Before an Independent Hearings Panel

The Proposed Waikato Regional Plan Change 1

IN THE MATTER OF	the Resource Management Act 1991 (**RMA**)
IN THE MATTER OF	the Proposed Waikato Regional Plan Change 1, Block 3 hearings, Allocation - C4.3 Policy 7 (future allocation) and related provisions and submissions

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PRIMARY EVIDENCE OF JUDE ADDENBROOKE ON BEHALF OF MIRAKA LIMITED

(Environmental Management)

Dated: 5 July 2019

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1. EXECUTIVE SUMMARY

1.1 My full name is Jude Addenbrooke. I am an Environmental Management Consultant.

1.2 Miraka supports a staged approach to achieving long term water quality goals, with the Stage One focus on making a start on reducing contaminant discharges through a range of Practice Change mechanisms, and processes and decisions about making further reductions occurring in Stage Two.

1.3 Miraka opposes any pre-emption of this second plan change process, including the presumption that land suitability is the preferred approach, and any proxy or de facto allocations that are within PC1 or proposed by other submitters. We consider there has been insufficient consideration, process or consultation on potential allocation frameworks to include any form of one in PC1.

1.4 I agree with the Section 42A report analysis that prediction of suitable allocation mechanisms for the future is challenging, with a range of issues that suggest a future framework may be quite different, given for example central government initiatives in this area and ongoing developments with respect to tangata whenua interests in water.[1] I also agree that any allocation system will need robust review at the time of its development, and that any future planning regime will be required to make assessments without pre-judgement.[2] I support the Officers' recommendation that Policy 7 be deleted.

1.5 A number of other submitters have sought to amend PC1 by including an allocation regime based on Land Use Capability (LUC) (as a proxy for Natural Capital). I consider LUC is inappropriate because it was developed nearly 70 years ago to categorise existing and potential production, and did not conceive of nor therefore include environmental externalities such as nitrogen loss, or impacts on receiving environments. LUC is not a proxy for Natural Capital and is not a reliable indicator for nitrogen loss.

1.6 For Stage Two of Healthy Rivers Miraka considers that any framework for the long-term determination of appropriate use of waters and the uses and management of land to support water quality should consider fundamental principles of allocation to water itself, water for all needs and the protection of the mauri of water, as well as the development of decision-making partnerships and relationship frameworks. I apply this lens to a review of the developing national Land Suitability approach.

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[1] Section 42A, paragraph 479.
[2] *Ibid*, paragraphs 481 and 482.

1.7 As a resource management professional, I acknowledge the complexity of attempting to determine fair and equitable use of resources amongst competing needs, including those of the environment itself. However, I consider that given the pressing resource management issues around water management Aotearoa / New Zealand needs to make such determinations. I consider it is vital that the process for making such determinations be robust, with careful consideration of principles, decision-making processes and frameworks before any allocation methods are used or quantitative assignments are made. This same process should apply whether each region identifies its own allocation regime or national direction is provided.

2. INTRODUCTION

2.1 My full name is Jude Addenbrooke. I am director of Addenbrooke Advisory Limited, an independent consultancy providing environmental science, resource management, integrated catchment management, farm environment planning, community engagement and associated services. My qualifications and experience are outlined in my evidence for Block 1, dated 15 February 2019.

2.2 In addition, my experience in relation to this topic includes working for hapu, iwi and runanga on Treaty of Waitangi case development, study of indigenous jurisprudence and alternative frameworks for managing resources in the context of freshwater and lakes, and extensive experience in resource management in Aotearoa. As a Pakeha, I do not attempt to present Maori values or frameworks, but as a resource professional I do recognise the need to not only consider such values but to acknowledge Maori frameworks of connection to resources, relationships, and decision-making.

2.3 I was engaged by Miraka Limited (**Miraka**) at the beginning of 2017 to assist with its response to Plan Change 1 and Variation 1 (**Plan Change 1**), including submissions, collaboration with other key parties, technical advice and hearings preparation.

2.4 My evidence is given in support of the submission made by Miraka to Plan Change 1.

2.5 I have read the Environment Court's Code of Conduct for Expert Witnesses, and I agree to comply with it. My qualifications as an expert are set out above. I confirm that the issues addressed in this brief of evidence are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

3. SCOPE OF EVIDENCE

3.1 My evidence relates to Topic 'C4.3 Policy 7 (future allocation), C4.2.8 3.11.4.7 Information needs to support any future allocation and C4.2.9 3.11.4.8 Reviewing Chapter 3.11 and developing an allocation framework for the next Regional Plan'. It is in support of Miraka's original submission on Policy 7 and various further submissions[3]. This topic is specifically addressed in the Section 42A report to Block 3. I have read the Section 42A report and respond to the analysis and recommendations on future allocation. Other submitters have given evidence on allocation within Block 2. I also respond to this evidence.

3.2 My evidence will:

(a) Address Policy 7 and why it should be deleted;

(b) Describe the issues with alternative allocation regimes proposed by other submitters; and

(c) Outline Miraka's approach to developing a process and framework for the long-term determination of appropriate use of waters and the uses and management of land to support water quality.

3.3 My evidence should be read alongside Miraka's evidence from Blocks 1 and 2.

4. ALLOCATION – PLAN CHANGE ONE

Response to Section 42A report

4.1 I agree with the Section 42A Block 3 report analysis that prediction of suitable allocation mechanisms for the future is challenging, with a range of issues that suggest a future framework may be quite different, given for example central government initiatives in this area and ongoing developments with respect to tangata whenua interests in water.[4] I also agree that any allocation system will need robust review at the time of its development, and that any future planning regime will be required to make assessments without pre-judgement.[5] I support the Officers' recommendation that Policy 7 be deleted in its entirety.

[3]Submission Point ID PC1-8821 primarily, and also submissions on 3.11.4.7 (PC1-8870); 3.11.4.8 (PC1-8882). Also Miraka's Further Submissions, including on Submission Points PC1-11491 (Beef+Lamb), PC1-10229 (DairyNZ), PC1-10667 (Department of Conservation), PC1-9789 (Fertiliser Association of NZ), PC1-10474 (Fonterra), PC1-10301 (Tuwharetoa), PC1-10944 (WDLG), PC1-3320 (Waikato & Waipa River Iwi), PC1-2112 (Wairarapa Moana), V1PC1-224 (Federated Farmers), V1PC1-441 (Iwi of Hauraki).
[4] Section 42A, paragraph 479.
[5] *Ibid*, paragraphs 481 and 482.

Policy 7 future allocation

4.2 Miraka opposes the notified version of Policy 7 future allocation, in particular its second element, which assumes future property or enterprise-level allocation of diffuse discharges of the four contaminants will be required. In my opinion the articulation of rights to discharge contaminants at the property or enterprise level, and how these rights should be allocated, will take considerable work. I understand this concern is shared by a number of other submitters such as Waikato and Waipa River Iwi.

4.3 The Section 32 Evaluation Report notes that "[t]he ability for Plan Change 1 to direct what happens in the next plan change may be somewhat uncertain…." It is my understanding that the jurisdiction of Plan Change 1 is generally limited to those provisions which are to be implemented during the life of Plan Change 1 (ie Stage One). It is inappropriate for a policy to prescribe what a future plan change should include.

