**Review of information on Lake Rotorua catchment phosphorus losses and reductions**

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| **To:** | **Rebecca Burton, BOPRC senior planner** |
| **Date:** | **24 February 2017** |

**Review purpose**

To summarise available information on P losses and anticipated reductions in the Lake Rotorua catchment.

**Summary**

The report ‘Anthropogenic Phosphorus Loads to Lake Rotorua’ ([Tempero et al, 2015](http://www.rotorualakes.co.nz/vdb/document/1409)) identified a total annual P load of ~49 tP/yr. This is split into an anthropogenic share of ~23 tP/yr and a baseline load of ~25 tP/yr. The high ‘natural P’ (geological) load highlights the need to reduce anthropogenic P to substitute for alum dosing. The sustainable P load requires that anthropogenic load decreases by 8-13 tP/yr.

This report reviews information on catchment P loads and potential reductions. Key observations include:

1. There is considerable uncertainty about the level of P loss from different activities and the options available for reducing these P losses.
2. Industry promoted good management practices (GMPs) offer major scope to reduce P losses. An extrapolation (by Simon Park) of GMP reductions identified by McDowell (2010) with comprehensive catchment-wide uptake suggests a 40% reduction in pastoral P loss is possible.
3. Examination of a detailed industry GMP guide (B&LNZ, 2015) showed relatively few GMPs delivered substantive dual N and P reductions i.e. a focus on N may not necessarily result in substantive ‘P bycatch’. This places a greater reliance on land use change.
4. The GMP of avoiding elevated soil Olsen P levels can deliver large reductions in P loss from pastoral land but this is difficult to estimate, especially given the lack of robust (and accessible) Rotorua farm data on current Olsen P levels.
5. PC10 includes P-related provisions which could deliver meaningful reductions in farm P loss. A small review of existing Nitrogen Management Plans (NMPs) and OVERSEER files suggests P outcomes are uncertain and variable from farm to farm.
6. Amendments to PC10 (proposed by staff in response to submissions) increases the focus on P, especially on Critical Source Areas which can contribute up to 80% of farm P loss.
7. A comprehensive catchment economic model (Parsons et al, 2015) provides P loss data as well as N data. This showed that PC10 (plus the incentives scheme) could reduce P load by ~12 tP/yr or 32% (based on OVERSEER 6.1.3 and ignoring attenuation), driven largely by ~6000 ha of land use change from pasture to pines. This promising result was sensitive to the assumed forestry P loss – if this rate increased from 0.12 to 1.0 kgP/ha/yr, the total P load reduction was ~5 tP/yr (or 12%).
8. There are several other lake programme actions that will reduce P load by varying degrees, including alum dosing, sewage/stormwater upgrades and detainment bunds. Further work is needed to assess the range of such P reductions.

**Background** (from Stephen Lamb ‘Approach to Phosphorus Project’ note, 8 Nov 2016)

Discussion at BOPRC’s November 2016 Phosphorus Workshop raised questions around Council’s approach to phosphorus. This comes about due to the importance of maintaining a suitable N:P ratio within Lake Rotorua and the current focus of PC10 being nitrogen. To date BOPRC has considered that nitrogen reduction initiatives will also achieve adequate phosphorus reductions. Discussion and presentations at the workshop indicated that this assumption does not necessarily hold true when farmers are looking for nitrogen mitigation actions to meet the proposed rules based on an “ease of implementation” basis. For example, reductions in stock numbers do not deliver a similar ratio of reductions in phosphorus loss.

However, it is noted that PC10 is one segment of the wider Rotorua Lakes Programme which manages non-regulatory activities that address either land use change or phosphorus reduction such as the Incentives Board, alum dosing and other engineering methods which will have associated phosphorus reductions.

