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Nitrogen Trading in Lake Taupo: An Analysis and Evaluation of an Innovative Water Management Strategy

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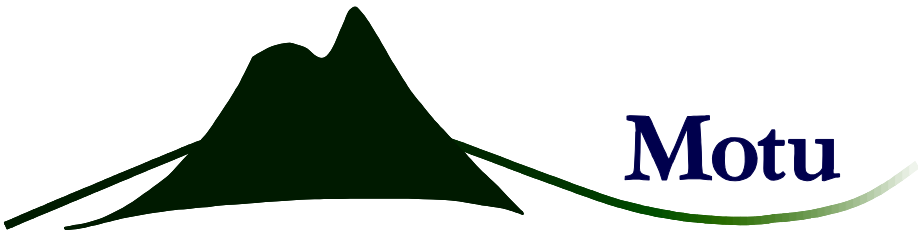

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Abstract

This paper provides a concise introduction to and evaluation of the Lake Taupo nitrogen cap and trade program established as part of Waikato Regional Council's recent Regional Plan Variation Five. The policy establishes a catchment-wide cap on nitrogen losses by allocating farmers individual nitrogen discharge allowances and allowing those farmers flexibility to trade allowances amongst themselves and to sell allowances to a public fund while remaining within the overall catchment cap. This paper seeks to explain the structure and evolution of the nitrogen trading market and to analyse its impact thus far by drawing on a wide variety of relevant perspectives. Research drawn from written material and basic quantitative data provide the basis for analysing the policy, while interviews with relevant stakeholders provide insight into the successful, surprising and contentious issues which arose throughout its development and implementation.

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1. Introduction

Known for its pristine water quality and breathtaking views, Lake Taupo and the surrounding catchment exists as an iconic feature of New Zealand's North Island for residents and tourists alike (Petch *et al.*, 2003). As the country's largest, Lake Taupo stretches 30 kilometres wide and 40 kilometres long (Young *et al.*, 2010). The 3,497 square kilometre catchment surrounding the lake plays host to a range of pastoral, forestry, urban and conservation land uses[1]. Those who benefit socially, economically and culturally from a healthy lake share a strong appreciation for the high quality of the lake's waters. Indeed, over 90% of landholders expressed that preserving the quality of the water is a top priority for the region (Environment Waikato, 2003).

1.1. Motivation: water quality decline and policy response

Although Lake Taupo currently exhibits exceptional water quality, a gradual increase in catchment land development over the past century threatens to substantially impact future water quality if left unchecked by an effective policy intervention. Recent scientific investigation has revealed a gradual but steady decline in the water quality of Lake Taupo over the past three decades, as evidenced by elevated levels of nutrients in the water (Vant, 2008). These investigations have confirmed the connection between intensified pastoral and urban land use over the past 35-50 years and the observed increase in nutrient levels (Young, 2007). As a result of both natural and human-induced processes, nutrients such as nitrogen enter the lake's waters and support growing algal populations which in turn reduce overall water clarity (Vant, 2008). In this way, intensification of land development in the catchment threatens to reduce Lake Taupo's water quality as measured in terms of nutrient density and water clarity.

In particular, nitrogen losses stemming from agricultural land uses have been identified as the primary threat to water quality. Total nitrogen discharges into the lake amount to an estimated 1360 tonnes per year, of which 804 tonnes per year originate from natural or unmanageable sources compared to 556 tonnes per year from manageable or human-induced sources. Pastoral activities alone account for 92% of all manageable sources of nitrogen loss, and thus provide the most promising avenue for achieving nitrogen reductions to protect water quality[2]. In the Lake Taupo catchment, it can take decades for nutrient losses in various parts of

[1] See appendix 6.1 for a map of catchment land uses over time and appendix 6.3 for a breakdown of land uses within the catchment

[2] See appendix 6.4 for a breakdown of sources of nitrogen within the catchment

the catchment to impact observed water quality. Because of the gradual progression from surface land to groundwater to lake water, there exists a considerable time lag between the activity causing nutrient discharge and the consequence of that discharge on water quality indicators (Vant, 2008). As a result scientists anticipate a continued decline in water quality as the impact of past decades is felt, even without further land use intensification.

This situation has motivated the development of a water management policy that preserves Lake Taupo's water quality by taking into consideration the impact of past, current and future land uses. Charged with the responsibility for developing such a policy, Waikato Regional Council (WRC, formerly Environment Waikato) set as a goal to restore water quality to 2001 levels by the year 2080. Importantly, WRC aims to achieve this goal while minimizing economic costs and sharing costs among local, regional and national communities (Environment Court New Zealand, 2011). In addition to preventing further increases in nitrogen losses each year, WRC determined that a 20% reduction in nitrogen losses across the catchment would be necessary to achieve this water quality goal (Vant, 2008).

Since agricultural activities targeted as the main source of nitrogen losses are key activities for agricultural businesses, policy measures to reduce nitrogen losses by capping or reducing farm production could have a significant impact on economic outcomes for farmers. Farm management changes aimed at reducing nitrogen losses such as lowering stocking rates or changing grazing patterns could shrink profits and prove very costly for farmers. Thus we would expect that any policy mandating certain farm management practices to limit nitrogen losses would place a significant financial burden on these farmers. Additionally, mandated farm management practices would severely restrict farmer flexibility to make individualized business decisions and would remove any incentive to seek other ways of reducing nitrogen losses associated with agricultural production. Similarly, any policy that calls for voluntary management changes by landowners would be ineffective, as few farmers would choose to adopt practices that limit nitrogen losses at the expense of profits if not required to do so (Ledgard, 2007).

It is within this context that WRC has developed Regional Plan Variation 5 (RPV5), an innovative water management policy which establishes a cap on nitrogen and seeks to permanently reduce nitrogen losses across the catchment[3]. In addition to various wastewater regulations not relevant to the current discussion, the policy consists of several main components. The first is a cap on all nitrogen discharges across the catchment which requires landowners to maintain nitrogen losses at current levels as specified by individual nitrogen

[3] See final version of RPV5, fully operative 7/7/2011 (Environment Court New Zealand, 2011)

discharge allowances. The second is a permanent 20% reduction in nitrogen discharges across the catchment which a publicly funded trust will achieve through the purchase and conversion of land or purchase and permanent retirement of nitrogen allowances.

A final key component of the policy is the establishment of a nitrogen trading scheme. This system provides farmers the flexibility to trade units of nitrogen allowances with other farmers or with the publicly funded trust. The policy allows for farmers to increase their own nitrogen losses above their individual allowance as long as that nitrogen increase is offset by an equivalent decrease elsewhere in the catchment by another farmer. The trading system is designed to provide farmers the flexibility to change management practices while preserving the overall catchment cap on nitrogen and thus ensuring that water quality targets are met.

1.2. Research focus and methodology

A nitrogen cap and trade program provides what could prove a powerful policy solution for addressing the water quality issues facing Lake Taupo. Given the intention of the policy to achieve a water quality target and provide farmers with additional flexibility, this paper seeks to analyse and evaluate the impact of the policy thus far. Our research seeks to identify useful lessons for this catchment and for other water management cases in New Zealand and abroad.

Our research draws on written materials, trading activity data and detailed interviews with stakeholders to provide context surrounding the development of the policy and the basis off of which to analyse the impact of the nutrient trading system.

1.3. Main findings and interpretation

While a nitrogen cap and trade system presents an innovative and significant policy solution, there have been several practical obstacles to designing and implementing the policy. Establishing the level of the cap needed to reach the environmental target has involved several key decisions which determine how land use activities and climatic conditions translate into a baseline measurement of nitrogen losses. Furthermore, determining a nitrogen reduction target has required close consideration of the complex science that governs the movement of nitrogen into the lake and the impact of that nitrogen on water quality over time. For example, while the 20% reduction target strikes a balance between scientific uncertainty, environmental goals and social and economic impacts there exists concern that additional reduction may eventually be needed to restore the quality of the lake's waters (Vant, 2008).

