduction target. Risk associated with this multi-dimensional approach can be managed with a monitoring and review process.

Key reference documents
• Greenhalgh (2009). Assessment of interventions for the Rotorua Lakes • Greenhalgh (2009). Design and implementation guidelines for some Rotorua Lakes interventions • Daigneault and McDonald (2012) Evaluation of the impact of different policy options for managing water quality limits

9.4 Appropriateness of rules

Section 32 of the RMA requires that Plan Changes are considered in the context of the appropriateness of rules. To manage the nitrogen entering Lake Rotorua, irrespective of the stated objective and the Regional Policy Statement, it is important to consider whether rules are required and are appropriate. The achievement of the lake water quality TLI as a result of alum dosing raises the question of whether a focus (and potentially rules) on phosphorus management would be more appropriate than nitrogen reduction rules. In essence there are two questions to the appropriateness of the Draft Rules:

- The appropriateness of rules: If alum dosing results in "clean" lake, then are rules needed and therefore could they be challenged on appropriateness?
- The scale of the rules: If phosphorus management can limit the lake's response to nitrogen, then could the rules be challenged on the basis of appropriateness (as to the scale of nitrogen reduction required) and should they be replaced with phosphorus/nitrogen rules?

The following sections address these two questions.

9.4.1 Alum dosing

Alum (aluminium sulphate) dosing is a recognised water treatment intervention, and started in the Utuhina Stream in 2006 and the Puarenga Stream in 2010, as a pilot nutrient management intervention. Monitoring has shown that the low levels of alum dosing have been highly effective in reducing available phosphorus. Alum dosing has an annual cost of $700,000.

Alum dosing does not in itself achieve the sustainable lake load of 435 tonnes of nitrogen as required by the RPS. The decision-making framework for alum dosing under the RMA has only considered it as a temporary mechanism – not as a long-term solution. Specifically, current dosing consents were for in-stream dosing on the basis that other land based interventions would be undertaken to support the long-term nutrient reductions that are required. It is likely that Alum dosing to some extent will be required into the future until nutrient management positions the Lake for the long-term.

To understand more about the potential for long-term issues with Alum dosing Council commissioned a report[59] specifically looking at the ecotoxicological risk associated with the use of alum in Lake Rotorua. The following summarises the alum dosing research and advice:

- Alum is highly effective at removing phosphorus from freshwater.
- Under neutral conditions aluminium forms a non-toxic solid substance. Under acidic or alkaline conditions aluminium dissolves and becomes toxic to aquatic animals.
- Current research indicates that the risk of bioaccumulation or biomagnification (through the food chain) is low; however there is limited research on chronic exposure.
- Current dose rates are relatively small and conservative.

[59] Tempero G (2015).

- Lake Rotorua has a very low buffering capacity because of low alkalinity caused mainly by geothermal inputs. This creates a risk of the lake condition moving beyond its buffering capacity.
- Alum has an acidifying effect. The longer the alum dosing continues, the greater the risk of the lake becoming acidified with adverse ecological consequences. There is a risk that the long-term alum dosing, even at the current levels, could trigger the lake becoming acidic.
- There is a risk of unforeseen events that are difficult to quantify and predict. For example, an event such as an acidic hydrothermal eruption could trigger a lake pH change. The result could be the release of free Al^{3+} ions, which are toxic to aquatic life. If that occurs, turning off the alum does not solve the problem; the load of aluminium already in the lake would be out of our control. This could also release the phosphorus that had been precipitated, nullifying the purpose of Alum dosing.
- The effect of reducing in-lake phosphorus reduces the growth of all species of algae, which in turn reduces the load of organic matter from algae die-off reaching the lake bed. This reduces the lake bed oxygen demand which is a driver for release of phosphorus in lake sediments.
- Alum overdosing due to human error, or from natural geothermal activity such as acidification of a stream inflow where dosing occurs, could cause a toxic event.
- There is a suggestion of an increase loading of phosphorous in the catchment soil (from fertilizer application) that will eventually enter the lake. This will increase the load of phosphorus coming to the lake and the need for alum dosing.

Iwi views on alum dosing

The Te Arawa Lakes Trust (TALT) is the owner of the lakebed of Lake Rotorua with a statutory acknowledgement over the lake water and freshwater fishery regulations and management responsibilities for the sustainable utilisation of six taonga species, namely the Koaro, Koura, Kakahi, Tuna, Inanga and Morihana. TALT is firmly of the view that "*alum dosing is not an ongoing intervention in perpetuity in Lake Rotorua*".

While the consenting of stream Alum dosing has been supported by some iwi there is opposition from Māori on cultural grounds to Alum dosing as a long-term solution, and to Alum dosing in its entirety. The following text is taken from the written position on Alum provided by Te Arawa Lakes Trust[60]:

"Te Arawa Lakes Trust (TALT) is firm in our view that Alum Dosing is not an ongoing intervention in perpetuity in Lake Rotorua.

TALT is firm in its view that alum dosing is a medium-term intervention to improving the water quality of Lake Rotorua.

[60] Te Arawa Lakes Trust (2015).

With the key guiding Te Arawa value being "Wai" or Water, all necessary steps must be taken to:

- *Acknowledge that alum dosing is seen by Te Arawa as a "practice of adding toxic chemicals to treat and remove other toxic chemicals from freshwater" or more specifically, tainting our Tupuna Roto/Ancestral Lake and possibly our taonga species and ecosystems within our Tupuna Roto*

- *Alum dosing is unacceptable to Te Arawa however, we understand that in order to improve the health and wellbeing of our Tupuna Roto, alum dosing will be tolerated on a* ***medium-term basis****, until such time that land practices within the catchment are improved and maintained through Rules and Incentives to ensure sustainability of our lands and waters for future generations*

- *There are unknown risks around alum dosing and there is a need to maintain a very proactive and strong programme of testing and monitoring to understand the risks to our taonga species and for the people who consume this traditional food source."*[61]

Ngāti Rangiwewehi has concerns about toxicity effects of Alum dosing on food sources such as koura, tuna and kakahi, and is also clear in its position "*against the addition of heavy metals as a dosing or capping agent, and advocates for the use of alternative methodologies to achieve the outcome of improved water quality within the Rotorua Lake*".[62]

Community perspectives

In public feedback on the draft rules, the following points were made in relation to Alum dosing. The Council should:

- Initiate an open dialogue with stakeholders and the community about the potential risks and benefits of Alum dosing and medium-term phosphorus management.
- Ensure the Regional Plan reflects a short, medium and long-term strategy for managing both phosphorus and nitrogen that explicitly includes how Alum dosing and catchment phosphorus mitigation would be used
- Investigate and consult over the issues of Alum dosing issues that may impact on Lake Rotorua.

Individual feedback responses questioned why rules were needed at all, if Alum dosing was proven to work.

Summary of position

Alum dosing of the Utuhina and Puarenga Streams is currently used to reduce phosphorus loads to Lake Rotorua. This has had the effect of limiting phosphorus in the lake for significant parts of the year (but not exclusively). Limiting phosphorus means that the high nitrogen load has much less impact on water quality (i.e. Lake Rotorua has been at or very near to its TLI target for the last three years).

[61] Te Arawa Lakes Trust (2015).
[62] Te Maru O Ngāti Rangwewehi Iwi Authority (2012).

The Regional Council has resource consents for Alum dosing which are due to expire in 2018 and 2019. Due to the long groundwater delays bringing nitrogen to Lake Rotorua from land use, it is expected that any benefits from improving land use will take time to become apparent in terms of the Lake's TLI, and that it will take many decades to reduce leaching to sustainable levels. As a result, Alum dosing may need to continue after 2018/19 to maintain the current improved water quality. An increased availability of phosphorus in the water means that algal blooms could occur unless steps are taken to reduce both the phosphorus and the nitrogen loads coming from the catchment. It has been suggested by some members of the community that we could take an alternative strategy to managing the water quality of Lake Rotorua, where instead of managing both nitrogen and phosphorus we take stronger action on reducing phosphorus coming from the catchment. Although there is some merit in that approach, specific environmental conditions around the Lake Rotorua catchment make that unadvisable. The Lake Rotorua science advisors (the Water Quality Technical Advisory Group) have continued to advise that a dual nutrient control strategy is necessary, due in particular to the fact that natural levels of dissolved phosphorus coming to the lake from the catchment geology are elevated. Therefore even a very strict regime of controlling phosphorus coming from land use activity would be highly unlikely to reduce in-lake phosphorus levels (without Alum dosing) to make the lake reliably phosphorus limited. Research supports this advice.

In summary, the risks and uncertainty associated with Alum dosing mean that it cannot be supported as a permanent intervention. In particular the low buffering capability of the lake and the risk of acidifying conditions developing (either from Alum or natural geothermal conditions) mean that there is a risk of an ecotoxic environment developing that would be extremely difficult to reverse. The longer the dosing continues the more this risk increases. In the absence of other technology Alum dosing will continue on a temporary basis (albeit for the medium term) to manage the lake's TLI until nutrients entering the lake are reduced to sustainable levels.

9.4.2 **Phosphorous management**

The co-management of phosphorus and nitrogen is important in order to bring the Lake back to an equilibrium that matches the TLI. The need to target both nitrogen and phosphorous has been a consistent message from the scientific advisors.

The Operative RPS does not include a target for phosphorus, as at the time it was developed the specific contaminant loads for phosphorus and its behaviour in reaching the lake were not as completely understood on the basis of scientific evidence. The draft Lakes Rotorua and Rotoiti Action Plan 2009 contained a target for a sustainable phosphorus load of 37 tonnes. This was based on technical advisory group recommendations from 1989. This analysis did not incorporate particulate phosphorus entering the lake via storm flow.

More is now known about the behaviour of phosphorus within the lake (as a result of alum dosing and storm flow research) but this does not provide a basis for establishing a rule framework that targets phosphorus.

While there is a clear phosphorous response occurring in the lake as a result of alum management of phosphorus there is not a complete understanding of what scale of phosphorus control is possible from managing catchment phosphorus sources from sustainable land use. Current research indicates managing phosphorus loads that coincide with the 435 t N target and the 4.2 TLI target will be challenging without the use of alum dosing. Consequently establishing whether other combinations of nitrogen/phosphorus might be relevant in reaching the TLI (in particular a higher nitrogen target and lower phosphorus target) is limited by the challenge involved in preventing phosphorus entering the lake.

One of the difficulties in potentially targeting phosphorus within the Lake's catchments is that due to the local geology, phosphorus originating from natural sources is relatively high, and targeting anthropogenic sources is unlikely to be of sufficient magnitude to reduce phosphorus to a level that it limits phytoplankton growth in the lake.

In other words if a high percentage of phosphorus in the catchment comes from natural sources then the capacity to reduce phosphorus by controlling catchment activities will be difficult as there are fewer opportunities to control the inputs. To establish the likely pool of manageable phosphorus within the catchment a study has been commissioned to quantify the sources of phosphorus in the catchment and to provide an estimate of phosphorus that may be manageable by typical land management actions. This research is relying on use of land use models and we understand that these models have limitations in their predictions due to the difficulty in modelling phosphorus pathways within the environment.

There is also uncertainty associated with any proposal to manage phosphorus under a regulatory framework in terms of how the discharge would be framed. Phosphorus has been extensively studied but there is limited information on how a property would be linked to its phosphorous discharge other than by the application of best management practices or land use change that results in the establishment of forestry and native bush areas from previous pastoral land. Transferring the challenge to the Lakes Programme (regardless of funding arrangements) for delivery would require renegotiation of the funding deed arrangements and consideration of a range of risks and mitigations would be required. Cost effectiveness and certainty of delivery would be key attributes that would need to be considered. Modelling of phosphorus losses is also an inexact science at present.

Scale of phosphorus reductions required

As already mentioned, work completed to date[63] indicates that a significant component of the phosphorus entering Lake Rotorua is derived from natural sources. Lake Rotorua has a relatively large volume of groundwater discharge to the lake that is enriched from long aquifer residence times. This groundwater is enriched with phosphorus which has leached from the rhyolitic pumice bedrock.

[63] Draft report by Temporo G, Abell J, Hamilton D, McBride C (2015).

Early results estimate the anthropogenic (human induced) Total Phosphorus load at 53.3% of the Lake load. The estimated loadings of Dissolved Reactive and Total Phosphorus[64] are:

	Baseline	Natural load	Anthropogenic load	Anthropogenic load %
Dissolved reactive phosphorus	27.73	19.61	8.30	29.3%
Total phosphorus	48.71	22.76	25.95	53.3%

In assessing the estimated loadings to the lake and the assumed sustainable load for phosphorus the most recent science advice that has been provided is that between 11 and 15 tonnes of phosphorus entering the lake would need to be removed to align with the 435 tonne nitrogen target. This provides a range of between 42.4% and 57.8% of the anthropogenic loading.

A significant proportion of anthropogenic phosphorus derives from ungauged stream catchments. Further analysis of natural phosphorus sources within this category may shift tonnage into the natural load. This would have the effect of increasing the percentages required to be removed from the anthropogenic loading.

Phosphorus reductions from nitrogen mitigation

There is an assumption that phosphorus reductions will accompany nitrogen reductions as a result of land management and land use change. If the nitrogen reduction is associated with pastoral-to-forestry land use change then this is likely to support phosphorus reductions. It is not necessarily the case with all lower nitrogen loss activities as some have the potential to increase phosphorus loss (such as farming activities that increase the risk of soil erosion).

Without controls on phosphorus there is also a risk that phosphorus use could increase. Both nutrients have differing modes of transport and transformations in the environment and it is possible that gains in nitrogen and phosphorus could be unrelated. This is an area that will continue to be explored.

Summary of position

Phosphorus reductions are required in association with nitrogen reductions identified in the RPS to achieve a sustainable lake load. The reductions to the level required from anthropogenic sources are substantial and therefore there is little confidence that reductions in excess of these levels can be achieved to allow any consideration of relaxing the nitrogen target.

[64] Dissolved Reactive Phosphorus is a component of the Total Phosphorus measurement.

Key reference documents

Technical reports

- IScribe Ltd (2014). *Lake Rotorua Draft Nitrogen Rules – Consultation Report.* Prepared by Lucy Brake (iScribe Ltd), November 2014. http://www.rotorualakes.co.nz/vdb/document/891
- Te Maru O Ngāti Rangiwewehi Iwi Authority (2012) *Ngāti Rangiwewehi Iwi Environmental Management Plan.* https://www.boprc.govt.nz/media/270922/ngati_rangiwewehi_iwi_environmental__management_plan__2012__part_1_smallest.pdf
- Hamilton, DP, McBride, CG, Jones HFE (2015*). Assessing the effects of alum dosing of two inflows to Lake Rotorua against external nutrient load reductions: Model simulations for 2001-2012.* Report prepared for the Bay of Plenty Regional Council. http://www.rotorualakes.co.nz/vdb/document/1034
- Tempero G (2015). *Ecotoxicological Review of Alum Applications to the Rotorua Lakes.* Environmental Research Institute and University of Waikato ERI Report Number 52. http://www.rotorualakes.co.nz/vdb/document/1283

10 Evaluation of policy and rule framework

10.1 Overview

This section evaluates the effectiveness and efficiency of elements of the policy and rule framework. The provisions have been evaluated as packages, rather than individual provisions. The Plan Change provisions are grouped as follows:

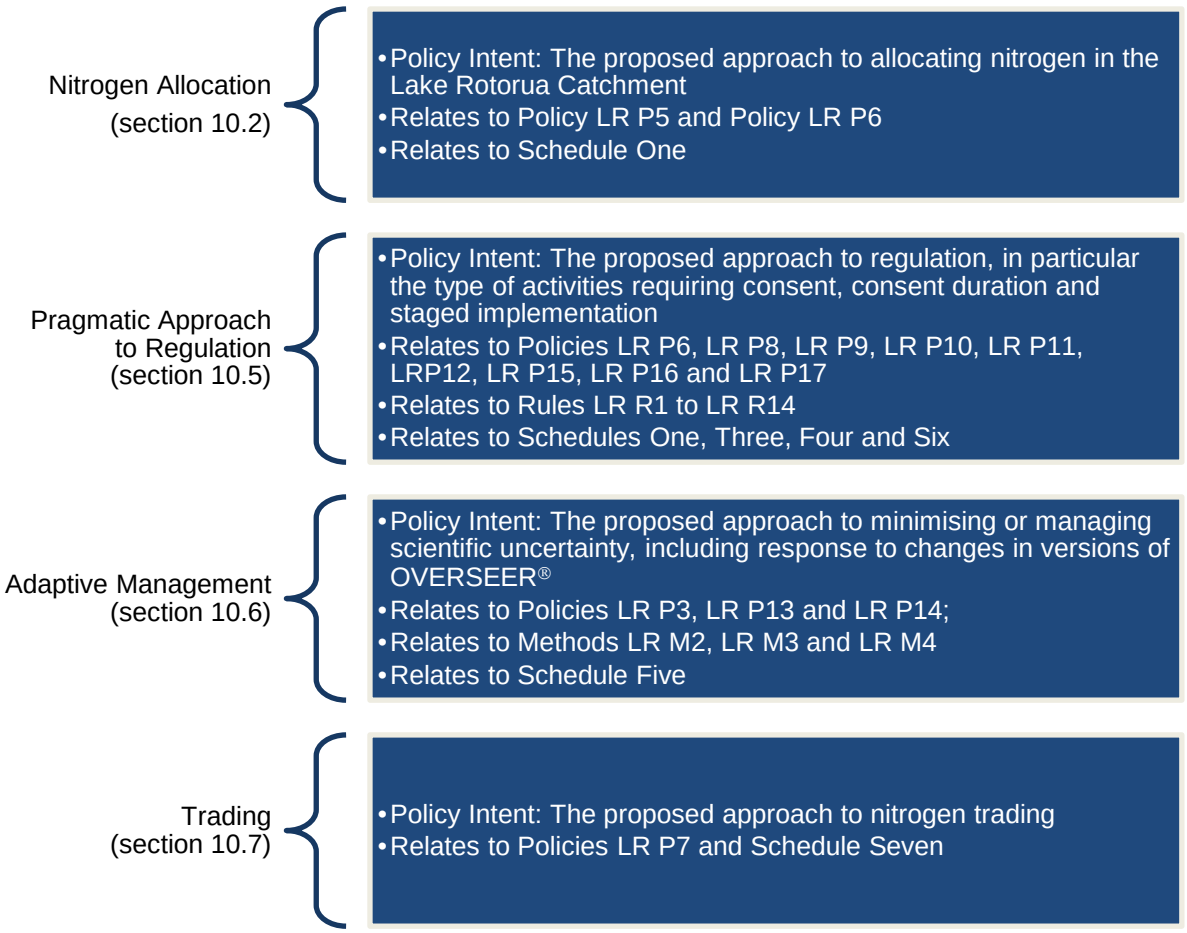


Figure 23 Evaluation of policy and rule framework.

The rules and policies are the outcome of active engagement and a collaborative process over three years. During that process stakeholders have sought information and analysis to increase the robustness of the rule process and associated knowledge base.

10.2 Nitrogen allocation approach

The RPS sets a sustainable nitrogen load for Lake Rotorua of 435 tonnes per year, to be met by 2032. This section describes methods available to allocate the sustainable load amongst users.

The way that the sustainable load of nitrogen is allocated is a contentious topic. The allowance allocated will impact on the activities farmers can undertake now and in the future, and potentially impacts on property values. Nitrogen allocation has important implications for:

- Public and private equity.

- Economic viability of pastoral farming sectors.
- Future land use patterns.
- Future development opportunities.
- Social, cultural and economic development.

The Stakeholder Advisory Group and industry sector representatives (notably DairyNZ, Beef and Lamb New Zealand and Federated Farmers) participated in a process to understand the implications of different allocation methods, and to endeavour to reach agreement on a preferred approach.

Linkage with relevant plan change provisions:

Nitrogen allocation approach
• Policy LR P5, Policy LR P6 and Schedule 1

10.2.1 Allocation principles

Nitrogen Discharge Allowances (NDAs) could be allocated in a variety of different ways. All allocation methods have implications for land values, farm profitability and future land use.

There is no 'right way' to allocate allowances and no generally agreed definition of how costs should be shared between individuals or sectors. The best allocation system will be the one that is seen as being fair by those it has the greatest impact on.

The RPS policy sets the context for rules development and the requirement for allocation. The allocation of nitrogen allowances is guided by Policy WL 3B and WL 5B of the RPS, as follows:

Policy WL 5B: Allocating the capacity to assimilate contaminants

Allocate among land use activities the capacity of Rotorua Te Arawa lakes and other water bodies in catchments at risk to assimilate contaminants within the limits established in accordance with Policy WL 3B having regard to the following principles and considerations:

(a) Equity/fairness, including intergenerational equity;

(b) Extent of the immediate impact;

(c) Public and private benefits and costs;

(d) Iwi land ownership and its status including any Crown obligation;

(e) Cultural values;

(f) Resource use efficiency;

(g) Existing land use;

(h) Existing on farm capital investment; and

(i) Ease of transfer of the allocation.

StAG considered the following additional principles for deciding the allocation method:

- No major windfalls for any sector.
- Preference will be given to the allocation approach that has the least overall economic impact.
- Existing investment (including in infrastructure, land value, cash investment and in nutrient loss mitigation) will be recognised.
- Practices that cause high nitrogen loss, relative to sector norms, will not be rewarded.

10.2.2 Alternatives considered

The following methods were considered in the course of plan change development:

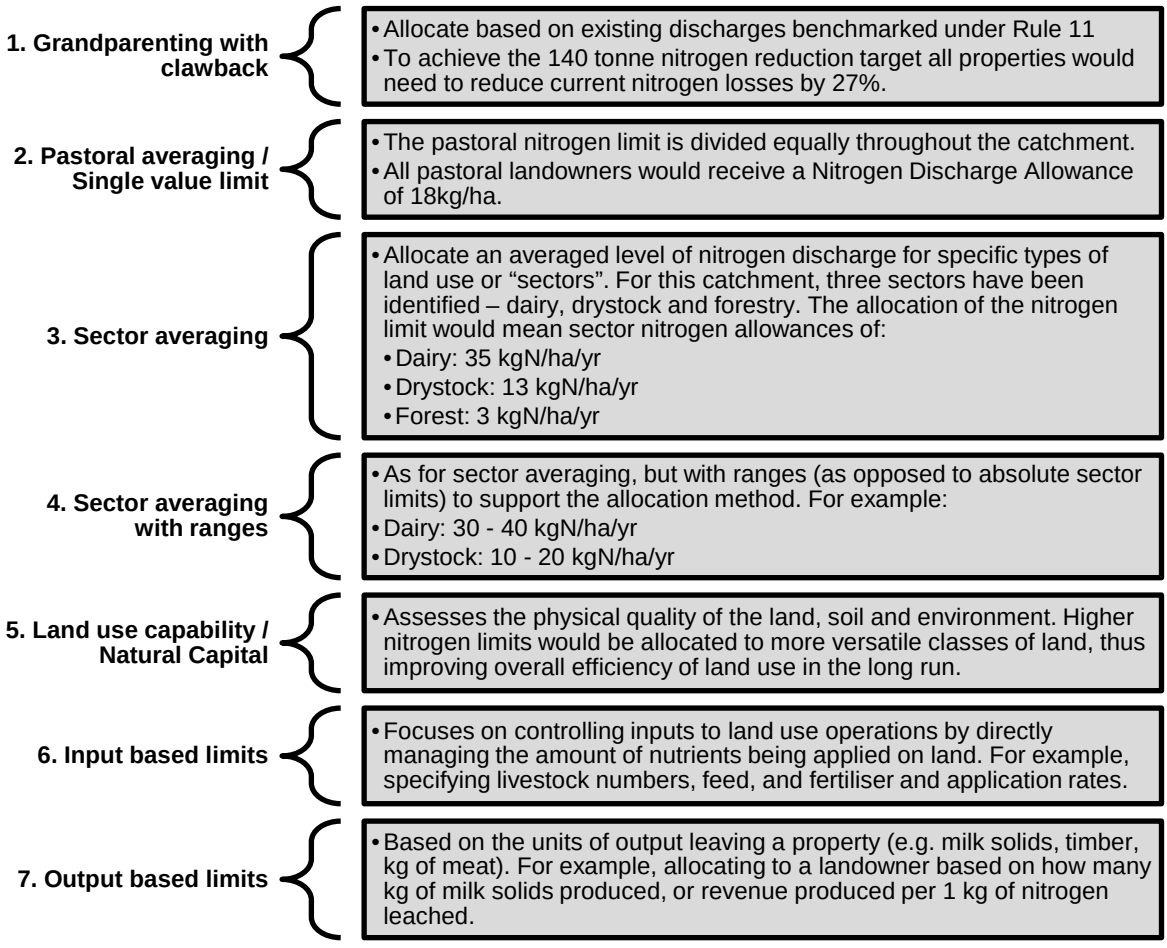


Figure 24 Methods for allocating nitrogen discharge allowances.[65]

Hybrid allocations based on combinations of the allocation methods in Figure 24 were also considered.

[65] Figures in this table are based on OVERSEER® 5.4 values, which have been updated in the subsequent version used for allocation.

Approaches to nitrogen allocation by other regional councils

Natural capital approaches

The *Otago Regional Council* water quality rules (Plan Change 6A – Otago Water Plan) restrict nitrogen leaching rates based on the location of the property in relation to Nitrogen Sensitive Zones. Leaching rates are limited to 15kgN/ha/yr, 20kgN/ha/yr and 30kgN/ha/yr, depending on the size of the catchment and the sensitivity of the aquifer. These limits apply from 1 April 2020.[66]

The *Hawke's Bay Regional Council*'s Tukituki River Catchment Plan Change 6 became operative in October 2015. Properties in the Tukituki catchment have until 1 June 2020 to achieve the Tukituki LUC Natural Capital nitrogen leaching rates (Table 5) or apply for a resource consent.[67]

Table 5 Tukituki catchment nitrogen leaching allowances.

LUC class	I	II	III	IV	V	VI	VII	VIII
Rate kgN/ha/yr	30.1	27.1	24.8	20.7	20.0	17.0	11.6	3.0

The *Horizons One Plan* uses Land Use Capability Class (LUC) to determine a leaching rate for a property (Plan Change 6). Provisions require existing intensive farming land use activities in targeted water management sub-zones and any new intensive farming land use activities in any water management sub-zone, to comply with cumulative leaching maximums (Table 6). Landowners are required to reduce to these limits over a 20 year period.

Table 6 Cumulative nitrogen leaching maximum by LUC, Horizons One Plan.

LUC class	I	II	III	IV	V	VI	VII	VIII
Year 1 kgN/ha/yr	30	27	24	18	16	15	8	2
Year 5 kgN/ha/yr	27	25	21	16	13	10	6	2
Year 10 kgN/ha/yr	26	22	19	14	13	10	6	2
Year 20 kgN/ha/yr	25	21	18	13	12	10	6	2

Grandparenting (historical allocation)

The *Waikato Regional Council* allocated Nitrogen Discharge Allowances to landowners in the Lake Taupō catchment based on historic leaching levels (Variation 5). The rules provide some limited flexibility for undeveloped and forested land.

[66] Limits are applied in a similar way to phosphorus, ammoniacal nitrogen and Escherichia coli. http://www.orc.govt.nz/Documents/Publications/Farming%20and%20Land%20Management/Water%20Plan%20Change%206A%20-%20Summary%20Guide.pdf?epslanguage=en-NZ

[67] Hawkes Bay Regional Council (2015). *Plan Change 6*.

The Proposed Canterbury Land and Water Regional Plan provides for differing nutrient management rules for each of the four "nutrient allocation zones".[68] The zones were established taking into account the water quality in the area and the remaining assimilative capacity. Medium leaching rates are classified as less than 20kg/ha/yr, and high are classified as greater than 20kg/ha/yr. Ability to increase nitrogen leaching depends on the zone and farm size. Where zones are over-allocated, farms with high leaching rates will require a resource consent and a Farm Environment Plan (as rules are implemented). All properties over five hectares must establish a nutrient losses baseline. Farms leaching less than 10kgN/ha/yr and properties of less than five hectares are permitted, provided they are not in lake zones. There is some limited opportunity to increase above the baseline, depending on the zone.

Pastoral averaging

In its notified plan, Environment Canterbury Regional Council's Plan Change 2 (Ashburton) provisions restrict the future nitrogen leaching rate to no more than 27kg/N/ha/yr for farming activities or farming enterprise in the Lower Hinds/Hekeao Plains area. Decisions on this allocation method are not out yet and are likely to be different from the notified provisions.

10.2.3 Allocation recommendations, decisions and milestones

The allocation of nitrogen discharge allowances has been considered by StAG. The following table presents the decisions and milestones that have informed the allocation and trading discussion:

Table 7 Stakeholder Advisory Group (StAG): Key milestones.

3 Dec 2012	• Requirement to reduce annual load of pastoral N from 526 tonnes to 256 tonnes confirmed.
29 Jan 2013	• Different approaches to allocating the 256tN/yr discussed.
14 Feb 2013	• Allocation principles drafted.
19 Mar 2013	• Allocation approaches assessed - some methods of allocation were put aside as not appropriate for the Lake Rotorua catchment. • Agreed to analyse sector-average allocation and compare against historical allocation (grandparenting).
16 Apr 2013	• Agreed to include Rule 11 data in allocation analysis. • Draft principles for the incentives scheme considered.
13 May 2013	• Draft results from Motu analysis of allocation options presented and considered.
18 June 2013	• Policy options for allocating nitrogen considered and agreed for the Primary Producers Collective to develop an alternative approach.
16 July 2013	• Primary Producers Collective proposal considered and agreed to as an allocation approach but with caveats on further work being done.
22 Oct 2013	• Dairy support sector considered.

[68] Red, orange and green/light blue zones, plus an 'unclassified' zone. http://www.ecan.govt.nz/our-responsibilities/regional-plans/lwrp/Documents/lwrp-faqs-and-what-does-it-mean.pdf

18 Nov 2013	• Nitrogen discharge allowance range options considered.
19 June 2014	• Nitrogen discharge allowance trading supported.
16 December 2014	• Draft sector targets in OVERSEER® 6.1.3 – methods and issues.
16 February 2015	• Draft conversion principles considered for transitioning reductions and allocations between OVERSEER® versions.
17 March 2015	• Allocation and ranges recommendations.
23 June 2015	• Considered allocation of nitrogen using OVERSEER® 6.2.

10.2.4 Evaluation of allocation approaches

The principles outlined in section 10.2.1 have been used to consider the options at all steps in the process. An extensive consideration of the options against the principles is contained within Regional Council report 17 September 2013. Community consultation also guided the selection of the preferred option.

Table 8 Evaluation of allocation approaches.

Approach	CRITERIA			
	No major windfalls for any sector	**Existing investment is recognised**	**Least overall economic impact**	**Practices with high nutrient discharge are not rewarded**
Grandparenting allocation approach	✓	✓	✓	×
Land use capability allocation approach	-	×	×	×
Pastoral averaging allocation approach	×	×	×	✓
Sector averaging allocation approach	✓	✓	-	✓
Input based allocation approach	✓	×	-	✓
Output based allocation approach	-	×	-	×

Appendix 7 provides commentary on how these principles have been interpreted.

Some options were eliminated as not being suitable for the Lake Rotorua catchment, such as allocation based on inputs or outputs. A key consideration was retaining flexibility for farmers to manage the adjustment to a low nitrogen leaching farming system, without the Regional Council "telling farmers how to farm". There was also a desire to encourage innovation within the pastoral sector.

Grandparenting, or historical allocation, can remove the disadvantage from farmers who have high rates of nitrogen loss due to geophysical factors outside their control, but it also tends to reward high leaching activities.[69] Single sector averaging was investigated alongside grandparenting.[70] A single sector allocation would reward past mitigation and sustainable farming practices (relative to farmers who had not undertaken such activities), but makes no allowances for differences in leaching due to differing geophysical factors. A hybrid of these two approaches – sector average with ranges – recognises the differences in sectors, and provides ranges based on historical use, so helps to address the issue of high leaching as a result of geophysical characteristics.

An approach using land use capability (natural capital) was supported as aligning the land resource with its productive capacity. Analysis undertaken later in the process showed that the distribution of allowances under this approach would differ considerably from current land use, therefore causing significant social and economic disruption. Under low trading efficiency the economic impact of this method is higher than alternatives.[71]

A stakeholder/expert workshop held on 11 December 2014 considered the allocation issue.[72] Key points from the workshop discussion were:

- Time to transition to allocations is important: "the longer time you allow to transition, the better off the farmer will be".
- Fairness and equity should be considered.
- Social and economic disruption should be minimised.
- Land use flexibility with minimal cost to transition is desirable.
- The approach should be as simple as possible.
- The ability to trade allowances and how this is provided for is important.
- A durable solution is required.

The workshop did not reach a clear recommendation. In general, the findings aligned with the principles discussed above and provided commentary on implementation of any decision. For example, the workshop recommended that adequate time be allowed for farmers to transition to different land uses. The importance of this has been recognised in the rule drafting process. Workshop participants supported the idea of natural capital but recognised the benefits of minimising social and economic disruption. Some of the principles work against the implementation of a natural capital approach.

10.2.5 Economic impact of allocation options

The economic impacts of alternative allocation methods have been modelled to better understand the impacts on farms, industry sectors, the catchment, the Rotorua district and the Bay of Plenty region.[73]

[69] Timar, Asastasiadis, Kerr (2015).
[70] Timar, Asastasiadis, Kerr (2015). Also refer to presentation to StAG, May 2013.
[71] Market Economics Ltd (2015).
[72] This workshop comprised Council staff, StAG members and consultants with expertise relating to allocation (economics, farm systems, land use options).
[73] Parsons et al (2015).

Catchment modelling was based on representative farm systems and mitigation protocols developed in workshops with Council staff, Dairy NZ, Beef and Lamb NZ and local farm consultants. The modelled farms were identified by farm system, soil type, rainfall and slope. Allocation methods modelled were:

- Sector averaging.
- Sector averaging with consideration of biophysical characteristics/
- Single range for all sectors/
- Natural capital/
- Equal allocation with partition for slope/
- Sector ranges (three alternative scenarios)/

Post-allocation trading of allowances was included in the modelling, using two trading efficiency scenarios. These were 100 percent and 50 percent efficient trading. A third restriction built into scenarios was based on limiting land use change to 5000 hectares. This limit reflected a reluctance of landowners to change from pasture to forestry because of factors such as lack of annual return or negative impacts on land prices.

The catchment level results showed that under any allocation scenario the average per hectare income across the catchment would increase, and assumptions of greater efficiency improved average outcomes. Per hectare profits increase because farms with more challenging conditions (e.g. leakier soils) move to lower nitrogen land uses, allowing the average per hectare return to move in accordance with the profitability of remaining farms. A substantial shift of land use change occurs under all allocations as landowners move towards lower allocation land uses.

Modelling shows that the distribution of impacts is uneven across farmers in the catchment. Geophysical characteristics (e.g. soil type, rainfall levels) are important in determining whether farmers can reach their allocation by land management change, or whether land use change is required. For example, the modelling suggests that most dairy farms on allophanic and pumice soils will change land use, possibly to forestry.

Where trading is assumed to be perfectly efficient and land use change is not restricted, the average per hectare operating profit for farm types (prior to trading NDA entitlements) is similar and higher for all the allocation methods except sheep and support[74]. When trade in entitlements is included the impacts on sectors differ, and this becomes more pronounced when lower levels of trading efficiency are assumed.

The following paragraphs describe the effects of sector averaging and natural capital allocation based on the scenario with 50 percent efficient trading and no land use change restrictions. Scenarios with less than efficient trading can provide better insights into possible outcomes than ‘efficient trading’ scenarios. In the latter, all allocation methods give the same end result (future equilibrium) because all choices are economically optimal, so all resources move to highest value use. In the Lake Rotorua catchment, trading is unlikely to be perfectly efficient. One of the main factors likely to influence trading efficiency will be the capital impacts of changing land use (e.g. dairy to forestry).

[74] Sheep and (dairy) support is one farm type in the model.

In the modelling, the trading efficiencies described above were applied evenly to both the Incentives Board nitrogen allowance purchases and farmer-to-farmer trading. Critiques of the modelling suggested that farmer-to-farmer trading would likely be less efficient than 50 percent, and Council considers that the Incentives Board is likely to be effective in achieving their target 100 tonnes. Further modelling was undertaken using a range of efficiency scenarios where the Incentives Board was highly efficient and farmer-to-farmer trading was relatively inefficient. The results of these additional scenarios were consistent with the 50 percent overall efficiency scenarios in magnitude and direction of effects.[75]

Comparison of sector range and natural capital allocations

Under a sector range allocation, average profit per hectare increases in all land-uses, reinforcing "the existence of some cost-effective mitigation options and win-win strategies, coupled with the opportunity to sell [nitrogen discharge allowances] to the incentives fund."[76] In the model, decisions to change land use relate to the ability to reduce nitrogen discharges – soil type and rainfall are key determinants in those decisions. The reduction in nitrogen allowances results is that less viable dairy farms move to other land uses, leaving the more profitable farms. This increases the average per hectare income for dairy farms by five percent (Figure 25), but at a loss of around half the dairy farms in the catchment (Figure 26).

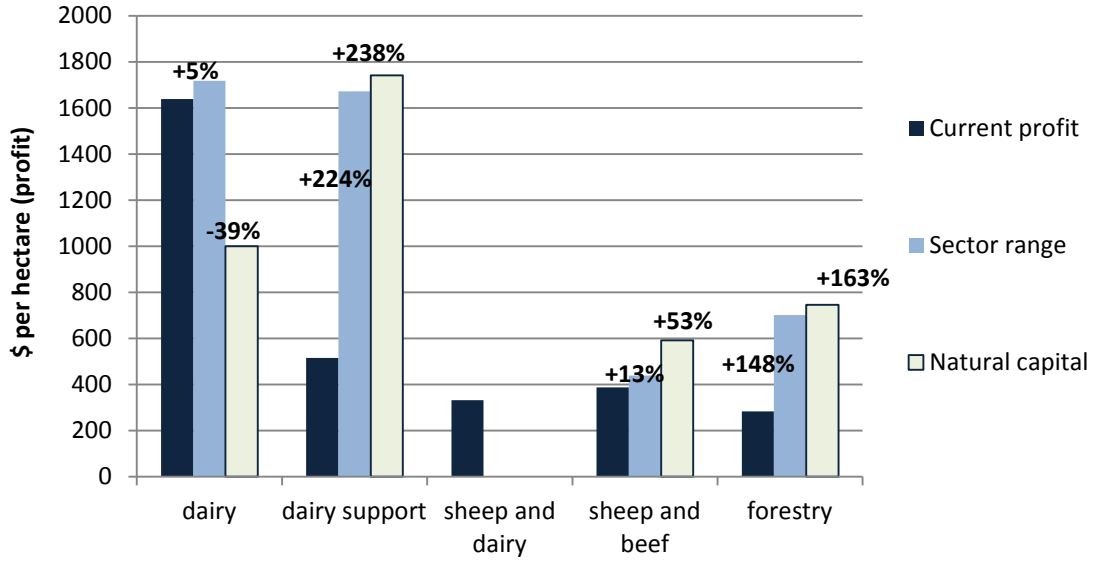


Figure 25 Average per hectare profitability under natural capital and sector range allocation (50% trading efficiency)

Under a natural capital scenario, dairy farming per hectare profitability drops by 39 percent and few dairy farms remain in that land use (Figure 25). The sharp drop in profitability is based on existing farmers purchasing nitrogen discharge allowances in order to remain in dairying.

[75] Summary report of spreadsheets stored in Objective File A2281571.
[76] Parsons et al. (2015, p.54).

Sheep and beef farming returns increase under either allocation scenario, though more so under natural capital (Figure 25). The increases under natural capital are due to the ability to sell nitrogen allowances.[77] While sheep and beef land increases marginally in the sector range scenario, it doubles in the natural capital scenario.

Under different efficiency scenarios, where farmer-to-farmer trading is assumed to be fairly inefficient (20 percent of economically optimal trades occur) and the Incentives Board is assumed to be fairly efficient (100% and *80%*) results are similar to the overall 50 percent efficiency scenarios (Table 9).

Table 9 Per hectare profit: Percentage change from current status under different efficiency assumptions.

	Sector range		**Natural capital**	
	100% *(80%)* IB; 20% fmr	**50% overall**	**100% *(80%)* IB; 20% fmr**	**50% overall**
Dairy	+8% *(+6%)*	+5%	-51% *(-64%)*	-39%
Dairy support	+190% *(+251%)*	+224%	+258% *(+254%)*	+238%
Sheep and beef	+11% *(+9%)*	+13%	+44% *(+24%)*	+53%
Forestry	+100% *(+80%)*	+148%	+236% *(+274%)*	+163%

Land in forestry increases by around 50 percent in a sector range scenario, while profit more than doubles. The positive impact comes about because of the shift from other land types to forestry, and the resulting ability of those landowners to sell assets such as livestock and nitrogen discharge allowances. Under natural capital the shift to forestry tends not to occur, but profitability increases because the incumbents are able to sell the nitrogen discharge allowances allocated under the natural capital approach.

Dairy support becomes a financially attractive activity under both allocation scenarios. Total land use in dairy support doesn't change (Figure 26), but in the model some dairy farmers move to dairy support (selling livestock, machinery and nitrogen discharge allowances) and some dairy support blocks change to sheep and beef or forestry (again with the annualised income from sale of assets).

[77] Income from sale of assets including nitrogen discharge allowances is annualised in the model.

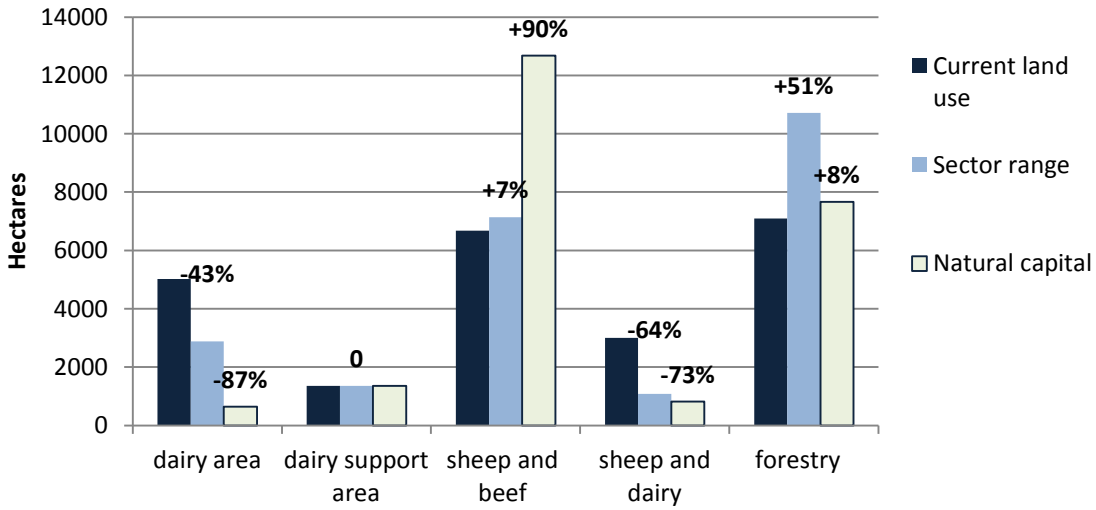


Figure 26 *Land use under natural capital and sector range allocation (50% trading efficiency).*

Under different efficiency scenarios, where farmer-to-farmer trading is assumed to be fairly inefficient (20 percent of economically optimal trades occur) and the Incentives Board is assumed to be fairly efficient (100% and *80%*) results are similar to the overall 50 percent efficiency scenarios (Table 10).

Table 10 *Land use: Percentage change from current status under different efficiency assumptions.*

	Sector range		Natural capital	
	100% *(80%)* IB; 20% fmr	**50% overall**	**100% *(80%)* IB; 20% fmr**	**50% overall**
Dairy	-43% *(+39%)*	-43%	-77% *(-78%)*	-87%
Dairy support	0 *(0)*	0	0 *(0)*	0
Sheep and beef	+11% *(+20%)*	+7%	+81% *(+94%)*	+90%
Sheep and dairy	-61% *(-65%)*	-64%	-76% *(-71%)*	-73%
Forestry	+46% *(+37%)*	+51%	+11% *(+3%)*	+8%

By 2032, production in milk solids may reduce by nearly 40 percent under the sector range scenario, beef production by eight percent, and wool and sheep meat by less than five percent (Figure 27).