Council’s phosphorus position can be summarised as follows:

* Nitrogen is the regulatory focus as set within the Operative RPS
* Nitrogen reductions will take some time to be experienced in the lake but phosphorus reductions can be achieved relatively quickly in response to any identifiable need into the future
* Alum dosing is a non-permanent, back-stop P mitigation action within the programme
* Phosphorus reductions are addressed at a programme level and are anticipated to occur as a part of rule implementation, the Lake Rotorua Incentives Scheme, sector best practice and engineering solutions.
* Council will monitor nitrogen and phosphorus reductions against sustainable lake load targets

**Review scope**

To support Council’s position, analysis is required to establish a broad picture of the likely or potential phosphorus reduction from the various aspects of the lakes programme.

Areas identified for possible analysis are:

1. **Sector promoted best practice**: If sectors are serious about implementing phosphorus reduction – irrespective of any regulatory framework – what may be expected over the short/medium term
2. **Implementation of PC10**: What mitigation actions are commonly appearing in NMPs and can be extrapolated across the catchment. For example, reduction in ha of fodder crops, increase in effluent discharge areas, and subdivision. This will require a generic understanding of what is occurring in the NMP process and what land practises or land use change has or will occur from time of benchmarking, the 2017 start point and the 2032 target.
3. **Lake Rotorua Incentives scheme land use change**: On the basis of assumed land use change to forestry phosphorus reductions will occur, agreements are specifying no increase in phosphorus. Identification of the area of land required to be converted to achieve the 100t/N reduction needs to be identified, and what flow on effect may this have to phosphorus. Scenarios should include conversion to forestry and subdivision.
4. **An overview of the specific actions completed and to be completed by the Te Arawa Lakes Programme.** Identification of how these contribute to a reduction in phosphorus losses. detainment bunds are an example of this. The new WWTP and future urban runoff actions may be useful to consider.

This review is a preliminary assessment of each of these four areas of P loss and potential reductions in P loss, and/or what further work may be needed to refine those figures.

1. **Sector promoted good practice**
   1. **Industry guidance overview**

Both the dairy and drystock sectors encourage their farmers to adopt industry-defined best practice, notably through their respective farm plan templates. Similarly, the forestry sector has well established Environmental Management Systems. Dairy effluent and forestry harvesting have long been managed through resource consents with conditions requiring practices to reduce nutrient loss, including P loss.

It will be difficult to determine what difference sector promoted good practice makes because:

* If good practices are already routinely followed, then there is little room for improvement
* Comparing pastoral sector ‘best practice’ with OVERSEER derived P loss rates is problematic due to OVERSEER’s general presumption that ‘good management practices’ are followed. OVERSEER can model some poor practice and therefore estimate what improvement is possible by adopting good practice. A pertinent example is ensuring Olsen P levels do not exceed the agronomic optimum.
* The forestry sector’s highly episodic harvesting cycle (and the associated high-risk period for sediment and P loss) makes it inherently difficult to measure or model good or poor practice.

A broad range of P mitigation practices was [presented](http://www.rotorualakes.co.nz/vdb/document/1454) to Land TAG in May 2016 by Dr Dave Houlbrooke on behalf of his AgResearch colleagues. A key graphic identified the relative proportions of the four main P loss sources as follows: fertiliser 10%; dung 30%; plant 20%; soil 40%. A series of mitigations was also identified by AgResearch with qualitative costs and effectiveness indicated for each practice. Many of these practices are incorporated[[1]](#footnote-2) into ‘sector promoted best practice’ systems (guidance, farm plan templates etc), which are illustrated as a sample[[2]](#footnote-3) in Table 1 below.