Beyond imposing a catchment-wide cap on nitrogen losses, establishing individual tradable allowances for a collection of diffuse non-point sources of nitrogen spread across the catchment presents a unique policy challenge. Losses from non-point compared to point sources such as large factories are more difficult to measure and monitor, and require reliable estimation and modelling to quantify (Greenhalgh, 2008a). Indeed WRC is the first worldwide to take on the challenge of establishing a non-point source nutrient trading system as a water quality solution. Although allowance trading applies mainly to agricultural landowners, the policy has impacted a wide variety of landowners in the catchment. The Ngati Tuwharetoa, as owners of some 40% of catchment land as well as owners and caretakers of the lake bed itself have a particular interest in and responsibility to protect the quality of the lake water (Young *et al.*, 2010). Forestry owners also stand to feel the impact of the policy as the grandparenting of allowances locks them into low nitrogen uses and threatens to restrict further development. This wide variety of stakeholders has made ownership and inclusion in the development process and satisfaction with the final policy design a challenging but nevertheless important process (Yerex, 2009).

Although RPV5 is yet a young policy and we should be careful to draw hard and fast conclusions regarding its impact, evidence indicates that the nitrogen cap has effectively limited nitrogen losses into the lake while the public fund and trading system have provided valuable flexibility to landowners. While a strict cap would otherwise prevent farmers from expanding production or converting land to a more profitable but more nitrogen-intensive use, including an allowance trading component has served to make the cap less restrictive. Given the option to buy or sell nitrogen, farmers can consider the relative costs and benefits to be gained from making management or land use changes that will enable them to increase production and purchase nitrogen, or decrease production and sell nitrogen[4]. In this way, farmers have enjoyed some limited flexibility in terms of land use and production intensity and so have been able to achieve nitrogen reductions at a minimal cost (Greenhalgh, 2008a and Greenhalgh, 2008b). The Lake Taupo trading system is still immature, however, the principles of flexibility provided by an allowance trading program have provided an intriguing market-based way to minimise the cost of reducing nitrogen losses, something that could not have been achieved by a regulated cap alone.

[4] See (Greenhalgh, 2008a) and WRC's Nitrogen Sourcing and Trading in the Lake Taupo Catchment (Environment Waikato, 2010) for a description of the conditions under which trading might occur and how the trading process takes place

1.4. Structure of paper

Section 2 provides an overview of the structure of the policy and the nutrient trading system established as a core element of the policy. Section 3 goes on to outline various key decisions taken during the development of the policy which provide context for understanding and interpreting the impact of the policy. Section 4 provides the bulk of the analysis and evaluation of the policy overall and the trading system in particular, and is followed by a brief conclusion in section 5.

2. Overview of policy design and nitrogen trading market

This section provides a general overview of the design of RPV5 with reference to each of the rules relevant to the nitrogen trading system and an overview of the trading market structure. Since its early stages in 2000, RPV5 has undergone several iterations and years of review in the Environment Court of New Zealand before its finalisation in July 2011[5]. The final version specifies rules that address who is covered by the cap, how nitrogen allowances are measured and allocated and how nitrogen allowances can be traded.

In order to account for nitrogen losses around the catchment, various land uses are classified as permitted, controlled or non-complying activities and regulated accordingly[6]. The nutrient trading system applies to those dry stock and dairy farming activities which result in substantial nitrogen losses that need to be measured and accounted for under the catchment-wide cap as controlled activities[7]. As controlled activities, farmers engaging in these land uses are required to apply for a resource consent with the Waikato Regional Council. This process requires farmers to establish an individualised nitrogen discharge allowance (NDA) based on

[5] See appendix 1.1 for a timeline of important events in the development of RPV5.

[6] **Permitted activities** are those whose nitrogen discharges are so minimal as to not require formal approval, benchmarking or measurement. These include low-nitrogen leaching farming activities as specified by rule 3.10.5.1. Rule 3.10.5.1 applies to farms leaching less than 8 kg/ha/year, and specifies certain stocking and fertiliser application limits. It is estimated that there are approximately 900-1200 such lifestyle farming blocks which together only account for 5% of all pastoral land in the catchment. Rule 3.10.5.2 applies to non-farming activities such as indigenous vegetation, forestry and golf courses conditional on certain nitrogen fertiliser application limits. Rule 3.10.5.12 assumes background leaching of 2 kg/ha/year for unimproved land and 3 kg/ha/year for plantation forestry. Low-nitrogen leaching activities resulting from the development of undeveloped or forestry land are classified as **controlled activities** under rules 3.10.5.4 and 3.10.5.5 and are subject to slightly different regulation. These rules permit the development of Maori and non-Maori lands by allowing landowners to exceed pre-determined background nitrogen leaching rates by 2 kg/ha/year for a collective total of 11,000 kg and 3,100 kg respectively. **Non-complying activities** as specified by rule 3.10.5.9 are those not defined as either permitted or controlled activities by rules 3.10.5.1 to 3.10.5.8.

[7] Rule 3.10.5.3 classifies nitrogen leaching farming activities as **controlled activities**. Note that lands converting from non-pastoral to pastoral uses after July 2005 must apply either as a permitted activity under rule 3.10.5.1 as a low nitrogen leaching farming activity or as a controlled activity under rule 3.10.5.3 as a nitrogen leaching farming activity.

exiting management practices and demonstrate ongoing adherence to that NDA[8]. Figure 1 summarizes the size of existing farms in the catchment. It is estimated that all farms greater than 20 ha and roughly 50 of those farms smaller than 20 ha will be required to apply for a resource consent as controlled activities, for a total of approximately 250 properties.

Property Size	Number of Properties	Total Area (ha) (Includes retired land)	Percent of Catchment Land
Less than 20 hectares	900 - 1206		5%
Between 20 and 100 hectares	100	4221	8%
Greather than 20 hectares	92 - 100	63318	87%

Figure 1: Summary of Pastoral Properties in the Lake Taupo Catchment (Hania, 2008) & (Hayward, 2011)

2.1. Benchmarking and allocation based on historical nitrogen losses

Benchmarking and allocation of nitrogen allowances to landowners in the Lake Taupo catchment follows a grandparenting scheme where historical nitrogen losses determine future nitrogen allowances. As will be further discussed later, this allocation method received resistance from those who found this form of allocation unfairly restrictive on historically non-intensive land uses and unfairly lenient on historically intensive land uses. These parties presented averaging or delayed averaging schemes as preferable alternatives for allocation. It was ultimately decided to allocate allowances on an individual basis using historical benchmarking, which calls for estimating recent nitrogen losses based on a specific set of management practices to determine a farmer's maximum allowable nitrogen output going forward.

Benchmarking on a case-by-case basis presents a particular challenge given uncertainty surrounding how particular land management practices translate into nitrogen losses. The fact that nitrogen losses are impacted not only by land management choices such as stocking rates and nitrogen fertiliser use, but also by uncontrollable factors such as the season, weather conditions and the property's proximity to the lake, further complicates the establishment of an individual nitrogen benchmark that will yield desired environmental outcomes. RPV5 standardizes benchmarking across heterogeneous farms by specifying the use of AgResearch's

[8] Following the finalisation of RPV5 on 7 July 2011, farmers have until 7 February 2012 to complete the benchmarking process and apply for a resource consent. As of July 2011, 97% of farms had completed the benchmarking process.

software tool Overseer™ (hereafter called Overseer). Overseer takes various management and environmental variables as inputs to generate an estimate of past nitrogen losses. As part of the catchment-wide cap, these estimates of past nitrogen losses determine a farm's initial NDA[9].

Any proposed land management changes, whether they will be undertaken independently or as part of a nitrogen trade, must be reassessed to demonstrate ongoing compliance with a farm's individual NDA and ensure that the catchment-wide cap is not exceeded. Farmers must outline the new practices in a nutrient management plan (NMP) and run Overseer to determine nitrogen losses that can be expected under the new management plan. NMPs are also required for approval in the event of purchasing or selling nitrogen allowances as is likely in the nitrogen trading market.

2.2. Nitrogen trading market

RPV5 grants farmers flexibility to deviate from their NDA by permitting those farmers to offset any nitrogen losses above and beyond their specified allowance by an equivalent corresponding decrease in nitrogen losses elsewhere in the catchment[10]. This essentially creates a nitrogen trading market, where farmers facing high nitrogen reduction costs in terms of output and profits may choose to buy nitrogen allowances from another farmer, and vice versa.

2.2.1. Buyers and sellers in the market

Buyers and sellers in the nitrogen trading market include those who perceive they have something to gain from changing management practices and trading their surplus or deficit of allowances with others. Sellers of nitrogen allowances might include farmers who have a relatively inexpensive way to reduce nitrogen losses and choose instead to discharge nitrogen below their initial allowance and sell the surplus nitrogen for a profit. Similarly, buyers are their natural counterpart; buyers are those farmers for whom more profits can be gained by intensifying production and paying for any additional nitrogen allowances needed by purchasing allowances from another farmer.