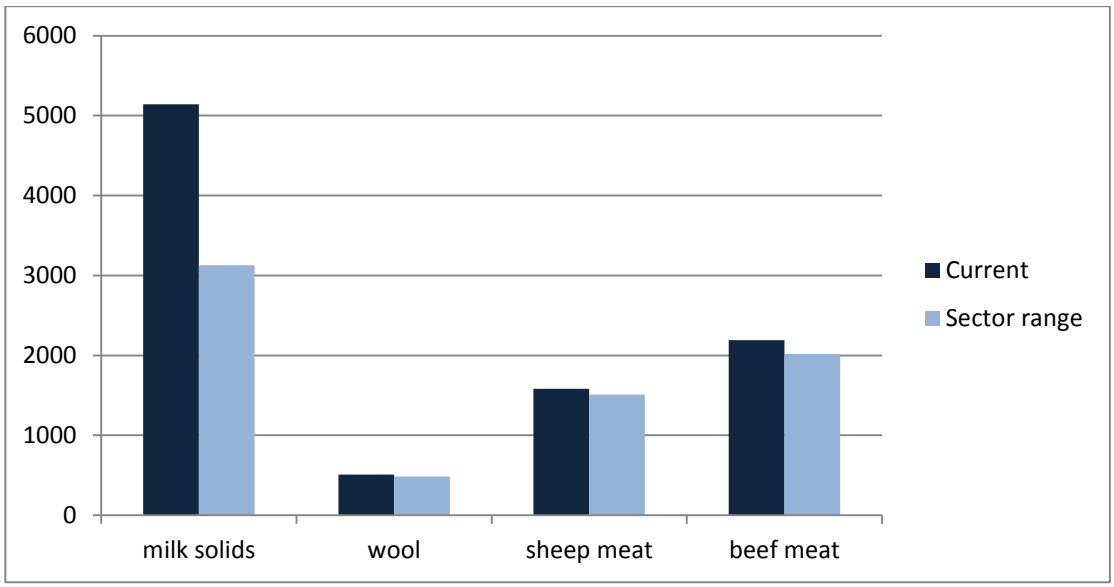


Figure 27 Changes in production under sector range scenario.

District/regional analysis

In the district/regional analysis, when trading is perfectly efficient, there is little difference between the costs of different allocation methods.[78] When trading frictions are included in the model, it is estimated that allocation methods closest to the status quo (e.g. grandparenting and sector ranges) have lower overall costs than methods that result in bigger movements from the status quo (e.g. natural capital). The distribution of the costs across sectors also changes markedly.

At the district, regional and national economy levels, the sector average with range allocation is expected to be a relatively low cost approach compared with the single sector average and natural capital options (Table 12). Economic modelling estimates that the farm system impacts of a natural capital allocation are more than twice as large as the sector range/benchmarking allocation in the district economy. This is largely because the closer to the status quo, the least disruptive economically. In terms of changes to employment within the Rotorua District, all are relatively similar. The sector range approach is estimated to result in a loss of 76 jobs, against 88 for natural capital.

Table 11 Impact of preferred allocation method on district economy and employment (50% trading efficiency).

	Single sector average	Natural capital	Sector range/ benchmarking
District GDP ($m)	-4.1	-8.3	-3.5
District employment (MEC)[79]	-78	-88	-76

[78] Market Economics (2015).
[79] Modified employment count is the number of jobs (not necessarily full time), and including working proprietors.

10.2.6 Preferred option

The preferred allocation approach is sector averages with ranges adjusted based on Rule 11 benchmarking.

The sector average with ranges approach is preferred because it:

- Recognises existing land use and investment.
- Accommodates dairy support and intensive beef in a suitable drystock range.
- Meets the principles and considerations defined in the RPS.
- Meets the principles adopted by StAG.
- Allows the allocation to match the Integrated Framework commitment.

The choice of ranges is important and StAG considered several alternatives. This is discussed in the following section.

10.3 Ranges

Section 10.2.6 of this report outlined preferred approach to nitrogen allocation, namely **sector averages with ranges adjusted based on Rule 11 benchmarking**. This is based on dual sector averages (drystock 20.4 kgN/ha and dairy 46.6 kgN/ha) with the following ranges: drystock range of 16 - 32 kgN/ha and dairy range of 39 - 52kgN/ha. This section provides further information about how the preferred ranges were selected.

The allocation methodology was developed through a process that took place over three versioning changes of OVERSEER®. Version 5.4 numbers were initially used, and were converted into version 6.1.3 to agree the allocation methodology. The ranges were subsequently converted into 6.2.0 on the basis that the integrity of the allocation methodology would be maintained.[80] Throughout the process the sector contributions have been maintained.

Options considered

The choice of ranges is also important to the allocation discussion, and StAG considered a wide range of potential ranges and alternatives. The nature of the discussion around ranges also caused some iteration of the primary options (such as considering using averages for specific sectors).

The detail of how each range would be applied was an important consideration as to how individual properties would be treated in relation to their current position. This was to ensure an outcome that is relatively fair between properties. The process of moving benchmark values to ranges involves the use of a pragmatic, mathematical approach that achieves the required reductions.

Each scenario involved the application of a standard percentage reduction (also called clawback) and then movement into the range if a property was still outside of the range. This is demonstrated below. Where sector averages are used then only the movement to the average was required.

[80] Rule Content: Allocation details. Report to Lake Rotorua Stakeholder Advisory Group http://www.rotorualakes.co.nz/vdb/document/120.

Issues that were considered during the evaluation of the ranges included:

- The presence or absence of windfall gains.
- The spread of impacts (associated with the ranges).
- The degree of impact per property.
- The principles and considerations defined in the RPS.

The following ranges were considered and modelled:[81]

1 Dual sector ranges: incumbent approach, gap between ranges (15-31kg drystock, 43.5-58 kg dairy).

2 Dual with adjoining ranges: stretched drystock range from permitted activity level up to the lower dairy limit (15 kg to 43 kg).

3 Dual: single average dairy NDA and adjoining drystock range.

4 Dual: single low dairy NDA and adjoining drystock range.

5 Combined (single sector): wide range.

6 Combined (single sector): medium range.

7 Combined (single sector): tight range.

8 Combined single average: no range.

As part of the discussion a further allocation was modelled by StAG during the 17 March 2015 workshop. This option looked to adjust the parameters of the range to match with the Integrated Framework's sector reductions.

Application of range methodology

To meet the required reduction the following methodology is applied:

1 Take current or derived benchmark.

2 Apply a standard percentage reduction for all properties except those properties:

- Where the benchmark is below the lower NDA range boundary,
- Where applying the standard percentage reduction would cause the NDA to fall below the lower NDA range boundary,
- In both of these cases the NDA will be set at the lower range boundary.

3 Following the standard reduction, any property that is above the upper NDA range boundary is moved down to that boundary.

The following diagram shows an application of this methodology to 28 dairy farms (x-axis) within the catchment. It uses the numbers from the preferred approach.

[81] Modelling based on OVERSEER® V6.1.3.

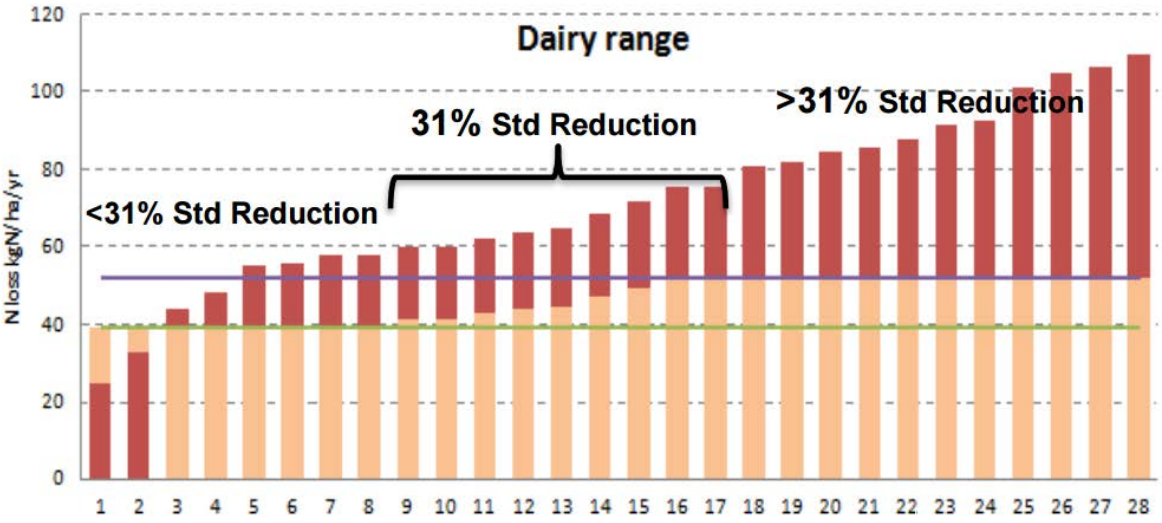


Figure 28 Example of application of sector range methodology (OVERSEER® 6.1.3).

The standard reduction percentage is 31 percent, the upper range is 52 kgN/ha and the lower range 39 kgN/ha.

Preferred approach

The preferred allocation method that received majority support at StAG (17 March 2015) is as follows:

Dual sector averages (drystock 20.4 kgN/ha, dairy 46.6 kgN/ha) with ranges:

- *drystock range of 16-32 kgN/ha*
- *dairy range of 39-52 kgN/ha.*

This allocation methodology was subsequently approved by the Regional Council (Regional Direction and Delivery Committee 2 July 2015 with the addition of "adjusted to OVERSEER® 6.2 and maintaining the integrity of the StAG 17 March 2015 decision" to the recommendation/resolution).

OVERSEER® 6.2.0 has the addition of better, more accurate soils data. Together with the improved drainage sub-model that was added in version 6.1.3, version 6.2.0 is an improved platform for Lake Rotorua. Drainage and soils in combination are critical elements of leaching potential. The use of OVERSEER® 6.2.0 supports the principle of "best science" that underpins the rules methodology.

Under OVERSEER® 6.2.0 the updated allocation methodology is:

Dual sector averages (drystock 25.6 kgN/ha, dairy 64.5 kgN/ha) with ranges:

- ***drystock range of 18-54.6 kgN/ha***
- ***dairy range of 54.6-72.8 kgN/ha.***

One small change to the ranges is that the gap that existed under version 6.1.3 has disappears under version 6.2.0. This is a factor of the need to maintain the sector contributions and to resolve eth ranges in response.

Fixing the allocation point

As with many aspects of the rules there are options. With allocation there is the need to specify a timeframe and the associated approach to OVERSEER® versioning. The table below outlines the two options: now or later.

Table 12 Comparison of approaches to OVERSEER® versioning.

Now (rule adoption)	Later (Operative 2017)
Certainty for pastoral sector to begin planning.	Updated versions (better science).
Incentives Board needs certainty to start (agreements more certain).	Property results may vary from current position.
Reference files approach provide for proportional change.	Winners and losers unknown.

A critical consideration is the need to support the work of the Incentives Board by providing certainty around available nitrogen. The preferred option is therefore to allocate at the rule adoption stage and to use OVERSEER® 6.2.0 as the basis for this.

On-farm economic impacts

Investigating the likely costs to farmers has included modelling the impacts based on eight different allocation options.[82] Modelling suggests that under the sector range allocation method (the optimum land use change/50% trading efficiency scenario) that:[83]

- The total farm profitability impacts will differ for individual farmers depending on their allocation relative to their current discharges, the type of farm and the characteristics of that farm such as soil type, rainfall and slope. For most farmers there will be relatively low cost management actions available in the first reduction period (2017 to 2022).
- For all farmers *per hectare* income is likely to increase. The biggest increases are for forestry and dairy support, mostly as a result of pastoral farmers shifting to these sectors and selling existing saleable assets such as Fonterra shares and livestock. The income from sale of these assets is annualised in the model. The increased profitability per hectare for dairy and sheep and beef is relatively small (Figure 25).
- Land use changes will occur in the longer term. By 2032, the existing dairy area may reduce by 43 percent, dairy support remains the same, sheep and beef increases by seven percent, sheep and dairy reduces by 64 percent (Figure 26). Forestry is estimated to increase by 51 percent, some of this on pastoral farms (i.e. partial conversion).
- By 2032, production in milk solids may reduce by nearly 40 percent under the sector range scenario, beef production by eight percent, and wool and sheep meat by less than five percent (Figure 27).

[82] Doole, Romera and Parsons (2015).
[83] The modelling includes land use change transition costs.

10.4 Summary

The allocation methods have been assessed against the criteria in the Regional Policy Statement and against the principles developed by StAG. Sector averaging with ranges based on existing nitrogen benchmarks[84] was assessed as best meeting those principles.

The sector range aspect of this approach:

- Contributes to equity and fairness.
- Keeps nitrogen discharges within sector norms by establishing upper and lower limits.
- Limits windfall gains by sectors. Sectors are not allocated more than they currently use.

The reference to benchmarking within this approach:

- Limits the extent of the immediate impact of individual farmers because the method is partially based on previous discharges, so farmers are working back from their nitrogen discharge limits under Rule 11.
- Existing land use and on-farm capital investment is recognised.

Most approaches have similar landscape impacts in terms of being likely to result in larger forested areas over time. The exceptions are natural capital and equal allocation, which would see a large increase in drystock and a relatively large decrease in dairy.

The choice of allocation approach based on using ranges is also influenced by how the ranges are set. The ranges that have been identified deliver on the sector reductions within the Integrated Framework.

[84] From Rule 11, where property benchmarks were established based on annual average 2001-04 nutrient discharges.

Key reference documents

Technical reports

- Bay of Plenty Regional Council (2012). Allocating Lake Rotorua's sustainable nitrogen limit amongst land use activities. Draft paper prepared by Council staff www.rotorualakes.co.nz/vdb/document/512.
- Greenhalgh (2013). Approach to assess the impacts of allocation options. Presentation to StAG.
- Lake Rotorua Stakeholder Advisory Group (StAG) Position Paper - Allocation Rules and Incentives, prepared for Council meeting on 17 September 2013, online here www.rotorualakes.co.nz/vdb/document/408.
- Market Economics Limited (2015). Economic Impacts of Rotorua nitrogen reduction. District, regional and national evaluation. Report prepared for Bay of Plenty Regional Council. www.rotorualakes.co.nz/vdb/document/1258.
- Parsons OJ, Doole GJ, Romera AJ (2015). On-farm effects of diverse allocation mechanisms in the Lake Rotorua catchment. Report prepared for the Lake Rotorua Stakeholder Advisory Group. www.rotorualakes.co.nz/EconomicImpacts.
- Perrin Ag Consultants Ltd. (2014). Rotorua NDA Impact Analysis: Phase 1 Project. Rotorua. www.rotorualakes.co.nz/vdb/document/736.
- Webber W, Morgan G. (2014). Evolving to nitrogen discharge allocations for the Lake Rotorua catchment. www.rotoruafarmers.org.nz/resources/farm-reports.

Stakeholder Advisory Group

- Meetings on 11 December 2014, 17 March 2015, 28 April 2015 to confirm approach http://www.rotorualakes.co.nz/stag.

Council report

- Bay of Plenty Regional Council Regional Direction and Delivery Committee. Meetings held on 17 September 2013, 9 December 2014, 2 July 2015. www.boprc.govt.nz/council/committees-and-meetings/regional-direction-and-delivery/.

Fact sheets

- Fact sheet 2 – Nitrogen Discharge Allowances.
- Fact sheet 3 – Draft Rules – Q&A.

10.5 Pragmatic approach to regulation

This Plan Change will be included as a new topic-based chapter to the RWLP, comprising 17 new policies, five new methods, 14 new rules, 23 new definitions and seven new schedules.

Key features of the Plan Change include:

- Managing farming activity land uses on the basis of property/farming enterprise size.
- Requiring resource consents for farming activities that have higher rates of nitrogen loss.

- Setting NDAs for all properties requiring resource consents.
- Allowing movement of NDAs between properties (i.e. trading).
- Requiring information reporting for all properties that have higher rates of nitrogen loss.
- Establishing staged nutrient reduction pathways by way of:
  - Nitrogen Management Plans, to show how landowners will make nutrient reductions over time towards their NDA.
  - Phasing in of rules between 2017 and 2022.
- Undertaking science reviews as specified in the rules framework.

This section outlines the pragmatic approach taken to the implementation and administration of new rules.

Linkage to relevant plan change provisions:

Pragmatic approach to regulation
• Permitted activities: - Policy LR P9, Policy LR P15 - Rules LR R1 to LR R7 - Schedule Two and Three • Activities requiring consent: - Policies LR P6, LR P10, LR P11, LR P12, LR P15, LR P16 and LR P17 - Rules LR R7 to LR R11 - Schedule One • Staged Implementation of Rules: Policy LR P10 • Managed Reduction:Policy LR P8 and Schedule Six • Implementation Plan Development: Method LR M5

Refer to section 11.4 and Appendix 9 for further information about Nitrogen Management Plans as the mechanism to deliver managed reduction.

10.5.1 Permitted activities (no consent required)

This classification is used for activities deemed to have a minor effect on the resource used or the environment. Activities can occur ‘as of right’ without the need to obtain a resource consent, provided they comply with the conditions stated in the rule.

Permitted activity rules: LR R1 to LR R7

Small blocks

Preferred option

- Permit properties less than 5 hectares with no commercial cropping, horticulture or dairying (no requirement to meet the stocking rate limits).
- Permit properties of 5-10 hectares that meet a stocking rate requirement.

Alternatives considered

- User alternative area thresholds (for example, 4ha).
- Use property size and nitrogen loss rate thresholds for permitted activity (consultation occurred on two hectares and no more than 18kg N/ha/yr: OVERSEER® 6.2.0).
- Require all properties to get consent.
- Limit commercial activity.
- Different ways to define intensive land use.

Evaluation

The permitted activity threshold for small blocks has been shaped by consultation. As a result of community feedback, the permitted threshold was raised from two hectares to 10 hectares (excluding specified intensive land uses). This was because:

- Properties less than 10 hectares are more likely to be lifestyle-focused rather than a commercial grazing enterprise and are therefore less likely to have intensive farming (although cropping/cultivation is possible)
- Consenting for small properties has the potential to be unnecessarily demanding on the skilled resources required for supporting certified nutrient budgets for managing nitrogen loss.
- The approximately 1,000 small properties in the catchment area of less than four hectares cover a total area of about 1,100 hectares. Drystock is the most common land use on small blocks (90%), and there is a low but unquantified level of dairy support occurring. The resources to include these properties in a regime that requires a high level of monitoring on the Council's part and reporting on the landowner's part is not likely to justify the gain in nitrogen management. There is unlikely to be any significant gain in nitrogen reduction from the small properties.[85]

For low intensity land use on properties of 5-10 hectares, the imposition of a resource consent cost is unlikely to be justified by the more intensive monitoring and compliance costs unless the properties are operating commercially in which case a resource consent is justified.

Staff consider that the adverse effects from these smaller properties (less than 10 hectares) can be adequately managed through conditions on permitted activities. The proposed conditions define low intensity land use. Any land use that does not meet the definition will require consent.

[85] Estimation of costs for landowners includes $1200 per resource consent, plus time to develop and update Nutrient Management Plans. Council costs would include monitoring and compliance costs.

The stocking rate table provided to assist with consultation process has been reviewed and formalised into the rule. The stocking table defines the stock numbers for a land owner to comply with a permitted activity status of 18kgN/ha/yr (OVERSEER® 6.2.0). The stocking table requirements were to achieve low intensity farming that approximates typical small block management practices. It was designed to comply with the following:

- Lowest practical stocking rate that achieves effective management of pasture grown.
- Can run a stock policy of 70% cattle
- Achieve leaching rate of less than 18kgN/ha/yr.

The stocking rate table methodology is defined in Perrin Ag Consultants Ltd (2015).

The analysis of small blocks in the catchment[86] estimates that there are 1,336 properties in the groundwater catchment less than 40 ha in size. The table below shows the distribution of small blocks (based on valuation references):

Table 13 Distribution of small blocks in the Lake Rotorua catchment area.

Area size band	Total small blocks
0.05 - 0.4 ha	214
0.4 - 2 ha	674
2 - 4 ha	157
4 - 10 ha	265
10 - 20 ha	102
20 - 30 ha	56
30 - 40 ha	16
Total	**1,484**

A number of properties are made up of several valuation references – the larger the property the greater the proportion[87] - so an estimate of the number of properties less than 40 ha is 1,366. For the purposes of this analysis the 1,484 figure has been used.

Originally there was a two hectare threshold below which nitrogen limitations were proposed to not apply. The communication on this was inexact as the rules still applied but no nitrogen leaching controls were going to be imposed. Above this size 2-40 hectares properties would have required consent.

As a result of feedback on this threshold between rule types, the consent threshold was lifted to 10 hectares. There is also a change in that the under two hectares were previously included as being subject to the permitted activity conditions – specifically the stocking rate table. There has been consultation feedback on both the inequity of excluding under 2 ha properties and on the idea that small properties should not require consents or be subject to the stocking rate table. The key reason given is that there is a cost imposed and little gain in terms of nitrogen management.

[86] Land Connect Ltd November 2015 *Lake Rotorua Catchment Small Block Sector Review*
[87] Ibid. (section 3.2).

There was also feedback that the application of rules to reticulated properties (those who had already contributed to nutrient reduction through this infrastructure development) were further penalised. The response to this is that the effect on reticulated communities is likely to be minimal as follows:

- Reticulated properties (such as in the lakes settlements) are usually small and do not generally have stock on them.
- If they do, they are unlikely to have stocking rates more than the permitted levels.
- If they intensively farm animals or discharge significant amounts of nitrogen then they are contributing to the nitrogen problem and need to be considered.

The information provided in the review of small blocks highlighted that there are significant numbers of small properties that were unlikely to be farming at commercial levels. The low risk that these properties present combined with the administrative costs means that it is reasonable to reintroduce a threshold for permitted activities (with conditions excluding high nitrogen loss activities – such as dairying and cropping).

The table below identifies the number and size of valuation references (assumed to be properties for the purpose of this analysis) in the Lake Rotorua Groundwater Catchment:

Table 14 Small blocks number and area.

Area size band	Total small blocks	Cumulative small blocks	Total area small blocks (ha)	Average small block size (ha)
0.05-0.4 ha	214	214	42	0.20
0.4-2 ha	674	888	624	0.93
2-4 ha	157	1,045	438	2.79
4-10 ha	265	1,310	1,501	5.66
10-20 ha	102	1,412	1,389	13.62
20-30 ha	56	1,468	1,129	20.16
30-40 ha	16	1,484	510	31.88
Total	**1,484**		**5,634**	**3.80**

The larger the size of property the more the risk increases with unmanaged nitrogen loss. Larger properties are more amenable to commercial operations or management and this tends to mean potentially more nitrogen loss. In terms of nitrogen management, smaller properties due to how they are managed (generally as lifestyle blocks) loss less nitrogen. The risk associated with these properties not being “managed” by rules is therefore low. This risk increases with property size.

The Small Block Sector analysis[88] models the amount of nitrogen loss against property size. Table 7 of the report shows that with three out of four scenarios the 4-10 ha category shows a significant reduction in nitrogen loss that is not experienced in the 0-4 ha range.

[88] Land Connect Ltd 2015.

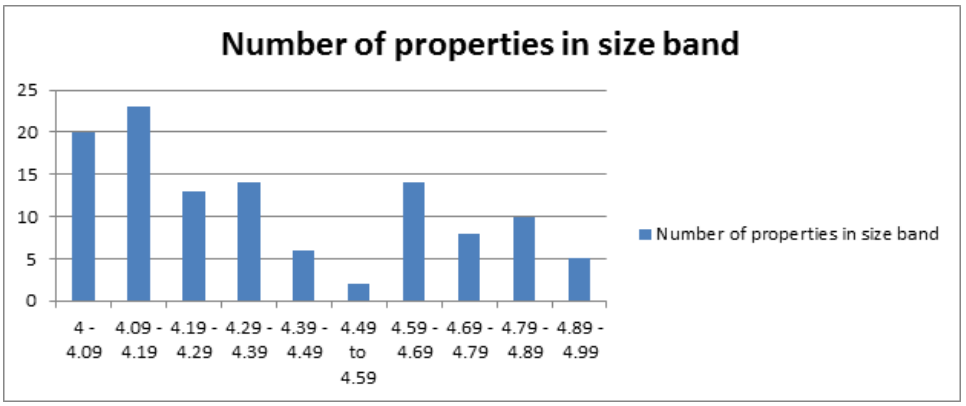
The limited number of benchmarked small blocks shows (on the basis of regression analysis) that 2-4 ha is closes to the permitted activity level of 18 kgN/ha/yr. The four to 10 ha category is benchmarked at 23.1 kgN/ha/yr[89]. There are only a limited number of benchmarked properties to derive this information from.

From the analysis, a threshold of four hectares was introduced into the draft rules. This threshold represented a significant proportion (70%) of properties in the catchment of which most are likely to be lifestyle properties. The Small Block Sector analysis indicates that there is a shift to higher levels of nitrogen loss at this threshold. The 4-10 ha category begins to include larger sizes of blocks that would be un-managed. As a threshold this would leave less than 19% of properties under specific nitrogen management.

However the data used in this analysis is very limited and not overly robust. Through the StAG process a number of other thresholds were discussed and the threshold of 5ha was promoted as capturing a greater proportion of properties most likely to be lifestyle in nature. The historical planning threshold of 10 acre for lot sizes is also slightly larger than 4 ha - 4.047 ha.

The following tables identify the number of properties around the 4 ha/5 ha thresholds:

Area bands	Count small blocks[VR]	Cumulative total small blocks[VR]	% of total small blocks[VR]
0.05-2 ha	888	888	68%
2-4 ha	157	1,045	80%
4-5 ha	117	1,162	89%
5-6 ha	44	1,206	92%
6-7 ha	43	1,249	95%
7-8 ha	25	1,274	97%
8-9 ha	18	1,292	99%
9-10 ha	18	1,310	100%
Total	**1,310**		



[89] Ibid: refer to Table 6.

From these tables it can be seen that 1,162 or 89% of small blocks are under 5 ha in area. Using a 5 ha threshold reduces the potential for consent administration costs and it is believed that 5 ha land use is unlikely to differ substantially from that which occurs on 4 ha. A substantial number of properties are just over the 4 ha threshold.

Through the process of approving the rules for notification that RDD Committee approved an increase in the permitted threshold to 5 ha on the basis that properties below this threshold were most likely to be lifestyle in nature and that the nitrogen loss risk is likely to be low.

Plantation forestry and bush/scrub

Preferred option

- Permit nitrogen loss from plantation forestry and bush (with conditions).

Alternative considered

- Require plantation forestry to get consent.
- Use nitrogen loss rates to define permitted activity status.

Evaluation

Forestry remains a permitted activity. Tree cover is an optimal land in relation to nitrogen loss and therefore it is unreasonable to require these land owners to gain consent. There are approximately 16 forestry blocks (with over 90% of property in forestry) covering over 8,000 hectares that will be permitted under this rule.

The issue of future use by the forestry sector of fertilizer application for enhanced growth rates will need to be worked through and may be the subject of future plan reviews. Any increase in nitrogen loss increases the risk to the lake water quality. Forestry is currently modelled at standard OVERSEER® loss rates.

Permitted threshold for low nitrogen loss rate

Preferred option

- Permit properties that are low intensity (using OVERSEER® to prove nitrogen loss rates).

Alternative considered

- Require all properties that do not meet other permitted activity conditions or larger properties with low nitrogen loss rates to gain consent.

Evaluation

This option (LR R7) provides for properties that may not meet permitted conditions or may be larger than 40 ha but can demonstrate they have a low nitrogen loss rate. This nitrogen loss rate is linked to the permitted activity reference file and there is an obligation on the owner to provide evidence that they are maintaining the low nitrogen loss rate over time.

It is efficient to permit low nitrogen loss land use rather than require consent. There could be an added benefit that landowners opt to change their land management practices in order to comply with this rule, rather than applying for consent.

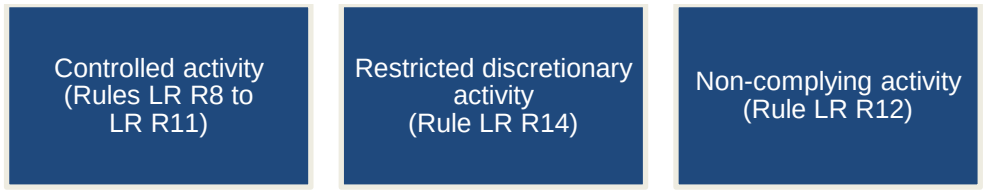
Information gathering on properties between 10-40 ha

Between 2017 and 2022, the focus will be on establishing baseline land use information for these properties. Properties between 10-40 ha will be required to submit information annually from 2017 detailing their land use activities.

Information gathered through this period will help develop the understanding of the catchment and for a property when consent is required. It will also guide the development of best management practice, mitigation options and templates for controlled resource consent applications.

10.5.2 Activities requiring consent

The proposed rules provide a cascade approach that allocates an activity class according to the severity of effects and the need to actively manage them. In the case of these new rules, the effects arise from the rate of nitrogen loss per hectare and the total loss of nitrogen per property.



Preferred option

- Range of activity statuses to reflect the level of effect and provide an incentive for action (consultation option and selected option).

Alternative considered

- Use of a single activity status (e.g. discretionary).

Evaluation

A controlled activity must be granted under the RMA. A longer consent term (20 years) will also be given for these activities under policy LR P16. This provides incentives for landowners, in exchange for certainty and security, to submit a Nitrogen Management Plan showing managed reduction to meet the property's NDA by 2032.

Properties not demonstrating managed reduction will be non-complying. This activity class was recently tested in the Environment Court whereby the Judge supported the default activity class to be non-complying as they are more restrictive than discretionary. Non-complying activities send a signal that the activity is generally not condoned and therefore a strong case needs to be made to support it.

A rule is needed to address the situation where land use activities are not able to be modelled OVERSEER®. This has been included as Rule LR R11. The rule follows the same approach used for OVERSEER® -based rules, but references alternatives ways to achieve the same result.

10.5.3 Staged implementation of rules

This section looks at the options considered in relation to how the rules are to be implemented i.e. when the rules should take effect.

Preferred option

- Staged rule implementation.

Alternative considered

- All properties require consent from the date of Plan Change notification (in accordance with s86B(3)(a) of the RMA).
- All properties require consent from 2017.

Evaluation

Properties larger than 40 ha require a resource consent in 2017. Other properties including: properties between four and 10 ha that do not meet the permitted conditions; properties between 10-40 ha; or properties not previously managed by Rule 11, all require a resource consent by 2022.

There are approximately 556 properties in the catchment that are over 10 ha in size that will ultimately require resource consent. To address the consenting burden that could occur as the rules become operative, the start date for properties between 10-40 ha is delayed until 2022. Reasons include:

- Balancing out the administrative burden compared to all properties requiring consent at once
- Targeted nitrogen management for potentially higher nitrogen loss properties in the first five years
- Time and support for small block owners and landowners in the groundwater catchment not previously managed by Rule 11 to accept change that will be required (refer Section 11.2 of this report). These land owners have had little involvement with Rule 11 and many were unaware that new rules would impact them.

The 40 ha threshold for requiring consent by 2017 was proposed because properties over 40 ha make up approximately 70% of the catchment area and contribute over 80% of the total pastoral load of nitrogen. This size threshold is also consistent with implementation of Rule 11 to date.

10.5.4 Managed reduction

The RPS establishes a Managed Reduction Target for nitrogen loss: 70% of the required reduction from 755 tN/yr to 435 tN/yr must be achieved by 2022. To achieve the 2022 target, the reduction of 44 tonnes will need to be achieved by the pastoral landowner share on individual farms through NDAs.

Preferred option

- Use Nitrogen Management Plans that set five year planning targets for individual properties.

Alternatives considered

- Property owners to only meet Nitrogen Discharge Allowance by or prior to 2032.
- Property owners to meet Catchment Management Target by 2022 and Nitrogen Discharge Allowance by or prior to 2032.

Evaluation

The preferred option - Use Nitrogen Management Plans that set five year planning targets for individual properties – is considered appropriate and effective in achieving managed reduction.

Refer to section 11.3 and Appendix 9 for further information about Nitrogen Management Plans as the mechanism to deliver managed reduction.

10.5.5 Implementation plan development

An Implementation Plan will set out how plan provisions will be applied including interpretation of any areas of discretion. This will provide certainty and consistency to council and landowners.

Preferred option

- Develop implementation plan to accompany rules.

Alternatives considered

- More prescriptive provisions in the plan change.
- No implementation plan, and treat each consent on a case-by-case basis.

Evaluation

Council is committed to providing as much certainty around rule implementation as possible. An implementation plan will be developed as an internal document that sets out key considerations and guides resource consent decision-making. The Implementation Plan will also be helpful in setting out the resource requirements to bring the rules into fruition. Topics will include:

- Matters of control/discretion.
- Consent duration.
- Mitigation options.
- NDA calculations.
- Monitoring and compliance.
- Industry-led initiatives including agreed best practice.
- Communications.
- Response to science review recommendations.

10.5.6 Evaluation of pragmatic approach to regulation

The pragmatic approach adopted by Council combines a number of elements, each requiring consideration of alternative options, as documented above. At the forefront of each decision point is the need to balance the need for intervention, the costs of that intervention, and confidence that the objective will be delivered.

Phased implementation is efficient in that it is purposefully designed to require immediate action from larger properties on the basis that they are the major contributors to the lake's nitrogen load. Permitting activities such as smaller properties with low-intensity land use and forestry is an efficient approach in that resources are not unnecessarily spent on managing land uses that have low nitrogen loss that could be efficiently managed by conditions on permitted activities.

The consent process and the implementation plan are effective mechanisms to check the pragmatic approach is delivering the objective. For example, the use of different activity classes incentivises landowners to opt for a managed reduction approach (i.e. submit a Nitrogen Management Plan showing pathway to achieve nitrogen reductions). Managed Reduction Targets provide an assurance to Council that nitrogen loss reductions will contribute to meeting the 2032 target.

Key reference documents
Stakeholder Advisory Group • Meetings held on 18 November 2014. Agenda and minutes: http://www.rotorualakes.co.nz/StAG_2014 Bay of Plenty Regional Council Regional Direction and Delivery Committee • Meeting held on 9 December 2014. Agenda and minutes: https://www.boprc.govt.nz/council/committees-and-meetings/regional-direction-and-delivery/ • RDD Committee Report: Approval for notification of Proposed Plan Change 10 (Lake Rotorua Nutrient Management Rules) to the Operative Bay of Plenty Regional Water and Land Plan 14 December 2015 and minutes.

10.6 Adaptive management

Planning often involves making decisions where there is uncertainty, and the first and perhaps most important step in the process towards making policy judgements is to recognise it exists.

Uncertainty can be addressed in two basic ways: minimising uncertainty, or managing with uncertainty. Council's approach has been to work in both of these areas. There is significant science and modelling analysis available to Council to inform its decision. There will always be more work that can be done on answering science and modelling questions, however there will also be some necessity to act in the absence of perfect information.

The plan change provisions recognise that variables are changing and adjustments may be needed – and the future management of the Lake Rotorua nutrients will involve having the ability in place to allow adaptation where required.

Two variables in particular are discussed and evaluated: regular science reviews, and OVERSEER® version control.

Linkage to relevant plan change provisions:

Adaptive management
• Policies LR P1 and LR P4 • Methods LR M2, LR M3 and LR M4 • Schedule Five

Refer to section 11.1 for further information science and managing uncertainty.

10.6.1 Regular science and policy reviews

The need to keep the science that underpins the regulatory framework under review has been a consistent theme from StAG and the community. The impacts of the rules are significant and therefore it is appropriate that the Regional Council has a commitment to this. This commitment is referenced in the multi-party Oturoa Agreement.[90] While this is a non-statutory document, the Oturoa Agreement contains obligations for all parties and it has been subsequently referenced in the RPS (Policy WL 6B - Managing the reduction of nutrient losses).

Council has obligations within the RMA to carry out five-yearly reviews of policy statements and plans. Under section 35 of the RMA, Council needs to carry out necessary research, monitor the state of the environment and assess the effectiveness of policy statements and plans. There is also the requirement to undertake a full review of the RPS and plans after 10 years.

The intention of this would be that science reviews are programmed in as part of Council's regular business. It is expected that the reviews would follow a rigorous scope that would cover all relevant matters.

Preferred option

- Include specific policies and an extensive method within the plan change.

Alternatives considered

- Rely on RMA section 35: five-year and 10-year requirements (no specific method)
- Include a simple method within the plan change
- Include specific terms of reference for reviews within the Plan Change.

The current position is to include an extensive method within the plan change. The first two alternatives do not adequately recognise the importance of this issue even though technically they would have the same impact. The third alternative is seen as too prescriptive and of having an unnecessary level of detail.

[90] In 2013, Bay of Plenty Regional Council, Federated Farmers Rotorua and the Primary Producers Collective signed the Oturoa agreement. This outlined the agreed timelines to achieve catchment nutrient reduction targets.

Therefore the Plan Change incorporates a method specifically to signal the use of regular reviews of relevant science underpinning the policy approach. This will include:

- Timeframes for commencing and completing the reviews.
- Key science themes that will be considered in the reviews.
- Options available if science advice changes.
- The appropriateness of the overall catchment target.

Evaluation of preferred option: Regular science reviews

The expectation is that the science reviews will occur on a five-yearly cycle. This is a reasonable expectation given the ongoing research that continues to deliver new information for consideration. As noted in the Oturoa Agreement, the RMA requirement applies to the RPS which contains the annual nitrogen target derived from lake science and modelling: the 435 tonne sustainable lake load. The RPS became operative on 1 October 2014. The five year review is therefore due 1 October 2019, and this will be a policy review.

The approach is supported by Policy LR P1 that signals the intention to monitor the future target and adapt where necessary. The downside of this approach is uncertainty for people whose land use activities are affected by the rules. The uncertainty may impact negatively on some property values[91] and may be a source of stress to property owners.

The Integrated Framework references the need for a science review in 2017. All aspects of the science package would be considered at that time. This timing would then see the science review being available to support the required policy review.

10.6.2 OVERSEER® Version control

The OVERSEER® nutrient budget model is updated from time to time with new versions to reflect:

- Improvements to the model algorithms and the user interface.
- Additions of new farm systems, farm practices and mitigation options.
- Corrected software issues.

Each of these OVERSEER® versions updates may, to varying degrees, result in different outputs. This means the key nitrogen leaching predictions may vary, even though the same farm inputs are entered into the model.

Preferred option

- Always use the latest version of OVERSEER® and specify a method to adjust NDAs to maintain proportionality between current and target NDA levels (reference files).

[91] Where pastoral farming is the best use for that property. Telfer Young (2014).

Alternatives considered

- Ignore version changes by using a specific OVERSEER® version indefinitely, with compliance against fixed NDA levels.
- Use a specific OVERSEER® version for a finite period, then formally update the specified version and recalculate NDAs via a plan change process.
- Do not specify any version, but rely on OVERSEER®-based actions being incorporated into the Nitrogen Management Plan which is subject to compliance monitoring.
- Always use the latest version of OVERSEER® and allow some informal compliance flexibility against fixed NDA levels.

The preferred option has been selected because:

- OVERSEER® version updates represent improvements in usability, nutrient science and mitigation options that would not be available to landowners under a fixed version regime.
- Older versions of OVERSEER® software are automatically over-written by new versions when they are released. The increasingly common on-line OVERSEER® functionality only uses the latest version. Most OVERSEER® expert users update to the latest version as a matter of course. While it may be possible to negotiate (with the OVERSEER® owners) an operating licence for a superseded version, this incurs significant maintenance costs and may not overcome growing software stability risks.
- The frequency of OVERSEER® version updates varies considerably and it would not be practical to synchronise typically lengthy plan processes with the most critical version updates.
- The overall policy objective is to achieve the sustainable load of 435 tN/yr and this numeric specificity necessitates a quantitative NDA regime with quantitative compliance monitoring: that is, farm or nitrogen management plans are important, but do not directly provide a quantitative reference point in the way that a refreshed OVERSEER® file can.

The use of reference files is supported by LR P4. The maintenance of proportionality between current and target NDA levels enables consistent temporal fairness (i.e. the same property treated similarly over time) and spatial fairness (i.e. different properties and land uses treated similarly). It is recognised that this is likely to create issues at a farm-based level where if reference files were not being used the task of achieving an NDA may be easier for some farmers. Conversely though, it would be harder for others. The key factor is the uncertainty that would accompany version change and the reference file approach is designed to reduce this.

10.7 Trading

Trading regimes can provide flexibility in resource sharing under scarcity and deliver economic efficiencies, reducing the cost of regulatory compliance. Markets offer resource users the ability to compare their marginal value for a resource, and make decisions on whether to use more or less of the resource in order to maximise their economic position. Ideally this would enable the resource to be used in the combination of ways that has the highest value to society.

In the Lake Rotorua catchment, trading has the potential to increase flexibility for farmers by enabling operational changes as the nitrogen cap reduces, and facilitating longer term decisions to intensify or de-intensify land use. For example, a farmer may choose to remain at the benchmarked level by purchasing NDA, or delay mitigation to fit a preferred timeframe. Farmer costs of reducing nitrogen discharges can be lowered through trading, and the ability to sell excess rights encourages farmers to find new and different ways of reducing discharges.

Resource scarcity, heterogeneity, well-defined rights, plenty of traders and relatively low transaction costs are all essential for effective and efficient markets. In the Rotorua catchment, given that the cap is less than current use, allowances will be scarce. Heterogeneity exists in terms of farm type and size, management and geophysical characteristics (e.g. soil type, rainfall), and this creates differences in the availability and cost of mitigation options for farmers.

In the Lake Rotorua case, under the Integrated Framework, there are a number of complexities created by the requirement for trading to operate, notably the interaction with the Lake Rotorua Incentives Scheme, which is required to reduce total nitrogen discharges by 100 tonnes in the 2017-2022 period.

The Taupō cap-and-trade scheme provides a successful working model for a nitrogen discharge allowance trading system in the New Zealand context. Trading started in that market in 2009, and by 2015 30 of the 180 farmers in the catchment had engaged in at least one trade, and three leases had occurred. While it is not possible to know whether the market is fully efficient, the existence of a reasonable number of trades, particularly between farmers, suggests the market is functioning.[92] The relatively small size of the Taupō market makes it relatively simple for traders to find each other – usually by word-of-mouth, although there is provision for a notice board. The rights associated with nitrogen discharge allowances correspond to the requirements for valuable rights, such as quality of title, exclusivity, duration, transferability, flexibility and divisibility.[93]

Linkage to relevant plan change provisions:

Trading
• Policiy LR P7, Rule LR R10 and Schedule Seven

10.7.1 Consideration of options

Preferred option

- Enable long-term trading of “permanent” nitrogen discharge allowances.
- Enable short term trading – where trading of entitlements occurs during the period of transition to NDAs.
- Delay trading until 2022.

[92] Kerr, Greenhalgh and Simmons (2015).
[93] Barns and Young (2013).

Alternatives considered

- No trading.
- No short term trading.
- No long-term trading.

The Lake Rotorua StAG considered trading at several meetings. On 17 March 2014 and again on 28 April 2014 trading was specifically addressed. StAG supports trading as part of the regulatory framework. A key discussion point was that trading offered flexibility, and the opportunity for efficient market response. A key concern was that the system established to facilitate trading would need to keep transaction costs sufficiently low in order to make trading worthwhile.

10.7.2 Evaluation of preferred option

The need and desirability of an environmental trading market should be assessed in terms of potential contribution to:

- Achieving the environmental goal: the 70% reduction target by 2022, and the 435 tonne limit by 2032.
- Lowering costs of compliance compared with alternative mechanisms.
- Providing regulated entities with an incentive to innovate to create efficiencies.
- Lowering regulatory costs (admin, monitoring, and enforcement) compared with alternative mechanisms.

The success of a trading regime will be judged through its use: by the number of trades and through higher economic performance under resource constraints.