**Table 1: Sample of industry good phosphorus practices**

| **Sector** | **P good practice** | **Comment** |
| --- | --- | --- |
| **Sheep and beef (also deer)** | P good practice is captured within B&LNZ’s [Land and Environment Plans](http://www.beeflambnz.com/farm/environment/land-and-environment-planning-toolkit/), including its [Menu of practices to improve water quality](http://www.beeflambnz.com/Documents/Farm/Drystockfarms.pdf) which includes advice on a wide range of practices targeting N, P, sediment and micro-organisms, with estimates of reduction (low, medium & high), relative cost and relative benefit (latter refers to farm profitability). ‘Menu’ examples for P include:   * Keep Olsen P at agronomic optimum (using soil testing) – this has a ‘high’ rating for P reduction with low cost and high benefit * Stock management to reduce erosion, pugging * Managing critical source areas – hotspots e.g. Direct stockyard run off to paddock | The ‘Menu’ good practice document was developed in association with the Upper Waikato Primary Sector Partnership but appears relevant to Lake Rotorua catchment |
| **Dairy** | DairyNZ has developed a comprehensive range of (N & P) nutrient good practice guides, tools and extension capability. Key resources include:   * [Nutrient management on your dairy farm](http://www.dairynz.co.nz/media/3361747/Nutrient_management_on_your_dairy_farm.pdf) which covers many N and P good practices as well as the fundamentals of N and P sources, cycles, loss pathways and waterway impacts | Good effluent practice has historically been noted as a significant means of reducing P loss from dairy farms, especially shifting from ponds (discharging to water) to land irrigation. However, land irrigation has been the norm for all BOP dairy farms for many years. |
| **Deer** | The [NZDFA Landcare Manual Deer](http://deernz.org.nz/sites/dinz/files/NZ%20Deer%20Farmers%20Landcare%20manual%202012%20for%20web.pdf) provides specific practice guidance for deer farms while building on many practices identified for sheep and beef farms. There is a particular focus on:   * soil protection e.g. minimising fence-line pacing * water protection e.g. managing wallowing | NZDFA has a relationship with B&LNZ to enable use of the LEP toolkit on deer farms. |
| **Forestry** | The NZ Forest Owner’s Association (NZFOA) has promoted good nutrient management as part of a formal Codes of Practice since 1990. The 2015 [Environmental Code of Practice](http://www.nzfoa.org.nz/resources/file-libraries-resources/codes-of-practice/44-environmental-code-of-practice/file) (E-CoP) was developed by a team including several BOP contributors. The E-CoP targets operational practitioners and forest planners within a EMS framework. Numerous listed practices seek to minimise soil disturbance and sediment loss with consequent P benefits, including:   * Earthworks controls and revegetation * Engineered stream crossings * Avoiding earthworks within 5m of waterways | In addition to E-CoP, most commercial NZ foresters participate in the internationally recognised Forest Stewardship Council (FSC) EMS ([2013 version](http://www.nzfoa.org.nz/images/stories/pdfs/content/certification/1309FSC-STD-NZL-01-2012New_Zealandplantations_0913.pdf)).  Scion continues to [develop the NuBalM model](http://www.scionresearch.com/general/publications/annual-reports/2016-annual-report/research-performance/commercial-forestry-impact-stories/precision-nutrient-management-for-maximum-productivity) which will ultimately be able to predict N & P loss rates, with scope to link to OVERSEER. |
| **Small blocks** | The Small Block guide (prepared by Landconnect Ltd, awaiting publication) |  |

* 1. **Good practice ‘P by-catch’ when focusing on N**

As noted by participants at the November 2016 P workshop, N mitigation does not always mean there will be accompanying P mitigation. However, an indication of the scope for accompanying P mitigation (‘P by-catch’ in this context) can be found by considering recommended practices with both N and P mitigation benefits. The B&LNZ [Menu of practices to improve water quality](http://www.beeflambnz.com/Documents/Farm/Drystockfarms.pdf) can be assessed in this way. B&LNZ rates each practice as low, medium or high for N and/or P reduction efficacy, in terms of likely water quality benefits. In broad terms, the ratings correspond to these estimated % reductions (at whole farm scale):

* Low = <10% for N, <20% for P; Medium = 10-25% for N, 20-50% for P; High = >25% for N, >50% for P

A review of the B&LNZ ‘menu’ practices indicates that:

* There are 37 listed practices with at least a low rating for N or P benefit, including seven relevant to cropping management. Of these 37 practices, 30 have at least some N and P co-benefit
* Of 9 practices with at least medium N rating, 5 also had P benefit with at least medium rating
* Conversely, of the 30 practices with at least a medium rating for P benefit, only 5 also had N benefit with at least a medium rating (the same 5 practices as noted in the previous bullet)
* The initial rows in the B&LNZ practices table cover whole farm planning and nutrient budgeting. Due to the variable and farm-specific N and P benefits that may accrue from such planning/budgeting, the low/medium/high ratings are not given in the way they are for the individual practices in the balance of the table.