[9] Landholders are free to choose any year-long period between July 2001 and June 2005 off of which to base the assessment of their historical nitrogen losses in order to determine their NDA going forward.

[10] Rule 3.10.5.7 provides flexibility for offsets (trades) among high nitrogen leaching farming activities deemed controlled activities by rules 3.10.5.3, 3.10.5.6, and 3.10.5.9. Note that rule 3.10.5.6 refers to the division of high leaching farms. See footnote 6 for more on descriptions of rules 3.10.5.5 and 3.10.5.9. RPV5 also allows for previously low nitrogen leaching farming activities to expand production and apply for a resource consent under rule 3.10.5.3 so long as they purchase nitrogen from a willing seller to offset their increase in nitrogen.

Another common buyer of allowances is the Lake Taupo Protection Trust (LTPT), a public fund jointly financed by national, regional and district government and charged with accomplishing the mandated 20% permanent reduction in nitrogen losses[11]. In addition to purchasing and converting land, LTPT purchases and permanently retires allowances available for sale, thus indirectly helping farmers gain a benefit from their nitrogen-reducing management changes.

2.2.2. Format of nitrogen trading market

Although RPV5 itself does not explicitly outline the infrastructure of the nitrogen trading market, WRC has established certain guidelines to enable trading to take place (Greenhalgh, 2008a). An online guide for farmers outlines how the trading process should take place and what conditions would help a farmer gain from trade (Environment Waikato, 2009). WRC has established an online marketplace for the advertisement of NDAs offered for sale or sought for purchase[12]. This format allows all interested parties the ability to access information regarding who is offering NDAs for sale or for purchase, what is the proposed price and what is the length of the trade. All trades are permitted for a period of time up to but not beyond a common expiration date of July 2034 (Environment Court New Zealand, 2011).

3. Policy evolution: successes, surprises, opportunities to improve

The initial water quality concern for Lake Taupo evolved over the course of nearly a decade into the nitrogen management policy currently under implementation in the catchment. Extensive stakeholder engagement, 136 submissions to Waikato Regional Council and several months of Environment Court hearings went into developing the policy into its current state. While all parties expressed general support for taking action to preserve the quality of Lake Taupo's waters, there was less agreement about what form such a policy should take[13]. Understandably, landowners in the catchment expressed concern for what a limit on their allowable nitrogen discharge would mean for business, while others outside the catchment

[11] Note the Lake Taupo Protection Trust aims to remove 20% of manageable nitrogen entering the lake, roughly 100 tonnes nitrogen per year. 100 tonnes entering the lake equates roughly to 153 tonnes nitrogen per year occurring at the land surface level. See http://www.laketaupoprotectiontrust.org.nz/page/lake_27.php#purchase.
[12] See Waikato Regional Council http://www.waikatoregion.govt.nz/Templates/Public/Classified/Search.aspx
[13] Interview with Tim Bennetts, Local Government New Zealand and formerly of the Ministry for the Environment, 8 July 2011

echoed with concern for what a nutrient management policy within the catchment would mean for forestry and farming industries as other catchments followed suit. In order to better understand and evaluate the impact of the policy, it is important to provide context as to how certain key decisions were made and what factors drove those decisions.

3.1. Lake Taupo Protection Trust and 20% nitrogen reduction target

The decision to create a public fund to permanently remove 20% of nitrogen discharges from the catchment reflects a commitment to the water quality objective and to sharing the required economic costs among local, regional and central government.

A return to the water quality levels of 2001 requires taking into consideration both previous and current land uses impacts. A simple cap alone would be insufficient to reverse the decline and restore 2001 water quality, since there remains a substantial amount of nitrogen progressing through a decades-long transit into the lake's waters. As stated in the final variation, the permanent removal of nitrogen intends to compensate for this nitrogen 'load to come' and to ensure that the lake reaches long term equilibrium (Environment Court New Zealand, 2011). The exact percentage chosen reflects a balance between scientific knowledge of the environmental impact of nitrogen and the social implications of reduction (Young, 2007). The higher the reduction target, the greater the costs imposed on farmers, whose production levels and nitrogen discharges are closely correlated to production and revenue through stocking levels. On the other hand, there exists some scepticism about whether a 20% reduction target will be enough to fully compensate for the load to come. Scientific estimates for the exact percentage of the load to come range from 30% to 41% of the current manageable load, with other estimates as high as 80% (Hadfield *et al.*, 2007). During the Environment Court hearings, a panel of scientists agreed that a 20% reduction would be sufficient for achieving medium-term environmental goals, but warned that the actual load to come over the medium term will most likely exceed 20% (Hadfield *et al.*, 2007). In a situation where additional reductions would come at a greater social and economic cost, several sources indicated a preference for establishing the 20% target in the interest of moving forward and leaving the option for future review as more scientific understanding becomes available[14].

The establishment of the Lake Taupo Protection Trust as the body responsible for funding and achieving the 20% reduction reflects a unique commitment on the part of government to ease the financial burden on landowners in the catchment. Central, regional and

[14] Interview with Tim Bennetts, 8 July 2011

local governments each provide the Trust with 45%, 33% and 22% respectively, for a total of $81.5 million in yearly instalments terminating in 2018 (Environment Court New Zealand, 2011). In order to "minimise the cost of social change" the Trust funds nitrogen reductions instead of regulating that pastoral landowners themselves bear the costs (Environment Court New Zealand, 2011). From a farming perspective, the cap alone imposes significant costs by placing a ceiling limit on production while costs of production continue to rise. To add the burden of downscaling production by 20% may have put farms out of business and threatened the viability of farming within the catchment. Others consider that it would be unfair to hold farmers accountable to pay the full cost of clean-up, since farm development was encouraged by the government as late as the 1980s and farmers were operating in good faith using what was understood at the time to comprise best management practices (Environment Court New Zealand, 2011). Government provision of public funds aims to ease the burden of social change and strike a balance between lake preservation and protection of social and economic well-being . Furthermore, joint oversight by central government, Waikato Regional Council, Taupo District Council and Ngati Tuwharetoa gives Tuwharetoa a valuable role as "core and equal players" in overseeing the Trust's operations and guiding decisions that impact the overall preservation of the lake[15].

3.2. Historical allocation versus averaging or delayed averaging

The requirement under RPV5 to specify and hold landowners accountable to an individual nitrogen discharge allowance introduced several practical challenges and sources of disagreement. As an issue with strong economic and equity implications, determining how nitrogen allowances would be allocated across a wide variety of land uses and individual situations proved to be one of the most contentious issues in the development of the policy.

As briefly mentioned, it was ultimately decided to use grandparenting or historical allocation method for nitrogen allowances. This method calls for allocating allowances at levels consistent with each land block's recent nitrogen discharges. In this way, all landowners receive equal treatment, since all are similarly restricted to their current chosen land use and none are required to make costly changes or to de-intensify (Counsel for the Waikato Regional Council, 2008). Enabling farmers to continue operating at existing levels recognises and values investments they have made to maintain a certain level of production but still prevents further intensification.

[15] Interview with Tim Bennetts, 8 July 2011

Historical allocation, however, faced stiff resistance from those parties involved in less nitrogen intensive land uses who feared such allocation would severely limit their future development options. Owners of forested and undeveloped land did not want to see their land use options restricted by a 3 kg/ha/year nitrogen limit while farmers would be allocated between 10 and 40 kg/ha/year and hence would maintain a greater range of land use options. These parties expressed frustration that they should be disadvantaged by allocation intended to correct damage that had been largely caused by farming, whether intentionally or not. Tuwharetoa forest trusts in particular felt that extensively forested areas, for example on the eastern side of the lake, had been deliberately planted in order to protect the water from the adverse impacts of land use, and that such protection should not go unrewarded in a policy meant to achieve a similar goal.

Forestry groups such as Carter Holt Harvey (CHH) proposed as alternative allocation mechanisms averaging or delayed averaging. Under these mechanisms, all landowners would be held accountable to the same catchment-wide average nitrogen discharge limit, either immediately or some years in the future. These mechanisms would allocate excess nitrogen to forest owners and leave farmers with a nitrogen deficit, which would require them to either downscale or purchase additional nitrogen to continue operations. Although this would have had unequal distributive impacts, CHH considered this a fair way to enforce the polluter pays principle (Counsel for the Waikato Regional Council, 2008). However, just as the use of the term "polluter" proved ultimately toxic and inappropriate as applied to farmers exercising best practices in the catchment, similarly WRC determined to apply a grandparenting mechanism as the most equitable scheme which would cause the "least social disruption" (Young, 2007).

