BEFORE THE HEARINGS PANEL

IN THE MATTER **of hearings on submissions concerning the Proposed One Plan notified by the Manawatu-Wanganui Regional Council**

SECTION 42A REPORT OF MS HELEN MARIE MARR

ON BEHALF OF HORIZONS REGIONAL COUNCIL

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1. INTRODUCTION

1.1 My qualifications/experience

1. My full name is Helen Marie Marr. I have a Bachelor of Resource and Environmental Planning (specialisation in Environmental Science) with Honours from Massey University. I am also a qualified RMA decision maker under the 'Making Good Decisions' programme.

2. I have worked as a planner for the last nine years. I have worked for Greater Wellington Regional Council as the Policy Section Leader for the Wairarapa Division. There I lead the consultation on and development of a pan council and iwi coastal development strategy. I have also worked for the Ministry for the Environment in the RMA Policy team. There I worked on preparing recommendations to select committee on the 2005 RMA Amendment. I also worked on the early stages of development of a number of National Policy Statements and National Environmental Standards. I have also worked as a planner in the United Kingdom.

3. I have read the Environment Court's practice note 'Expert Witnesses – Code of Conduct' and agree to comply with it.

1.2 My role in Proposed One Plan

4. I began working at Horizons on the One Plan in August 2006, first as Senior Policy Analyst and Project Manager, and now as One Plan Manager. I have led and been personally involved in the final stages of the consultative process prior to notifying the plan. I have also led the final stages of the development of the policy and rules of the plan in response to submissions on the Draft One Plan and guiding the work of other planners and consultants. I have had a particular involvement in the development of the regime to manage non point source pollution from intensive land uses. This has included liaison with technical experts, including working on the test Farmer Applied Resource Management Strategy (FARMS) project, consultation with stakeholders and submitters regarding the rule, and refining the approach in the proposed plan and in response to submissions.

1.3 Scope of evidence

5. This evidence is in two parts. The first part provides summary answers to the questions posed by the Water Hearing Chair in Minute #6 regarding the rule regime for non point

source pollution. The second part identifies and introduces consultants and farmers who participated in the FARM Strategy process who have not prepared separate expert evidence but who will be available to the hearing panel to answer questions in relation to their perspectives on the FARM Strategy process.

2. EVIDENCE

2.1 Responses to Minute 6#

6. Minute #6 asks a number of questions relating to the regime in the proposed One Plan regarding non point source pollution. The Minute asks that these questions be answered as part of providing s42A reports for the water hearing. The majority of the answers to these questions can be found in the technical evidence from other experts. However there is a large amount of evidence and finding the specific evidence that deals with each question could be difficult for those unfamiliar with the material. This evidence pulls together the information from those other pieces of evidence and provides an easily accessible summary answer. This evidence heavily references other evidence and reports, and those should be relied on for detail.

2.1.1 Nutrient, faecal and sediment contamination commented upon

7. The questions asked by the Chair in relation to Rule 13-1 are focused on nutrients – with the greatest focus being on nitrogen. Horizons Regional Council has identified three major contaminants to water bodies – nutrients (including both nitrogen and phosphorus), faecal contamination and sediment. The approach to non point source pollution proposed in Rule 13-1 is intended to address each of these contaminants to some extent or other. In answering the questions posed by the minute, where it is appropriate, I have commented on these other types of contaminants. This is done to assist the hearing panel by giving a complete picture of the issues and impacts addressed by Rule 13-1.

2.1.2 Question 5.1. What data or research shows that intensive farming is the cause of elevated nutrients in the receiving rivers in each of the identified problem catchments?

Summary answer: State of the environment monitoring over many years shows that the level of nutrients in the targeted waterbodies is above the acceptable standards set by the Regional Council. Analysis of this information and point source discharge monitoring data shows that there is a large difference between the amount of nutrient measured in some water bodies and the level that can be explained by point sources. The difference comes from non-point source pollution. Analysis of potential non point sources and research on the nutrient losses of different farm types, indicates that intensive farms are the main contributors of non-point source pollution. **Links to POP provisions:** Issue 6-1, Policy 6-4, Policy 6-7 **Links to evidence:** Jon Roygard Brent Clothier Kate McArthur Dr Davies-Colley Roger Parfitt Dave Houlbrooke Ross Monaghan

8. This question is addressed in three parts. First, what evidence shows that there is an elevated level of nutrients in the problem catchments. Secondly what is known about the non-point source contribution to the total load of nutrients in the identified catchments. And thirdly, what is the contribution of identified intensive land uses to the non-point source nutrient load.

9. Faecal contamination is the other type of contaminant specifically dealt with by proposed rule 13-1, through the provisions of the FARM Strategy. The sources of faecal contamination are identified in the evidence of Dr Davies-Colley as being largely from non-point sources. The sources of faecal contamination from farms are identified in the evidence of Dr Monaghan and Dr Houlbrooke.

10. Sediment is another contaminant of water bodies that has been identified as being from predominantly non-point sources, specifically from erosion of soil (see the evidence of Roger Parfitt for more detail). This issue is acknowledged in Chapter 6 (Issue 6-1(b) and Policy 6-7(c)) and some of the measures to control faecal contamination (excluding stock from waterways) will also reduce erosion on intensively farmed land. However this issue is primarily from extensively farmed land and is dealt with in Chapter 5 – Land, and in Chapter 12 which regulates land uses on erodible land.

2.1.2.1 What evidence shows that there is an elevated level of nutrients in the identified problem catchments?

11. State of the Environment monitoring shows that the levels of nutrients, sediment and faecal contamination exceed the standards set by the Regional Council for maintaining instream values and life supporting capacity in the identified problem catchments.

12. Jon Roygard (section 16.18.2) describes in his evidence the location, type and length of record of monitoring that is undertaken in this Region. His maps 10 and 11, show the catchments where nutrient concentrations exceed the water quality standards set by the Regional Council. On these maps he also shows the target catchments for Rule 13-1, and these maps show the correlation between exceedence of the nutrient standards, and the identified problem catchments.

13. Kate McArthur's evidence comments on this in more detail. Her Appendix 2 shows each water management subzone in the region and indicates whether the standards for each contaminant are met at different river flows. Mrs McArthur comments for each of the targeted catchments, the level of contamination, and the likely source of that contamination in section 9 of her evidence.

2.1.2.2 What is known about the non-point source contribution to the total load of nutrients in the identified problem catchments?

14. The contribution of non point sources to nutrient loads has been determined using a mass balance. In simple terms, the amount of nutrient in the water body is known from State of the Environment monitoring. The amount of nutrient load from point source discharges is also known or can be calculated. The difference is considered to be from non point and natural sources. This method is detailed in the evidence of Jon Roygard and Kate McArthur.

15. Using this technique, in each of the identified problem catchments, non point source pollution has been identified as the primary cause of elevated nutrients. In some identified catchments non point sources account for up to 97% of the nitrogen found in the river at any one time (Box 44 Jon Roygard).

16. The evidence of Jon Roygard (section 6.15.3) describes how information about the total nutrients, nutrients from point source pollution and river flows has been analysed to identify the contributions of point and non-point source pollution to the total load of nutrients at different river flows.

17. The results of this analysis are shown for all water management subzones in Kate McArthur's Appendix 2, and comment on the predominance of non point sources to the total load is made for each of the identified problem catchments in section 9 of her evidence.

18. This question has asked about receiving rivers specifically, however I note that 7 of the 35 targeted catchments are lake catchments. Lakes are much more complex systems than rivers in our region (having complex interactions with river and groundwater and nutrient recycling processes, details of which are provided in the evidence of Max Gibbs). Our level of data about nutrient inputs and levels is much lower than for rivers (as a result of a far less comprehensive monitoring regime). However the data that we do have is summarized in Kate McArthur's evidence (section 6) and indicates that the lakes targeted by Rule 13-1 have elevated nutrient levels in excess of those desirable to maintain their values. Only two lakes have point source discharges into their catchments (Lake Waipu receives treated sewage from Ratana and Lake Horowhenua receives stormwater from Levin). For all other lakes it is assumed that the only source of nutrients is non-point source nutrients from farm land in the surrounding catchments, or recycling of nutrients which historically entered the lake.

2.1.2.3 What is the contribution of identified intensive land uses to the non-point source nutrient load?

19. There is evidence at the national, catchment and farm level that identifies intensive land uses as the predominant source of non-point source pollution. In summary this work has identified that the individual land uses that have the biggest relative contribution to non-point source nitrogen pollution are dairy farming, intensive sheep and beef farming, cropping and market gardening.

20. In order to understand the relative contributions of all land uses across a catchment, Horizons Regional Council commissioned the Sustainable Land Use Research Initiative (SLURI) to identify and advise on the relative contributions of the various different land uses. At the national level, a literature review presented in Clothier et al. identified and ranked the likely nutrient losses from four farming types. This work is summarized in Box 56 of Jon Roygard's evidence. The identified land uses were (in order of greatest losses) market gardening, cropping, dairying and intensive sheep and beef farming.

21. The contribution of these intensive land uses is also recognized at the national level by industry, who identify in The Primary Sector Water Partnership Leadership Document (May 2008),, that dairying, arable and horticulture operations account for 2/3 of total nitrogen losses and 1/3 of total phosphorus losses.