Table 15 Summary of benefits and costs of trading.

Benefits	Costs
- A tool to assist farmers to manage transition to low nutrient state (flexibility). - Incentivises efficient resource use. - Lowers costs for farmers. Economic impact analysis at the farm and catchment level shows trading lowers the cost for farmers and the wider economy. The more efficient trading, the lower these costs.	- Council cost in setting up trading mechanism. - Adds complexity to the rules framework. - Farmers costs associated with recording trades. - Requires Council develop rules for NDA rights (e.g. where, when and how the NDA can be used, how sold, to whom, duration of right). - Increases the need for effective monitoring and enforcement in order to maintain the value of the right.

Trading short-term entitlements

A short term entitlement (STE) trading system would allow nitrogen to be traded on a short term basis through to 2032. A number of methodologies were discussed as possibilities. For example, STEs could be designed as "nitrogen shares" which would proportionally disappear from the market. Under such an approach, a robust framework would be developed in the rules to support trading STEs. Examples of how STEs could be designed include proportional shares of nitrogen, shares that equate to an amount of nitrogen, or a system of trading that assesses nitrogen against each property.

Tradable STEs potentially offer the efficiency benefits of NDA trading and are subject to the same challenges in terms of setting up a system. A market for STEs may have more participants than an NDA market and would not undermine the 2022 target for the Incentives Scheme. The summary of benefits and costs produces a mix of both trading and delaying trading options.

Table 16 Summary of benefits and costs of tradable STEs.

Benefits	Costs
- A tool to assist farmers to manage transition to low nutrient state (flexibility). - Incentivises efficient resource use both in the short term and the longer term. - As with trading of long-term rights (above) trading of STEs will lower costs to farmers and to the wider economy. - If NDA trading delayed until 2022, STEs would enable the benefits of trading while increasing certainty of reaching the 100t incentives target. - Allows more farmers to participate in trading than with NDA alone.	- Council cost in setting up trading mechanism. - Adds complexity to the rules framework and to the trading environment. - Increased administration costs associated with recording trades of STE. - Requires a definitive trading environment to be established via the rules (certain property rights). - Requires Council to develop rules for STE rights (e.g. where, when and how the STE can be used, how sold, to whom, duration of right). - May require additional support from Council to ensure manageable transaction costs.

Council's initial view was that STE trading was not supported, as it would be complex to define STEs and there would be substantial challenges in establishing an efficient market. It could also potentially allow properties to operate past their benchmarks.

There is also a risk to the Incentives Scheme associated with pre-2022 nitrogen loss being given a value. This is on the basis that all nitrogen loss ("above and below the line") could be sold alongside an NDA, thus making it less likely that a sale of NDA would be to the Incentives Scheme.

Trading prior to 2022

The incentives scheme is the community contribution to the nitrogen discharge reduction required under the Integrated Framework. The target is to purchase the 100 tonnes of permanent reduction of nitrogen entering the lake by 2022. This forms a substantial part of the 70% reduction required by 2022, and will be a significant challenge.

A ‘free market’ where farmers and the Incentives Board compete for NDA is likely to add to this challenge. For some farmers, the ability to trade long-term allowances prior to 2022 would provide flexibility to intensify productive activities, but NDA trading in this period is likely to undermine the Incentive scheme’s ability to reach its target.

Trading NDAs will contribute to the likelihood of success for the Integrated Framework and provide flexibility to farmers. However, trading allowances may jeopardise meeting the overall policy objective.

10.7.3 Summary

Based on a range of views and analysis the following trading position was determined:

- NDA trading is supported.
- Short term trading is supported to meet managed reduction targets.
- Trading is limited to post 1 July 2022.

Staff explored this issue extensively and the initial view that STEs should not be used was changed. The key reason for this was that STEs were seen by some within the pastoral sector as being of potential assistance to meet Managed Reduction Targets as part of the transition period. The methodology used to support STEs simply uses resource consents and therefore no “scheme” is required to be set up by Council.

The use of “short term trading” will require property owners to obtain a new controlled activity consent and this would have consequential changes to nitrogen management plans to recognise the new managed reduction pathway. Consents would be required from the destination land and the source land.

To mitigate the potential risk to the Incentives Scheme, trading is not allowed until 1 July 2022. This date should have no impact on current farming activities as short term trading will only be needed in order to meet the 2022 Managed Reduction Target. NDA trading is more likely to occur in the longer term as properties/farming enterprises need to reduce their discharge closer to 2032. It would be economically inefficient to purchase NDA for use in 15 years’ time. The possibility is not however discounted as decisions may be made for long-term future proofing of individuals aspirations.

Key reference documents

Technical reports

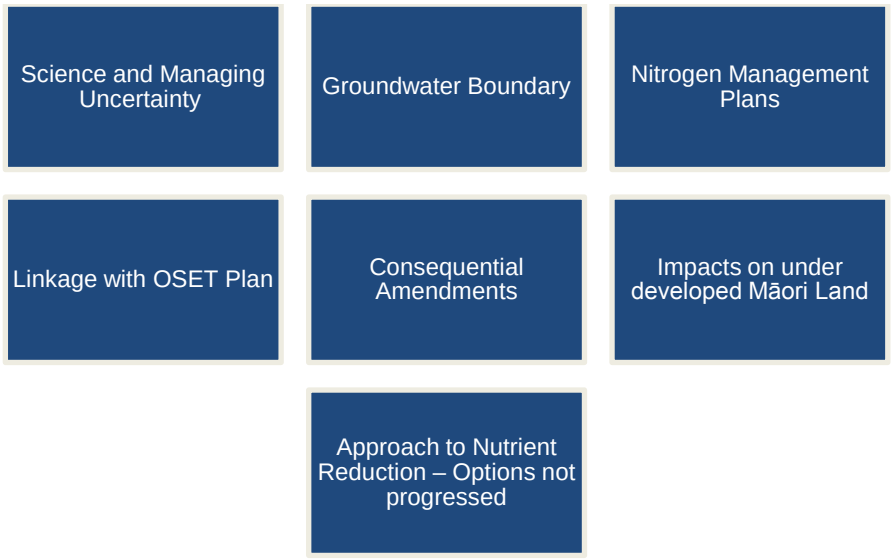
- Connor R (2014) Incentives scheme scenarios – Input for paper to Council on "Ownership of 100 tonnes".
- Connor R (2014). Nutrient Trading in the Lake Rotorua catchment. Report prepared for the Bay of Plenty Regional Council.
- Connor R (2014) Options for trading nitrogen discharge entitlements in the Lake Rotorua catchment. Paper prepared for the Bay of Plenty Regional Council.
- Connor R (2014) Rotorua Lakes nutrient trading working paper. Working Paper prepared for the Bay of Plenty Regional Council.
- Doole GJ, Romera AJ, Parsons O (2015). Economic effects of diverse allocation mechanisms in the Lake Rotorua catchment. Draft Report prepared for the Lake Rotorua Stakeholder Advisory Group.
- Greenhalgh S, Walker S, Lee B, Stephens T, Sinclair R J (2010). Environmental markets for New Zealand: the barriers and opportunities. Landcare Research Science Series No.40. Canterbury, Manaaki Whenua Press. www.mwpress.co.nz/.
- Market Economics Limited (2015). Economic impacts of Rotorua nitrogen reduction. District, regional and national evaluation. Report prepared for the Bay of Plenty Regional Council.

Lake Rotorua Stakeholder Advisory Group

- Meetings held on 19 June 2014, 16 December 2014, 16 February 2015, 17 March 2015, 28 April 2015, 21 May 2015 and 21 July 2015 to discuss trading. Short term trading – 18 August 2015. Agenda and minutes: http://www.rotorualakes.co.nz/stag

11 Supplementary information

This section includes consideration of special topics that influence or are affected by the policy and rule framework. This section also includes additional information that would otherwise detract from the main body of the report, e.g. evaluation of rejected options in Section 9.



11.1 Science and managing uncertainty

The science to support the sustainable nitrogen limit has been developed over a long period of time and from a range of experts. The sustainable nitrogen limit was first identified in 1986 and has been reassessed and confirmed three times.

For more than ten years, a Water Quality Technical Advisory Group (WQTAG) has been in place to provide technical advice on lake science and management to help reach the water quality targets for Lake Rotorua and other nearby lakes. The science behind what we know of Lake Rotorua is considered to be world class. However, there are some inherent assumptions and uncertainties in the science and information used to determine the trophic level index (TLI), sustainable limit, as well as current nitrogen inputs to the lake.

While the current science base is the best information available, it is critical that science and modelling is continually updated to ensure nutrient reduction policies are soundly based.

Modelling of nitrogen loads in the catchment

Modelling of nitrogen loads in the Rotorua catchment has used the Rotorua and Taupō Nutrient model (ROTAN). This is a geographic information system based catchment hydrology and water quality model developed by NIWA to predict nitrogen yields and exports in the catchment under different scenarios.

There is some uncertainty in estimating lake loads and response times, arising from factors such as uncertainty in:

- Historic land use and in particular which areas were dairy and drystock.
- Historic nitrogen export rates from each land use.

- When land use and export rates changed.
- Aquifer boundaries and parameters (including the proportions of total infiltration that enter the quick flow, slow flow and deep aquifers, and the volume, porosity and conductivity of those aquifers), which determine groundwater lag times.
- Nitrogen attenuation.[94]

There are also uncertainties in the parameters used to inform the model like current land use and current exports from pasture, as some of this information was based on best estimates from expert discussion as opposed to measurements.

While ROTAN is an excellent model, it has been developed to provide estimates in lake loads rather than accurate values.

OVERSEER®

Two field trials were undertaken to compare measured N leaching values against modelled N leaching values for the same farm system using OVERSEER®. These were the Wharenui and the Parekarangi Trust research trials.

A general finding from these trials was that "When drainage is aligned OVERSEER® estimates of N leaching compare reasonably well with measured N leaching values for the two research trials investigated in this report."[95] Further calibration effort will be useful to increase the understanding of the catchment parameters and to support the catchment modelling. This is part of Council's science planning under the Rotorua Lakes Programme.

Approach for regular science reviews

As outlined earlier, this Plan Change incorporates a method specifically to signal the use of regular reviews of relevant science underpinning the policy approach. This will include:

- Timeframes for commencing and completing the reviews.
- Key science themes that will be considered in the reviews.
- Options available if scientific advice changes.
- The appropriateness of the overall catchment target.

This is the most appropriate way to move forward given the inherent uncertainties in the information base. The alternatives would be either delaying action until more or better science is available, or phasing in rules periodically between 2017 and 2032 as the science improves.

Reviews are proposed for 2017 and five-yearly thereafter, to ensure that the latest knowledge and interventions are used to support the rules.

[94] Nitrogen attenuation is the term applied to the temporary storage and/or permanent loss of nutrient between where it is generated in the catchment and where it enters the lake, (Rutherford et al., 2009, p.32).
[95] Watkins N, Shepherd M, Ledgard S (2015).

Key reference documents

Technical reports

- Bay of Plenty Regional Council (2013). Trends and state of nutrients in Lake Rotorua streams. Environmental Publication 2013/08. www.rotorualakes.co.nz/vdb/document/769.
- Rutherford, J.C., Pridmore, R.D., White, E. (1989), Management of phosphorus and nitrogen inputs to Lake Rotorua, New Zealand, Journal of Water Resources Planning & Management 115 (4): 431-439.
- Rutherford, K., (2003), Lake Rotorua Nutrient Load Targets, NIWA Client Report: HAM2003-155.
- Rutherford, K. (2008), Nutrient load targets for Lake Rotorua - a revisit, NIWA Client Report: HAM2008-080.
- Rutherford K, Palliser C, Wadhwa, S (2009). Nitrogen exports from the Lake Rotorua catchment – calibration of the ROTAN model.
- Rutherford, K.C., Palliser, C., Wadhwa, S. (2011). Prediction of nitrogen loads to Lake Rotorua using the ROTAN model. NIWA client report HAM 2010-134.

Council Report

- Bay of Plenty Regional Council Regional Direction and Delivery Committee. Meeting held on 9 December 2014. Agenda and minutes: www.boprc.govt.nz/council/committees-and-meetings/strategy,-policy-and-planning/.

Fact Sheets

- Fact Sheet 3 – Draft Rules – Q&A.
- Fact Sheet 8 – Science beyond the nitrogen limit.

11.2 Determining the geographic scope of the Plan Change

Currently, Rule 11 for the Lake Rotorua catchment only applies to those properties that fall within the surface water catchment and the Bay of Plenty region. It also includes the western part of the Mamaku township (which sits outside of the catchment boundary). However, Policy WL 3B of the RPS sets a sustainable nitrogen load for Lake Rotorua, which includes "*stream and groundwater flows".*

Determining the boundary for which discharges from land use have an influence on water draining to Lake Rotorua is crucial, as it determines the extent of the area that the Plan Change provisions will apply to. It will also influence the reductions required per hectare to reach the sustainable lake load.

Preferred option

A boundary based on the groundwater catchment for Lake Rotorua. This boundary includes:

- Surface and groundwater that flows to Lake Rotorua. The boundary was determined by using the existing surface water catchment boundary and a groundwater catchment boundary on the Mamaku plateau.
- Three areas within the Waikato region.

- The spring-fed streams that drain Mamaku Plateau (Hamurana, Awahou, and Waitetī) which flow into Lake Rotorua.[96]

Alternatives considered

A Retaining the Rule 11 boundary. This is fundamentally based on the Lake Rotorua surface water catchment boundary.

- Including the western part of the Mamaku township, which sits outside of the catchment boundary
- Excluding land that is outside of the Bay of Plenty region

B Using the surface water catchment boundary for Lake Rotorua.

- This option covers a larger area than the Rule 11 boundary, and includes all land that contributes surface water to Rotorua catchment, and some land in the Waikato region.

Refer to Appendix 8 for the map and assessment of all three options.

Evaluation of preferred option: Groundwater boundary

This option is consistent with Policy WL 3B of the RPS which specifically refers to stream and groundwater flows. It is approximately 4,900 hectares larger than the Rule 11 boundary (i.e. Option A) meaning that there is a higher likelihood that the nitrogen limit may be able to be achieved, as all of the land that contributes to the lake will be included.

New properties affected by the rules within the Bay of Plenty

An additional 2,400 hectares in the Bay of Plenty region is captured by the groundwater boundary. The additional area will impact approximately 20 landowners. In particular:

- 30 land parcels (1,357 ha) are already partially covered by Rule 11. Eleven of these properties are greater than 2 ha in size.
- 8 land parcels (1,049 ha) are not currently covered by Rule 11. Therefore, any new rules imposed on these eight properties would be the first nutrient rules that these landowners would have faced.

Mamaku North Forest was returned to Ngāti Rangiwewehi in 2014 as part of the Crown's commercial redress package[97].

The precise nature of this impact has not been investigated, but is likely to be significant given that many landowners have not been subject to the Rule 11 cap, and others may be using their non-Rule 11 land parcels to increase productivity. The Section 32 analysis for Rule 11 identified social and economic benefits as being high and identified a cost to productivity (lost) for some properties. These costs and benefits were canvassed in Welsh, 2001 however these were focussed on lost productivity around intensification of pastoral land where mitigation to retain an unchanged nutrient position was not possible. Conversion from forestry to agriculture was not considered as mitigation requirements would be too great. Lost productivity would of course apply in terms of lost opportunity cost.

[96] Lake Rotorua catchment boundary relevant to Bay of Plenty Regional Council's water and land management policies. (White et al., 2014).
[97] Ngāti Rangiwewehi Claims Settlement Act 2014

As discussed in section 10.3.4 of this report, rules for these land parcels will be implemented in stages, in order to provide additional time and support for affected landowners. Resource consent will not be required until 1 July 2022 (Policy LR P10).

Accuracy of catchment boundary

The accuracy of the catchment boundary line is informed by the quality of the data that it is based on. Where the boundary sits has high relevance to the people who own land in or around the vicinity of the boundary line (i.e. the accuracy of the line will determine whether or not property owners are affected), and it will determine how much of the catchment (or how much of another catchment) is covered by the rules.

The level of accuracy for both the surface catchment options is high: 95% confidence intervals give a result within +/- 20 metres. The level of accuracy for the groundwater catchment, on the other hand, is less precise: using 95% confidence intervals the boundary is only accurate within +/- 200 m at the Mamaku Plateau, and between -640 m and +740 m at Awahou and o Waitetī. Although the surface water boundary has the higher level of accuracy, this should not prevent Council undertaking a precautionary approach and using the best information available for managing the total nitrogen load.

Cross-boundary issues

Approximately 3,463 hectares of the groundwater catchment are within the Waikato region. Of the 47 land parcels, approximately 26 are larger than two hectares and would therefore be affected by the new rules. This area of catchment in the Waikato region (5% of the total) could be contributing up to 40 tonnes of nitrogen per year to Lake Rotorua.

The Waikato Regional Council has indicated support for working with the Council to manage the properties affected, but would prefer to do so at the time dictated by their own implementation of the National Policy Statement for Freshwater Management, when limit setting occurs in that part of their region.

11.2.1 Groundwater sub-catchments

The rules and Integrated Framework treat the groundwater catchment for Lake Rotorua as a generic resource, however it is known that there are different groundwater sub-catchments that could theoretically be defined. These sub-catchments have different groundwater ages and would also have different attenuation rates associated with them. Sub-catchments have not been implemented within the rules due to an inability to link nitrogen loss from particular properties to the nitrogen input from sub-catchments to the lake. Linkages cannot be made for two reasons:

1 <u>Different locations contribute to groundwater</u>

Groundwater age (dated through isotopes) is an average of all the input's sources for the sample site. Nutrients entering the lake from properties will have different lag time, and rule implementation could theoretically be staged against the lag time. However, from the top to the bottom of a groundwater sub-catchment there are different input zones overlain with pastoral properties. This makes identification of precise inputs very difficult. Each property would theoretically have a different attenuation factor determined by its location and the timing of when its nitrogen enters the groundwater.

The rules are also being implemented on the basis that the longer implementation takes the longer until the lake reaches its equilibrium, and 2032 has been provided as a realistic timeframe within which change needs to occur: so staging against lag time may not even be a desirable option in order to meet targets, even if it were practicable.

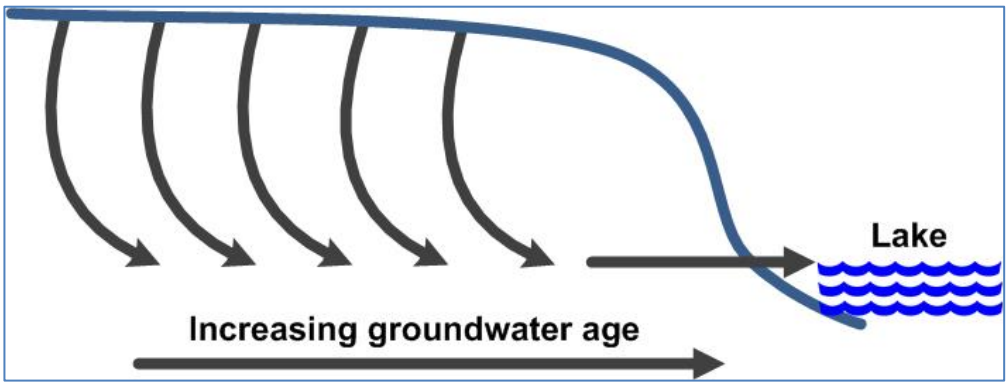


Figure 29 Lag time in nutrient entry to lake.

2 Different locations have different attenuation potential

Attenuation of nitrogen is an important factor for determining the amount of nitrogen entering the lake. Attenuation requires the absence or low levels of oxygen and the presence of carbon. The ground above the sub-catchments will contain a range (of unknown distribution) of carbon sources (see Figure 30 below). Each property would theoretically have a specific attenuation potential or factor however this is impractical to establish and implement.

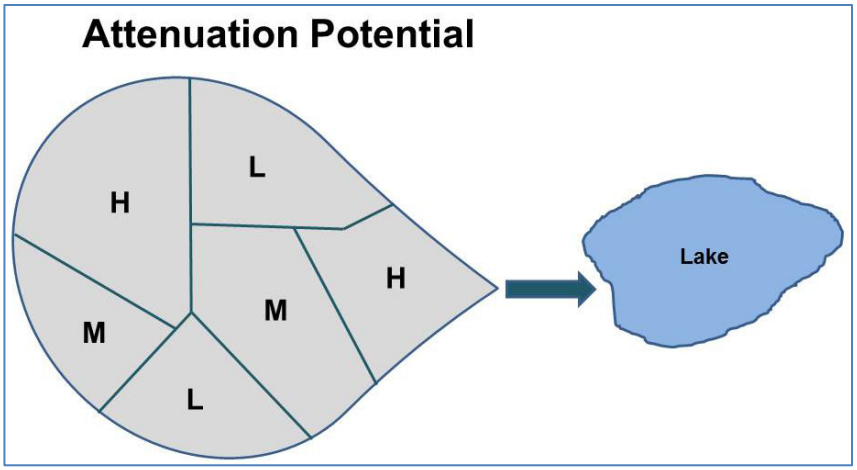


Figure 30 Attenuation potential may vary between properties (high/low/medium).

Implementing a sub-catchment approach would further increase rule complexity and the need for monitoring, as well as creating issues with defining boundaries. It would also undermine the NDA trading framework, as trading could only occur within sub-catchments or between sub-catchments if the trade benefitted the lake (such as a "high attenuation" NDA moving to a "low attenuation" property). This would limit the number of potential traders within the markets. The differentiation into sub-catchments would increase the risk to the Integrated Framework of the Incentives Scheme not achieving its objective.

The issue of lag times for groundwater as noted above is mostly addressed by the approach of the rules: that the sooner changes are made, the sooner the results will be seen – and it is recognised that this may be intergenerational. The timeframe of 15 year proposed in the rules is a relatively long period of time to address a current issue.

Treating the Lake catchment as a single entity carries a risk that land use change or nitrogen loss reduction might occur exclusively in "low attenuation" potential sub-catchments and therefore the lake target would not be achieved, or may occur in the sub-catchments with the longest lag times, which would result in the lake equilibrium taking longer to achieve. This is considered a low risk, and it is probable that nitrogen loss actions will occur across the range of sub-catchments. The continuing development of knowledge about the lake's groundwater dynamics will enable monitoring of this risk.

Key reference documents

Bay of Plenty Regional Council Regional Direction and Delivery Committee

- Meeting held on 9 December 2014. Agenda and minutes: https://www.boprc.govt.nz/council/committees-and-meetings/regional-direction-and-delivery/.
- White PA, Lovett A, Tschritter C, Cusi M (2014). Lake Rotorua catchment boundary relevant to Bay of Plenty Regional Council's water and land management policies. GNS Science Consultancy Report 2014/11 http://www.rotorualakes.co.nz/vdb/document/866.

11.3 Nitrogen Management Plans

Purpose

The purpose of a Nitrogen Management Plan[98] is to identify and document how the Nitrogen Discharge Allowance for an individual property is to be achieved by 2032.

Minimum information requirements will include:

- Identifying all sources of nitrogen associated with the property.
- The Nitrogen Discharge Allowance for the property.
- The pathway of managed reduction with specific targets at certain dates.
- Mitigations to achieve the Nitrogen Discharge Allowance.

Nitrogen Management Plans will be prepared with land owners by approved certified nutrient management advisors and form part of the resource consent. These Plans will be updated every five years.

How Nitrogen Management Plans relate to the Plan Change provisions

Nitrogen Management Plans will apply to all properties that require resource consent under the proposed rules. Of particular relevance are the following Plan Change Provisions: Policy LR P8; Rules LR R7, LR R8, LR R9 and Schedule 6.

[98] Previously referred to as a Farm Nutrient Plan or Nutrient Management Plan.

Approaches taken elsewhere

Waikato Regional Council requires a Nutrient Management Plan to satisfy a permitted fertiliser discharge rule.[99] Horizons Regional Council also require Nutrient Management Plans for intensive farming activities within the target catchment. Most farmers will need resource consent and to prepare a farm environment plan within the Canterbury, Manawatu-Wanganui, and Hawke's Bay regions, and they are a voluntary tool in Northland, Waikato and Southland.

There are also industry based guidelines and codes of practice[100] that advocate for the use of nutrient management plans and/or improving land management practices that reduce nitrogen loss.

Options considered

In terms of the proposed approach to the preparation and use of Nitrogen Management Plans, the following options were assessed:

- Nitrogen Management Plan prepared at the time of resource consent application, with quantitative data (numbers) provided every five years to demonstrate progress towards Nitrogen Discharge Allowance.
- No Nitrogen Management Plan prepared, and property owners to meet Nitrogen Discharge Allowance by or prior to 2032.
- Nitrogen Management Plan prepared at the time of resource consent application, with qualitative data (descriptions) provided every five years to demonstrate progress to Nitrogen Discharge Allowance.

Refer to Appendix 9 for the assessment of these options.

Which option was chosen and why

In determining the most effective and efficient option for achieving the purpose of the rules Council considered all of the factors identified in Appendix 9, including:

- The quantity and quality of information collected, if it is not mandatory.
- The impact on the overall catchment target being achieved by 2022 and 2032.
- The ability to effectively undertake monitoring and compliance.

The preferred option is Option A (submit Nitrogen Management Plans that demonstrate managed reduction using Managed Reduction Targets and quantitative data). To support land owners with the implementation of this option, and the associated changes in land use and/or land use practice, Council:

- has allocated $2.2 million to assist farmers get from best practice to their NDA (Advice and Support Programme), and
- will provide support to Dairy NZ, Beef + Lamb and agricultural consultants to help farmers complete their Nitrogen Management Plans.

[99] Rule 3.9.4.11 of the Waikato Regional Plan.
[100] Such as the Code of Practice for Nutrient Management 2013; New Zealand Deer Farmers Landcare Manual 2012; and DairyNZ Guides "Nutrient management on your dairy farm" (2013); Reducing Nitrogen loss (2014) and Farm Dairy Effluent Design Code of Practice (2013).

Key reference documents

Stakeholder Advisory Group

- Meeting held on 10 April 2014 and 18 November 2014. Agenda, minutes and presentations: http://www.rotorualakes.co.nz/StAG_2014.
- Sub-Committee meeting held on 10 April 2014. Minutes: http://www.rotorualakes.co.nz/vdb/document/697.

Bay of Plenty Regional Council Strategy, Policy and Planning Committee

- Meeting held on 17 September 2013. Agenda and minutes: http://www.boprc.govt.nz/council/committees-and-meetings/strategy,-policy-and-planning/.

Bay of Plenty Regional Council Regional Direction and Delivery Committee

- Meetings held on 24 June 2014 and 9 December 2014. Agenda and minutes: https://www.boprc.govt.nz/council/committees-and-meetings/regional-direction-and-delivery/.

11.4 Linkage with the OSET Plan

The On-Site Effluent Treatment (OSET) Regional Plan 2006 deals with the effects of domestic wastewater on water quality in the Bay of Plenty. On-site effluent treatment systems include septic tanks and associated soakage fields and advanced aerobic systems.

In preparing this Plan Change, Council has been mindful of the requirements of, and linkages to the OSET Plan. This is because domestic wastewater disposal on properties less than two hectares are managed under the OSET Plan, whereas domestic wastewater disposal on properties over two hectares is managed under the RWLP.

Although there is not a specific rule regarding onsite wastewater disposal within the Plan Change, it could be managed under Rule LR R14. This rule specifies that an increase in the export of nitrogen or phosphorus from a point source activity is a restricted discretionary activity (the discharge of treated domestic wastewater being a point source activity). One of the matters Council has reserved its control over is 'aspects of the activity that cause an increase in the export of nitrogen or phosphorus'. This means that an onsite domestic wastewater discharge can be assessed and, if granted, appropriate conditions put in place as required.

However OSET discharges are managed under the more specific rules within the OSET Plan such as Rule 4 for new houses. Any new discharge or increase in discharge from an onsite domestic wastewater system is also assessed under the existing Rule 37 ('Discharges to Land or Water') of the RWLP. An advice note is included within Part LR specifying that all onsite effluent treatment systems, regardless of size, must comply with the minimum requirements set out in the OSET Plan.

11.5 Consequential amendments

As a result of the new rules, some consequential changes will be made to existing provisions within the RWLP. The main change is the removal of all references to the Lake Rotorua catchment from Section 9.4 ('Discharges of Nitrogen or Phosphorus from Land Use and Discharge Activities in the Rotorua Lakes Catchments'). Text will be added to Section 9.4 to clarify that the discharge of nitrogen and phosphorus in the Lake Rotorua catchment is now dealt with within Chapter LR of the RLWP.

Other consequential changes to the RWLP include formatting-related changes such as updates to the contents page to reflect the addition of the new chapter; updating table references and flow diagrams where appropriate; and the addition of references to the new rules throughout the RWLP where relevant and appropriate. These consequential changes are included in a separate document, which show the track changes to the RWLP (i.e. strike out for deleted text and underline for additional text).

As mentioned earlier, this Plan Change adds a new topic-based chapter to the RWLP. This was done to keep all rules regarding discharges of nitrogen and phosphorus (whether point source or non-point source) in the Lake Rotorua catchment in one place for logical reading. Rule LR R10 was derived from existing Rule 11F (and therefore the rule is similar in structure) but is specific to the Lake Rotorua catchment only. For example, the new rule contains references to Nitrogen Discharge Allowances and the sustainable lake load as matters Council may take into account when considering resource consent applications under this rule.

11.6 Under developed Māori Land

Māori Land is land held in multiple ownership under the Te Ture Whenua Māori Land Act 1993. Nationally, over 1.5 million hectares of land is Māori land.[101]

Within the Lake Rotorua catchment, a quarter of the catchment (11,000 hectares) is owned by Māori trusts and incorporations. Land use on Māori Land is predominantly drystock farming (40 percent) and bush and scrub (22 percent). Production forestry occurs on 16 percent of Māori land, and dairy farming (including dairy support) on 10 percent.[102]

Māori have a distinctive role in water catchments as tāngata whenua, but also fill many other – potentially conflicting – roles as small and large pastoral landowners, forest owners, and water users. These various roles bring about a number of issues that Māori landowners will face under any regulation to improve water quality.

Based on 2014 data, 27% of the Lake Rotorua Groundwater catchment is in Māori ownership. Across the sectors Māori ownership is generally proportionally represented except in forestry. Māori also have a higher proportion of ownership of steeper land classes for forestry.

[101] PricewaterhouseCoopers (2013).
[102] Data received from Office of the Māori Trustee (2014). Stored Bay of Plenty Regional Council Objective reference A1969765.

Table 17 Proportional land use.

Land use	Māori (ha)	Total (ha)	% Māori/total
Dairy	1,199	4,982	24%
Drystock	5,269	1,6571	32%
Non-productive trees	2,788	10,027	28%
Forestry	1,714	8,859	19%

Constraints to Māori land development

Developing multiple-owned Māori land tends to be more challenging than developing land in general title. This is recognised as an issue of significance in the RPS.[103] Reasons for this include, but are not limited to:

- Multiple owners, including absentee owners, who each hold a small interest in individual titles or amalgamated entities (e.g. ahu whenua trusts, incorporations). This can make communication and decision-making difficult. Administration costs are also high because of the large numbers of owners.
- A minority of shareholders can prevent a change in land use.
- Apathy of shareholders to attend meetings and participate in decisions to effect change.
- Tension between retaining customary Māori land and the development of that land for the benefit of the owners (both of which are objectives under Te Ture Whenua Māori Land Act 1993). The retention of Māori Land for cultural reasons constrains economic use, and owners can be unwilling to accept actions that place the land at risk - resulting in a conservative approach.[104]
- Funding difficulties that stem from multiple-owned Māori land as it is more difficult for the land to be used as security against loans.
- Historical confiscation of Māori land focused on better quality land.[105] This means that remaining lands may not be as productive.
- Lack of infrastructure, particularly in remote and/or land-locked areas.

To put this into perspective, only 20% of Māori Land nationally is considered well developed for agribusiness. The remaining 80% of Māori Land is categorised as underperforming relative to industry benchmarks (40%) or under-utilised (40%). Lifting productivity to average industry benchmarks could result in an additional $8 billion in gross output nationwide.[106]

The Toi Moana Bay of Plenty Growth Study[107] states that initiatives are in place to assist Māori/iwi/hapū to determine the best use of land and to improve its productive potential.

[103] Section 2.6.10, Issue 5 - Difficulties developing Māori land: Legislative provisions, lack of infrastructure and prior planning and resource allocation mean multiple-owned Māori land is often more difficult to develop than general land.
[104] Ministry of Agriculture and Forestry (2011).
[105] Ministry of Agriculture and Forestry (2011).
[106] PricewaterhouseCoopers (2013).
[107] Ministry of Business, Innovation and Employment & Ministry for Primary Industries (2015).

Because of these constraints, Objective 16 and Policy IW 1B of the RPS seek to enable the development of multiple-owned Māori Land. Furthermore, Policy WL 5B seeks to ensure that regard is given to Iwi land ownership and its status including any Crown obligation, for example when considering nitrogen allocation.

Implications of Rule 11 on Māori land development

Introduced in 2005, Rule 11 set a discharge limit or nutrient benchmark based on the land use of each affected property (calculated from annual average nitrogen discharges for the period 1 July 2001 to 30 June 2004). This meant that there could be no permitted changes to land use (such as from forestry to grazing), and no intensification of land use beyond the benchmark.

Most Māori Land within the Lake Rotorua Groundwater Catchment is already subject to Rule 11. A large portion of this land was under-developed at the time of Rule 11 due to management restrictions, limited investment funds and a conscious decision to minimise the impact on the lake.[108] The drivers for economic return (and development) for these properties have often been quite different from the drivers that influence development of individually-owned private land. The result is commonly a pattern of traditional pastoral grazing or investment in forestry or retention of indigenous forest.[109]

Environmental Management Services Limited (2009) identify the potential inequalities associated with Rule 11:

- Where land has not been developed intensively, Rule 11 does not 'credit' landowners for the extent to which a property has minimised the amount of nitrogen discharged.
- Rule 11 prevents intensification of the land and therefore constrains future economic opportunities.

The report questions whether Rule 11 properly recognises and provides for the relationship of Māori with their ancestral lands.

Impact of Plan Change on Māori land development

As mentioned in section 7.2, this Section 32 report evaluates the scale of impact of new provisions, **beyond what is already in effect as a result of Rule 11**. In terms of Māori Land:

- Intensified land blocks (e.g. dairy farming) will need to meet their Nitrogen Discharge Allowance by or prior to 2032.
- Owners of Māori Land would experience reduced lease income as opposed to reduced economic returns.[110]
- Opportunities to sell land and utilise capital elsewhere are more limited for owners of Māori land since the land is unlikely to be sold.
- There is no significant change for undeveloped Māori Land as a result of the Plan Change in terms of the inability to intensify or change the use of land except in relation to the allocation methodology.[111]

[108] StAG Meeting of 18 June 2013 & Landcare Research (2012).
[109] Environmental Management Services Limited (2009).
[110] Nimmo Bell (2002).

The following table shows the results on the basis of land that:

- is categorised in the benchmarking data as *Pastoral Drystock* and *Pastoral Dairy Support*;
- is benchmarked (the actual benchmarks provide a picture of land use); and
- increases under the allocation methodology (as an indicator of land being under-developed).

	Total BM ha	BM tN	NDA tN	Increase tN	Average kgN/ha increase
All land	3289.8	43.56	59.22	15.66	4.76%
Non-Māori Land	1328.8	17.17	23.92	6.75	5.08%
Māori Land	1963.0	26.39	35.30	8.91	4.54%

Māori land has more of the total increase (tonnes) but a lower average increase/ha than for Non-Māori land (lower by 11%).

	Ha with Increases	% of area with Increases	Ha with Decreases	% of area with Decreases
All land	3289.8	100%	8199.5	100%
Non-Māori Land	1328.8	40.4%	5895.8	71.9%
Māori Land	1961.0	59.6%	2303.8	28.1%

In terms of total drystock ha that increases or decreases NDA under the allocation methodology, Māori land has more of the increases (on a per hectare basis) and less of the decreases:

- 59.6% of ha that increase NDA.
- 28.1% of ha that decrease NDA.

Using an increase in NDA (under the allocation methodology) as an indicator of under-developed land:

- Of the hectares of under-developed land (blocks subject to an increase in NDA), proportionally more is in Māori Ownership (59.6% compared to catchment ownership rate of 27%).
- Of the hectares of land subject to a decrease in NDA, land in Māori ownership is comparable to the catchment ownership rate of 27%.
- Māori land is on average 11% less under-developed (therefore more developed) than Non-Māori land.
- In terms of the number of properties that contain with blocks that increase (can be one or more per property) 23 are Māori owned and 40 Non-Māori owned.

[111] The allocation methodology means that properties farmed at low intensities (during the benchmarking period) may receive increased NDAs where the methodology brings them up to the bottom of the range. This is particularly relevant to the drystock sector.

Dairy land for Māori and Non-Māori land is substantially benchmarked. In terms of land ownership the following table shows Māori land is generally proportional to the catchment ownership rate of 27%:

	Hectares	Māori	Non-Māori
Dairy NDA increases	246.0	21%	79%
Dairy NDA decreases	4440.5	25%	75%

Alongside the rules, there are opportunities to explore innovative land use on Māori Land, supported by the gorse conversion and incentives programmes. This could include afforestation as well as growing hazelnuts, ginseng, truffles and mānuka (for honey).

Key reference documents

YouTube Video

www.youtube.com/watch?v=6NT0qcFU8pk&list=UUnIAqmkGz2sKqAuuau5wDBg

- A 5 minute video was uploaded to YouTube which detailed the project, the proposal and the draft rules. The video focused on Māori farmers, as 25% of landowners in the Rotorua Lakes catchment, and included Māori translation.

Technical reports

- Ministry of Business, Innovation and Employment & Ministry for Primary Industries (2015). Toi Moana Bay of Plenty Growth Study: Opportunities Report
- Bay of Connections (2014). He Mauri Ohooho: Māori Economic Development Strategy.
- PricewaterhouseCoopers (2013). Growing the Productive Base of Māori Freehold Land. Prepared for Ministry for Primary Industries
- Landcare Research (2012). Evaluation of the impact of different policy options for managing to water quality limits. MPI Technical Paper No: 2012/46
- Ministry of Agriculture and Forestry (2011). Māori Agribusiness in New Zealand: A Study of the Māori Freehold Land Resource.
- Environmental Management Services (2009). Regional Water & Land Plan Rule 11 - Review of Efficiency and Effectiveness.

11.7 Approach to nutrient reduction – Options not progressed

Section 9.1 of this report outlined nine potential options to achieve nutrient reduction in the Lake Rotorua groundwater catchment. Based on the selected criteria, three options (1, 2 and 4) were evaluated further in section 9.2.

This section provides a brief analysis of the six options that did not progress further, in terms of the policy development process. The delivery of public projects to achieve the nitrogen reduction is also discussed under section 11.9.4.

11.7.1 Prescriptive input-based regulation

Under this option, nitrogen discharge values would be developed for livestock types (by age, gender, sub-type), fertiliser and other relevant farm inputs. Total nitrogen input limits would be established for each property based on size. This could be refined for property characteristics such as soil type and rainfall.

Constraints would be applied to prevent inputs moving to or between properties that undermine the premise of an input rule. For example, if the initial average stock allocations were aggregated into more intensive operations on leaky soils the overall leaching would be greater than modelled.

Evaluation

This option has potential to achieve the 435tonne target, and would be a relatively straight-forward and transparent approach. It would provide farmers with a high degree of certainty. Farmers manage their farms within the confines of a highly controlled system. Success in achieving the environmental target relies on intensive monitoring (although monitoring will be important for all options).

Input-based rules are not common in New Zealand. Prescriptive regulations such as input rules tend to be expensive and inefficient because they are a 'blanket' approach that doesn't recognise the actions individual farmers could and would take to improve environmental outcomes. In this way they discourage innovation by individual farmers. For farmers, input rules would reduce farmer flexibility for on-farm decision making. To an extent this could be ameliorated by a trading framework but this would raise the issue noted above about inputs moving outside of the environmental design parameters.

An overarching issue is that nitrogen discharges in the Lake Rotorua catchment are above sustainable levels, and so in applying input rules, farmers would still be subject to substantial reductions from their current positions. This, along with complexities around shifting inputs (offsetting), and the lack of recognition of individual actions to reduce nitrogen discharges, mean that this option would not provide for an efficient outcome.

This option will not be effective in achieving the environmental target with certainty, and would not incentivise efficient resource use.

11.7.2 Land acquisition and removal of nitrogen loss activities

Under this option, ratepayers and taxpayers would fund, via Council (through an appropriate mechanism), the purchase of pastoral farms in the catchment. The farms would then be on-sold with agreements in perpetuity for low nitrogen land use only (such as forestry).

Evaluation

The option of purchasing pastoral farming businesses to meet the target has been considered a number of times through the policy process. On the face of it, this option appears to offer a pragmatic and "one-off" solution that avoids lengthy management and compliance costs. It would also reduce the need for policy development and scientific research.

The nitrogen leached by the dairy sector approximates the required reduction (240 tonnes). In February 2012 a study[112] was commissioned (using December 2011 values) to value the dairy farms in the catchment. At that time the valuation difference involved with the land use change from dairy to forestry was assessed at $104 million (based on Capital Value):

Table 18 Valuation differences involved with changes in land use.

	Value	Compensation required
Rating Value 2011	$147,766,000	
Assessed value	$145,964,000	
Valued at NDA 18, intensive drystock	$111,977,000	$33,987,000
Valued at NDA 4, forestry	$41,777,000	$104,187,000

Note: This analysis used OVERSEER® 5.4 values.

The analysis advised that while values at that time were lower than the 2007/08 peak, higher values were likely to be sought by owners, and that the impact of Rule 11 was yet to be experienced. At that time programme funding was structured around a series of projects and the level of funding required for a land purchase option was not available.

The restructuring of the Crown Funding Deed that supports the Lakes Programme provided another opportunity to consider the land purchase option. While the Lakes Programme has significant funding to achieve its aims, it does not have sufficient to purchase the land required to make this option successful.

A key reason for restructuring the Funding Deed was to support the Integrated Framework initiated by the Pastoral Collective and developed through the StAG process. This saw the introduction of a substantial move towards land purchase through the introduction of the Incentives Scheme. This objective of the Scheme is to secure a reduction of 100 tonnes of the nitrogen entering Lake Rotorua from a fund of $40 million. The Incentives Scheme buys from below the nitrogen discharge allowance limits and therefore it is likely that it will need to purchase reductions at the higher end of the mitigation cost curve (e.g. land use change).

The programme costs for Lake Rotorua can be estimated over a 10 year period at around $70 million (a net present value using 5% of $55 million). This includes the $40 million incentives funding. Additional funding would need to be secured to implement a land purchase option.

Impediments to the option of purchasing land to reduce nitrogen discharges include:

- Māori land, which makes up 25 percent of the catchment, would not be available for purchase.
- A purchasing programme would most likely work from current value (and associated leaching rates) – not benchmarked leaching rates.
- Complications associated with the Regional Council's ability to purchase and re-sell land as this would create taxation implications for the Council Controlled Organisations. This could put at risk a significant revenue stream.

[112] Telfer Young (2012).

- Uncertainty around the total cost. The availability of public funding could increase price expectations.
- Reliance on voluntary property sales, so no guarantee that purchases would occur (there would not be the ability to compulsorily acquire land). Rules would be required in addition to the purchase of land in case properties couldn't be acquired (or acquired at a reasonable price).
- Purchasing land carries risks because property prices are subject to market fluctuations.[113]
- Community support for a "purchasing land" approach is likely to be difficult to achieve as it likely to be seen as the polluters not facing the results of their action.
- Central Government's funding may be put at risk. The Deed Funding discussions were based around retaining economic pastoral units and may not be available to implement a "purchasing land" option.
- A key position of the Lake Rotorua Nutrient Rules project - that everyone needs to be part of the solution – would not be delivered through a "purchasing land" option.

This option will not be effective in achieving the environmental target with certainty, and would not incentivise efficient resource use.