In order to ease the restrictive nature of historical allocation on Tuwharetoa and other forest owners, RPV5 grants flexibility for developing undeveloped land. This rule allocates an extra 11,000 kg and 3,100 kg to the aggregate development of Maori and non-Maori lands, respectively. While this rule will have only a small impact on water quality, the flexibility could prove very valuable for undeveloped land owners (Vant, 2008). This flexibility could prove particularly valuable for collectively-owned Maori lands whose owners expect to own the land in perpetuity, and thus are very concerned with the future land options they could consider[16]. Several sources expressed that all allocation mechanisms inevitably create wins and losses for different landowners, and this case would be no different, however, solutions such as the flexibility rule and the establishment of the Lake Taupo Protection Trust would help to alleviate and reduce the strain of transitioning into a regulated environment for catchment stakeholders.

[16] Email correspondence with Geoff Thorp, Forest Operations Manager for Lake Taupo Forest Trust, 17-18 August 2011

3.3. Benchmarking and use of Overseer

Historical allocation requires that all farms be allocated a nitrogen allowance or NDA consistent with their recent nitrogen output, a requirement that introduced a variety of theoretical and practical challenges[17]. It was initially assumed that each farm would be benchmarked based on averaging nitrogen discharges between July 2001 and June 2005, which are assumed to vary with climate and weather variations. During the submissions stage, Taupo Lake Care (TLC), an organisation of farmers within the catchment, launched a successful challenge against this benchmarking standard. TLC argued that farmers should be free to establish a benchmark based on any single year period within that time frame, and thus given the appropriate maximum allowance for which their farm had been established and investments had been made. TLC argued that to establish an NDA based on an average value would be to force a reduction in production in the best of years, while climate and weather conditions would naturally enforce additional reductions in the worst of years[18]. From a scientific standpoint, benchmarking based on the single best year would contribute an estimated extra 162 tonnes each year, having a moderate adverse effect on lake quality (Vant, 2008 and Ledgard, 2007). Other landowners expressed frustration to see this advantage so readily granted and to see some farmers benefitting from windfall gains from a generous allocation.

Another practical challenge facing the establishment of individual allowances was to select an accurate means of modelling the relationship between past management decisions and the resulting nitrogen discharge. As mentioned before, Overseer was determined to be the best tool for taking various inputs to model expected nitrogen output on a case by case basis. Overseer demonstrates high performance in terms of a close correlation between measured and modelled nitrogen leaching and facilitates comparisons between different management practice options (Ledgard, 2007). However, the use of software to model nitrogen output presents several ongoing challenges. Its success relies on the accurate and complete disclosure of farm-specific information. For those farms with incomplete data, conservative default measures would be assumed, which could underestimate the nitrogen leached by an individual farm (Hania, 2008). Other farm management styles do not closely align to Overseers assumption, for example, those farms running a two year rotation or changing animal stocking numbers throughout each year.

[17] NDA requirement not applicable to low-nitrogen leaching farms as permitted activities under rule 3.5.10.1
[18] Interview with Mike Barton, 14 July 2011

Ideally, Overseer software would fully account for new management practices, so that farmers get an accurate assessment of their nitrogen output and thus reap the benefits of any innovative nitrogen reducing changes made. However, until the scientific research is proven to the software developers and new versions are released and approved for use in assessing farm management plans, farms are limited to assessment using the specified version of Overseer. RPV5 specifies the use of a particular version of Overseer to ensure consistency among all the initial benchmarked NDAs. The ongoing challenge for WRC will be to assess management plan changes using the latest software compared to NDAs established using a previous version of Overseer.

3.4. Trading System

The establishment of the nitrogen cap and reduction target as well as benchmarking and allocation mechanisms attracted the greatest attention in the decision making process during the development of RPV5. Indeed, these elements have the greatest impact on the functioning and usefulness of the trading market insomuch as initial allocation determines whether an individual farmer will be in a position to buy, sell or maintain his or her allowance in order to achieve a certain level of production. However, no evaluation of the trading system would be complete without some description of the infrastructure itself that governs trading and how that infrastructure does or does not facilitate trading.

Since consent-holding landowners are legally bound to the conditions of their consent under the Resource Management Act (RMA), the procedure for trading allowances involves applying for a resource consent change in addition to negotiating with another trading partner on the conditions of trade. Both trading parties must apply for a section 127 resource consent change under the RMA. This process requires both parties to submit a proposed NDA and corresponding nitrogen management plan prepared using Overseer to demonstrate how the farm will operate within their proposed NDA. Allowances can be leased on a short-term basis or sold for the duration of the resource consent, all of which expire after 25 years[19]. Concerns existed that this method of trading would be too cumbersome and unsophisticated to facilitate effective trading among farmers. However, this process introduces few additional costs above and beyond

[19] See appendix 6.5 for a timeline of important events in the development of RPV5

the original costs of benchmarking and compliance with the conditions of consent, which all consented landowners would face with or without trading activity (Hania, 2008)[20].

On the other hand, since the value of one unit of nitrogen varies across farm locations and management practices, an effectively functioning market should work to gradually move nitrogen around the catchment from where reductions are least costly and towards where nitrogen is most highly valued (Young *et al.*, 2010). In this way, trading could grant farmers flexibility and give them an incentive to make decisions and change management practices in order to reduce costs and maximize profits, the benefits of which could outweigh the additional costs of applying for an altered resource consent. Whether or not the trading system has facilitated options and improved outcomes for farmers operating within a capped environment remains a key question in evaluating the policy so far.

4. Evaluation of policy impact

As the first nutrient trading system among diffuse non-point sources of nitrogen, it is not immediately obvious how to assess the success or failure of that system. Nitrogen trading within the catchment cap on discharges has the potential to not only facilitate water quality objectives, but also to ease the impact of the regulation on those landowners most affected by its restrictions. The explicit goal of the trading system is to provide flexibility for landowners to make land use and management practices changes while preserving the overall nitrogen cap established for the catchment (Counsel for the Waikato Regional Council, 2008). Beyond the capability of the policy to facilitate flexibility for capped landowners, a trading system could have the added benefit of providing incentives for research and discovery nitrogen reduction possibilities, that is to find cost effective ways to reduce nitrogen output in hopes of securing financial gains from sales of excess nitrogen and work towards the quality of the lake. It is with these two criteria in mind, providing flexibility and fostering innovation, that the nitrogen trading system can be evaluated. More broadly, the policy in general can be assessed against its water quality objectives and intention to minimize and distribute economic and social costs.

[20] Hania estimates that administrative fees associated with applying for a resource consent change could amount to $400. Benchmarking could cost a farm between $2,500 and $10,000, processing consents could total between $600-$1,700 and that annual consent holder charges could total $400. WRC implementation manager Natasha Hayward estimates these costs to total closer to $1,000 - $1,500. Note that the Lake Taupo Protection Trust has agreed to shoulder the cost of benchmarking for those farms greater than 20 ha in size, in order to further ease the financial burden associated with compliance under RPV5.

4.1. General findings

Not surprisingly, the imposition of the policy has prompted a variety of positive and negative reactions from various landowners, reactions that are by no means uniform within a single group of landowners. Although it remains early for an assessment of environmental outcomes, the policy has successfully limited increases in nitrogen leaching that would have otherwise been expected in the absence of regulation, particularly from the expansion of dairy farming. In this way, the cap has proven effective in halting further in land development and increases in nitrogen discharges. In terms of achieving the reduction target, as of July 2011 the Lake Taupo Protection Trust had entered into agreements to remove 100 tonnes of nitrogen and remains ahead of schedule in securing its required 153 tonnes of nitrogen reductions by 2018. Initial reductions came from the sale and conversion of several whole farms, but over time have shifted to partial farm conversions where farmers plant trees on less-productive marginal lands, reduce their effective nitrogen output and sell surplus allowances to the Trust. About 3,000 ha have been converted into forestry and 16,000 have undergone management changes. Together, these changes have affected approximately 36% of the total 52,500 ha of effective pastoral land in the catchment. Although the Trust has exhibited positive performance on its progress to date, its management remains cognizant that the final reductions will prove more difficult than the first.