22. This was tested at the catchment level using the Upper Manawatu Catchment as a case study, by Clothier et al. This work used information about total nitrogen in river, area of land in intensive and non-intensive land uses and identified that dairy farming (as the only intensive land use in that sub zone) contributes 43% of the nitrogen. Brent Clothier summarises the process undertaken and the results in his evidence. Barry Biggs presents his review and endorsement of the approach taken in his evidence.

23. The expected leaching rates set out above have been found to be accurate in the 21 test FARM Strategies that have been commissioned by Horizons. These assessed (amongst other things) the individual nitrogen contributions of the selected farms. There was a high level of agreement between the ranges of nitrogen losses expected, and the actual levels of nitrogen leaching modeled on the individual farms. The results of these FARM strategies are discussed in the evidence of Andrew Mandersen, Peter Taylor and Mark Shepherd.

24. I have summarized the information referred to above in **Table 4. Summary of modelled and measured nitrogen loss under existing, intensification and reduction scenarios in the Upper Manawatu catchment. Data taken from Clothier et al. Data is for Manawatu above Hopelands excluding Weber, except where marked * where data is from Manawatu above Hopelands including Weber.**and more discussion on this subject can be found in the answer to question 5.11.

2.1.3 Question 5.2. Has that situation changed since the POP was notified?

Summary answer:
No. Most recent monitoring continues to show a trend in elevated nutrient levels from non-point sources.

Links to POP provisions:
Issue 6-1, Policy 6-4, Policy 6-7

Links to evidence:
Kate McArthur

25. The trend of the majority of nutrients in rivers coming from non-point sources has not changed since the plan was notified. Kate McArthur presents in her evidence the analysis of the most recent nutrient monitoring data in her evidence (Appendix 2) which includes data up until July 2009.

26. The analysis of the relative contributions of each land use to this non-point source nutrient pollution has not been repeated since the original work done by SLURI. The work was based on nationwide research based knowledge of the nutrient losses from various farm types, and the knowledge of farm system experts familiar with the study area. This information is assumed not to have changed since the work was originally commissioned.

27. What may have changed since the notification of the POP is the relative mix of different land uses in each catchment. Anecdotal evidence suggests that there has been a change to more intensive land uses (as low intensity farms convert to more intensive uses such as dairy farming) or a change to further intensification of existing intensive farms (more cows per hectare for example).

28. One new environmental problem that may be linked to intensive land use has emerged since the plan was notified. Cyanobacteria proliferations in rivers in the targeted catchments have been recorded for the first time last summer. This emerging issue can have serious implications for recreational river users, and this is discussed by Barry Gilliland in his evidence.

2.1.4 Question 5.3. What problems do elevated nutrients cause in rivers and lakes? For rivers, how do such problems affect the Schedule D values for the rivers?

Summary answer:

Nutrients cause periphyton and cyanobacterial blooms. Periphyton blooms in rivers affect a wide range of instream, recreational and consumptive values identified in Schedule D by smothering the bed of the river making it unsuitable for supporting insect and fish life, slippery, unpleasant or dangerous to use recreationally and by clogging up water intake structures. Algal blooms in rivers or lakes present a hazard to human and animal health.

Links to POP provisions:

Schedule D

Links to evidence:

Jon Roygard
Barry Biggs
Kate McArthur
Barry Gililand
Max Gibbs
Hisham Zarour

29. The most common effects of elevated nutrients in rivers is an increase in the risk of nuisance periphyton blooms. Periphyton blooms can cause a reduction in the life supporting capacity of a river by smothering the substrate of river bed and reducing the habitat available for macro invertebrates. This reduction in life supporting capacity has a number of flow-on adverse effects on the values of the water body, reducing the ability of the river to sustain fish life, which impacts on the native fish values, trout fishery and trout spawning values.

30. A recent observed effect in rivers has been the occurrence of toxic cyanobacterial blooms. The extent of these blooms, and their impact on recreation users is set out in the evidence of Barry Gilliland. Cyanobacteria can produce natural toxins known as cyanotoxins. These toxins are a health threat to humans and animals when there is a contact with affected water. This can affect contact recreation and fishing values.

31. I refer you to the evidence of Barry Biggs for more discussion on the links between nutrient loads, nuisance periphyton blooms, and impacts on life supporting capacity and other waterbody values, and also to the evidence of Kate McArthur on the links between the standards set for nutrients and the effects on waterbody values.

32. In lakes, the most obvious effects of elevated nutrients is cyanobacterial blooms. These can have an adverse effect on recreation and life supporting capacity, as explained by Barry Gilliland and Max Gibbs.

33. Elevated faecal levels can make water unsafe for swimming and for stock and human drinking water. Elevated sediment levels make the water more turbid (less clear) and can affect life supporting and infrastructure values. The effects of these contaminants on each value identified in Schedule D (now Schedule Ba) are summarized in Table 1 below.

34. The question has not asked about effects of elevated nutrients on groundwater. However for completeness I note that the key nutrient of concern that impacts on groundwater is nitrogen. Elevated nitrogen levels in groundwater can have serious health implications for those that utilize groundwater as a drinking water source. Nitrogen levels have not reached a level of concern in this region, except for some wells in the Otaki Sand Formation in the Horowhenua area. I refer you to the evidence of Hisham Zarour (from paragraph 103) for more detail about the current quality of groundwater in the region, and the implications of any deterioration in quality.

Table 1. Effects on schedule D values of elevated nutrients, sediment or faecal contamination in rivers

Value Group	Individual values		Effect on value of elevated nutrients	Effect on value of elevated faecal and sediment contamination	More information can be found in evidence
Ecosystem	NS	Natural State	Any increase in the level of nutrients, sediment or faecal contamination will mean the waterbody moves away from the natural state that it is being managed for.		
	LSC	Life-supporting Capacity	Periphyton blooms can smother the substrate of river bed and reduce the habitat available for aquatic macroinvertebrates. This results in a reduction in life supporting capacity. Macroinvertebrate communities may change from high quality insect species (mayflies, caddis flies and stoneflies) to a community dominated by midges, worms and snails. These changes in community structure have flow on effects to other values. For example, native fish (LSC and SOS-A values) and Trout Fishery and Spawning (juvenile recruitment) can be adversely affected if high quality species are absent from rivers and streams. High periphyton levels can reduce dissolved oxygen at night, causing mortality to fish and invertebrates. Elevated ammoniacal nitrogen can cause chronic and acute toxicity effects on fish and invertebrates.	Life-Supporting Capacity can be detrimentally affected by suspended and deposited sediment. Deposited sediment has a marked effect on aquatic macroinvertebrate communities by smothering the bed, filling in interstitial spaces which reduces habitat and dissolved oxygen availability. Habitat for gravel spawning fish is significantly reduced, smothering trout redds and causing mortality in bully juveniles. Suspended sediment physically abrades the gills of macroinvertebrates and fish and can reduce the ability of fish to sight feed. Suspended sediment can also cause avoidance of habitat by inwardly migrating juvenile fish species.	Barry Biggs (periphyton) Kate McArthur (periphyton and sedimentation) Dr Bob Wilcock (Ammoniacal nitrogen effects) Dr Roger Young and Dr John Quinn (evidence relating to dissolved oxygen reduction effects from periphyton).
	SOS-A	Sites of Significance - Aquatic	A reduction in life supporting capacity will affect the ability of these sites to support the significant	Deposited sediment can affect the successful spawning and recruitment of species such as bullies and dwarf	Kate McArthur Dr Bob Wilcock (Ammoniacal

Value Group	Individual values		Effect on value of elevated nutrients	Effect on value of elevated faecal and sediment contamination	More information can be found in evidence
			indigenous fish species current present at these sites. Ammoniacal nitrogen can cause direct toxicity effects on fish and aquatic macroinvertebrates (depending on temperature and pH)	*Galaxias*. Suspended sediment can cause the avoidance of habitat by inward migrating juveniles and can cause localised population changes or extinctions.	nitrogen effects)
	SOS-R	Sites of Significance - Riparian	These sites are used by birds when not covered by water	Stock access has the potential to cause adverse effects similar to the disturbance and habitat change discussed in the evidence of James Lambie.	James Lambie
	IS	Inanga Spawning	A reduction in life supporting capacity will affect the ability of these sites to support the significant indigenous fish species currently present at these sites. Ammoniacal nitrogen in high concentrations can cause toxicity effects on adult and juvenile fish.	Stock disturbance (trampling of eggs and removal of essential spawning vegetation) of estuarine spawning areas can negatively impact inanga spawning and successful juvenile recruitment. Inanga are relatively tolerant of suspended sediment but if estuaries are heavily sedimented the access to marginal estuarine vegetation for spawning may be limited.	Kate McArthur Dr Bob Wilcock (Ammoniacal nitrogen effects)
Recreational and Cultural	CR	Contact Recreation	Recreational swimming values can be directly impacted by periphyton blooms. A river bottom which is covered in slippery algae is unpleasant at best and dangerous at worst for recreational swimmers. Cyanobacterial blooms can cause cyanobacterial toxins. These toxins can make water unsafe for	Elevated levels of sediment in rivers reduces their clarity. A 'murky' river is less attractive to swim in and may be less safe as it is harder for swimmers to see the bottom or any potential hazards. Elevated faecal contamination levels indicate the presence of disease causing micro-organisms. This poses	Kate McArthur Barry Gilliland Water quality survey results referred to by Greg Carlyon

