under:	the Resource Management Act 1991	
in the matter of:	Proposed Plan Change 5 to the Canterbury Land a Water Regional Plan	
and:	Barrhill Chertsey Irrigation Limited	
	Submitter	C16C/30978

Further submitter C16C/30978

Statement of evidence of Eva Harris

Dated: 22 July 2016

REFERENCE:

BG Williams (ben.williams@chapmantripp.com) ADW Brent (allan.brent@chapmantripp.com)

Chapman Tripp T: +64 3 353 4130 F: +64 3 365 4587

245 Blenheim Road PO Box 2510, Christchurch 8140 New Zealand www.chapmantripp.com Auckland, Wellington, Christchurch



STATEMENT OF EVIDENCE OF EVA HARRIS

- 1 My name is Eva Harris.
- 2 I have the following qualifications and experience:
 - 2.1 Master of Applied Science (Environmental Science) from Lincoln University – First Class Honours, specialising in dairy effluent nutrient interactions in riparian zone soils;
 - 2.2 Post Graduate Certificate of Resource Studies from Lincoln University;
 - 2.3 Post Graduate Diploma of Science (Chemistry) from the University of Canterbury;
 - 2.4 Bachelor of Science (Chemistry) from the University of Canterbury; and
 - 2.5 Certificate of Completion in Advanced Sustainable Nutrient Management from Massey University.
- 3 In 2004 to 2007 I was a Technical/Environmental Officer at Silver Fern Farms. There I prepared site environmental management plans, assisted the site manager with any environmental compliance issues, and completed internal audits on food safety standards following internal audited self-management and ISO9000 Procedures.
- 4 In 2007 to 2015, I held Senior Resource Management Officer/Compliance Officer roles at Environment Canterbury (*ECan*), Northland Regional Council and Hawke's Bay Regional Council (*HBRC*). At those regional authorities I co-ordinated teams to enforce water metering regulations, and I undertook monitoring and regulatory enforcement with dairy, water take and industrial consents.
- 5 At HBRC, I also developed a compliance extension pilot programme to improve awareness of the impacts of industrial activities on stormwater and in an effort to minimise spillages.
- 6 From 2015 until the present, I have been the Environmental Manager at the Irrigo Centre Limited (*Irrigo*). Irrigo is a collaboration between Mid-Canterbury irrigation schemes, including Acton Farmers Irrigation Co-op Ltd (*Acton*), Ashburton Lyndhurst Irrigation Ltd, Barrhill Chertsey Irrigation Limited (*Barrhill*), Greenstreet Irrigation Society Limited (*Greenstreet*), Mayfield Hinds Irrigation Ltd and Valetta Irrigation Ltd (*Mayfield-Valetta*).

- 7 At Irrigo I have a wide-ranging brief, including to:
 - 7.1 create and co-ordinate Audited Self-Management Programmes Barrhill, Acton and Greenstreet;
 - 7.2 co-ordinate and report on scheme N losses according to consent conditions;
 - 7.3 develop an online Schedule 7-compliant Farm Environment Plan (*FEP*) Template;
 - 7.4 ensure every shareholder completes a FEP;
 - 7.5 train and support both internal and external FEP auditors; and
 - 7.6 co-ordinate training sessions, resources and one-on-one assistance to shareholder farmers to assist them with defining and then implementing good management practices (*GMP*) at their farms.
- 8 I am authorised to give evidence on behalf of Barrhill (noting that although this evidence may raise issues that are in common with the other irrigation schemes that are involved with Irrigo, my evidence is limited to the submission and further submission provided by Barrhill).

SCOPE OF EVIDENCE

- 9 In my evidence I provide:
 - 9.1 an explanation on the context of my evidence, and Barrhill's position in relation to other submissions;
 - 9.2 an overview of Barrhill's resource consents and operations;
 - 9.3 an assessment of how realistic it is to meet the nutrient loss reduction requirements of Plan Change 5 to the Canterbury Land and Water Regional Plan (*PC 5*) including technical challenges in using OVERSEER® and with Farm Portal Proxies; and
 - 9.4 my experience of the way that collective nutrient allocation consents such as Barrhill's can improve and normalise best practice behaviours; and
 - 9.5 brief comments on the manner in which PC 5 appears to impact on section 14(3)(b) rights to take stockwater.

EXECUTIVE SUMMARY

- 10 Barrhill is the first irrigation scheme in Canterbury to operate under a nitrogen cap set under the Canterbury Land and Water Regional Plan (*LWRP*).
- 11 Our experience has demonstrated several issues with using OVERSEER® as a tool to measure compliance with the nitrogen cap including that:
 - 11.1 the programme is incapable of modelling arable, dairy support or sheep and beef farm systems for compliance purposes;
 - 11.2 OVERSEER® cannot be used to trend N reductions over time on a large scale, including comparisons with Baseline nutrient budgets; and
 - 11.3 there is insufficient industry capability to consistently prepare budgets on the scale the PC 5 will require.
- 12 Furthermore, Farm Environment Plan (*FEP*) Audit results have identified serious issues with the Farm Portal GMP proxies. We have found that farms audited as meeting GMP after a detailed on-farm inspection are still required to make an average reduction of 29% to meet the Farm Portal GMP Loss Rates. These reductions are beyond even best farm practice, are not reflective of GMP according to the description in the *Industry-Agreed Good Management Practices Relating to Water Quality (September 2015) (Agreed GMPs)*, and are definitely not achievable by 2020.
- 13 We have also found our shareholders are generally on board with implementing GMP on-farm (i.e. the Agreed GMPs), want to look for opportunities to improve their practices and respond well to one on one support.
- 14 Due to the issues and opportunities identified, Barrhill proposes greater emphasis of on-farm Good Management Practice (i.e. the Agreed GMPs) and the FEP Audit Process in PC 5, including:
 - 14.1 providing for creation of Nutrient User Groups and Collectives;
 - 14.2 supporting changes to simplify nutrient management rules for farmers;
 - 14.3 providing a "base" land use description in Schedule 7; and

- 14.4 providing new targets to assess "base" land use and nitrogen management practices not measured by OVERSEER®.
- 15 As it stands at present Barrhill is concerned that the notified PC 5 provisions try to use OVERSEER® in a manner that it was not designed for, and is currently incapable of achieving. We believe focussing resources on ensuring GMPs are met on Canterbury farms will result in greater improvements in water quality in a constructive and on-going manner than a modelled N-loss regime will. This focus is not to question any "commitment" to OVERSEER, as I will explain below.

CONTEXT OF MY EVIDENCE

- 16 Barrhill's submissions in relation to Plan Change 5 come against a background of significant involvement in the Plan Change 2 (*PC 2*) process. Barrhill along with two other submitters have appealed the decision on PC 2 to the High Court. Barrhill's submissions nor this evidence concerns issues associated with PC 2.
- 17 On PC 5, Barrhill has raised a number of concerns that in some instances are covered in greater detail by other submitters. For that reason, my evidence is generally focused on the issues that Barrhill has direct experience on or has a particular interest in. However, for clarity I note that Barrhill still maintains its submissions and further submissions on all matters submitted on.

BARRHILL'S CONSENTS AND OPERATIONS

- 18 Barrhill is a co-operative company with over 130 farmer shareholders from mid-Canterbury. It is the joint venture partner with Electricity Ashburton Limited (the Ashburton co-operative lines company) in relation to the development and operation of the Barrhill Chertsey Irrigation Scheme (*the Scheme*). Barrhill also provides water to Acton for its scheme. Acton then supply water to a further 58 shareholders between Rakaia and the sea. In total, nearly 200 shareholders are managed under the Barrhill Audited Self Management programme.
- 19 Barrhill holds what is now resource consent CRC143165 to take 17 cumecs of water from the Rakaia River for irrigation and hydroelectricity generation. The original resource consent (CRC990088) was granted in 2001. Since that time, Barrhill has entered into agreements with TrustPower Limited and Rangitata Diversion Race Management Limited regarding a 'water swap' and the use of the Rangitata Diversion Race (*RDR*) as a means to convey water across the mid-Canterbury plains. This agreement allows Barrhill to take 10 cumecs from the RDR with Barrhill making up any take from its own Rakaia takes.

- 20 Barrhill, through its agreement with TrustPower, also has a right to call upon the release of Lake Coleridge 'stored water', which can provide water to the scheme when the Rakaia River levels are low.
- 21 Under its resource consents, the Scheme is authorised to provide water to an area not exceeding 40,000 hectares across the mid-Canterbury plains (between both the Rakaia and Rangitata Rivers). At least until recently there has been no further specification on where the water can be used/discharged to land.¹
- 22 Barrhill gave effect to its first primary resource consents in 2010.
- 23 In September 2013, Barrhill was granted land use and discharge resource consent CRC141388 (now CRC162882) in relation to the management of nutrients (*the Land Use Consent*).² The Land Use Consent identifies an area of 17,604 hectares where supply agreements were in place prior to July 2013 and a further 22,396 hectares of 'new irrigation'.
- 24 In simple terms the Land Use Consent allows water to be supplied to new and existing irrigators provided the collective nitrogen losses do not exceed a nutrient 'cap' that has been allocated to the Scheme.
- 25 The nitrogen cap was calculated assuming current land use was limited, and "Advanced Mitigation" farm management practices (*AM1*) were implemented. Nitrogen losses for new-irrigated land was allocated a lower limit, and assumed a higher standard of practice called "Advanced Mitigation 2" (*AM2*). The principles of AM1 and AM2 farm management were used in Schedule 24 of the Hinds Plains/Hekeao Sub-Regional plan.
- 26 The Land Use Consent has only a five year term, an arrangement agreed between Barrhill and ECan so that it could be processed on a non-notified basis pending the LWRP and now PC2 and PC 5 processes.
- 27 Barrhill is the first scheme to implement nutrient management restrictions under an Audited Self-Management programme and therefore has the most comprehensive data set of any scheme or industry in Canterbury with regards to the management of nutrients under the LWRP.

¹ Noting that where Barrhill can exercise its consent may be limited by PC 2 although at the time preparing this evidence this is a matter that is under appeal.

² Each of Barrhill's key resource consents are attached to my evidence at **Annexure 1**.

28 To that extent, Barrhill's experience is to some extent the same as that of the 'canary in the mine' in that it is identifying, or has already identified issues that other schemes, individuals and operators will also find material as they move further into nutrient mitigation.

Description of Barrhill's Audited Self Management programme to date

- 29 Barrhill has been committed to the implementation of our Audited Self Management programme, as we value the benefits of supporting our shareholders to implement GMPs. We have focussed on continuous improvement over time, and built in feedback loops reinforcing good management practice into the process. For example, we require our shareholders to update their FEP annually and incorporate the actions suggested to them in their FEP audit, and to re-evaluate their practices over the last 12 months.
- 30 In our view, simplifying and supporting the FEP, FEP audits and nutrient budgeting process for our shareholders will likely result in better uptake of GMP on-farm. For this reason, we have allowed whole properties and enterprises, whether or not they are fully irrigated by the Scheme, to be managed under FEPs within our ASM programme. To do otherwise would introduce unnecessary complications and reduce shareholder buy-in with the process.
- 31 Since February 2015, Barrhill has:
 - 31.1 employed myself, as Environmental Manager;
 - 31.2 prepared a Scheme Management Plan (SMP);
 - 31.3 ensured all shareholders have prepared FEPs;
 - 31.4 ensured all shareholder properties have completed OVERSEER nutrient budgets;
 - 31.5 ensured all shareholders are aware of the Agreed GMPs; and
 - 31.6 completed over 95 FEP Audits to the standards set in the FEP Auditors Training Manual (Feb 2016) to assess whether GMPs are being met.
- 32 All land managed under Barrhill FEPs is required to comply with the Scheme Management Plan (*SMP*) as a condition of every shareholder's Water User Agreement, regardless whether the land concerned is irrigated by Barrhill or not.

- 33 The SMP sets out Barrhill is environmental management policies, expectations, auditing and reporting requirements, including limitations on intensification and N losses. It also explains the ability to exclude shareholders from the scheme for breaches of their Water User Agreement.
- 34 All shareholder FEPs are audited to ensure they are on track to meeting the Agreed GMPs. The FEP Grades vary from 'A' to 'D', with the grade determining when the next audit is due. An 'A' grade indicates the property meets all GMPs (i.e. demonstrates a range of actual on-farm practices at a high standard). A 'B' grade indicates some GMPs are not met, but a plan is in place to achieve them. 'C' and 'D' grades are given when GMPs are not met and there is no plan to achieve them.
- 35 Overall, our process is designed to identify and address the reasons for a lower audit grade and provide the resources the farmer needs to improve on-farm practices.
- 36 For instance, when a 'C' or 'D' grade is issued, we follow up with our shareholders and help them address the reasons for the 'C' or 'D' grade. Where the shareholder has taken no action halfway between their FEP Audits, we will issue a formal warning explaining the period of time water will not be supplied if action is not taken to address the issues identified in the audit. If a second 'C' or 'D' grade is then granted, we would issue a cease water notice in accordance with the shareholders' Water User Agreement. The period of time water is not supplied increases when repeated breaches of the Water User Agreement are identified.
- 37 Since the start of our Audited Self Management programme in 2015, we have issued 7 formal warnings and 1 cease water notice to properties that were irrigated prior to 10 September 2015 for failing to complete the FEP within our internal timeframes (noting that under the Land Use consent FEP's had to be prepared for preexisting irrigated properties by 10 September 2015). All shareholders who received the notices completed their FEPs promptly and we fully complied with the timeframes specified in our Land Use Consent. In my view, the support/penalty balance is working well and going forward, in terms of any new irrigated properties they will need to have FEPs in place prior to receiving water (in accordance with the conditions of the Land Use consent).
- 38 All shareholders are currently in the process of completing their annual FEP update to the Irrigo online FEP template (the template was was approved by ECan as meeting the requirements of PC 5 in June 2016).

- 39 Based on information provided in the 2015 FEPs, 60% of the land managed under the Barrhill FEPs was primarily for arable³ land use, 29% dairy platform⁴, 8.3% dairy support⁵ and the remainder sheep and beef or other uses (see **Table 1** and **Figure 1**). Approximately 80% of shareholders reported some other use of their land as part of their farming system e.g. winter grazing of sheep on arable properties.
- 40 As shown in **Figure 1** below, due to the large proportion of arable properties within our scheme, we are acutely aware of the challenges that our shareholders have found with using OVERSEER® to estimate N losses for their farm system. In particular, it has been very difficult and in some cases impossible to have confidence in the use of OVERSEER® for modelling arable farms for compliance purposes.