4.4 Decisions on future methods to reduce contaminant discharge and improve water quality should be left to the future, and any future plan change should be subject to full public process under the First Schedule of the RMA. In addition to Policy 7, I therefore support Miraka's request to remove any reference to future allocation in Plan Change 1. The list of principles for consideration for future allocation (Policy 7 a.-d.) should also be removed, along with the criteria in footnote 5, and references in other parts of the Plan.

4.5 I am aware that some other parties have suggested there is value in having longer term certainty beyond the 10 year horizon of the Plan Change via a more formal allocation regime. I agree that is a valid matter, but I consider that the Vision and Strategy and the 80 year water quality targets clearly signal there will be a reduction of discharges and improve water quality over time, so the overall resource management strategy is clear. I do not consider that the need for certainty outweighs the other factors I have outlined.

4.6 Miraka supports the principle of the first element of the notified version of Policy 7 relating to the collection of information and undertaking research as part of a staged approach to the improvement of freshwater quality. However, this concept is better placed as part of the related parts of Methods 3.11.4.7 and 3.11.4.8.

4.7 Improving our understanding of current discharges and their effects on receiving environments, developing better tools for mitigation and estimation of discharges and effects, and sharing knowledge with communities are essential to effectively evaluate alternative methods to achieve further reductions in subsequent regional plans.

4.8 I support the CSG's position, which was reflected in the notified version of the Plan, that our current knowledge is insufficient to underpin long term decisions. However, in my view information gathering, modelling and research into spatial variability will be insufficient. The relationship and decision-making frameworks outlined in section 5.4 below require casting the knowledge net wider, and includes acknowledgement of the primacy of matauranga Maori in relation to water, mauri, decision-making processes and relationships. A framework for the long-term health and wellbeing of our rivers and communities should be based on a common language of resource use and care, and must be based on more than what information, modelling and science alone can tell us. Science may inform part of the process, but should not determine the outcome or framework.

Opposition to specific preferred allocation frameworks

<u>Land suitability – PC1</u>

4.9 As discussed above, Miraka opposes the indication of a preferred framework in PC1. 3.11 Background, Policy 7 and Methods 3.11.4.7 and 3.11.4.8 all refer to 'land suitability' or 'suitability of land' as a means of future allocations of contaminant discharges. This is premature, suggesting that decisions have been made for the next stage after 2026 to allocate via land suitability, even though lack of agreed criteria and information is a current constraint to decision making.

4.10 At the outset it is important to understand that 'land suitability' or 'suitability of land' is different from Land Use Capability. Land suitability is not well defined, as I discuss below, and this uncertainty is an additional reason to not include it in the plan.

4.11 I agree with the Fertiliser Association of NZ's assessment that "Policy 7 introduces principles which apply to a separate (future) planning process, and increases uncertainty for land managers by reference to 'future allocation' with no indication of timeframes, and by reference to 'land suitability' with no reference to how that might be assessed and what impact it may have on current or future investment in land development."[6]

4.12 A 'land suitability' mechanism has the potential to create serious inequities and economic hardship, which need full investigation and consideration. From my reading, I understand that no material was presented to the CSG or provided in the

[6] Submission Point PC1-9789

s32 Evaluation report to support land suitability as the most efficient or equitable allocation mechanism.

4.13 There have been a range of recent evaluations of alternative allocation approaches or methods in the New Zealand resource management and water quality context, including material presented to the CSG[7]. None of these contain any assessment of a land suitability approach. It could perhaps be aligned with a natural capital or Land Use Capability approach, or perhaps it has more in common with a nutrient vulnerability approach, or even an input control approach. Uncertainty as to how to categorise the land suitability approach for comparison against known allocation methods underlines the lack of information, evaluation and consultation around it. Also, there is no agreement on the criteria and their weightings. This is very important to Maori and their values.

4.14 Further, I note with concern that the land suitability criteria as presented in PC1 are in direct opposition to those criteria developed by the National Science Challenge relating to Land Use Suitability[8], which the CSG was referred to during the development of PC1. The National Science Challenge Land Use Suitability concept explicitly **includes** economic, environmental, social and cultural values within the feedback loops and the receiving environments, and acknowledges the importance of human interventions that can enhance natural resilience. By contrast, the land suitability criteria under Policy 7 explicitly exclude economic, social and cultural criteria, exclude current land use and water quality (feedback from receiving environments), and exclude the moderating effects of potential mitigations. Reference to the concept of land suitability in PC 1 is premature because, amongst other things, it lacks agreed definition and clarity.

4.15 Miraka therefore opposes the inclusion of 'land suitability' as a future allocation approach in PC1, opposes land suitability as a principle for future allocation (Policy 7a) and opposes the criteria set out in the footnote to Policy 7, in particular the exclusions.

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[7] For example:

- Greenhalgh, S., A Daigneault and O. Samarasinghe, 2015, "Sharing the Pie: The dilemma of allocating nutrient leaching between sources", Landcare Research Manaaki Whenua Policy Brief No 12 (ISSN: 2357-1713) Freshwater Allocation (presented to CSG)
- WRC Powerpoint presentation to CSG: 241 – 3478130
- WRC paper to CSG: "Water quality allocation: transition and making room for new users" 390 – 3632027
- Bay of Plenty Regional Council staff, "Draft assessment of possible allocation approaches"
- Daigneault, A., O. Samarasinghe and L. Lilburne, 2013, "Modelling Economic Impacts of Nutrient Allocation Policies in Canterbury: Hinds Catchment" Landcare Research Manaaki Whenua Contract Report LC 1490, prepared for Ministry for the Environment.

[8] National Science Challenges: Land Use Suitability www.ourlandandwater.co.nz

Other approaches (Natural Capital and Land Use Capability)

4.16 Miraka also opposes the inclusion of alternative allocation frameworks proposed by some other submitters. The reasons include those outlined above with respect to PC1 focusing on Stage One practice change mechanisms to reduce discharges (ie Practice Change) and gathering sufficient information to inform long term decisions in a future plan change, and requiring an extensive process to ensure mana tangata and community input into the development of any potential allocation frameworks.

4.17 It also specifically opposes using the concept of Land Use Capability (LUC) as an allocation framework, as suggested by Department of Conservation and by Beef+Lamb NZ and other parties within the drystock sector (or LUC as a proxy for Natural Capital). Land Use Capability is not a proxy for Natural Capital; it was developed during the 1950s and following decades to characterise New Zealand's soil resource in terms of existing and potential production. There are insufficient links to the relatively recent concept of Natural Capital to enable it to be an effective proxy.

4.18 Land Use Capability is also not a reliable proxy for Nitrogen (N) loss. Environmental externalities, like nitrogen loss, were not considered during the development of the LUC framework and are therefore not effectively included in the LUC approach[9]. The inaccuracies associated with using LUC as a proxy for N loss simply compound the issues already present with using Overseer outside of its competency, which Miraka outlined in its Block 2 evidence. The LUC approach does not consider receiving environments and their proximity. In this sense, Wairakei Pastoral Limited's 'Vulnerable Land' concept and criteria is more relevant to water quality.

4.19 Further, the determination of a quantitative discharge allowance to be assigned to each LUC class requires specific algorithms, the detail and relevance of which are questionable. Proposed assignation of allocations based on LUC appears to be primarily, if not solely, in relation to nitrogen. This is in contradiction to the PC1 approach of addressing all four contaminants. The LUC explicitly and effectively encompasses key factors (such as geology, slope, erosion type) that directly affect the rate of loss of sediment and phosphorous, but does not include any factors that explicitly relate to nitrogen loss (as nitrogen discharge was not conceived of at the time of LUC development).