Value Group	Individual values		Effect on value of elevated nutrients	Effect on value of elevated faecal and sediment contamination	More information can be found in evidence
			swimming, and may result in waterbodies being closed to contact recreational uses.	a threat to the health of swimmers and other recreational users.	
	AM	Amenity	These are sites regularly utilized by the public, either as popular swimming, picnicking or walking sites. The presence of periphyton blooms will detract from the communities enjoyment of these sites by making them unusable for swimming, or unpleasant due to the visual effects of periphyton blooms. Cyanobacterial blooms are not only visually unpleasant, they create a very unpleaseant smell when they break down. These blooms can also be toxic to dogs and people, making the site unsuitable for some uses.	A 'murky' river is perceived as less attractive and less usable than a clear one. Elevated faecal contamination levels indicate the presence of disease causing micro-organisms. This poses a threat to the health of swimmers and other recreational users.	Kate McArthur Barry Gilliland (swimming spots) Water quality survey results referred to by Greg Carlyon
	WM	Whitebait migration	Ammoniacal nitrogen can cause some inwardly migrating whitebait species to avoid using some rivers (known as 'avoidance effects').	Sedimentation can cause some inwardly migrating whitebait species to avoid using some rivers (known as 'avoidance effects'). Banded kokopu in particular are susceptible to avoidance of highly turbid waters.	Kate McArthur Dr Bob Wilcock (Ammoniacal nitrogen effects)
	MAU	_Mauri_*	A reduction in life supporting capacity caused by periphyton or cyanobacterial blooms will adversely affect the mauri of the waterbody	Direct discharges of effluent are considered to directly affect the mauri of waterbodies.	
	SG	Shellfish Gathering	Shellfish gathering sites only occur in the coastal marine area (CMA) identified in Schedule H. The CMA is the ultimate receiving environment for all nutrients discharged into rivers. Elevated nutrients in the CMA can cause algal blooms which	Faecal contamination indicates the presence of disease causing microorganisms. These can have a direct effect on the safety of eating shellfish in the affected waters.	Dr John Zeldis

Value Group	Individual values		Effect on value of elevated nutrients	Effect on value of elevated faecal and sediment contamination	More information can be found in evidence
			can poison shellfish and make them unsafe to gather. Macroalgal blooms can also cause low dissolved oxygen in coastal sediments (particularly in estuaries) negatively affecting the abundance and diversity of invertebrates such as shellfish.		
	SOS-C	Sites of Significance - Cultural	These sites and effects on them are not identified.		
	TF	Trout Fishery	A reduction in life supporting capacity will reduce the food available for trout, and adversely affect the value and viability of the trout fishery. Periphyton can cause reductions in dissolved oxygen at night that can be directly lethal to trout, invertebrates and native fish. Ammoniacal nitrogen can be directly lethal to trout in high concentrations.	Sediment will cause trout to not be able to sight feed and also smother the bed of the river reducing the quality of macroinvertebrates available for food. High concentrations of faecal contaminants affect the suitability of waters for contact recreation, which includes activities such as fishing and boating.	Dr John Hayes Dr Roger Young and Dr John Quinn (evidence relating to dissolved oxygen reduction effects from periphyton).
	TS	Trout Spawning		Sediment (both suspended and deposited) will cause eggs and juvenile trout to suffocate in redds due to lack of dissolved oxygen. Habitat for spawning is significantly reduced by deposited sediment.	Dr John Hayes Dr Roger Young
	AE	Aesthetics	Sites identified as having an aesthetic value are highly valued by the community for their wild and scenic or landscape characteristics. The presence of periphyton or cyanobacterial blooms can impact on the aesthetic value of a river, as the river is no longer perceived as	A murky river is seen as less attractive then a clear one.	Water quality survey results referred to by Greg Carlyon

Value Group	Individual values		Effect on value of elevated nutrients	Effect on value of elevated faecal and sediment contamination	More information can be found in evidence
			being wild, and a slimy river is seen as less attractive or desirable than one which is flowing clean and clear.		
Water Use	WS	*Water*^ Supply	When a periphyton bloom is complete, and the material is washed from the river bottom, it can adversely affect all abstractive values of the waterbody – periphyton mats may clog water intakes for drinking water, industrial, irrigation or stock water, affecting the ability of these users to utilize the resource. Cyanobacterial blooms that occur in water supply catchments or storage dams can make water unsafe or unpalatable for human or stock drinking. Elevated nitrogen levels could make water unsuitable for human or stock drinking water supply.	Faecal contamination indicates the presence of disease causing microorganisms. These can have a direct effect on whether a waterbody is safe for human or stock drinking water, or some industrial processes. Elevated faecal contamination will increase the cost of treating the water to make it suitable for its intended use. Sedimentation can also have this effect, blocking intake galleries at abstractions sites. This primarily affects water abstracted during high river flows.	Kate McArthur Barry Gilliland
	IA	Industrial Abstraction			
	I	Irrigation			
	S	Stockwater			
Social/ Economic	CAP	Capacity to Assimilate Pollution	Currently the ability for the targeted water bodies to assimilate pollution is exceeded because of uncontrolled non point source pollution. The effect of this is that no new point or non point source discharges to water can be accepted by the water bodies without further adverse effects on values.		

Value Group	Individual values		Effect on value of elevated nutrients	Effect on value of elevated faecal and sediment contamination	More information can be found in evidence
	FC	Flood Control	No effects identified.	Elevated sediment levels in rivers can lead to increased berm levels when sediment is deposited on the banks of the river after flood flows recede. This directly reduces the effectiveness of the flood mitigation works.	Allan Cook evidence to Land Hearing Panel.
	D	Drainage	Excess weed growth caused by excess nutrients in drainage systems leads to a reduction in the ability of the drainage system to convey water and increased costs of clearing the drains.	Excess sediment levels in drainage systems leads to a reduction in the ability of the drainage system to convey water and increased costs of clearing the drains.	See evidence of Allan Cook for general discussion of works carried out in drainage schemes.
	EI	Existing *Infrastructure*^	No effects identified.	Sediment carried and deposited by flood flows can damage infrastructure in the bed of the river.	

2.1.5 Question 5.4. Why is Rule 13-1 proposed to become operative in different catchments in different years?

Summary answer: The staged roll out of Rule 13-1 is designed to: Recognise the existing capacity of the farm consultancy community to provide farmers with advice in completing a FARM Strategy • Provide those catchments with the majority of cropping and gardening farms with a longer lead in time so that those farmers could upskill • Allow efficient processing of the resource consents within the resources of the Regional Council **Links to POP provisions:** Table 13.1 **Links to evidence:** Peter Taylor Jon Roygard

35. The dates in Table 13.1 are different for different catchments in order to provide for a staged roll out of the proposed rule. A staged roll out is appropriate to work within the resources of the farming and consulting sector in preparing FARM Strategies and allow for the efficient processing of the resource consents that result.

36. There are around 900 dairy farms in the Horizons Region. Approximately 463 of these are in the catchments targeted in Rule 13-1. In addition there are estimated to be approximately 85 cropping, intensive sheep and beef and market gardening properties in the targeted catchments. The number of targeted farms in each of the catchments is presented in Table 2.

Table 2. Number of dairy farms in each target catchment

Catchment	Number of Dairy farms
Mangapapa	7
Mowhanau	Proposed to be removed
Mangatainoka	100
Upper Manawatu above Hopelands	149
Lake Horowhenua	10
Waikawa	8
Manawatu above Gorge	43
Other south-west catchments (Waitarere and Papaitonga)	4
Other coastal lakes	40
Coastal Rangitikei	95
Mangawhero/Makotuku	5

37. Many of the farmers who require a FARM Strategy will require the assistance of a farm adviser or consultant. If all of the properties required to complete a FARM Strategy were required to do so in one year, it would put pressure on the resources of farm advisers in the region. There is currently sufficient expertise in the region to deal with the numbers in the proposed roll out, and demand for expertise will likely result in an increase in capacity in this sector, but it is important that those who require assistance with their FARM Strategy are not delayed because of demand for help exceeding the supply of expertise.

38. The Regional Council would also like to ensure that it can efficiently process the resulting resource consents in a timely manner. A staged roll out is the most cost effective way to do this without the Council having to increase its staff resource significantly

39. There is also a varying level of understanding and knowledge about nutrient management amongst farmers themselves. Dairy farmers have a relatively high level of awareness about the basics of nutrient budgeting (the first step in nutrient management, discussed further in the answer to question 5.12) thanks largely to the compulsory requirement for all Fonterra suppliers to have a nutrient budget in place to meet the requirements of the Dairying and Clean Streams Accord. There will be some notable exceptions, but generally, outside the dairy farming sector there is a comparatively low level of awareness about nutrient management. In order for some cropping, intensive sheep and beef farmers and market gardeners to engage positively in the FARM

Strategy process some capacity building will be required. Having the catchments where these land uses are predominant coming under the rule later (notably Lake Horowhenua and Mangawhero/Makotuku (gardening) and Coastal Rangitikei (cropping)) allows time for Horizons to work with industry groups and farmers in those areas for some years prior to the rule coming into force.