Figure 1: Primary Land Use on BCIL Managed Properties (2014-15 season)

- ⁴ "Dairy Platform" is the land supporting milking dairy cows during lactation, generally surrounding a dairy shed
- ⁵ "Dairy Support" includes raising replacement dairy herd stock, grazing of bulls and wintering of milking dairy cows

³ "Arable" farm system is loosely defined as a farm system which grows diverse range of crops e.g. cereals and grains, fodder, vegetables and seeds.

- 41 We found 95% of land managed under our FEPs has a very low risk of run-off into natural waterways. Therefore the most common risks for managing nutrients within the scheme relate to ensuring the efficient irrigation and optimising land use to minimise leaching to groundwater.
- 42 Because Barrhill is a developing scheme, most infrastructure on shareholder farms is relatively modern, with 80% of irrigation applied using efficient Pivot or Lateral spray irrigation systems. This compares to 54% for mid-Canterbury as a whole.
- 43 The difficulties with undertaking compliance is further illustrated by the fact 45% of Barrhill shareholder properties were also irrigated by another water source and many were operated as part of a larger enterprise (see **Figure 2** and **Figure 3**). Therefore, while Barrhill only irrigates approximately 22,000 ha, nearly 55,000 ha of farmland is now actively managed and audited under our Audited Self Management programme.
- 44 As I mentioned above, OVERSEER® nutrient budgets were prepared for the 2014-15 season for all shareholders in the winter of 2015. Based on the budgets provided, Barrhill used only 42% of the scheme nitrogen load limit while irrigating 45% of the consented area. We are therefore on target to meet the nitrogen loss limit when the Scheme is fully developed.
- 45 Based on the 2014-15 season nutrient budgets, arable properties made up 59% of the irrigated land area managed by the FEPs, but contributed to 35% of the N losses. Dairy platform and dairy support collectively contributed 62% of N loss from 37% of the land (See **Table 1**).

Table 1: Barrhill and Acton Relative Land use and N lossContribution by Area

Land Use	% Land Use by Irrigated Area	% Contribution of N load
Arable	59%	35%
Beef	0.73%	0.30%
Dairy	29%	41%
DS	8.3%	21%
Sheep	2.9%	2.5%
Other	0.19%	0.7%

46 A shareholder survey was completed early in 2016 to determine progress with our Audited Self Management programme. We found that nearly 60% of shareholders had made some improvements or changes as a direct result of the programme, such as improving record keeping, staff training and installing soil moisture monitoring technology.

- 47 Feedback from outside professionals completing nutrient budgets and FEP audits indicates that our farmers have a high level of awareness and understanding of the nutrient management process, compared to 'your average Canterbury farmer' (accepting that over time, with the introduction of PC 5, awareness will presumably increase across the board).
- 48 I have also found shareholders respond very well to the FEP audits because they respect having someone come onto their property, understand their system and provide specific feedback and guidance which is helpful to them.
- 49 Generally, our shareholders are more motivated to make improvements and seek out information after their FEP Audit.
- 50 While the Barrhill Audited Self Management programme has only been in place for a single season, we have been able to engage our shareholders to start making the changes required to achieve GMP. With the regular FEP updates, audits and extension services that we can provide, combined with the Water User Agreement penalty structures, I fully expect these changes to be permanent and result in improvements in groundwater quality over time.



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Figure 2: Primary Source of Irrigation Water within Barrhill Managed Properties



Figure 3: Properties irrigated by Barrhill, Acton and others within the Barrhill ASM programme

TECHNICAL CHALLENGES IN USING OVERSEER TO MONITOR N LOSSES

Introduction

- 51 Paragraphs 6.21 and 6.22 of the section 42A report are at the heart of the technical challenges of using OVERSEER in the way that PC 5 does.
- 52 Those paragraphs advise:
 - 6.21 A number of submitters have raised the general point that GMPs are best implemented "on farm", and should not be the basis of a numeric limit. This is addressed in some detail in the Section 32 report, and it is clear that the development of the numeric outputs from the Farm Portal are based on the industry-agreed GMPs through the "proxies". The individual farmer inputs OVERSEER® files and the Farm portal outputs the relevant GMP loss rates. Fundamentally, in my opinion, the GMP Loss Rate number is inseparable from the GMPs, in that all other things being equal, the GMP loss rate is only able to be achieved through undertaking the appropriate practices on farm.
 - 6.22 It is also clear that through the decisions on the CLWRP, the various sub-region plan changes that have progressed to date and PC5, that the CRC is committed to the use of the OVERSEER® model. In the Council Officers' opinion, the model is appropriate to use in these circumstances, provided the acknowledged issues regarding the updates to the model and its use in thresholds, as explained in the Section 32 report, are addressed.
- 53 Barrhill agrees with the Officer's comments (at para [6.21]) to the extent that the "*Good Management Practice Loss Rate number*" and the on-farm GMPs **ought** to be inseparable.
- 54 However, my evidence shows that while the implementation of onfarm GMPs is essential to meet the "*Good Management Practice Loss Rate" number*, in most cases this alone is not enough and significant farm system changes will be required to achieve the GMP Loss Rates.
- 55 In my view, the current difference that we are experiencing in the N loss between a farm operating good management practices and its modelled Good Management Practice Loss Rate can imply only one of two things. There is either:
 - 55.1 an issue in the auditing of farms (i.e. with what auditors say is and is not 'GMP'); or

- 55.2 a problem with the tool modelling the Baseline GMP Loss Rate.
- 56 The industry agreed good management practices *are* on farm practices. Therefore, *they* must be the starting point for checking whether a farm is "*at GMP*" if a model approximation shows a '*different number*' the problem can *only* be with the modelling tool.
- 57 OVERSEER and the Farm Portal are expected by PC 5 to perform the role of a measurement device with, we would expect, an accuracy akin to a water meter (which is typically accurate to +/- 5%). In my view, the Farm Portal may one day reflect GMP. However, that does not change my view that the current uncertainties in:
 - 57.1 the data provided to prepare a nutrient budget;
 - 57.2 the variance in how nutrient budgets are prepared;
 - 57.3 the limitations of OVERSEER with modelling some farm systems;
 - 57.4 the processing bugs in the Farm Portal, rejecting valid files; and
 - 57.5 the erroneous calculations of the irrigation and fertiliser proxies in the portal,

ensure any 'number' prepared in OVERSEER and assessed through the Farm Portal cannot currently determine whether a property is managed according to GMP without an on-farm FEP Audit.

- 58 This mismatch between expectations for OVERSEER® and the Farm Portal and their ability to deliver are at the very core of the reason Barrhill calls for a regime focussed on on-farm GMPs, and one where OVERSEER® modelling plays the role of broad cross-check and catchment accounting guide. The alternative (which is also supported by Barrhill) would be an "*alternative pathway*" available if the N loss rate associated with a farm operating to the Agreed GMP does not match the Good Management Practice Loss Rate as calculated by OVERSEER® and the Farm Portal.
- 59 It may be that such an alternative regime(s) is only required on a more interim basis as discussed above, in my view both OVERSEER® and the Farm Portal can and probably will be able to deliver the requisite accuracy one day.

60 None of this, however, is to question ECan's commitment to OVERSEER®, as the section 42A officer implies. It is merely a plea to ensure the rule framework aligns with the limitations of OVERSEER®, not the other way around.

Background

- 61 None of the features of Barrhill's Audited Self Management programme that I discussed above rely directly on nutrient modelling. In my view, this is just as well, because our farmers currently have very little trust in their OVERSEER® `number'. Direct reliance would undermine their willingness to engage, reduce their awareness of the Agreed GMPs and ensure on-farm practices are not improved.
- 62 Irrigo's experience with implementing nutrient management under the proposed PC 5 regime has demonstrated several issues with using OVERSEER® to set hard limits through the Farm Portal, particularly for arable properties.
- 63 Barrhill's key concern is that the proposed PC 5 planning rules treat OVERSEER® as a measurement device, with an accuracy and consistency akin to a water meter. However, OVERSEER® is a model, and can only estimate average nitrogen losses from steady state farm systems (i.e. systems in a single state over a long period). OVERSEER®'s function is *not* to measure N loss with data inputs over only 12 months. Similarly, it can only be used for comparative purposes where budgets are prepared in a similar way.
- 64 Barrhill is concerned that the proposed PC 5 planning framework requires OVERSEER® to be used as a modelling tool outside of its current capability. This will require significant investment of resources to produce an estimation of N loss that cannot be verified, differs according to who prepared the budget and is incapable of reflecting the N losses from some farming systems altogether.
- 65 Barrhill does not object to limiting N losses or managing intensification, however it just does not believe these limitations can be enforced by using OVERSEER® alone, or that an OVERSEER®based approach is even likely to be the most effective means of achieving the desired limits on N loss, at least under the model's current capabilities.
- 66 Until the model has developed further, Barrhill therefore supports Fonterra's proposal for an 'alternative pathway' where a property exceeds its Good Management Practice Loss Rate (as determined by OVERSEER® and the Farm Portal), or where a nutrient budget cannot be prepared for a property, but where that property is demonstrating on-farm GMPs (i.e. the Agreed GMPs) in an FEP

audit. We also support expansion of the requirements of the FEP framework to enable more diverse methods to assess GMP on-farm.

Technical challenges in measuring N loss

- 67 The challenges of measuring scheme N loss through the sum of individual nutrient budgets include:
 - 67.1 inconsistent preparation of nutrient budgets between individuals (even when working to the common Best Practice Data Input Standards (*BPDISs*));
 - 67.2 the difficulties with using OVERSEER® on some farms systems especially arable farms that typically cannot be modelled fairly in OVERSEER® and require workarounds;
 - 67.3 nutrient budgets that require updating with OVERSEER® version changes, increasing workload;
 - 67.4 the challenges associated with any requirement to trend N losses over time;
 - 67.5 the challenges associated with calculating nitrogen baseline files and the fact that the resulting 'number' does not necessarily represent what occurred on a particular year within the baseline period;
 - 67.6 the challenges of retrospectively collecting good quality nitrogen baseline data (especially in circumstances where farmers had not to date been required to calculate their individual baselines);
 - 67.7 the issues with modelling N loss from different nutrient management zones (e.g. where a property falls in a red and an orange zone or crosses another zone boundary); and
 - 67.8 as I have touched on earlier in my evidence, the current shortage of appropriately skilled people to provide appropriate OVERSEER® (and Farm portal) analysis.
- 68 Each of these is discussed below.

1) Nutrient budget inconsistencies

69 OVERSEER nutrient budgets were prepared for all Barrhill and Acton shareholders in the winter of 2015. All nutrient budgets were prepared by suitably qualified professionals according to the BPDISs. In total, approximately 35 different suitably-qualified Irrigo personnel prepared the budgets in 2015.

- 70 Despite all using the BPDISs, our FEP Auditors found similar farm systems were modelled quite differently, depending on who prepared the budget.
- 71 One source of modelling differences is how irrigation practice is described. We found those preparing nutrient budgets had quite variable methods, resulting in vastly different N loss calculations for the same property. For example, a shareholder has a potato crop irrigated with a centre pivot without soil moisture monitoring. They measure their water usage and know they applied 330 mm/year of irrigation. This block was modelled in OVERSEER®, changing only how irrigation was put into the model. **Table 2** demonstrates the effect on N loss calculation by adjusting the irrigation inputs using three common irrigation scheduling strategies to reflect reasonable water usage.

Table 2: Example of Impact Minor Variation in Irrigation Inputs
have on N Loss Calculations through OVERSEER

Input Method	Rules	Calc. Irrigation App. Depth (mm/year)	Calculated N loss (kg N/ha/year)
Fixed Depth Fixed Return Default	Default	630	82
Fixed Depth Fixed Return User Defined	80 mm per 30 days	336	76
Fixed Depth Fixed Return User Defined	40 mm per 15 days	330	65
Fixed Depth Fixed Return User Defined	13 mm per 5 days	328	58

- 72 All four methods in **Table 2** were used for nutrient budgets prepared in 2015, depending on who and when they completed the budget. Most of the nutrient budgets provided met the requirements of "robust" and were prepared using BPDISs.
- 73 As a Scheme, Barhill can request all nutrient budgets are prepared in a standardised way to ensure consistency between shareholders, but an average individual farmer will not be aware of how their number was calculated and the impact it has on their N loss. At any rate, the point is that budgets between properties and across time are in many cases not comparable.
- 74 Until these inputs are standardised in the industry, it is impossible to tell whether a property was operating to GMP based solely on their N loss numbers, and a reviewer cannot directly compare one farm with the next without first understanding how data was described in the model.

75 By comparison, monitoring of GMP based on the Agreed GMPs allows for a more consistent comparison between farms, and is much more effective at assessing the actual on-farm management practices and identifying specific areas for improvement.

2) OVERSEER unable to assess N loss from all farm systems

- 76 The proposed PC 5 planning framework seems to assume OVERSEER® works well for all land uses. However, other than dairy, we have been having challenges with the use of OVERSEER® on other every farm system.
- 77 I understand that it has been estimated that 5,000 Canterbury farms will need FEPs and therefore baseline nutrient budgets and regular year-end nutrient budgets. Only about 1,000 of those are dairy farms. Therefore potentially up to 80% of properties needing to show compliance with Good Management Practice Loss Rates through the Farm Portal may be affected by the issues I will describe in this section.
- 78 As described in **Table 1** above, at least with the Barrhill Scheme properties arable farms contribute far less nitrogen per hectare to groundwater than other land uses, but face the highest compliance costs due to the complexity of their nutrient budgets - which are often modified to resolve errors and result in needing to use a nutrient budget which does not actually reflect their farming system.
- 79 While the costs of modelling an available system can be significantly reduced by averaging crop rotations and inputs, reducing the complexity, this also reduces the confidence you can have in the calculated N loss figure.
- 80 The end result will be either significant compliance costs to prepare and maintain the nutrient budgets, or budgets which barely resemble the farming system.
- 81 It is common for arable farmers to utilise stock (usually low intensity sheep, beef or dairy support) to complement their arable rotations. Currently 98% of Barrhill arable farmers have some stock on their property. OVERSEER® struggles to calculate the feed available from these crops for stock as it assumes nothing is left after harvest, which is seldom the case. In this regard, if the actual situation were entered into OVERSEER® the model creates an error, preventing the calculation of N losses on the property.
- 82 Experienced users of OVERSEER® implement 'workarounds' and adjust feed and stock numbers in order for the model to make a calculation. It is important to understand that once these 'workarounds' are made, the modelled N losses are, at best, an

approximation of the farm system, not a true reflection of what occurred during the previous 12 months.