4.20 There are many more criticisms of the LUC approach, both in its own right and as a proxy for natural capital. Some of these have been discussed in the rebuttal evidence

[9] The five primary physical factors underpinning a LUC classification are rock type, soil type, slope, erosion potential and vegetative cover.

of Mr Ian Millner (Federated Farmers) and Dr Paul le Miere (Federated Farmers). In particular, I agree with Mr Millner's points regarding:

(a) Low spatial resolution of existing LUC mapping from desktop exercises (paragraphs 2.5-2.7) and incorrect classifications (paragraph 2.36);

(b) Subjectivity of farm-scale mapping for the purpose of PC1 and allocation (paragraphs 2.9 and 2.12);

(c) Extent of resource required for farm-scale LUC mapping (paragraphs 2.9 and 2.10) (and the limited availability of professionals with expertise in this skill);

(d) Appropriateness of applying a tool that was designed to inform farm management decisions to a regulatory allocation of nitrogen (paragraph 2.13)

(e) Uncertainty as to how sub catchment nitrogen loads will be apportioned among LUC classes, and the resultant property-level allocation (paragraph 2.2);

(f) Issues with the application of LUC to identify N leaching limits or thresholds in Horizon's One Plan and Tukituki PC6 (paragraphs 2.17-2.18)

(g) Issues with determination and application of 'Top Farmer' stocking rates to LUC classes and then allocations (paragraphs 2.20-2.23, 2.26, 2.31-2.35, 2.41-2.52), including the reliance on the application of fertiliser to attain such stocking rates (paragraph 2.50)

(h) Issues with the use of LUC as a proxy for natural capital, which is not able to be measured (paragraph 2.29) and in particular the focus on nitrogen allocation rather than all aspects of a farm system and its biophysical context, and the inability of LUC to incorporate or consider regulating services, attenuation and environmental effects (paragraphs 2.53, 2.56-2.63).

4.21 A discussion of the concept of natural capital (and LUC proxy) and of natural capital as a means of allocating nitrogen was presented to the 2017 NZ Association of Resource Economics conference by Phil Journeaux[10], and I have included this paper as an appendix. I commend it to the Commissioners' attention, as it provides factual descriptions of both Natural Capital and LUC, and discussion on the implications of their use for allocation, including practical, social and economic implications.

[10] Journeaux, P., 2017, "Thoughts on the allocation of nutrients; the issue with Natural Capital allocation", unpublished paper to NZARES Conference 2017

5. ALLOCATION – FIRST PRINCIPLES

5.1 As a resource management professional, I acknowledge the complexity of attempting of determine fair and equitable use of resources amongst competing needs, including those of the environment itself. However, I consider that given the pressing resource management issues around water management Aotearoa / New Zealand needs to make such determinations. I consider it is vital that the process for making such determinations needs to be robust, with careful consideration of principles, decision-making processes and frameworks before any allocation methods are used or quantitative assignments are made. This same process should apply whether each region identifies its own allocation regime or national direction is provided.

Allocation of water in the context of Maori customary rights

5.2 In the past 5-10 years there has been increasing concern about the recognition of Maori customary title over fresh water. The Crown has, however, struggled to resolve this matter with Maori in a way that provides certainly and clarity on subsequent management regimes. These proceedings are no exception. Until the question of ownership/customary rights has been resolved at a Crown-iwi/Maori level any allocation regime is, ultimately, established on contested ground. Miraka first principle is that Maori customary rights to water be agreed upon by Crown-iwi/Maori context and formalised in law prior to any regional allocation.

Framework for an allocation process

5.3 During Miraka's consideration of PC1, a number of workshops were held to discuss Miraka values and principles and how they related to its position on PC1. We specifically discussed principles and frameworks for the long-term determination of appropriate use of waters and the uses and management of land to support water quality. I present them here, summarised into three areas:

(a) <u>First principles:</u> There are three fundamental principles to follow in relation to limit-setting or allocation of water (including land uses that affects water):

i) The importance of water itself, of and for itself (sometimes referred to as intrinsic value) which requires allocation methodologies and outcomes that provide for water itself;

ii) Water for all needs. This principle acknowledges basic rights to life, including access to water and implies fairness and equity in a context of moderation, where people are able to provide for their needs but not necessarily their wants or commercial gain; and

iii) Use does not impact mauri. The mauri (life-force and integrity) of various waters is to be maintained and supported, with kaitiaki and mana tangata determining what is required to achieve this and whether it is being achieved.

(b) Decision-making partnerships: The decision making process should be formed in such a way that recognises kaitiaki, tangata whenua, mana whenua and iwi/hapu/marae have the right to make decisions based on their values, principles and knowledge of their local resources as part of a decision partnership.

(c) Relationship framework: The framework for considering any resource allocation should be made within the context of relationship – relationships between kaitiaki, mana whenua and resource, and between kaitiaki, mana whenua, community and local and central government. The framework needs to be based as much on mana whenua principles, perspectives and knowledge as it is on central government legislation (such as RMA) and quantitative science and modelling. The nature of the relationship framework is more than decisions about a particular resource, and requires power sharing to co-design a common understanding for the use, management and protection of resources.

5.4 I acknowledge that many of these aspects extend beyond the purview of the Panel in its deliberation of Plan Change 1, but consider that it is necessary for long-term determination of resource use and allocation to provide certainty and sustainability going forward to meet the 80-year objectives of the Vision and Strategy.

6. ALLOCATION - FUTURE FRAMEWORKS

6.1 Miraka opposes any specification or indication of a future allocation regime within PC1. However, it wishes to outline its current preferred approach for consideration in future planning processes. I discuss below what that approach is and identify some of the benefits and challenges.

6.2 Significant investment into research on potential future frameworks and models to inform nutrient discharge allocation is being made nationally in New Zealand at present. This will inform future regional plan changes, following Stage 1.

6.3 As I noted above, the concept and application of Land Use Suitability is being investigated by the National Science Challenge. This proposes a much more holistic and integrated view of Land Use Suitability (LUS) than is offered in the PC1 footnote definition within Policy 7. According to the National Science Challenge, LUS is a framework for assessing the suitability of land for primary production that accounts for the connections between land use and economic, environmental, social and cultural impacts[11]. While it begins with the contaminant losses from land use, it also includes economic, environmental, social and cultural feedback from the receiving environments, and considers its collective resilience, including increased resilience through the use of interventions or mitigations.

6.4 McDowell et al[12] have developed a schema for the LUS concept to be applied to production land use within water quality constraints in New Zealand, called the Productivity within Environmental Constraints (PEC). A PEC assessment has three main components:

1. the capacity of a land parcel for primary productivity (productive potential)
2. the potential of a land parcel to contribute contaminants (relative contribution), and
3. the response of receiving environments to contaminants (pressure).

6.5 The current conceptualisation of PEC considers the assimilative capacity of receiving environments for four contaminants (nitrogen, phosphorus, sediment and E. coli).

6.6 The LUS concept has been demonstrated through implementation of a PEC assessment by Snelder et al[13] in Southland. One notable feature of the paper is the number of models and classification systems utilised to populate the various components of the assessment. For example:

(a) Land parcels were defined through the intersection of layers from the national land cover database version 4 (LCDB4), AgriBase GIS and sub-catchment boundary layers as defined by a GIS digital drainage network.