2.1.6 Question 5.5. Are the Nitrogen Leaching/Run-off Values in Table 13.2 measured as root zone leaching or nitrogen reaching the river after attenuation?

Summary answer:
Root zone.

Links to POP provisions:
Table 13.2
Links to evidence:
Jon Roygard
Stewart Ledgard
Brent Clothier
Alec McKay

40. The values in Table 13.2 are measured as OVERSEER® modeled root zone leaching values. This is clarified in the FARM Strategy workbook. Nitrogen reaching the river after attenuation is estimated to be approximately 50% of the root zone leached amount.

2.1.7 Question 5.6. Explain the allocation of the Nitrogen Leaching/Run-off Values by land use capability class compared to alternative allocation options. Please compare the economic efficiency of the identified allocation options.

Summary answer:
The allocation of nitrogen leaching/run-off values by land use capability class is a new approach developed during the preparation of the Proposed One Plan that caters for continued economic growth and ongoing flexibility of land use while providing the basis for meeting soluble inorganic nitrogen water quality targets. It is considered the most effective and efficient approach when compared to alternative approaches for nitrogen loss allocation.

Links to POP provisions:

Table 13.2 and Rule 13-1 **Links to evidence:** Dr Alec McKay Neild and Rhodes

41. The key requirements of a methodology for nitrogen leaching/runoff allocation in the Manawatu-Wanganui Region are considered to be:
    i. that the key role that farming plays in the Region's social and economic well being is recognized;
    ii. that nitrogen loss allocation should not form an unreasonable barrier to economic growth;
    iii. that efficient use of the land resource in water management zones is provided for;
    iv. that future land use change and options are not unreasonably limited; and
    v. that the method is effective in making demonstrable progress towards achieving the water quality objectives of the Proposed One Plan (recognizing that achievement of the ultimate water quality goal may not be possible in the short term).

42. The primary options evaluated by Horizons while developing the Proposed One Plan were:
    i. no allocation – do nothing;
    ii. input limits;
    iii. grandparenting;
    iv. industry benchmarking; and
    v. the LUC allocation method - nitrogen loss values linked to the productive capability of the land.

43. These options are discussed in detail in the evidence of Dr Alec MacKay. Dr McKay also evaluates the additional options of limiting intensive land uses, nutrient use efficiency and best management practices. Neild and Rhodes assess the economic efficiency of the LUC option and grandparenting.

44. The LUC allocation method was chosen as the most efficient and effective method because it is the best match to the key requirements set out in clause 41 above.

45. The following sections summarise the evidence on each of the options considered by the Regional Council in preparing the Proposed One Plan. Where possible, this includes a comparison is made of their:

i. effectiveness in achieving the objective; and
ii. efficiency, including an analysis of the economic efficiency where this is practical.

46. For full details of the analyses and for discussion on other options, please refer to the full evidence that is referred to.

47. The majority of submissions seek replacement of the regulatory framework with a non-regulatory framework for nitrogen loss management. The form or basis of these non-regulatory approaches is not specified, so I cannot assess effectiveness or economic efficiency of a non-regulatory approach at this stage. If more detail is provided in submitters' evidence these options can be evaluated and the results provided to the Panel as a supplementary report.

48. Only one alternative allocation option for nitrogen loss allocation was sought in submissions. That option is 'nutrient use efficiency'. A detailed evaluation of this option can be found in Alec McKay's evidence and I have included a brief evaluation in this response.

No allocation – do nothing

49. The 'do nothing' policy option is to have no allocation of nitrogen loss. Under this option nitrogen loss would not be controlled, soluble inorganic nitrogen levels in water bodies will increase and the adverse effects exacerbated.

50. It is reasonable to assume that producers will continue with the strategy of intensification of land use to remain profitable in the future and that this will result in an increase in the amount of nitrogen entering water bodies. Roger Parfitt explains the nitrogen loss implications of current and projected growth in the dairy sector at a national level in his evidence and Alec McKay summarises the work done by Clothier *et al* for intensification scenarios in the Upper Manawatu River catchment. The results of this are summarized in **Table 4.** Summary of modelled and measured nitrogen loss under existing, intensification and reduction scenarios in the Upper Manawatu catchment. Data taken from Clothier et al. Data is for Manawatu above Hopelands excluding Weber, except where marked * where data is from Manawatu above Hopelands including Weber.Table 4 in the response to Question 5.11. This modeling provides evidence that applying no

limit to the nitrogen leached will lead to a continuing increase in the amount of nitrogen in water bodies.

51. An increase in nitrogen entering water bodies will result in the water quality standards being exceeded more often and a continuing decline in water quality values including life supporting capacity. The likely effects of intensification scenarios on expected periphyton biomass is described by Barry Biggs (See Table 3 of his evidence).

52. There will be no financial costs imposed on intensive land users under this option, however the environmental costs of increased nitrogen in water bodies will be externalized by the farmers and born by the environment and the community. This may have a regional economic cost, but this has not been modeled.

53. The ‘do nothing’ option will not be effective in achieving the water quality objectives of the Proposed One Plan. Soluble inorganic nitrogen and periphyton biomass standards are already exceeded in many water management zones and impacts on values such as life supporting capacity, trout fishery and contact recreation. The ‘do nothing’ option is rejected on this basis.

Input limits

54. A nitrogen input limit approach seeks to control nitrogen loss to water bodies by limiting the amount of nitrogen applied to the land from all sources.

55. This is considered a ‘one size fits all’ approach best suited to situations where farming systems, land uses and land types are uniform. This is not the case in water management zones targeted for nitrogen loss allocation where these factors vary significantly between individual farms. Input limits can be described as a blunt tool for these situations and there is a risk that nitrogen input limits could be imposed that are ineffective and/or come at cost disproportionate to the benefit in nitrogen loss reduction. Alec MacKay and Ross Monaghan both discuss the variability in cost and outcome of input based nitrogen limits in their evidence.

56. The use of input based nitrogen limits is also at the front end of the nitrogen cycling process and its effectiveness is therefore difficult to predict in terms of achieving the water quality standards for soluble inorganic nitrogen in water bodies.

57. Input limits were proposed as the management option in early drafts of the One Plan. This took the form of a limit on the maximum rate of nitrogen fertiliser that could be applied (Draft One Plan Table 16.1 and Rule 16-2). This option was abandoned early on in the process because of the shortcomings outlined above and in response to clear feedback from stakeholders, particularly Federated Farmers, that this option was not supported.

Grandparenting

58. Grandparenting is an option that seeks to limit or ‘cap’ nitrogen losses at levels based on current or a historical rate of nitrogen loss. The cap will prevent further increases in nitrogen loss to water bodies, but if no other mechanisms are put in place to reduce nitrogen losses (such as a reducing cap) then water quality will not improve towards water quality standards for soluble inorganic nitrogen.

59. A key disadvantage of this option is that properties that have historically leached a large amount of nitrogen can continue to do so, but properties on which nitrogen control has been practiced receive no benefit for good practice and must continue achieve low nitrogen losses.

60. In addition, landowners who have low nitrogen loss due to low intensity land use, will not be able to change to a more intensive land use unless they can acquire a bigger share of the nitrogen loss allocation (for example a farmer who has land suitable for dairy farming, but has traditionally only farmed sheep and beef). The effect of this on land will be to limit the future land use options that may lead to economic growth.

61. Grandparenting is used in the Lake Taupo catchment by Environment Waikato. It is considered appropriate because some of the limitations of this option are overcome by implementing a nitrogen trading regime (whereby farmers could buy and sell nitrogen loss rights) and by setting up a public fund to purchase some of those nitrogen loss rights, thereby reducing the total amount of nitrogen in the system over time.

62. This approach is not considered to be an appropriate response in the Manawatu-Wanganui Region. The main reasons for considering this option inappropriate are outlined in Alec McKays report where he notes that grandparenting fails to allow for future growth options and flexibility of land use. He identifies significant potential for future development of land in the Upper Manawatu River catchment and estimates the

opportunity could contribute $105million into the regional economy. This is unlikely to be realized under a grandparenting scenario.

63. There are many more properties involved in this Region (35 water management zones containing a total of 500 landowners) compared to the Lake Taupo example (one catchment with approximately 80 farms) so setting up a similar scheme may not be administratively practicable. A large public fund would also need to be made available to purchase nitrogen loss rights to make progress towards meeting water quality standards for soluble inorganic nitrogen.

64. Neild and Rhodes state in their evidence that they consider the grandparenting option to be less efficient than the LUC allocation method. They consider that while it does recognise historical investment in production, it fails to recognise investment in nitrogen loss mitigation and does not provide for equal opportunities for all land users to consider alternative land use options.

65. Although it may be an effective approach when combined with a trading regime, grandparenting is not considered to be as efficient as the LUC allocation method.

Industry or sector benchmarking

66. This option uses the concept of estimating the 'typical' or 'average' nitrogen loss from a specific type of land use and land use. If benchmarking is followed by adoption of nitrogen loss mitigation measures, it has the potential to both prevent further increases in nitrogen loss to water bodies and achieve reductions in nitrogen losses over time. However, it is still considered to be 'one size fits all', albeit industry specific approach, to nitrogen loss allocation.