- 83 I estimate approximately 85%-95% of Barrhill arable farm systems had to implement 'workarounds' in order to calculate a N loss number for their property.
- 84 However, in some situations, errors generated by OVERSEER® cannot be overcome using 'workarounds' and an N loss number cannot be calculated at all. Barrhill had 6 properties (7% of arable) in this situation last year.
- 85 The Foundation of Arable Research (*FAR*) have advised me that there are approximately 900 levy payers in Canterbury. If 85% of arable farms require 'workarounds' to model their farm system, these challenges will impact on over 750 arable properties.
- 86 Furthermore, the average arable farm will take a competent nutrient budget practitioner between 8-12 hours to complete, compared to 1-3 hours for a dairy farm. Arable farmers do not currently use the budgets for any purpose other than N loss reporting as they know the information used does not represent actual N losses from their property. Therefore, in reality, they have little trust in the outcome.
- 87 By comparison, the uptake of Agreed GMPs (ie on-farm GMPs), positive responses to the Audited Self Management programme and FEP audits amongst Barrhill's arable farmers has been widespread and significant. This further illustrates that realistic nutrient management responses on farm and positive outcomes for water quality and quantity can be better achieved through a more holistic approach to GMP than that offered by the often unreliable calculations produced by OVERSEER®.

3) Impact of OVERSEER version changes

- 88 OVERSEER® is updated twice a year, generally once in April/May and a second update in October/November. The updates are necessary as they often help with the issues outlined above, and the model is also updated to include new information (e.g. irrigation inputs) and incorporate new science.
- 89 One challenge faced by Barrhill is that each OVERSEER® version change (i.e. software update) results in a different N loss calculation.
- 90 Sometimes the change in the number is significant (e.g. when irrigation was included in v6.2.0), but also the changes are, at least for some properties, often minor. However, the 'number' is never the same after a version change, and the change is different for each property. Or, to put that another way, you cannot just say the

update had a blanket 10% increase in N losses, it might be -5% on one property and +15% on another.

- 91 In order to calculate Barrhill's Scheme N loss load against the N cap, we need to make sure all nutrient budgets are prepared using the same version, creating significant resourcing issues due to the short amount of time available to complete all budgets at the same time.
- 92 We have also found a large proportion of nutrient budgets cannot open in later versions of OVERSEER® and often need the 'workarounds' themselves re-worked. For example, 58% of the 2014-15 Barrhill nutrient budgets provided in v6.2.0 of OVERSEER® failed to open in v6.2.1. For arable systems, a full 83% failed to open in the later version.
- 93 The low success rate of arable systems is likely due to the 'workarounds' needed to make the file work in the older version. To counter the old file's workaround and create new ones, updating a file in the new version will often mean recreating the original nutrient budget (i.e. starting from scratch).

4) Challenges with Trending N losses over time

- 94 OVERSEER® version changes also make it impossible to trend improvements in N loss over time (either for the Scheme or for individual properties) without first ensuring all data files being compared are in the same version of OVERSEER®.
- 95 As an example of why this is challenging: To calculate the scheme load, Barrhill have about 200 nutrient budgets submitted annually. As about half of the Barhill Scheme are arable properties, approximately 80 annual files will need to be completely re-worked to ensure they open in a later version of OVERSEER®. To trend N loss over, say, 5 years, all 1,000 nutrient budgets will need to be updated into a single version. Of that 1000, about 400 will need to be completely re-made. This is assuming no significant information needs to be included in later versions was not included in earlier versions. Over 10 years, this will increase to 2,000 files and so on.
- 96 Only once we have each annual dataset set of nutrient budget files prepared in the same version of OVERSEER® will we be able to precisely assess whether or not we have achieved N Loss reduction targets.

- 97 If every farm in Canterbury needed to demonstrate compliance with meeting N loss reduction targets over time in a purely OVERSEER® based system, the task of constructing a dataset (let alone analysing that dataset) would involve the updating of about 50,000 files annually, each requiring a minimum of 2-3 hours each. All of these files will need to be updated by suitably qualified professionals with knowledge of local conditions, of which there are currently few in Canterbury. Even with a reduction in the number of updates and improvements in the modelling skill base, this task is likely to be near impossible.
- 98 For this reason alone, Barrhill questions whether it is or will ever be actually possible to determine if anyone, let alone schemes, are on track to meeting N loss reduction targets requested by some submitters (e.g. Nga Runanga and Te Runanga O Ngai Tahu in submission PC5LWRP – 792).
- 99 We again believe better environmental outcomes will be achieved by focussing resources on improving on-farm practice (i.e. working on actual industry-agreed GMPs), keeping GMP under review and enabling farmer uptake of new technologies.

5) Challenges with Nitrogen Baseline files

- 100 As I understand it, the idea of a 'baseline' N loss is intended to provide the limit for land use intensification at what occurred in the 2009-2013 seasons. The mechanism proposed in PC 5 to measure whether this outcome is achieved (as with the existing LWRP) is through the use of OVERSEER®. By June 2020, farmers are expected to be limited to their Baseline GMP Loss Rate, (i.e. at the 2009-2013 baseline assuming Good Management Practice at that time). Converting a raw OVERSEER® output to a Good Management Practice Loss Rate requires the file to go through the Farm Portal.
- 101 When putting an OVERSEER® file through the Farm Portal, the challenges in maintaining the files remain. Even where Good Management Practice Loss Rate is defined as the Nitrogen Baseline (because the output "*cannot be generated by the Farm Portal*"), the challenge is the same because of OVERSEER®'s challenges.
- 102 As mentioned above, a single OVERSEER® nutrient budget for an arable farm system can take 8-12 hours to prepare. The time requirements increase significantly when these files need to go through the Farm Portal. To calculate Baseline GMP Loss Rate, typically 4 files will have to be created because quarterly crop rotations cannot currently be averaged. Furthermore, it is highly likely that 'workarounds' will need to be applied in order to overcome errors.

- 103 To compare the baseline N losses with current N losses, all five files (i.e. the four 'seasonal' files and the 'average' file) will need to be updated and reworked to open in the most recent version of OVERSEER®, with the same workarounds applied.
- 104 Over time, it will be increasingly difficult to ensure the nitrogen baseline files bear any resemblance to the farm system during the 2009-13 period. This is because the original data is often not kept with the nutrient budget file when a workaround is made. Starting such a practice would lead to significant cost in database upkeep, and even if we did start this practice, it would not help the situation in early years.
- 105 If the current farming system exceeds the Baseline GMP Loss Rate for any reason, the previous 3 seasons' nutrient budgets will also need to be updated, resulting in up to 8 nutrient budget files to be updated and re-worked into a single version of OVERSEER®. In total, an arable farmer might potentially have to pay a professional consultant for 35-55 hours annually (i.e. more than a working week) to calculate whether their N losses exceeded their Baseline GMP Loss Rate. This simple illustration shows that 'operating' the PC 5 regime is, put simply, likely to be very difficult (especially why there are limited people with the expertise to undertake such work) with some properties being considerably more challenging than others.
- 106 These estimates of time exclude the additional time taken where a new version of OVERSEER® requires completely new inputs, due either to version changes or real on-farm changes. Both sources require re-blocking of the original file.
- 107 Both sources are common. For example v6.2.0 required new irrigation inputs. On farm, the most common change comes from the fact that over time, a significant number of farmers change their farm boundaries through land swaps and farm sales etc (and frequently do that to create land parcels shaped to increase irrigation efficiencies).⁶ In all of these situations, all files will need to be re-modelled, assuming 'good' information is available, and the time taken to update nutrient budgets will be more similar to creating a new file from scratch.
- 108 There are also many circumstances where a farm's Baseline GMP Loss Rate might be exceeded, but the farm is still operating within the same 2009-13 farm system. For example:

⁶ See original submission point 15 regarding Policy 5.42.

- 108.2 deer payout better than lamb this year, therefore increase proportion deer and reduce sheep;
- 108.3 switching low protein straw silage to higher protein grass silage as it could be sourced locally that year; or
- 108.4 the fodder crop rotation happens to lie within lighter soils for a season.
- 109 In these examples, there is no fundamental change or intensification of land use and there is unlikely to be a long term average increase in N loss from these activities. This illustrates that the Baseline GMP Loss Rate cannot be viewed in isolation from the actual activity taking place on-farm. This goes again towards the point that reliance on numbers and modelling, without allowing adequate consideration of the wider picture of GMP, leads to unachievable (and arguably irrelevant) limits.

6) Challenges of retrospectively collecting good quality nitrogen baseline data

- 110 With these challenges, complying with a resource consent that requires demonstration of meeting Baseline GMP Loss Rates for an irrigation scheme under and 4.41C (i.e. using OVERSEER® nutrient budgets) and other potentially relevant policies (such as Policy 4.37⁷) will be unmanageable at a Scheme level. It will also be virtually impossible to verify. A key challenge that we will face is the quality of data to calculate Nitrogen Baseline.
- 111 Our shareholders currently operate under permitted activity rule 5.60 of the operative LWRP. They have not been required to calculate their nitrogen baseline under that rule. For that reason, the data required to calculate a Baseline GMP Loss Rate may not even exist, particularly where a farmer has purchased into the Barrhill scheme since the baseline period or not maintained a full set of records. Our shareholders have also been operating under resource consent CRC162882, which permits increases in N loss above baseline until 2018, provided the scheme N losses are under cap. This means that many of the input parameters required by OVERSEER® and the Farm Portal will have changed over time. Particularly where ownership has changed, land use has changed or management has changed, the selection of appropriate inputs can reduce to a 'guess'.

⁷ Although note Barrhill's submission that Policies 4.37 to 4.38D should not apply to irrigation schemes because they will render further expansion, perhaps already underpinned by water supply agreements, very difficult.

- 112 The tone of the section 42A report suggests to me a 'too bad, you should have known you would be held to baseline' attitude. However this does not change the fact that the information required simply does not always exist. Environment Canterbury also needs to keep in mind that the number of nitrogen baselines completed to date is significantly less than the number of farms in Canterbury.
- 113 If the underlying data used to prepare a nitrogen baseline nutrient budget cannot be established because the data did not exist, in my view it will be impossible for Environment Canterbury to enforce suspected intensifications of land use above baseline. To some extent this does leave Barrhill in the position of asking why require those rules at all.
- 114 If a future consent limits Barrhill to a 'collective' Baseline GMP Loss Rate, then according to Policy 4.41C, it appears that Barrhill would be required to start collecting baseline land use data 9 years after the fact (from the time the existing Land Use consent expires). Furthermore, even if good data was collected for part of that time, the information needed to complete a nutrient budget now is different to what was needed in 2009-13 and it will be impossible to retrospectively collect this information. Traditional sources of data, such as accounting records, will also not be available as this information is only held for 7 years. And as I mentioned above, there are a number of situations where even if partial information was available, our selection of appropriate inputs would effectively be a guess.
- 115 To complete a scheme nitrogen baseline will therefore effectively require 'best guess' information, making the Baseline GMP Loss Rate potentially meaningless and to some extent a work of fiction.
- 116 Policy directions calling for Baseline GMP Loss Rates only where the nitrogen baseline was exceeded after 13 February 2016, or unlawfully before then, are one way of practically addressing this significant issue, as are qualitative 'base' land use descriptions.⁸
- 117 As per its original submission, Barrhill's view is also that such directions (contained in Policy 4.38A) should apply to unimplemented or partially-implemented resource consents, and not just implemented consents. This is because if a resource consent has been granted, but not fully exercised, I understand that the law provides that the consented activity must be considered part of the *existing land use*. And every consent granted prior to 13 February 2016 that exceeds baseline (implemented or otherwise) has had its adverse effects assessed and also considered acceptable.

⁸ See proposed PC 5 policy 4.38A (a), Barrhill original submission point 12.

118 But, in my view, a better outcome will be achieved by aligning irrigation scheme load expectations with individuals, and focussing our efforts on ensuring shareholders achieve actual on-farm Good Management (i.e. Agreed GMPs).

7) Challenges of modelling N loss from different nutrient management zones

- 119 Proposed Rule 5.42A of PC 5 allows for properties straddling different catchment or nutrient management zones (*NAZs*) to operate each part of the farm according to their NAZ N loss limits. The intent seems to be to allow farmers to take advantage of potentially more lenient zone rules on the part of the farm where those rules apply.
- 120 If a property is managed as one operating unit, in Barrhill's view it is not possible to manage them according to the principles of Rule 5.42A.
- 121 Fundamentally, this is because, OVERSEER® models a whole farm system and cannot model parts of farms sensibly. This is due to the interactions of nutrient transfer by stock. To effectively manage N losses in this way will become a logistical nightmare for the farmer and for whoever needs to ensure the farmer is meeting their obligations. In my view, it would probably require separate OVERSEER® files for the parts of the farm in each NAZ, and estimates of the 'average' stock numbers on each part, despite the extreme difficulty of planning stock movements with precision (let alone modelling them after the fact). With the addition to the modelling difficulties I discussed above, budgets of this kind will be another very good example of budgets that are not realistic to the actual farm system occurring.
- 122 When our consent expires, shareholders straddling two zones may face having to complete a FEP and annual nutrient budgets and keep precise records for each part of their property in order to meet the specific rules and nutrient reduction targets for each area. This would present a significant compliance cost, and my view on the utility of such budgets should now be obvious - splitting a farm in this way will reduce the accuracy of nutrient budgets, and with the more general modelling issues identified above, these inaccuracies will be magnified on 'boundary' farms.
- 123 Barrhill's experience has been that both farm professionals and ECan's own staff struggle with getting their heads around the different rules for different areas. It is therefore difficult to see how a farmer could be expected to implement completely different farm practices within, potentially, the same paddock of their property.