Despite only recent implementation of the policy following 10 years of development, implementation progress is well underway. Roughly 97% of pastoral lands in the catchment have been preliminarily benchmarked with 67% having completed nitrogen management plans and 30 total consents granted, the final stage in the process (Hayward, 2011)[21].

4.2. Trading activity

Trading activity itself has been "a bit of a non-event, other than the Trust being in the market.[22]" Most trading activity thus far has consisted of farmers selling allowances to the Trust or to a dairy farmer in the catchment, the second of the two largest players in the market. While the dairy farmer negotiates deals on a case-by-case and confidential basis, the Trust has established a standard price of $400 kg/ha/year paid over time, estimated to equate to an

[21] Email correspondence with Natasha Hayward, WRC Programme Manager 17-18 August 2011
[22] Interview with Graeme Fleming, CEO of Lake Taupo Protection Trust, 15 July 2011

upfront price of roughly $300/kg/year[23]. Most trades have been long term sales lasting the duration of the resource consent, a reflection of the long term nature of capital investments made to farms to accommodate certain production levels[24].

Other one-to-one sales besides those involving these two major players have been virtually non-existent, though not necessarily a signal of market failure (Greenhalgh, 2008a). It could be that high transaction costs and imperfect information regarding how the trading system functions would discourage trading activity and cause market failure (Selman *et al.*, 2007). This explanation is unlikely, however, as the costs of participating in the market add few costs above and beyond those already borne by consented landowners. Furthermore, farmers have demonstrated a remarkably high level of understanding of how the trading system operates[25].

Another explanation is that limited trading could simply reflect an immature market or that the cap is not yet binding on farmers, perhaps due to benchmarking based on the single best year, which has had "a big effect, a very big effect.[26]" However, as uncapped famers nationwide increase their productivity and Taupo famers seek additional allowances to stay competitive, we could observe additional trading activity going forward. Indeed we already see this occurring in cases where a dairy farming operation has profitably expanded by purchasing nitrogen from presumably less profitable uses elsewhere in the catchment. While trades with the Trust are noteworthy in that they represent permanent removal of nitrogen from the catchment due to disparate management practice changes, trades with the dairy farmer represent instances where nitrogen reductions are able to occur at least cost and to provide farmers with flexibility to expand or contract their businesses in response to changing economic conditions and personal circumstances.

4.3. Farming perspective

Although the initial reaction of farming to the policy was largely negative, relations and perceptions have improved over time as the policy has evolved and concerns have been voiced and considered (Young *et al.*, 2010). Now that the ten year period of deliberation and development has come to a close, many farmers express an acceptance for the policy and a desire to move on. Others, however, exhibit continued frustration with the inconveniences and

[23] Interview with Graeme Fleming, 15 July 2011 & Interview with Mike Barton 14 July 2011. For the purposes of valuation of consented land with a particular NDA, valuation company Landmass Technology assumes a sale price of $300 kg/ha/year and a purchase price of $330 kg/ha/year to account for risk. See section 4.4 for more detail.
[24] Interview with Mike Barton, 14 July 2011
[25] Interview with Mike Barton, 14 July 2011
[26] Interview with Graeme Fleming, 15 July 2011

costs of carrying out farming as a consented activity, something not required of competing farmers outside the catchment. Graeme Fleming of the Lake Taupo Protection Trust expressed optimism for the catchment as a whole, saying that fears of negative social impacts due to the widespread end of farming were alleviating. Indeed, the existence of a single highly active dairy farmer in the market provides positive evidence that even intensive farming can continue within the boundaries of the policy, although others remain acutely aware that dairy intensification is necessarily complemented by de-intensification elsewhere in the catchment as facilitated by trading. Though it remains to be seen over time what the true impact of the policy will mean for farming in the catchment, initial reactions are that the policy and the trading system have enabled flexibility and provided options for remaining viable within the cap, at least in the short term.

The policy has thus far enabled farmers to undertake a variety of land use and management changes, positive evidence that the policy has facilitated flexibility. Some landowners have exited the catchment while others have maintained, reduced or even expanded production. Those farmers exiting the catchment have largely transacted with the Trust, as few others have bought into the catchment in recent years. In these transactions, the Trust has funded business consultants, encouraged farmers to fully consider their decision and offered competitive prices to ensure that any such deals not only remove nitrogen from the catchment, but also ease the financial and social burden imposed on framers.

Although the Trust has facilitated land use changes to willing sellers in this way, both sellers and those who remain in the catchment express negativity to see neighbours removed from the catchment and to see productive and attractive farmland purchased and converted to forestry. One farming couple expressed feeling pressure to exit the catchment. Seeing properties failing to sell and limited by an inability to wait for the development of alternative management practices, this couple decided to exit the catchment, leaving not only a business, but also a home behind. In some cases, movement out of the catchment has split up communities and impacted those remaining in the catchment. Another farmer emphasized that to see farmers go "has hit me quite hard" and the imposition of the policy overall with no recognition of the hardship it entails has dampened his enthusiasm and mental well-being.

For other landowners, the imposition of the policy and option to sell allowances to the Trust has provided the opportunity to consider management changes in coordination with selling allowances to the Trust. Some farmers have reduced production or stocking rates, while others have planted portions of their land in forest and sold excess nitrogen to the Trust. As in the latter case, many conversions have occurred on marginal or less productive lands, leaving the

remaining productive land to be farmed in a more efficient manner[27]. These partial conversions hint at efficiency gains, where trading has moved nitrogen from less productive uses and reserved it for more productive uses. Interactions with the Emissions Trading Scheme (ETS) have made the option of partial plantings more attractive. In deals facilitated by the Trust, landowners plant portions of their land in forestry, sell nitrogen to the Trust and sell carbon credits to nearby power companies held accountable for sourcing carbon credits under the ETS, reaping a dual benefit from the planting of trees[28].

As with the conversion of whole farms into forested lands, the conversion of attractive and productive farmland into forestry has provoked negative psychological reactions from some landowners who question the benefits of planting in forestry and calls into question the long term future of farming in the catchment. While many have come to see the necessity of the regulation, accept its limitations and seek the opportunities it could provide, others remain sceptical about the general approach of converting into forestry, hoping that future hindsight will not provide a sense of regret to have lost productive farmland in exchange for plantation forests. Furthermore, this option remains more feasible for those farmlands with marginal lands available for conversion, but may not as readily apply to smaller farms limited by space and by the number of carbon credits they could offer to carbon credit-seeking companies. Finally, the ability to seek such opportunities is to a large extent dependent on initial allocation. Those landowners which for whatever reason were allocated a relatively low initial nitrogen allocation have fewer options compared to landowners with greater NDAs, perhaps due to capital constraints or an abnormally unproductive year during the benchmarking period. In this way, the implementation of historical allocation has differentially impacted various landowners in the catchment.

Despite mixed reactions and experiences caused by the imposition of RPV5, the policy impacts farmers equally in one significant way: by providing certainty to consent-holders. The lengthy development process saw many farmers stalled in uncertainty, unsure of whether to invest in farm improvements and unsure of their future viability in the catchment. This situation has given way to a feeling of certainty felt by those holding a 25 year resource consent to farm. Compared to other locations around the country facing the potential restrictions as a result of new environmental policy, farmers in the Taupo catchment hold resources consent that guarantee them certain rights and expectations for operating their businesses relatively far into the future. In contrast, other catchments may or may not see mandated management practices or

[27] Interview with Graeme Fleming, 15 July 2011

[28] See (Media Release: Carbon Transactin Supports Environmental Benefits to Lake Taupo, 2010) for a description of one such deal involving interactions between nitrogen and carbon markets.

other restrictive policies that will impact day to day farming practices more invasively than RPV5. Although the certainty granted by RPV5 comes at additional expense and recordkeeping requirements, the policy allows farmer to remain responsible for their own decisions without being told how to run their business, one reason that TLC supported a trading system over other alternatives from the start[29].

4.4. Impact on land values

Although the introduction of the trading system has for the most part effectively opened up options for catchment landowners, those options remain to some extent limited by other elements of the policy. Limitations on the amount of nitrogen various land blocks can discharge which equate roughly to productive potential, has impacted land values. While the group responsible for valuing land in the catchment contends that the impact has been ambiguous compared to similar land outside the catchment, others believe that land values have suffered a 5 to 10% reduction[30]. For those sheep and beef farmers in the business primarily for capital gains, a reduction in the value of their land because they cannot sell to profitable dairy uses without purchasing additional allowances has very real implications for financial security and retirement options[31]. Because the value of land is closely linked to the nitrogen allowance assigned, those lands assigned a below average allowance compared to lands with similar characteristics experience a greater decline in the value of their land[32]. In this way, landowners experience not only different impacts of the policy in terms of their productive capacity and ability to trade, but also different long term impacts in terms of what they can expect to earn from the sale of that land.