67. This method has several limitations (refer to Alec McKay's evidence):

    i. there is no direct link between this approach and making progress toward meeting soluble inorganic nitrogen water quality standards in water bodies unless combined with a nitrogen loss allocations for individual properties. In the absence of allocation, nitrogen loss to water bodies in the water management zone would not be capped and as more land is converted to intensive land use, nitrogen loss to water bodies will increase.

    ii. it does not provide for the variability of climate, land soil or land use within a catchment or at an individual farm scale; and

iii. it is linked to current land use and may form a barrier to intensification of current land use or development of land with the potential for further intensification, especially if combined with individual farm nitrogen loss allocation.

68. It is considered that this method is not as effective or efficient as the LUC allocation method.

Nutrient use efficiency

69. Nutrient use efficiency is in its development as an approach to managing nitrogen loss. The basis of the method is a nutrient efficiency index (also termed a environmental or production efficiency index) defined as the ratio of nitrogen loss versus production or nitrogen loss versus financial return.

70. Alec McKay deals with this approach in detail in his evidence and it appears that the method currently has similar limitations as those specified for industry benchmarking. It is therefore considered that this method is not as effective or efficient as the LUC allocation method.

Allocation by land use capability class

71. This is a new method developed during the preparation of the Proposed One Plan. This method is discussed in detail in Alec McKay's evidence.

72. In summary, the method is based on the 'attainable livestock carrying capacity' determined from LUC worksheets as a proxy for a measure of 'natural capital'. These stocking rates are transformed into pasture production and used in the OVERSEER nutrient budget model to calculate the nitrogen loss under pastoral use. This result is a methodology for calculating nitrogen loss limits according to the potential of soil types within a water management zone and an individual property to support production. These nitrogen loss limits form the basis of Table 13.2 of the Proposed One Plan.

73. The key strength of the LUC allocation method is that nitrogen loss allocations are not linked to the current land use in a water management zone, but to the underlying potential of the land resources. It does not target land use, intensity of use or limit inputs. The LUC allocation method is considered to resolve several of the limitations of other options considered for nitrogen loss allocation because it provides for continued economic growth and ongoing flexibility of land use

74. The on-farm financial costs are discussed in detail in the evidence of Neild and Rhodes. In summary, on-farm costs are predicted to increase by $41,882 and $453,235 as a result of implementing nitrogen mitigation strategies, depending on the number and type of mitigation strategies that an individual farmer needs to adopt to reach the targets set in Table 13.2 of the Proposed One Plan. Although expenses change, income generated by the farm does not change on most farms. Money is not lost, but may be spent on different things, e.g, some spending may move from (possibly off-farm) discretionary spending to being spent on-farm for nitrogen loss mitigation. This translates to a small impact on the regional economy.

75. On a broader scale there are likely to be economic benefits to the Region from yet to be developed land with potential for intensification that may have been limited by other methods of nitrogen loss allocation.

76. It is considered that this approach is the most effective and efficient option currently available for managing nitrogen loss that caters for continued economic growth and ongoing flexibility of land use while providing the basis for meeting soluble inorganic nitrogen water quality targets.

2.1.8 Question 5.7. Why was a trading regime for the Nitrogen Leaching/Run-off Values not included in the POP? What are the economic implications of this?

Summary answer:
Trading can occur between farms in the same catchment if they are both incorporated into a FARM Strategy

Links to POP provisions:
Rule 13-1

Links to evidence:
Andrew Mandersen

77. The proposed framework for Rule 13-1 does provide for trading of nitrogen loss limits within farms and between farms, although this is not set out in the rule through an explicit transfer system.

78. Trading can be provided for between and within farms by incorporating more land within the FARM Strategy. For example a dairy farmer who also owns a grazing run-off within the same catchment could include that run-off within his farm strategy. Incorporation of less intensively farmed land within the FARM Strategy has the effect of 'trading off' under utilized nitrogen loss limit that can be off-set against greater losses on the main block. This is balanced by the less intensive block having to meet other requirements of the FARM Strategy (such as fencing) and being part of a nutrient management framework. This is shown in the study on the Flock House AgResearch FARM Strategy which is summarized in Andrew Manderson's evidence.

2.1.9 Question 5.8. How were the Year 1 Nitrogen Leaching/Run-off Values in Table 13.2 selected?

Summary answer:
The year 1 nitrogen loss limits where selected to approximate current leaching on different land use capability classes

Links to POP provisions:
Table 13.2

Links to evidence:
Alec McKay
Brent Clothier
Test FARMS (Peter Taylor, Andrew Manderson, Mark Shepherd)

79. The intent of the year 1 leaching figures was to approximate current leaching. The intent is that the first year of obligation will introduce nutrient management discipline to all farms, but only those farms leaching more than the average will be required to make changes to reduce their leaching. The year 1 nitrogen loss limits were selected by modeling average potential production scenarios on the different land use capability classes, and adjusting for likely attainment of that potential. These were then checked by farm consultants in the area, and have been further 'ground truthed' by the test FARMS that have been completed.

80. The average potential production scenario for each land use capability class is explained in Alec McKay's evidence. In summary each different land use capability

class has different limitations to production. There is a maximum potential production on each land use capability class, without providing extra inputs (for example extra feed). This maximum production was modeled through Overseer to produce a modeled nitrogen loss rate at that level of production.

81. The maximum nitrogen loss rates that this modeling produced have been adjusted to account for the fact that not all land is used at its maximum level; some land is used for non productive uses (houses, tracks, bush) and some land is not as intensively used as it could be (e.g. small areas of land suitable for cropping in the middle of a larger farm are unlikely to be used for cropping). Flatter more productive land is likely to be better utilized and used closer to its productive potential, (because it is easier and more cost effective to develop and utilize this land). For higher LUC classes, VI and above, land is generally more hilly, more difficult to develop and likely being used at a lower percentage of potential.

82. For these reasons the potential figures where adjusted by 0.9 for better class land, and by 0.75 for lower class land. These were checked against knowledge of actual Overseer modeled losses from farms in these catchments to benchmark against current losses.

83. The results of this are summarized in Table 3.

84. These figures have been ground truthed by the test FARMS that have been completed. Excluding the outliers (farms with low LUC, high rainfall and high intensity combinations) the year one targets reflect close to current practice.

Table 3. Modeling of potential and likely nitrogen loss on various classes of land

	LUC I	LUC II	LUCIII	LUCIV	LUCV	LUC VI	LUC VII	LUC VIII
Overseer modeled based on potential production	30	27.4	23.5	17.5	16.3	14.5	8.3	0.0
0.9 potential	27	24.7	21.1	15.8	14.7	13.1	7.5	0.0
0.75 Potential	23	20.6	17.6	13.1	12.3	10.9	6.2	0.0
Table 13.2 value	32	29	22	16	13	10	6	2

2.1.10 Question 5.9. How were the Nitrogen Leaching/Run-off Values for years 5 and beyond in Table 13.2 selected?

Summary answer: The year 20 nitrogen loss limit was chosen as a conservative reduction target that would be achievable using current technology. The rate of change towards the year 20 target was chosen to a) align with industry targets and b) implement change towards the target over a reasonable time frame. **Links to POP provisions:** Table 13.2 **Links to evidence:** Brent Clothier Alec McKay

85. The nitrogen loss limits for year 5 and beyond were chosen to be achievable with current technology, align with industry targets and expectations, and provide reasonable time for the changes required.

86. Clothier et al. gathered information on best management practices around the country and concluded that a reduction in nitrogen leaching of about 1/3 is possible on dairy farms using currently available technology. Given that this 1/3 reduction is currently achievable it was taken to be an achievable longer term target.

87. Some of the nitrogen mitigations identified in the answer to question 5.14 are cost neutral (ie the cost of implementing the technology is offset by savings in other areas, or increased grass growth) while others come at a financial cost. It was decided that given that some extra costs would be incurred on some farms, to require all necessary management changes to be implemented in year one was not practical or reasonable, and a longer time period to reach the target was considered reasonable.

88. The values in year 5 represent a reduction of between 5% and 15% from the year one values. This was chosen to closely align with the Federated Farmers "10 in10" Campaign, launched in 2006, with a goal to reduce nitrogen losses from farms by 10% in 10 years. It is acknowledged that the rates of changes do not align exactly with that

goal, but it was considered at the time that it was closely enough aligned to be in step with the industry's own expectations.

89. The values for year 10 are an intermediate step towards the year 20 values.

90. At the time the POP was notified, the Dairy Industry had a 'stretch' target (expressed in the Dairy Industry Strategy for Sustainable Environmental Management, March 2006) that water pollution would be reduced by 30% in key catchments, by 2010. Key catchments were defined by the Strategy as catchments where the relevant regional plan for water quality are not being met by a significant margin or where there is a risk of regulation being introduced. The catchments targeted by rule 13-1 would meet this definition of key catchments.

91. The Primary Sector Water Partnership Leadership Document (May 2008), has a Dairy Sector And Fonterra Commitment to "Demonstrate, by 2016, a significant reduction (30% as an interim stretch target) in nutrient losses, at a catchment scale, in areas where water quality is identified as being 'at risk'." This document does not define 'at risk' catchments, but states they will be identified and prioritized by November 2008.

92. It is acknowledged the Strategy and Leadership Document also contains other goals key to achieving the specific nutrient management targets, related to working with communities, councils and provision of tools. However the targets outlined in those documents are considered to reflect the dairy industry's recognition that significant and immediate change is required and an indication of the scale of change considered appropriate by that industry.