- 124 The situation created by proposed rule 5.42A is not uncommon. Barrhill has shareholders which border the Hinds Plains and the Ashburton River catchments. The boundary of these catchments cuts half way through paddocks. Stock freely move between the zones in the same paddock, with fertiliser, irrigation and soils management all identical – but the Hinds Plains NAZ has a different description of "good farm practice" than the Ashburton River NAZ and has different expectations around how irrigation and fertiliser should be managed.
- 125 This issue is also widespread as the NAZ boundaries do not seem to follow common, identifiable features, such as roads or property boundaries. All properties along these boundaries will soon be in a similar situation we have already identified with our shareholders.
- 126 In Barrhill's case, the vast majority of affected properties straddle orange and red nutrient management zones, which both have fairly similar controls to minimise N loss (so it would not be a significant impact to treat the whole property as being placed in one zone).
- 127 Properties which are both red/orange/lake and green are far less common. However, even allowing these properties to be classified as "Green zone" will have a minimal effect on water quality as these properties will still require resource consent and, at worst, are permitted to increase their N losses by 5 kg N/ha/year, which is still quite limiting for properties on free-draining soils.
- 128 Barrhill propose that if a property crosses more than one nutrient management or catchment zone, the zone rules where the majority of the property sits will be appropriate. Barrhill has also proposed policy relief in this regard.⁹

8) Resources to process nutrient budgets not available

- 129 I have already touched on this earlier in my evidence. Due to the technical subtleties in the operation of OVERSEER®, it is essential that quality personnel complete the nutrient budgets to ensure a consistent and reasonable result which can be assessed for compliance purposes.
- 130 Currently, most of Barrhill's nutrient budgets are prepared by the two major fertiliser companies, who have dedicated teams to complete nutrient budgets for regulatory purposes.
- 131 Barrhill have arranged Memorandums of Understanding (*MOUs*) with both companies to ensure that the nutrient budgets prepared for our shareholders are completed in a consistent manner and within our consented timeframes.

⁹ See Barrhill's original submission at point 15.

- 132 Over the winter, Fonterra also uses the fertiliser companies to complete over 10,000 dairy farm nutrient budgets at the same time.
- 133 Between ourselves, other irrigation schemes and Fonterra, all suitably qualified staff available to prepare budgets in both fertiliser companies are fully occupied between May and October, leaving individuals requiring nutrient budgets on a waiting list of several months.
- 134 This list will only get longer once all 5,000 farms in Canterbury require regular year-end nutrient budgets.
- 135 Barrhill has noticed that other regional councils are also beginning to require more regular nutrient budgets, and in future this will only put more pressure on the limited resources available.
- 136 While staff can be employed and trained to complete nutrient budgets, in Barrhill's view none of this work provides value to farmers unless the budget results are explained. If all suitably qualified staff are tied up preparing "robust" nutrient budgets, they will not be available to advise farmers about how they can be achieving Good Management Practice.

Summary of technical issues with OVERSEER®

- 137 Barrhill believes that the most effective method to improve water quality outcomes is through the implementation of Good Management Practices. OVERSEER® is a useful tool to evaluate some aspects of good management practice and being able to use the Farm Portal will also be helpful to create a benchmark.
- 138 However, the technical issues we have identified to date suggest OVERSEER® is not a suitable model to use to create a hard limit, which has the consequence of turning a farm into a prohibited activity. The use of the Farm Portal (which similarly relies on OVERSEER®) also raises similar issues and in Barrhill's view some flexibility needs to be provided around being able to use an alternative consenting pathway.
- 139 I turn specifically to the Farm portal in the next section of my evidence.

TECHNICAL ISSUES WITH FARM PORTAL PROXIES

- 140 Our experience with processing shareholder OVERSEER® nutrient budgets through the Farm Portal has identified the following issues:
 - 140.1 Farm Portal GMP Loss Rates that do not reflect the Agreed GMPs;

- 140.2 the Farm Portal not processing files prepared to BPDISs, even in the same version of OVERSEER®;
- 140.3 Farm Portal proxies assuming average data inputs; and
- 140.4 the Farm Portal being unable to account for early uptake of BMP technologies.
- 141 For Barrhill, OVERSEER® nutrient budgets are in the process of being prepared for all shareholders for the 2015-16 season. All budgets were valid in v6.2.2 of OVERSEER and have been prepared by suitably qualified professionals according to the BPDISs of May 2016.
- 142 I discuss each below.

1) Farm Portal not reflecting Agreed GMP

- 143 Separate to notification of PC 5 we have already been encouraging our shareholders to implement GMPs, as defined by the Agreed GMPs.
- 144 Barrhill started auditing FEPs in 2016 to the standards set by the FEP Auditors Manual (February 2016). To date, we have completed over 95 audits and assessed the outcomes of these audits against the 2015-16 season OVERSEER® nutrient budgets, where they have been provided.
- 145 We identified 31 shareholders on 38 properties who had provided a 2015-16 season nutrient budget and had achieved a High Level of Confidence (*LOC*) on the following targets in the FEP Audit:
 - 145.1 Targets 3&4 of the Irrigation Efficiency Objective: *All* applications of irrigation water are justified on the basis of soil moisture data, climatic information and crop adjustments; and
 - 145.2 Target 3 of the Nutrient Management Objective: *The amount and rate of fertiliser applied do not exceed agronomic requirements of the crop*
- 146 We have focused on these two targets because they relate to the GMPs which will have the greatest impact on modelled N losses to groundwater. The other 16 targets measured during the FEP audit either cannot be modelled in OVERSEER® or will have a negligible impact on N loss rates e.g. phosphorus and sediment management.
- 147 To achieve a High LOC for these targets, shareholders needed to provide objective evidence to demonstrate how these GMPs were being met, such as soil moisture monitoring traces which show

minimal leaching has occurred through the season and provided a nutrient management plan (and demonstrated the plan was followed through fertiliser records).

- 148 Irrigo has undertaken an analysis of the shareholders who we would expect to have 2015-16 season N losses (ie 'an OVERSEER® number') within or below expected Baseline GMP Loss Rates as calculated by the Farm Portal. We compared the expected Good Management Practice Loss rates with shareholders who have been audited as not meeting GMP or have not been audited at all¹⁰.
- 149 A summary of all results is included in **Table 3**.

¹⁰ Expect the non-audited group to best represent the average Mid-Canterbury property

Overall					
	Total	Arable	Dairy	Dairy Support	Mixed/Other
# of Files	49	19	13	13	4
# of Files GMP calculated	32	9	9	10	3
Farm Portal Success Rate	65%	47%	69%	77%	75%
Average N Loss (kg	66	39	53	103	22
N/ha/year)					
Average GMP Loss Rate	40	24	46	48	18
(kg N/ha/year)					
Average Reductions	39%	38%	13%	53%	18%
Required					
Properties Audited as Meeti	ng GMPs				
	Total	Arable	Dairy	Dairy Support	Other
# of Files	21	12	6	3	0
# of Files GMP calculated	12	4	6	2	-
Farm Portal Success Rate	57%	33%	100%	66%	-
Average N Loss (kg	58	47	47	113	-
N/ha/year)					
Average GMP Loss Rate	41	23	51	50	-
(kg N/ha/year)					
Average Reductions	29%	51%	-9%	56%	-
Required					
Properties Audited as Not M	eeting GMP				
Properties Audited as Not M	eeting GMP Total	Arable	Dairy	Dairy Support	Other
Properties Audited as Not M # of Files	eeting GMP Total 12	Arable	Dairy 4	Dairy Support	Other 2
Properties Audited as Not M # of Files # of Files GMP calculated	eeting GMP Total 12 7	Arable 1 0	Dairy 4	Dairy Support 5 5	Other 2 1
Properties Audited as Not M # of Files # of Files GMP calculated Farm Portal Success Rate	eeting GMP Total 12 7 58%	Arable 1 0 -	Dairy 4 1 25%	Dairy Support 5 5 100%	Other 2 1 50%
Properties Audited as Not M # of Files # of Files GMP calculated Farm Portal Success Rate Average N Loss (kg	eeting GMP Total 12 7 58% 80	Arable 1 0 -	Dairy 4 1 25% 41	Dairy Support 5 5 100% 106	Other 2 1 50% 49
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Table 3: Shareholder 2015-16 N Loss Compared to FarmPortal GMP Loss Rate (v6.2.2)

- 150 To date, we have received a total of 49 nutrient budgets (i.e. budgets for just under half of our 95 audited farms). Of the 49 budgets:
 - 150.1 21 were from properties audited as meeting GMP for irrigation and fertiliser management;
 - 150.2 12 were from properties audited as meeting GMP for all management targets (and received an "A" FEP audit grade);
 - 150.3 the Farm Portal only yielded Good Management Practice Loss Rates for 32 of the files; and
 - 150.4 the Farm Portal did not yield Good Management Practice Loss Rates for 17 of the files.
- 151 Of the 12 farms that received an 'A' FEP audit grade (circled in Figure 4), the Farm Portal calculation showed that the modelled N loss from 8 farms was above the Good Management Practice Loss Rate, some significantly so. Despite the small dataset, in my view Figure 4 more or less concretely shows that Farm Portal (and the Good Management Practice Loss Rate from it) does not describe the Agreed GMPs. As discussed below, the level of reduction required from the Good Management Practice Loss Rate is well in excess of what can realistically be achieved, even under the strictest adherence to Agreed GMPs.
- 152 When we processed these files through the Farm Portal, the audited-GMP farms were required to reduce their N losses by 29%, while the farms audited as being short of GMP needed to reduce their losses by 39%. For the non-Audited properties, the average GMP N loss calculation was 47% below the 2015-16 N Loss.
- 153 The inequity in the calculation between land uses is clear when we compare expected Good Management Practice Loss Rates with the 2015-16 N Losses, as shown in **Figure 4**, where the GMP from farms that received "A" audit grades is compared to their Good Management Practice Loss Rates. On average, the overall Good Management Practice Loss Rates were most similar for Dairy (13%) than for other land uses. The greatest impact was on Dairy Support (53%), followed by Arable properties (38%). Other land use (e.g. Sheep and Beef, calf rearing, horticulture etc) seem to be similar effect as arable as N losses increase, however our data set is too small to be sure.





- 154 Where N losses were calculated to be greater than about 30 kg N/ha, the Good Management Practice Loss Rates universally required reductions for all land uses, other than dairy, suggesting a bias in the GMP Loss programming towards higher intensity pastoral systems.
- 155 It is important to note the three highest N loss arable properties and the highest N loss dairy support property, were all audited as meeting GMP for irrigation scheduling and fertiliser management.
- 156 The other interesting trend is the variation of Good Management Practice Loss Rates of between 17-74 kg N/ha/year on the dairy support properties with 2015-16 N losses between 80-100 kg N/ha/year.
- 157 When we initially processed our nutrient budgets through ECan's "GMP Tool" (a cross-checking tool) to understand which proxies had the greatest impact, we found of 75% of the files could not be assessed because the GMP Tool still ran using v6.2.1 of OVERSEER, whereas all nutrient budgets were prepared using v6.2.2 (as required). The GMP Tool was only updated to v6.2.2 on the 14th

July 2016, despite v6.2.2 of OVERSEER being released on 23^{rd} May 2016.

158 Once the GMP Tool was updated to v6.2.2, 61% of our nutrient budget files could be assessed. A summary of the impact of the individual proxies is illustrated in **Figure 5**.



Figure 5: 2015-16 Loss Rates vs GMP Loss Rates By Proxy

159 In summary, the data presented in Figure 5 shows that proxies relating to soils, effluent and cultivation management had a negligible effect on GMP N loss, while the irrigation proxy had the most significant effect (average reduction of 24%, ranging from 0% - 58%), followed by the fertiliser proxy (average reduction of 12%, ranging from 29% increase to a 61% reduction).



Figure 6: 2015-16 N Loss vs GMP Loss Rates - Irrigation Proxy Only

- 160 When we analysed the effect of the irrigation proxy alone, the properties audited at an 'A' grade (ie as meeting GMP) for irrigation were still required to make a 22% reduction compared to 31% for properties audited as not meeting the irrigation GMP. In fact, the one property that the irrigation proxy *did not require an improvement* from was also only the property audited as a Low LOC for irrigation management (see **Figure 6**).
- 161 Turning to a useful case study, the FAR demonstration farm in Dorie, who is also an Acton shareholder, was of particular note. I attended the FEP Audit for this property and can confirm their irrigation and fertiliser management was at Best Management Practice standards, with over 80% of the property irrigated using efficient, modern infrastructure. Thirteen soil moisture probes were used (one for each different crop - generally only one or two representative probes are used). This farm was awarded an "A" Audit grade, which means they met all GMPs for every management area.
- 162 The Good Management Practice Loss Rate calculation for the FAR demonstration property required a N Loss reduction of 25%, compared to current practices. When processed through the GMP Tool, it was found the irrigation proxy resulted in all of the reductions. Since this property is very well set up and managed, I

suspect the irrigation proxies not only reflect GMP poorly, but are in fact unrealistic.

163 For the Fertiliser proxy, the properties audited as meeting GMP for fertiliser were still required to reduce their N losses on average by 22%, compared to 23% for the properties audited as not meeting GMP. If I removed the Audited GMP dairy support properties from my calculations, the fertiliser proxy required only an average 4% reduction, indicating the fertiliser proxy seems to poorly assess GMP fertiliser requirements for dairy support properties.

Figure 7: 2015-16 N Loss Rates vs GMP Loss Rates - Fertiliser Proxy Only



- 164 In Barrhill's view the Farm Portal (i.e. Baseline GMP Loss Rate) should be calibrated to FEP Audit results. As discussed throughout, our current data indicates the calculated Good Management Practice Loss Rates are unrealistic, unpredictable and poorly reflect on-farm GMP for individual properties.
- 165 Based on our own data and experience, Barrhill is concerned about the proxies used to model N losses at Good Management Practice and therefore:
 - 165.1 support Irrigation New Zealand and Ravensdown with developing new/corrected irrigation and fertiliser proxies;

- 165.2 support an alternative consenting pathway;
- 165.3 place greater focus on the FEP and Audit process to determine whether GMP has been met, including the provision of a "base" land use description as an alternative to assessing intensification with OVERSEER®; and
- 165.4 allow formation of collectives to support the implementation of GMPs through the FEP and Audit process.

2) Farm Portal errors – files being unable to be processed

- 166 To date, 49 2015-16 season nutrient budgets have been provided, of which only 32 have been able to be processed through the Farm Portal. The errors provided by the portal cite issues with the ineffective blocks and how the amount of supplements was recorded. When these files were reviewed, the inputs which created the error were reasonable and follow the BPDISs.
- 167 While I am sure these technical issues will be resolved over time, it is important to remember a farmer has paid for these files, the files have been prepared correctly, according to the BPDISs and the farmer will have to pay for them again to be adjusted in order to calculate their Good Management Practice Loss Rate through the portal.