4.5. Ngati Tuwharetoa and forestry perspective

As feared during development, non-farming Tuwharetoa landowners and other forestry owners have seen their future land use options restricted by the nitrogen cap. Background leaching rates for unimproved and forestry land are assumed to be 2 and 3 kg/ha/year respectively. Without increasing nitrogen discharges under the development flexibility rule, these

[29] Interview with Mike Barton, 14 July 2011

[30] Phone conversation with Mark Grinlinton of Landmass Technology, Ltd., 15 August 2011 and Interview with Graeme Fleming, 15 July 2011

[31] For example, assume that a farmer has an assigned NDA of 24 kg/ha/year. In order to sell to dairy, that land would need an allowance of about 35 kg/ha/year. Upgrading that land to dairy would cost an additional $300 * 11 = $3300 per hectare/year if allowances were purchased to enable such an intensive use.

[32] Phone conversation with Mark Grinlinton and presentation explaining the valuation method used in Taupo

limits essentially lock those landowners into low nitrogen leaching uses in perpetuity. The flexibility rule established for development of Maori and non-Maori lands is designed to facilitate future land use options rather than to provide short term financial gain by allowing landowners to sell this limited development allowance[33]. While this flexibility remains limited to an additional 2 kg/ha/year above background leaching rates, it provides useful options for those large land blocks that can consider intensive development on a portion of that land block which would average out over the entire block. However, those smaller block owners may have less opportunities to make such land use changes[34]. To date, none have taken advantage of the additional tonnage allotted to previously undeveloped and forested land[35]. Nevertheless the rule has indeed provided some limited flexibility by introducing the possibility of conversions to residential and tourism uses in the future[36].

From an environmental perspective, some Tuwharetoa stakeholders in the catchment would have liked to see a greater commitment to responsible stewardship of Lake Taupo, particularly in the form of a higher nitrogen reduction target. Acknowledging that nitrogen reductions do not come easily and usually come at a cost to business, George Asher defends that protection of the lake nevertheless presents a "challenging obligation on everybody" and that "nobody should shun their responsibility for responsible stewardship"[37]. Tuwharetoa landowners themselves have made land use decisions in order to deliberately protect the lake, often at the expense of potential commercial gain. Potentially productive lands, especially on the eastern side of the lake, were instead planted into forestry with the goal of reducing negative environmental impacts on both lake and land. As Asher explains, "commercial gain didn't enter the picture," saying that for Tuwharetoa landowners, the "perspective is quite different from a normal landowner perspective.[38]"

In other ways, the introduction of the policy has had lesser negative impacts on Tuwharetoa landowners. As landowners with collective-ownership and hence a longer term perspective than other private landowners, any reductions in land value due to the restrictions of the policy have been less of an imposition. Furthermore, long term nitrogen reduction schemes which involve reverting to forestry and reaping a dual nitrogen and carbon income may appear

[33] See footnote 7 for a description of the flexibility rule
[34] Email correspondence with Geoff Thorp, 17-18 August 2011
[35] Interview with Natasha Hayward, 9 August 2011
[36] Interview with George Asher, CEO of Lake Taupo Forest Trust, 8 August 2011 & Interview with Geoff Thorp, 15 July 2011 & Interview with Natasha Hayward 9 August 2011
[37] Interview with George Asher, CEO of Lake Taupo Forest Trust, 8 August 2011
[38] Interview with George Asher, CEO of Lake Taupo Forest Trust, 8 August 2011

more attractive to those Maori farmers motivated by both environmental reasons and a longer term perspective towards land ownership.

4.6. Lake Taupo Protection Trust

The Lake Taupo Protection Trust has garnered much enthusiasm for its performance so far as an instrumental player in the implementation of the policy[39]. In a combination of purchasing and on selling land and purchasing and retiring nitrogen allowances, the Trust has permanently removed 100 tonnes of nitrogen from the catchment. 13 deals have been completed, 5 of which have consisted of whole farm purchases and 8 of which have consisted of nitrogen allowance purchases. These transactions have removed between 3 and 22 tonnes each, with most clustered on the lower end of that scale[40].

Several factors, both by design and by chance, have facilitated such transactions. On the one hand, the Trust has committed to providing business consultants and encouraging prospective sellers to thoroughly consider the implications of their choice. Secondly, offering payments over time has enabled farmers to gradually reduce stock numbers rather than having to make sudden and costly changes[41]. Most significantly, the introduction of synergy with the ETS allows farmers to earn income from both nitrogen allowances and carbon credits sold. Both of these factors have made selling nitrogen an attractive opportunity from a business standpoint. While purchases of entire farms was neither financially sustainable for the Trust nor positively received by those farmers disappointed to see their neighbours go, management practice changes that allow farmers to continue their operations and sell only excess nitrogen to the Trust provide a more favourable alternative, and we are seeing more of such deals occur over time[42].

Despite substantial progress towards its reduction goal, the Trust faces a considerable challenge going forward. While the $72 million actual endowment of the Trust remains a fixed pool of money, a recent increase in the targeted reduction has sparked concern about the funding available to finance remaining nitrogen reductions[43]. It was initially assumed that 153 tonnes would need to be removed, however completion of benchmarking including the single best year benchmarking standard has necessitated that an additional 30 tonnes be removed. Because the Trust receives its funding in $6 million yearly increments, there is a limit to the

[39] Interviews with George Asher, 8 August 2011 and Geoff Thorp 14 July 2011.
[40] Interview with Graeme Fleming, 15 July 2011. See appendix 6.6 for a summary of nitrogen removed thus far.
[41] Interview with Graeme Fleming, 15 July 2011
[42] Interview with Graeme Fleming, 15 July 2011
[43] $72 million represents the committed $81.5 million less GST

number of deals that can be paid for at any one time (Kneebone, 2009). The Lake Taupo Protection Trust has recently decided to initiate a community engagement exercise to generate innovative ideas and strategies for the last 85 tonnes. As an example, smaller blocks could pool nitrogen reductions together and to reduce the legal costs per kg of transacting with Trust compared to those that would be incurred from individual transactions.

4.7. Innovative responses

In addition to enabling land use and management practice changes, the introduction of the policy and motivation to protect the lake has facilitated innovative responses and ongoing research into alternative management practices. The Trust has dedicated up to $5 million over its lifetime to researching low nitrogen alternative land uses within the catchment. Potential solutions include nitrification inhibitors such as DCD, high sugar grasses, and cut and carry lucerne which would take up a large amount of nitrogen leached and then be exported out of the catchment. While research within the catchment has yet to provide any clear alternative crops or management practices, many express optimism that the possibility of reducing nitrogen to make the excess available for trade could encourage farmers to "think outside the box" and generate solutions that didn't previously exist.

In addition to ongoing research and innovative solutions linking nitrogen and carbon credits, some farmers have begun to explore green marketing solutions, hoping to differentiate and earn a premium on their product. One such example comes in the form of Taupo Beef, a project initiated by two farming families in the catchment. Marketing the beef as local and sustainable in terms of protecting Lake Taupo's water quality, these families have received positive response and feedback that at least some people are willing to pay a premium in order to support products produced in an environmental manner. In this way, farmers could recover the costs associated with reducing their nitrogen discharge or increasing their nitrogen discharge by purchasing additional nitrogen. While some remain sceptical that alternative management solutions and green marketing of products will enable farming to remain viable within a cap on nitrogen, these instances do provide positive evidence for the future of farming in Taupo.

4.8. Lingering concerns and future challenges

Although implementation progress to date has been positive, there remain several challenges that will impact the success of the policy in the long run. As more scientific data is

gathered and our understanding of the impact of land use activities on water quality improves, it could be that a higher reduction target is required. Since it will be a long time before the adequacy of the 20% target is confirmed or invalidated, environmental groups such as Environment Defence Society remains convinced that a higher target is already justified (Environmental Defence Society, 2004). Any increase in the reduction target necessarily implies additional social and economic costs, and it remains to be seen how these will be distributed and how the regulation will be redesigned to accommodate any such changes.