(b) Then each land parcel was assigned a land use capability (LUC) category from the Land Resource Information geospatial layer.

[11] National Science Challenges: Land Use Suitability www.ourlandandwater.co.nz
[12] McDowell, R.W., T. Snelder, S. Harris et al, 2018, “The land use suitability concept: Introduction and an application of the concept to inform sustainable productivity within environmental constraints” in Ecological Indicators 91 (2018) 212-219

[13] Snelder, T.H., L Lilburne, DJ Booker, et al, *in prep*, “Assessing land-use suitability in Southland, New Zealand”

(c) Land parcels were also assigned to a physiographic zone to characterise combinations of biogeochemical and hydrological controls that affect the risk of loss of the four contaminants.

(d) There were further models and classification systems for the surface water drainage network, aquatic receiving environments, freshwater targets, nitrogen loss scenarios using Overseer and SPARROW, standardised source loads, transport pathways and nitrogen attenuation.

(e) Each farmable land parcel was categorised in terms of the three PEC components for each combination of land use scenario and water quality target and assigned a productive potential indicator, and at each critical point the relative contribution indicator for all upstream land parcels was calculated from the individual delivered standardised loads.

(f) The pressure indicator was evaluated as the ratio of delivered scenario load to maximum acceptable load at the critical point.

(g) Then, there are several potential methods for combining the indicators into suitability indices, both quantitative and qualitative, and with varying perspectives and weightings given to different values.

There was substantial variation in the outcomes, with a range from only one category 1 indicator through to 14 (out of total 36 over 5 index values)[14].

6.7 The detail in the above description is deliberate, to illustrate the complexity of the application of the Land Use Suitability concept. On the one hand, its complexity allows for a holistic and integrated assessment of multiple factors, and can be applied across all four contaminants. However, each model and system used has its own limitations in terms of original purpose and current fit-for-purpose, scale, representation and accuracy. That same complexity of interacting models introduces much opportunity for compounding of error, distrust by the 'recipients' of the modelling, and ongoing debate.

6.8 The Snelder et al results show that land use suitability is not an intrinsic and unchanging property of a land parcel, but is dependent on the wider environment (the catchment in the PEC application) and on normative decisions concerning environmental targets, assumptions about catchment land use, and different perspective on trade-offs between production and the environment. It is still possible for some nutrients to be prioritised over others (eg N over P), some environments

[14] Snelder et al *in prep*

over others (eg water over climate), some land users over others, and so on. Land use suitability is inherently subjective and therefore also subject to ongoing debate. Equity will be in the eye of the beholder.

6.9 In summary, there is substantial flexibility within the LUS concept to allow for assessments to be tailored to various needs of different situations, and it is intuitively attractive. However, its flexibility and complexity also leave it wide open for compounding errors, subjective differences and ongoing debate. Further, it is based essentially on science perspectives and models. From the Miraka consideration of first principles, decision-making partnerships and relationship frameworks, such an approach cannot be sufficient in itself but rather could be a component within a wider socio-cultural framework for sustainable resource management into the future.

7. SUMMARY

7.1 In summary, Miraka considers that any development of allocation principles, process and approaches should be undertaken in Stage Two. Miraka opposes any pre-emption of this second plan change process, including the presumption that land suitability is the preferred approach, and any proxy or de facto allocations that are within PC1 or proposed by other submitters. We consider there has been insufficient consideration, process or consultation on potential allocation frameworks to include any form of one in PC1.

7.2 I agree with the Section 42A report that any allocation system will need robust review at the time of its development, and that any future planning regime will be required to make assessments without pre-judgement.[15] I support the Officers' recommendation that Policy 7 be deleted.

7.3 I oppose the proposal of other submitters to amend PC1 by including an allocation regime based on Land Use Capability (LUC)/ LUC is inappropriate because it was developed to categorise production, and did not conceive of nor therefore include environmental externalities such as nitrogen loss, or impacts on receiving environments. LUC is not a proxy for Natural Capital and is not a reliable indicator for nitrogen loss.

7.4 For Stage Two of Healthy Rivers Miraka considers that any framework for the long-term determination of appropriate use of waters and the uses and management of land to support water quality should consider fundamental principles of allocation to

[15] *Ibid*, paragraphs 481 and 482.

water itself, water for all needs and the protection of the mauri of water, as well as the development of decision-making partnerships and relationship frameworks.

Jude Addenbrooke

5 July 2019

APPENDIX 1

Paper to NZARES Conference 2017

Thoughts on the allocation of nutrients; the issue with Natural Capital allocation.

Phil Journeaux
AgFirst

1. Background

With the advent of the Resource Management Act (1991) and particularly the National Policy Statement on Freshwater Management (NPS-FM, MfE, 2014, 2017), Regional Councils are required to have regional plans in place by 2025 which address issues of water take and water quality within the region.

As part of these regional plans, councils are often looking to cap and reduce nutrient discharges from farms, particularly nitrogen. Often this cap is in the form of a per farm allocation, i.e. x kilograms of nitrogen leached per hectare per year, based on various criteria.

The form the allocation takes tends to be contentious because although the water quality target may represent the optimal water quality for society, achieving it potentially limits current and future economic activities of individuals and businesses. While economic, environmental and equity arguments can be made for all allocation mechanisms, there is no single approach that can make all those with an economic interest at least as well off as they currently are.

In this context, this paper looks at (a) the concept of a natural capital allocation, where currently Land Use Capability classification (LUC) is being used as a proxy, and (b) at the economic sense of natural capital as a means of allocating nitrogen

2. Natural capital

In some recent submissions on proposed regional plans, there has been a request to allocate nitrogen leaching on a "natural capital" basis. A natural capital approach to nutrient allocation is often argued for as providing better economic outcomes (i.e. increased productivity), better environmental outcomes, and better equity outcomes. The term "natural capital" is a concept used to liken natural resources to other forms of capital such as manufactured capital (e.g. buildings) that policy makers may be more familiar with (Roberts, 2012).

In a broad sense the definition of natural capital is "the total stocks and flows of natural resources and services in a given ecosystem or region" (Pembina, 2008). Mackay (2010) provides a definition of: *the ability of a soil to sustain a legume-based pasture that fixes N biologically under optimum management and before the introduction of additional technologies*, which is a measure of the productivity of soils.

While natural capital can take many forms (depending on the outcome being sought and the social application of that outcome[16]), LUC is frequently seen as a proxy. For example, in the Hearings for BOPRC Plan Change 10 the commissioners noted:

> [383] *The most common alternative sought was a natural capital approach, which appeared to be derived from the productive capacity of land, based on land classification* (BoPRC, 2017).

LUC was developed in the 1950s and 1960s in New Zealand, and is defined as *a systematic arrangement of different kinds of land according to those properties that determine its capacity for long-term sustainable use.* Capability is used in the sense of suitability for productive uses after taking into account the physical limitations of the land (Landcare Research, 2009).

Under the LUC system, productive capacity depends largely on the physical qualities of the land, soil, and environment, with five primary physical factors involved, namely; rock type, soil type, slope, erosion potential, and vegetative cover. Limitations to land use therefore include; susceptibility to erosion, steepness of slope, susceptibility to flooding, liability to wetness (i.e. poor drainage), liability to drought, salinity, depth, texture and structure of the soil, natural fertility, and climate. LUC 1-4 are also assessed on arable cropping suitability, not pastoral suitability.