The B&LNZ practices with high ratings for either N or P are summarised in Appendix 2.

* 1. **Keep Olsen P at the agronomic optimum**

The Olsen P soil test is a measure of plant-available P. The agronomic optimum Olsen P level is where near-maximum (97%) pasture production can be achieved (provided other facto are not limiting growth). The agronomic optimum level varies across soil types and with farm type and intensity. Olsen P units are mgP/L of soil, or µg P/cm3 of soil. For pumice soils, the optimum Olsen P level[[3]](#footnote-4) is 35-45 units under dairy farming and 20-30 under drystock (Fert Research 2012; [DairyNZ Farm-fact 7-12](https://www.dairynz.co.nz/media/255819/7-12_Phosphorus_fertiliser_2012.pdf)). This matters because:

It becomes wasteful to have higher than optimum levels in most situations because higher P applications are required to maintain higher Olsen P levels and there is no corresponding increase in pasture production. To have Olsen P levels above this range invites unnecessary environmental damage ([Efficient use of phosphorus, Waikato Regional Council, 2015](http://www.waikatoregion.govt.nz/PageFiles/30016/factsheets/CNM%20factsheet%20phosphorus_use_9.pdf))[[4]](#footnote-5).

Further, there is some evidence of elevated Olsen P levels on Rotorua farms, with Redding et al (2005[[5]](#footnote-6)) reporting that a majority of Rotorua dairy farms have levels in excess of the economic optimum.

The relationship between soil Olsen P levels and P runoff is incorporated into the OVERSEER P runoff sub-model ([McDowell et al, 2005](http://www.tandfonline.com/doi/pdf/10.1080/00288233.2005.9513643?needAccess=true)). A review of the OVERSEER P model ([Gray et al., 2016](http://www.massey.ac.nz/~flrc/workshops/16/Manuscripts/Paper_Gray_2016.pdf)) found it could predict pastoral P losses reasonably well, although numerous recommendations for improvements were made.

* 1. **Phosphorus GMP recommendations for Lake Rotorua catchment**

BOPRC commissioned AgResearch to produce ‘The efficacy of strategies to mitigate the loss of phosphorus from pastoral land use in the catchment of Lake Rotorua’ ([McDowell 2010](http://www.rotorualakes.co.nz/vdb/document/83)). This gave a range of potential P practices with P loss reductions and cost bands (McDowell’s table 2 is appended to this report).

In 2012, this author (then trading as Headway Ltd) applied McDowell’s P reduction estimates to ROTAN land use/area data to test what range of catchment P load reductions was plausible. Pastoral farm P reductions of about 40% appeared possible but did rely on comprehensive good practice adoption. A simple series of OVERSEER scenarios incorporating a suite of these practices also indicated this level of P reduction was plausible. This analysis is appended to lake modelling report by [Hamilton et al (2012).](http://www.rotorualakes.co.nz/vdb/document/383)

* 1. **Summary of sector promoted good practice**

There is a comprehensive guidance available for each of Rotorua’s major land use sectors. Analysis of B&LNZ’s ‘Menu [of] practices to improve water quality’ shows scope for several practices to deliver N and P co-benefits but there are more listed practices that do not.

Many Rotorua farmers will have voluntary industry farm plans (SMPs and LEPs) that both assist with the regulatory NMP and which encourage P good management practices.