Similarly, the possibility of spatial variation of the impact of nitrogen presents an additional future challenge. It could be that the spatial movement of nitrogen around the catchment would have adverse environmental consequences, even if the total amount leached remains the same. For example, "hotspots" of high nitrogen concentration could develop in bays nearby intensively farmed areas. While spatial considerations were initially dismissed because of fairness and equity concerns, it may be that future policy versions need to consider spatial variation by introducing different regulations for sub-catchments or trading ratios to allow trading while accounting for spatial variation. However, such additional features could increase the complexity and transaction costs of making a trade, which could have the adverse effect of discouraging trading activity.

5. Conclusion

Certain critical elements have enabled the policy to transition from an initial water quality concern to a comprehensive nutrient management scheme some ten years later. One such element was that all stakeholder groups were aligned in their desire to protect the lake, which provided common ground and enabled parties to focus attention on how to achieve that goal rather than debating the motivation for action (Counsel for the Waikato Regional Council, 2008). Throughout the development process, extensive stakeholder meetings and a high level of involvement enabled parties to voice their concerns and to gain an understanding of the issues at stake. As one example, TLC represented some 90% of the catchment's farmers, and thus was able to effectively represent the concerns of the farming community (Young, 2007). Cooperation and partnership between different government agencies, as well as strong and consistent leadership in key development and implementation positions has helped move the process along[44]. A four-way partnership between national, regional, district level governments and Ngati

[44] Interview with Natasha Hayward, 9 August 2011 and Interview with Mike Barton 14 August 2011

Tuwharetoa leadership has further facilitated cooperation and ensured that relevant stakeholders remain involved[45]. Practically speaking, the ability and willingness of the government to fund reductions and remove the financial burden from farmers has been a key element, as had the unexpected but providential introduction of the ETS and the range of possibilities it has provided.

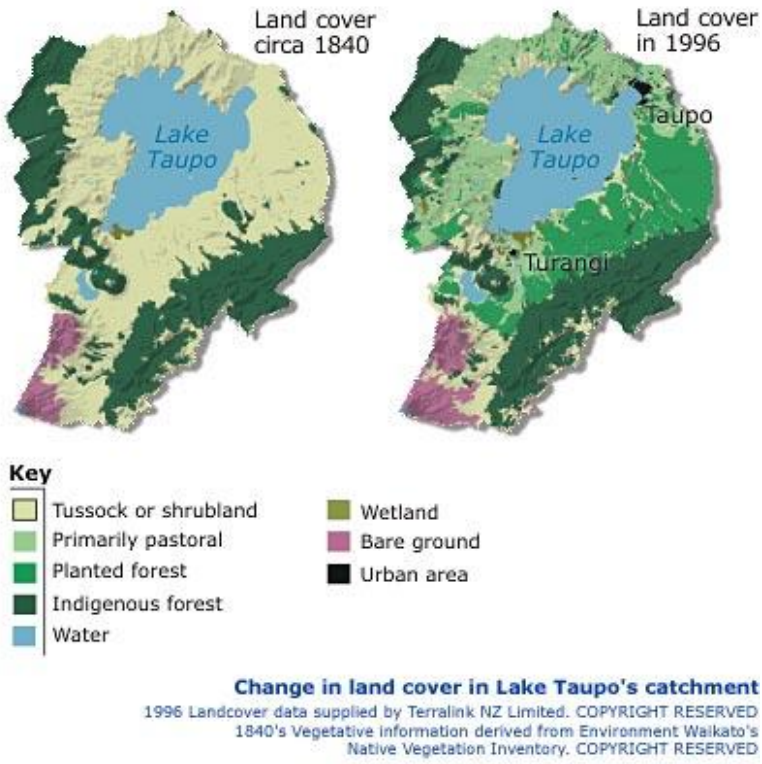
Looking critically at the design and impact of the policy, certain key lessons and opportunities emerge. Graeme Fleming applauds the success of the program for generating quick results stemming from a policy design that combines a regulatory component with an appropriate incentive structure[46]. Some remain dissatisfied with the regulation and would like to see a tighter cap imposed and more responsibility for reductions borne by farmers, who although relieved of the label "polluters" and having developed their farms in good faith, are generally understood to be the primary source of nitrogen discharges. Others would like to see incentives to innovate encouraged rather than stifled or limited by the rigid benchmarking process that cannot take into consideration potential but unproven mitigation strategies[47]. Furthermore, the process of applying for an updated resource consent to finalise trades could prove to be an unnecessarily cumbersome process, and WRC is committed to streamlining the process as much as possible to ensure that the trading infrastructure itself does not skew incentives to trade[48].

Overall, the progress of the nitrogen trading system in Lake Taupo presents a compelling case for the feasibility of implementing a non-point source trading program as a nutrient management solution. As previously stated, the relative newness of the policy overall and immaturity of the market caution against concluding too soon whether or not the program has been a success or failure. Indeed, as time moves on, the impact of the policy on landowners and the frequency and nature of trades could look very different. For example, as the Trust exits the market having completed its nitrogen reduction target or as the cap becomes binding and farmers are forced to consider purchasing additional nitrogen or downscaling or closing their businesses, we could see other players more actively engaged as purchasers of nitrogen. At least in the short term, the trading system and activity of the Trust have effectively provided landowners with additional flexibility to change management practices or pursue alternative land uses.

[45] Interview with George Asher, 8 August 2011
[46] Interview 15 July 2011
[47] Phone conversation with Suzie Greenhalgh, Senior Economist at Landcare Research, 1 August 2011
[48] Interview with Natasha Hayward, 9 August 2011