11.7.3 Direct tax on inputs or on outputs

Under this option a direct tax on inputs (such as number of livestock) or outputs (such as kg milk solids) would be set at a level to achieve the specific reduction in nitrogen discharges required. This option would see a taxation framework used to modify property owners' behaviour. The principle would be that a taxpayer would seek to avoid the taxation by changing the way they farmed or managed the property. The tax paid could be used to address nitrogen issues.

Evaluation

This approach clearly recognises the "polluter pays" philosophy. A major advantage of a tax is that it would allow farmers to decide how much or little to produce in order to limit their tax payments.[114] Taxes also have benefits of transparency, being fairly easy to understand, incentivising farmers to innovate and to reduce nitrogen discharges. Tax collected could be hypothecated for spending on nutrient issues such as scientific research, farm system research, or directly improving water quality.[115]

[113] The Lake Taupō Protection Trust's initial strategy was to purchase land, convert to forestry, and then resell with appropriate covenants. Falling land prices made this a costly strategy, and the Trust moved to the less risky option of purchasing nitrogen discharge allowances from landowners (Barns and Young, 2013).
[114] Weimer and Vining (1999).
[115] OECD (2011).

One challenge would be to set the tax at a level that would achieve the sustainable limit of nitrogen to the lake, as required by the Regional Policy Statement. Farmers are generally price takers, and particularly so when you take a subset of the farmer population, so any shifts in production as a result of a tax would come from changes in farmer behaviour (rather than consumer behaviour in response to price changes). To set the tax rate equal to the environmental damage (to achieve the sustainable lake limit), the Council would require sound information about the marginal costs of production for farm businesses and how farmers would respond to a tax, in terms of changing production.[116] At best, imposing a tax would be an iterative and probably difficult process that would create uncertainty for farmers, high costs for the Council, and would likely be politically challenging.

It is not clear that the Regional Council would have the ability to impose a tax as anticipated by this option, although this could potentially be achieved through Central Government, or through an RMA charging regime.

It is not clear whether this option is within Council power, and it would be unlikely to be effective in achieving the environmental target with certainty.

11.7.4 Targeted rate with remissions

The Regional Council has the ability to impose rates under the Local Government (Rating) Act 2002. Under this option a targeted rate would be applied within the Lake Rotorua groundwater catchment. Ratepayers would be rated based on actual or modelled nitrogen discharges. A remissions policy could be implemented to recognise mitigation actions (if a rate is set for a specific period) or the rate could be reviewed on an annual basis.

The idea of a rate is to impose a cost that matches the cost of mitigation. It is assumed that the funds raised would be used to undertake mitigation actions. Council monitors mitigation actions and new technology for the potential for these to be part of the solution for Lake Rotorua, if they represent cost-effective options. An example that has been considered previously is floating wetlands. These have been assessed for their nitrogen removal capacity which is low in a lake environment.

Evaluation

This option has many of the same benefits and costs as an environmental tax. It recognises the “polluter pays” philosophy, is transparent, and reasonably easy to understand. If set in relation to appropriate activities, it could provide incentives to innovate or abate. The rating revenue could be used to fund actions that address nitrogen issues.

Setting the targeted rate at the optimum level (an exact level to achieve the 435 tonne reduction) would require Council to have good information the marginal costs of farm businesses in the catchment and production decisions in relation to changes in marginal costs. Further, Council would have to respond to changes in production as a result of changes in input costs or output prices for farmers. Farming businesses are diverse, which would create further challenges in trying to achieve a specific target of tonnes of nitrogen to the lake. Ongoing changes would create uncertainty for farmers and high costs for the Council, and would be politically challenging.

[116] OECD (2011).

This option would be unlikely to be effective in achieving the environmental target with certainty.

11.7.5 Reliance on industry best practice

Under this option, the focus would be on requiring best practice nitrogen leaching management. This could be through industry bodies or via a specific rule. Industry delivery could be via a voluntary or "regulated" method.

Evaluation

It is likely that this option would generate the best level of industry and farmer buy-in. The level of transparency and incentivising of innovation and nitrogen reduction would depend on industry best practice guidelines.

Investigations into the ability of best industry practice to achieve the reductions required found *'voluntary or mandatorily applied 'good management practices' will not achieve reductions in catchments that are significantly over-allocated, such as [Lake] Rotorua.*[117] Given the significant required reductions it is very unlikely that this option will achieve the sustainable lake load. This option will not be effective in achieving the environmental target with certainty.

11.7.6 Subsidies for delivering environmental goods and services

An alternative to taxing environmental 'bads' is to subsidise environmental goods. This option would comprise identifying high nitrogen discharging activities and providing subsidies to implement actions that reduce nitrogen leaching: for example, paying landowners to keep livestock off pasture in periods of high rainfall.

Evaluation

A benefit of this approach would be encouragement of good behaviours; however this option requires the wider community to pay the full cost of the solution. It would set up expectations that may become unaffordable in the future – particularly if the subsidy price increases due to Council needing to secure environmental results. Subsidies could not be relied upon to provide the sustainable load of nitrogen to the lake.

In general, subsidies frameworks do not deliver efficient outcomes because they involve 'picking winners' by focusing on particular practices, and provide little incentive for finding alternative means of reducing nitrogen discharges.[118]

This option will not be effective in achieving the environmental target with certainty, and would not achieve efficient resource use.

[117] Daigneault and McDonald (2012).
[118] OECD (2011).

Bibliography

Science and modelling

AgResearch (2010): *The efficacy of strategies to mitigate the loss of phosphorus from pastoral land use in the catchment of Lake Rotorua*. Retrieved from http://www.rotorualakes.co.nz/vdb/document/83.

AgResearch (2011). *Intervention packages for Lake Rotorua summary report*. Report prepared for the Bay of Plenty Regional Council in association with NIWA, Nimmo-Bell, AgResearch, GNS Science and Market Economics. Retrieved from www.boprc.govt.nz/knowledgecentre/our-library/consultant-publications/.

Bay of Plenty Regional Council (2013). *Trends and state of nutrients in Lake Rotorua streams.* Environmental Publication 2013/08. Retrieved from www.rotorualakes.co.nz/vdb/document/769.

Boffa Miskell Limited (2011) *Gorse Identification: Lake Rotorua and Lake Okareka Catchments.*

Clearwater SJ, Hickey CW, Thompson KJ (2014). *The effect of chronic exposure to phosphorus-inactivation agents on freshwater biota.* Hydrobiologia 728:51-65. Retrieved from: www.researchgate.net/publication/260603495.

Environment Bay of Plenty (2010) *Quantification of nitrogen leaching from gorse in the Lake Rotorua Catchment* Environmental Publication 2010/03.

Environmental Research Institute (2012). *Predicting the effects of nutrient loads, management regimes and climate change on water quality of Lake Rotorua*. Retrieved from www.rotorualakes.co.nz/vdb/document/770.

Hamilton, DP, McBride, CG, Jones HFE (2015). *Assessing the effects of alum dosing of two inflows to Lake Rotorua against external nutrient load reductions: Model simulations for 2001-2012.* Report prepared for the Bay of Plenty Regional Council.

Kingi T, Sprosen M, Ledgard S, Morrell S, Matheson L, Park S. (2015). *Meeting nutrient loss targets on dairy farms in the Lake Rotorua catchment.* Final report on Sustainable Farming Fund Project 11/023. http://www.rotoruafarmers.org.nz/meeting-nutrient-loss-targets-on-dairy-farms-in-the-lake-rotorua-catchment-2/.

Magesan, G. and Wang, H. (2008) *Nitrate leaching behaviour of Gorse.* SCION for Environment Bay of Plenty.

NIWA (2011a). *Prediction of nitrogen loads to Lake Rotorua using the ROTAN model.* NIWA Client Report: HAM2010-134. NIWA Project BOP11202.

NIWA (2011b). Unpublished ROTAN modelling report to Bay of Plenty Regional Council. In Beca (Ed) *Intervention packages for Lake Rotorua Summary Report*. Report prepared for the Bay of Plenty Regional Council.

Palliser C, Rutherford K and Wadhwa S (2011). *Use of a model to predict the effects of land use changes on nitrogen delivery to Lake Rotorua, especially the lags involved with groundwater,* 2011 FLRC proceedings.

Park S, Kingi T, Morrell S, Matheson L, Ledgard S (2014). *Nitrogen losses from Lake Rotorua dairy farms – modelling, measuring and engagement*. Retrieved from www.massey.ac.nz/~flrc/workshops/14/Manuscripts/.

Rutherford JC, Pridmore RD, White E (1989). *Management of phosphorus and nitrogen inputs to Lake Rotorua, New Zealand*, Journal of Water Resources Planning & Management 115 (4): 431-439.

Rutherford K (2003). *Lake Rotorua Nutrient Load Targets*, NIWA Client Report: HAM2003-155.

Rutherford K (2008). *Nutrient load targets for Lake Rotorua - a revisit*, NIWA Client Report: HAM2008-080. Retrieved from, www.envbop.govt.nz/.../TechReports.

Rutherford KC, Palliser C, Wadhwa S (2009). *Nitrogen exports from the Lake Rotorua catchment – calibration of the ROTAN model.* NIWA client report HAM 2009-019. Report prepared for the Bay of Plenty Regional Council.

Rutherford KC, Palliser C, Wadhwa S (2011). *Prediction of nitrogen loads to Lake Rotorua using the ROTAN model.* NIWA client report HAM 2010-134. Report prepared for the Bay of Plenty Regional Council.

Tempero G (2015) *Ecotoxicological Review of Alum Applications to the Rotorua Lakes* Environmental Research Institute and University of Waikato ERI Report Number 52 http://www.rotorualakes.co.nz/vdb/document/1283.

Tempero G, Abell J, Hamilton D, McBride C (2015) *Anthropogenic phosphorus loads to Lake Rotorua.* Environmental Research Institute and University of Waikato ERI Report Number 66.

Unwin M (2009). *Angler usage of lake and river fisheries managed by Fish & Game New Zealand: results from the 2007/08 National Angling Survey.* NIWA Report CHC2009-046 prepared for Fish & Game New Zealand, Project FGC08503, National Institute of Water and Atmospheric Research, Christchurch, New Zealand: 110pp.

White PA, Lovett A, Tschritter C, Cusi M (2014). Lake Rotorua catchment boundary relevant to Bay of Plenty Regional Council's water and land management policies. GNS Science Consultancy Report 2014/11 http://www.rotorualakes.co.nz/vdb/document/866

Overall approach, including rules and allocation

AgResearch (2008). *Nitrogen and Taupo: Objective 5: Developing equitable process for policy outcomes*.

Anastasiadis S (2011). *Water quality management in Lake Rotorua: A comparison of regulatory approaches using the NManager model*. Retrieved from www.motu.org.nz/publications/.

APR Consultants (2004). *Economic impact of tourism on the Rotorua District economy*. Report prepared for Tourism Rotorua.

APR Consultants Limited (2013). *Review of small holdings in the Lake Rotorua catchment*. Report prepared for the Bay of Plenty Regional Council.

Bay of Plenty Regional Council. (2007). *Rotorua Lakes Protection and Restoration Programme Update.*

Bay of Plenty Regional Council (2010). Proposed Bay of Plenty Regional Policy Statement. Section 32 report Water quality and land use. Strategic Policy Publication 2010/07 www.boprc.govt.nz/media/78773/strategicpolicypublication201007-waterqualityandlanduse.pdf.

Bay of Plenty Regional Council. (2010). *Memorandum: When to consider the allocation of nutrient discharges*. Bay of Plenty Regional Council.

Bay of Plenty Regional Council (2011): *Bay of Plenty Regional Council's position statements on land use and land management change in the Lake Rotorua catchment*. Retrieved from www.boprc.govt.nz/.

Bay of Plenty Regional Council (2012). *Economic benefits of clean lakes.*

Bay of Plenty Regional Council. (2013). *Land Management Change & Land use change in the Lake Rotorua Catchment.*

Beca (2011). *Intervention packages for Lake Rotorua summary report*. Report prepared for the Bay of Plenty Regional Council in association with NIWA, Nimmo-Bell, AgResearch, GNS Science and Market Economics. Retrieved from www.boprc.govt.nz/knowledgecentre/our-library/consultant-publications/.

Botha, N (2012). *Social impact of Variation 5 on the Taupō community*. Report prepared for Beef and Lamb New Zealand. Retrieved from www.beeflambnz.com/Documents/Farm/.

Daigneault A, McDonald H (2012). *Evaluation of the impact of different policy options for managing water quality limits.* Report prepared for Ministry of Primary Industries.

Daigneault A, Greenhalgh S, Samarasinghe O, Sinclair R (2011) *Estimating co-benefits of Agricultural climate policy in NZ: A catchment-level analysis.* Agricultural and Applied Economics Association>2011 Annual Meeting, July 24-26, 2011, Pittsburgh, Pennsylvania.

Daigneault A, Greenhalgh S, Samarasinghe O (2014), *A Response to Doole and Marsh ([Doole, G., 2013]) Article: Methodological Limitations in the Evaluation of Policies to Reduce Nitrate Leaching from New Zealand Agriculture* (April 2014). Australian Journal of Agricultural and Resource Economics, Vol. 58, Issue 2, pp. 281-290, 2014.

Doole GJ, Romera AJ and Parsons O (2015). *Economic effects of diverse allocation mechanisms in the Lake Rotorua catchment.* Report prepared for the Lake Rotorua Stakeholder Advisory Group.

Environment Bay of Plenty, Rotorua District Council Te Arawa Māori Trust Board, (2013). *Vision and Strategy for the Lakes of the Rotorua District*, www.rotorualakes.co.nz/strategy.

Environmental Management Services Ltd (2009). *Regional water and land plan Rule 11: Review of efficiency and effectiveness.* Report prepared for the Bay of Plenty Regional Council. Retrieved from www.rotorualakes.co.nz/vdb/document/162.

Fenton T. *Options for the Allocation of Nutrients Discharge Rights*. In Alchemists Ltd (Ed.).

Gibbs and Hamilton (2009). *Sediment capping in Lake Rotorua*. Presentation prepared for consultation meeting April 2009. Retrieved from http://www.boprc.govt.nz/media/34509/TechReports-090701-SedimentCappingLakeRotorua.pdf.

Greenhalgh S (2009). *Assessment of interventions for the Rotorua Lakes.* Report prepared for Environment Bay of Plenty.

Greenhalgh S (2009). *Design and implementation guidelines for some interventions for the Rotorua Lakes.* Report prepared for Environment Bay of Plenty.

Greenhalgh S (2013a). *Approach to assess the impacts of allocation options*. Presentation to Lake Rotorua Stakeholder Advisory Group 19 March 2013.

Greenhalgh S (2013b). *Costs and benefits of achieving a clean lake: Rotorua lakes.*

Greenhalgh, S (2009). *Assessment of Interventions for the Rotorua Lakes*. Landcare Research Contract Report LC0910/021.

Grow Rotorua (2014). Annual Report 2013-2014. Retrieved from www.rotoruanz.com/getmedia/.../Grow-Annual-Report-online-version.pdf/.

Horgan (2001). *The social and economic importance of the Rotorua Lakes.*

Howard S, Romera A, Doole GJ (2013). *Selwyn-Waihora Nitrogen Loss Reductions and Allocation Systems.* Dairy NZ*,* Hamilton.

Hurunui Waiau Water Management Zone Committee (2011). *Hurunui Waiau Zone Implementation Programme* (ZIP).

IScribe Ltd (2014) *Lake Rotorua Draft Nitrogen Rules – Consultation Report.* http://www.rotorualakes.co.nz/vdb/document/891.

IScribe Ltd (2015) *Lake Rotorua Draft Nitrogen Rules Summary of additional consultation.*

Infometrics (2012). Rotorua District annual economic profile. Retrieved from www.rotoruanz.com/getmedia/.

Kerr S, Anastasiadis S (2011) Managing water quality in Lake Rotorua: *The design of regulation to reflect groundwater nitrogen lags.* http://www.motu.org.nz/publications/detail/managing_water_quality_in_lake_rotorua_the_design_of_regulation_to_reflect_.

Key Research (2005). *Destination Rotorua.* Lake Water Quality Perceptions Report.

Kingi T, Park S, Scarsbrook M (2012). *Solutions for a sustainable Lake Rotorua: the farmers' perspective*. Retrieved from www.rotoruafarmers.org.nz/resources/farm-reports/.

Lake Rotorua Stakeholder Advisory Group (StAG) *Position Paper - Allocation Rules and Incentives*, prepared for Council meeting on 17 September 2013 http://www.rotorualakes.co.nz/.

Landcare Research. (2009). *Assessment of Interventions for the Rotorua Lakes.*

Landcare Research. (2009). *Design and implementation guidelines for some interventions for the Rotorua Lakes.*

Landcare Research. (2011). *Modelling economic impacts of nutrient reduction policies in the Hurunui Catchment.*

Landcare Research. (2012). *Evaluation of the impact of different policy options for managing to water quality limits*. In Landcare Research (Ed.), (pp. 127). Wellington: Landcare Research.

Land Connect Ltd November 2015 *Lake Rotorua Catchment Small Block Sector Review.* Report prepared for the Bay of Plenty Regional Council.

Ledgard, Ghani, Redding, Sprosen, Balvert and Smeaton (2007). *Farmers taking control of their future: Research into minimising nitrogen and phosphorus from pasture land into Rotorua lakes.*

MacIntosh (2012): Alum Dosing of two stream discharges to Lake Rotorua. http://www.rotorualakes.co.nz/vdb/document/151.

Mackay EB, Maberly SC, Pan G, Reitzel K, Bruere A, Corker N, Douglas G, Egemose S, Hamilton D, Hatton-Ellis T, Huser B, Li W, Meis S, Moss B, Lurling M, Phillips P, Yasseri A, Spears BM (2014). Geoengineering in lakes: Welcome attraction or fatal distraction. Inland waters (2014, 4, pp439-356). Retrieved from www.fba.org.uk/journals/index.php/IW/article/viewFile/769/418.

McIntosh, J (2012). *Alum Dosing of two stream discharges to Lake Rotorua.* Bay of Plenty Regional Council.

Market Economics Limited (2011). *Intervention packages for Lake Rotorua. Evaluation of Regional and National economic impacts*. In Beca (2011) *Intervention packages for Lake Rotorua summary report*. Report prepared for the Bay of Plenty Regional Council.

Market Economics Limited (2015). *Economic impacts of Rotorua nitrogen reduction. District, regional and national evaluation.* Report prepared for the Bay of Plenty Regional Council.

Mkwara and Marsh D (2011). *Valuing trout angling benefits of water quality improvements - An application to Rotorua Lakes.*

Ministry for the Environment (2014). Climate Change Information New Zealand. Forestry in the Emissions Trading Scheme. Retrieved from www.climatechange.govt.nz/emissions-trading-scheme/participating/forestry/.

New Zealand Business Council for Sustainable Development. (2008). *New Zealand and Water: Key Facts.*

Nimmo-Bell (2003). *An economic evaluation of land use change options. Section A: Cost benefit and opportunity cost analysis – Lake Okareka. Section B: Economic impact on Rotorua District and Bay of Plenty Region of water quality induced changes to land use and tourism in Rotorua Lakes catchments.* A report prepared for Environment Bay of Plenty.

Nimmo Bell (2003) *Market tools to facilitate land use change*. Report prepared for Rotorua District Council.

Nimmo Bell (2004). *An economic evaluation of water quality induced changes in Rotorua and Rotoiti catchments.* Report prepared for Environment Bay of Plenty.

Nimmo Bell (2004). *The Rotorua Lakes evaluation of less tangible values.* Report prepared for Environment Bay of Plenty.

Nimmo Bell (2011). *Land use change economics. Policy options for achieving the nutrient reductions from land use in the Lake Rotorua catchment*. Part of the Beca (2011) *Intervention packages for Lake Rotorua summary report*. Report prepared for the Bay of Plenty Regional Council.

NZIER (2013). *Feasibility of two-step N leaching policy.* An exploratory analysis.

OECD (2011). Environmental taxation. A guide for policy makers http://www.oecd.org/env/tools-evaluation/48164926.pdf.

Park S (2014). *Final report to Council on using* OVERSEER® *in new rules for the Lake Rotorua catchment.*

Park S, MacCormick A (2009). *Practical and regulatory factors in nutrient benchmarking with OVERSEER® – a Rotorua Lakes perspective*, FLRC 2009 Proceedings.

Park S, MacCormick P (2011). *Rotorua benchmarking: challenges and progress*. Retrieved from www.rotoruafarmers.org.nz/resources/farm-reports/.

Park S, Kingi T, Morrell S, Matheson L, Ledgard S (2014). *Nitrogen Losses from Lake Rotorua Dairy Farms – Modelling, Measuring and Engagement.* Retrieved from www.rotoruafarmers.org.nz/resources/farm-reports/.

Park S, Kingi, T, Morrell S, Matheson L, Sprosen L, Ledgard M (2015). *The context and practice of nutrient mitigation on Rotorua dairy farms*. Retrieved from www.rotoruafarmers.org.nz/resources/farm-reports/.

Parsons O, Doole G, Romera A (2015). *On-farm effects of diverse allocation mechanisms in the Lake Rotorua catchment.* Report prepared for the Lake Rotorua Stakeholder Advisory Group.

Parliamentary Commissioner for the Environment (2006). *Restoring the Rotorua Lakes. The ultimate endurance challenge.* Retrieved from www.pce.parliament.nz/publications/.

Parliamentary Commissioner for the Environment (2013). *Water quality in New Zealand: Land use and nutrient pollution.* Retrieved from http://www.pce.parliament.nz/media/1275/pce-water-quality-land-use-web-amended.pdf.

Perrin Ag Consultants Ltd (2012) *Farmer Solutions Project*. Report prepared in association with AgResearch for the Bay of Plenty Regional Council. www.rotorualakes.co.nz/vdb/document/363.

Perrin Ag Consultants Ltd (2013). *Supplementary paper to the farmer solutions project*. www.rotorualakes.co.nz.

Perrin Ag Consultants Ltd (2014). *Rotorua NDA Impact Analysis: Phase 1 Project.* Rotorua. Retrieved from www.rotorualakes.co.nz/.

Perrin Ag Consultants Ltd (2015). *Methodology for creation of NDA reference files and stocking rate table*. Report prepared for the Bay of Plenty Regional Council.

Phillips N, Steward M, Olsen G, Hickey C, Tipa G (2011). *Risk assessment of contaminants from kai from within the Te Arawa rohe – Summary report*. Report to the Te Arawa Lakes Trust and Health Research Council of New Zealand.

Resource and Environmental Management Ltd (2009). *Regional Water and Land Plan Rule 11. Review of efficiency and effectiveness.* Retrieved from www.rotorualakes.co.nz/vdb/document/162.

Rotorua Te Arawa Lakes Programme (2013). *Vision and strategy for the Lakes of the Rotorua District.* www.rotorualakes.co.nz/vdb/document/533.

Simmons DG, Fairweather JR (2000). *Tourism in Rotorua: Destination evolution and recommendations for management.* Rotorua Case Study Report No. 18/2000.

Statistics New Zealand. *Agricultural Production Census 2012*.

Statistics New Zealand. *2013 Census* www.stats.govt.nz/Census/2013.

Te Arawa Lakes Trust (2015a). *Te Tūāpapa o ngā wai o Te Arawa Te Arawa Cultural Values Framework.*

Te Arawa Lakes Trust (2015b). Alum dosing workshop with Regional Councillors 26 June 2015. Te Arawa Lakes Trust notes on alum dosing.

Te Maru O Ngāti Rangwewehi Iwi Authority (2012) *Ngāti Rangiwewehi Iwi Environmental Management Plan.* Retrieved from www.boprc.govt.nz/ .../ngati_rangiwewehi_iwi_environmental _managment_plan_2012.pdf

Te Maru O Ngāti Rangwewehi Iwi Authority (2015). *Lake Rotorua alum dosing programme – a cultural perspective.* Presentation for Alum dosing workshop with regional councillors 26 June 2015.

Telfer Young (2012). *Market valuation of dairy farms – Lake Rotorua catchment.* Report prepared for the Bay of Plenty Regional Council.

Telfer Young (2014). *Land values in the Rotorua area and the Lake Rotorua catchment.* Report prepared for the Bay of Plenty Regional Council.

Timar L, Anastasiadis S, Kerr S (2013). *Potential impacts of nutrient discharge allowance allocation methods among heterogeneous farmers in the Lake Rotorua catchment.* Presentation available at http://www.rotorualakes.co.nz/vdb/document/355.

Weimer DL, Vining AR (1999). *Policy analysis. Concepts and practice.* New Jersey: Prentice Hall.

Watkins, N, Shepherd M, Ledgard, S (2015) OVERSEER® *Nutrient Budgets information base for the Rotorua catchment* Agresearch RE500/2015/030.

Webber W, Morgan G. (2014). *Evolving to nitrogen discharge allocations for the Lake Rotorua catchment.* Retrieved from www.rotoruafarmers.org.nz/resources/farm-reports/.

Welsh C. (2001). *Cost Benefit Assessment Rule 11* Resource and Environmental Management Ltd.

Welsh (2002) *Equity issues: Rule 11 and other land use management approaches.*

Welsh (2002) *Rotorua Lakes. Water quality impacts on lakeside property prices.*

Woodham M, Marsh D (2011). *The effect of water quality on house prices around the Rotorua Lakes. A preliminary analysis.* Published by Department of Economics, University of Waikato.

Yao RT, Barry LE, Wakelin SJ, Harrison DR, Magnard LA, Payn TW (2013). Planted forests. In JR Diamond (Ed), Ecosystem services in New Zealand (pp.62-78). Christchurch NZ: Caxton Press.

Nutrient trading

Barns S, Young J (2013). *Cap and trade of diffuse emissions of nitrogen in Lake Taupō Catchment. Reviewing the policy decisions and the market.* Waikato Regional Council Technical Report 2013/34.

Chapmann Tripp (2008). *Initial report on nutrient trading under the Resource Management Act (1991).*

Chapmann Tripp. (2010). N*utrient trading programme - incorporation into Bay of Plenty Regional plan*. Letter legal advice received from Chapman Tripp. Chapmann Tripp, Auckland.

Connor R (2014) *Rotorua Lakes nutrient trading working paper.* Working Paper prepared for the Bay of Plenty Regional Council. www.rotorualakes.co.nz/vdb/document/734.

Connor R (2014). Nutrient Trading in the Lake Rotorua catchment. Report prepared for the Bay of Plenty Regional Council.

Connor R (2014) Options for trading nitrogen discharge entitlements in the Lake Rotorua catchment. Paper prepared for the Bay of Plenty Regional Council.

Grow Rotorua (2014). Grow Rotorua Annual Report 2013-14. http://www.rotoruanz.com/getmedia/9c4fea7e-34d0-46f5-a9f0-df154d8bc50e/Grow-Annual-Report-online-version.pdf/.

Kerr S, Greenhalgh S, Simmons G (2015). The Taupō nitrogen market: The world's only diffuse source trading programme. Mōtū Note #20 http://www.motu.org.nz/assets/Documents/our-work/environment-and-resources/nutrient-trading-and-water-quality/Motu-Note-20-Taupo-Nitrogen-Market.pdf.

Kerr S, Lock K (2009). *Nutrient Trading in Lake Rotorua: Cost Sharing and Allowance Allocation,*" Motu Working Paper 09-09. www.motu.org.nz/publications/detail/nutrient_trading_in_lake_rotorua_cost_sharing_and_allowance_allocation.

Kerr S, Lauder G and Fairman D (2007). *Towards design for a nutrient trading programme to improve water quality in Lake Rotorua.*

Lauder (2009) *The Rotorua nutrient trading study group* (NTSG), 2007-2008. Report for Mōtū Economic and Public Policy Research.

Lock K, Kerr S (2008). *Nutrient trading in Lake Rotorua: Social, cultural, economic and environmental issues around a nutrient trading system.*

Lock K, Kerr S (2008). Nutrient trading in Lake Rotorua: *Overview of a prototype system.*

Macfie R. (2010, August 2010). *The price of milk.* Listener.

Motu Economic and Public Policy Research. (2007). Markets and water quality.

Motu Economic and Public Policy Research. (2007). Nutrient trading in Lake Rotorua: Goals and Trading Caps.

Motu Economic and Public Policy Research. (2007*). Nutrient trading in Lake Rotorua: where are we now?*

Motu Economic and Public Policy Research. (2007). *Towards design for a nutrient trading programme to improve water quality in Lake Rotorua*.

Motu Economic and Public Policy Research. (2008). *Assessing design options for a nutrient trading system using an integrated model.*

Motu Economic and Public Policy Research. (2008). *Greenhouse gases and water pollutants: interactions between concurrent NZ trading systems.*

Motu Economic and Public Policy Research. (2008). *Nutrient trading in Lake Rotorua: choosing the scope of a nutrient trading system.*

Motu Economic and Public Policy Research. (2008). *Nutrient trading in Lake Rotorua: Determining net nutrient inputs.*

Motu Economic and Public Policy Research. (2011). *Does complex hydrology require complex water quality policy? Wellington*.

Rutherford K, Cox T. (2009). *Nutrient trading to improve and preserve water quality*. Water & Atmosphere, 17(1), 12-13.

Development of Māori Land

Bay of Connections (2014). *He Mauri Ohooho: Māori Economic Development Strategy*.

Environmental Management Services (2009). *Regional Water & Land Plan Rule 11 - Review of Efficiency and Effectiveness*.

GHA (2014) *Summary Report. NDA Rules Presentations and Promotion amongst Māori Land Owners*. Prepared for Bay of Plenty Regional Council.

Landcare Research (2012). *Evaluation of the impact of different policy options for managing to water quality limits*. MPI Technical Paper No: 2012/46.

Ministry of Agriculture and Forestry (2011). *Māori Agribusiness in New Zealand: A Study of the Māori Freehold Land Resource*.

Ministry of Business, Innovation and Employment & Ministry for Primary Industries (2015). *Toi Moana Bay of Plenty Growth Study: Opportunities Report.*

PricewaterhouseCoopers (2013). *Growing the Productive Base of Māori Freehold Land*. Prepared for Ministry for Primary Industries.

Council strategic and regional plans

Bay of Plenty Regional Council (2014). Operative Regional Policy Statement. http://www.boprc.govt.nz/knowledge-centre/policies/operative-regional-policy-statement/.

Bay of Plenty Regional Council (2010). *Proposed Bay of Plenty Regional Policy Statement. Section 32 report Water quality and land use.* Strategic Policy Publication 2010/07 www.boprc.govt.nz/media/78773/strategicpolicypublication201007-waterqualityandlanduse.pdf and www.boprc.govt.nz/media/221485/water_quality_and_land_use_section_32_2__a__report_pdf.pdf.

Environment Bay of Plenty, 2008: Regional Water and Land Plan, http://www.envbop.govt.nz/knowledge-centre/plans/regional-water-and-land-plan.aspx.

Environment Bay of Plenty, 2009: Lakes Rotorua and Rotoiti Action Plan; http://www.rotorualakes.co.nz/vdb/document/78.

Appendices

Appendix 1 - Section 32 of the Resource Management Act

32 Requirements for preparing and publishing evaluation reports

(1) An evaluation report required under this Act must—

(a) examine the extent to which the objectives of the proposal being evaluated are the most appropriate way to achieve the purpose of this Act; and

(b) examine whether the provisions in the proposal are the most appropriate way to achieve the objectives by—

(i) identifying other reasonably practicable options for achieving the objectives; and

(ii) assessing the efficiency and effectiveness of the provisions in achieving the objectives; and

(iii) summarising the reasons for deciding on the provisions; and

(c) contain a level of detail that corresponds to the scale and significance of the environmental, economic, social, and cultural effects that are anticipated from the implementation of the proposal.

(2) An assessment under subsection (1)(b)(ii) must—

(a) identify and assess the benefits and costs of the environmental, economic, social, and cultural effects that are anticipated from the implementation of the provisions, including the opportunities for—

(i) economic growth that are anticipated to be provided or reduced; and

(ii) employment that are anticipated to be provided or reduced; and

(b) if practicable, quantify the benefits and costs referred to in paragraph (a); and

(c) assess the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions.

(3) If the proposal (an amending proposal) will amend a standard, statement, regulation, plan, or change that is already proposed or that already exists (an existing proposal), the examination under subsection (1)(b) must relate to—

(a) the provisions and objectives of the amending proposal; and

(b) the objectives of the existing proposal to the extent that those objectives—

(i) are relevant to the objectives of the amending proposal; and

(ii) would remain if the amending proposal were to take effect.

(4) If the proposal will impose a greater prohibition or restriction on an activity to which a national environmental standard applies than the existing prohibitions or restrictions in that standard, the evaluation report must examine whether the prohibition or restriction is justified in the circumstances of each region or district in which the prohibition or restriction would have effect.

(5) The person who must have particular regard to the evaluation report must make the report available for public inspection—

(a) as soon as practicable after the proposal is made (in the case of a standard or regulation); or

(b) at the same time as the proposal is publicly notified.

(6) In this section,—

objectives means,—

(a) for a proposal that contains or states objectives, those objectives:

(b) for all other proposals, the purpose of the proposal

proposal means a proposed standard, statement, regulation, plan, or change for which an evaluation report must be prepared under this Act

provisions means,—

(a) for a proposed plan or change, the policies, rules, or other methods that implement, or give effect to, the objectives of the proposed plan or change:

(b) for all other proposals, the policies or provisions of the proposal that implement, or give effect to, the objectives of the proposal.

Appendix 2 - Relevant provisions of the RPS and RWLP

Bay of Plenty Regional Policy Statement (2014)

Policy WL 3B: Establishing limits for contaminants entering catchments at risk

Establish limits for the total amount of specified contaminants that enter the receiving waters within a catchment at risk including:

(a) Contaminants to be managed to avoid compromising public health and each catchment's ecology, mauri, fishability, swimmability and aesthetics;

(b) For the Rotorua Te Arawa Lakes the amount of nitrogen and phosphorus that can enter each lake in order to achieve its target trophic level index; and

(c) For Lake Rotorua the total amount of nitrogen that enters the lake shall not exceed 435 tonnes per annum.

Policy WL 5B: Allocating the capacity to assimilate contaminants

Allocate among land use activities the capacity of Rotorua Te Arawa lakes and other water bodies in catchments at risk to assimilate contaminants within the limits established in accordance with Policy WL 3B having regard to the following principles and considerations:

(a) Equity/Fairness, including intergenerational equity;

(b) Extent of the immediate impact;

(c) Public and private benefits and costs;

(d) Iwi land ownership and its status including any Crown obligation;

(e) Cultural values;

(f) Resource use efficiency;

(g) Existing land use;

(h) Existing on farm capital investment; and

(i) Ease of transfer of the allocation.

Policy WL 6B: Managing the reduction of nutrient losses

Require, including by way of rules, the managed reduction of any nutrient losses that are in excess of the limits established under Policy WL 3B by ensuring that:

(a) Rural production land use activities minimise their loss of nutrients as far as is reasonably practicable by implementing on-farm best management practices;

(b) Any land use change that is required within the Rotorua Te Arawa lakes catchments to achieve the limits takes into account an equitable balancing of public and private costs and benefits; and

(c) No discharges shall be authorised beyond 2032 that results in the limit for Lake Rotorua being exceeded. A catchment intermediate target for the managed reduction of nitrogen loss is to be set to achieve 70% of the required reduction from 746 t/yr to 435 t/yr by 2022.

Bay of Plenty Regional Water and Land Plan (2008)

Issue 10 Land use and management practices that are inappropriate to the specific characteristics of the site, (including soil type) may cause adverse effects on the environment.

Objective 11 The water quality in the Rotorua lakes is maintained or improved to meet the following Trophic Level Indices:

…

(j) Lake Rotorua – 4.2

Policy 21 To manage land and water resources in the Bay of Plenty within an integrated catchment management framework to:

(a) Maintain or enhance water quality in individual lakes to meet their Trophic Level Index ('TLI') and Water Quality Classification.

(b) Require the management of nitrogen or phosphorus in individual Rotorua lake catchments.

(c) Reduce cyanobacterial algal blooms on the Rotorua Lakes by managing nutrient inputs in the lake catchment.

(d) Maintain or improve water quality in streams and rivers to meet their Water Quality Classification.

(e) Have full regard to the water quality classifications for coastal waters (including harbours and estuaries), and policies relevant to the coastal environment in the Bay of Plenty Regional Coastal Environment Plan.

(f) Recognise and provide for heritage values in resource management decisions.

(g) Maintain existing high quality groundwater, where the following have been identified:

(i) Potable water, including aquifers used for municipal water supply.

(ii) Natural water quality that has not been adversely affected by land use or point source discharges.

(iii) Recharge areas of aquifers related to areas specified in (i) and (ii), and

(iv) In the groundwater catchments of the Rotorua lakes, Ohiwa and Tauranga harbours.

(h) Avoid, remedy or mitigate adverse effects on groundwater quality in other areas not otherwise addressed by (g).

(i) Ensure the levels of bacteria in those rivers and streams that have been identified as important swimming sites and in lakes in Schedule 10 meet the Ministry of Health/Ministry for the Environment Recreational Water Quality Guidelines (1999) as a minimum.

(j) Understand the effects of changing land cover and land use practices on water flows and levels in rivers, streams, lakes.

(k) Promote and encourage the adoption of sustainable land management

(l) practices that are appropriate to the environmental characteristics and

(m) limitations of the site to:

(i) Protect the soil and avoid, remedy or mitigate the adverse effects of erosion.

(ii) Maintain the health of the region's soil resources for future generations.

(iii) Achieve the appropriate management of riparian areas, including the retirement and planting of riparian areas of streams, rivers, lakes, wetlands and estuaries.

(iv) Avoid, remedy or mitigate adverse effects on water quality in the receiving environment.

(v) Take into account the assimilative capacity of the soil.

(vi) Recognise and provide for heritage values of the site.

(vii) Maintain or improve the protective function of coastal sand dunes.

(viii) Control sediment entering estuaries and harbours from use and development activities.

(n) Manage land and water resources according to realistic management goals that are appropriate to the existing environmental quality and heritage values (including ecosystem values) of the location.

Policy 23 To develop equitable and workable provisions in relation to existing land uses, where investigations indicate that changes to existing land management practices, or land use restrictions are required to maintain or improve water quality.

Method 41 Develop and implement Action Plans to maintain or improve lake water quality to meet the TLI set in Objective 11. Action Plans will be developed according to the following process.

(Entire method wording not included)

Method 43 Support land use changes, and changes to land use rules, that:

(a) Achieve lake management objectives identified in lake Action Plans developed in accordance with Method 41.

(b) Integrate land use planning and rules in Environment Bay of Plenty's resource management plans and Rotorua District Council's District Plan for lake catchments.

(c) Recognise that land use change and land management practices are an important part of lake management.

(d) Actively promote and support low nutrient loss land uses and land management practices in the catchments of the Rotorua Lakes.

Appendix 3 - Roles and Responsibilities of the Rotorua Lakes Strategy Group

Te Arawa Lakes Trust	Rotorua Lakes Council	Bay of Plenty Regional Council
• Represent iwi. Te Arawa has mana whenua as the owner of the lakebeds and provides cultural advice on all aspects of the lakes. • Aid in the protection of the cultural identity of Te Arawa people and their lakes. • Ensure the cultural identity wairua, tikanga and kawa of the Te Arawa people is invested in the strategy to improve the lakes of the Rotorua District. • Protect the mauri of the lakes. • Ensure meaningful and binding working relationships with iwi/hapu and their ancestral lakes.	• Administer the relevant sections of the Resource Management Act 1991. • Provide and maintain sewerage and storm water discharge infrastructure. • Contribute to funding to help improve the health of Rotorua lakes in association with the Crown and Regional Council. • Plan for and manage land uses within the lake catchments.	• Implement the Strategy for the Lakes of the Rotorua District. • Administer the relevant sections of the Resource Management Act 1991. • Implement the Rotorua Lakes Recreation Strategy and Regional Pest Management Plan. • Implement the Rotorua Te Arawa Lakes Programme through operational objectives. • Contribute to funding to help improve the health of Rotorua lakes in association with the Crown and District Council.

Appendix 4 - Evaluation Table: Integrated Framework

BENEFITS

	Evaluation
Social benefits	The *health and mauri of the people* is a compulsory value in the *National Policy Statement for Freshwater Management 2014*. This value requires that as a minimum, the lake 'will present no more than a moderate risk of infection to people when wading or boating or involved in activities that involve only occasional immersion in the water' and that toxins, such as toxic algae will not be present in quantities that will harm people's health. Related to this value, the social benefits derived from Lake Rotorua include boating and navigation, swimming, waka ama, harvesting and producing food. Improvements in water quality allow the avoidance of health issues from secondary contact.[119] The Vision and Strategy for the Lakes in the Rotorua District (2013) is a living document that reflects the community vision for the Rotorua Lakes: *The lakes of the Rotorua district and their catchments are preserved and* *protected for the enjoyment of present and future generations,* *while recognising and providing for the relationship of Te Arawa with their ancestral lakes*[120] The key elements of the Vision and Strategy are 'connected, iconic and prosperous'. This is about the Rotorua community working together to preserve and protect the lakes. The vision describes the approach of protection, restoration and enhancement, achieving healthy ecosystems and a healthy food basket using innovative solutions, while balancing conflicting aspirations, economic development and enhanced lakes, cultural prosperity, and quality of life. Permanently reducing nitrogen discharges by addressing the sources of the pollutants rather than the outcome will ensure that future generations do not have to deal with this problem. While alum dosing is currently maintaining the TLI, it relies on continuous inputs, and may leave future generations to deal with problems associated with the alum toxicity. Lake Rotorua is a community resource and taonga. The integrated framework recognises this and shares the responsibility and cost of reducing nitrogen discharges amongst farmers and the wider community through on farm reduction requirements and the incentive scheme. The integrated framework recognises the hardship to farmers should they be required to make the entire reduction without assistance and the benefits that accrue to the community from a clean lake. In this framework the wider community takes responsibility for 100 tonnes of reductions via the Incentives funding, plus a further 30 tonnes via the gorse conversion. The framework includes a $5.5m fund, contributed to by the regional and national communities, providing advice and support to farmers.

[119] Greenhalgh, S (2013b).
[120] Rotorua Te Arawa Lakes Programme (2013).

Evaluation	
	Direct and indirect use of Lake Rotorua is enjoyed by the local community, and domestic and international tourists. While local people enjoy and appreciated the Lake Rotorua, the Rotorua area hosts large numbers of domestic and international tourists (925,000 and 826,000 visitor nights respectively in the year to July 2013). The tourist industry is the biggest sector in the Rotorua district economy, contributing $210m (10.5 percent) to the $2002m GDP in 2012. Reductions in the number of tourists visiting would mean job losses in the tourism industry (accommodation, restaurants, tours etc.) and in those sectors supplying tourism. For example, a 2 percent decrease in tourism income to the district is estimated to result in the loss of 67 jobs locally, increasing to 85 jobs nationally.[121] The health and mauri of the environment *(Additional Value in the NPS – FW).* The recreational and amenity values associated with the lake are high. Reductions in water quality equate to losses of amenity and recreational values. A survey of willingness-to-pay suggested that Rotorua residents were willing to pay an average of 113_{2011}$/year for water quality improvements in the Rotorua Lakes, while across the Bay of Plenty region residents were willing to pay an average of 15_{2011}$/year.[122] In another study, Auckland anglers fishing on the Rotorua lakes expressed a willingness to pay values of 304_{2011}$/year on average.[123] The rainbow trout fishery currently provides around 210,000 angler days per year.[124]
Cultural benefits	The *health and mauri of the water* is a compulsory value in the *National Policy Statement for Freshwater Management 2014*. This is covered below under environmental benefits. The Te Arawa people have expressed concern about the declining lake water quality.[125] The values and aspirations of Te Arawa are reflected in the Vision and Strategy for the Lakes of the Rotorua District.[126] The goals of the strategy are to improve water quality; reduce nutrient loss to water; create positive experiences for lake users; protect, restore and enhance the lake water quality; ensure the lakes catchment is a healthy food basket; and maintain healthy ecosystems. The lakes are a taonga of the Te Arawa people. Importantly modifying the management approach to water quality improvement will in turn, improve and enhance the mauri of Lake Rotorua. Food gathering, places for food *(Additional Value in the NPS – FW).* The Rotorua Lakes, including Lake Rotorua, have been an important source of freshwater fish, invertebrates, waterfowl and plants for the Te Arawa iwi for centuries. Important local food species include kakahi (freshwater mussel), tuna (long fin eel), watercress, and the (introduced) rainbow trout. The koura (freshwater crayfish) was once an important fishery for Te Arawa, but declining lake water quality, due to eutrophication and invasion of exotic aquatic plants, has impacted on the ability of Te Arawa to catch koura.[127]

[121] Market Economics Limited (2015).
[122] Nimmo Bell (2011) Figures updated from Bell and Yap (2004). *Authors advise caution on interpreting these figures.*
[123] Nimmo Bell (2011).
[124] Unwin (2009).
[125] Environmental Management Services Limited (2009).
[126] Rotorua Te Arawa Lakes Programme (2013).
[127] Phillips et al. (2011).