3) Difference in assumptions when modelling GMP Loss Rates (and Farm Portal proxies assuming average data inputs)

- 168 Compliance with resource consents and Baseline OVERSEER® calculations are expected to be prepared using auditable "year-end" data. For instance, the addition of irrigation and fertiliser in May will generally result in greater leaching as plant growth tends to be low and soils tend to be wetter. The Farm Portal removes May nitrogen fertiliser and reduce irrigation inputs and the OVERSEER® model will assume higher N losses.
- 169 However, the Agreed GMPs state:
 - 1. Manage the amount and timing of fertiliser inputs, taking account of all sources of nutrients, to match plant requirements and minimise risk of losses; and
 - 2. Manage the amount and timing of irrigation inputs to meet plant demands and minimise risk of leaching and runoff.
- 170 In a season such as 2015-16, where soil temperatures were high, plant growth was on-going and there was little rain, the addition of fertiliser and irrigation in May is reasonable and in my view meets the Agreed GMPs.

- 171 The key difference is that the Farm Portal calculates the Good Management Practice Loss Rate assuming a static farm system in an average climatic season, but the annual nutrient budgets use variable year-end data.
- 172 In my view it is simply not reasonable to compare a single year-end nutrient budget with an averaged farm-system Good Management Practice Loss Rate and assume that a farm has exceeded their nitrogen cap. The difference could well be (and in fact is likely to be)due to natural variance within their farm system, not intensification.
- 173 The current system allows for a farmer to average their N losses over the previous 4 years to counter this effect, however I do not think this solution is practical or reasonable, particularly when a suitably qualified person (such as a FEP Auditor) can clearly see the exceedance is within acceptable variance of a farmer's 2009-13 land use.
- 174 Where land use has not changed since their baseline period, or consented/permitted land use, GMP of current practice will be the same as GMP during the baseline period.
- 175 Barrhill propose the FEP Auditor is provided the descriptive information of the land use in the 2009-13 period or of the consented/permitted land use (a "base" land use) to identify farms who have likely exceeded their baseline and require only those properties to update their budgets. This solution will significantly reduce the resources required to ensure baseline nutrient budgets are kept up to date on a regular basis and target properties of greatest risk of non-compliance with the requirements
- 176 For these reasons, Barrhill:
 - 176.1 supports Fonterra's submission points and comments on the need for an alternative consenting pathway;
 - 176.2 calls for clarification that policies 4.37-4.38D should not apply to irrigation schemes where intensification was ongoing or contemplated by resource consents when PC 5 was notified;¹¹ and
 - 176.3 in the alternative, relief through amendments to policies
 4.38C and 4.38D (plus a new Policy 4.38CC) in relation to compliance with GMP by 30 June 2020.¹²

¹¹ See original submission point 10.

¹² See original submission point 14.

177 In addition, and as I comment on later in my evidence, the issues that I have discussed in relation to the reliance on OVERSEER® tracks into the drafting of Schedule 7.

4) Inability to account for early uptake of BMP technologies

- 178 I touch on this issue later in my evidence but for immediate purposes simply note that unless OVERSEER® and the Farm Portal have been updated to recognise a particular new BMP, the early adopters of such science will not be recognised or 'rewarded' for reducing their N losses (with OVERSEER and the Farm Portal continuing to model losses on the basis the new BMP did not exist).
- 179 Barrhill is concerned that this might see farmers and Scheme shareholders more reluctant to incorporate new BMP's in their farming businesses.

PROVISION FOR THE FORMATION OF COLLECTIVES

- 180 In Canterbury, most farmers are incredibly proud of the work they do 'feeding the world'. Our farmers in Mid-Canterbury consistently achieve yields equal to or exceeding world records for wheat and seed production and are world leaders in production innovations and profitability.
- 181 In every measure to date, our farmers have stacked up as 'Good Farmers' and being a 'Good Farmer' forms a core part of their own personal identity.¹³
- 182 To achieve all GMPs therefore requires systemic behaviour change in a community which is hugely diverse in every way and whom all think they are 'Good Farmers' who do not 'waste anything' and often think 'I'm not the problem, it's that guy over there...'.
- 183 In order to facilitate behaviour change, it is absolutely essential to create a trusted, supportive community network, which can deliver consistent, simple messages and provide one-on-one guidance.¹⁴
- 184 One mechanism to achieve implementation of GMP within the farming community is to allow the formation of Nutrient User Groups, facilitated by Irrigation Schemes and Collectives. Nutrient User Groups can achieve the desired water quality outcomes by limiting collective N losses, while avoiding many of the pitfalls of

¹³ McGuire J. Reconstructing the Good Farmer Identity: Shifts in Farmer Identities and Farm Management Practices to Improve Water Quality Agric. Hum. Values (2013) 30:57-69

¹⁴ Blackstock K.L., et al Understanding and Influencing Behaviour Change by Farmers to Improve Water Quality, Science of the Total Environment 408 (2010) 5631-5638

OVERSEER® on individual farms and provide the support network needed to improve farmer uptake of Good Management Practice.

- 185 If ECan is unsure whether a Nutrient User Group can achieve what is necessary, membership of a Nutrient User Group could be tied to water take consent conditions, ensuring on-going water supply is tied to Nutrient User Group membership. Due to the critical importance of water to Canterbury farms, most operators will be strongly motivated to do what they need to protect their water supply.
- 186 My more anecdotal observations also indicate that scheme properties are more desirable for purchase than properties irrigated outside of schemes, due to the support network provided around the nutrient management rules.
- 187 Landcare Research identified the benefits of groups to achieve ongoing transformational change in 2002.¹⁵ Participation in the group normalises good practices and can create a culture of co-operation which furthers motivates members to play their part.
- 188 More recently, uptake of BMPs by Waikato Dairy Farmers was improved where they had access to good information, participated in dairy-related social activities and if they were located near an early BMP adopter property¹⁶.
- 189 The formation of farmer collectives to manage nutrients is also a cornerstone of the Hurunui-Waiau Plan and the Waitaki Sub-Regional Plans, with excellent community support for these initiatives. However, there is currently no policy framework in PC 5 to allow the formation of Collectives outside of the Waitaki. Furthermore, the Policies 4.41C and 4.41D will undermine initiatives to improve water quality through the Barrhill Scheme's Audited Self Management programmes.
- 190 Barrhill therefore request provisions for the formation of Nutrient User Groups are included in PC 5, which are similar to those requested in the Waitaki Sub-Regional Plan.
- 191 Barrhill acknowledges the distinction discussed by the reporting officer¹⁷, and also acknowledges the background that gave rise to

¹⁵ Allen W., Kilvington M., Horn C., Using Participatory and Learning-Based Approaches for Environmental Management to Help Achieve Constructive Behaviour Change (May 2002) Landcare Research Contract Report LC0102/057

¹⁶ Yang W., Spatial Dependence and Determinants of Dairy Farmers' Adoption of Best Management Practices for Water Protection 2016 Integrated Nutrient and Water Management for Sustainable Farming (eds. L.D. Currie and R. Singh) Occasional Report No. 29 Fertiliser and Lime Research Centre, Massey University

¹⁷ See paragraph 7.299 of the section 42A report.

nutrient user groups in the Waitaki Sub-region. On the other hand, none of the officer's comments appear to address the advantages of nutrient user groups that I have discussed above.

- 192 The officer's concern is that nutrient accounting may be made more "opaque" where nutrient user groups overlap. The implication appears to be that overlap will be used as a means to 'hide' nutrient loss. The current rules framework clearly defines whether a property is included or excluded from a scheme or enterprise to address the issue of 'overlap' which concerns the officer. Any property who becomes a member of a Nutrient User GroupI expect should face similar limitations to those currently within schemes or enterprises.
- 193 The option for a Nutrient User Group is specifically to provide those outside of the support networks or the schemes or enterprises with similar benefits to enable help them achieve GMP on-farm. The discussion above will show that I do share that view, and instead take a positive view of the potential for Nutrient User Groups.

SCHEDULE 7

- 194 Barrhill generally supports the theme of Schedule 7: that FEPs are the means to achieving N loss reductions and, with FEP Audits, provide an ideal solution to meeting the desired water quality outcomes.
- 195 However, in Barrhill's view, a number of matters in Schedule 7 require attention to ensure that on-farm GMPs (i.e. the Agreed GMPs) are adequately assessed during the FEP Audits.
- 196 The reporting officers were dismissive of Barrhill's concerns with Schedule 7 after concluding that it was of limited application to irrigation schemes, because "*farming activities managed under the resource consent held by an irrigation scheme…are permitted activities under Rule 5.41A(a) and subject to the scheme's requirements, not Schedule 7 per se.*"¹⁸
- 197 While this is true, Schedule 7 remains very relevant to Barrhill's farmers, because the conditions of the Barrhill Scheme resource consents now, and in the future, are very likely to mirror the requirements of Schedule 7. Therefore, even if not by direct impact, the effects and approach of Schedule 7 will be felt by our farmers when our consent is renewed in 2018.

40

¹⁸ Section 42A Report, paragraph 8.174

Schedule 7 does not assess intensification since the baseline period

- 198 This concept is closely linked with my earlier discussion about creating nutrient baseline files. The first issue is that Schedule 7 does not contain any concept of 'base' land use. 'Base' land use is a description of the land use on the property during the 2009-2013 baseline period, **or** the lawful land use for the property.¹⁹
- 199 If a property has not made any significant change to their land use since the 'base' land use period, by default there will be no increase in their N losses. Updating baseline OVERSEER® nutrient budgets to compare to a recent budget will not be an effective use of time or resources in these circumstances.
- 200 Without such a concept, Schedule 7 cannot deal with the reality that nutrient intensification occurred during or after the baseline period as a result of resource consents granted by ECan itself.
- 201 Policies 4.41B (e) and (f) allow for nutrient budgets to be prepared where the auditor suspects the irrigation area or winter grazing area has increased in the baseline period. But there is no information available to check land use change, other than OVERSEER® baseline nutrient budget files (where this information can be collected).
- 202 Accordingly, Barrhill's view is that a 'base' land use description within the FEP is necessary in order to effectively implement Policies 4.41B(e) and (f). We believe the "base" description should be included as requirement 1A for a Farm Environment Plan, and that this description measured against new proposed targets included under section 5 of the FEP requirements.²⁰
- 203 In Barrhill's view, such information very obviously does give additional information 'over and above' an OVERSEER file, and is not the 'nice to have' that the reporting officer presents it as.²¹
- 204 A 'base' land use will enable a 15 minute assessment by the FEP Auditor to determine if a property has *likely* intensified beyond baseline, instead of requiring a farmer to spend \$6,000 - \$10,000 and up to a week of their own time preparing nutrient budgets to come to the same conclusion. Where land use is similar to the

¹⁹ "Lawful land use" means permitted by a resource consent, permitted activity rule, or a change in land use demonstrated as meeting nitrogen baseline N losses.

²⁰ See original submission point 26. NB: Having considered the matter further, Barrhill is of the view that a description (g) should be added to the matters originally listed, being "(g) supplementary feed used on and/or removed from the property."

²¹ See Section 42A report at 8.132.

'base' period, focus will be to ensure GMP is being implemented on farm.

- 205 In Barrhill's view, explicit targets tracking indicators of intensification would assist ECan and FEP auditors by targeting the scarce time and resources of nutrient management specialists on those farms with the strongest indicators of intensification.
- 206 This is again consistent with Barrhill's support for the an alternative consenting pathway (being put forward by Fonterra) and development of alternative proxies to better model GMP (being put forward by various submitters).

Parts of Schedule 7 do not accommodate irrigation schemes

- 207 The second issue is that various elements of Schedule 7 appear to be directed at individual farming operations and inadequately drafted to accommodate irrigation schemes.
- 208 Clause 4B(b), for example, requires a report from the Farm Portal. However, a farm within an irrigation scheme will be subject to the reporting requirements of the resource consent under which the scheme operates. For example, Barrhill's land use consent (CRC162882) requires collective reporting of N losses, not individual.
- 209 It is up to the scheme how to allocate their load between their shareholders. Holding the shareholders individually to GMP N loss is not the standard authorised by the scheme consent.²²
- 210 The intent of Target 1 of the Nutrient Management Area is to set an N loss limit, which is achieved regardless of whether the limit is the Farm Portal or the resource consent.
- 211 The "*Management Area: Nutrient Management"* is similarly focused on individual farms and farm enterprises, but not irrigation schemes and the alternative methods to limit N loss through their Audited Self Management programmes.
- 212 Having reflected further on the latter relief, Barrhill wishes to shift the emphasis in its original submission on "*Management Area: Nutrient Management"* as follows.

Target 1: Nitrogen Losses from farming activities are at or below GMP Loss Rates for the property

213 As mentioned above, this target is not applicable to properties operating under a resource consent with a different N load limit.

²² See CRC162882, Clause 4.

- 214 Furthermore, there is no place which would allow the FEP auditor to assess whether a property has intensified their land use since the baseline period or take into account practices which will realistically reduce N losses to groundwater, but cannot be accounted for in OVERSEER®.
- 215 Barrhill therefore proposed an amendment to Target 1 to read:

<u>(1a)</u> Nitrogen losses from farming activities are at or below the GMP Loss Rates; <u>or are compliant with the Scheme Nitrogen Discharge</u> <u>Allowance; or any applicable and consented nitrogen loss rates; and</u>

(1b) Current farm practice is unlikely to increase N losses compared to the base land use description.

- 216 Barrhill is also uncomfortable with measuring the Baseline GMP Loss Rate solely through the Farm Portal.
- 217 OVERSEER® N loss models rely on years of scientific research, which is on-going. DairyNZ's Forages for Reduced Nitrogen Leaching project has published many studies looking at the impact of particular feed and grasses species on N leaching. This research will take years before it is able to be quantified and included in OVERSEER®.
- 218 Early adopters of this science will not be rewarded in OVERSEER® or recognised in the Farm Portal for reducing their N losses.
- 219 Conversely, OVERSEER® assumes animal effluent spreading is always to good practice. Where a property consistently applies effluent excessively, OVERSEER® is not able to recognise this practice and will underestimate N losses and run-off in these areas.
- 220 The Farm Environment Plan and the FEP Audit are an excellent solution to ensure GMPs continue to be implemented, as the auditor can identify practices which cannot be modelled in OVERSEER®.
- 221 Barrhill therefore recommends a new target relating to nutrient management, intended to recognise all management practices impacting on N losses to water, which cannot be measured through OVERSEER®. We proposed the wording to be:

"Nitrogen Losses to water from farming activities are minimised."