It is plausible that a high adoption level of P (and sediment) good practices would result in a meaningful reduction in current P losses from each of the major land use sectors, as illustrated in reports by McDowell (2010) and a related extrapolation by Park (2012). However, it is difficult to reliably quantify the potential reduction in P loss if landowners followed sector good practice without further analysis.

1. **Implementing PC 10** 
   1. **Overview of PC10 provisions on phosphorus**

It is acknowledged that the main thrust of PC 10 to reduce nitrogen losses from land to help meet the sustainable annual lake load of 435 tN. However, there are a number of P provisions in PC 10:

* **Policy P2:** To manage phosphorus loss through the implementation of management practices that will be detailed in Nitrogen Management Plans prepared for individual properties/farming enterprises.
* **Method M2:** The five yearly science reviews will include ‘...an assessment of the efficacy and risks of alum dosing and an assessment of land-based phosphorus loss mitigation.’
* **Method M5:** Council will….

(d) provide land advisory services and incentives to support land use management change and land use change that reduces nitrogen **and phosphorus** loss in the catchment; and

(e) encourage industry good practices to be implemented on rural properties/farming enterprises to reduce nitrogen **and phosphorus** loss in the catchment. [**emphasis** added]

* **Schedule Six – Nitrogen Management Plans** [includes]

5(b) *Phosphorus management:* To identify the environmental risks associated with phosphorus and sediment loss from the subject property, the significance of those risks and implementation of industry best practice management to avoid or reduce the risks.

Additional NMP requirements relate to effluent management (5(d) and fertiliser management (5(f)), both of which address P losses and good practice.

In response to PC10 submissions, staff propose that NMPs are now Nutrient Management Plans (i.e. more explicitly N and P) and that Schedule Six 5(b) is expanded by adding [after ‘good practice management measures…]:

This shall include the identification of appropriate mitigation actions within critical source areas, with these areas including:

1. overland flow paths and areas prone to flooding and ponding
2. erosion prone areas
3. farm tracks and races and livestock crossing structures
4. areas where effluent accumulates including yards, races and underpasses
5. fertiliser, silage, compost, or effluent storage facilities and feeding or stock holding areas

These amended provisions strengthen PC10’s focus on P i.e. PC10 is not solely about N. The new recommended critical source area provisions (CSAs) in PC10 are particularly important given CSAs can contribute ~80% of total farm P loss from ~20% of the area (McDowell, Land TAG presentation 2016). McDowell also notes (ibid) that in a study across 14 farms/sub-catchments (spread throughout NZ), targeting CSAs only would deliver a 40% reduction in P loss at an average cost of 2% EBIT (earnings before interest and tax). In contrast, a broader approach would reduce P loss by 48% but at a much higher cost of 12% EBIT.

* 1. **P loss within current provisional NMPs**

As with sector promoted good practice, it is difficult to assess what degree of P reduction will occur because of the indirect approach to P mitigation in PC10. Informal discussion with staff (Nov 2016) suggests that P mitigation has not featured in provisional NMPs to date. . A brief review of two completed (but still provisional) NMPs indicated that:

* The NMP includes a ‘Phosphorus loss’ subheading followed by a current state OVERSEER block loss table, total P loss and average kgP/ha loss, followed by comments e.g. noting where block losses appear high and stating the possible reasons for that (high Olsen P, low soil ASC (anion storage capacity))
* No actions explicitly targeted P mitigation although one nominated NPKS fertiliser regime may have achieved this in part. As noted above, some N mitigation actions will have some ‘P bycatch’

It would be possible to review additional completed provisional NMPs. For farms over 40 ha, there are 8 completed dairy NMPs and 15 completed drystock NMPs (as at late November 2016). In addition to the 37 completed NMPs (all property sizes), there are a further 17 NMPs in various stages of preparation and an additional 19 Current State Assessments underway (pers. Comm, Rosemary Cross, Nov 2016).