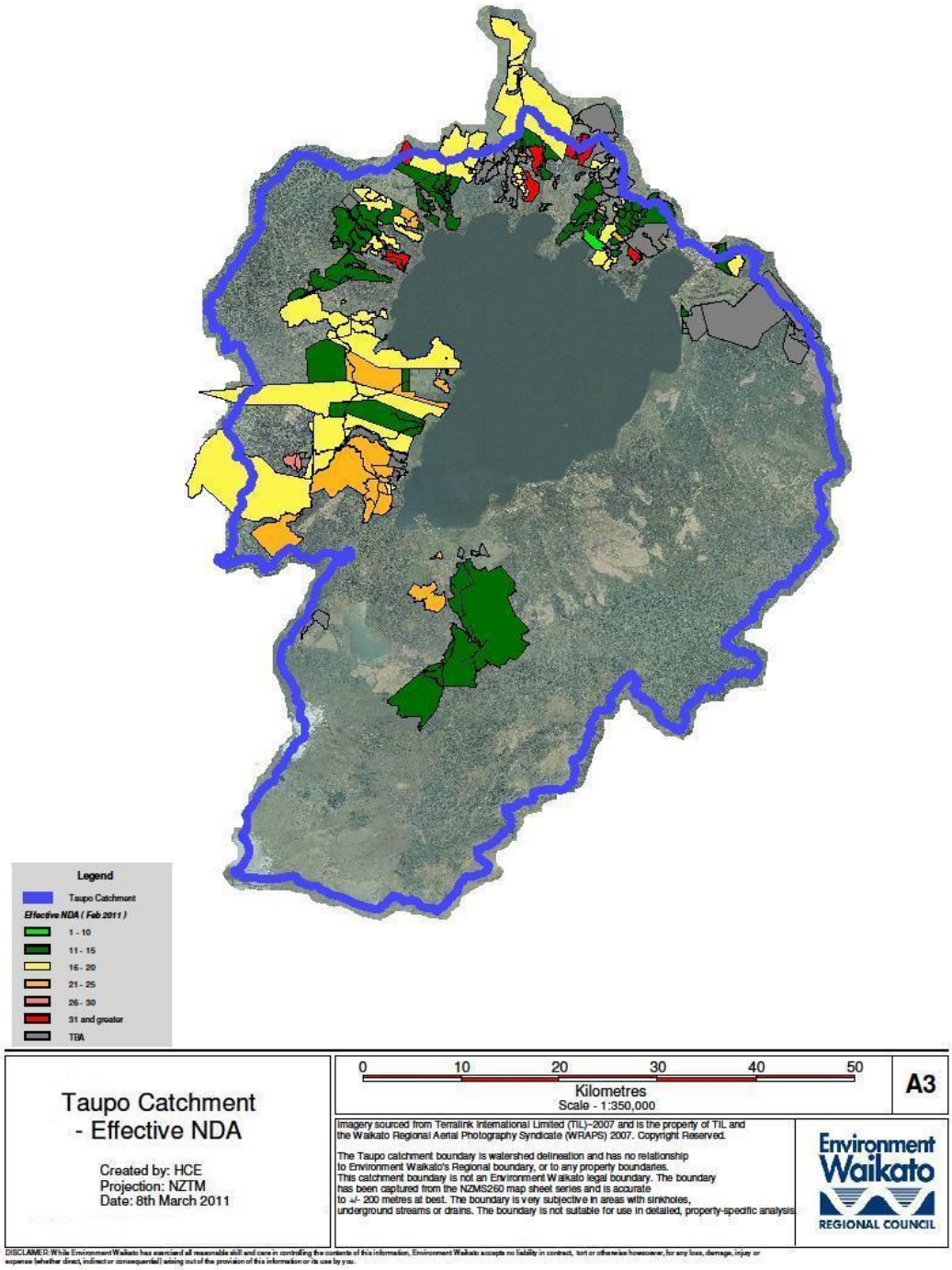
6. Appendices

6.1. Map of catchment land uses over time[49]



[49] Source: http://www.waikatoregion.govt.nz/Environmental-information/Rivers-lakes-and-wetlands/Learn-about-our-lakes/Lake-Taupo/How-land-use-affects-Lake-Taupo/

6.2. Map of catchment highlighting NDAs[50]



[50] Map courtesy of Waikato Regional Council

6.3. Breakdown of land uses in the catchment[51]

Land Use	Tuwharetoa Land (hectares)	Government Land (hectares)	Privately Owned Land (hectares)	Total	Percent of land in each use
Undeveloped	50840	103660	0	154500	56%
Planted forests	35500	4300	24700	64500	23%
Sheep and beef	23800	14800	12100	50700	18%
Dairy	778	0	1022	1800	1%
Urban	0	0	3500	3500	1%
Total	110918	122760	41322	275000	
Percent of land held by each landowner category	40%	45%	15%		

[51] (Young, 2007) page 6

6.4. Breakdown of sources of nitrogen in the catchment[52]

	Source		Load of N (tonnes/year)	Effective Yield (kg N/ha/year)	% Total	% Category
Unmanageable load (natural)	Atmospheric deposition		272	4.4	20%	34%
	Undeveloped land		311	2	23%	39%
	Pine on unimproved land		122	2	9%	15%
	Tongariro Power Development		87		6%	11%
	Pine on unimproved pasture		12	2.7	1%	1%
	Subtotal		804		59%	
Manageable load (human-induced)	Pastoral Uses	Non-dairy pasture	442	8.6	33%	79%
		Dairy pasture	68	29	5%	12%
	Urban runoff		16	8	1%	3%
	Sewage		17		1%	3%
	Pine on improved pasture		6	4.2 - 6.0 [53]	0.4%	1%
	Nitrogen-fixing scrub		7	12	0.5%	1%
	Subtotal		556		41%	
	Total		1360		100%	

[52] See (Environmental Court, 2008) page 17

[53] Note that pine on improved pasture is assumed to trend down to 3 kg/ha/year long term average. For discussion see (Environmental Court, 2008) pages 37-40 & 71.

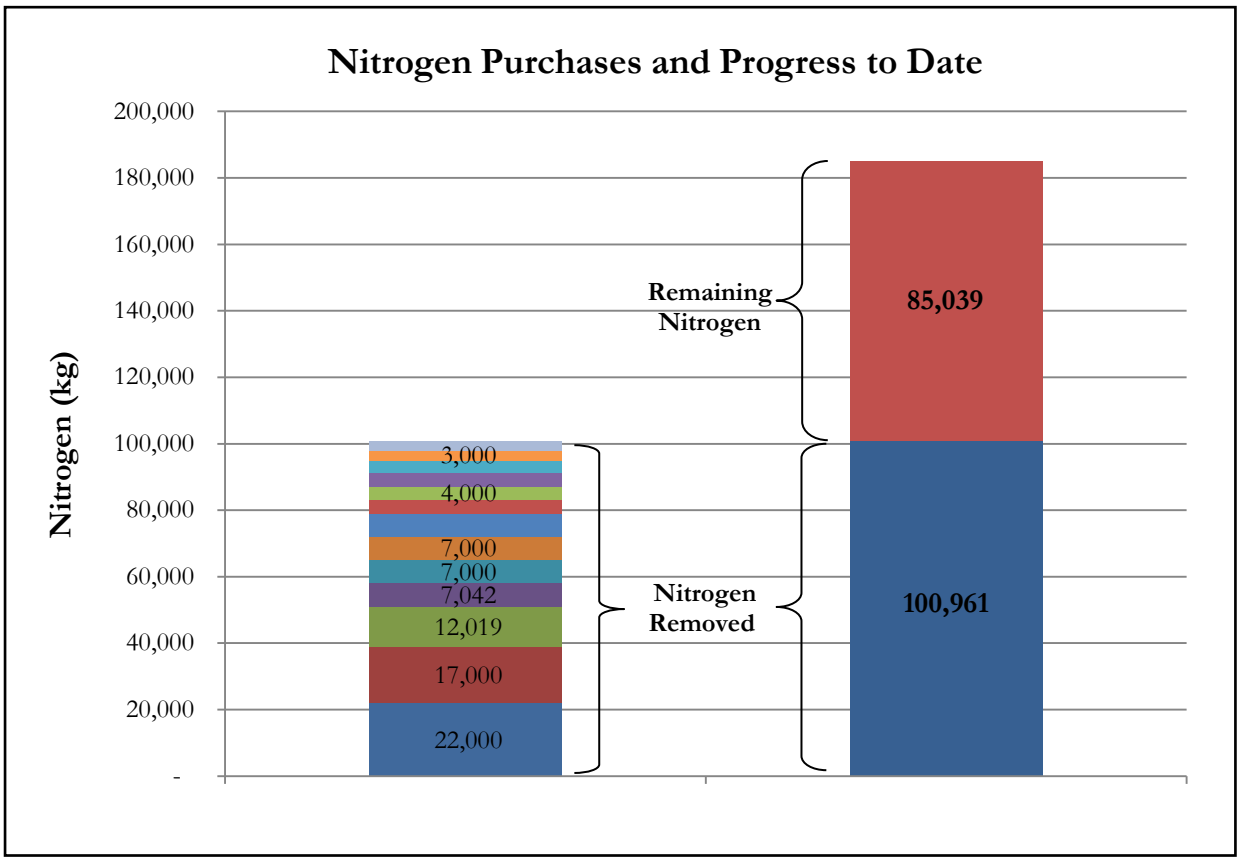
6.5. Timeline of important events in development of RPV5

1955	160 km² of catchment land in developed pasture
1973	470 km² of catchment land in developed pasture
2002	525 km² of catchment land in developed pasture[54]

1998	WRC enters Memorandum of Understanding with Tuwharetoa Maori Trust Board (TMTB)
2000	Start of technical investigations into land use impacts on lake water quality, key stakeholders notified of impact of land use on lake water quality[55]
Sept 2000	"Issues and Options for Managing Water Quality in Lake Taupo" circulated to determine public attitudes towards water quality options[56]
Sept 2001	WRC Council resolution to "maintain water quality by reducing nitrogen output from existing land uses and preventing further land use intensification[57]
Feb 2001 – Feb 2005	35 consultative meetings between WRC, Taupo Lake Care (TLC) and farms systems experts[58]
9 July 2005	Notification of RPV5
9 Feb 2007	Lake Taupo Protection Trust established[59]
15 March 2007	Waikato Regional Council decision released
May – June 2008	Environment Court hearings
12 Nov 2008	Environment Court releases interim decisions
17 June 2011	Finalisation of RPV5 in Environmental Court
7 July 2011	RPV5 fully operative
7 Feb 2012	All farmers must have applied for resource consents with WRC
2018	Reassessment of 20% nitrogen reduction target[60]
July 2034	Common expiration of all NDAs[61]

[54] (Young, 2007) page 7
[55] (Young, 2007) page 5 & 14
[56] (Young, 2007) page 15
[57] (Young, 2007) page 15
[58] (Young, 2007) page 20
[59] (Young, 2007) page 24
[60] (Environment Court New Zealand, 2011) page 14
[61] (Environment Court New Zealand, 2011) page 10

6.6. Lake Taupo Protection Trust Nitrogen Purchases



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