222 By ensuring that irrigation schemes still need to provide FEPs through Schedule 7, but by separating out the requirements for such plans when compared with 'standard' FEPs:

- 222.1 any concerns about reliance on the similar information provided through consent conditions is dealt with;
- 222.2 the actual information being provided, or otherwise available, to ECan is enhanced; and
- 222.3 the cost in time and money to determine compliance by irrigation schemes is reduced without environmental compromise.
- 223 Barrhill believe that the proposed inclusion of further targets relating to "base" land use and farm practices which directly impact on N loss to groundwater, but cannot be measured in OVERSEER®, would be an ideal solution to achieving water quality outcomes until the issues with OVERSEER® are resolved.

Positive impact on water quality by meeting GMP

- 224 The Agreed GMP guide was finalised in September 2015, providing the first definitive narrative of what a good practice farm looks like.
- 225 Our experience is that (contrary to many people's perceptions) the Agreed GMP guide sets a high standard of farm practice and your average farmer will need to make significant improvements to their farm system to meet the Agreed GMP standards.
- 226 For example, Barrhill have audited 95 shareholder farms to determine how many are meeting all GMP practices. All audits were completed according to the requirements set by the FEP Auditor Training Manual by three suitably qualified individuals.
- 227 On a whole, we expect Barrhill shareholders to perform better than average as farm infrastructure tends to be relatively new and our shareholders have been comparatively well-informed and supported.
- 228 As discussed above in relation to **Figure 4**, we found that only 21 of 95 farms were at GMP for both the fertiliser and irrigation targets, and just 12 of 95 farms were at GMP for all targets.
- 229 Irrigation scheduling and fertiliser management will have a significant impact on N losses and implementing GMP for these targets on the other 74 properties so far audited by Barrhill will result in real reductions of N losses to water.
- 230 Furthermore, a nutrient budget only assesses 3 out of 18 Schedule 7 Targets. The FEP audit can pick up on issues relating to effluent spreading, stock in waterways and identification of Critical Source Areas, which OVERSEER® is not designed to do, particularly on flat or undulating land.

- 231 In fact, limiting stock access to natural waterways, where practical, is the single most effective action to improve surface water quality²³.
- 232 The Agreed GMPs are achievable and measureable. Our farmers have bought into the process. Our farmers are motivated to being recognised as "good farmers".
- 233 Barrhill's view is that focussing on good management practice onfarm through Schedule 7 FEPs and the audits will result in significant reductions in N loss to water.

Controls on the take of stockwater

- 234 This concern also relates to "Management Area: Water Use Management (excluding stock water)" in Schedule 7. In short, this rule appears to cover domestic and stock water that can be taken as of right under section 14(3)(b) of the Resource Management Act 1991. Barrhill is concerned that by including monitoring requirements for such takes in the wider FEP requirements, will provide leverage to require reduction of such takes – i.e. reduction of a statutory right.
- 235 Even if the intention relates only to monitoring of dairy shed water use to meet the Sustainable Dairy Water Accord, the Resource Management (Measurement and Reporting of Water Takes) Regulations 2010 only require metering of consented water takes greater than 5 litres per second.²⁴ In Barrhill's view, it cannot be appropriate to seek monitoring of non-consented domestic/stockwater takes below those thresholds where national regulations clearly sets a lower bound.
- 236 Barrhill would also like to highlight the impact on FEP Audit grading by creating a management area solely focussed on small water takes. For example, one of our arable shareholders supplies stockwater for about 600 sheep and 150 cows from six different points off the mainline irrigation system. A water meter with telemetry costs between \$5,000 - \$10,000, and six of them will be required on this shareholder's property in order to measure the volume stockwater.
- 237 The only target in the Water Use management area requires demonstration that actual water use is measured and efficient. Therefore, the best grade can only be a Low Level of Confidence (LOC) for that management area.

²³ Haycock N.E., Pinay G., Walker C. (1993) Nitrogen-Retention in River Corridors – European Perspective. Ambio 22:340-346

²⁴ I understand that this comes from clause 4 of the Resource Management (Measurement and Reporting of Water Takes) Regulations 2010.

- 238 Under the FEP Auditor Training Manual, the overall FEP Audit grade is determined by the Level of Confidence achieved in each Management Area. A single Low LOC for any management area results in an overall "D" FEP Audit grade - the lowest possible grade.
- 239 The example farm I have provided you is a FAR demonstration farm, which has been audited as meeting Best Management Practice for all other aspects of their property. Barrhill is concerned that to grade this farm a "D" because it hasn't installed six water meters on takes authorised under section 14(3)(b) of the RMA is grossly out of proportion to the potential effects on water quality and quantity by not measuring it.
- 240 Another example to consider is where stock water is supplied through an open-channel district council network. I'm not sure how the use of stockwater from an open channel would be measured, nor how knowing the volume used will assist with proving the amount the stock drank was "efficient".
- 241 The reasonable volume of water for both domestic and stockwater use are provided for in section 14(3)(b) of the RMA, which refrains from setting a precise limit on the volume considered reasonable as a thirsty animal has a right to drink what it needs when it needs it.
- 242 The only determinant of whether the use of stockwater and domestic water is "efficient" is by the management of the networks used to distribute these water sources, such as ensuring reticulated systems are not leaking etc. Measuring water volume used will unlikely assist with the identification of management issues any more than driving around and looking at the condition of their reticulated system.

For the reasons above, Barrhill seeks:

- 242.1 the moving of the target under "Management Area: Water Use Management (excluding irrigation water)" to "Management Area: Irrigation Management", and the deletion of the first management area; and
- 242.2 an amendment to "Management Area: Irrigation Management", to read "Management Area: Water Use Management", and
- 242.3 clarification that the target under "*Management Area: Water Use Management (excluding irrigation water)"* only applies to consented takes over 5 litres per second.

Dated: 22 July 2016

Eva Harris

ANNEXURE 1

CRC143165 and CRC 162882

RESOURCE CONSENT CRC143165

Pursuant to Section 104 of the Resource Management Act 1991

The Canterbury Regional Council (known as Environment Canterbury)

Barrhill Chertsey Irrigation Limited
To divert, take and use water from the Rakaia River.
05 May 2014
28 Jan 2035
Barrhill - Chertsey Area, METHVEN

SUBJECT TO THE FOLLOWING CONDITIONS:

- 1 The rate at which water is diverted from the Rakaia River:
 - a. at or about map reference NZMS 260 K36:050-393, shall not exceed 40 cubic metres per second; and
 - b. within an area defined by map references NZMS 260 L36:270-198, L36:277-208, L36:365-150, and L36:350-137, shall not exceed 6 cubic metres per second; and
 - c. at or about map reference NZMS 260 K36:081-363, shall not exceed 10 cubic metres per second; amd
 - d. between approximate map references Topo50 BX21:0579-6651 and Topo50 BX21:0662-6548, shall not exceed 10 cubic metres per second.
- 2 The rate at which water is taken from the Rakaia River:
 - a. at or about map reference NZMS 260 K36:057-393, shall not exceed 17 cubic metres per second (the Upper/Original Intake); and
 - b. at or about map reference NZMS 260 L36:327-164, shall not exceed 3 cubic metres per second (the Lower/Acton Intake); and
 - c. at or about map reference NZMS 260 K36:081-363, shall not exceed 8 cubic metres per second (the Highbank Intake); and
 - d. at or about map reference Topo50 BX21:0704-6486, shall not exceed 5 cubic metres per second (the Barrhill Intake).
- 3 The net rate of take between conditions 2 a., 2 b. 2 c.and 2d. shall not exceed 17 cubic metres per second.

Advisory Note: Whilst the net abstraction authorised by this consent must not exceed 17 cubic metres per second, water that is taken at an upstream location and then discharged back to the river can be taken out at a location downstream of the discharge point for reuse, provided that the total net take along any reach of the river does not exceed 17 cubic metres per second.



RESOURCE CONSENT CRC162882

Pursuant to Section 104 of the Resource Management Act 1991

The Canterbury Regional Council (known as Environment Canterbury)

GRANTS TO:	Barrhill Chertsey Irrigation Limited
A LAND USE CONSENT:	to change condition 4 of CRC147697 - to use land for a farming activity and to discharge nutrients onto or into land
CHANGE TAKES EFFECT DATE:	11 Dec 2015
EXPIRY DATE:	09 Sep 2018
LOCATION:	Barrhill - Chertsey Area, between Rakaia River and Rangitata River, Ashburton

SUBJECT TO THE FOLLOWING CONDITIONS:

1 This consent authorises:

- a. the use of land for farming; and
- b. the discharge of nutrients to water arising from the use of farming authorised in clause a..
- 2 The use of land and discharge specified in condition 1. shall only occur within a maximum of 40,000 hectares on:
 - a. the areas marked as Areas 1-8 on attached plan CRC141388, which forms part of this consent; and
 - b. any land located between the Rakaia and Rangitata Rivers covered by a separate consent to use water that has been taken under CRC132861 or any subsequent variation thereof.
- 3 A Farm Environment Plan (FEP) shall be prepared:
 - a. by 10 September 2015 for any properties that had existing water supply agreements with the consent holder that were in place prior to July 2013; and
 - b. for any properties with agreements subsequent to those specified in clause a., prior to the delivery of water to that property.

The FEP shall be prepared in accordance with Schedule One, which forms part of this consent. The FEP shall be updated as necessary and on farm practice shall be in accordance with the FEP.

4 Audited Self Management Programme

- a. Prior to 1 July 2016, the consent holder shall implement and adhere to an audited self-management programme (ASM), which is developed by a suitably qualified person and approved by the Canterbury Regional Council. The ASM document shall include, but is not limited to:
 - i. Environmental targets and objectives for the scheme and its shareholders;



- ii. The proposed monitoring and reporting regime including but not limited to a description of the:
 - a. Farm Environment Plan (FEP) audit process and the frequency used to assess individual on-farm progress with the content of any FEP and Schedule One;
 - Methods used to follow up with shareholders who are not achieving the environmental objectives of Schedule One as identified during individual on-farm audits;
 - c. The proposed data to be collected and reported to the Canterbury Regional Council;
 - d. Independent annual review of the FEP audit process;
 - e. How nutrients from all land subject to the scheme or principal water supplier will be accounted for;
- b. Any significant changes to the ASM document shall be implemented only after approval confirmed in writing by the Monitoring and Compliance Manager, Canterbury Regional Council.
- c. FEP audits shall be undertaken by a suitably qualified person at a frequency determined in accordance with Schedule Two, with the exception of the first audit, which shall be completed in accordance with conditions 4(c)(i) and 4(c)(ii);
 - i. 50% of all FEPs prepared prior to 10 September 2015 shall be audited by 10 September 2016.
 - ii. 50% of all FEPs prepared prior to 10 September 2015 shall be audited by 10 September 2017
 - iii. All FEPs prepared after 10 September 2015 shall be audited within 12 months of being completed.
- d. The consent holder shall prepare an annual report describing the results of the ASM programme and the audits that have been conducted each year. The report shall include:
 - i. The name of the FEP auditor(s);
 - ii. A summary of the audit performance grading;
 - iii. A summary of the reasons for any farm receiving a C or D grade;
 - iv. A summary of the actions taken to address C or D grades;
 - v. A summary of farms that repeatedly received a C or D grade;
 - vi. The progress achieved for previously identified issues, if applicable;
 - vii. The total annual loss of nitrogen from all properties within the Irrigation Scheme or Principal Water Supplier over the reported year.
 - viii. The performance of the scheme in meeting its environmental targets and objectives.
- e. A copy of the annual report shall be provided to the Monitoring and Compliance Manager, Canterbury Regional Council, by 30 November each year;
- f. The FEP audit records for each property undertaken in accordance with condition
 (4) shall be kept and made available for the Canterbury Regional Council to inspect, upon request.
- g. The consent holder shall notify the Monitoring and Compliance Manager, Canterbury Regional Council within 20 working days of any exclusion of a shareholder(s) from the ASM programme.



CRC162882

- 5 The combined average annual amount of nitrogen lost to water as calculated from the individual Farm Environment Plans prepared in accordance with condition 3. shall not exceed a total of 1,232 tonnes if Overseer version 6.0.3 is used or X tonnes if a subsequent Overseer version, or equivalent model approved in writing by the Canterbury Regional Council RMA Compliance and Enforcement Manager is used. For the purposes of this condition, X equals the total average annual nitrogen loss calculated using the current version of Overseer, or equivalent model approved in writing by the Canterbury Regional Council RMA Compliance and Enforcement Manager, based on the following:
 - a. 17,604 hectares of land with irrigation supply agreements in place with the consent holder prior to July 2013; and
 - b. 22,396 hectares of subsequent irrigation areas;

Provided that the land uses and management practices modelled must be consistent with the activities described in the application.

- 6 The consent holder shall ensure that each farm that it supplies water to shall maintain detailed records of fertiliser application rates, location and crop type (including winter feed/forage crops), cultivation methods, stock units by reference to type and breed, and all other inputs to the Overseer nutrient budgeting model. The records shall be made available to the Canterbury Regional Council on request.
- 7 The Canterbury Regional Council may, once per year, on any of the last five working days of May or November, serve notice of its intention to review the conditions of this consent for the purposes of dealing with any adverse effect on the environment which may arise from the exercise of the consent and which it is appropriate to deal with at a later stage.

Issued at Christchurch on 11 December 2015

Canterbury Regional Council

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Environment Canterbury Regional Council Kaunihera Taiao ki Waitaha





Schedule One - Farm Environment Plan

A Farm Environment Plan shall be prepared for the subject property. The plan shall take into account all sources of nutrients used for the farming activity and identify all relevant nutrient management practices and mitigation measures.