93. The values in year 20 represent an approximate 20% reduction in N leaching for class I to IV land. Class V land reduces at a lower rate for the same reasons as Class VI to VIII land which is dealt with in the next question. This 20% reduction is less than the 30% reduction that the research tells us is possible with current technologies, and less than the Dairy Industry stretch target. However, taking into account cost of this change, and time required to change, this 20% in 20 years target was considered to be a very achievable reduction, and a very realist amount of time to account for the change.

2.1.11 Question 5.10. Why do the proposed Nitrogen Leaching/Run-off Values not reduce for land use capability classes VI to VIII?

Summary answer: The nitrogen loss limits proposed for classes I to VIII land reflect the limited land use option available on these classes of land and the limited number of useable nitrogen mitigation practices available on that land. **Links to POP provisions:** Table 13.2 **Links to evidence:** Alec Mackay

94. Nitrogen loss limit values for classes V to VIII closely approximate the expected current leaching of land uses on those classes of land. The reduction required is small, recognizing the limited mitigation options and the fact that farms on this class of land are already having a relatively low nitrogen loss.

95. Alec Mackay outlines in his evidence that the number of mitigation options decreases as the LUC capability increases. These available mitigations then also come at increasing cost (this is summarized in his Table 7). These variations are recognized by requiring only those small changes which are possible on the lower capability land.

96. Land use capability class VIII is most suitable for forest land uses. Research available at the time of notifying the plan assumed that land under production forest would leach 2kg/N/year. There are no opportunities to mitigate nitrogen loss below this level, therefore it is appropriate to not reduce this number.

2.1.12 Question 5.11. Why are the land uses specified in Rule 13-1 targeted and not other land uses?

Summary answer:

The targeted land uses account for the majority of nitrogen found in the targeted water bodies. By managing the nitrogen losses from these land uses a greater impact can be made on reducing nitrogen losses than by managing extensive land uses.

Links to POP provisions:

Rule 13-1

Links to evidence:

Brent Clothier

Alec McKay

97. By targeting the identified land uses, approximately 50% of the nitrogen in rivers can be targeted.

98. The proposed rule targets the four land uses that have the highest potential nitrogen losses. These, are identified in Clothier et al, based on national research, as market gardening, cropping, dairying and intensive sheep and beef farming.

99. The Clothier et al. report examined the likely effect of requiring nutrient reductions on the two main types of farming in the Upper Manawatu – dairy and extensive sheep and beef. The study showed that both increases and reductions in nitrogen lost from dairy farming using reasonable intensification and reduction scenarios, had a large comparative impact on nitrogen entering the river. In contrast intensification and reduction scenarios for extensive sheep and beef farms show a comparatively small effect on N in the river. The figures from that report are summarised in Table 4.

100. The figures in Table 4 show the relative numbers of properties used for each type of land use. This shows that if the Rule 13-1 were applied to land uses in the catchment, then an extra 160 FARM Strategies and resource consents would be required. This would achieve a reduction of only 9.8% of nitrogen entering the river.

101. Taking into account the effectiveness (amount of nitrogen controlled) and efficiency (number of landowners and resource consents) of the proposed approach, it was

concluded that targeting the specified land uses was the most appropriate way to work towards an improvement in water quality.

Table 4. Summary of modelled and measured nitrogen loss under existing, intensification and reduction scenarios in the Upper Manawatu catchment. Data taken from Clothier et al. Data is for Manawatu above Hopelands excluding Weber, except where marked * where data is from Manawatu above Hopelands including Weber.

	Dairy	Extensive Sheep and Beef
Number of properties	112 properties 14 709ha 27.1% of catchment	160 properties 33 521ha 62% of catchment
Modeled N loss range from individual farms – national kg-N/ha/yr	15-115	6-60
Modeled N loss from individual farms – region kg-N/ha/yr	31	7
Modeled N loss from all farms of type kg-N/yr	455979 43%*	234647 51%*
Modeled intensification scenario 2 and 4 Increased production on existing land kg-N/ha/yr	+132 381 +33%	+33 521 +8.4%
Modeled intensification scenario 5 Increased in hectares of land in dairy farming kg-N/ha/yr	132 555* 17.8%*	NA
Modeled reduction scenario 1 and 3 – 1/3 reduction from adoption of BMPs kg-N/ha/yr	-73 545 -18.3%	-39 387 -9.8%

102. Targeting these land uses is also consistent with the targets set by industry. The definition of intensively farmed land set out in the Primary Sector Water Partnership Leadership Document, identifies dairy, arable and horticultural operations as targets for nutrient management plans.

2.1.13 Question 5.12. What are the key differences and similarities between a Clean Streams Accord nutrient budget, a nutrient management plan, a FARM Strategy and farm-based nutrient management plans prepared by other councils?

Summary answer: The FARM Strategy is targeted at the water management issues of concern in the Horizons Region. It has a specified nutrient loss reduction goal and it also deals with all water body contaminants of concern (nutrient, faecal and sediment). Both of these features are uncommon in other types of nutrient management plans or budgets. **Links to POP provisions:** Policy 6-7 Rule 13-1 **Links to evidence:** Peter Taylor Neild and Rhodes Stewart Ledgard

103. In the simplest form required by the Dairy and Clean Streams Accord (DCSA), a nutrient budget simply states nutrient inputs and outputs. A nutrient management plan takes the information provided by a nutrient budget and uses it to make recommendation to change farm management to achieve some outcome. A FARM Strategy is essentially a contaminant management plan. It deals with faecal contamination as well as nutrients. It also has a very specific goal – to reduce nutrient loss to water to the specified levels.

104. The DCSA sets a target that: "Nutrients are managed effectively to minimise losses to ground and surface waters." The performance target for this is: "100% of dairy farms to have in place systems to manage nutrient inputs and outputs by 2007." It is generally accepted that having a nutrient budget prepared using Overseer is compliance with this target. The fundamentals of an Overseer nutrient budget are discussed by Stewart Ledgard in his evidence. A nutrient budget takes information about nutrient inputs (fertiliser, effluent, stock, supplementary feed etc) and information about nutrients taken off farm as production (ie milk solids) and models the amount of nitrogen that has been lost from the farm, either as gaseous losses or leaching to water. The Overseer budget

is a fundamental building block of a nutrient management plan (discussed shortly) but in its simplest form, and the form required by the DCSA, it simply states inputs and outputs.

105. A nutrient management plan takes the information provided by a nutrient budget and uses it to make recommendations to change management to achieve some outcome. A nutrient management plan can have many types of outcome goals, for example reducing cost, maximizing crop growth, or minimizing nutrient loss. A common type of nutrient management plan is that provided by farm consultants to make fertiliser recommendations. This type of plan uses information about nutrient inputs and outputs to identify the most cost effective fertiliser application strategy.

106. A FARM Strategy is essentially a nutrient management plan with a very specific goal – to reduce nutrient loss to water to the specified levels. The FARM Strategy also includes requirements to reduce faecal contamination of waterways, which (as faecal contamination is not a nutrient) is uncommon in other types of nutrient management plans. The FARM Strategy also identifies and manages sources of nutrients that are not covered by Overseer (the reasons for this are covered in the answer to question 5.13).

107. The very specific environmental goal makes the FARM Strategy different from other types of nutrient management plans. But the process for preparing one, the tools used (primarily Overseer) and the skills required are the same as for other types of plans.

2.1.14 Question 5.13. Why are other activities like offal holes included in Rule 13-1 and is that appropriate given what can be modelled in OVERSEER?

Summary answer:

Activities such as fertiliser use are included in Rule 13-1 for two reasons, firstly, to ensure best practice assumed by Overseer is being applied, and secondly to enable consent conditions to be put in place for activities that would otherwise be permitted.

Links to POP provisions:

Rule 13-1

Links to evidence:

Stewart Ledgard

108. To be effective, a nutrient management plan aimed at reducing losses of nutrient to the environment, must a) take into account all sources of nutrients, and b) apply best practice to all activities that may contribute to nutrient loss.

109. When modeling nitrogen loss, Overseer assumes that best management practices are being followed for all activities on the farm (see the evidence of Stewart Ledgard for more detail). For example it assumes that effluent is being managed effectively and fertiliser is being applied appropriately. If these assumed best practices are not followed, then the Overseer modeled output may be underestimating the real nitrogen loss.

110. To ensure that the targets set in Table 13.2 are being met in reality, it is necessary to ensure that best practices for these activities are being followed. This means that consents granted under Rule 13-1 must include conditions requiring best practice to be followed.

111. The management changes identified by an individual farmer to minimize nutrient losses may include provisions that relate to these other activities, for example restricting when nitrogen fertiliser is applied. Application of fertiliser is otherwise a permitted activity under Rule 13-2, with no restrictions as to timing of application. Rule 13-1 needs to allow for best practice or other restrictions to be included as conditions of consent so that nitrogen mitigation practices can be agreed and if necessary enforced.

2.1.15 Question 5.14. What is the range of farm management practices that the POP envisages being used on-farm to reduce nitrogen leaching in order to achieve the Table 13.2 Nitrogen Leaching/Run-off Values?