Evaluation	
	While the water quality in Lake Rotorua improved with alum dosing in the Puarenga and Utuhina Streams, the Te Arawa Lakes Trust (TALT)[128] is firmly of the view that '*alum dosing is not an ongoing intervention in perpetuity in Lake Rotorua. As the owner of the lakebed of Lake Rotorua with a statutory acknowledgement over the lake water and freshwater fishery regulations and management responsibilities for the sustainable utilisation of six taonga species, namely the Koaro, Koura, Kakahi, Tuna, Inanga and Morihana.'* *With so many unknowns around the cumulative effects of alum on our taonga species and also trout, further research and monitoring needs to be carried out on this important traditional food source of Te Arawa and the Rotorua community as a whole.*[129] Achieving the sustainable nitrogen load to the lake through the Integrated Framework, as opposed to continuing alum dosing will allay Ngāti Rangiwewehi and Ngāti Rangiteaorere concerns about toxicity effects of alum dosing on food sources such as koura, tuna and kakahi, as expressed in the Ngāti Rangiwewehi Environmental Management Plan.[130,131]
Environmental benefits	The *health and mauri of the water* is a compulsory value in the *National Policy Statement for Freshwater Management 2014*. The ecosystem services provided by Lake Rotorua include nutrient processing, biodiversity, provision of food, science and education, and amenity and recreation. Deterioration of the lake water quality reduces the value these ecosystem services provide. For 2012, the total annual value of these ecosystem services was estimated to range from NZ$95-130million. Managing ecosystem health will assist in maintaining these values.[132] The policy will encourage low nitrogen land uses such as forestry. Planted forest ecosystem services include provisioning services of wood and fiber and biofuel, regulating services of carbon sequestration, avoided erosion, water quality improvement, flood mitigation and biodiversity, and cultural services including recreation and native species conservation.[133] Modelling suggests that the increase in exotic forest could be as low as 28 percent (1,980 hectares) to as high as 85 percent (6,003 hectares). The provision of timber is quantified in the economic benefits; forestry recreation services are also discussed in that section. Carbon sequestration, a regulating ecosystem service, is important for meeting New Zealand's international obligations for greenhouse gas emissions.[134] At an average sequestration rate of CO_2 of planted forests of 10-19 tonnes/hectare[135], these newly forested areas will contribute positively to this ecosystem service.

[128] 'The Trust is the settlement entity that has been established to receive, manage and administer the trust funds on behalf of and for the benefit of present and future members of Te Arawa as prescribed within the Te Arawa Lakes Settlement Act 2006.' www.tearawa.iwi.nz/about/
[129] Te Arawa Lakes Trust (2015).
[130] Clearwater et al. (2014).
[131] Te Maru O Ngāti Rangwewehi Iwi Authority (2012).
[132] Mueller suggests that a reduction in Lake Rotorua water quality to a TLI of 4.8 could result in damage costs in the order of $13-50m (Pers.comm). The TLI for Lake Rotorua was 4.9 in 2007 and has gradually improved.
[133] Yao et al. (2013).
[134] Ministry for the Environment (2014).
[135] Average sequestration rates per hectare vary over time as the age-class structure of forest changes. For [New Zealand] planted forests as a whole the rate has varied from 10 to 19 t $CO_2 ha^{-1}$ since 1990 (Yao et al. 2013, p.69).

Evaluation	
	Maintaining the current level of water quality (the TLI for 2013 and 2014 has been steady at 4.2) relies on continued dosing of alum, which started 2006 with 30 tonnes of alum dosed into the Utuhina Stream. In the year to June 2014, 1,600 tonnes of liquid aluminium sulphate was delivered to the Utuhina and Puarenga Streams. The long-term toxicity impacts of alum into the streams are not well understood.
Economic benefits	Tourism is the biggest single contributor to the Rotorua District economy, at 10.5 percent of district GDP in 2012. Poor water quality is a threat to this sector. Lake Rotorua is currently achieving its TLI as a result of alum dosing and favourable climatic conditions, but it is seen as a short terms solution. Loss of water quality is likely to impact on local income and jobs. For example, just a 2 percent decrease in 2012 would equate to $2.8m in the local economy, and 67 jobs (both figures include the flow-on impacts to other sectors). The area in commercial forestry (a low-nitrogen discharge land use) is expected to increase as a result of the rules. This increase is likely to be around $3m, including backward linkages such as transport, and flow on effects such as manufacturing. These increases will lead to around 20 additional jobs. The long timeframe for achieving reductions (staged reductions to 2032) provides a period for investigating and establishing new ventures. This type of process would also occur if external economic conditions meant that dairy farming became uneconomic. Potential changes within the pastoral farming industry include production for niche markets, such as high quality beef from a sustainably managed catchment.[136] Forestry potentially presents new opportunities too. The Bay of Plenty region is New Zealand's main wood processing area with planted forests covering 20% of the region. Outside of the GDP generated for the region, opportunities exist to produce bioenergy from the non-utilised in-forest residues.[137] Other new commercial endeavours could include production of mānuka honey and mānuka oil, for example.[138] Planted forests can provide significant opportunities for recreation and tourism. For example, in 2009 people made 300,000 recreational visits to the Whakarewarewa Forest, predominantly for mountain biking (34%) and walking (29%). This forest is managed for timber production, recreation and natural resource conservation. A study of travel costs estimated that the median willingness to pay to visit the forest was around $34 for walkers and $48 for bikers, producing an annual economic benefit of around $8m.[139] This type of activity creates tourism-related economic benefits for the Rotorua district, including employment. Achieving the water quality target under this approach would potentially allow alum dosing to be discontinued, reducing costs to the Regional Council by around $550,000 per year.

[136] For example Taupō Beef www.nzfeatrust.org.nz/vdb/document/269
[137] Yao et al. (2013).
[138] Grow Rotorua (2014).
[139] Yao et al. (2013).

COSTS

	Evaluation
Social costs	The rules will have varying impacts on the approximately owners of the approximately 1600 property in the Lake Rotorua catchment. Those people whose livelihoods are tied to their properties may be most impacted. Coping with the changes is likely to be stressful. Under Rule 11 (RWLP) • Properties between 0.4ha and 40ha were capped at the annual average level of nitrogen discharges for the 2001-2004 period. Seventy-four of the estimated 1488 (5 percent) properties below 40ha have been benchmarked at the landowners request (Table 16).[140] Properties smaller than 0.4ha with less than 10kg annual nitrogen loss/ha are classified as a permitted activity. • Properties greater than 40ha were benchmarked based on annual average 2001-2004 nitrogen discharges; landowners are required to farm within that bound. Of the larger benchmarked farms, 26 are dairy farms, and 80 drystock (including around six deer farms). All properties over 0.4ha in the groundwater catchment will be subject to the new rules. Small properties with low intensity land use will be a permitted activity. Low intensity land use will not exceed defined livestock rates (per ha) and will not crop or cultivate. Large properties (>40ha): Rules apply from 2017. For the 128 pastoral farms over 40 hectares the new rules will apply from 2017, and landowners will be required to apply for a resource consent. • For owners of larger blocks, the new rules will require that they reduce emissions from current levels based on the sector range allocation method. This will mean that they will have to make farm management changes at a minimum, and for some, land use changes.[141] • Social disruption – the alteration of the social make-up of the catchment – is unavoidable. This impact is likely to have the greatest impact on owners of larger properties. Social disruption can take the form of reductions to services, for example, where the size of a rural population falls, schools may close. The large number of small properties in the catchment may act as a buffer to these types of changes. • High debt levels will contribute to landowners stress, particularly where the farm is the main (or important) income. Although economic analysis suggests that on average the impact is modest, 'the impacts on profit are distributed unevenly across sectors, land uses and geophysical zones.' Reduced profitability may make it difficult for farmers to service debt, and decreased land value associated with nitrogen restrictions may mean that for some farmers, debt will exceed equity.[142]

[140] Land Connect Ltd (2015).
[141] Perrin Ag (2014); Parsons et al. (2015).
[142] Parsons et al. (2015, p.67).

	• Several elements in the rules will help to mitigate social disruption. Sharing of costs of nitrogen discharge reduction with the community through the Incentives and the Gorse schemes is a direct means of reducing the costs to the farming community. Less directly, but importantly, the selected allocation method (sector average with ranges) limits social disruption in that it is based on current discharges for the sectors. The ability to trade nitrogen discharge allowances encourages mitigation where it is most affordable, and allows landowners flexibility to make choices in how to reduce and to benefit from selling excess allowances. Although the rules start in 2017 and farmers are required to put in place Nitrogen Management Plans, the first 'hard target' is in 2022, giving farmers time to decide how to make reductions in that first period. The 15-year timeframe for reduction is specifically referred to in the RPS as a means of reducing social disruption, providing time for landowners to explore and implement mitigation options. The rules are also supported by the advice, support, research and funding available to landowners. Small properties (10-40ha): Rules apply from 2022. These properties will require resource consents, unless low intensity land use. • 43 percent (75) of properties in this group are GST registered, and 29 percent (51) are benchmarked. The size of property, GST registration and the fact that nearly a third of these properties are benchmarked suggests that some of the properties in this group will not meet the definition of low intensity land use, and will therefore move into a consenting regime, with the requirements associated with that. Properties will be required to meet reduction targets (as with properties >40ha), and will potentially face costs of reducing nitrogen leaching associated with that. Research indicates that although many small block owners are engaged in some form of production from their land, it is not usually the sole support of the household. In cases where the farm income is the sole source of income, or an important part of the household income, the changes are likely to be stressful, and high debt levels will exacerbate this. Small properties (4-10ha): Rules apply from 2022. These properties will require resource consents, unless low intensity land use. • Around 13 percent of these properties are GST registered and very few are benchmarked, suggesting a small number of landowners are running a business on their property which may be impacted by the rules. As properties become smaller, it is less likely that the income from the property forms the only or main source of household income.[143] • Livestock restrictions will impact properties if they are currently above the limits set in the rules. Small properties (<4ha): Rules apply from 2022. No livestock restrictions, but must not crop or cultivate. • Very few of the properties in this group are GST-registered or benchmarked, suggesting that there is little business activity attached to these properties (Table17). The lack of livestock restrictions suggest that little change will be required for most of these properties.[144]

[143] Land Connect Ltd (2015).
[144] Statistics New Zealand. Agricultural Production Census 2012. Registration is compulsory for businesses with turnover of >$60,000, below that registration is voluntary.

Table 19 GST-registered farm businesses by farm type and land size.[145]

Farm type	< 4ha	4 - 9 ha	10 - 19 ha	20 - 40 ha	Total
Dairy	0	3	0	0	3
Deer	0	0	3	0	3
Sheep and beef	6	21	18	30	75
Other livestock	6	6	3	0	15
Other agricultural activity	12	9	9	6	36
Total GST	24	33	39	36	132
Total small blocks[VR]	1,045	265	102	72	1,484
% GST registered	**2%**	**12%**	**38%**	**50%**	**9%**
% benchmarked	**23 (2%)**	**20 (20%)**		**31 (42%)**	**74 (5%)**

Amenity values: This Plan Change will result in changes in the local landscape which may impact negatively on amenity values.[146] Shifts to lower intensity land use include dairy to drystock, dairy to forestry, drystock to forestry, and changes to other low nitrogen land uses. Exotic forest for harvest currently makes up around 8,900ha of the 46,000ha catchment (excluding the lake of 8,000 ha). Land use change under the sector range allocation scenario could result in an additional 2,000-6,000ha of plantation forestry.

Cultural costs

Sections 6 and 8 of the RMA provide for the relationship of Māori with their ancestral lands and the principles of the Treaty of Waitangi. Development of Māori Land blocks (and other undeveloped land blocks) has already been restricted as a result of Rule 11, which has been in place since 2005. In relation to the Integrated Framework:

- Intensified land blocks (e.g. dairy farming) will need to meet their Nitrogen Discharge Allowance by 2032 in accordance with the staged reduction target dates;
- Owners of Māori land would experience reduced lease income as opposed to reduced economic returns.[147]

[145] LandConnect (2015).
[146] Report to Council Strategy, Policy and Planning Committee; 17 September 2013
[147] Nimmo Bell (2002)

- There is no significant change for undeveloped Māori Land in terms of the inability to intensify or change the use of land.
- Opportunities to sell land and utilise capital elsewhere are more limited for owners of Māori land since the land will not be sold. [148]

The integrated framework provides significant opportunities relative to a rules only approach, enabling exploration of innovative land use on Māori Land, supported by the gorse conversion and incentives programmes. This could include afforestation as well as growing hazelnuts, ginseng, truffles and mānuka (for honey).[149]

Preliminary investigations into differences in land use by ownership of land in the groundwater catchment show that more than half the Māori owned land is in pastoral farming, with Māori land more likely to be in drystock, less likely to be in dairy. Pastoral land use on Māori land is 40 percent, 9 percent and 6 percent in drystock, dairy and dairy support respectively. This compares with 30 percent, 12 percent and 6 percent of the balance of land.

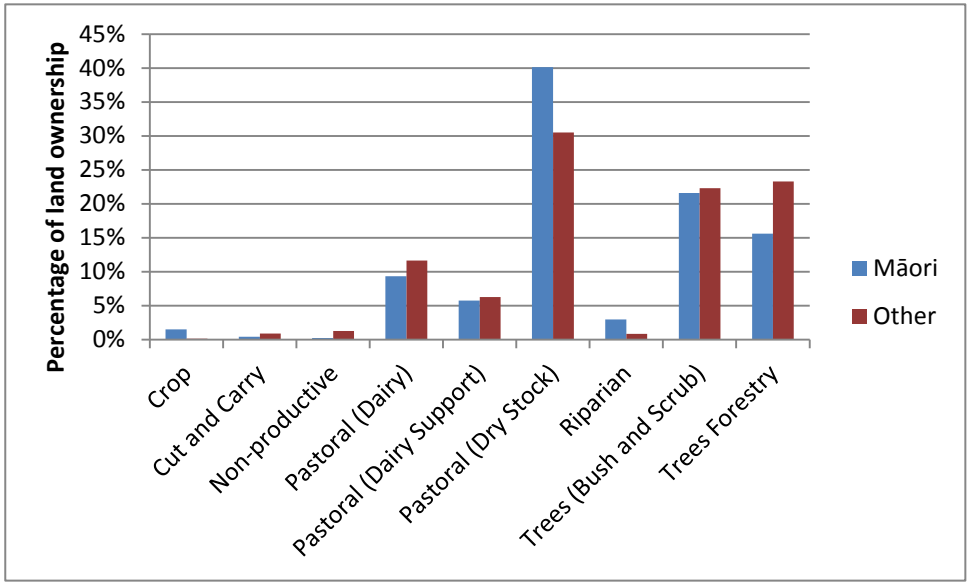


Figure 31 Land use by ownership, groundwater catchment.

[148] Nimmo Bell (2002)

[149] For example, in the Lake Taupō case (Variation 5, Waikato Regional Council), landowners were able to sell allowances to the Lake Taupō Protection Trust, which then funded new projects such as conversion to forestry (Barns and Young, 2013).

Environmental costs	Sediment and phosphorus issues may arise with additional production forestry in the catchment. The long implementation period for this policy delays the results in terms of improved water quality. Even if a step-change of land use occurred (2015), the change in water quality would not be seen for about 35 years. This is due to the time required for nitrogen stored in the soil to be depleted following land use change.[150] This approach is in keeping with the timing stipulated in the Regional Policy Statement.
Economic costs	<u>Large properties (>40ha) and smaller properties where the farm is the main source of income</u> Farm level impacts have been investigated throughout the policy process to develop an understanding of what mitigation options are available and what the policy is likely to cost farmers. Management options available to farmers to reduce nitrogen discharges include wintering off livestock, lower nitrogen fertiliser use, standoff pads, lower stocking rates, replacing nitrogen fertiliser with low nitrogen feed, partial or full changes in stock class, ceasing cropping and increasing effluent storage.[151, 152] While there is evidence of 'win-win' situations where a farmer can reduce nitrogen and increase profitability[153], catchment modelling has shown that costs will vary significantly by farming sector and by farm characteristics such as soil type and rainfall, with important implications for the distribution impacts of the policy.[154] The financial implications of meeting the nitrogen reduction targets will vary at the individual farm level and will require more than best practice.[155] A case study analysis[156] of pastoral farms in the Lake Rotorua catchment found: • Factors that will be important to achieving the on-farm nitrogen reduction targets are geophysical characteristics of the farm (e.g. soil type, rainfall levels), historic nitrogen use, farmer preferences and farmer management ability • Some farms will be able to reduce nitrogen discharges and maintain, or even improve profitability through management changes in their current farming systems. Of the case study farms, half the dairy farms (3 of 6) and two-thirds of the drystock farms (4 of 6) were able to achieve their provisional NDAs • Dairy farms may face greater challenges than drystock farms • Changes in input and output prices change the costs for farmers in reaching the provisional NDA. For example, as milk solids prices fall, the lost income from reducing nitrogen becomes less.

[150] NIWA (2011a, p.5).
[151] Kingi et al. (2012).
[152] Perrin Ag (2012)
[153] Kingi et al. (2012)
[154] Parsons et al. (2015).
[155] Perrin Ag (2014).
[156] Perrin Ag (2016). This analysis updated a 2014 analysis that examined 14 case study farms ((6 dairy; 8 drystock) to determine the extent to which these farms could reduce nitrogen discharges and retain profitable. The requirement was to stay within the current farming system. The analysis was repeated in 2015/16 using OVERSEER® 6.2, and using provisional Nitrogen Discharge Allowances for the case study farms, obtained from BOPRC.

	• Farmers will need to change their farming practices, and in some cases upskill, for example in grass management • Balance sheet commitments will influence how important the reductions in profitability are for individual farmers • On-farm changes that reduce the inefficient cycling of nitrogen are required. In summary, this analysis found that some strategies can result in an improvement in financial performance. Farms with lower levels of productivity have the greatest capacity to reduce nitrogen losses while maintaining or increasing profitability, but there will be negative impacts on the EBIT for most farmers. For many farmers, achieving their nitrogen discharge allowance will mean up-skilling. The financial impact for farmers will be influenced by product and input prices, and balance sheet commitments. The case study findings (above) are generally supported by catchment economic modelling results.[157] Catchment modelling suggests that *on average*, 'profit increases in all land-uses in all scenarios, with the exception of profit on sheep and dairy support with optimal land use', thus demonstrating 'the existence of some cost-effective mitigation options and win-win strategies, coupled with the opportunity to sell [nitrogen discharge allowances] to the incentives fund.'[158] This positive result is based on the average per hectare income shifting upwards as a result of businesses on marginal land changing land use; the results conceal the variation of impacts on individual farms related to farm characteristics such as soil type and rainfall. Investigating the economic impact of the rules for farmers and the catchment has included modelling the sector impacts of a range of allocation options on farming situations and mitigation options.[159] The modelling used four different land use change/trading efficiency scenarios. In the situation where land use change was restricted to 5,000 hectares and trading was assumed to be efficient, the per hectare profit increases for all sectors. The biggest percentage and absolute increases were in forestry and dairy support under all allocation scenarios. This occurs largely as a result of pastoral farmers moving into these sectors and selling saleable assets such as Fonterra shares, livestock and nitrogen discharge allowances. The income from sale of these assets is annualised in the model. In the modelling, the trading efficiencies described above were applied evenly to both the Incentives Board nitrogen allowance purchases and farmer-to-farmer trading. Critiques of the modelling suggested that farmer-to-farmer trading would likely be less efficient than 50 percent, and Council considers that the Incentives Board is likely to be effective in achieving their target 100 tonnes. Further modelling was undertaken using a range of efficiency scenarios where the Incentives Board was highly efficient and farmer-to-farmer trading was relatively inefficient. The results of these additional scenarios were consistent with the 50 percent overall efficiency scenarios in magnitude and direction of effects for land use change, per hectare profitability and production from catchment.[160] The increased profitability per hectare for those remaining in dairy and sheep and beef farming is relatively small, and reflects the shift of less profitable farming units to other land uses, lifting the average profit per hectare of those remaining.

[157] Parsons et al. (2015).
[158] Parsons et al. (2015, p.54).
[159] More of the results on the allocation options in Section 10.2.
[160] Summary report of spreadsheets stored in Objective File A2281571. Also refer to Tables 9 and 10 in this report for comparison of results for these measures.

Under the sector range allocation, with 50 percent efficient trading, the modelling suggests that the existing dairy area reduces by 2,140 hectares (43%), dairy support remains the same, sheep and beef increases by 450 hectares (7%), sheep and dairy reduces by 1930 hectares (64%), and forestry increases by 3,620 hectares (51%) (Figure 32). The forestry is made up of forestry conversions and changes within existing pastoral farms – for example, conversions of less productive areas such as steep faces.

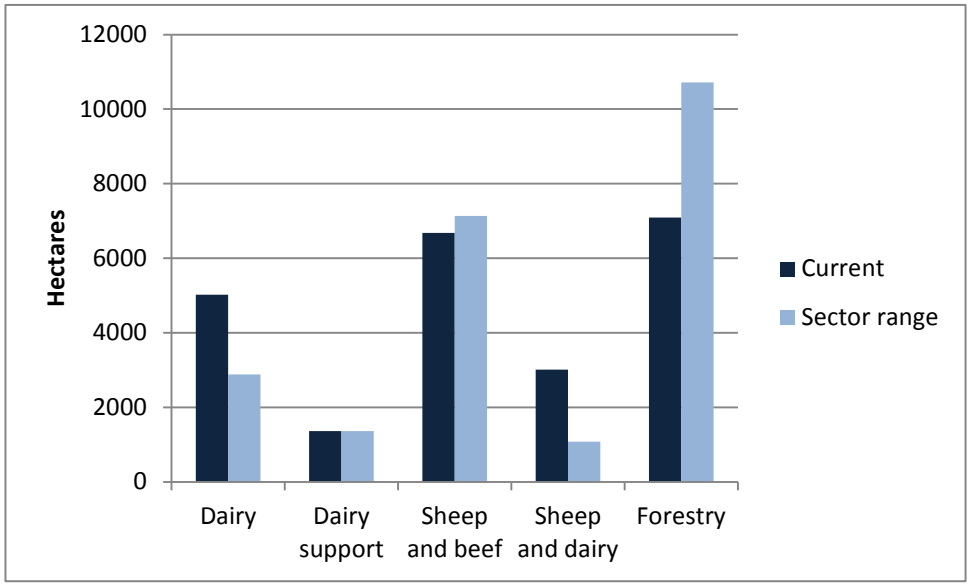


Figure 32 Changes in land use (sector range, 50% trading efficient trading)

Changes in land use bring changes in production. Accordingly production in milk solids falls by 39 percent under the sector range scenario, beef production by 8 percent, and wool and sheep meat by five percent (Figure 33).

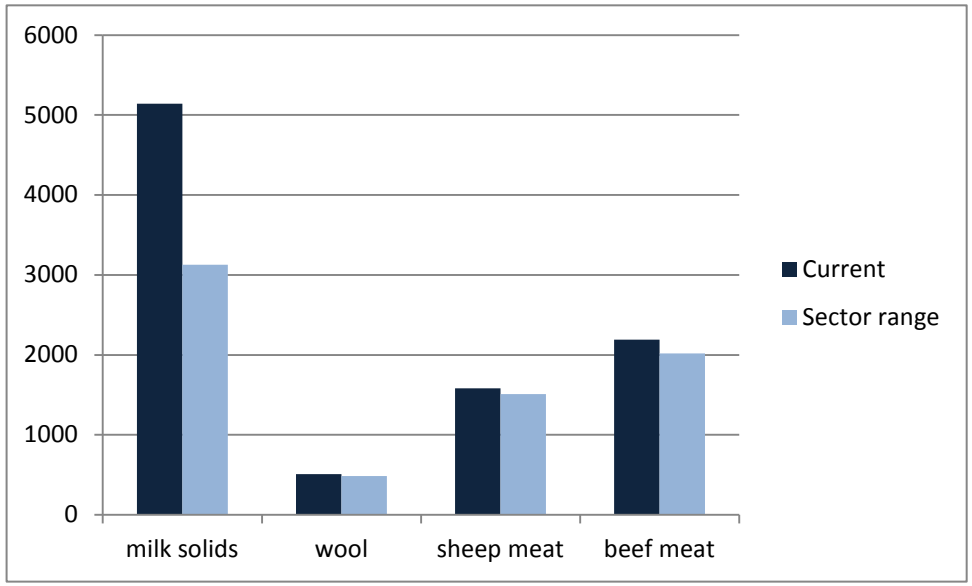


Figure 33 Production changes on dairy and drystock farms

Modelled examples of farmer responses to rules[161]

The potential outcomes for individual farms are described in the catchment modelling report. In the following example, the sector range allocation shows the possible decision making on a farm where a comparatively low profit per hectare relative to the amount of nitrogen leached. The example result is based on the modelling scenario of a 5000ha land use change constraint and frictionless trading. In this situation, a farmer's best economic option is to change land use and sell of nitrogen discharge allowances:

Farm 1: Land use change decision-making on a dairy farm on pumice soil in a high rainfall zone

- *Current leaching and EBIT: 84kg nitrogen/ha/year, making $934/ha/year EBIT.*
- *Allocation: 53kg nitrogen/ha/year*
- *Mitigation: This farm type can mitigate to 73kg nitrogen/ha/year, making $812/ha/year EBIT. This is 20kg nitrogen/ha/yr above allocation.*

[161] These examples from Parsons et al. (2015). These are subject to assumptions used in the modelling and the limitations of modelling.

- *Option 1: Buy nitrogen discharge allowances*
  - *The farmer would have to purchase 20kg nitrogen/ha/year at a total cost of $118/ha/year (annualised price of $5.91/kg/year). This leaves a residual profit of $694/ha/yr.*
- *Option 2: Land use change*
  - *In this case, a specialist dairy support operation on the same land could earn $954/ha/year, leaching 36kgN/ha/yr.*
  - *This land-use change would enable the sale of 17kg nitrogen/ha/year ($100ha/year).*
  - *This land use yields a residual profit of $1054/ha/yr.*
  - *This would be in addition to one-off transition benefits of $12,949/ha.*

In an unconstrained environment for nitrogen, the land-use change from dairy to dairy support would be unlikely due to the similar profit levels and sunk cost in infrastructure. However, with the introduction of the opportunity to sell nitrogen discharge allowances, this land-use change becomes significantly more attractive.

Again in the sector range allocation scenario, a second dairy farm example illustrates that the diversity of farm characteristics (e.g. soil, rainfall) suggests farmers will take different paths when responding to nitrogen restrictions under the rules. In the following situation the best option for the farmer is to purchase additional nitrogen discharge allowances:

Farm 2: Decision-making on a dairy farm on a podzol soil

- *Current leaching and EBIT: 70kg nitrogen/ha/year, making $2011/ha/year EBIT.*
- *Allocation: 44kg/nitrogen/ha/year*
- *Mitigation: It is only economic for this farm to mitigate to 65kg/nitrogen/ha/year. Beyond this it will cost more to reduce nitrogen than to buy additional nitrogen discharge allowances.*
- *Best option: Buy nitrogen discharge allowances to stay viable*
  - *Under a sector range allocation this would cost $84/ha/year ($5.91 annualised). This results in a 4% loss in EBIT*
  - *Under a natural capital allocation this would cost $257/ha/yr, resulting in a 13% loss of EBIT.*

The residual profit is highly-sensitive to the allocation method.

In a third dairy farm example, several mitigation options are explored:

Farm 3: Decision-making on a dairy farm on a podzol soil

- *Current leaching and EBIT: 29kg nitrogen/ha/year, making $813/ha/year EBIT.*
- *Allocation: 19kg/nitrogen/ha/year*

	• *Mitigation:* • *Option 1: Remove nitrogen fertiliser.* ► *Cost $20/ha/year to reduce leaching to 22kg/nitrogen/ha/yr. This is a likely option because it produces a cost effective reduction of nitrogen discharges.* • *Option 2: Remove calf grazing.* ► *This could increase profit by $22/ha/year and reduce nitrogen discharges by 20kg/ha/year. This is a favourable option because it provides a potential increase in profit (a win-win option).* • *Option 3: Remove winter cows.* ► *This would cost $379/ha/year to reduce nitrogen discharges to 18kg/ha/year. This option is not cost effective.* • *Option 4: Buy nitrogen discharge allowances.* ► *At a cost of $5.91/ha/year to increase allocation to 20kg/ha/year. This option is highly cost effective.* *The best options are to remove nitrogen use and calf grazing, and to buy nitrogen allowances in order to maintain the cow wintering component of the business. The final outcome is a net profit of $809/ha/yr (0.5% less than current EBIT), with leaching of 20kg/ha/year.* <u>Impacts on the wider economy</u>: Agriculture, forestry and tourism are the mainstays of the Rotorua economy. In 2012, the district GDP was NZ$2,002m. Tourism was the biggest contributor at $210m (10.5 percent). Forestry and logging was the second largest contributor in 2012 at $153m (7.6 percent), wood product manufacturing $66m (3.3 percent), dairy cattle farming $124m (6.2 percent), Sheep and beef cattle is a modest contributor at around $17m (less than 1 percent).[162] The Rotorua District dairy herd comprises 170,432 dairy cattle. Twelve percent of these are in the Lake Rotorua catchment. Around one-third of the District beef and sheep are in the catchment, and 16 percent of the district's deer herd.

[162] Infometrics (2012).

Table 20 Total livestock in Lake Rotorua catchment and Rotorua district.[163]

	Dairy cattle	Beef cattle	Sheep	Deer
Lake Rotorua catchment	20,296	11,022	45,728	4,044
Rotorua District	170,432	34,721	168,632	25,381
Catchment as a percentage of district	12%	32%	27%	16%

In terms of farms, the dairy farms in the catchment are a similar percentage to the dairy cattle. The percentage of drystock farms in the catchment is higher than might be expected when looking at the percentage of animals, but this is likely to be due to the large number of small properties (<40ha). Of the 4,076 effective hectares in small properties, 3,729ha (91%) is used for drystock, versus 29 ha (<1%) used for dairy farming.[164]

Table 21 Total farms in Lake Rotorua catchment and Rotorua district.[165]

	Dairy	Beef and sheep	Deer
Lake Rotorua catchment	33	114	9
Rotorua District	303	267	33
Catchment as a percentage of district	11%	43%	27%

An investigation into the impacts of this policy on the Rotorua district, Bay of Plenty region and New Zealand economies showed that at the macroeconomic level, the major impacts are to dairy farming (negative), sheep and beef farming (negative), forestry (positive) and wood and wood product manufacturing (positive). Where trading is not fully efficient, the allocation methods closest to the status quo have lower economic impacts. For example, with 50% efficient trading and optimal land use change, the cost to dairy farming in the district is $51m, where under natural capital the cost is $84m, and under a single target for each sector the cost is $61m. However, job losses are lower in a less efficient market.

[163] Statistics New Zealand. 2012 Agricultural Production Census.
[164] Landconnect (2015).
[165] Statistics New Zealand. 2012 Agricultural Production Census.

	The modelled indicates:[166] • Under optimal land use/50 percent trading efficiency, the value added loss (loss to GDP) is $14.4m nationally, which includes $4.3m to the Bay of Plenty economy, and $3.5m in the Rotorua District economy. Most of the loss ($3.2m) is within the Lake Rotorua catchment. For Bay of Plenty, the $3.4m represents 0.03 percent of the $11b GDP in 2014. For Rotorua District, the $2.5m is 0.1 percent of district GDP.[167] • Employment impacts tend to be concentrated in the Lake Rotorua catchment. In this analysis jobs are either full or part-time, and include working proprietors. Under optimal land use/50 percent trading efficiency, around 76 jobs are lost in the district. This increases to 178 at the national level. • Employment is more affected where the market is more efficient and where allocation scenarios are closer to the status quo. • The biggest part of the economic impact is felt outside the Rotorua District. There are three main reasons for this: (1) the regional and national funding of the incentives scheme creates a net flow of funds into the district and catchment, (2) most product processing occurs outside the district, and (3) a high proportion of the indirect effects from changes in the agricultural systems impact on businesses outside the district (e.g. transport, fertiliser products, machinery). Increases in water quality may be associated with increases in tourism income, and conversely declining water quality may lead to a lower income from tourism. A 1 percent change in tourism income for the Rotorua district equates to $1.4m in local GDP and 34 local jobs. If that change was 3%, the change in the district economy would be around $4.2m, and 101 local jobs.

[166] Market Economics Limited was commissioned by the Bay of Plenty Regional Council as part of a wider programme of work evaluating the economic effects of alternative nitrogen discharge allowance allocation scenarios.
[167] Contrast these figures with similar modelling done in 2011 (Market Economics Limited), where the impact on the regional economy was expected to be 0.1 – 0.2 percent, with a loss of around 180-250 jobs. This earlier modelling did not include the incentives funding.

Under a 'sector average with ranges' allocation scenario, the projected impacts under different assumptions about land use change and market efficiency are[168]:

Table 22 Projected financial impacts under various efficiency and land use assumptions.

	Pastoral farming, forestry and flow on impacts $m			Tourism impacts for 1%-3% increase in district tourism $m	
	District	Regional	National	District	National
Optimum land use change, 100% efficient trading	-2.5	-3.4	-12.9	+1.4 to 4.2	+2.2 to 6.7
Land use change restricted to 5000ha, 100% efficient trading	-3.7	-4.8	-16.7		
Optimum land use change, 50% efficient trading	-3.5	-4.3	-14.4		
Land use change restricted to 5000ha, 50% efficient trading[169]	-2.0	-2.5	-9.2		

The changes seen in income at the local and national level will also impact on the number of jobs in the Rotorua district, the Bay of Plenty Region, and nationally. These jobs affected are those in the pastoral farming and forestry sectors, and also in the sectors supplying goods and services to the farming and forestry sectors, such as transport and fertiliser suppliers. Under the 'sector average with ranges' allocation method, the projected number of jobs affected are:

[168] Market Economics (2015)

[169] The modelling suggests that under a land use restriction and 50% efficient trading the incentives fund would not achieve the 100 tonne reduction required. Because of this the GDP impacts and job losses are less than they would otherwise be.

Table 23 – Projected impacts on jobs under various efficiency and land use assumptions

	Pastoral farming, forestry and flow on impacts (MEC)			Tourism impacts for 1%-3% increase in district tourism (MEC)	
	District	**Regional**	**National**	**District**	**National**
Optimum land use change, 100% efficient trading	-89	-97	-192	+34 to 101	+43 to 128
Land use change restricted to 5000ha, 100% efficient trading	-91	-102	-219		
Optimum land use change, 50% efficient trading	-76	-83	-178		
Land use change restricted to 5000ha, 50% efficient trading	-45	-50	-109		

These results come about through:

- Changes to pastoral farming systems resulting in changes in the purchase patterns of dairy and drystock farms, and reduction in the outputs generated by farms. These changes impact on upstream suppliers (e.g. fertilizer manufacturers) and downstream processors (e.g. dairy product manufacturers).
- Reductions in the land used for pastoral farming, again impacting on upstream suppliers and downstream processors.
- Reductions in incomes for pastoral farming income impacting household expenditure patterns.
- Increased demand for farm advice
- Conversion of land to forestry, generating greater demand for forestry suppliers and greater output by downstream processors (e.g. Wood product manufacturing).
- Potential to avoid losses in tourism income through water quality in Lake Rotorua

	The changes in GDP (described above) are brought about by land use change and land management change at the farm level. Reducing nitrogen discharges will generally be easier and cheaper where it can be achieved by farm management changes rather than land use change.[170] Actions to reach nitrogen discharge targets will differ for individual farms. For example, soil type will influence ability to meet targets, and meeting targets is likely to be a particular challenge for farmers who were at low discharge levels prior to benchmarking. The changes required by the rules will have a wide range of financial implications. The lengthy implementation period (2017 to 2032) will allow time for investigating new opportunities. Establishing a trading market will help to reduce the overall costs and provide benefits to some farmers. The efficiency of trading will determine in part the size of the costs and benefits to sectors and the community. Tourism is a large component of the Rotorua District economy. This, plus the low proportion of the district's dairy farms in the catchment (Tables 45 & 46), and the low level of dairy processing in the district suggest that changes that impact on dairy farming in the catchment are unlikely to have a major impact on the district economy. This is borne out in the modelling results. <u>Property values:</u> Property values in the Lake Rotorua catchment will be negatively impacted relative to properties outside the catchment and not affected by nitrogen-related rules, where the property's nitrogen discharge allowance is below its highest and best use. An study of the impact on land values in the catchment advised that:[171] • Taking into account differentials in contour, size and productive capacity, the rules restricting nitrogen use will have an estimated negative value impact of 10-20% on properties in the catchment • The characteristics of the land will influence the value loss. For example, steeper land that is unsuitable for dairy will be less affected than land that could have been converted • Dairy farms have experienced a 10-15% decline in value because of the expected reduction in nitrogen discharge allowances below the Rule 11 benchmark. The allocation method will be a factor in determining the extent of the value decline • Farms closer to the lake and able to be subdivided are likely to be less impacted than those without subdivision potential • Lifestyle blocks are less impacted where their commercial potential is reduced by allocation. This may be in the region of 10%-25% • Smaller lifestyle blocks are less impacted than larger. The extent of the impact depends on the economic potential of the property (in terms of nitrogen leaching activities).

[170] Report to Council, September 2013.
[171] Telfer Young (2014). These reductions in property values are in addition to those experienced as a result of Rule 11.

Journeaux (2015) contends that land value is made up of productive, speculative and consumptive components, and the Lake Rotorua rules will impact on the productive value to the degree that the nitrogen limit stops farms producing at their capacity. Speculative value will also be impacted where a property cannot be used for its highest and best use. However, Journeaux also refers to consumptive values as appearing to have a significant effect on land values, difficult to quantify due to variability and individuality of impact. Consumptive value includes amenity factors such as scenery, amenity, and undoubtedly the extent that people who live at or visit the lake value the beauty and health of the lake and the absence of algal blooms.

Fiscal costs

Incentives fund:

The Incentives Scheme comprises a fund under the Regional Council's Ten Year Plan 2012-2022 to fund a $40m nutrient reduction and $5.5m in advice and support to farmers This funding represents the community share of the nitrogen discharge reduction, reducing the costs to farmers of 'rules alone' approach. The $40m incentives fund is made up of $20m from Central Government and $20m from Regional Council, made up of contributions from regional and Rotorua ratepayers. The agreement between the funding partners is that the 100t purchase will be achieved by 2022. Establishing and administering the sub-committee that manages the Incentives Fund is a cost to Council until 2022.

Table 24 Share of costs between Central Government and Council.

	Central Government	Council
Incentives Scheme	$20m	$20m
Advice and Support	$1.1m	$1.1m
Research	$1.65m	$1.65m

The $5.5m advice and support funding is available from the funding partners to provide advice and support for farmers looking to make changes to their current system, or to make land use changes.

Gorse conversion fund:

For gorse conversion to forestry, the average cost is estimated at $3,000/ha.

Policy development costs

Policy development costs

	Policy development costs rise once formally notified[172]. Although draft rules have been developed collaboratively with StAG, the rules impact on farmer livelihoods and history suggests reasonable likelihood of submissions and appeals to the Environment Court. Council needs to be aware of possible costs[173] and delays resulting from Environment Court proceedings.[174] **Costs to landowners in the catchment[175]** In the short term the compliance costs to landowners will be their contribution of time to setting up their nitrogen management plans (with the farm advisors), and their resource consenting costs.[176] Until 2022, these costs accrue only to landowners with 40+ hectares. Those landowners with low nitrogen activities (e.g. forestry) are also excluded. In 2022, Nitrogen Management Plans will require updating. At that time the costs of farm advisors, should they be required, will be a landowner cost. Similarly in 2027, nitrogen management plans will require updating. These processes should be substantially less than the initial process. In 2022 small properties (<40ha) that are not covered by the permitted activity rule will come into the rules framework. Advice and support funding will be available to owners of small properties. The costs include the landowner's time in developing Nitrogen Management Plans and costs associated with applying for a resource consent. Nitrogen Management Plans will require updating in 2027. Business activities are likely to be the main driver for small properties (<40ha) to apply for a resource consent. Using GST registrations as an indicator, 132 properties would apply for consents. If benchmarking was the indicator, that number may be as low as 74. **Total costs** The individual costs of the aspects described above are shown in Table 1. Costs are recorded as at 2017 when the policy is implemented.[177] To aid comparison over time, these costs have been annualised at the base of this table. The annualised cost over a 20 year period (life of a resource consent) for the Council is $604,580 per year. On a per household basis across the region, the annualised cost to $5.91. For properties greater than 40 hectares the annualised cost is $498, and for properties of less than 40 hectares $400. Refer Appendix 10 for more detail on the individual costs, descriptions and assumptions.

[172] Development of the Regional Policy Statement cost $563,538.14 for 2009/10, $591,517.48 for 2010/11 and $711,748.44 for 2011/12. Whilst the Regional Policy Statement is a planning document for the entire region, new rules to manage nitrogen loss in the Lake Rotorua catchment are likely to be challenged at every step.
[173] In 2011, Environment Waikato staff advised the development of rules to cap nutrient discharges and associated consultation and negotiation cost them between $700,000 and $1,000,000 per year (over 5-6 years) In a report to Strategy Policy and Planning in 2011, *Developing Rules to Manage Nutrient Discharges to the Rotorua Te Arawa Lakes - Timing and Costs*, staff estimated similar costs in the appeals period. These costs are likely to have risen since then.
[174] Report to Council June 2014.
[175] Does not include costs to farmers of undertaking activities to reduce nitrogen.
[176] Time based on 2014-15 farm management labour costs of a herd of 300 cows plus the basic salary rate. This equates to $55,500. See http://www.dairynz.co.nz/media/2840751/Operating_Profit_Adjustments.pdf
[177] To keep the analysis relatively simple 2017 has been used as the starting date for all costs. This approach ignores the time value of payments prior to that date, such as the Council staff role to manage and advice and support which started in 2015. The effect of this is relatively minor.

Appendix 5 - Evaluation table: Rules only

Note on evaluation of the rules only: The 'rules only' approach is essentially the same as the rules section of the integrated framework, with the exclusion of the community assistance in the form of the incentives fund and the gorse fund. For the purposes of the rules only evaluation, key points are summarised and areas of difference are identified.

BENEFITS

	Evaluation
Social benefits	Vision and Strategy for the Lakes of the Rotorua District: Like the integrated framework, the rules only approach is aligned environmentally with the Vision and Strategy, however, it appears to fall short on social and economic aspirations (refer social costs). The community benefits related to safe enjoyment of activities including boating, swimming, waka ama, and harvesting food remain. Good water quality contributes positively to domestic and international tourism, including jobs in the tourism and associated sectors. Future generations will not have to address the issue of unsustainable load of nitrogen entering the lake, or address any legacy issues associated with long-term alum dosing.
Cultural benefits	The rules only approach is designed to meet the requirements for a sustainable load of nitrogen in the Lake, as defined in the RPS. This is aligned with the goals identified in the Vision and Strategy for the Lakes of the Rotorua District. One of the goals of the Vision and Strategy is a health food basket. The Rotorua Lakes, including Lake Rotorua, are an important and traditional source of kai. Some species such as Koura are at risk from declining lake water quality – due to eutrophication and invasive weeds. Reduction of nitrogen will contribute to achieving a healthy food basket. Alum dosing has been identified by the Te Arawa Lakes Trust as *'not an ongoing intervention in perpetuity…with so many unknowns around the cumulative effects of alum on our taonga species and trout…'* [178] Reducing the nitrogen entering the lake provides a permanent solution with the benefit of stopping nitrogen at its source.
Environmental benefits	The National Policy Statement for Freshwater identifies ecosystem health as a compulsory national value of freshwater. The ecosystem services provided by Lake Rotorua include nutrient processing, biodiversity, provision of food, science and education, and amenity and recreation. Deterioration of the lake reduces the value these ecosystem services provide.