Plan requirements

The farm environment plan must clearly identify how and by when the assigned industry 'good practices' and/or property nutrient allowances will be achieved. The plan shall contain as a minimum:

- 1. Property details:
 - (a) Physical address.
 - (b) Description of the ownership and name of a contact person.
 - (c) Legal description of the land and farm identifier.
- 2. A map(s) or aerial photograph at a scale that clearly shows:
 - (a) The boundaries of the property.
 - (b) The boundaries of the main land management units on the property.
 - (c) The location of permanent or intermittent rivers, streams, lakes, drains, ponds or wetlands.
 - (d) The location of riparian vegetation and fences adjacent to water bodies.
 - (e) The location of storage facilities, offal or refuse disposal pits, feeding or stock holding areas, effluent blocks, raceways, tracks and crossings.
 - (f) The location of any areas within or adjoining the property that are identified in a District Plan as "significant indigenous biodiversity".
- 3. An assessment of the risks to water quality associated with the major farming activities on the property and how the identified risks will be managed.
- 4. A description of how each of the following management objectives will, where relevant, be met:
 - (a) *Nutrient management*: To maximise nutrient use efficiency while minimising nutrient losses to water in order to meet specified nutrient allowances.
 - (b) *Irrigation management:* To operate irrigation systems that are capable of applying water efficiently and management that ensures actual use of water is monitored and is efficient.
 - (c) *Soils management:* To maintain or improve the physical and biological condition of soils in order to minimise the movement of sediment, phosphorus and other contaminants to waterways.
 - (d) *Wetlands and riparian management:* To manage wetland and waterway margins to avoid damage to the bed and margins of a water body, avoid direct input of nutrients, and to maximise riparian margin nutrient filtering.
 - (e) *Collected animal effluent management:* To manage the risks associated with the operation of effluent systems to ensure effluent systems are compliant 365 days of the year.
 - (f) *Livestock management:* To manage wetlands and water bodies so that stock are excluded as far as practicable from water, to avoid damage to the bed and margins of a water body, and to avoid the direct input of nutrients, sediment, and microbial pathogens.

The plan shall include for each management objective:

- (i) user defined measurable targets that clearly set a pathway and timeframe for achievement of the objective.
- (ii) a description of the good management practices together with actions required to achieve the objective and targets.
- (iii) the records for measuring performance and achievement of the target.
- 5. A nutrient budget shall be prepared annually using the current version of the Overseer model, or equivalent model approved in writing by the Canterbury Regional Council RMA Compliance and Enforcement Manager, to cover the land specified in Condition 1 for the upcoming 12 months. At the end of each 12 month period the modelling shall be revised, if necessary, to accommodate any differences between the projected modelling and actual farm practise, to calculate the average annual amount of nitrogen loss from the subject land.

Schedule Two

4 PROCEDURES

4.1 FARM ENVIRONMENT PLAN AUDIT PROCESS



WATER SWAP

- a. The rate at which water is taken at various locations from the Rangitata Diversion Race (being water diverted and taken from the Rakaia River under this consent or the Rangitata and Ashburton Rivers under consents CRC011237 and CRC011245 or any subsequent replacement consents) shall not exceed 10 cubic metres per second provided that:
 - i. the holder of consents CRC011237 and CRC011245 (or any subsequent replacement consents) is taking water from either the Rangitata and/or Ashburton Rivers; and/or
 - ii. the consent holder is taking water from the Rakaia River and placing that water into the Rangitata Diversion Race and the total amount diverted and taken by the consent holder from the Rangitata Diversion Race does not exceed the total of that taken under condition 4a.i.and ii.
- b. the water diverted and taken under condition 4 a. may be used in accordance with condition 11.

Advisory Note: In accordance with this resource consent and any agreement between the consent holder and the holder of consents CRC011237 and CRC011245:

- a) the consent holder is authorised to take up to 10 cumecs of water from Rakaia River into the Rangitata Diversion Race for the purposes of providing that water to:
 - i. the consent holder to divert and take that water from the Rangitata Diversion Race (or to use it within the race) for any purpose specified in condition 11; or
 - ii. the holder of consents CRC011237 and CRC011245 (or any subsequent replacement consents) to divert and take that water from the Rangitata Diversion Race (or to use it within the race) for any of the purposes specified in condition 11.
- b) the consent holder is authorised to divert and take discharge up to 10 cumecs of water from the Rangitata Diversion Race (including water taken from the Rakaia, Rangitata and Ashburton Rivers) for any of the uses specified in condition 11) provided that the total divert and take by the consent holder from the Rangitata Diversion race under a. and b. does not exceed 10 cumecs.
- c) Nothing in this consent shall prevent:
 - i. the holder of consents CRC011237 and CRC011245 fully exercising its consents to the exclusion of the water swap arrangements described in condition 4 and this Advisory note should it choose to do so.
 - ii. the consent holder exercising its consents without reliance on the water swap described in condition 4 and this Advisory note.



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FLOW RESTRICTIONS FOR THE RAKAIA TAKE

- a. The following minimum flow will apply to the abstraction of 14,872.5 L/s of Band 4 water:Whenever the flow (expressed in cubic metres per second) in the Rakaia River, as estimated by the Canterbury Regional Council from measurements at either the gorge recorder site (at or about map reference NZMS 260 K35:015-424) or the recorder site at Fighting Hill (at or about map reference NZMS 260 K35:997-437) falls below the following flows, the taking of water in terms of this permit shall cease:Month: JAN FEB MAR APR MAY JUN JUL AUGFlow: 150.5 134.5 131.5 123.5 121.5 122.5 117.5 118.5 Month SEP OCT NOV DEC Flow: 116.5 132.5 155.5 165.5.
 - b. The following minimum flow will apply to the abstraction of 2,127.5 L/s of Band 5 water: Whenever the flow (expressed in cubic metres per second) in the Rakaia River, as estimated by the Canterbury Regional Council from measurements at either the gorge recorder site (at or about map reference NZMS 260 K35:015-424) or the recorder site at Fighting Hill (at or about map reference NZMS 260 K35:997-437) falls below the following flows, the taking of water in terms of this permit shall cease:Month: JAN FEB MAR APR MAY JUN JUL AUGFlow: 184.8 168.8 165.8 157.8 155.8 156.8 151.8 152.8 Month SEP OCT NOV DEC 150.8 166.8 189.8 199.8
- a. The following sharing restriction shall apply to the abstraction of Band 4 water:Whenever the flow (expressed in cubic metres per second) in the Rakaia River, as estimated by the Canterbury Regional Council from measurements at either the gorge recorder site (at or about map reference NZMS 260 K35:015-424) or the recorder site at Fighting Hill (at or about map reference NZMS 260 K35:997-437) falls below the flows shown on the horizontal axis of the annexed Graph CRC990088.6A, then the rate of abstraction permitted in terms of this permit shall not exceed that shown as corresponding on the vertical axis of the annexed Graph CRC990088.6A.
- b. The following sharing restriction shall apply to the abstraction of Band 5 water: Whenever the flow (expressed in cubic metres per second) in the Rakaia River, as estimated by the Canterbury Regional Council from measurements at either the gorge recorder site (at or about map reference NZMS 260 K35:015-424) or the recorder site at Fighting Hill (at or about map reference NZMS 260 K35:997-437) falls below the flows shown on the horizontal axis of the annexed Graph CRC990088.6B, then the rate of abstraction permitted in terms of this permit shall not exceed that shown as corresponding on the vertical axis of the annexed Graph CRC990088.6B. PROVIDED THAT Whenever the Canterbury Regional Council, in consultation with a Water Users Group involving two or more consent holders who have determined upon a water sharing regime which complies with the National Water Conservation (Rakaia River) Order 1988, and
 - i. All consent holders in the Water User Group are recording their rate of water abstraction by tamper-proof electronic recording systems such that the abstraction rate and volume of water is measured at least once every 15 minutes, and a record is made at a remote location via telemetry of the recorded abstraction rate and volume; and
 - ii. The recorded data shall not be changed or deleted by any person, unless twelve months have passed since the date of recording; and



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- iii. The measuring and recording devices shall be available for inspection at all times by the Canterbury Regional Council subject to providing adequate protection against vandalism which may require the consent holder's assistance on site to unlock or remove barriers.
- iv. All data from the recording devices shall be provided to the Canterbury Regional Council on request.
- v. Four months after the commencement of the Water User Group sharing and during every second year of Water User Group sharing thereafter, the consent holder shall provide a certificate to the Canterbury Regional Council Attention: RMA Compliance and Enforcement Manager, signed by a suitably qualified person certifying the accuracy of the measuring and recording devices; then the taking of water in accordance with that determination shall be deemed to be in compliance with all parts of condition 5 and 6 of this consent.

FISH SCREENS

- a. Upper/Original Intake:
 - i. Fish screens shall be installed and maintained on the diversion channel and the mesh aperture size of the screen shall not exceed five millimetres except from August 1 to November 15 when the mesh aperture size of the screen shall not exceed 3.8 millimetres; and
- b. Lower/Acton Intake:
 - i. The consent holder shall, within three years of the first exercise of this consent, design, construct and commission a fish exclusion device to be applied near, at or within, the Acton intake or diversion channel subject to:
 - a. Water shall only be taken when a fish exclusion device with the following design criteria, or a device that achieves the same, or better, level of fish exclusion effectiveness is operated and maintained across the intake to ensure that fish and fish fry are prevented from passing through the intake. Design criteria: a maximum mesh width and height size of three millimetres or slot width of two millimetres, or other such screen system as approved by the Canterbury Regional Council.
 - b. The fish exclusion device shall be positioned to ensure that there is unimpeded fish passage to and from the waterway and to avoid the entrapment of fish at the point of abstraction, and to minimise the risk of fish being damaged by contact with the face of the exclusion device.
 - c. The fish exclusion device shall be designed and installed to ensure that:
 - i. The majority of the exclusion device surface is oriented parallel to the direction of water flow.
 - ii. Where practicable, the exclusion device is positioned in the water column a minimum of 300 millimetres above the bed of the waterway and a minimum of one exclusion device radius from the surface of the water.



- iii. The approach velocity perpendicular to the face of the exclusion device shall not exceed 0.06 metres per second if no self-cleaning mechanism exists, or 0.12 metres per second if a self-cleaning mechanism is operational.
- iv. The sweep velocity parallel to the face of the exclusion device shall exceed the design approach velocity.
- d. The fish exclusion device shall be designed or supplied by a suitably qualified person who shall ensure that the design criteria specified in condition 7(b)(i)(b)-(c) of this consent is achieved. Prior to the installation of the fish exclusion device, a report containing final design plans and illustrating how the fish exclusion device will meet the required design criteria, and an operation and maintenance plan for the fish exclusion device shall be provided to the Canterbury Regional Council, attention RMA Compliance and Enforcement Manager.
- e. A certificate shall be provided to the Canterbury Regional Council by the designer or supplier of the fish exclusion device to certify that the fish exclusion device has been installed in accordance with the details provided to the Canterbury Regional Council in accordance with condition 7(b)(i)(e) of this consent.
- f. The fish exclusion device shall be maintained in good working order. Records shall be kept of all inspections and maintenance, and those records shall be provided to the Canterbury Regional Council upon request.
- g. The consent holder shall supply annually in November each year an update to the Canterbury Regional Council, Attention: RMA Compliance and Enforcement Manager, on the progress of installing fish exclusion devices, until required devices are in place.
- c. Highbank Intake
 - The consent holder shall install, operate and maintain a fish diversion barrier in accordance with the NIWA publication "Fish Screening: Good Practice Guidelines for Canterbury, October 2007", NIWA Client Report CHC2007-092 near, at or within, the Highbank intake or diversion channel subject to:
 - ii. the fish diversion barriers shall have a maximum cross-sectional approach velocity of no greater than 0.12metres per second; and
 - iii. the sweep velocity across the fish diversion barriers shall exceed the approach velocity except where the barrier location and settling pond layout confines the submerged barriers to the extent there is little or no cross flow possible across the submerged barrier installation; and
 - iv. an effective bypass system shall be maintained at all times that water is diverted into the scheme, to connect to an active braid of the river.
 - a. In the event that a fish diversion barrier is damaged so as to be rendered less effective at excluding fish from the take, the consent holder shall repair or replace the fish diversion barrier as soon as practicable, or shall shut down the fish diversion barrier such that water ceases to pass through it. In the event that a fish diversion barrier is shut down, it shall not be reopened until such time as it complies in full with the provisions of condition 7 c. (i) of this consent.



- b. All incidence of fish diversion barrier shut down shall be recorded by the consent holder and reported to Fish and Game New Zealand within four hours. These records of fish diversion barrier failure shall be forwarded to the Canterbury Regional Council to the attention of the Canterbury Regional Council Compliance and Enforcement Manager, at the end of each irrigation season, or upon request.
- c. The design plans for the fish diversion barrier shall be certified by an appropriate fisheries expert to confirm that the design, function and operation of the fish diversion barrier is in accordance with the guidelines detailed in condition 7(c).
- d. Prior to commencement of construction the consent holder shall provide to the Canterbury Regional Council Attention: RMA Compliance and Enforcement Manager:
- e. the certified design plans showing the sweep velocity, approach velocity, and a by-pass which returns fish to an actively flowing braid of the Rakaia River;
- f. a report from the certifying fisheries expert which certifies and explains how the certified design and operation of the fish diversion barrier demonstrates compliance with the guidelines detailed in condition 7(c).
- g. The consent holder shall within 12 months of the construction of the fish diversion barrier undertake monitoring to assess compliance with condition 7(c)(ii) (maximum approach velocity of no greater than 0.12m/s). If it is found that fish are being impinged due to approach velocity, the necessary adjustments will be made to ensure full compliance with 7(c)(ii).
- d. Barhill Intake
 - i. The consent holder shall install, operate and maintain a rock fish barrier within the settling pond in accordance with the NIWA publication "Fish Screening: Good Practice Guidelines for Canterbury, October 2007", NIWA Client Report CHC2007-092 as necessary to prevent fish entering the pipeline intake. The screen shall:
 - a. Provide a physical barrier to the full flow diverted through the settling pond
 - b. Have a maximum cross-sectional approach velocity no greater than 0.12 metres per second; and
 - c. Have a sweep velocity across the fish barrier at least as high as the approach velocity except where the barrier location and settling pond layout confines the submerged barriers to the extent there is little or no cross flow possible across the submerged barrier installation; and
 - d. Be constructed along with an effective fish bypass system that shall be maintained at all times that water is diverted into the scheme, to connect to an active braid of the river.