Summary answer:

There is a wide range of farm management practices available to achieve the nitrogen loss limit. The choice of practices implemented to meet the nitrogen loss limit is up to the individual farmer, and the number of practices that will need to be implemented will vary from none (for farms currently operating within their nitrogen loss limit) to implementation of a large number of practices (for those operating well above the nitrogen loss limit).

Links to POP provisions:

Table 13.2

Links to evidence:

Andrew Manderson

Ross Monaghan

Clothier et al.

112. The management practices available to farms to achieve the prescribed nitrogen loss values varies from no change to current practice through to a wide range of different best environmental practices.

113. The range of practices available is set out in the evidence of Ross Monaghan, Andrew Manderson, Alec Mackay, and David Houlbrooke's evidence and also in Clothier et al. A brief summary of the available best management practices is provided in Table 5.

Table 5. Farm management practices to reduce contaminants

MITIGATION OPTIONS	Contaminant controlled
Mitigations captured by Overseer	
Avoid winter (May, June or July) N-applications	N
Ensure effluent application area is large enough to keep loading <150kg N/ha/yr	N, faecal, P
Avoid winter effluent applications	N, faecal, P
Use supplements with N-concentrations that are lower than pasture (or higher energy content - e.g. maize)	N
Replace fertiliser N with equivalent supplement-N	N

MITIGATION OPTIONS	Contaminant controlled
Ensure other nutrients are non-limiting (optimal) for max yield per kg N input	N
Decrease use of N-fertiliser	N
Decrease stocking rate	N, faecal
Change stock type or class	N
Reduce imports of supplementary feed	N
Graze cattle off during winter (May, June, July)	N, faecal, P, sediment
Use a sealed wintering/standing pad with effluent collection and storage system	N, faecal
Increase supplement exports off farm	N
Recycle effluent to land rather than pond treatment & disposal to waterways	N, faecal, P
Use conservation tillage techniques for cropping or vegetable growing where possible	N, P, sediment
Other mitigation activities	
Time N-fertiliser application for periods when N demand is greatest	N
Avoid high-rate, single dressings of N-fertiliser. Use split dressings (20-50kg N/ha per dressing)	N
Adjust N-fertiliser rates & timings seasonally to respond to actual or expected production demand (seasonal variations)	N
Use an N-fertiliser product with an N-uptake efficiency that is better than the current N-product	N
Avoid N-applications when soils are saturated (leaching/runoff & low plant activity).	N
Avoid N-applications during excessive dry periods (plant N-uptake low)	N
Consider timing N-fert using a water balance on soils with high leach/runoff risk (shallow gravel soils, soils with high water tables, artificially drained soils)	N
Delay N-applications directly after dry periods until pastures have started recovering	N
Ensure an adequate buffer distance from waterways when applying fertiliser	N, P
Use urea product treated with urease inhibitor	N
Ensure the extra grass grown when N-fertiliser is utilised	N
Spray nitrification inhibitor according to manufacturer recommended rates and timings, particularly on highly stocked areas (e.g. camps)	N
Use an irrigation schedule or soil-water monitoring to guide effluent application.	N, faecal, P
Ensure effluent storage ponds do not overflow (part. winter)	N, faecal, P
Use adequate buffer distance from waterways when applying effluent (+20m)	Faecal, N, P
Irrigation systems: Avoid N runoff & deep drainage losses by ensuring effective application rates & timings according to soil-water balance, irrigation scheduling, or soil-water monitoring	N
Other best management works	
Ensure all paddocks are supplied with adequate troughs or dams	Faecal, N, P, sediment
Replace fords with bridges or culverts	Faecal, sediment, N, P

MITIGATION OPTIONS	Contaminant controlled
Exclude stock from flowing waterways by fencing	Faecal, sediment, N, P
Create wetlands and wetland attenuation zones where runoff converges	Faecal, sediment, N, P
Create riparian attenuation zones wider than 10-30m	Faecal, sediment, P, N
Ensure runoff from tracks/lanes is not channelled into streams near crossings	Faecal, sediment, N, P
Ensure there are no major leaks in the effluent irrigation system (e.g pipe joins).	N
Invest in a high efficacy effluent treatment/disposal system (e.g. digesters)	N, faecal, P
Ensure runoff from yards, feed pads, etc. does not go directly into waterways	Faecal, N, P, sediment
Ensure effluent storage ponds are sealed	N, faecal
Ensure effluent storage ponds are of a sufficient size	N
Store leakable supplementary feeds (e.g. silage) on a sealed base with an effluent collection/storage/disposal system	N
Avoid extended fallow periods between crops	N, P, sediment

114. It is important to note that while there is a large tool box available, the number of mitigations required, and the individual choice of mitigations will varying greatly for each farm. A mitigation that will have a high level of effectiveness on one property may be only marginally effective on another property. Likewise some farms can continue their current management regime and not need any mitigations, while another farm may have to implement a comprehensive suite of mitigations to meet the nitrogen loss limit. This issue is discussed in the evidence of Andrew Manderson, Alec Mackay, Ross Monaghan and Neild and Rhodes.

2.1.16 Question 5.15. What types of farm management and practice changes will need to be made on farms to achieve the Nitrogen Leaching/Run-off Values?

Summary answer: The types of changes on each individual farm need to be assessed at the individual farm scale. Based on the information collected through the test FARMS Horizons have commissioned, changes range from none (continue current good practice) through to implementing all possible nitrogen mitigation practices. **Links to POP provisions:** Table 13.2 Rule 13-1 **Links to evidence:** Peter Taylor Neild and Rhodes

115. Based on the research commissioned by Horizons, Peter Taylor and Neild and Rhodes have estimated that 68% of farms (Neild and Rhodes group 3 and 4) will have to make minor management changes (such as changing fertiliser timing, changing feed practices), 20% (Group 2) will need to make more significant management changes to meet the nitrogen loss limits (for example grazing cows off in winter or using feedpads) and the remaining 11% (Group 1) will need to make all possible management changes.

116. As noted above while there is a large tool box available, the number of mitigations required, and the individual choice of mitigations will vary greatly for each farm. A mitigation that will have a high level of effectiveness on one property may be only marginally effective on another property. Likewise some farms can continue their current management regime and not need any mitigations, while another farm may have to implement a comprehensive suite of mitigations to meet the nitrogen loss limit. This issue is discussed in the evidence of Andrew Manderson, Alec Mackay, Ross Monaghan and Neild and Rhodes.

2.1.17 Question 5.16. What are the financial and economic impacts of these on-farm changes? Please identify the costs for a range of farm types, including transaction costs and the costs of preparing FARM strategy documents and an estimation of economic effects (including multiplier effects) on a regional scale.

Summary answer: The increased expenses of the nitrogen mitigation required by Rule 13-1 on farm is estimated to range between $41,882 and $453,235 over 20 years with an average of $136,077. Most of this extra expense is recycled into the regional economy and very little production is lost, which results in a net loss to the regional economy of $3,310,000. **Links to POP provisions:** Table **Links to evidence:** Jeremy Neild and Tony Rhodes Ross Monaghan

117. Two types of costs have been identified in Neild and Rhodes -financial costs and regional costs. Financial costs are the costs incurred on farm to implement nitrogen mitigation practices, or costs of decreased production which lead to a decrease in income. Regional costs are the costs the flow on to the region from the decrease in production and income.

118. Financial (on farm) costs have further been delineated into the various parts of the FARM Strategy. Some parts of the FARM Strategy are already required by current consent requirements (ie no ponding of effluent), some mirror DCSA requirements (fencing off waterways), and some are required by other parts of the POP (sealing effluent ponds). The remaining financial costs are incurred as a result of the nitrogen loss limit. Differentiating between these types of financial costs allow us to analyse the effect of adding or deleting requirements or phasing in their implementation.

119. Neild and Rhodes identified 4 groups of farms based on their rainfall and land use capability class. The average net present value of the financial on farm costs of implementing all the requirements outlined above are summarised in Table 6. The range of financial costs per farm is estimated to range from $86,900 to $516,470.

Table 6. Average on farm costs from implementing Proposed One Plan requirements

Discount Rate	**6.5%**
Clean Streams Accord (CSA)	**$6,660,496**
Compliance With Current Consent Conditions	**$2,396,800**
Rule 13-3	**$3,997,254**
Rule 13-5	**$75,770**
Rule 13-6	**$10,735,784**
Rule13-1	**$58,241,256**
Cost of Proposed One Plan (POP)	**$73,050,064**
Cost of rule 13-1/Farm	**$136,077**
Cost of POP, CSA & CCC	**$82,107,360**
Cost of POP/farm	**$170,678**
Cost of POP, CSA & CCC/farm	**$191,840**

120. The increased expenses are not lost economic benefits to the region. These expenses continue to be spent and generate economic benefit in the Region. For this reason the regional economic effects to the region are very low. Only a low proportion of the costs incurred are production cost. The small amount of lost production has a very small flow on effect on the regional economy, largely because of the small amount of processing carried out in the region.

121. The regional economic costs calculated by Neild and Rhodes are summarized in Table 7.

Table 7. Regional Multiplier Effect Adjusted to 2009 Values from Neild and Rhodes

	Impact
Direct Effect	$3.31 million
Flow-on Output Effects	$1.72 million in output
Flow-on Value Added	$0.90 million
Flow-on Net Household Income	$342,000

2.1.18 Question 5.17. Do the financial and economic impacts of on-farm changes vary if the rate of implementation currently set out in Table 13.2 is varied?