[178] Te Arawa Lakes Trust website.

	A rules only approach expected to result in additional planting of exotic forest in the catchment. Planted forest ecosystem services include provisioning services of wood and fiber and biofuel, regulating carbon sequestration, avoided erosion, water quality, flood mitigation and biodiversity, and cultural services including recreation and native species conservation.[179] While alum dosing improves lake water quality by locking up phosphorus, limiting the availability of this nutrient and reducing the incidence of algal blooms. However, it does not stop high levels of nitrogen entering the lake and the cumulative effects of long-term dosing not well understood[180]. Alum dosing is considered a short term solution (refer 11.5).
Economic benefits	While this policy has a negative impact on GDP in relation to pastoral farming and supporting sectors, this is partially offset by increases in forestry in the Rotorua catchment, and the reduction of the risk to tourism that deteriorating water quality would bring. The long timeframe for achieving reductions (staged reductions to 2032) provides a period for investigating and establishing new ventures. Potential changes within the pastoral farming industry include production for niche markets, such as high quality beef from a sustainably managed catchment.[181] Other new commercial endeavours might include production of mānuka honey and mānuka oil, for example.[182] Increases in forestry area take advantage of existing competitive advantages that the Rotorua district has in this sector, for example existing infrastructure for processing. Opportunities exist to produce bioenergy from the non-utilised in-forest residues.[183] Forestry also has potential for other benefits related to recreation and tourism, for example, Whakarewarewa forest mountain biking and walking recreation activities.

COSTS

	Evaluation
Social costs	The Vision and Strategy for the Lakes of the Rotorua District: Like the integrated framework, the rules only approach is aligned environmentally with the Vision and Strategy, however, arguably falls short on social and economic aspirations. The Vision is for communities working together to address is water quality issue (he tāngata – the people together), and maintaining prosperity by balancing conflicting aspirations, economic development alongside enhanced lakes, and sustaining industry. In these aspects, the rules only approach impacts largely on farmers and farming communities.

[179] Yao et al (2013).
[180] Mackay et al (2014).
[181] For example Taupō Beef http://www.nzfeatrust.org.nz/vdb/document/269
[182] Grow Rotorua (2014).
[183] Yao et al (2013)

Evaluation	
	Social disruption: These are likely to impact on the social wellbeing of the farming community. Under this approach there is no support from the wider community in terms of reducing nitrogen discharges (e.g. through incentives or other funding). This approach puts a high level of reliance on the pastoral farming sector to be willing to make reductions.[184] The level of nitrogen discharge reduction required will cause stress for farming families and the farming community in the Lake Rotorua catchment. An approach that involves a single sector (agriculture) bearing the cost, when all benefit from the production of the agricultural sector may be seen as unreasonable to farmers, and threaten the social wellness of the wider community. This policy will encourage changes in land use which will change the landscape and may impact negatively on amenity values.[185] Land use change to achieve nitrogen discharge reductions could be from dairy to drystock, dairy to forestry, drystock to forestry, and changes to other low nitrogen land uses. Exotic forest for harvest currently makes up around 8,900 hectares of the 46,000 hectare catchment (excluding the lake of 8,000 ha). While the policy has a staged implementation period, the large reductions required will reduce the range of options open to farmers. A shift towards more plantation forestry would be expected with this policy.
Cultural costs	Sections 6 and 8 of the RMA provide for the relationship of Māori with their ancestral lands and the principles of the Treaty of Waitangi. Development of Māori Land blocks (and other undeveloped land blocks) has already been restricted as a result of Rule 11, which has been in place since 2005. In relation to the Integrated Framework: • Intensified land blocks (e.g. dairy farming) will need to meet their Nitrogen Discharge Allowance by 2032 in accordance with the staged reduction target dates; • Owners of Māori Land would experience reduced lease income as opposed to reduced economic returns.[186] • There is no significant change for undeveloped Māori Land in terms of the inability to intensify or change the use of land. • Opportunities to sell land and utilise capital elsewhere are more limited for owners of Māori land since the land will not be sold. [187]
Environmental costs	The long timeframe over which this policy is introduced will delay the results in terms of improved water quality. This is due to the time required for nitrogen stored in the soil to be depleted following land use change[188] Increased forestry in the catchment could increase sediment into the lake at harvest time. This potential impact could be managed through appropriate policy.

[184] Beca (2011)
[185] Report to Council, September 2013
[186] Nimmo Bell (2002)
[187] Nimmo Bell (2002)
[188] NIWA (2011, p.5.)

Evaluation	
Economic costs	Impacts on farmers: Farm level impacts have been investigated using case study approaches and modelling.[189] All have confirmed that the costs to farmers will be significant, and in general more than can be achieved by best practice. This is particularly so in a 'rules only' approach. For example, in a 2012 study, using a sample of 12 farms in the catchment, the studied farms were able to reduce 62.3t of nitrogen at an average economic impact of $559/kgN. Land management change from this group was achieved at an average cost of $171kgN, while land use change proved much more expensive at average $960/kgN. The costs for nitrogen reductions differed between farm types. In the costs for land management change, dairy farmers achieved 71 percent of the reductions and 94 percent of the economic impact. When extrapolated to the catchment, the reductions modelled in this research reduced the annual load of N from the dairy and sheep and beef sectors to the sustainable limit of 281t, and the cost of these reductions at $88.1m in EBIT.[190] Under a rules only approach, management options available to farmers remain the same, and include wintering off livestock, lower nitrogen fertiliser use, standoff pads, lower stocking rates, replacing nitrogen fertiliser with low nitrogen feed, partial or full changes in stock class, ceasing cropping and increasing effluent storage.[191] However, the size of the reduction required is more likely to take farmers into the land use change space than an approach that includes sharing the cost with the community, and the voluntary sale of nitrogen discharge allowances that is part of that approach. Further, the requirement for a 70 percent reduction in the 2017-2022 period would push farmers into early decisions – more time potentially provides more options. The case studies and modelling show that for some farmers there is potential for 'win-win' outcomes where a farmer can reduce nitrogen and increase profitability, but these opportunities will vary from farm to farm, and farm characteristics (soil type rainfall etc.) are likely to be factors determining whether and the degree to which opportunities exist.[192] Under the rules only approach farmers will be required to mitigate much further than under an approach where cost is shared with the community, so win-win opportunities could be expected to be less likely. <u>District and regional impacts</u> The regional impact of achieving the entire nitrogen discharge reduction required at the farm level was investigated in 2011.[193] The modelling suggested that the annual cost to the regional economy would be between 0.1 - 0.2 percent of regional GDP with the loss of an estimated 180 to 250 jobs depending on the time allowed for farmer adjustment to the nitrogen discharge allowances. Similar modelling undertaken in

[189] Including the Perrin Ag (2012), Perrin Ag (2014), Nimmo Bell (2011), Parsons et al (2015).
[190] Perrin Ag (2012)
[191] Kingi et al. (2012); Perrin Ag (2012)
[192] Kingi et al. (2012), Perrin Ag (2012), Parsons et al. (2015)
[193] Market Economics (2011)

Evaluation	
	2015 suggests that the introduction of the incentives scheme has a positive impact on these figures, reducing regional GDP impacts to around 0.03 percent, and halving job losses.[194] At the district and regional level, impacts on economic sectors are positive and negative and include: • Changes to pastoral farming systems resulting in changes in the purchase patterns of dairy and drystock farms, and reduction in the outputs generated by farms. These changes impact on upstream suppliers (e.g. fertiliser manufacturers) and downstream processors (e.g. dairy product manufacturers). • Reductions in the land used for pastoral farming, again impacting on upstream suppliers and downstream processors. • Reductions in incomes for pastoral farming income impacting household expenditure patterns. • Greater demands for farm advice • Conversion of land to forestry, generating greater demand for forestry suppliers and greater output by downstream processors (e.g. wood product manufacturing). The degree of reduction required at the farm level would make it difficult for farmers to remain farming, and would require wholesale shifts to low nitrogen land use. Forestry, and potentially lifestyle blocks with low nitrogen discharge activities are two options currently available. At the current rate of uptake of lifestyle blocks (nine new lifestyle blocks/year), the conversion modelled would supply new lifestyle blocks for 28 years.[195] This would place a high and probably unrealistic demand on farmers. Farmers will fact future costs related to obtaining resource consents, and monitoring and compliance. <u>Property values</u> Property values in the Lake Rotorua catchment will be impacted relative to those outside the catchment and not affected by nitrogen-related rules where the allocation of allocation of allowances is below that land's highest and best use. An estimation of impact on land values suggested that:[196] • Taking into account differentials in contour, size and productive capacity, it is estimated that the rules restricting nitrogen use will have a negative value impact of 10-20%.[197]

[194] Modelling in 2015 was undertaken by Market Economics Limited. The basis of the 2011 work differed from the 2015 work, importantly it did not include the positive impacts of incentives funding.
[195] Nimmo Bell (2011)
[196] Telfer Young (2014)
[197] Property prices having already experienced a decline in value of 10-20% with the introduction of Rule 11.

	Evaluation
	• Characteristics of the land will impact on value. For example, steeper land that is not suitable for dairy is less affected than land that could have been converted • Dairy farms have experienced a 10-15% decline in value because of reduction of allocation below Rule 11 benchmark. The extent of the decline will be determined by the allocation method. • Farms closer to the lake and able to be subdivided generally less impacted than those without subdivision potential. • Lifestyle blocks less impacted where their commercial potential is reduced by allocation. This may be in the region of 10%-25%. <u>Fiscal costs – costs to ratepayers</u> The fiscal costs of the rules only approach would be similar to those outlined in the integrated framework. Given that a rules only approach will require considerably more effort from farmers in reaching their nitrogen discharge allowance, monitoring and compliance costs may be higher in a rules only approach.

Appendix 6 - Evaluation table: Status quo (Rule 11)

BENEFITS

Evaluation	
Social costs	The current rules have increased community and landowner awareness of Lake Rotorua water quality issues. Retaining the status quo would allow farmers to continue with their current farming practices; however the current annual load of nitrogen discharges is well above the estimated sustainable load of 435 tonnes/annum required by the Regional Policy Statement. A 320 tonne reduction is required to meet the sustainable lake load.
Cultural costs	The Te Arawa people have expressed concern about the declining lake water quality.[198] The values and aspirations of Te Arawa are reflected in the Vision and Strategy for the Lakes of the Rotorua District.[199] Goals of the strategy are to improve water quality; reduce nutrient loss to water; create positive experiences for lake users; protect, restore and enhance the lake water quality; ensure the lakes catchment is a healthy food basket; and maintain healthy ecosystems. The lakes are a taonga of the Te Arawa people. These are not being addressed under the status quo approach.
Environmental costs	Rule 11 has restricted intensification of farming practices in the Lake Rotorua catchment through benchmarking farms based on annual average 2001-2004 nitrogen discharges and requiring that these do not increase. The effect of this has been to halt increases in the amount of nitrogen entering the lake from pastoral land.
Economic costs	Benchmarking of farms at annual average 2001-2004 nitrogen discharge levels limited the ability of farmers' to increase production and profitability to means that were achievable within allowable nitrogen discharge levels. If the Rule 11 remained, farming income would remain the relative within the catchment[200] all else being equal, but might fall in relation to farming incomes in areas outside the catchment where the ability to intensify is not restricted.

[198] Environmental Management Services Limited (2009)
[199] Vision and Strategy for the Lakes of the Rotorua District (2013)
[200] Daigneault and McDonald (2012).

COSTS

	Evaluation
Social costs	Human health for recreation is a compulsory national value for fresh water in the National Policy Statement for Freshwater Management.[201] Under this value there should be no more than a moderate risk of infection to people when engaging in frequent emersion activities such as swimming or water skiing, or in occasional immersion activities such as wading or boating. At a TLI of 4.2 Lake Rotorua is achieving its TLI target, but the success is due largely to alum dosing rather that a reduction of nutrients. Lake Rotorua is classified as eutrophic[202] because its natural waters are enriched with plant nutrients. The excessive nutrients in the lake create a risk of toxic algal blooms.[203] Social costs under the existing regime include reduction of amenity and recreation values as a result of reductions in water quality (in the absence of alum dosing). Algal blooms negatively impact the values people hold for Lake Rotorua. A 2004 willingness-to-pay survey of residents of the Rotorua district, the Bay of Plenty region, and anglers from Auckland confirmed that poor water quality results in fewer days spent on recreational activities on the lake. The survey results suggested people in these three groups were willing to pay on average $117/year, $15/year and $316/year respectively for improvements in water quality.[204],[205] Fishing values are at risk from eutrophication (TLI >4) which can result in deoxygenation, and directly affect the trout fishery. Studies show that the growth rate of trout is faster where habitat is favourable. That is, with dissolved oxygen .6.0mg/L^{-1} and temperatures less that 21^{o}C, and slower in lakes with increased turbidity, chlorophyll *a* and nitrogen concentrations. Benchmarking under Rule 11 was based on annual average 2001-2004 nitrogen discharges. Rule 11 creates inequity in the primary production development potential that is available for undeveloped or under-developed land compared with established intensively farmed properties.[206] Landowners who have developed the economic potential of their land (with consequent effects of nutrient export) are able to continue to enjoy that advantage, while those that have not are denied it. This may have had a disproportionate impact on multiple-owned Māori land, and on drystock farmers relative to dairy farmers. This is applicable only where the land is not being used to its full economic potential, and obviously not all land is fit for dairy farming, for example.[207] A rule change would bring the opportunity to reassess allocation in the context of the principles and considerations provided in the Bay of Plenty Regional Policy Statement.

[201] National Policy Statement for Freshwater Management 2014
[202] Bay of Plenty Regional Council (2011). 2010/2011 Rotorua Lakes Trophic Level Index Update.
[203] Gibbs and Hamilton (2009).
[204] Nimmo Bell (2004).
[205] These values have been converted to 2014 dollars using the Consumer Price Index (General).
[206] Environmental Management Services Ltd (2009)
[207] Park and MacCormick (2011).

Evaluation	
Cultural costs	Rule 11 constrains multiply-owned Māori ancestral land to the extent that it prevents reasonable use and development of land. Rule 11 does not 'credit' landowners of Māori Land for the extent to which a property has minimised the amount of nitrogen discharged. There is a question as to whether the rule framework properly recognises and provides for the relationship of Māori with their ancestral lands and properly applies the principles of the Treaty of Waitangi as required by sections 6 and 8 of the RMA. This is because Rule 11 prevents intensification of the land to the same level as other land in the catchment and thereby constrains future economic opportunities. [208] The Ōhau Channel diversion wall was constructed to prevent 180 tonnes of nitrogen and 15 tonnes of phosphorus entering Lake Rotoiti from Lake Rotorua, and diverting the nutrients into the Kaituna River. Iwi and hapū submitting on the Ōhau Channel diversion wall application (63209) expressed concerns about deteriorating water quality in the Kaituna River, the river as a major source of food, the mauri of Hinemoana, Tangaroa and the Awa of Ngatoroirangi. The submission asked that Lake Rotorua be cleaned up rather than diverted into the Kaituna River. The safe harvesting and eating of food gathered in freshwater is a national value in the NPS for Freshwater, as is the maintaining the mauri of the place. Alum dosing is part of the management of water quality under the status quo, reducing phosphorus loads into Lake Rotorua. Ngāti Rangiwewehi is clear in its position against the addition of heavy metals as a dosing or capping agent, and advocates for the use of alternative methods to improve water quality in the Rotorua Lakes.[209]

[208] Environmental Management Services Ltd (2009)
[209] Te Maru O Ngāti Rangwewehi Iwi Authority (2012)

Evaluation	
Environmental costs	The sustainable level of nitrogen entering Lake Rotorua is estimated to be 435 tonnes per annum. Achieving this required a reduction of 320 tonnes of nitrogen annually. The current rules were not designed to reduce nitrogen discharges below their current levels. The Bay of Plenty Regional Council has monitored water quality in Lake Rotorua since 1990. Quality is expressed as a Trophic Level Index (TLI). The 3-yearly average TLI for Lake Rotorua for the period 2007 to 2014 is:[210,211] *Table 25Historical 3-yearly average TLIs in Lake Rotorua* **Year** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **Target** **Rotorua TLI** | 4.9 | 4.8 | 4.7 | 4.7 | 4.6 | 4.4 | 4.2 | 4.2 | **4.2** Lake Rotorua has achieved the TLI target in 2013 and 2014. These levels were the best TLIs levels in Lake Rotorua since the 1990s. The improvement is attributed to alum dosing, in conjunction with favourable climate conditions and on-farm changes. Alum dosing limits the availability of phosphorus, and was started in 2006/07 in the Utuhina Stream. In 2010 dosing started in the Puarenga Stream. The two streams received around 1,600 tonnes of liquid aluminium sulphate in the year to June 2014. Alum dosing is not a permanent solution and its continuance relies on renewal of the resource consent in 2017. The beneficial effects of alum dosing would last around 2-3 years if dosing was stopped.[212] The health of New Zealand's ecosystems is increasingly recognised as important; the National Policy Statement for Freshwater identifies ecosystem health as a compulsory national value of freshwater. Ecosystem services provided by Lake Rotorua include nutrient processing, biodiversity, provision of food, science and education, and amenity and recreation. Deterioration of the lake reduces the value of these ecosystem services. For 2012, the total annual value of these ecosystem services was estimated to range from NZ$95-130million. Water quality deterioration resulting in a TLI of 4.8 could result in damage costs in the range of NZ$13-50m[213] (Mueller, pers comm)

[210] 2010/2011 Rotorua Lakes Trophic Level Index update. Bay of Plenty Regional Council Environmental Publication 2011/17 A trophic level index of 4-5 is poor water quality (eutrophic) and greater than 5 is very poor (supertrophic) www.rotorualakes.co.nz/vdb/document/139 Trophic Level Index Lake Facts, Rotorua Lakes. Fact sheet 3.
[211] Memorandum from P Scholes to A Bruere 1 August 2014. Subject: Rotorua Lakes 2013/14 TLI update. Objective file ref A1654375.
[212] Hamilton, McBride and Jones (2015).
[213] 2014NZ$

Evaluation	
Economic costs	Tourism is a mainstay in the Rotorua district economy, contributing just over 10 percent to the local economy annually.[214] In the year to July 2013 domestic and international visitors spent 925,000 and 826,000 visitor nights respectively in Rotorua. The number of domestic visitors to Rotorua is on a par with domestic visitor nights in Queenstown, and for international visitor nights Rotorua is New Zealand's the second highest tourist destination after Queenstown.[215] Lake Rotorua is an important feature of local tourist activities such as photography, paddle boarding, cruising and trout fishing. "While thermal attractions were the most significant attraction for visitors to the Rotorua district, domestic visitors were more attracted by the general activities and the natural environment of the area than they were by thermal attractions. Thermal attractions were, to some extent, primarily for international visitors. For over half of the visitors to Rotorua the most important natural attractions were those associated with the lakes." This was one of the findings of a 2000 study of Rotorua tourism.[216] This and the results of other studies regarding values for improvements in water quality[217] suggest that efforts to maintain and improve water quality are likely to yield economic returns. If water quality declined to TLI values such as those in the mid-2000s, then a negative impact on tourism income might be expected. A loss of 1-2 percent of tourism income in the Rotorua district is around $34-67m in district GDP, and $43-85m in the New Zealand economy.[218] Property owners in the vicinity of Lake Rotorua can be faced with moderate costs related to proximity to poor water quality. An analysis of 1100 property sales in the area around the Rotorua Lakes over a 5 year period showed a statistically significant relationship between water quality/clarity and house sale price. The study estimated that a one metre improvement in water clarity resulted in an average house sale price increase of 7 percent.[219] Pastoral and forestry properties in the Lake Rotorua are limited to annual average 2001-04 nitrogen discharge benchmarks and rights to discharge nitrogen have not been fully specified. Rights to discharge nitrogen under Rule 11 do not satisfy the requirements for an efficient trading market. Tradable rights would reduce the overall costs of achieving the sustainable nitrogen limit for Lake Rotorua by incentivising those farmers with lower costs of reduction to do so, and to sell the rights to those with higher costs.

[214] Infometrics (2013)
[215] Destination Rotorua Marketing (2013). Rotorua Tourism in Focus.
[216] Simmons and Fairweather (2000).
[217] Nimmo Bell (2011), Mwaro and Marsh (2012)
[218] Market Economics (2015). These figures include the backward linkages associated with the tourism sector.
[219] Woodham and Marsh (2011)

Evaluation	
	Under Rule 11, alum dosing is used as a means to managing water quality, ensuring that the lake reaches the target TLI (discussed above). In the year to March 2015 bulk deliveries of liquid aluminum sulfate cost ratepayers around $536,000. Continuing with the current approach imposes economic costs on future generations who will be faced with changing land use activities to stop nitrogen entering the lake, or continuing end-of-pipe style approaches such as alum dosing and weed harvesting, or continuing to live with a eutrophic lake and the environmental, social, cultural and economic costs that are part of that.

Table 26 Summary of evaluation of Rule 11 option

Effectiveness
The sustainable level of nitrogen entering Lake Rotorua is estimated to be 435 tonnes per annum to maintain the TLI of 4.2 in the absence of ongoing alum dosing. Rule 11 has halted intensification of pastoral farming and conversion of forestry to farming in the catchment, but it is not effective in achieving the 435t limit set in the RPS. Further, the allocation method does not meet the principles and considerations established in the RPS. The current approach will not be effective in achieving the objective of this policy.
Efficiency
Aside from not being effective in achieving the objective of this policy, Rule 11 is not efficient. The TLI set is the RPS is deemed to be the socially optimum limit based on consultation at that time, and the is to be achieved by reductions in nitrogen discharges, rather than the alum dosing that is currently undertaken.
Risk of acting or not acting if there is uncertain of insufficient information
As noted in the reports reviewed, the risk of not acting is too great on the Rotorua lake catchment environment and the scale of change is significant. It is considered that continuing to enforce Rule 11 is inconsistent with Part 2 of the RMA and Objective 11 and only provides for the short term gain rather than achieving the long-term change required to return the lake back to sustainable levels. Not acting would result in a conflict with Part 2 of the RMA, particularly “sustaining the potential of natural…resources; safeguarding the life supporting capacity of…water; …the preservation of the natural character of...wetlands, and lakes and rivers; and…intrinsic values of ecosystems”.

Appendix 7 - Description of Allocation Principles

In relation to Policy WL 5B (allocating the capacity to assimilate contaminants) of the RPS:

- **Equity/fairness, including intergenerational equity**

  An allocation process seeking an equitable and fair solution that recognises

  - history of the issue
  - contribution of different land uses to the economy
  - investment

  An equitable and fair solution will not result in big windfall gains or losses and does not reward poor

- **Extent of the immediate impact**

  This criterion focuses on negative impacts. For example:

  - immediate changes to land use and land management that may be required, and consideration of whether or not landowners have the capacity to make those changes in the short, medium or long-term
  - economic impacts, including those on the lake's community (e.g. farming, tourism, recreation)

  Positive environmental, cultural and social impacts will occur over time when the allocation approach is implemented.

- **Public and private benefits and costs**

  Public benefits relate primarily to the values the community derives from improved water quality. This is more relevant to implementation of allocation, rather than the allocation method itself. Public costs relate to compliance and transaction costs. These costs affect the ratepayer. Other public costs include social disruption and flow-on economic impacts.

  Private costs and benefits relate to landowners affected by allocation. Private benefits include certainty for land users, and opportunities for development, land use intensification and improved efficiencies. Private costs consist of cost of implementing changes imposed, initial reductions, mitigation costs, and limits on future land use flexibility.

- **Future vision for landscape**

  This considers whether the approach is future proofed and allows a transition towards a catchment where land is used efficiently and sustainably for an on-going prosperous community.

- **Iwi land ownership and its status including any Crown obligation**

  Implications of the approach on Māori owned land recognising the complexities of multiple owned land and how allocation may impact on the ability of Māori to plan for the strategic development of their land. Recognition of obligations under Treaty settlements.

- **Cultural values**

  Cultural values will be derived from improved water quality which relates to implementation of allocation. The allocation approach allows landowners to use the concept of kaitiakitanga and stewardship.

- **Resource use efficiency**

  Considers whether the allocation approach:

  - supports efficient use of land and resources

o enables land use appropriate to the lands' natural capacity o supports sustainable land uses (sustainability tends to support resource efficiency)
• **Existing land use** Recognition of the way land is currently used, including current good management practices in place and mitigation measures already undertaken. Also considers the large variability within and between land uses, land use practices and nitrogen leaching rates.
• **Existing on farm capital investment** Recognition of investment in on-farm infrastructure (including nutrient management and mitigation measures).
• **Ease of transfer of the allocation** The ease of implementation of allocation and transition to that allocation approach including: o Degree of difficulty, time and cost involved in implementing the change required o Recognition of obstacles (including landowner buy-in)

In relation to additional principles developed by the Lake Rotorua Stakeholder Advisory Group:

• **No major windfalls for any sector** Adjunct to Policy WL 5B(a). There is a consistent view that windfalls should be limited or removed wherever possible. This provides more specific commentary on this important point. In the allocation process the nitrogen associated with a windfall needs to come from other properties.
• **Preference will be given to the allocation approach that has the least overall economic Impact** Adjunct to Policy WL 5B(g). An important consideration for StAG and for Council is to maintain the economic viability of farm systems and the pastoral sector to the extent possible.
• **Existing investment (including in infrastructure, land value, cash investment and in nutrient loss mitigation) will be recognised** Adjunct to Policy WL 5B(i) above. This principle provides more specific commentary on the recognition of existing investment. Existing efforts in nitrogen mitigation are identified to recognise that some farmers are already working to reduce nitrogen losses and that this should not be penalised if possible.
• **Practices that cause high nitrogen loss, relative to sector norms, will not be rewarded.** This principle acknowledges that activities that leach significant amounts of nutrients are contributing proportionally more to the issue and where possible should not have this recognised in an allocation methodology.

Source: Regional Direction and Delivery Committee Report 2 July 2015.

Appendix 8 - Evaluation: Groundwater boundary approach

Option	Benefit	Cost
OPTION A Rule 11 Boundary (combination surface water and regional boundary) Area: 40,758 ha (excluding the lake)	• As this is the same boundary that was used for Rule 11 it provides the advantage of consistency and cross-over (i.e. nearly all properties over 40 ha will have existing nutrient benchmarks, and there is a history of consultation nutrient capping under Rule 11. • All of the land is wholly in the Bay of Plenty meaning that there are no cross boundary issues to consider. • The data which Option A is based on (prior to alterations) has a high level of accuracy.	• It does not include all areas of land which best science tells us contributes nitrogen to Lake Rotorua (i.e. it excludes land between the surface water catchment and the boundary of the groundwater catchment (approximately 4,963 ha). • Property owners with land within Option A will effectively have to 'pick up the slack' of the properties that are known by best science to contribute nitrogen to the Lake in order to meet the limits set by the RPS and the integrated framework. If this is not done, then it is likely that the limit set in the RPS or the decisions on which the Integrated Framework is based on would need to be revisited. This would not be an insignificant piece of work (i.e. the limits were set through much collaborative work between partners and legal processes). • Nitrogen losses on border properties outside Option A, but within Option C may actually increase nitrogen losses due to not being affected by the rules (i.e. as the productivity of neighbouring properties decreases their productivity goes up).
OPTION B: **Surface water boundary of Lake Rotorua** (derived from 2006 LiDAR data) Area: 42,258 ha (excluding the lake)	• It has the lowest margin of error out of the three options (e.g. using 95% confidence intervals the best-estimate surface water catchment boundary represents +/- 20 metres, whereas best-estimate for groundwater range from +/-200 m, to -640m and +740 m). • This option encapsulates all land that contributes surface water to Rotorua catchment (as opposed to Option A which is roughly 1,500 hectares smaller due to modifications to the boundary). This option has more land to work with to reduce nitrogen losses.	• Not all of the properties have existing benchmarks, and a number of property owners (i.e. between Option A and B) would be encountering nitrogen management rules for the first time. • An increased number of people are likely to experience personal and financial stress as a result of the rules applying to a larger catchment. • Some of the land in is in the Waikato Region which means if this option was selected it would become a cross boundary issue (which means there is less control over how nitrogen losses is managed, if at all). • It does not include all the land mass that contributes nitrogen to Lake Rotorua.

Option	Benefit	Cost
		• There is a risk that nitrogen losses on border properties (i.e. between the true surface water boundary and the groundwater catchment) may increase as other properties are forced to reduce their nitrogen losses.
OPTION C: **Groundwater Catchment** Area: 45,721 ha (excluding the lake)	• This option most accurately meets the definition of catchment boundary in RPS (i.e. it includes surface water and groundwater flows). • This boundary is the largest boundary which means there is a greater area to work with to reduce overall nitrogen loss for the catchment which means that there is a higher likely hood that the N target of 435 T can be achieved. This option is approximately 4,900 hectares larger than the Rule 11 boundary (i.e. Option A) meaning that there is a higher likelihood that the nitrogen limit may be able to be achieved, as all of the land that contributes to the lake will be included.	• The science which determines the boundary line is the least certain out of the three options. • Some of the land is outside of the Bay of Plenty region (approximately 1200 hectares) which means cross boundary issues will need to be taken into account (and no guarantee of outcome). • Some of the properties do not have an existing benchmark as they were not within the old Rule 11 boundary. • A number of people will experience personal, financial stress as a result of the rules applying to a wider catchment area • Implications for funding for reticulation project

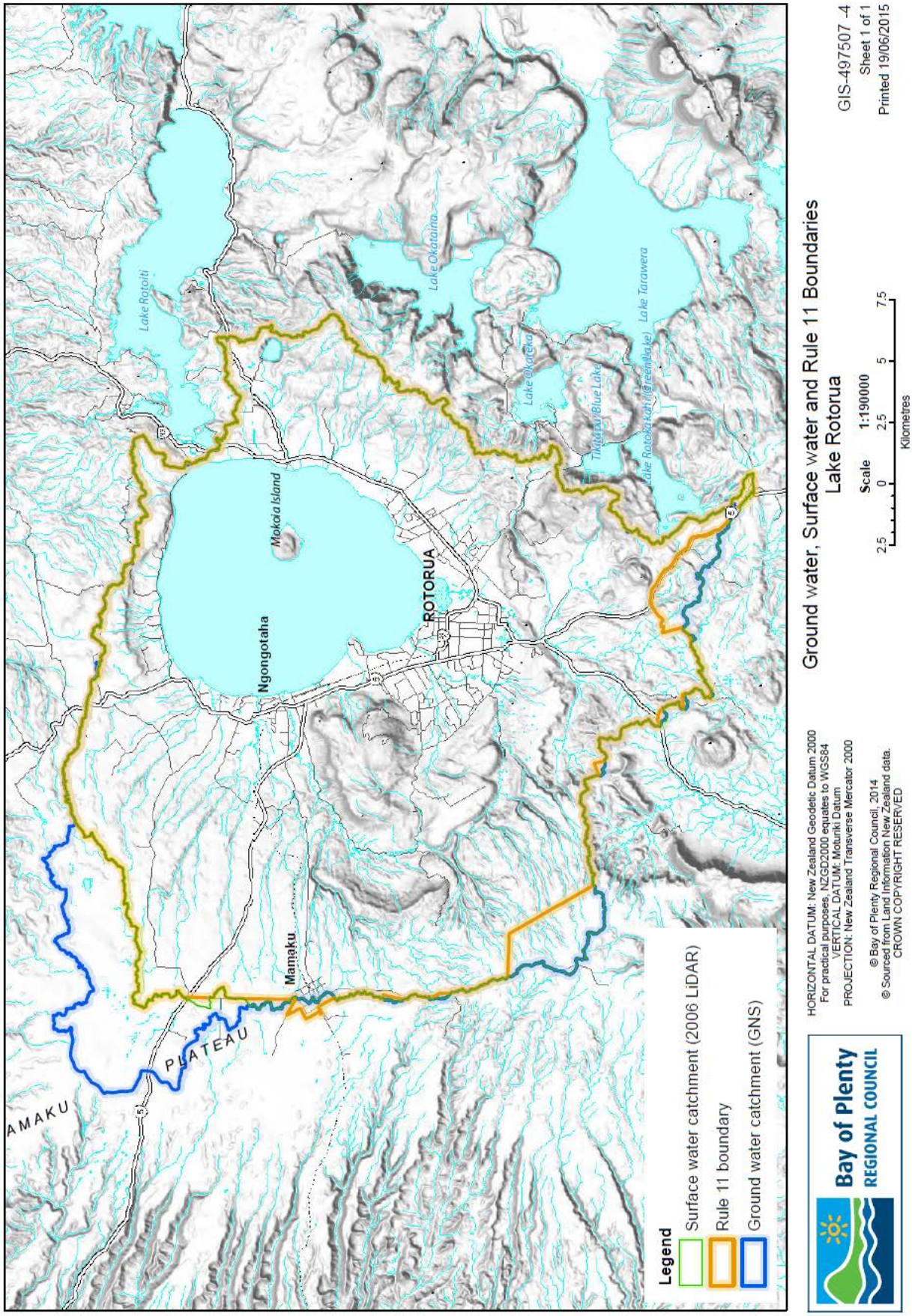


Figure 34 Map of groundwater and surface catchment areas, and Rule 11 boundaries.

Appendix 9 - Evaluation: Nitrogen Management Plan approach

Option	Benefit	Cost
OPTION A Nitrogen Management Plan prepared at the time of resource consent application & provide quantitative data every five years to demonstrate progress to Nitrogen Discharge Allowance	• There is an increased likelihood that a higher number of Nitrogen Discharge Allowances will be achieved by the target date simply because of the planning process that would have been undertaken early in the piece (i.e. the preparation of a NMP identifying Managed Reduction Targets and methods to achieve those targets) i.e. 'having a plan in place is half the battle'. • The use of a Managed Reduction Target (assuming that property owners reach them) means that there is a greater chance that the 2022 70% catchment target will be met. • NMPs provide a framework to identify how specific properties may achieve their NDAs, and where support may be needed. • Synergies in preparing NMPs may be able to be identified due to the majority of NMPs needing to be prepared at more or less the same time (i.e. 2017 or 2022). This may lead to the identification of methods/approaches that could be used by multiple properties (i.e. innovative thinking and sharing of ideas). • The requirement in the NMP schedule for consent applicants to demonstrate how they will achieve IPTs is useful as it will help avoid a scenario where land-owners delay making land use changes until the last few years before 2032. Cumulative 'gain's to reducing nitrogen losses would be lost if the Managed Reduction Target were not in place. • The ability to base NMPs on information derived from work completed for industry environment management programmes (such as Land and Environment Plans) means that landowners will be able to avoid unnecessary duplication of work.	• The opportunity cost of resources (both time and financial) that is lost due to the preparation and implementation of NMPs (i.e. time and resources could have been invested into other land management practices that may have been higher priority for the landowner). • Some landowners may find they are in a situation where they need to radically reduce stock levels and/or change other land management practices, or land use altogether. This has obvious costs to the property owner, people that work on the farm, and the immediate and wider community, particularly in terms of social and economic wellbeing.

Option	Benefit	Cost
	• By having clear targets to be achieved by certain dates makes this option easier to track from a compliance and monitoring point-of-view than other options considered, and also allows Council to track progress towards catchment targets. • Is consistent with what the Collective agreed to as part of the Integrated Framework approach. • Provides certainty for land owners and Council – i.e. it is clear what is expected right from the start. • All properties that require resource consent will need to supply an NMP, otherwise they will be non-complying, which means that the number of property owners preparing and submitting NMPs is likely to be high, as will quality. • This option is consistent with that agreed to by the Collective.	
OPTION B No Nitrogen Management Plan prepared & Property owners must meet Nitrogen Discharge Allowance by or prior to 2032.	• This option is likely to be most palatable to land owners as it is the least prescriptive option. • Allows time to save for costly land use / land practices changes as changes could be delayed to the few years leading up to 2032. • Accommodates planned land retirement (e.g. convert to forestry in 2032). • More opportunity for landowners and Council to look at a range of land use / land practices options. • Allows more time to take advantage of advances in science. • Less administration for land owners (i.e. simply do the work to reduce N losses, and by 2032 demonstrate that the NDA has been reached (i.e. 'no paperwork in-between'). In other words 'put faith in landowners that the required reductions will be made by the target date'.	• If there was no requirement that information be submitted there is a very real risk that measurements of nitrogen inputs and outputs would not be measured, and steps to reduce nitrogen loss not undertaken. • The cumulative impact of reduction of nitrogen losses will for the most part not be achieved compared to options where managed reduction must be achieved. • Is not consistent with the 'managed reduction' approach which was agreed to by the Collective. • Means the 70% catchment Managed Reduction Target is unlikely to be reached by 2022. • Potential tension between neighbours (i.e. why should I start reducing now if my neighbour isn't?).

Option	Benefit	Cost
OPTION C Nitrogen Management Plan prepared at the time of resource consent application & provide qualitative data every five years to demonstrate progress to Nitrogen Discharge Allowance	• More palatable than Option A to land owners as it is seen to be less prescriptive. • Less administration for land owners (i.e. ability to simply state what actions have been taken over the last five years to reduce nitrogen losses without getting actual measurements taken) – reduced time and effort, for the potentially the same outcome in 2032 • More flexible for property owners than Option A as the degree of reductions can be determined by the property owner rather than a 'number on a paper', provided that the NDA is met by 2032.	• High level of discretion for consent officers which may lead to inconsistent outcomes. • Hard to track actual progress towards achieving NDA without hard numbers • Difficult to monitor progress towards catchment target • Landowners may think they are making more progress than they are and receive a shock when actual measurements are taken, presumably somewhat closer to 2032, unless they are measured for some other purpose such as for an Industry Environment Plan, or good practice. • No hard data needs to be provided by 2022 which it would make it very difficult to determine if the 70% reduction catchment target has been met or not.

Appendix 10 - Estimate of implementation and ongoing costs

The Bay of Plenty Regional Council (BOPRC) will incur implementation and ongoing costs with respect to the rules. Administration costs will also be imposed on landowners, where those above a defined threshold of leaching are required to hold resource consents. Central Government has contributed to funding advice and support to landowners. This report describes and estimates the costs expected to be incurred by each of these parties. Costs are estimated over the lifetime of a consent under this regime – 20 years (under the draft rules approach), and based on the best information available at the time of writing.

Not included are costs associated with the incentives scheme, except where they cannot easily be separated from rules-related costs, such as the Lakes Restoration staff recording nitrogen discharge allowance (NDA) purchases by the Incentives Board. Also excluded are costs associated with changes to management practices or land resulting from the rules.

Costs to the Regional Council

The advice and support budget for the rules is $2.2m, made up of equal contributions by BOPRC and Central Government. This is used to provide affected landowners with assistance to develop the nitrogen management plans that will become part of their resource consent conditions, and includes funding external advisors. Two technical/administrative roles are associated with this, making up 1.7 FTEs until 2022. These are funded by BOPRC. An existing permanent position as team leader/manager for advice and support has 0.8 FTE in the Lake Rotorua policy and implementation.

Land Management Officers (4) currently employed in the Rotorua BOPRC office will continue to spend an average of 60% (2.4 FTEs) of their time working with farmers in the catchment as they adjust to the new rules regime. It is anticipated that this will continue until 2022.

In addition to the roles for advice and support for farmers, 3 permanent FTE roles will be required for processing returns, providing technical information and recording trades. [220] Two of these FTEs are for the Lake Restoration Officers whose role will include preparing and checking OVERSEER® files, processing OVERSEER® returns, providing information, recording trades (including the Incentives Board purchases), recording property changes in OVERSEER® files, and providing quality control on the nitrogen management plans provided by landowners. The third FTE is in monitoring and compliance. This role will include checking and auditing landowner returns based on a system designed to identify potential issues with compliance (described as monitoring based on exception). The costs of the monitoring and compliance position are shared with landowners.[221] This is the only position that will require additional staffing.

[220] These positions may filled by existing staff now employed in this role, or new staff positions.
[221] A proportion of the monitoring cost is recovered from landowners in accordance with s36 policy through the annual plan process. This is yet to be determined, but has been assumed to be 50% for the purposes of this analysis.

The workload of the consents team is expected to increase during the period that initial consents are processed. While individual consents are likely to be a fairly straight forward process, the quantity of consents could be reasonably expected to be around 300. This would be split between the properties consented in 2017 and the smaller properties (<40hectares) brought into the framework in 2022.[222] The volume of activity may mean that additional staff have to be employed at these key times, however the costs of resource consents will be passed on to individual landowners.

Costs to landowners in the catchment[223]

In the short term the compliance costs to landowners will be their contribution of time to setting up their nitrogen management plans (with the farm advisors), and their resource consenting costs.[224] Until 2022, these costs accrue only to landowners with 40+ hectares. Those landowners with low nitrogen activities (e.g. forestry) are also excluded. In 2022, nitrogen management plans will require updating. At that time the costs of farm advisors, should they be required, will be a landowner cost. Similarly in 2027, nitrogen management plans will require updating. These processes should be substantially less than the initial process provided there is no significant farm system change.

In 2022 small properties (<40ha) that are not covered by the permitted activity rule will come into the rules framework. Advice and support funding will be available to owners of small properties. The costs include the landowner's time in setting up nitrogen management plans and costs associated with applying for a resource consent. Nitrogen management plans will be updated in 2027.

The number of small properties (<40ha) that could be expected to apply for resource consent may be similar to the number registered for GST. This would equate to around 130 properties.

Costs to Central Government

Central Government and the BOPRC have shared costs for the incentives, advice and support and research.

Table 27 Share of costs between Central Government and BOPRC.

	Central Government	BOPRC
Incentives Scheme	$20m	$20m
Advice and Support	$1.1m	$1.1m
Research	$1.65m	$1.65m

[222] The split may be relatively even, given a total of 144 pastoral farms over 40 hectares coming under the rules in 2017.
[223] Does not include costs of undertaking activities to reduce nitrogen by farmers.
[224] Time based on 2014-15 farm management labour costs of a herd of 300 cows plus the basic salary rate. This equates to $55,500. See http://www.dairynz.co.nz/media/2840751/Operating_Profit_Adjustments.pdf

Total costs

The individual costs of the aspects described above are shown in the table below. Costs are recorded as at 2017 when the policy is implemented.[225] To aid comparison over time, these costs have been annualised at the base of this table.

The annualised costs over a 20 year period (life of a resource consent) for the BOPRC is $604,580 per year. On a per household basis across the region, the annualised cost is $5.91. For properties greater than 40 hectares the annualised cost is $498, and for properties of less than 40 hectares that cost is $400. These costs are based on the assumptions in Table 28.

Table 28 Individual costs, NPV, annualised costs and costs per household of the proposed rules for Lake Rotorua. Base year 2017. Figures have been rounded.

KEY TO TABLE	One off cost immediate	**Future one-off cost**	Annual cost		
Implementation costs	**BOPRC costs**	**Landowner cost >40 ha**	**Landowner cost <40 ha**	**Total costs for all landowners**	**Central Government costs**
2017					
Advice and support	$1,100,000				$1,100,000
NMPs for farms		$254		$36,630	
Consenting - farms		$1,200		$172,800	
2022					
NMPs for <40 ha properties			$254	$18,926	
Consenting for <40 ha properties			$1,200	$89,280	
Updates for >40ha NMPs		$1,005		$144,750	
2027					
Updates for NMPs		$1,005	$1,005	$219,538	
Ongoing costs					
Staff: Manage advice and support service 0.8FTE	$70,450				
Staff: Advice and support technical assistance 1.7 FTE	$179,870				
Staff: Land Management Officers 2.4FTE	$152,360				
Staff: Lakes Restoration Officers	$228,964				

[225] To keep the analysis relatively simple 2017 has been used as the starting date for all costs. This approach ignores the time value of payments prior to that date, such as the BOPRC staff role to manage and advice and support which started in 2015. The effect of this is relatively minor.