The system comprises eight land use classes, with limitations to use increasing, and versatility of use decreasing, from LUC 1 through to LUC 8. This is illustrated below.

Table 1: LUC Classification and land use suitability

LUC Class	Arable Cropping/Horticulture Suitability	Pastoral grazing suitability	Production forestry suitability	General Suitability
1	High	High	High	Multiple use land
2				
3				
4	Low			
5	Unsuitable			Pastoral or forestry land
6				
7		Low	Low	Conservation land
8		Unsuitable	Unsuitable	

Source: Landcare Research 2009

3. LUC 1-4: Assessed on arable suitability

Land assigned to LUC Classes 1–4 must be suitable for arable use, which is interpreted as being suitable for tillage for cropping, and the land is capable of growing at least one of the common annual field crops (e.g. wheat, barley, maize) with average yields under good management without any permanent adverse soil effects (Lilburne *et al* 2016).

This means that the land's suitability for arable use does not necessarily equate with its potential pastoral productivity, especially for those Classes of land with a wetness, wind erosion or climatic limitation. In other words, the LUC Class focuses on soil versatility, which is not the same as its 'capacity … to sustain legume and grass growth', which contributes to the variability of pasture growth within a LUC Class (Lilburne *et al* 2016).

[16] For example, areas of a class of natural capital land may not be given an allocation – such as urban land -because it is deemed unusable for primary production purposes.

4. LUC Classification and variability of pastoral productivity

Productivity indices for LUC classification units were developed based on three levels of stock carrying capacity, for pastoral use. These were assessed for each LUC Unit, based on:

(i) Present average: The number of Stock Units per hectare (su/ha) that the 'average farmer' was typically carrying on a particular LUC Unit.

(ii) Top farmer: The number of Stock Units per hectare that the farmer with the highest level of stocking rate, with at least average stock performance, was carrying on a particular LUC Unit.

(iii) Attainable potential (rain-fed): The number of Stock Units per hectare capable of being carried on a particular LUC Unit, assessed within the limits of present technology (i.e. 1950s-60s) and given favourable socio-economic conditions. (Lilburne *et al* 2016).

These stock-carrying capacities only apply to sheep & beef farming systems, and not to dairying or arable farming systems.

For Canterbury, this approach gives rise to the following Table:

Table 2: Estimates of NZLRI attainable stock-carrying capacities for LUC Classes mapped in the Canterbury Region under rain-fed agricultural conditions (Table 2, Lilburne *et al* 2016)

		Attainable stock-carrying capacity (su/ha)			
	LUC Class	Maximum	Mean	Minimum	Difference
Arable land					
	1	22	20	18	4
	2	20	18	16	4
	3	24	15.5	10	14
	4	19	11.6	5	14
Non-arable (assessed under perennial vegetative cover)					
	5	13	10	4.5	8.5
	6	14	8.3	2	12
	7	10	3	0.1	9.9
	8	Unsuitable for pastoral production			

What this shows is the significant variation of stock-carrying capacity within a LUC class, and Lilburne (*et al* 2016) point out that some Class 3 soils have a higher carrying capacity than Class 1 and 2 soils, and some Class 6 soils are comparable to some Class 3 soils. All of which underlines that LUC classifications are a poor proxy for soil "natural capital".

5. Land Use Capability and nitrogen leaching

While LUC can be a useful tool in assisting in land use decisions, its use as a proxy for nitrogen leaching allocation suffers one serious drawback – it was not designed for nitrogen leaching, and as a result the relationship between LUC and nitrogen leaching is unreliable. LUC can show a relationship to productivity and productivity can show a relationship to nitrogen loss. The range of factors used to inform LUC, however, can cause substantial differences in nitrogen leaching rates.

The amount of nitrogen leached from a farming operation is a function of a wide range of variables, including;

- Soil type, particularly drainage characteristics
- Rainfall
- Farming type, i.e. dairying, drystock, cropping, permanent horticulture
- Type of pasture/crop

- Fertiliser; timing and amount of nitrogen fertiliser
- Effluent management
- Farming system and grazing management
- Stock type, e.g. specie, age, sex

Another important determinant of nitrogen leaching is land management, or what could be called "human capital", related to *farming system and grazing management*. This is the difference between farmers regarding their skill, expertise, and experience in managing a farm. The end result is that similar farms, on the same LUC, will leach differing amounts of nitrogen due to farm management.

In other words, there are many factors driving nitrogen leaching. Of the variables above, soil type is covered by LUC, rainfall is not part of LUC but is a natural process, and the balance are about how the land is used and managed, including such aspects as stock type, the farm system, stocking rate, and grazing management. A change in any one of the above factors will alter the quantum of nitrogen leaching.

Because LUC includes five primary factors, each contributing to the classification, the interactions result in different characteristics making up any particular land use capability class. Ledgard (2012) notes:

> *For two farms with the same level of productivity and N excretion in urine, N leaching losses will be higher on a moderate LUC site with shallow stony or sandy soils than on LUC I soils. However, an anomaly to this pattern of increased N leaching with increased LUC class is that N leaching will generally be lower from poorly-drained soils in mid LUC classes than from LUC I soils (with the same productivity and N excretion) due to greater gaseous N losses. Thus, there may be greater variation in N leaching within an LUC class than between LUC classes due to different soil characteristics.*

Ledgard (2012) concludes that '*the main drivers of N leaching are not well aligned to the LUC classes'.*

For example, a dairy farm near Tokoroa on a pumice soil (LUC 3) leaches 59kgN/ha/year (based on OVERSEER®). A farm near Morrinsville on an ash soil (LUC 3) using the same farming system leaches 53 kgN/ha/year. There is a significant difference in average rainfall between Tokoroa and Morrinsville; 1600mm versus 1150mm, which directly affected nitrogen leaching. For the purposes of this analysis rainfall was held the same for both areas, so the only variant was the soil type. If the correct rainfall is entered, the nitrogen leaching figures are; 83kgN/ha on the Tokoroa farm versus 51kgN/ha on the Morrinsville farm. The LUC remains the same.

A similar example illustrating the effect of rainfall is; a hill country sheep and beef farm on LUC 4 land, if average rainfall is 1,000mm/year, N leaching = 14 kgN/ha/year. If average rainfall is 1,500mm/year, N leaching = 23 kgN/ha/year. Same farm, same system, same everything, except a difference in rainfall.

It may be possible to combine some if not all of the aspects bullet-pointed at the start of this section, although developing a system which incorporates a wide range of varying factors in order to provide a simple allocation approach, is difficult to envisage.

6. Land Use Capability and technological change

LUC classification was developed in part to provide an estimation of the "productivity capacity" of the soils, usually expressed as carrying capacity, i.e. stock units/hectare. This was done based on the best information at the time, but technology and farming systems have changed, which has increased the productive capacity of the land.

Examples of this include;

(i) Artificial drainage. One of the classification factors within LUC is the internal drainage characteristics of the soil; poor internal drainage is very likely to result in a lower LUC classification. This can often be readily remedied via artificial drainage (which will often increase nitrogen loss) but could mean lifting a (say) LUC 3 soil up to a LUC 1 equivalent regarding productivity.