* 1. **Assessing likely PC10 ‘P bycatch’ by reviewing OVERSEER files**

Three pairs of OVERSEER files were compared to check what level of ‘P bycatch’ may occur when the focus is on N. The comparisons were:

* One dairy and one drystock example, both comparing ‘benchmark’ vs ‘2032 NDA’ files
* The PC10 drystock reference files, comparing:
  + the ‘as notified’ file that targeted the average drystock NDA with ~27 kgN/ha/yr in OVERSEER v6.2.3
  + the revised file that aims to be representative of all benchmarked drystock

The results of these comparisons are summarised in the table below:

|  |  |  |  |
| --- | --- | --- | --- |
| **BM to NDA comparison** | **Decrease**  **in N loss** | **Decrease**  **in P loss** | **Comment** |
| **real dairy farm** | 14% | 34% | An unusually low N reduction with an unusually high P reduction. Actions included less N fert, no crop, effluent upgrade but also higher stocking rate. Current state N & P losses are lower than either BM or NDA. |
| **real drystock farm** | 0% | 22% | Mitigations include lower N and P fert, less crop, slightly less effective area. |
| **drystock reference files** | 20% | 4% | The hypothetical mitigations include lower N fert, no crop and different stock mix, although the NDA version has higher SR |

**Interpretation:** Both farm case studies appear to show useful P bycatch whilst meeting NDAs. However, little can be drawn from this due to the randomness of single case studies and the apparent disconnect within the files on what is driving the respective N and P reductions. More concerning is the low 4% P reduction in the reference file comparison, despite achieving a 20% N reduction. While artificial, the BM reference file is explicitly representative of 2001-2004 farm inputs and both BM and NDA files have the same soil-based block composition that is directly proportional to BM soil data.

The two drystock OVERSEER reference files were examined for soil order and slope influence on N and P loss. The results are appended as a poster paper (for the NZASSS conference, Queenstown, 12-16 Dec 2016). While the results show contrasting P loss rates across different soil orders, it is not clear if/how this can be targeted given there are fundamental soil properties underpinning this variation, notably Anion Storage Capacity (ASC, or ‘Phosphate Retention’).

1. **Estimate of overall change in Lake Rotorua P loss**

This section of the review looks at estimates of overall P load, not just the incentives scheme as indicated in the ‘Review Scope’.

Land use change and land management change may occur due to any combination of landowners meeting NDA, trading NDA or selling NDA to the Lake Rotorua Incentives scheme (LRI). It is difficult to separate out any one component. Fortunately, we do have a useful combined N and P scenario dataset in the recent catchment economic analysis by Parsons, Doole and Romera (2015). This was developed by DairyNZ (with input from BOPRC and Perrin Ag) to guide Stakeholder Advisory Group and Council on N allocation for Lake Rotorua catchment i.e. it was designed to test alternative 2032 N allocation scenarios, the associated costs and the degree of land use change.

* 1. **Parsons et al P analysis**

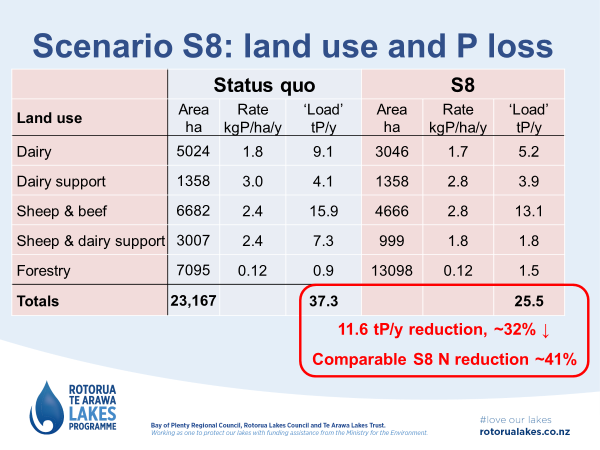
The raw model economic model Excel outputs were sorted to focus on P losses under the main land uses. The main comparison was between the status quo land use and Scenario ‘S8’. The latter is similar to the PC10 allocation regime in combination with the Incentives Scheme. Key points about this analysis are:

* Multiple realistic farm ‘typologies’ were modelled in OVERSEER v6.1.3 and FARMAX, with N mitigation cost curves determined via a hierarchy of system and land use changes.
* The focus was ‘commercial’ land including forestry, with ~5000 ha small blocks ignored
* All N allocation scenarios were forced to reduce aggregate N loss from 633 →372 tN/y, ↓41%, with a range of constraints around cost-effectiveness and landowner willingness to trade N
* Fortuitously, land use P losses (ex-OVERSEER) were also recorded for each N scenario

Some caution is warranted in interpreting the Parsons et al P data because:

* The area modelled is less than the actual area due to the ‘commercial’ assumption
* The OVERSEER P loss boundary is the ‘2nd order stream’ and further attenuation is not modelled
* P was not the focus and there may be unforeseen methodology anomalies.

The P results are summarised in the table below:



* 1. **Parsons et al P observations**
* Scenario S8 gives a 11.6 tP/y or 32% reduction in P loss ‘without trying’ i.e. P bycatch. This is mainly driven by ~6000 ha pasture converting to pine forestry
* The P reduction is very sensitive to the OVERSEER forestry P loss @ 0.12 kgP/ha/y. **IF** forest P loss rate is assumed = 1.0 kgP/ha/y, total P reduction is only 5.4 tP/y or 12% (relative to status quo)
* Additional P loss reductions (beyond S8) would be possible via (i) improved P farm practices and (ii) GMPs on ~5000 ha non-commercial pasture, mainly small blocks <40 ha.
  1. **Revised Lake Rotorua Incentive scheme terms of reference**

BOPRC is proposing to revise the ToR for LRI (and dropping ‘Board’ from its title), with a modified clause 2:

* Negotiate agreements to reduce nitrogen and secure no exacerbation in phosphorous loss to Lake Rotorua on a willing buyer/willing seller basis (new words underlined)

The revised ToR are subject to approval by RTALSG on 20 December 2016. While this amendment does not secure additional P, it is a safeguard against a win/lose (N/P) outcome.

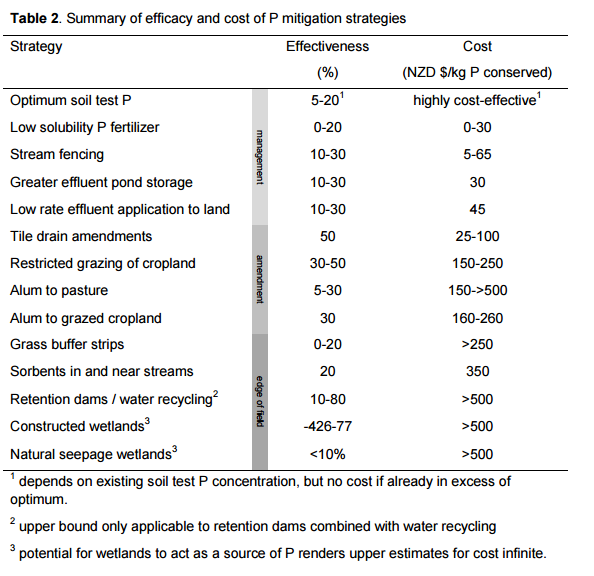
1. **Other actions in the Rotorua Te Arawa Lakes Programme**

The rules and incentives are two significant parts of a wider programme – these other actions are summarised in the table below. The assessment of P reduction is indicative only, and based on reviewing the references cited for each action.