KEY TO TABLE	One off cost immediate	Future one-off cost	Annual cost

Implementation costs	BOPRC costs	Landowner cost >40 ha	Landowner cost <40 ha	Total costs for all landowners	Central Government costs
2FTE					
Staff: Monitoring and Compliance 1 FTE	$52,903	$242	$242	$52,903	
Staff: Consents team - advice annual	$5,555				
Net present value	**$6,934,489**	**$5,712**	**$4,593**	**$1,164,241**	**$1,100,000**
Equivalent annual cost	**$604,580**	**$498**	**$400**	**$101,504**	**$95,903**
Number of contributing properties	**102,273**	**1**	**1**	**-**	**1,549,890**
Annual cost per contributing party	**$5.91**	**$498**	**$400**	**-**	**$0.06**

Table 29 Assumptions about implementation costs.

Item	Assumption	Source/note
Discount rate	6%	
Start year	2017	
Year properties <40 ha introduced	2022	
First update NMP	2022	
Second update NMP	2027	
Update NMP cost (avg)	$700	Perrin Ag. Depending on complexity. Range $500 to $1,250.
Advice and support fund	$2,200,000	Actual.
Initial NMP landowner time (avg) >40 ha	11 hrs	Perrin Ag estimated 5.5 hr working directly with landowner. Added 5.5 hr for additional farmer time.
Update NMP landowner time (avg) >40 ha	6 hrs	Perrin Ag estimated 3.0 hr working directly with landowner. Added 3.0 hr for additional farmer time.
Initial NMP landowner time (avg) <40 ha	11 hrs	Assume same as property >40 ha.
Update NMP landowner time (avg) <40 ha	6 hrs	Assume same as property >40 ha.
Consent costs	$1,200	This cost assumes that consents come in with approved NMP and processing is straightforward.
Number of dairy and drystock properties	144	Actual.
Number of properties <40 ha	1,488	Land Connect Ltd (2015). Lake Rotorua Catchment. Small block sector review.
Proportion of properties 10 ha-40ha consented	5% (74)	Assumption based on proportion of currently registered GST properties of 10 ha-40 ha to total small properties.

Item	Assumption	Source/note
Percentage of properties <10 ha consented	0 (0)	Assume properties <10 ha do not apply for resource consent. Currently 3.8% of properties <10 ha in catchment are GST registered.
Salary grade 16 midpoint (LRO)	$88,063	HR advice/ BOPRC Intranet.
Salary grade 15 midpoint (Consents)	$81,389	HR advice/ BOPRC Intranet.
Salary grade 15 hourly rate	$51	Based on salary grade 15 (including overheads).
Farmer hourly rate	$23.125	Based on 300 cows. Sourced from DairyNZ.
Staff overhead	30%	LGNZ suggestion – informal email.
Additional staff LRO	2	
Additional staff monitoring	1	
Council share of monitoring staff	50%	A percentage of the monitoring cost is recovered from farmers in accordance with S36 policy through the annual plan process. Assumption used here of 50% recovery.
Consents team advice per consent per year	0.5 hr	Hours/consent/year on average for advice to monitoring staff.
Lifetime of consent	20 years	Based on current draft rules framework.
Advice and support management role. 80% of an FTE.	80%	Advised by Team Leader, Land Resources, Rotorua Catchment.
Staff: Land Management officers	2.4	4 LMOs spending 0.6 of their time working with land owners in the catchment until 2022.
Staff: Advice and support technical/admin	1.7	Two staff supporting advice and support advisors.

Appendix 11 - Response to feedback on Draft Section 32

1 Response to feedback on the Draft Section 32 from Lake Rotorua Primary Producers Collective

The following is the response to the points raised by the Lake Rotorua Primary Producers Collective in their review of the Draft s32 for the Rotorua draft rules (August 2015). The draft version referred to here was presented at the Regional Direction and Delivery (RDD) Committee at the 2 July 2015 meeting.

Response from Lake Rotorua Primary Producers Collective on the Draft section 32 on the effects of the proposed 'Rules' to reduce nitrogen in Lake Rotorua.

Comment 1: The impact on individual 'affected parties' is not explained adequately in the s32 reports. Affected parties referred to include farmers, local businesses, multiple-owned landowners and small block owners.

- The draft rules were released in late 2014. At that time one additional small block member and a new member from the deer sector joined StAG. Owners of multiple-owned Māori land have been represented on StAG.
- As information has been received it has been added into the s32. Key sources of information about pastoral (dairy and drystock) farmers, both in terms of economic and social impacts, is contained in the 2015 report by Parsons, Doole and Romera, which is part of the economic impact analysis. Other reports that have informed the economic and social impacts include:
    - Perrin Ag (2014) Rotorua NDA impact analysis.
    - Perrin Ag (2012) Farmer Solutions Project.
    - Grazing Systems Limited (2015). Summary notes for: Response to differences in farm model analysis.
- When the Draft s32 was presented at the RDD meeting, the final report from Parsons, Doole and Romera had not been received. Findings from this report on the impacts on farming types by farm characteristics have since been added into the s32 report.
- The impacts on deer farmers have been investigated through sector data from Statistics NZ, a deer farm case study (venison operation). In addition, all deer farmers in the catchment have been contacted to ensure they are aware of the draft rules and enable them to provide feedback.
- Several projects have been done to understand the impacts of the rules on small properties. The most recent is the Small Block Sector Review[226] which brings together all available information including number and size of blocks, tenure, land use, and valuation. This has been taken into account in the s32.
- Draft rules were released for further consultation in July 2015, giving the community further opportunity to ensure their views are considered in the rules. Small block owners were a key focus of this consultation.
- Additional information on the affected parties has informed and refined the rules.

[226] Land Connect Ltd (2015)

Comment 2: StAG's true effectiveness was limited by its Terms of Reference with the result that the s32 report has not considered equally effective but alternative solutions based on an optimal mix of catchment nitrogen and phosphorus reductions and alum dosing.

- The Terms of Reference for StAG is aligned with the policies in the Regional Policy Statement:
  - (i) Policy WL 3B requires the annual load of nitrogen to be reduced to 435 tonnes.
  - (ii) Policy WL 5B requires the assimilative capacity of the lake to be allocated based on identified principles.
  - (iii) Policy WL 6B requires managed reduction of nutrients, including by way of rules. This policy also refers to the balancing of public and private costs and benefits.

Comment 3: Nitrogen trading is an intricate part of the economic report yet no explanation is given as to how it will operate or if indeed it is bankable at an individual farm level. There has been very limited consultation with affected parties on possible trading. StAG has asked for the modelling to be rerun with no trading.

- Trading has been an important part of discussion at StAG over the past 12 months plus. It has included inviting Robin Connor (MPI) to prepare papers on trading and present at StAG, and StAG have provided recommendations for inclusion of trading in the rules:
  - o June 2014: Robin Connor (MPI) presented a paper about trading[227] to StAG at the June meeting. This paper discussed the reasons for incorporating trading, responded to questions on trading, and provided preliminary advice on issues raised by StAG about trading.
  - o September 2014: Robin Connor (MPI) attended the StAG meeting to present on the risks of achieving the 100 tonne N reduction, and N trading.
  - o December 2014: Robin Connor (MPI) presented a paper[228] to StAG. The paper provided analysis and recommendations for trading, including trading long-term and short term entitlements. The recommendations were specific to the Lake Rotorua rules/trading environment.
  - o February 2015: Robin Connor (MPI) presented a paper on trading options.[229] The paper included suggestions on alternative ways of defining short term allowances to enable trading, and recommended delaying trading long-term rights until 2022.
  - o March 2015: Stephen Lamb presented paper to StAG, on trading nitrogen discharge allowances, confirming support and seeking recommendations. Minutes record trading was supported by 11/14 votes

[227] Connor R (2014) Rotorua Lakes nutrient trading Working paper. Objective ref A1874072
[228] Connor R (2014) Nutrient trading in the Lake Rotorua catchment. Report prepared for the Bay of Plenty Regional Council. Objective ref A2000664
[229] Connor, R (2014) Options for trading nitrogen discharge entitlements in the Lake Rotorua catchment. Draft report. Objective reference A2020419

- April 2015: Sandra Barns presented on trading, seeking recommendations. Landowner trading of NDAs supported by 10, opposed by 1, abstain 2. At that meeting there was reasonably strong support for trading short term entitlements, and strong support for leasing of allowances.
- May 2015: The merits of trading short term entitlements were discussed.
- July 2015: Sandra Barns presented on trading short term entitlements.

- The economic impact modelling includes levels of inefficient trading. The least efficient scenario includes trading at 50 percent efficient, with a restriction on land use change at 5000 hectares. Given that the nitrogen restrictions occur progressively over 15 years, it is highly unlikely that decisions to trade will not be made as landowners find ways of reaching their allocated NDA.
- The background of this question refers to a $160m loss of capital, which is covered by the explanation in Comment 5.

Comment 4: The detail in the Doole report shows clearly that none of the modelled dairy farms can get down to the proposed NDA

- The Doole report shows that few (if any) farms will be able to reach their allocated NDA without making some changes. The modelling shows that for some dairy farmers purchasing nitrogen allowances will be necessary. Others will make changes in farming practices, and yet others will move to other land uses, including dairy support, sheep and beef, and forestry.
- Under efficient trading scenario for the sector range allocation 2,830 ha stays in dairy farming. Soil type is an important driver of land use change. Movement from dairying tends to be from allophanic and pumice soils. Around 1,700 ha moves from dairy into forestry, 450 ha into dairy support. Around 203 ha on podzol soil moves into dairy farming from other land uses.
- The modelled changes result in overall increase in per hectare income, although the impacts will vary from farm to farm. It is partly achieved by less efficient producers moving from the industry which pushes up the average income.
- The effects on equity are addressed in the Doole report by using the modelled cost of nitrogen allowances multiplied by the number reduced for each property. That is, a dairy farmer who wanted to maintain the same level of production and the same equity in his or her property could buy the allowances to remain at that level.

Comment 5: Using the Doole report data and assumed nitrogen values, land use change has significant financial effect on individual affected parties and the wider community. If all 5000ha of dairy converts to pines this creates a capital loss of $162m to the district.

- The projected capital loss of $162m is based on the conversion of all dairy farms in the catchment to forestry. That is, 5,000 ha reduced from $35,000/ha to $2,500/ha.
- There is not expectation or reason for all dairy farms in the catchment to convert to forestry.
- Where nitrogen discharge allowances have been defined in relation to land, conversion from one land use to another must take into account for both the land value and the nitrogen discharge allowance value.

- Dealing with the land value first: The Telfer Young report on land values[230] in the Lake Rotorua district shows that from 2009-2013, $20,000/ha was a good price for dairy farms outside the catchment. In 2014, those prices outside the catchment increased to $28,000. During 2009-2013, under Rule 11, dairy land prices in the catchment reached a high of around $18,000/ha. In 2014 that increased to around $24,000/ha. NB These values are based on a fairly small sample.
- The price of forestry land is around $3000/ha. This suggests that taking the best price for dairy land in the Lake catchment ($24,000/ha), on a land for land basis, the value lost by dairy farmers would be $105m.
- Nitrogen discharge allowances effectively become part of the land value. Converting from dairy to forestry, a dairy farmer would also sell, on average 43.6kg N/ha. Based on the Lake Taupō sales of NDA at $400/kg[231], this would yield around $17,400/ha. Multiplied by 5000 hectares equals $87.2m.
- On this basis, the final loss across all dairy farms would be $105m less $87.2m equals $17.8m.
- If the market was flooded with this amount of NDA the competitive price could be less than that provided for the example, although the Incentives Board will be in the market to purchase 100t, so demand can be expected to be high.
- The background information for this question includes a column of inputs from the appendices for the Parsons et al. report and presents it as evidence that 'no [dairy] farm model in the catchment can get near to the N loss of 46, required for dairy.' Three comments on this: Firstly, the Collective states this is based on OVERSEER® V5. It is in fact based on OVERSEER® V6.1.3. The dairy sector range for this version of OVERSEER® is 54.6 – 72.8kgN/ha/yr. Secondly, these input results are pre trading. Farms above their benchmark trade in the model. Thirdly, these results are for three farm systems. For example, AL1 is one farm moving through successive mitigation actions which reduce the nitrogen leached, the kgMS/ha, and the EBIT. The first mitigation reduces autumn N application and replaces it with a lower N feed. This first action reduces nitrogen leached by 19.4 percent and EBIT by 9.7 percent.
- The background of this comment refers to the lack of sensitivity analysis in the Parsons et al report. The report used the long-term price for milk solids and inputs. Sensitivity analysis was not included.

Comment 6: The on-farm consent process is very complicated, and will result in the stifling of innovation as well as significant ongoing compliance costs.

- Allocation can be seen as a long-term (permanent) allocation, and a short term allocations that reduce from 2017 to 2032. Compulsory targets occur at five year intervals. The long-term allocation is where farmers will be in 2032, unless farmers choose to buy or sell those long-term rights.

[230] Telfer Young (2014) analysed each sale to assess the underlying land value. This eliminates variance due to the size and quality of housing plus other building/infrastructural improvements, and allows a direct comparison of land values.
[231] Illustrative only. The price of NDA in the Lake Rotorua catchment is unknown.

- The five year reductions will be managed through nitrogen management plans that farmers develop with farm advisors. The NMP is based on committed actions for the first five years and proposed actions after that. It gives farmers a lot of flexibility because under the draft Rules the NMP is reviewed at five-yearly intervals (or more often if required) and adjustments can be made along the way, provided the five-yearly targets are achieved. Compliance with the nitrogen management plan will be monitored, and can be enforced because compliance is a condition of the resource consent.
- Council has considered allowing the trading of the short term allocations. Robin Connor (Ministry Primary Industries) presented several papers to StAG and included discussion and analysis of methods to include trading short term rights. Council rejected this option as complex and expensive. The possible benefits that could be gained from trading short term rights could be gained more simply in the policy.
- The consent process will be streamlined. Once the landowner has a nitrogen management plan that meets the requirements of Schedule 6 of the Rules, the consent conditions will require the landowner to comply with their nitrogen management plan. At a practical level, the council consents team will receive the nutrient management plans that have been checked and confirmed by the Lakes Restoration Officers (who also manage the OVERSEER® files). The consent will then be processed. Site visits will not be necessary for most applications.

Comment 7: The TLI target has been met for several years, even though the nitrogen reduction target has not bee. Alternative N and P loading targets have not been explored in the S32 report and should have been for completeness.

- The S32 report is the record of the policy journey. It is not a separate analysis of what could have been done (i.e. it is not a cost benefit analysis). It brings together the relevant information that policy staff have gathered and puts it into a format proscribed by MfE, which includes the social, cultural, environmental and economic costs and benefits.
- The Objective of this Plan Change is to reduce nitrogen losses from rural land within the Lake Rotorua catchment to meet the nitrogen limit set by the Regional Policy Statement.

Comment 8: Alum is a natural element that is used to treat urban water supplies throughout the world. It enters the lake naturally yet a measured, controlled and monitored application is being treated suspiciously.

- The rules are designed to meet the policies stipulated in the Regional Policy Statement to reduce nitrogen to the sustainable load.

2 Response to feedback on the Draft Section 32 from PWC

The following is the response to the points raised in the PWC high-level review of the Draft s32 for the Rotorua draft rules (August 2015), commissioned by Rotorua Lakes Council. The draft version referred to here was presented at the Regional Direction and Delivery (RDD) Committee at the 2 July 2015 meeting.

Review of Bay of Plenty Regional Council draft section 32 evaluation report: Lake Rotorua nutrient rules plan change

The following responses are based on the points made in the summary of findings, and where relevant to those points, draws from the body of the PWC report.

Comment 1: Costs for individual properties – the focus of the analysis in the s32 report is at the regional and national levels. It is unclear what the costs will be for individual properties which are affected in the short and long-term.

- Costs for landowners in obtaining resource consents and setting out nitrogen management plans have been included in updated version of the s32.
- The difference in costs and benefits of the rules versus integrated framework options was clarified in the updated s32.
- As the s32 has been developed and information received, it has been added into the s32. Key sources of information about pastoral (dairy and drystock) farmers, both in terms of economic and social impacts, is contained in the 2015 report by Parsons, Doole and Romera, which is part of the economic impact analysis. Other reports that have informed the economic and social impacts include:
    - Perrin Ag (2014) Rotorua NDA impact analysis
    - Perrin Ag (2012) Farmer Solutions Project
    - Grazing Systems Limited (2015). Summary notes for: Response to differences in farm model analysis.
- At the time of the draft s32, the final report from Parsons, Doole and Romera had not been received. This has since been incorporated into the document.
- The draft rules were released in late 2014. At that time one additional small block member and a new member from the deer sector joined StAG. During the August/Sept 2015 phase of consultation additional information is being sought about the impacts on small block owners.
- The impacts on deer farmers have been investigated through sector data from Statistics NZ, a deer farm case study (venison operation). In addition, all deer farmers in the catchment have been contacted to ensure they are aware of the draft rules and enable them to provide feedback.
- Several projects have been done to understand the impacts of the rules on small properties. The most recent is the Small Block Sector Review which brings together all available information including number and size of blocks, tenure, land use, and valuation. This has been taken into account in the s32.
- Draft rules were released for further consultation in July 2015, giving the community further opportunity to ensure their views are considered in the rules. Small block owners were a key focus of this consultation.
- Additional information on the affected parties has informed and refined the rules.

Comment 2: Costs of changing land use – although the s32 report identifies how land use could change, it is not clear how this is modelled. In addition, it is unclear whether the future land use scenarios are likely to occur.

- The reports for the modelling referred to in the s32 are now available on the Council website http://www.rotorualakes.co.nz/Draft_rules
- PWC suggest that modelling should include costs of conversion to other land uses and profitability of alternatives. This has been done in the Parsons et al. modelling/report.

- A net present value modelling approach would provide another modelling approach to this issue. It would require the council or modellers to make assumptions about farmer actions on a year-by-year basis (rather than choosing a point at the end of a period after the rules have worked through). It is likely there would be significant debate about farmer actions. It is questionable whether such an approach would add any value, as the outputs would depend on the inputs, as the approached used by Parsons et al. does.
- PWC ask for greater clarity on the assumptions so that stakeholders can better understand the results. As noted by PWC, assumptions were required about input and output prices, levels of production and changes in technology. Input output prices in the model are based on long-term averages. Levels of production are based on current farm size but does not allow for increasing or decreasing returns to scale, and changes in technology, while likely to be positive, have not been included. These assumptions have been noted in the s32, and are also clear in the Parsons et al. report. The report is available on the Council website.

Comment 3: Efficiency – the discussion of efficiency in the s32 report is focused on sharing the total cost across parties, rather than identifying the lowest cost option (per the Resource Management Act 2013 Section 32 analysis guidance)

- The RPS requires that the amount of nitrogen entering the Lake be reduced to 435 tonnes per year (Policy WL 3B), that the assimilative capacity of the Lake be allocated (Policy WL 5B), and that rules are included in the approach (Policy WL 6B). Two approaches have been considered: A rules only approach and the integrated framework, which consists of rules, incentives and gorse conversion.

Comment 4: Trading – the ability to trade nitrogen discharge allowances is not clearly explained raising questions about how the mechanism will work in practice and who will benefit.

- Trading has been explored through papers and presentations to the StAG meetings by Dr Robin Connor, MPI. The level of detail requested by PWC is beyond what is required in the Section 32. However the suggestion of a separate paper is useful and to an extent is covered by the material that has been presented to StAG and RDD Committee.
- The alternative and preferred allocation methods for nitrogen discharge allowances are discussed in the s32 report (refer section 10).
- The rights specified by the nitrogen discharge allowances will meet the requirements for valuable property rights related to quality of title, exclusivity, duration, transferability, flexibility and divisibility. This has now been added to the s32 allocation section.
- This is not the first nitrogen trading scheme to be established in New Zealand. The Lake Taupō nitrogen provides a successful working example.

Comment 5: Comparison between the three options – we see the three options as a natural progression, however there is not a clear comparison between the additional/marginal benefits and costs of each option.

- For a clear comparison between the three options a ‘detailed cost benefit analysis’ is suggested by PWC. A detailed cost benefit analysis is not a requirement for the s32, and would fail to adequately take into account the intangible and non-monetary benefits and costs associated with the provisions, such as cultural values.

- To aid comparison of the two options that will meet the requirements of the RPS, results have been tabulated in the report, and marginal changes clarified. The appendices contain a fuller summary of results of the evaluation.

Comment 6: 10 ha threshold – there is limited discussion regarding the 10 ha threshold (the threshold determines which properties are required to reduce their nitrogen loss) and the effect of setting it slightly higher or lower.

- The thresholds for small blocks have been reassessed with additional information now available on small blocks.

Comment 7: Sub regional analysis – the s32 report does not discuss the effects of the nitrogen limit on business and landowners outside the Rotorua Lake catchment.

- The district, regional and national economic analysis (Market Economics 2015) estimates the monetary impact on the business community outside the catchment. It does not identify individual businesses.
- Tabulated and summarised results are included in the s32 as appropriate
- The report on the impacts of the policy on the wider economy is available on the Council website http://www.rotorualakes.co.nz/Draft_rules

Comment 8: Review of economic reports – a number of the reports referred to in the s32 (particularly in the appendices) do not have full citations or are unavailable to review. If they are to be relied on, they should be attached to the report.

- The citations for reports have been checked and edited for the final version of the s32. The reports are too numerous to attach to the s32, but key reports have been made available on the Council website.

Comment 9: Appropriate caveats to quantified outcomes – the modelling results from the Market Economics (2015) and Telfer Young (2015) reports are presented without the appropriate caveats to the analysis. There is a risk that the results could be misinterpreted as fact.

- This has been addressed in the s32.

Comment 10: Market Economics (2015) report a range of scenarios that have been modelled. One of these, the most optimistic one, has been included in the s32 report, but there is no discussion of how likely this outcome is. Our assessment has been that the results used and reported in the s32 report are the 'best case scenario' outcome and the negative impact on GDP and employment could be larger.

- The full table of results from Market Economics is included in the draft and final s32, and includes the less optimistic results and provides a commentary.

Comment 11: Telfer Young (2015) uses farm sales data to estimate the impact of the announcement of the nutrient reduction rule, inside and outside the catchment area. In our view, we do not think there is enough data and detail to the analysis to draw the conclusions reached. These conclusions have been included in the s32 report. We suggest that BOPRC includes some commentary on the confidence level it has on the conclusions in the Telfer Young report.

- Telfer Young (Rotorua) is a valuation company in Rotorua. In their report on property prices in the Lake Rotorua catchment, they use the sales data and their expert judgement to reach conclusions about property valuations. Based on their expertise, Council is confident about the findings of this report.

Comment 12: Uncertainty – there is a provision included in the s32 report to allow the regulation to be updated if the 'science' changes. This creates uncertainty for rural land users and could affect land values and investment in the catchment

- PWC suggest improvement in clarity about how the regulations will change if limits prove to be insufficient. This appears reasonable but is not necessary in the s32 and is a policy decision. The s32 assesses the draft rules which contain a method for undertaking science reviews (discussed and approved by StAG). There are RMA policy review requirements also in place via legislation. As a comparison, Variation 5 (WRC) has a policy to review the nitrogen reduction target and its method of achievement, but doesn't say how changes will be undertaken if they are required.

PWC conclude: These areas of improvement vary in their degree of significance. Additional analysis to support the evidence base for the plan change could be added over time i.e. the next five years while the plan change is implemented.

We note the analysis highlighted above may have already been undertaken, in which case it could be included in the main section of the report for completeness.

Appendix 12 - Executive summaries from key reports

Science reports

Bay of Plenty Regional Council (2013). *Trends and state of nutrients in Lake Rotorua streams*. Environment Publication 2013/08.

Monitoring of Rotorua stream inflows has been undertaken as part of the Bay of Plenty Regional Council's (BoPRC) wider integrated catchment management activities, and previously as part of the old Catchment Boards programme (now the Kaituna Catchment Control scheme) to maintain lake and stream water quality. The monitoring now supports the

Rotorua Te Arawa Lakes Programme which is a partnership between Rotorua District Council, Bay of Plenty Regional Council and Te Arawa Lakes Trust.

Monitoring of these inflows provides valuable insight into the potential sources of lake water quality degradation and helps indicate if lake restoration methods are successful. Stream monitoring also provides ongoing data to be used in modelling of present and future scenarios of nutrient exports to the lake and for modelling lake water quality. The objective of this report is to examine state and trends of nutrients in the major streams to Lake Rotorua, and test these against some of the Rotorua Lake Management Strategy's targets.

Changes in stream load nutrients are influenced by land use change within the catchment.

Nitrate or nitrate-nitrite-nitrogen (NNN) is the dominant form of nitrogen entering.

Lake Rotorua that is readily available to phytoplankton in the lake, and is the most useful indicator of nitrogen inputs due to its soluble nature and movement through soils. These features make it one of the best indicators to show how quickly catchments respond to changes in land use.

As Rutherford found in 2003, nitrate concentrations in Rotorua streams continue to show an increasing trend. Trend analyses show that from 1992 to 2012 eight of the nine major inflows to Rotorua have a significant increasing trend in NNN. However, this trend is not apparent in three streams (the Puarenga, Waiohewa and Waiowhiro Streams) over the last decade, where concentrations have stabilised. With the exception of the Waiowhiro Stream, concentrations of NNN in most streams have doubled over the past 37 years. The Waiohewa

Stream stands out as a significant contributor of nitrogen to Lake Rotorua due to geothermal fluids from the Tikitere geothermal field.

Nitrogen contributions to the lake are now fairly well understood. Rutherford (2009, 2011) has thoroughly explored the relationships of land use change, and particularly pastoral farming's role and contribution of nitrogen in the Rotorua catchment. Prioritisation of nitrogen sources can be undertaken with the ROTAN model at the catchment scale by examination of various land use change scenarios. The potential for nitrate leaching from various land uses can also provide a priority mechanism for change and generally follows the order (Meenner et al., 2004):

- Vegetable cropping> dairy farming> arable/mixed cropping> sheep/beef/deer farming>forestry.

Of the nine major inflows analysed, five show significant decreasing trends in dissolved reactive phosphorus (DRP) concentration over 1992 to 2012 and likewise for four streams over 2002 to 2012. Utuhina's downward trend can be explained by recent alum treatment to the stream, but explanations for the decreasing trends in other streams are not so obvious.

These trends are likely to be a combination of land-use changes, possible changes in the rate of change of DRP in groundwater under differing groundwater levels and mineral fluxes, and increased buffering of DRP in stream waters.

The annual nitrogen loadings from the nine major inflows into Lake Rotorua have increased over the last two decades. Dissolved nutrient loads increase with flow, such that in wetter years higher nutrient loadings can be expected, along with an increasing component of particulate and organic nutrients.

Arresting storm-flow components of the particulate forms of phosphorus and nitrogen will play a valuable part in reducing total nutrient load to Lake Rotorua, but measuring and monitoring restoration efforts in reducing these nutrient contributions is problematic and costly. Nutrient loads based on monthly sampling data can often underestimate total loading contributions to the lake. For example, underestimates from the Ngongotahā catchment for phosphorus could be in the order of 50%, depending on the storm events in a given year.

Phosphorus load figures generated by Abell (2012) and others show that flood-flow phosphorus is a major source, and work of Rutherford (2009) and Abell (2012) shows which

Rotorua stream catchments generate the greatest phosphorus loads. A priority catchment list was created for the reduction of particulate phosphorus from the flood-flow percentage calculations from Rutherford (2008):

- Ngongotahā>Puarenga>Utuhina>Waiohewa>Waitetī>Waiowhiro>Waingaehe~ Awahou>Hamurana.

Here, the Ngongotahā catchment should be the highest priority for reducing export of particulate phosphorus, and the Hamurana the lowest. Examination of annual average loads from the nine major Rotorua Streams was compared to the annual average nutrient load exiting Lake Rotorua via the Ōhau Channel. Data shows that net import of phosphorus to the lake is similar to net export. Exceptions occurred in 2004 when severe algal blooms occurred, increasing the export of phosphorus out of the lake due to uptake by algae; and 2011 where intense storm events have resulted in increased particulate phosphorus entering the lake. Much of this particulate phosphorus will remain in the lake to be incorporated in sediment or released in a soluble form under anoxic conditions.

External nutrient load reduction targets are necessary in order to meet sustained water quality in line with community objectives. These targets become more important against the current background of increasing trends in nitrogen, and the risk of continued internal nutrient releases from potentially anoxic sediments.

Maintaining the lake in its current trophic status or improving the trophic status will depend on the lakes ability to assimilate an increasing load of labile nitrogen. Restoration techniques and land management options will also need to address the increasing nitrogen load to the lake, as well as manage phosphorus. The ability to address particulate phosphorus on the land with increasingly extreme climatic conditions predicted could pose an increased challenge to reaching lake water quality objectives.

Environmental Research Institute (2015). *Ecotoxicological review of alum applications to the Rotorua Lakes*. Report prepared for the Bay of Plenty Regional Council.

The use of alum (aluminium sulphate) has become a recognised technique for the restoration of freshwater systems. When added to water, alum dissociates and dissolved aluminium undergoes a series of hydrolysis reactions resulting in the formation of aluminium hydroxide (Al(OH)3) which adsorbs dissolved phosphorus and coagulates suspended solids. The resulting flocculent sequesters dissolved and particulate phosphorus, reducing primary production, thereby improving water clarity.

Aluminium hydroxide is a relatively benign substance with peak abundance occurring at pH 6.3; above and below this point, soluble, more toxic aluminium species predominate. For example, under alkaline conditions (>pH 8.5) toxic Al(OH4)- forms, while below pH 4.5 free monomeric aluminium (Al3+) becomes prevalent. The hydrolysis reaction of aluminium (Al) causes the release of H+, lowering pH and potentially causing the formation of toxic aluminium species. It is therefore critical that application rates do not exceed the buffering capacity of the treated system. In addition, eutrophic systems often experience photosynthetic driven alkaline pH shifts, resulting in Al solubilisation and the formation of the toxic Al species (Al(OH)4-).

The Bay of Plenty Regional Council has initiated several alum dosing programmes in the Rotorua lakes district in an effort to reduce lake trophic levels. Currently, continuous alum dosing is undertaken on the Puarenga and Utuhina Streams discharging to Lake Rotorua and the Waitangi Soda Stream discharging to Lake Rotoehu. In addition, seven discrete alum applications have been conducted on Lake Okaro since 2003. This has resulted in the total applications of 444.2, 55.2, and 2.8 tonnes of Al to lakes Rotorua, Rotoehu and Okaro respectively. Current estimated continuous lake water dose rates for Lake Rotoehu 6.72 µg Al l-1 and Lake Rotorua 2.62 µg Al l-1 are low by international standards and the estimated maximum dose applied to Lake Okaro of 0.22 mg Al l-1 lake water was also conservative.

A literature review was undertaken to provide guidance on a number of concerns associated with alum dosing of the Rotorua lakes. This includes; (1) the likely concentration thresholds for acute toxicological effects from Al dosing and whether current dosing programmes are likely to exceed them; (2) the fate of flocculated Al in lake sediments and whether they pose an ecological hazard; (3) the risk of the buffering capacity of water in the Rotorua lakes being exceeded leading to release of toxic Al species; and (4) the risk to biota of burial by Al-floc and its potential to disrupt lake processes.

The toxicity of Al is closely associated with pH, and acute toxic effects are likely to be a combination of physiological responses to both acidic pH and Al. Fish appear to be the most susceptible group to Al toxicity with respiratory disruption initially occurring at pH 6.0 due to gill irritation by colloidal Al. This is followed by increasing levels of osmoregulatory disruption peaking at pH 3.0 where Al3+ is the predominant species. Toxic effects may also manifest under alkaline conditions (pH >8.5), and although the precise mechanism is unknown it is theorised that the gills may be the primary site of action. As well as pH, susceptibility to Al toxicity is dependent on a number of factors including species, life stage, and even whether the organism has had previously exposure to Al. In addition, a number of chemical components have an ameliorating influence; foremost amongst these are dissolved organic matter (DOM), silica and calcium concentrations.

Due to the complexity and large influence of pH in determining Al toxicity, a conservative approach to selecting toxic threshold values was adopted. It is recommended that total Al does not exceed 200 µg l–1 at pH >6.0, 75 µg l–1 at pH 5.0 - 6.0 and 25 µg l–1 at pH 4.0 - 5.0 to avoid acute lethal effects. These proposed threshold values are based on soft water conditions, with low DOM and silica concentrations. Current alum dose rates and measured water column total Al concentrations are below these proposed threshold values.

The buffering capacity of the Rotorua lakes is low. This restricts the quantity of alum that can be applied either continuously or as a discrete dose. Current application rates to the Rotorua lakes are conservative, but the low buffering capacity provides little capacity to increase dose rates without initiating environmental acidification. As well as direct toxicological effects environmental acidification also carries the risk of mobilising toxic Al species from sedimented Al-floc. This may be somewhat mitigated by the fact that Al has a higher affinity for silica minerals which are located deeper in the sediment, compared to humic (organic) substances that predominate in the surface layers. This results in Al diffusing through surface sediment and forming aluminosilicate complexes deeper in the sediment thereby providing a limited separation buffer from transient acidic events in the water column. In addition, flocculated Al(OH)3 undergoes an aging process, changing from a colloidal amorphous solid to microcrystals, and then to the mineral gibbsite, although this process may take up to a year. In this final stage, Al is more resistant to mobilisation by acidification and is less likely to bioaccumulate.

Current research suggests that the risks of Al bioaccumulation are relatively low. Most animals accumulate Al through incidental ingestion and the majority is subsequently excreted. Increased tissue concentrations of Al have been reported in koura (Paranephrops planifrons) and common bully (Gobiomorphus cotidianus) in the Utuhina Stream but no toxicological effects have been observed. There is little evidence in support of Al biomagnification through the food chain, as rates of trophic transfer appear to be relatively limited. It should be noted that chronic effects of Al exposure are not as well studied and a cautious approach is recommended.

The depth of flocculent formation following alum application is rarely reported and relatively little is known about the effect of Al-floc on lake processes. It has been reported that sustained (12 months) high dose rate alum applications (>8 mg Al l-1) can result in flocculent accumulation to a depth of 50 cm and localised hypoxia. However, the comparatively low dose rates utilised in the Rotorua lakes will result in minimal floc formation. Further research is needed to determine the effect of flocculent deposition on benthic organisms and whether bio-geochemical processes are disrupted by alum dosing.

The current alum dosing programme for the Rotorua lakes is appropriately conservative due to the low buffering capacity of the lakes. The risk of acute Al toxicity is therefore minimal under the current regime. The risk of bioaccumulation and biomagnification also appear to be minimal provided pH levels are maintained above 6.0. However, the low buffering capacity of the lakes means there is little capacity to significantly increase application rates and serious consideration should be given to the use of buffering agents such as sodium aluminate if there is a move towards increased dosing rates. There is relatively little information examining the ecological effects of Al-floc formation and deposition. Current dose rates to the Rotorua lakes are unlikely to form significant quantities of Al-floc but adverse effects of floc deposition are poorly studied.

Hamilton DP, McBride CG, Jones HFE (2015). ***Assessing the effects of alum dosing to two inflows to Lake Rotorua against external nutrient load reductions: Model simulations for 2001-2012*****.**

This study considers the effects on Lake Rotorua water quality of alum dosing of its stream inflows. Alum dosing commenced in the Utuhina Stream in 2006 and in the Puarenga Stream in 2009. Dosing rates were highly variable in each stream on a daily time scale. A one-month ‘rolling average’ showed that the combined dose to the streams was up to 400 kg Al per day. Dosing rates were consistently higher once the Puarenga inflow dosing commenced and particularly from 2011 to the end of our study period in 2012. Alum dosing was highly effective in adsorbing (‘locking up’) dissolved reactive phosphorus (DRP) in the stream inflows, particularly above certain threshold concentrations (c. 100 kg Al day-1 in Utuhina Stream and 75 kg Al d-1 in Puarenga Stream). The effects of dosing were extremely low dissolved reactive phosphorus concentrations and low ratios of DRP to total phosphorus

(DRP:TP) in the stream inflows below the dosing point. Concentrations of TP remained largely unchanged in the streams below the dosing point, suggesting that turbulence in the streams maintained the adsorbed DRP as suspended particulate phosphorus.

Our study included an analysis of the time series of discharge and nutrient concentrations in the lake inflows including the nine major stream inflows, combined minor stream inflows, and rainfall. No trend analysis was carried out for the stream inflow data because its primary purpose was to generate input data and verify output from the catchment model (ROTAN) used as input to the DYRESM-CAEDYM lake model. It was evident, however, that over the 12 years (2001-2012) nitrate concentrations were increasing in some inflows (e.g. Awahou) as expected from progressive enrichment of large groundwater aquifers due to historical changes in land use and agricultural intensification. It was unexpected, however, that some inflows (e.g. Awahou and Waitetī) showed a recent period (2010-2012) of elevated and highly variable TP concentrations, which may be related to erosion and loss of particulate phosphorus from high-intensity rainfall events over this period. The exception was Puarenga, which showed a clear decrease in DRP concentrations commencing around 2009, little change in TP concentrations, and a consistent reduction in total nitrogen (TN) and nitrate (NO3-N) concentrations over the study period. We attribute at least some of these effects to changes in treatment processes at the Rotorua Wastewater Treatment Plant.

We examined nutrient concentrations in surface and bottom waters at a central site in Lake Rotorua from 2001 to 2013. Concentrations of TP and DRP began to decrease around 2007-8. This period also corresponded to reduced TN and chlorophyll a concentrations, while annual TLI decreased to the point where it reached the ‘target’ (prescribed in the Bay of Plenty Regional Council Land and Water Plan) of 4.2 in 2012. This period also corresponded to lower rates of deoxygenation in bottom waters observed when the water column was stratified. These in-lake improvements were achieved despite the changes in inflow concentrations mentioned above.

On the basis of DYRESM-CAEDYM model simulations it was surmised that alum dosing was impacting on lake concentrations beyond simply locking up DRP in the Utuhina and Puarenga Steam inflows. This conclusion was based on the fact that simulated trophic state of the lake remained substantially above the observed level using the previously calibrated and validated model (i.e. 2001-2007; mostly prior to alum dosing which was initiated in the Utuhina Stream inflow in 2006) and applying it to the period of intense alum dosing in both stream inflows (2009-2012) and including removal of the DRP locked up by alum dosing through the latter period. It is conceivable that dosing the Utuhina and Puarenga not only reduces DRP loads from those inflows, but also results in 'excess' alum entering the lake where it 'locks up' additional phosphorus and removes it from the water column. We therefore increased rates of sedimentation of organic matter and decreased rates of sediment phosphate release, both individually and together, in order to achieve a satisfactory match of trophic state (i.e. TLI and its water constituents of TN, TP and chlorophyll a) for the period 2009-2012. We also justified this approach on the basis that there would be increased rates of flocculation and sedimentation of organic matter in the lake as a result of alum dosing, and rates of oxygen consumption by bottom sediments appeared to have decreased based on high-frequency monitoring data for dissolved oxygen in bottom waters. Simulation of alum effects was not dynamic (i.e. alum concentrations were not explicitly simulated in the model) but provided a satisfactory simulation of the observed average TLI over the four-year period of particular interest. On consideration of hydraulic flushing rate, estimated sedimentation of the alum floc and the time scale for changes in bottom water oxygen consumption rates, we estimated that there may be persistent effects from alum dosing lasting perhaps 2-3 years.

Alum dosing in the stream inflows is now highly regulated to maintain three-month surface TP concentrations at 20 mg m-3, i.e., around one-half of the very high levels observed in the lake in the mid-2000s. Concentrations now show much less seasonal variability than before alum dosing. Of considerable importance is whether alum dosing has brought about a transition in nutrient limitation status of phytoplankton in Lake Rotorua. Studies of nutrient limitation in the mid-2000s have commonly shown addition of both nitrogen + phosphorus to have had the greatest growth-stimulation effect on phytoplankton (i.e. 'co-limitation'). The most recent study (Abell et al. 2012) was undertaken during a 'trough' in nitrate concentrations in the lake, compared with periods before and after their study. This may explain the observed dominance of N limitation but with some co-limitation. We hypothesise that had Abell et al. conducted their study during adjacent periods of much higher nitrate concentrations then P limitation would have been dominant. High nitrate concentrations in 2011-12 suggest that demand for dissolved inorganic nitrogen by phytoplankton was lower, consistent with phosphorus concentrations being reduced to limiting levels whereby excess nitrate remains unutilised in the water column.

Much recent speculation has considered managing nutrient loads so that either N or P is controlled to limiting levels whilst the other is less stringently controlled. Even with alum dosing, Abell et al.'s (2014) study and field observations suggest that in Lake Rotorua there are locations where, and periods when, either nutrient or both limit phytoplankton growth. The efficacy of controlling a single nutrient to limit primary production in freshwaters is not well supported by direct measurements (e.g., using bioassays), of which there are remarkably few (see Abell et al. 2010).

The possibility that recently observed improvements in Lake Rotorua water quality are a result of a regime shift towards more frequent P-limitation is an important consideration for the management of the lake. Specifically, the intensity and sustainability of alum dosing needs to be carefully weighed against the management of present and future loads of both nitrogen and phosphorus from catchment land use.

Rutherford KC, Palliser C, Wadhwa S (2011). *Prediction of nitrogen loads to Lake Rotorua using the ROTAN model*. NIWA client report HAM 2010-134. Report prepared for the Bay of Plenty Regional Council.

This report is the third in a series prepared for Bay of Plenty Regional Council. It outlines recent refinements made to the ROTAN model, and describes several scenarios of land use change and mitigation. Findings are intended to help managers develop policy by estimating the extent of export reduction required to meet the lake target of 435 tN/yr, and how quickly the load to the lake is likely to respond to such reductions. The results will be used by the University of Waikato to predict likely changes in lake water quality.

We reviewed the history of the target lake load. A limit of 435 t/yr on the nitrogen input to the lake was first suggested in 1986 by the National Water & Soil Conservation Organisation. Their figure included nitrogen in streams and groundwater (375 tN/yr), rainfall on the lake (30 tN/yr), and treated sewage (30tN/yr). Since the advent of the Rotorua Land Treatment System (RLTS) in 1991, the allowance for treated sewage enters the Puarenga Stream in drainage from the RLTS. Therefore, we compare model results for nitrogen in streams and groundwater with the figure of 405 tN/yr which is the target for streams and groundwater (375 tN/yr) plus the consented input from the RLTS (30 tN/yr) but excludes 30 tN/yr in rainfall on the lake.

This study estimates that currently the total nitrogen export from forests, farmland, geothermal, urban and treated sewage is 725 tN/yr which is similar to values in the Proposed Action Plan of 783 and 746 tN/yr. To meet the target of 405 tN/yr in streams and groundwater, we estimate that exports need to be reduced by about 320 tN/yr. If the total nitrogen export remains constant at the current level, the lake load is likely to increase slowly over the next 60-70 years and to approach a steady state of 725 tN/yr by about 2080. If the total nitrogen export is reduced by 320 tN/yr and held constant, the lake load is likely to decrease quickly and to approach the target of 405 tN/yr within about 35 years.

The predicted recovery time of about 35 years is faster than expected, but plausible assuming that: the average proportions of nitrogen reaching the lake via deep groundwater (slowly) and near-surface flow (quickly) are 53% and 47% respectively; and that deep groundwater is well-mixed. The actual recovery rate is likely to be slower than this because all the land use change is unlikely to occur in a single year.

It has been assumed that the best way to reduce the lake load is to reduce nitrogen exports in catchments with short groundwater lag times. However, modelling indicates that catchments with widely differing groundwater lag times respond at a similar rate in terms of nitrogen export. Consequently, the best strategy for most of the Lake Rotorua catchment may be to focus mitigation measures on those land parcels where it is easiest to reduce nitrogen exports, regardless of where these are located. The response time of the Hamurana Stream catchment is unique because of its very small surface catchment, and it will take many years for nitrogen export loads to fully reflect changes in land use.

Reports on the overall approach

Greenhalgh S (2013). *Costs and benefits for achieving a clean lake: Rotorua Lakes*. Prepared for Bay of Plenty Regional Council.