(ii) Use of fertiliser. Most New Zealand soils have relatively low natural fertility, and the addition of fertiliser (NPKS) can materially increase pasture growth across all LUC categories, particularly so with nitrogen fertiliser applications. Improvement in productivity capacity via this technology is likely to continue to improve given the advent of precision application, particularly on hill country. As an example, fertiliser trials on the Ballantrae Research farm have shown a lift in stocking rate from the initial 6 SU/ha up to 10SU/ha for the low fertiliser input farmlet, and 16SU/ha for the high fertiliser input farmlet (Roberts, 2012).

(iii) Irrigation. Liability to drought is a factor in LUC classification. Irrigation can readily address this, and has been seen in New Zealand to significantly lift the productive capacity of soils. An example here is irrigation of the west coast Manawatu sand country, which lifted productivity by around ½ LUC equivalent (Grant, 2012).

(iv) Frost protection. Similarly, climate extremes affect LUC classification, and frost can be a significant factor in horticulture production. But again, can be readily rectified using current technologies, e.g. wind fans, water irrigation.

When LUC was first developed, dairy farming on the lower LUC categories (e.g. LUC 4-6) was probably not envisaged. Today, with a combination of various technologies, e.g. irrigation, supplementary crops or bought-in supplements, modern pasture species and good management, this is now economic because the productivity of the land has been enhanced. (Edmeades, 2012)

Another factor which could fit within this category is a change in *knowledge* rather than a change in technology per se. As our knowledge around primary production systems and environmental impacts increases, changes can be made in the way land is managed with could improve productivity and/or lessen environmental impacts.

In summary, changing technologies directly improves the productive capacity of the land, along with actual physical production from the land, which directly differs from LUC-based potential production.

7. Economics, allocation and natural capital

The placing of a nutrient cap on a catchment, or region, will have economic and social consequences. In respect to allocation, good policy should be to minimise these consequences, and particularly the transfer of wealth between sectors or groups within the community.

The issues described in this section are relevant to natural capital as an allocation approach, although the examples use LUC to illustrate points.

Allocation systems that differ from the status quo cause economic and social disruption. The further from the status quo, the greater the disruption. While some disruption may be acceptable for the greater good, in cases where an allocation system is both distant from the status quo and not reliably and consistently correlated with nitrogen leaching, the outcome is inefficient.

A hypothetical example to illustrate this:
Assume a catchment with a range of land uses, with the whole catchment classified as LUC 1 (statistics on land use by LUC are not readily available, so difficult to do a more detailed analysis). Current nitrogen leaching is shown in the following table, along with the nitrogen allocation (as per Horizon's One Plan[17]), and the relative adjustment required.

Table 3: Impact of nitrogen allocation

	Current kgN/ha/yr	N Allocation (kgN/ha/yr)	Difference (kgN/ha/yr	% Difference
Dairy	45	30	-15	-33%
Drystock	20	30	10	50%
Forestry	2	30	28	1,400%
Kiwifruit	10	30	20	200%
Arable cropping	30	30	0	0%
Intensive vegetables	70	30	-40	-57%

What this shows is a direct transfer of wealth from the higher nitrogen leaching systems (dairy, intensive vegetables) to the lower nitrogen leaching systems (drystock, forestry, kiwifruit). Plus, potentially, between farms within the same sector depending on their individual nitrogen leaching level. In essence, there are direct windfall gains for the lower nitrogen leaching systems, and windfall losses for the high nitrogen leaching systems. Intensive vegetable production is likely to cease to exist, as the reduction is too great to achieve with current technology. This translates to high levels of economic cost and social disruption, which means that a natural capital allocation would largely be a lottery relative to existing land use, as the allocation would be based on land quality rather than whatever land use is currently in place. So a farmer, for example, on lower quality land who has employed a range of technology/farm systems to improve the productivity of the land, would lose out, thereby raising the question of equity.

The allocation approach for the Tukituki catchment also reflects the illustration above.

Table 4: LUC-based allocations for the Tukituki catchment

	Base (kgN/ha/yr)	LUC Allocation (kgN/ha/yr)	% difference
Arable	27.6	20	-28%
Dairy	40	20.9	-48%
Dairy/Heavy soil	51.2	21.8	-57%
Dairy/Light soil	59.8	22.7	-62%
Mixed Arable	30	23	-23%
Mixed Livestock	24.3	20.4	-16%
Orchard	18.6	23.9	28%
Sheep/Beef	13.2	16.8	27%
Vineyard	12.7	23.4	84%

Source: Jacobs, 2014

[17] Refer table at end of References

Again, as illustrated in this table, there is a transfer of nitrogen between sectors, from arable and dairying to horticulture and sheep & beef. Given a 50-60% reduction, it is likely that little dairying would survive, meaning economic and social disruption is high.

The recipients of any extra nitrogen leaching allowance are in fact being compensated for loss of future opportunities at the expense of other sectors/landowners.

An interesting issue regarding Table 3 is the case of kiwifruit. It is a high value horticultural enterprise, requiring high quality soils; basically, a "highest and best use" type crop. So, assuming it is being grown on LUC 1 soil, and currently leaching is (say) 10kgN/ha/year, but is then allocated 30kgN/ha/year, what "higher and better" use will (or could) the land be put to? The same applies to vineyards in Table 4.

The other economic impact of allocation is, due to the transfer of wealth, is the potential to have stranded capital, and a negative impact on land values. This is difficult to quantify generically, as it would vary on a case by case basis, particularly depending on whether the allocation was above or below current leaching levels and the quantity of this difference.

In any allocation system, it is important that all land uses are incorporated within the system, otherwise anomalies can arise. Which is the case with the LUC based allocation system used in Horizons, namely the absence of the drystock sector (and forestry) from the LUC-based allocation. For example, if you were dairy farming on LUC 8 land (not a high probability, but the principle is there) and leaching say 30kgN/ha/year, then this is bad and you need to reduce to 2kgN/ha/year (as per the allocation for LUC 8 land). If you were drystock farming, of which there are 43,600 hectares in Horizons on LUC 8, and leaching say 8-10kgN/ha/year, then that's fine; no reduction required. Incorporating all land uses however also has the effect of generating a higher level of disruption in economic and social terms. If forestry is added to a system with a cap or reducing nutrient limit on pastoral land the available nutrient load will be spread across a wider area of land, placing significantly more pressure on the existing activities and will lead to increased economic disruption. This can be illustrated from the Rotorua Lakes situation:

Table 5: Lake Rotorua effect of adding Forestry on allocation

LUC	Drystock (ha)	Total Nitrogen at 25.6kg/ha allocation (kg N)	Forestry (ha)	Drystock and Forestry ha	Total Nitrogen at 25.6kg/ha allocation (kg N)	Forestry conversion to Drystock (ha)	Drystock remaining (ha)	Drystock removed (ha)
2	393	10,061	20	413	10,573	20	393	
3	2,671	68,378	815	3,486	89,242	815	2,671	
4	5,005	128,128	2,760	7,765	198,784	2,760	5,005	
6	6,867	175,795	4,559	11,426	292,506	1,883	2,837	4,030
7	1,272	32,563	1,419	2,691	68,890			1,272
8	176	4,506	102	278	7,117			176
	16,384	419,430	9,675	26,059	667,110	5,478	10,906	5,478

Source: Table 2 and Table 4 of Moleta, 2017

Note: Using average allocation to show the impact and ignoring LUC suitability for activities.