- e. In the event that a fish barrier is damaged so as to be rendered less effective at excluding fish from the take, the consent holder shall repair or replace the fish diversion barrier as soon as practicable, or shall shut down the fish barrier such that water ceases to pass through it. In the event that a fish barrier is shut down, it shall not be reopened until such time as it complies in full with the provisions of condition 7(d)(i)(a) (d) of this consent.
- f. All incidence of fish diversion barrier shut down shall be recorded by the consent holder and reported to Fish and Game New Zealand within four hours. These records of fish diversion barrier failure shall be forwarded to the Canterbury Regional Council to the attention of the Canterbury Regional Council Compliance and Enforcement Manager, at the end of each irrigation season, or upon request.
- g. The design plans for the fish barrier shall be certified by an appropriate fisheries expert to confirm that the design, function and operation of the fish barrier is in accordance with the guidelines detailed in condition 7(d)(i)(a)-(d).
- h. Prior to commencement of construction the consent holder shall provide to the Canterbury Regional Council Attention: RMA Compliance and Enforcement Manager:
 - i. The certified design plans showing the sweep velocity, approach velocity, and a by-pass which returns fish to an actively flowing braid of the Rakaia River; and
 - A report from the certifying fisheries expert which certifies and explains how the certified design and operation of the fish barrier demonstrates compliance with the guidelines detailed in condition 7(d)(i)(a)-(d) of this consent.
- i. No less than one calendar month prior to the first use of the scheme, the consent holder shall submit to the Canterbury Regional Council attention: Compliance Manager and copy to Fish and Game New Zealand, a comprehensive monitoring programme prepared by a suitably qualified and experienced independent fisheries expert, as necessary to monitor the function and effectiveness of the fish barrier and fish return channel. The monitoring programme shall include the release and capture of live fish within the screening area to measure the effectiveness of the barrier. Within 12 months of first taking of water through the barrier the consent holder shall provide a report to the Canterbury Regional Council (attention: Compliance Manager) and Fish and Game New Zealand from a suitably qualified and experienced independent fisheries expert that details the results of the monitoring programme and provides comment on whether the fish barrier achieves the following performance objectives:
 - i. exclude all adult fish; and
 - ii. exclude at least 95% of juveniles salmonids that have entered the settling pond



- j. In the event that the monitoring demonstrates that the fish barrier is not fully effective in achieving the objectives in condition 7(d)(i)(a)-(d) the consent holder shall immediately commission a report. This report shall be prepared by a fisheries biologist/s with knowledge of salmonid and native fisheries and shall address the consequences of non-compliance on the fisheries of the river and, if appropriate, shall recommend mitigations. Such recommendations may include improvements to fish exclusion and/or enhancements to fish populations such as fishery habitat improvements or other actions considered appropriate by the author/s. The report shall be prepared in consultation with North Canterbury Fish and Game Council and the Department of Conservation and shall be delivered by the consent holder as soon as reasonably practicable but in any event no later than 6 months of confirmation of non-compliance, to the Canterbury Regional Council, Attention: RMA Compliance and Enforcement Manager.
- k. In the event that monitoring demonstrates that the fish barrier is not fully effective then the Consent Holder shall ensure that the barrier is modified to level specified in Condition 7(d)(i)(i)(i) and 7(d)(i)(i)(i), or that recommendations identified in any report commissioned in respect of Condition 7(d)(i)(j) are implemented.

FISH SCREEN INSPECTION

- a. Upper/Original Intake: Each fish screen in condition 7 a. shall be inspected at maximum intervals of two days for any damage causing fish to pass through the screen, or once every 24 hours period when the flow in the Rakaia River is greater than 300 cubic metres per second, as estimated by the Canterbury Regional Council, from measurements at either the gorge recorder site (at or about map reference NZMS 260 K35:015-424) or the recorder site at Fighting Hill (at or about map reference NZMS 260 K35:997-437).
 - b. Barrhill Intake: The fish barrier shall be inspected at a frequency of no less than once every 48 hours, or once every 24 hours when the Rakaia River flows exceed 300 cubic metres per second as estimated by Environment Canterbury at the Rakaia Gorge recorder site (at or about map reference Topo50 BX20:9142-8080) or the recorder site at Fighting Hill (at or about map reference Topo50 BX20:8961-8199).

DAMAGE TO FISH SCREEN

- a. Upper/Original Intake
 - i. In the event that a screen installed in accordance with condition 7 a. is damaged such that the screen mesh aperture is greater than those specified in condition 7 a., the screen shall be repaired or replaced immediately with a screen that complies with condition 7 a., or the damaged screen shut down. Any screen shut down shall not be opened again until a screen that complies with condition 7 is fitted.



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- ii. The incidence of screen shut downs shall be recorded and reported to the North Canterbury Fish and Game Council within four hours. Records of screen failure shall be forwarded to Canterbury Regional Council Attention: RMA Compliance and Enforcement Manager at the end of each irrigation season, or as requested.
- b. Lower/Acton Intake
 - i. In the event of a fish exclusion device installed in accordance with condition 7 b becoming damaged or ineffective, the consent holder shall, within 24 hours of becoming aware of the failure of the device, notify the Canterbury Regional Council, Attention: RMA Compliance and Enforcement Manager, of the situation, the action that will be taken, as soon as practicable, to correct the failure, and the timeframe within which the repairs will be completed.
- c. Highbank Intake
 - i. In the event of a fish diversion barrier installed in accordance with condition 7 c. becoming damaged or ineffective, the consent holder shall, within 24 hours of becoming aware of the failure of the device, notify the Canterbury Regional Council, Attention: RMA Compliance and Enforcement Manager, of the situation, the action that will be taken, as soon as practicable, to correct the failure, and the timeframe within which the repairs will be completed.
- d. Barrhill Intake
 - i. In the event that the fish barrier installed in accordance with condition 7 d. is damaged so as to be rendered ineffective at excluding fish from the pipeline intake, the consent holder shall:
 - a. repair or replace the barrier immediately, or
 - b. shut down the scheme such that water ceases to pass through the pipeline intake; and
 - c. for all such incidents, notify the Canterbury Regional Council, Attention: RMA Compliance and Enforcement Manager, of the situation, the action that will be taken, as soon as practicable, to correct the failure, and the timeframe within which the repairs will be completed within 24 hours of becoming aware of the failure of the device, upon request, and at the end of each irrigation season; and
 - d. ensure that where the scheme is shut down for this reason, it shall not be reopened until such time as the fish barrier is able to comply with the conditions of this consent.

WATER MEASUREMENT

- 10
- a. Upper/Original Intake
 - i. The rate at which water is taken shall be measured to within an accuracy of 10 percent, and the measurement and the hours during which water is taken shall be recorded. A copy of the records shall be provided to the Canterbury Regional Council upon request.



- b. Lower/Acton Intake
 - i. The consent holder shall, within three months of the commencement of this consent, install a water level measuring device at the Acton intake; in a location that will enable the determination of the continuous rate of flow and volume of water being taken to within an accuracy of plus or minus 10 percent, and
 - a. The measuring device shall, as far as is practicable, be installed at a site likely to retain a stable relationship between flow and water level. The measuring device shall be installed and maintained in accordance with the manufacturer's instructions.
 - b. The level of water in the race, and times of abstraction, shall be recorded by tamper-proof electronic recording system such that the level of water is measured at least once every 15 minutes, and a record made either on site or at a remote location via telemetry of the recorded levels such that the flow volume through the site may be derived for time increments not exceeding 60 minutes using the current site rating relationship. The recorded data shall not be changed or deleted by any person, unless twelve months have passed since the date of recording.
 - c. The measuring and recording devices described in clauses (a) and (b) shall be available for inspection at all times by the Canterbury Regional Council subject to providing adequate protection against vandalism which may require the consent holder's assistance on site to unlock or remove barriers.
 - d. All data from the recording device described in clause (b), and the corresponding relationship between the water level and flow, shall be provided to the Canterbury Regional Council on request.
 - e. Maintain a rating curve to convert water levels to flow in accordance with good hydrological practice.
 - f. Four months after the commencement of this consent, and at twoyearly intervals thereafter, the consent holder shall provide a certificate to the Canterbury Regional Council Attention: RMA Compliance and Enforcement Manager, signed by a suitably qualified person certifying that the accuracy of the measuring and recording devices installed in accordance with (a) and (b) and also certifying that data from the recording device described in condition (b) can be readily attained by the consent holder.
- c. Highbank Intake
 - i. The consent holder shall, prior to taking water via the Highbank Intake, install a water level measuring device at the Highbank Intake; in a location that will enable the determination of the continuous rate of flow and volume of water being taken to within an accuracy of plus or minus 10 percent, and
 - a. The measuring device shall, as far as is practicable, be installed at a site likely to retain a stable relationship between flow and water level. The measuring device shall be installed and maintained in accordance with the manufacturer's instructions.



- b. The level of water in the race, and times of abstraction, shall be recorded by tamper-proof electronic recording system such that the level of water is measured at least once every 15 minutes, and a record made either on site or at a remote location via telemetry of the recorded levels such that the flow volume through the site may be derived for time increments not exceeding 60 minutes using the current site rating relationship. The recorded data shall not be changed or deleted by any person, unless twelve months have passed since the date of recording.
- c. The measuring and recording devices described in clauses (a) and (b) shall be available for inspection at all times by the Canterbury Regional Council subject to providing adequate protection against vandalism which may require the consent holder's assistance on site to unlock or remove barriers.
- d. All data from the recording device described in clause (b), and the corresponding relationship between the water level and flow, shall be provided to the Canterbury Regional Council on request.
- e. Maintain a rating curve to convert water levels to flow in accordance with good hydrological practice.
- f. Four months after the commencement of this consent, and at twoyearly intervals thereafter, the consent holder shall provide a certificate to the Canterbury Regional Council Attention: RMA Compliance and Enforcement Manager, signed by a suitably qualified person certifying that the accuracy of the measuring and recording devices installed in accordance with (a) and (b) and also certifying that data from the recording device described in condition (b) can be readily attained by the consent holder.
- d. Barrhill Intake:
 - i. The consent holder shall, prior to taking water via the Barrhill Pipeline Intake, install a flow measuring device at the pipeline intake in a location that will enable the determination of the continuous rate of flow and volume of water being taken to within an accuracy of plus or minus 10 percent, and
 - a. The measuring device shall be installed and maintained in accordance with the manufacturer's instructions.
 - b. The level of water in the Barrhill settling pond, and times of abstraction via the pipeline intake, shall be recorded by tamper-proof electronic recording system such that the level of water is measured at least once every 15 minutes, and a record made either on site or at a remote location via telemetry of the recorded levels such that the flow volume through the site may be derived for time increments not exceeding 60 minutes using the current site rating relationship. The recorded data shall not be changed or deleted by any person, unless twelve months have passed since the date of recording.
 - c. The measuring and recording devices described in clauses (a) and (b) shall be available for inspection at all times by the Canterbury Regional Council subject to providing adequate protection against vandalism which may require the consent holder's assistance on site to unlock or remove barriers.



- d. All data from the recording device described in clause (b), and the corresponding relationship between the water level and flow, shall be provided to the Canterbury Regional Council on request.
- e. Maintain a rating curve to convert water levels to flow in accordance with good hydrological practice.
- f. Four months after the commencement of this consent, and at twoyearly intervals thereafter, the consent holder shall provide a certificate to the Canterbury Regional Council Attention: RMA Compliance and Enforcement Manager, signed by a suitably qualified person certifying that the accuracy of the measuring and recording devices installed in accordance with (a) and (b) and also certifying that data from the recording device described in condition (b) can be readily attained by the consent holder.
- 11 Water may only be used to:
 - a. irrigate up to 40,000 hectares of land:
 - i. within Areas 1 to 8, shown on the attached plan (CRC990088.3 which forms part of this consent); and/or
 - ii. on any land between the Rakaia and Rangitata Rivers covered by a separate consent to use water (if required); and
 - b. to fill on-farm storage reservoirs; and
 - c. to generate electricity.
- 12 For properties located in Area 6 which border the Rakaia River, water shall only be supplied if the property has a farm management plan which prohibits the alteration of river protection works and the removal of riparian vegetation without first obtaining the written approval of the Canterbury Regional Council River Engineer. A copy of this farm management plan must be lodged with the Canterbury Regional Council before the consent holder can supply water to these properties.
- 13 The combined use of water from this consent and any other consent for the irrigation of properties utilising existing consented water abstractions shall not exceed the higher of the irrigation application rates listed on those existing consents or that allowed under this consent.
- 14 Water may only be supplied to properties where the combined effect of the irrigation water from this consent and from any other consent held for irrigation shall comply with the following criteria:
 - a. The average rate that irrigation water is applied to the land, including the combined rate of application from any other water source, shall not exceed the existing consented rate or 5.2 mm/day;
 - b. The irrigation water shall be used in a manner that takes all practicable steps to:
 - i. Ensure that the volume of water used for irrigation does not exceed that required for the soil to reach field capacity; and
 - ii. Avoid leakage from pipes and structures; and
 - iii. Avoid the use of water onto non-productive land such as impermeable surfaces and river or stream riparian strips.



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- 15 A steel grill shall be placed over the inlet to the box culvert intake structure in condition 7 a., and as far as is practicable shall be positioned such that it minimises the probability of water users becoming pinned against it.
- 16 Signs warning of the position of the intake structure in condition 7 a., shall be erected at points upstream of the intake that are used by the public to enter the Rakaia River.
- 17 A warning sign visible from 50 metres upstream shall be erected adjacent to the intake in condition 7 a.
- All commercial users and recreational boat clubs shall, as far as is practicable, be informed in writing of the position of the intake in condition 7 a., within one month of the start of construction of the intake.
- 19 The Canterbury Regional Council may, on the last working day of June each year, serve notice of its intention to review the conditions of this consent for the purposes of dealing with any adverse effect on the environment which may arise from the exercise of the consent and which it is appropriate to deal with at a later stage, including any adverse effects arising from the inefficient use of water.
- 20 The lapsing provisions of section 125 of the Resource Management Act 1991 shall not apply until after the expiry of five years from the date of the commencement of this consent.
- 21 The Canterbury Regional Council may, on any of the last five working days of June 2015, 2020, 2025 and 2030, serve notice of its intention to review the conditions of this consent for the purposes of:
 - a. altering the rate of abstraction to correspond to the actual rate of water usage; and/or
 - b. amending the minimum flow restrictions in condition (5) to reflect any changes in the abstraction rate of the other abstractors from the river.
- 22 Notwithstanding conditions (5) and (6) above, Stored Water (as defined in the amended National Water Conservation (Rakaia River) Order 1988) may be taken or diverted provided that:
 - a. The consent holder is listed on the Register (as defined in the amended National Water Conservation (Rakaia River) Order 1988).
 - b. The consent holder complies with any conditions imposed as a condition to being listed on the Register.
 - c. No Stored Water shall be taken, unless the consent holder has requested the release of Stored Water so taken and the holder of the resource consents for the Coleridge Hydroelectric Power Station has subsequently released that Stored Water.
 - d. The total taking or diversion of Stored Water does not exceed the maximum abstraction rate for that consent holder recorded on the Register.
 - e. The total abstraction of water (including Stored Water) does not exceed 17 cubic metres per second.

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Canterbury Regional Council