The purpose of this report is to provide insights into possible approaches to compare the costs and benefits of a clean lake (Lake Rotorua) for the Bay of Plenty Regional Council (BOPRC). The report describes:

- possible approaches to compare costs and benefits
- some of the analyses conducted to assess the impact of water quality limits in the Rotorua lakes
- a framework to determine how landowners will respond to policy options
- some factors to consider on farmer adoption of sustainable management practices
- a potential alternative assessment pathway given the likely time and resources available to undertake any further assessment of the impacts of implementing water quality limits in the Rotorua lakes.

Ecosystem services, values and uses of water bodies

As yet there is no definitive set of values and uses that must be considered when assessing water quality impacts. However, the National Policy Statement for Freshwater Management, the synopsis of the National Objective Statement in the 2013 Freshwater Reforms, and the Millennium Ecosystem Service Assessment ecosystem service categories provide some guidance on the services, values and uses that could be considered. The use of ecosystem service categories is helpful as this provides a comprehensive and consistent set of ecosystem benefits that can be linked to values and uses.

Comparing costs and benefits

While the most common approach for comparing costs and benefits is cost-benefit analysis, a number of other approaches can be used, including multi-criteria assessment, partial equilibrium modelling, and scenario analysis. All have their advantages and limitations, and not all depend on using economic valuations to derive the costs and benefits.

Landowner responses to policy

Within the Policy Choice Framework (Kaine 2012) there is a framework to help determine how landowners will respond to policy options. This relies on information relating to their involvement with both the policy instrument and the issue (policy outcome). Landowners with low involvement in both the policy outcome and primary instrument are likely to comply with a policy, and any non-compliance is unintentional. Where landowners have high involvement with the policy outcome but low involvement with the primary instrument, then non-compliance with the instrument is largely unintentional. If landowners exhibit high involvement with the policy outcome and the primary instrument, and their attitude towards the primary instrument is favourable then they will comply with the instrument. However, if landowners have an unfavourable attitude towards the primary instrument they may comply reluctantly and any non-compliance will be intentional. Last, if landowners have low involvement with the policy outcome but high involvement with the primary instrument, and have a positive attitude towards the primary instrument, they will comply with the instrument. Those with an unfavourable attitude towards the primary instrument will comply reluctantly and any non-compliance with the instrument will be intentional.

Farmer adoption of sustainably management practices

Some key factors to consider for why and how landowners may respond to policy and adopt different management practices include:

- Lack of belief that a potential problem or opportunity exists. Lack of belief in the science, underlying worldviews, or that the problem exists “but not on my farm”
- Lack of personal responsibility for their contribution to a problem or opportunity
- Whether farmers have the adaptive capacity for the magnitude and rate of change
- People listen to others whom they trust for information and that varies depending on what information they seek.

Rapid assessment approach as alternative pathway to assess costs and benefits

This proposed assessment is to identify rapidly which ecosystem services/values/uses should be included in any assessment of costs and benefits and determine where additional information may be required. This assessment uses three criteria:

- Expected impact if the policy option/instrument is imposed or not imposed
- Whether the ecosystem service/value/use is considered ‘critical’
- How substitutable the ecosystem service/value is

Legal requirements will also provide some clear direction for the importance of some ecosystem services/values/uses. A scenario analysis approach can then be used to estimate with and without impacts of water quality limits on the important ecosystem services/values/uses identified using the 3 criteria above.

Applying to Lake Rotorua

From a rapid assessment undertaken by the author, the important ecosystem services/values/uses to consider for Lake Rotorua included livestock, flax and mahinga kai gathering, drinking water, flood control, human health for secondary contact, ceremonial uses and Māori relationships with water, and natural character. This assessment would benefit from input by council or the community.

Based on the existing analyses there appears to have been insufficient information gathered on Māori cultural services and values and how the water quality target will affect their relationship with the Lake as well as drinking water, human health for secondary contact with water, flood control and natural character.

Recommended next steps

BOPRC has invested in analyses of the impact of water quality limits on a sub-set of ecosystem services/values/uses. This is an incomplete list. This rapid assessment identifies where additional information should be sort. If no additional information is available then using a scenario analysis approach can be helpful to portray the broader impacts of a set of potential external future drivers and the implications of with and without interventions to improve water quality. The assessment of any scenarios was beyond the scope of this report.

Any rapid assessment and scenario analysis is not likely to provide the details of the range and size of impacts, unless information already exists. For a full scenario analysis it is likely additional information would be needed on all the ecosystem services/values/uses considered important; however, the likely direction of distributional impacts could be predicted relatively easily.

Kingi T, Sprosen M, Ledgard S, Morrell S, Matheson L, Park S. (2015). *Meeting nutrient loss targets on dairy farms in the Lake Rotorua catchment*. Sustainable Farming Fund Project 11/023: Final Report.

Dairy farmers in the Lake Rotorua catchment will need to make large reductions in farm nitrogen (N) leaching losses to meet the annual catchment target of 435 tonnes N by 2032. Dairy farmers initiated a Sustainable Farming Fund Project in 2011 to promote the adoption of N mitigation methods using three strands of work: (i) farm trials of differential N fertiliser rates, (ii) farm system modelling and (iii) farmer engagement. These three strands of work were led respectively by AgResearch, Perrin Ag Consultants and DairyNZ. This final project report summarises the main results from each strand.

Farm trials:

The impacts of different N fertiliser rates were assessed in two trials that ran in parallel for approximately three years on the Parekarangi Trust dairy farm south of Rotorua. A **pasture plot trial** compared nil, strategic (~60 kgN/ha/yr) and regular (~160 kgN/ha/yr) urea fertiliser applications to grazed dairy pasture. The average annual responses to N fertiliser were 6-14 and 7-8 kg DM/kg N applied for the strategic and regular N treatments, respectively. There were no significant treatment differences in pasture composition from first sampling in August 2011 to the final sampling in February 2014.

The **farm system trial** at Parekarangi compared nil-N and plus-N (~140-160 kgN/ha/yr) fertiliser application to grazed dairy pasture on twelve paired paddocks. Grazing was managed to simulate a “farmlet” trial system. In addition to regular pasture production and composition monitoring, the farm system trial measured pasture N content and N leaching (latter via 300 suction cup samplers). The first year (2012) proved to be a “settling-in” period with treatment differences developing in 2013 and 2014 (denoted as years 1 and 2). The farm system pasture production response to applied N varied greatly between years 1 and 2

from ~7 to ~15 kg DM/kg N applied (respectively). As in the plot trial, there were no significant trends in pasture composition. N leaching was significantly greater in the plus-N treatment, being five-fold and two-fold more than the nil-N treatment in years 1 and 2. The significant leaching and pasture response differences between years 1 and 2 in the plus-N treatment was probably due to a combination of drought in year 1, accumulated soil nitrate-N levels and some direct fertiliser N leaching when >200mm autumn drainage occurred shortly after urea application.

Some practical implications from this on-farm research are:

1 Strategic N fertiliser use in late-winter/spring, rather than regular applications, could achieve good pasture growth responses and reduced N leaching risk.

2 Where the use of N fertiliser is reduced or ceased, pasture management in spring should target good control of pasture covers to avoid clover shading by grasses and encourage increased clover N fixation, with reduced browntop ingress.

3 N fertiliser can provide useful increases in pasture growth at relatively low cost but it is of low farm N efficiency and can lead to significant increases in N leaching. Thus, reducing or ceasing N fertiliser use and replacing it with a low-protein feed source (from outside the catchment) can significantly decrease N leaching from farms.

4 The coarse texture of the pumice soils (with associated limited water holding capacity) and relatively high rainfall (including risk of heavy rainfall events) mean that care is needed in timing of N fertiliser application. It also means that using lower rates more often will reduce risk of direct fertiliser-N leaching.

Farm modelling:

Three dairy farms were initially modelled in OVERSEER® and Farmax for status quo and future mitigated scenarios, based on each farmer's perspective on what mitigation practices they could adopt. This analysis was expanded to other dairy farms through related projects funded by Bay of Plenty Regional Council. The cost-effectiveness of a wide range of on-farm mitigations were assessed in terms of "capitalised" cost ($/kgN mitigated) and annual profit impact ($/ha). Capitalised N mitigation costs ranged from just under $100/kgN (e.g. substituting N boosted pasture with bought-in maize silage) to over $700/kgN (partial conversion of pasture to pines). Access to OVERSEER® files of historic N losses (2001-2004) enabled a comparison with current losses (generally 2012-2013) for 13 dairy farms, representing ~54% of dairy land use in the catchment. This comparison over approximately 10 years showed that while productivity per hectare had increased by 27%, N leaching losses had decreased by 8% per hectare.

Farmer engagement:

A series of farm discussion groups and four field days have been run during the project. Farmer participation has varied during the project and it is too early to determine what level of practice change has occurred on-farm. Rural professionals have been regular attendees. Recurring messages from Rotorua dairy farmers include the need for: (i) practical, local and long-term farm trials; (ii) cost-effectiveness modelling of N mitigation options, both singly and in combination across a farm system; (iii) certainty around Council policy in order to understand their individual farm constraint.

The anticipated new N rules and individual farm "Nitrogen Discharge Allowances" are still being developed (as of March 2015). This uncertainty made it more difficult to engage the catchment dairy farmers. However, the leading catchment dairy farmers have been closely involved in influencing policy through the Stakeholder Advisory Group where project and related presentations have helped ground the policy debate.

Land Connect Ltd (2015). *Lake Rotorua Catchment: Small block sector review*. Report prepared for the Bay of Plenty Regional Council.

Executive summary

Bay of Plenty Regional Council (BOPRC) has set a sustainable annual nitrogen load target for Lake Rotorua of 435 tonnes of nitrogen (N). New rules are being developed to limit the nitrogen loss from land-based activities by allocating nitrogen to the various land use sectors and to individual properties via Nitrogen Discharge Allowances (NDAs). The information presented in this report is intended to assist with the development of the Draft Nitrogen Rules and how these rules may impact on Small Block owners. Small Blocks are defined as less than 40 hectares, consistent with the draft rules context.

Overview of the small block sector

- Using Valuation References as a measure of properties indicates that there are 1,484 Small Blocks in the Lake Rotorua Catchment. However this is likely to be an overestimate, as a single property may be made up of more than one Valuation Reference. A review of multiple Valuation References associated with benchmarked properties (<40ha) indicates that the total number of Small Blocks could be 20% lower (1,163 Small Blocks), however the sample used for this estimate is small.
- The Small Block sector covers 5,634 hectares across the catchment, making up 13% of total rural land (41,760 ha) in the catchment.
- Most Small Blocks are less than 4 hectares (1,045, 70% of total Small Blocks) covering 1,104 hectares, but only 18.5% of total land in the Small Block sector.

People Living on Small Blocks

- An estimated 3,188 people or 5.7% of the total catchment population live on small blocks.
- Approximately 70% of Small Blocker owners (2,215) live on properties <4 ha.

Tenure of small blocks

- Māori land makes up 11% of total small block area, based on the Rule 11 surface catchment. This is proportionally lower than Māori land in this catchment (24%).

Land use in the small block sector

- The effective land area (pastoral, cut and carry, crop and horticulture, plus grazed trees) in the small block sector is 4,155 ha. This is 19% of the total effective land area in the catchment (22,112 ha).
- Drystock is the most common effective land use in small blocks (90%, 3,755 ha) followed by Dairy Support (6%, 265 ha). The Dairy Support category will be under-represented because that land use is only assigned when a property has been benchmarked.

Small blocks as business units for agricultural production purposes

- Very few small blocks <4 ha are registered for GST (2%).
- Agricultural GST registration (i.e. generally earning >$60k per annum) is much higher in the 10-40 ha range, indicating these owners have businesses more aligned with commercial farmers.

- Research indicates that while the majority of small block owners are engaged in some form of production from the land, generally this did not solely support their households.

Land valuation

- The 2014 total land value (rating valuations) of the small block sector is just under $389 million or 49% of the total value of rural land in the catchment ($800 million).

Attitudes to environmental practice

- Local research indicates small block owners tend to have low awareness about nutrient discharges and land use changes that reduce nutrient losses. Low awareness was linked to small block owners not having access to information from agricultural organisations to the same degree as farmers on large holdings. Low awareness was also linked to small block owners placing less importance on nutrient management.
- The two larger studies (regional and national) indicated that small block owners did not voluntarily engage in environmentally friendly practices and environmental monitoring to the same extent as seen in larger holdings. However, many small block owners intended to protect or encourage growth of native bush.

Estimates of nitrogen loss from the small block sector

- A total of 58 small blocks have been benchmarked, covering 1,016 total hectares and 855 effective hectares. The latter is 21% of the total small block sector effective area of 4,085 hectares (excluding dairy and grazed trees). Estimates of total small block N loss and potential 2032 NDA reductions were extrapolated from this 21%.
- A pro-rata extrapolation of known and area-banded small block provisional NDAs to the full small block sector gave a total potential reduction of 11.7 tN/yr. This reduction is relative to a status quo N loss estimate based on extrapolating known small block benchmarks to the full small block sector.
- Alternative small block extrapolations gave reductions ranging from 2.6 to 16.5 tN/yr, dependant on what proportion of small blocks were assumed to be permitted (@18 kgN/ha/yr) or given the default derived NDA (@24.7 kgN/ha/yr).
- The “simple” pro-rata small block extrapolation of 11.7 tN/yr represents 13% of the total drystock sector reduction of 86 tN/yr
- An 11.7 tN/yr reduction is 4.4% of the 264 tN/yr total pastoral sector total reduction envisaged under the draft rules, based on OVERSEER® 6.2.0 values. The small block contribution rises to 5-6% of total pastoral N reductions under alternative small block pNDA assumptions.

Market Economics Limited (2015). *Economic impacts of Rotorua nitrogen reduction: District, regional and national evaluation*. Report prepared for the Bay of Plenty Regional Council.

Executive summary (abridged)

To limit the deterioration of the water quality in Lake Rotorua, a nitrogen limit of 435tNyr-1 has been set by the Bay of Plenty Regional Policy Statement. This target requires a total reduction of 320 t N yr_{-1} with approximately 280 t N yr_{-1} arising from the pastoral sector. A Stakeholder Advisory Group was established to provide advice and recommendations on the development of policy to meet the nitrogen discharge restrictions set by the Policy Statement. It is envisaged that in addition to changes in pastoral land use and land management, the N targets will be met through allocation of N discharge allowances to land owners, purchases of those allowances from land owners by an ‘incentives fund’, and trading among landowners of the N discharge allowances.

Using input-output analysis this report calculates economic impacts, in terms of changes in industry value added and employment, for the district, regional and national economies arising out of changes in agriculture and forestry land use and practices to meet the nitrogen load targets. In addition to the national and economic data underlying the construction of the economic input-output model, the primary information relied on in this analysis is the outcomes of the farm and forestry-level modelling work undertaken on behalf of the

Stakeholder Advisory Group (Parsons et al., 2015). Eight different scenarios were considered in the farm and forestry-level modelling, each involving alternative assumptions about the way in which nitrogen discharge rights are initially allocated among land owners. This report considers only three of the eight scenarios: the 'single sector target' scenario (S1), the 'natural capital allocation' scenario (S4), and the 'sector ranges' scenario (S8).

Importantly, providing the trading of nitrogen discharge rights is fully efficient, the farm and forestry-level modelling produces the same distribution of land uses and types of farm systems across the catchment. This is because regardless of the allocation mechanism, the management regimes move towards the same (most efficient) use of land (although capital/equity impacts will vary for landowners depending on the initial allocation). To help further inform stakeholders of the potential outcomes of the policies, the farm and forestry level modelling also considers situations where land use change and trading in N discharge allowances is not fully efficient. Thus this report also presents results for scenarios assuming that total land use change is restricted to 5,000 ha and/or 50% N trading frictions.

To help place the impacts arising out of changes in pastoral and forestry systems in context, and to explore some of the potential positive impacts on the economy arising out of reduced nitrogen accumulation, this report also presents possible changes in value added and employment from increased tourism in Rotorua District. Conceptually, positive tourism impacts may arise from both increased visitor/tourist spending within the Rotorua District, or avoided losses in visitor/tourist spending. It is beyond the scope of this study to precisely identify the magnitude of likely tourism impacts associated with a cleaner Lake Rotorua.

Instead, we approach the quantification of these potential impacts through the use of a 'what if' scenario analysis, specifically by assessing the implications of a 1, 2 and 3 percent change in tourist expenditure within the Rotorua district economy.

Results

Comparison of scenarios

As explained above, a key aim of this work is to compare alternative scenarios pertaining to the allocation of N discharge rights among land owners. Considering four sets of assumptions regarding land use change and trading frictions, S8 performs the best of the allocation options considered, closely followed by S1. S4 is clearly the least favourable allocation option, particularly when the possibility of trading frictions is considered. Under this allocation scenario, considerable trading in nitrogen entitlements would be required in order to achieve the optimum land uses in the catchment, which is not possible when trading is restricted. It is important to note that while the value added and employment impacts may overall be the least severe when we assume only 5 000 ha and 50% trading frictions, the N load reduction achieved under this set of assumptions is less than that achieved under the other assumption sets.

Distribution of impacts

Assuming land owners fully optimise by way of land use change and nitrogen right trading, a total annual value added loss of $12.9 mil is estimated for the New Zealand economy as a result of changes within the pastoral sector to reduce N discharges. Of this total impact, $3.4 mil originates from within the Bay of Plenty Region and $2.5 mil from the Rotorua District. These impacts equate to approximately 0.09% of the economy at the district level, 0.03% at the regional level, and 0.01% at the national level. For Rotorua District, the economic impacts are primarily within the agricultural sectors themselves (e.g. of a total of 89 job losses, 60 job losses are in dairy farming and 48 in sheep, beef and grain), along with some flow-on impacts to dairy product manufacturing and services supporting agriculture. Value added impacts are about 36% greater at the regional level compared to the district level, and more than four times greater at the national level compared to the district. The primary differences between the region and district appear to be greater losses at the regional level for meat and dairy processing and agricultural supporting services (e.g. transportation and wholesale trade), as well as generally higher losses for service sectors due to supply chain linkages and reductions in consumer spending.

There are three primary reasons why a very high proportion of the total value added and employment impacts (at least in absolute terms rather than percentage terms) occur outside of the district and even the region: (1) the incentives scheme is funded equally by the Regional and National governments. This essentially creates a net flow of funds from the whole region and nation into Rotorua District to foster land use change, and by corollary the opportunity cost in terms of reduced expenditure elsewhere is felt across the whole region and nation; (2) a high proportion of the key manufacturers responsible for processing primary outputs from the Lake Rotorua Catchment are not located within the local catchment, or even the local district; and (3) a high proportion of the indirect effects associated with changes in agricultural systems affect organisations outside of the district.

Impacts for Rotorua District

The appropriate management of nitrogen load reductions for the Lake Rotorua Catchment is a policy issue particularly pertinent to Rotorua District economy and its local government. The estimated economic impacts on the district resulting from changes in farm systems necessary to meet N reduction policies alongside the estimated impact for the district assuming 1% net gain in tourism. In the interest of brevity, only results for the optimum land use and no trading friction assumptions are reported. These results help to highlight the importance of trade-offs in the allocation and use of the district's valuable environmental capital. Of no surprise, the sectors which are most likely to benefit from a net gain in tourism activity are also those which are among the least impacted within the region from the likely changes in farm systems. Importantly, just over half of the total tourism impact occurs within the two industries 'accommodation' and 'food and beverage services' (these are aggregated into the sector 'other services' for reporting), whereas for the farm system impacts these same two industries account for only about 0.1% of the total loss in value added (assuming optimal land use and no trading frictions.

Other considerations

This analysis has not attempted to calculate the full range of potential benefits (including avoided costs) and costs of reduced nitrogen discharges for the district, regional and national economies. This is largely justified given that the focus has been on evaluating alternative allocation options for nitrogen discharge rights under a consistent nitrogen load target.

Nevertheless, it is acknowledged that avoiding the accumulation of reactive nitrogen within the environment is likely to be of significant benefit to environmental/ecological systems and the industries and people who obtain value from these systems. Furthermore, the benefits of reducing nitrogen accumulation are likely to be of an ongoing nature, affecting generations to come. Equally this analysis does not attempt to evaluate any social costs arising from the N-reduction policies, including stress and disruption to land owners associated with transitioning to a lower-nitrogen discharge future.

It is also worth noting that this study (and the farm and forestry-level modelling upon which this study depends) applies current prices and mitigation options in evaluating the future outcomes of the N reduction policies. Additionally, forestry is the only major low-N land use option considered in the farm and forestry-level modelling. Future changes in prices may alter the assessment of optimum land uses and thus impact on land owner's decisions in ways different from those modelled. Also, significant research is being undertaken, both in New Zealand and abroad, on ways to improve nitrogen management within farming systems. Uptake of new methods, technologies and land use options could potentially mean that the nitrogen targets assigned to land uses could be met at different costs than those evaluated in this study.

Parsons O, Doole G, Romera A (2015). *On-farm effects of diverse allocation mechanisms in the Lake Rotorua catchment*. Report prepared for the Lake Rotorua Stakeholder Advisory Group.

Executive summary

The objective of this report is to evaluate a number of proposed nitrogen (N) allocation systems for producers in the Rotorua catchment. The results of this analysis provide information about private benefits and costs in terms of farm profit (EBIT) and capital impacts on land value. The different scenarios also provide insights about resource efficiency and the ease of transfer of the entitlements to leach nitrogen that each farm could receive across these allocation mechanisms.

Context

This report is intended to provide direct information for the Rotorua Stakeholder Advisory Group (STAG) and Bay of Plenty Regional Council (BOPRC), as well as to support wider district economic modelling undertaken by Market Economics. These discrete pieces of work support the section 32 report associated with new nitrogen rules for the Lake Rotorua catchment. The project brief was developed collaboratively between BOPRC, DairyNZ, Beef + Lamb New Zealand, with input from STAG members during the latter part of 2014. Draft modelling results were presented to StAG in March, April, May, June and July 2015, and feedback was incorporated up until August 2015.

Methods

The evaluation of allocation mechanisms involves the application of a catchment-level optimisation model. The method for developing this model involved:

1 Dividing the catchment into biophysical zones based on soil type, slope and rainfall.

2 Establishing representative farm systems (dairy, sheep and beef, sheep and dairy support, and specialist dairy support) for each biophysical zone. Drystock enterprises include small, medium, and large farms.

3 Developing agreed and consistent modelling protocols to reflect how Rotorua farmers would be most likely to mitigate nitrogen losses.

4 Applying the modelling protocols to each farm system, using FARMAX and OVERSEER® (version 6.1.2), to establish relationships between profit and nitrogen leaching.

5 Obtaining annualised forestry-profit information from SCION (including carbon at a price of $4 tonne-1).

6 Obtaining data on the financial costs and benefits of land-use change from Waikato Regional Council.

7 Integrating this information on profit and nitrogen leaching for individual farm types into an economic model describing the whole catchment. This model incorporates trading of N leaching rights both among farmers, and with an incentives fund that buys out nitrogen. Nitrogen prices are generated endogenously by the catchment model based on mitigation costs which drive supply and demand.

The optimisation model focuses on alternative steady-state or equilibrium outcomes. That is, it does not study the transition pathways between the current state and where alternative policy outcomes are predicted to lead. This approach is consistent with standard practice regarding the economic evaluation of alternative environmental policy instruments. Where time has a major impact on economic aspects (for example, capital impacts), results are discounted to 2015 dollar impacts.

Ownership of land is not represented within the model. Thus, any distinction between individual farms and ownership (e.g. iwi-owned property) is not made. Rather, the main building blocks are the individual zones, describing given land-uses and the biophysical conditions under which they are located (see steps 1–2 above).

Representative farm systems and mitigation protocols (each specifying the sequence of mitigation use for each farm type) were developed in workshops involving Bay of Plenty Regional Council (BOPRC) staff, DairyNZ, Beef + Lamb New Zealand, scientists, local extension agents, and agricultural consultants. Mitigation curves were not smoothed; accordingly, gaps between individual scenarios were not filled with hypothetical information. This approach was applied to ensure the maximum amount of rigor, transparency, and repeatability of the results (a full list of all input information into the economic model is provided in the Appendices).

The mitigation protocols, in most cases, result in costs arising on farms as they undertake nitrogen mitigation. This is in agreement with mainstream environmental-economics theory, but the relationship is not forced. Indeed, in some cases, increases in profit occur from improvements in efficiency (for example, by eliminating unprofitable inputs). These “win-win” outcomes occur on a number of different individual farm types, as has been previously documented in New Zealand case studies. In general however, the scale of reductions required in the Rotorua catchment is so significant that most individual farmers experience a net cost due to mitigation.

The costs and benefits of transition from the current land use to a new one are included in the catchment model. While some transitions impose a cost to producers, de-intensification also has some benefits in that it frees up capital invested in certain fixed assets (e.g. livestock or supplier shares). Carbon liability is incorporated in the computation of transition costs, and is also factored into the profitability of the forest sector (determined by SCION) incorporated within the model at $4 $tonne_{-1}$.

A number of different scenarios are analysed. This includes eight different allocation options (Table E1). These are evaluated for two levels of market efficiency for nutrient trading, and two levels of land-use change (Table E2). These scenarios are based on the needs articulated by the stakeholder group for the Lake Rotorua catchment. Market efficiency is explored through allowing free trade in entitlements and then only 50% of the optimal level; in the latter case, the remainder of the entitlements being retained by producers following allocation. Simulation of market inefficiency is consistent with experience in water quality and quantity markets where levels of rigidity are present, often due to risk aversion. The constraint on land-use change is introduced to reflect the fact that it is unlikely that the full amount of land-use change predicted by optimisation would occur in reality. This is because land-use change from pasture to forestry is tempered by factors such as the lack of an annual return, or negative impacts on land prices.

Other scenarios have been explored (e.g. greater or lesser levels of land-use change), but are omitted from this report for brevity. The predominant focus of analysis has been on the impacts on farm profit, the level of nutrient trading that occurs, and the distribution of income under different scenarios. This has been explored in considerable depth at the zone- and farm-level with stakeholders[232], but is limited to selected examples for this report.

Table 30 Eight allocation options studied for the Lake Rotorua catchment.

Allocation scenario number	Allocation option
Base	Baseline
S1	Sector averaging
S2	Sector averaging with biophysical adjustment
S3	Single range
S4	Natural-capital allocation
S5	Equal allocation
S6	Range 0A
S7	Range 1
S8	Range 2

Table 31 Scenarios used to explore the relative value of each allocation option.

Catchment scenario	Description
Base	This represents the status quo.
Optimal trading, optimal land-use (Scenario #1)	A theoretical outcome of perfect efficiency for comparison.
Optimal trading, 5,000 ha land-use change constraint (Scenario #2)	A scenario where not all efficient land-use change occurs due to risk-aversion by producers, but nutrient trading is efficient. Total land-use change is limited to 5,000 ha.
50% trading frictions, optimal land use change (Scenario #3)	This scenario includes optimal land-use change, but a constraint on the efficiency of nutrient trading, with 50% of allowances being retained by original holders.

[232] E.g. meetings of the Rotorua Stakeholder Advisory Group of 17 March, 28 April, 23 June and 21 July.

Catchment scenario	Description
50% trading frictions, 5,000 ha land use change constraint (Scenario #4)	This scenario includes a constraint on land-use change, as well as a constraint on the efficiency of nutrient trading, with 50% of allowances being retained by original holders.

Results

Overall, catchment-level impacts on total profit are modest, with slight increases for most scenarios and slight decreases for the natural-capital and equal allocation options, when these allocations are modelled with market inefficiency. However, this is distributed very unevenly across land-uses and biophysical conditions. Some enterprises experience benefits, while others face significant costs. Capital impacts on land values are significant across all land-uses. This poses particular risks in relation to the equity position of producers and their ability to manage commodity price volatility.

Several key general relationships are observed in model output. First, land-use transition is significant if cost-effective mitigation is to be attained. However, the study of land-use change in economic models of this kind is difficult, and this output is therefore subject to a range of restrictive assumptions outlined in the report. Second, nitrogen restrictions motivate deintensification of dairy production and associated support activities. Third, reducing high leaching rates involves a mixture of land-use change and on-farm mitigation. Last, inefficiency in the level of trading observed in the market for nutrient entitlements has significant impacts on the extent and distribution of farm returns. Expected values of N produced from the modelling were extrapolated to assess the likely impacts on land value associated with decreased rights to leach N.

More specifically, key impacts across all scenarios are:

1 An increase in forestry area, around 85% and 60% in Scenarios 1 and 2 (an increase from 7,095 ha to 13,085 and 11,403 and ha respectively)

2 A reduction in dairying area of around 40% from 5,024 to 3,046 ha.

3 A reduction in sheep and dairy support area of approximately 37% from 3007 to 1,900 ha.

4 Remaining dairy farm types must purchase N in order to remain viable. Changes to the allocation vary the costs for these farms, but not the optimal-management regime.

5 Lower-intensity dairy-support options involve substantial scope for de-intensification at reasonable cost, though this is balanced by relatively high capital impacts.

6 The profit of many drystock enterprises benefits from a capacity to increase their nitrogen use efficiency and sell entitlements to dairy farms and the incentives fund.

7 The impacts on land prices from reducing nitrogen-leaching entitlements are significant for both drystock and dairy farms. Profit data and regional analysis masks significant risk to existing farm businesses and potential for adverse social impacts as a result of negative equity positions.

8 A significant reduction in cow number, nitrogen fertiliser application, supplement use, and farm labour, with each effect likely to have regional implications.

9 Changes in the efficiency of land-use change or nutrient trading have large implications for the overall cost.

Results show a modest overall impact on total catchment profit. However, the impacts on profit are distributed unevenly across sectors, land-uses, and biophysical zones. Different allocation regimes create further variation in this distribution of cost. In general, drystock farm profits benefit from the ability to sell N (to businesses with higher profit per kilogram of N and the incentives fund). Dairy farm profits fall due to the need to acquire N in order to continue operating. Under allocations with more redistribution (such as equal allocation and natural-capital systems), dairy farm profits fall further, but drystock profits are not correspondingly improved. This is due to a large number of allowances being transferred from dairy farms to foresters under these regimes, rather than other pastoral uses. Allocation regimes which require a large amount of redistribution also result in increases in the N price, due to greater dependence on trading and increased market demand.

Pastoral farming profit within the catchment is reduced by around 5% in both land-use scenarios when a 50% trading friction is introduced to the model. Trading rigidities in the market have significant implications for the price of N, increasing the price for perpetual allowances from around $118 and $60 kg N-1 in the 5,000 ha limited and unlimited land-use change scenarios, to around $444 (up to $551 for natural-capital allocation). This higher price reflects an increased scarcity of nutrient entitlements in the market and is consistent with economic theory. This highlights that practices to pragmatically address rigidities in the market for nitrogen-leaching entitlements in the Lake Rotorua catchment will have direct benefits for increasing the amount of nitrogen that could be purchased by the incentive fund, while also reducing on-farm costs through promoting more cost-effective nutrient mitigation.

Likely capital impacts due to the change of rights in land are large, particularly when market frictions are considered. The capital costs on farms range from $2.5m to $18.4m under the range scenarios (S6–S8 in Table E1), to $22.9m under natural-capital allocation. Capital impacts are larger on dairy farms under all scenarios. The natural-capital allocation results in the majority of capital impacts falling on dairy and dairy support farms ($6,906 and $1,449 per hectare, respectively), with large gains to forestry owners relative to the current rules ($2,413 per hectare). Smaller capital costs occur for sheep and dairy and sheep and beef farms ($201 and $405).

The Range allocation scenario still produces higher capital costs for dairy farms ($2,357 per hectare) than other land-uses, due to the higher percentage clawbacks proposed for these land uses by the Stakeholder Advisory Group, relative to drystock. Dairy support, sheep and dairy, and sheep and beef experience costs of $1,074, $401, and $585 per hectare, respectively. Due to the fact that the range scenario does not allocate additional nutrients to forestry, there is no change for this sector relative to the current regulatory environment under Rule 11.

While the impacts on dairy capital value are higher (even in a proportional sense), it is important to recognise that the estimated capital impacts of Rule 11 are higher for drystock farms and the impacts of new rules are in addition to this. These capital impacts are of significant concern due to the possibility of debt exceeding equity for some farms in the catchment, creating significant social disruption.

Perrin Ag Consultants Ltd (2014). *Rotorua NDA impact analysis: Phase I Project, Rotorua*. Report prepared for the Bay of Plenty Regional Council.

Executive summary

The Bay of Plenty Regional Council ("BOPRC") is in the process of developing Nitrogen Discharge Allowances ("NDA") for all pastoral land in the Lake Rotorua catchment with the purpose of improving water quality by reducing nitrogen and phosphorus inflows into the lake. The BOPRC and the Stakeholder Advisory Group ("StAG") have suggested draft restricted NDA levels of 35kgN/ha/year for dairy, 13kgN/ha/year for drystock farms and 3kgN/ha/year for trees. The draft NDA values are based on analyses using versions of OVERSEER® 5.

Perrin Ag Consultants Ltd ("PAC") was engaged to analyse the financial implications of the NDA levels at an individual farm level. This was accomplished using a range of hypothetical and real farm case studies that were deemed to be illustrative of farms within the Lake Rotorua catchment. The case study farms were modelled in Farmax and OVERSEER® to determine how operating profitability changed as farmers made realistic decisions to optimise their farm systems in a restrictive N loss environment. These changes were limited to those appropriate within the existing farming systems.

Reducing nitrogen losses in existing pastoral grazing systems primarily requires changes that should reduce the inefficient cycling of N that occurs in pastoral systems. Some of these strategies can result in an accompanying improvement in farm financial performance, but invariably it appears to be farm systems that have lower levels of productivity that have the greatest capacity to reduce whole system N losses while maintaining or increasing underlying profitability. This assumes that such farms and farmers have the capacity to achieve these higher levels of productivity. However, where farms already utilise N efficiently, system changes to reduce N losses were found to result in losses of farm profitability.

The case studies analysed suggest that farming under a restricted nitrogen loss regime, like that proposed for the Lake Rotorua catchment, is likely to have differing financial impacts across farms and farm systems.

The dairy farm case studies typically relied on a combination of lower annualised stocking rates, improved per cow milk sol ids production and replacing high N feed and high N loss feed with low protein alternatives to achieve N loss targets. However, despite these changes, most of the case studies experienced some degree of decline in operating profit (EBIT), ranging between 0% and 10%, in reaching the proposed limits. It is recognised there is likely to be a knowledge/capacity gap within many existing dairy farmers that needs to be bridged to allow many of these mitigations to be implemented. There may be some structural and industry issues that will also need to be addressed e.g. providing large quantities of low N forage/feed with its own manageable environmental footprint.

Dry stock case study farms typically relied on firstly eliminating the use of N fertiliser where it was deemed to be unprofitable and eliminating winter cropping to lower N losses. After that maximising meat, wool and feed sold off farm from the available feed and/or shifting feed used for livestock maintenance into more N efficient livestock classes were key strategies.

In the case studies, mixed sheep, beef and deer systems appeared to have a greater ability to meet suggested targets, particularly the single NDA limit of 13kg N/ha/year, without nominal reductions in profitability from current levels, borne out by the fact that many of the case studies already operated under, at or close to that NDA limit. However, the extent to which these changes resulted in profit increasing, decreasing or remaining unchanged relied heavily on the relative profitability of the various enterprises and their mix in the system. As with the dairy farm cases studies, the ability of individual farmers to implement higher levels of productivity within their systems is likely to be a significant factor in whether or not N mitigation can be successfully implemented without reduction in operating profit. Further

reductions beyond this level [13kg N/ha/year] will likely have negative implications for sheep & cattle farmer profits, particularly once productivity improvements have been exhausted. Those systems exposed/taking advantage of the dairy industry's requirement for off-farm grazing are potentially amongst those most affected by the need to reduce N losses.

It is also important to recognise that the forecast reductions in operating profit will have differing implications for farm businesses, given their individual balance sheet configuration and the extent of commitments on their business that fall outside of the operating profit measure. In this sense, operating profit provides an excellent measure of system resilience to N loss restrictions, but not necessarily that of individual farm businesses in the community.

The proposed NDA restrictions for the Rotorua catchment will undoubtedly require some degree of farm system change over the coming years and some economic and social disruption to the farming (and wider) communities. The extent to which farm systems will be financially affected by this, against the normal backdrop of price and climate volatility and the differing goals and objectives of individual farmers, is difficult to determine. Our analysis suggests that improving productivity and system efficiency will be vital elements in ensuring farm businesses stay viable.

For both drystock and dairy farmers, level of farming efficiency and/or profitability can be expected to follow a normal distribution. Hence there will always be below-average and above average farmers. The notion that below-average farmers can somehow become average or above-average farmers is somewhat simplistic. Level of farming performance is influenced by a range of drivers including business and personal goals, and management skills. Whilst the former might be influenced by regulation, it is not a simple task to lift inherent farm management skills. *The BOPRC will need to actively engage with industry to ensure that farmers are adequately supported to make these changes.*

While OVERSEER® is currently the best tool available for estimating the likely impact of farm system change on nutrient losses from the farm system, the significant and sometimes inconsistent increases in forecast N losses from the case studies when modelled in OVERSEER® v6.1.2 provide some cause for concern, particularly for non-dairy farmers. Accordingly, we recommend farmers and regulators focus on the implementation of management and system changes to increase individual animal productivity, reduce inefficient N use and reduce the incidence and intensity of urine patches during the late autumn and winter periods with a view that these will result in real and measurable reductions in N losses once apparent OVERSEER® irregularities are resolved.

The conclusions reached from this analysis are undoubtedly limited by the small sample size (18 case studies) and the fact that only four were real farms, although the hypothetical farms were largely based on real enterprises. It is therefore impossible to make any valid catchment extrapolation, although we note this was not an expectation or deliverable from Phase 1 of the project. The use of EBIT as a profitability measure also focuses on the financial impacts at a farm system level, rather than at an individual farm business level. While this provides for comparisons between individual farm types and enterprise mixes, it doesn't provide any insight into the overall resilience of the individual farm businesses that will be affected by the proposed NDA limits.

As regards expanding on findings from this Phase 1 project which considers financial implications for individual farms in the Rotorua catchment, we would recommend additional analysis on:

(i) Separating the impact of productivity improvements from pure mitigation activity i.e. "optimise" farm system first and then apply mitigation actions;

(ii) The implications of managing the impacts of wintering milking cows on dairy platforms, with or without infrastructure i.e. barns;

(iii) Considering elevated per cow production levels (System 5 farms, >500kg MS/cow) for a real dairy farm system, perhaps in conjunction with (i) above;

(iv) Considering the resilience of the low N loss scenarios for case studies under more extreme pasture growth conditions (i.e. drought in 2012/13, wet year in 2011/12) and the input/output prices that accompanied these;

(v) Expanding financial analysis of the real farm case studies to an NPAT level or looking at the NPAT impact for hypothetical case studies using assumed equity levels, and then sensitising against cost of capital.

(vi) Looking at less simplified afforestation options for mitigation on more marginal sheep & beef land;

(vii) An alternative deer farming scenario, say a velvet/stud operation

In the context of the wider catchment impact analysis flagged to follow the Phase 1 project, we would recommend that stakeholders examine:

(i) The implications of large scale adoption of preferred mitigation tools on the cost/benefit of these e.g. trebling maize silage use in the local dairy industry;

(ii) Alternatives for sourcing low protein feed stuffs;

(iii) Downstream community economic effects from potential losses in profitability;

(iv) The impact of land values over time and how real farms might be affected by this.

Telfer Young (2014). *Land values in the Rotorua area and the Lake Rotorua catchment*. Report prepared for the Bay of Plenty Regional Council.

Summary

In all the analyses, there is a small data sample creating limited statistical reliability. Farms and lifestyle blocks are highly varied in their physical characteristics and as such analysis in terms of $/ha is not particularly reliable. A valuer undertakes more detailed analysis to allow for differentiation in physical characteristics, size, contour, soil type and other characteristics. The stated opinions of the value impact are considered to provide a superior interpretation as to the actual value implications of location within the Lake Rotorua catchment.

5.0 Lending criteria

A questionnaire (Appendix 3) was circulated to the 5 major lending institutions for rural and lifestyle property to ascertain whether conditions imposed on landowners in the Lake catchment differ from those imposed on other borrowers.

Due to confidentiality issues associated with this information, the survey results are summarised only:-

1 None of the lending institutions imposed any specific loan conditions on property loans within the catchment as opposed to outside of the catchment

2 The majority of the lenders are required to identify specific risk factors associated with all property. Location within a Lake catchment is a risk factor. Compliance with rules/regulations are a condition of most loans.

3 The majority of loans are subject to a 3 year valuation review. This review is either internal bank valuation or external registered valuation.

4 On review of valuations it is expected that any negative value impact on rural property values due to nutrient regulations will be incorporated within the valuation. (This impact may already have been factored into current loans. Any further value impact due to changing policy may further reduce loan valuations).

5 All of the banks anticipate location in the catchment has resulted in value reduction although this is not quantified

It can be concluded that nutrient policy has indirectly impacted on mortgage lending simply through any valuation changes which occur following the introduction of new or proposed policies. The banks generally undertake stress testing on farm budgets, which testing is potentially more vigorous on lake catchment farms, particularly in view of new proposed policies.

6.0 Draft policy

The draft policy details have only been confirmed as of July 2014 with initial Public Consultation scheduled up to 14 October 2014 (extended to 31 October) and revised draft rules to go before councillors in December in preparation to formally notify in March 2015. It is considered too early for any meaningful analysis to be undertaken as to the impact of these policies however the following matters are apparent within the rural property sector

1 Knowledge of the impact on lifestyle size blocks is increasing. With this awareness the subjective 5% reduction in value for smaller blocks is expected to be substantiated.

2 For Dairy and Dry-stock values we conclude that Rule 11 impact has a correlation to the economic constraints with a benchmark imposed on a farm.

3 It is expected that the Draft rules will create a further 10-15% decline in both dry-stock and dairy farm values.

7.0 Conclusions

1 In summary, for dairy farms the introduction of Rule 11 is considered to introduce a nominal 10% reduction of value simply reflective of imposition of land use restrictions. A further 5%-10% reduction is considered to apply dependent upon the actual nutrient allocation (higher % where low nutrient benchmark). The Regional Policy Statement (RPS) proposal is expected to create a further 10%-15% reduction by reducing the farming capacity below the previous benchmarks.

2 Based on sales data, and taking into account differentials in farm contour, size and productive capacity, it is our opinion that there is a negative value impact of 10-20% on pastoral farms (dry-stock) in the catchment will arise following the RPS This class of farm land having potentially experienced a 15-25% impact on value as a consequence of Rule 11. The quantum reduction is reflective of the limit which either the initial benchmark or revised nitrogen cap imposes on the lands highest and best use.

3 Values for lifestyle blocks in the catchment are significantly higher than for those outside based on proximity to the city, lake views and other amenity values. The value of larger blocks is affected because of restrictions in commercial potential (10%-25%). The lifestyle block impact is negligible where there is no economic return. It is recognised that the farm values whilst related to economic indicators are also influenced by locational/lifestyle/development factors. The existing Certificate of title make up and/or subdivision potential may partly offset the impact of the nutrient rgulations.

4 In terms of rating assessments, I believe the data will show that an approximate lift of 20% above the 2011 values for farms outside of the lake catchment reflecting an uplift in sale prices, however for lake catchment farms there will likely have been minimal change between 2011 and 2014. I would conclude that the rating assessments inside the catchment should not have changed or may indeed have been reduced to show the differential inside/outside which may not have existed beforehand.

5 For both Rule 11 and RPS, the impact on property values is highest where the assessed benchmark results in the land's highest and best use potentially not being feasible. For example, a dairy farm with Rule 11 N allocation of 65 kg N/ha/yr would have a lower discount in value than a farm allocated 40 kg N/ha/yr due to having limitations on potential farm management practices. Under the RPS, where the NDA of a dairy farm falls to the minimum allocation, it will become difficult to farm viably and owners may be forced to consider a less intensive land use. In this scenario, a greater reduction in value will occur in comparison to the farm at the upper end of the scale which, although restricted, will still be able to adopt viable dairying practices.

6 There is no evidence of a discernible impact on the number of sales of pastoral farms, dairy farms or lifestyle blocks in the Lake Rotorua catchment due to the introduction of nutrient regulations.

7 Certainty is important and enables the market to operate efficiently. Uncertainty creates a greater price differential, and is likely to impact on decisions to buy or sell.