From the above table it can be seen that either there is a significant wealth transfer (5,478 ha of drystock cannot remain and becomes forestry and vice versa) or all land faces a much tighter nitrogen limit - a 37% reduction from the 25.6 kg/ha average to 16.1 kg/ha so that the total load from drystock is retained but over drystock and forestry.

The other risk with a natural capital based nitrogen allocation is the possibility of creating even more nitrogen as a result. This is illustrated in Tables 3 and 4 by the positive figures, where nitrogen has been allocated above the level of current leaching. The hope is that this is (more than) offset by the reduction in nitrogen as evidenced by the negative figures. But the quantum of this is difficult to readily calculate given the absence of good statistics around land use by LUC or nitrogen leaching rates by land use by LUC. It would largely depend on the proportionality of existing low nitrogen leaching land uses, e.g. forestry, permanent horticulture and drystock, relative to higher nitrogen leaching land uses, e.g. dairy, relative to the quality of land they were being carried out on.

A simple hypothetical example to illustrate this:

A catchment is 100,000 hectares, evenly divided between forestry and dairying, and all LUC 1, with a nitrogen allocation of 30kgN/ha/year. The 50,000 hectares of forestry would be allocated a total of 1,400 tonnes on nitrogen (moving from 2kgN/ha to 30kgN/ha). The 50,000 hectares of dairying would "lose" 1,000 tonnes of nitrogen (moving from 50kg/ha to 30kgN/ha). So the overall allocation has increased nitrogen in the catchment by 400 tonnes.

8. Optimal land use

One of the arguments for a natural capital allocation is that it would result in optimisation of land use, i.e. the best land would be farmed at their "highest and best use", which is often translated as highest economic return, or that the land use best suits the soil.

The question of land use optimisation raises a number of issues, particularly as to the definition of "optimisation" and who is doing the defining – often it is a matter of personal perspective.

Optimisation in production or best use can also change dependent on changing circumstances and/or the use of technology. Examples include:

- The use of drainage and/or frost protection, thereby allowing a crop to be grown that would not necessarily be possible in the natural state.
- The recognition that some land use (or crop) is possible on what was previously considered poor soil. The classic example here is viticulture on the Gimblett Gravels near Hastings.

Part of this argument is, for example, "farmers should not be running heavy cattle on heavy soils on hill country in winter." Which indeed they shouldn't. But a natural capital allocation system cannot guarantee this will not occur; it is entirely possible to damage soils while operating under a nutrient cap, as it is related to farmer skill and experience (i.e. the human capital factor).

The land use choices of individuals and businesses are driven by a wide range of factors:

Biophysical, which includes:

- Soil type - whether free-draining or not, whether suitable for horticulture compared with pastoral agriculture, how deep the topsoil, how fertile it is.
- Topography - how flat or steep the land is, the aspect of the land, how suitable for mechanised farming, how prone to erosion.
- Climate - how much rainfall, how windy, sunshine hours, degree of seasonal variation, how hot or cold it is at different times of the year.
- Availability of water - for example, for irrigation or domestic/industrial consumption, and the quality of that water.

Economic, which includes:

- Profit - what are the comparative costs and returns from particular land uses.
- Capital - access to capital for investment, development and seasonal finance. This can vary; at an aggregate level New Zealand is not short of capital, but at an individual level it varies widely.
- Markets - is there a market for whatever land use is envisioned, what is the proximity to the market. There is also the issue of market timing – is investment and land use change responding to a market cycle? Once made, investment or disinvestment decisions cannot be altered on a short-term timeframe.
- Infrastructure - whether there is infrastructure available to support the proposed land use – be it servicing firms, processing firms, marketing firms. If no infrastructure currently exists, what is the likelihood/speed of development?
- Access to information - availability of information/technical advice around the proposed land use change.
- Access to (skilled) labour necessary to run the proposed new land use activity.
- Land tenure - if the land owner has secure property rights to the land, then the incentive to consider long-term land use decisions is enhanced. If land tenure is uncertain, then the incentive is to concentrate on short-term farming activities, and forgo any longer-term options.

Technology. This was touched on earlier in this paper, where technology or management systems can be used to offset biophysical limitations and/or change the productivity of the soils.

Societal/Regulatory factors. This relates to the concept of "social license to farm", which has always affected farming, and becoming more prevalent around animal welfare and environmental concerns. Which is where the restrictions on nutrient discharges is based, although the manifestation of this will be in economic terms.

Individual factors. This covers the wide range of difference in individuals which may affect their thinking around land use. It would include aspects such as age, education and experience, family circumstances, attitude to risk, access to capital, access to information, and attitude to change. In other words, their personal preference; e.g. some people like working with livestock, others prefer plants.

While a review of the literature (Journeaux *et al* 2017) indicates that the main two drivers of land use change are the biophysical aspects of the land, and economic factors, all of the above factors interact in an infinite array of permutations, meaning that any one factor is unlikely to drive an optimisation of land use. For this reason, restricting land use based on one measure – natural capital – is unlikely to deliver on an optimal land use pattern – but is likely to result in high economic and social costs (disruption to the status quo). This can be demonstrated by using LUC as a proxy for natural capital and analysing current land cover patterns as shown in Table 5.

Table 6: New Zealand Land Cover by LUC Classification (ha)

	LUC								
Landcover	1	2	3	4	5	6	7	8	Total
Cropland	25,378	148,406	143,916	39,858	735	9,924	1,752	167	371,721
Exotic forest	1,621	11,625	92,865	302,476	14,231	987,482	635,234	34,845	2,093,333
Grass and scrub	3,054	21,279	57,791	78,269	8,300	375,173	272,280	408,757	1,244,867
Grassland	136,816	947,837	2,000,541	1,988,679	160,323	4,305,897	2,152,720	1,504,129	13,307,392
Horticulture	12,365	27,547	40,028	13,297	173	7,437	2,600	243	104,458
Natural forest	1,328	12,679	56,966	287,962	19,128	1,704,582	2,521,526	3,035,210	7,656,719
Other	1,093	8,323	23,276	47,169	6,229	66,334	97,262	814,494	1,463,112
Urban	5,454	23,793	27,033	18,768	760	14,373	4,608	966	223,290
Total	187,171	1,202,811	2,444,038	2,778,956	210,389	7,478,476	5,694,999	5,807,314	26,523,681

Source: LRI/LUCAS databases. Note: Totals exceed individual columns/rows, as some categories have been removed

Table 6 shows that there are 106,000 hectares of production forestry on LUC 1-3; the economic returns from those soils is likely to be much higher in another land use, such as cropping or horticulture. Similarly, there is 3 million hectares of grassland on LUC Class 1-3 soils, and again a higher economic return under cropping or horticulture is probable on much of this area. At the other end of the spectrum, there are 11,800 hectares of cropping on LUC 6-8, 10,300 hectares of horticulture on LUC 6-8, and 3.7 million hectares of grassland (presumably drystock) on LUC 7-8 soils. The reasons for these seemingly sub-optimal land uses are broader than the capability of the land and take into account the factors discussed earlier in this section, plus the changing technologies that make land more versatile than was envisaged when LUC was developed.