Summary answer: On farm financial impacts do not vary significantly if the rate of implementation is changed by extending the time taken to achieve year 20 targets. This is because most of the changes occur on the farms that incur the greatest costs in the first year. On-farm impacts may vary if the rule is changed to bring in fencing and effluent requirements separate from nitrogen mitigation requirements. Staging these may result in a reduction in net present value costs. Regional economic impacts do not occur for approximately 20 years out so there is considerable uncertainty about changes to relative costs and prices over that period. **Links to POP provisions:** Table 13.2 **Links to evidence:** Jeremy Neild and Tony Rhodes

122. Changing the rate of implementation by delaying the implementation of the rule makes a small reduction in the net present value costs. This is because most of the costs occur in the first year.

123. Delaying the implementation of the rule in this way will also result in a delay in receiving any environmental benefits from the change.

124. Neild and Rhodes examined an alternative option which is to phase in the various requirements of Rule 13-1. This is explained in table 26 of their evidence. The alternative option sets out that fencing and effluent requirements come into force in year 1, but year 1 nutrient mitigation obligations are delayed by 3 years. This method spread costs over more years and reduced the net present cost by 19%.

2.1.19 Question 5.18. What impact will the proposed reduction in nitrogen leaching have on nutrient levels in the receiving rivers? What contribution will this reduction make to the required nutrient load reduction required to meet the Schedule D water quality standards at the applicable Schedule D flows?

Summary answer:
The outcome of the proposed reduction in nitrogen will vary from catchment to catchment depending on the amount of land that converts to intensive land use. However it is expected that the regime will result in water quality being maintained or enhanced**.**

Links to POP provisions:
Table 13.1
Table 13.2
Schedule D

Links to evidence:
Kate McArthur
Jon Roygard
Barry Biggs

125. Each catchment is a unique combination of land use classes, land uses and rainfall and river flow. Each of these factors will influence the outcome of applying the nitrogen loss limits. Only one set of targets has been proposed in the plan, to reflect achievable best management practice on farm. Because each catchment that these targets are applied to is different the outcome in each river will be different. I consider that setting a practical achievable target is an appropriate first step when regulating non point source pollution from farming, as this has never been controlled before. A logical next step, after the implementation of this plan, may be a further refinement of targets, to reflect more refined instream goals.

126. In order to model the in-river effect of the proposed nitrogen reductions compared to the desired water quality standard, several calculations must be done to convert nitrogen load (kg/n) to concentration. The complexity of these calculations is explained in the evidence of Kate McArthur and Jon Roygard. In summary it is possible to accurately show the in-river effect and comparison with the Schedule D standards for the Upper Manawatu and Mangatainoka Rivers. The results of this modeling are summarised in

Figure 1 and Figure 2. More detail on this can be found in the evidence of Kate McArthur and Jon Roygard.

127. In summary, the modeling shows that if all land is fully utilized in each catchment and if all land operates to the nitrogen loss limits set out in Table 13.2 then in the Upper Manawatu we can expect an increase in intensive land use and the amount of nitrogen load to remain about the same. Currently only about half the land in the Upper Manawatu catchment is used to its full allowable nitrogen loss limit. The nitrogen load will not meet the standard, but there will not be further decline. In reality it is unlikely that all the land in the catchment will be used to its full nitrogen loss limit within 20 years so further reductions towards the standard are likely to be seen.

128. In the Mangatainoka catchment, if all land is fully utilized and if all land operates to the nitrogen loss limits set in Table 13.2, we can expect the nitrogen loads will be within or only slightly above the Standard load limit calculated from the nutrient standards in Schedule D of the POP. Because the Mangatainoka monitoring site (SH2) is not quite at the bottom of the target catchment, the nitrogen loads measured at the SH2 site will be lower than predicted by the figure below.

129. The translation of the Standard load limit (and the Year 20 predicted loads) into effects on periphyton biomass (as an indicator of effects on other Schedule D values) are detailed in the evidence of Dr Biggs for both the upper Manawatu and Mangatainoka catchments (see Table 3 of Dr Bigg's evidence).

130. For other rivers it is possible to show the expected load of nitrogen expected as a result of the nitrogen leaching reduction and these are shown in Section 9 of Kate McArthur's report. However it is not possible to compare this to the Schedule D standard. We must then make some inferences from the detailed catchment studies to the rivers with less information that the reduction in nitrogen leaching will result in the same or less nitrogen entering the river.

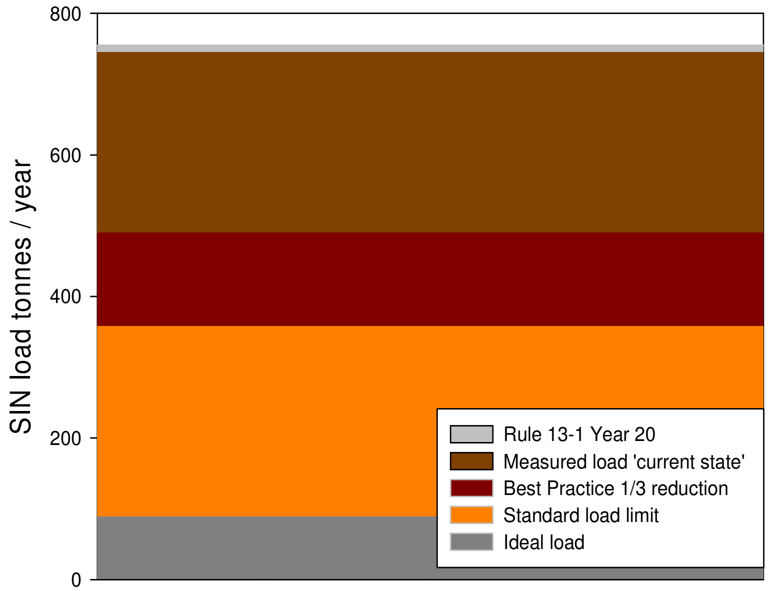

Figure 1. Simplified comparison of ideal, current and projected Soluble Inorganic Nitrogen (SIN) loads in the Upper Manawatu River at Hopelands. The ideal load relates to the ideal nitrogen concentration standard proposed by Dr Biggs. Figure reproduced from Roygard and McArthur (2008).

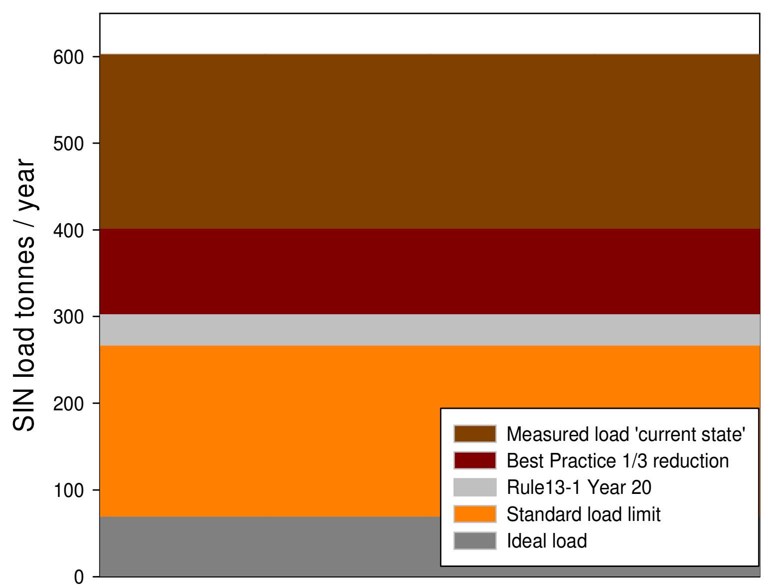

Figure 2. Simplified comparison of ideal, current and projected Soluble Inorganic Nitrogen (SIN) loads in the Mangatainoka River at SH2. The ideal load relates to the ideal nitrogen concentration standard proposed by Dr Biggs. Figure reproduced from Roygard and McArthur (2008).

2.2 Availability of consultants and farmers

131. Horizons Regional Council undertook a wide range of testing of FARM Strategies on various types of farms. That work has informed this report, and the evidence of others in assessing the implications of the FARM Strategy Regime. The test FARM Strategies were completed by a range of farm consultants with the cooperation of the farmers. All of the FARM Strategies are available and incorporated into evidence presented to this hearing. Some of the consultants have prepared separate evidence for this hearing, others have not.

132. All the consultants and the farmers involved in this project will be able to offer useful perspectives to the hearing panel about the process, experience, outcomes and implications of the FARM Strategies. Below is a list of consultants who prepared FARM Strategies and farmers whose farms were studied who are happy to make themselves available to the Hearing panel to answer any questions the Panel may have in relation to their experiences.

Consultants who prepared FARM Strategies

Lachie Grant, Landvision
Rachel Rogers, Shepherd Agriculture

Farmers who allowed their farms to be used for case studies

John Barrow (Dannevirke)
David Marshall (Tutu Totara, Marton)
Brendon Williams (Pencoed Trust, Marton)
Bryan Guy (Byreburn, Feilding)
Noel Johnston (Foxton)
Alison Martyn (Sanson)
Jim Galloway (Jala Enterprises, Eketahuna)

Helen Marr
August 2009