|  |  |  |  |
| --- | --- | --- | --- |
| **RTALP Action** | **Comment** | **P reduction** | **Reference** |
| Alum dosing | Ongoing, two consents to be renewed soon | Substantial | [P locking](http://www.rotorualakes.co.nz/phosphorus-locking); [Tempero et al, 2015](http://www.rotorualakes.co.nz/vdb/document/1409) |
| Sewage upgrade, Whakarewarewa alternative | Andy Bruere to advise | Possibly little change due to high current P removal rates | [RLC summary](http://www.rotorualakescouncil.nz/our-council/news/Pages/default.aspx?newsItem=7163) |
| Gorse project | Some gorse is grazed i.e. conversion to trees will reduce P loss | Minor, due to modest gorse areas and light grazing | [Gorse fund](http://www.rotorualakes.co.nz/gorse-conversion-fund) |
| Rotorua District Plan (RDP) subdivision | Landowners retiring 10 ha (dairy to drystock, or drystock to trees) gets one additional subdivision right. More generally, RDP objectives and policies links subdivision and water quality. supportive | Minor  Some subdivision-related land use change may be accounted for via parallel incentives scheme deals | Rotorua District Plan, [Objective 13.3.1 and Policies 13.3.1.1 on](http://geo.rdc.govt.nz/BOPLASS/Tiny/TRIM.aspx?recNum=RDC-656761) |
| Catchment management | BOPRC is working with a new (upper) Ngongotaha group to tackle flood and erosion damage. This will reduce sediment and P loss | Unknown  Potentially this is avoiding increased P losses | John Paterson |
| SFF P project | This project led by John Paterson and farmers aims to quantify the efficacy of farm detainment bunds and other P mitigations | Unknown | [Summary](http://www.rotoruafarmers.org.nz/new-project-to-assess-on-farm-detainment-bunds-and-phosphorus-mitigation/) |
| Urban stormwater | An action identified in the 2009 Rotorua-Rotoiti Action Plan | Estimated 0.5 tP/yr | [Action Plan](http://www.rotorualakes.co.nz/vdb/document/78) |

**Appendix 1**

Extract from [McDowell 2010](http://www.rotorualakes.co.nz/vdb/document/83):



**Appendix 2**

Summary of B&LNZ practices rated high ‘likely water quality benefit’ **for either N or P**. See [B&LNZ’s report](http://www.beeflambnz.com/Documents/Farm/Drystockfarms.pdf) for the full list of practices and explanations of high, medium, low (noted briefly in section 1.2 of this review) and the cost/benefit ratings of $, $$ and $$$

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Practice** | **Water quality benefit** | | **Farm business impact** | |
|  | **N** | **P** | **cost** | **benefit** |
| Keep Olsen P at agronomic optimum (using soil testing) | - | high | $ | $$$ |
| Match stock management to land use capability | low | high | $$ | $$ |
| Fence and plant out unproductive steeper slopes | - | high | $$$ | $$ |
| Manage or retire bogs and swampy areas | med | high | $$ | $$ |
| Reduce soil cultivation by strip tillage or direct drilling | low | high | $ | $$ |
| Cultivate along contours on slopes greater than 3° | low | high | $ | $$ |
| Use winter active crops | high | - | $ | $ |
| Maintain buffer strips on sloping cropping paddocks | - | high | $$ | $ |
| Use [nutrient] placement tools e.g. GPS guidance | high | high | $$$ | $$$ |

1. Commonality between pastoral sector guides partly reflects science relevant to these sectors and some common authorship, notably by AgResearch (NZ’s pastoral science CRI). [↑](#footnote-ref-2)
2. Even a summary of industry P practices would be lengthy and duplicate content from the documents referenced in the table – hence the table is titled ‘Sample of industry good phosphorus practices’. [↑](#footnote-ref-3)
3. There is ongoing debate and work on optimum Olsen P levels, the test itself and analysing data. For example, see [Edmeades, 2012](http://www.massey.ac.nz/~flrc/workshops/12/Manuscripts/Edmeades_2012.pdf)) [↑](#footnote-ref-4)
4. There are numerous versions of similar advice [↑](#footnote-ref-5)
5. [Redding M, Ghani A, Kear M, O’Connor M and Catto W, 2006](http://www.grassland.org.nz/publications/nzgrassland_publication_394.pdf): Phosphorus leaching from pastures can be an environmental risk and even a significant fertiliser expense. Proc. N. Zeal. Grass. Assoc. 68:293-296. [↑](#footnote-ref-6)