Table 6 also indicates that there are several million hectares of land suitable for horticultural purposes, which are currently not in horticulture, despite it being, in general, a higher economic return activity relative to pastoral uses (i.e. a “higher, better” use). This is due to a wide range of factors, of which nutrient discharge restrictions isn’t one. If nutrient discharge is restricted, this will not magically drive the development of horticulture, as all the other factors will still be relevant, and highest and best use may not require a large quantity of nitrogen.

The question therefore is whether a natural capital allocation would drive land use towards “best and highest” use. The answer is – very unlikely.

This is not to say that restrictions on nutrient discharge will not affect land use; the likelihood of this is very high, and will be manifest over the next two decades as more Regional Councils ratify/review their water quality plans. If nitrogen is available, then farms can convert to a higher nitrogen leaching land use, e.g. from drystock to dairy. If nitrogen is not available then obviously they can’t. It just won’t drive land use to any level of optimisation or best and highest use, as there are too many competing influences.

9. Trading and efficiency

The imposition of a cap or allowance on nutrient discharge at a farm level obviously imposes a degree of restraint on the land use, or potential land use change. One means of improving the flexibility of land use within the constraint, is to allow trading in the nutrients (i.e. nitrogen*); for individuals trading provides flexibility and, in theory, reduces the cost of regulatory compliance* (Kerr et al, 2015), for society, trading reduces the overall cost of the policy. This is important when considering the desire for compensation for loss of future opportunities. A simple analogy is when a person has an old car and wishes for a new one. The probability of the government or anyone else buying one for them is somewhat remote. But there is a remedy well at hand – they can buy a new one directly, as a functioning market is well established. The main point here is that we live in market economy and accept the “rules” involved.

There is a similar sense with land use; yesterday you could intensify and/or change land use relatively freely. Today you can’t because a restriction (i.e. a nitrogen cap or allowance) has been imposed. If a trading system is also in place then this (a) won’t necessarily mitigate the impact of the restraint, but (b) does offer some degree of flexibility.

As an example, assume a catchment with a current input of 1,000 tonnes of nitrogen. As a result of the cap and reduction, this is reduced to 600 tonnes. The important thing post the cap and reduction is to make the best use of the remaining nitrogen (i.e. the 600 tonnes), which is where a trading system greatly aids in the flexibility of this use, and enables the nitrogen to move to its highest value use.

Some see “cap and trade” as a constraint all in one. It is important to note that it is the cap which imposed the constraint, whereas trading offers a degree of flexibility. Within New Zealand it could be expected that nutrient trading markets will be (at least initially) both thin and sticky (i.e. relatively few traders and some reluctance to trade). But at the very least it provides an opportunity for that flexibility. This is important regardless of the initial allocation system[18].

There is a concern in some quarters that “bad” farmers could buy nitrogen from “good” farmers and thereby stay in business. This is quite possible, given the assumption that “good” farmers are willing to sell. At the end of the day trading is based on a willing seller/willing buyer basis, and as a generalisation, “good” farmers tend to be more profitable than “bad” farmers, so are more likely to be the buyers. Similarly, there is concern that all of the nitrogen will be bought by a few, or one, buyer. Again possible, but not very probable. The question could be raised as to so what; the environmental gain has been achieved via the cap and reduction, and the sellers are again presumably willing to sell their nitrogen leaching allowances.

Trading is the means with which the market achieves the optimal economic outcome, and enables those who have been allocated nitrogen that they do not want to use to sell it to those who do want to use it. Without trading, the cost of the natural capital arrangement described earlier is high; intensive activities on lower LUC classes are reduced, while less intensive activities on higher classes are allowed. The Council can demand that the former cease (and unrelocatable assets are potentially lost), but cannot demand that the latter invest.

It has been suggested that trading would not be necessary under a natural capital allocation system, inasmuch as it would result in optimal land use, as discussed earlier. Taking this a step further, if the allocation is based on the principle of natural capital as optimal, it has also been suggested that trading should not be introduced as to do so would undermine the basic principle being applied. Trading of nutrients from land with an “optimal allocation” provides for a compensation mechanism but undermines the fundamental allocation rationale.

Apart from the fact that an optimal land use pattern won’t happen, trading is still required; changes in technology and farming systems into the future are very likely, which will affect the productivity of the land, and hence trading is necessary to ensure there is flexibility to allow this to happen and to deliver economic efficiency over the longer term.

[18] Economic theory would indicate that if trading is fully efficient, then all allocation mechanisms will ultimately result in the same distribution of land uses and farm systems. This is seen for example in the analysis by Parsons et al (2015) and Market Economics Limited (2015) for BOPRC Plan Change 10 in the Lake Rotorua catchment. But the economic impact on individuals will differ widely, and as noted, nutrient trading is likely to be both thin and sticky, rather than “fully efficient”.

Summary

The purpose of this paper was to discuss the issues around a "natural capital" approach to allocating nitrogen. Given the lack of definition of what this means, Land Use Capability is often used as a proxy, and has been used directly by two Regional Councils.

As this paper has demonstrated there are significant issues with using LUC as an allocation tool given the tenuous relationship it has with the many factors that influence nitrogen leaching. It may be possible to define a "natural capital" allocation system with respect to relating it to nitrogen leaching factors, although developing a system which incorporates such a wide range of varying factors in order to provide a simple allocation approach, is difficult to envisage.

Part of the argument for a natural capital allocation approach is that it is more equitable. Equity, however, is often in the eye of the beholder, and the approach discussed in this paper would provide windfall gains for some and windfall losses for others, resulting in a high degree of economic and social disruption. It effectively results in compensation for loss of future opportunities for some, at the expense of others, which is perhaps less than equitable.

It is also argued that a natural capital approach to allocation will result in optimisation of land use. While nutrient allocation is very likely to have an impact on both land use and land use change, given the very wide range of factors that interact to drive both these aspects, it is unlikely that restricting a single factor will in fact drive optimisation. Some of our "highest and best" land use, on good soils, is horticulture, which is mostly a low nitrogen leaching land use. So why are they being allocated more nitrogen? Similarly, "bad" farming practices won't be stopped by any allocation system; the answer here is around education and perhaps direct regulation.

Trading of nutrients under a capped system is seen as a necessity, in order to provide flexibility to individuals and lower the cost of the regulation. It also lowers the overall cost of the policy. This directly applies to a natural capital allocation system; changes in technology and farming systems means that trading is necessary to ensure there is flexibility to adjust, and to deliver economic efficiency over the longer term.

The paper has concentrated on nitrogen allocation, as this is currently the only nutrient being allocated. It is possible that phosphorus could also be allocated at some time in the future, particularly as some Regional Councils (Waikato, Hawke's Bay, Canterbury, Southland) have also targeted phosphorus within their plans. A natural capital approach to phosphorus would also suffer similar limitations as discussed for nitrogen, and allocating them both in tandem would add a new level of complexity.

The issues highlighted in the paper, around nutrient allocation and trading, are critical issues facing Regional Councils and the primary sector, as water quality plans are being developed and promulgated. It is an area requiring a lot of research, and it is perhaps disappointing how little is being done.

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Cumulative nitrogen leaching maximum by Land Use Capability Class (Table 14.2, Horizons Regional Plan) kgN/ha/year

PERIOD (from the year that the rule has legal effect)								
LUC	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**
Year 1	30	27	24	18	16	15	8	2
Year 5	27	25	21	16	13	10	6	2
Year 10	26	22	19	14	13	10	6	2
Year 20	25	21	18	13	12	10	6	2