

**BEFORE THE ENVIRONMENT COURT
AT AUCKLAND**

ENV-2020-AKL-00087

**I MUA I TE KŌTI TAIAO
I TĀMAKI MAKĀURAU ROHE**

IN THE MATTER of the Resource Management Act 1991
(**RMA** or **the Act**)

AND

IN THE MATTER of the Proposed Plan Change 1 to the
Waikato Regional Plan

**STATEMENT OF EVIDENCE OF GILLIAN MARGARET HOLMES (WATER
QUALITY) ON BEHALF OF HORTICULTURE NEW ZEALAND**

28 JULY 2023

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EXECUTIVE SUMMARY

1. In total, Commercial Vegetable Production (**CVP**) occupies 0.6% of the total area of the Waikato River catchment and is estimated to account for 2.5% of the diffuse Total Nitrogen (**TN**) load and 0.9% of the diffuse Total Phosphorus (**TP**) load in the overall catchment.
2. The contribution of CVP to the Waikato River *E. coli* load is less than 3.5% in all sub-catchments, while the contribution of CVP to sediment loads predicted from each sub-catchment is also very low.
3. In my opinion, allowing the flexibility of rotation across sub-catchments within a Freshwater Management Unit (**FMU**) would result in negligible effects on water quality, for the following reasons:
 - (a) Mr Easton has estimated rotating the 97 Ha CVP rezoned urban land at the FMU level would result in a net reduction in N load within the Lower Waikato FMU load;
 - (b) Rotation for existing CVP within an FMU would, from a water quality perspective, keep potential effects at status quo given it is currently permitted at any scale;
 - (c) New CVP expansion would need to be assessed at three scales: farm, sub-catchment and river. Council has the discretion as to acceptable effects from such rotation;
 - (d) The water quality benefit associated with limiting the scale of crop rotation at the sub catchment compared with limiting crop rotation at the FMU scale is very low, with growers generally rotating on existing vegetable growing land.

4. Given its significance, I support the establishment of the separate Restricted Discretionary Activity (**RDA**) for activities proposed for the Whangamarino wetland catchment. This RDA allows for the specific management and environmental effects solely related to this catchment to be taken into consideration during the consenting process.
5. I do not support the area limits outlined in Table 1 of Rule 3.11.4.8 within the Decision Version of Plan Change 1 (**PC1**) or the amendments to those area limits proposed in the evidence of Mr Treblico, due to the following:
 - (a) The inclusion of Policy 5 within the Decisions Version of PC1, has meant that the area limits proposed in Rule 3.11.4.8 and the priority catchments in Table 3.11-2 both need to be taken into consideration. Four of the sub-catchments (totalling 30 ha) in Rule 3.11.4.8 are listed as nitrogen priority in Table 3.11-2. This would require any expansion in these catchments to be fully offset with regards to nitrogen, something that Mr Ford considers is economically unlikely to occur.
 - (b) I believe that Table 3.11-2 performs the same function as intended by the assessment that supported Table 1 in Rule 3.11.4.8 and provides a more robust assessment for the priority catchment contaminants.
6. I support the multi-contaminant offset and compensation approach provided in Policy 5 and Table 3.11-2. This policy reflects my preference for a multi-contaminant approach to managing water quality effects, by which the objectives of PC1 can still be achieved through a decrease in one contaminant (e.g., *E. coli*), while allowing a minor increase in another (e.g. nitrogen).
7. I support the inclusion of Table 3.11-2 as it provides clear guidance on the water quality priorities of individual sub-catchments and, with its inclusion in Policy 5, helps inform

whether or not offsetting and compensation can occur for any CVP under Rule 3.11.4.8. Table 3.11-2 essentially means that the multi-contaminant approach to offsetting and compensation cannot be used when the activity would result in an increase in a priority contaminant.

8. I recommend an area cap related to population growth be outlined in Rule 3.11.4.8. This could be done either through:
 - (a) updating Table 1 to be at an FMU scale, as outlined in Table 4 of Mr Easton's evidence and relying on the multi-contaminant approach to CVP expansion contained in Policy 3 and 5; or
 - (b) replacing Table 1 with a Waikato River Catchment cap (1,877 Ha) and relying on the multi-contaminant approach to CVP expansion contained in Policy 3 and 5.
9. In my opinion there is minimal difference between the water quality risks between setting a Waikato River Catchment, FMU or sub-catchment CVP expansion area cap, given that any expansion will be subject to assessment against Policy 3 and 5.
10. In addition, I believe the calculated increase in nitrogen load as a result of 1,877 Ha expansion of CVP (0.5% of total load) would have a negligible effect on the water quality of the Waikato River, particularly when consideration is given to the potential improvements in other contaminants.

INTRODUCTION

Qualifications and experience

1. My full name is Gillian Margaret Holmes. I hold the position of Principal Consultant – Hydrology and Hydrogeology with SLR Consultancy NZ Ltd. I have been in this position since October 2021.
2. I am contracted to provide water quality expertise on the Proposed Waikato Regional Plan Change 1 – Waikato and Waipa River Catchments (**PC1**) to Horticulture New Zealand (**HortNZ**).
3. I hold a Bachelor of Science (BSc) in Geography (2001) and a Master of Science Degree in Physical Geography (2004) from Otago University.
4. I have 19 years' experience in the field of hydrogeology and water resources. I started my career at MWH New Zealand Limited and worked for them between 2004 and 2007. From 2007 to 2021, I worked at Sinclair Knight Merz/Jacobs working up to an Associate Hydrogeologist role.
5. I have acted as an Expert Witness in groundwater-related consent hearings in New Zealand for the past 10 years. I have provided expert evidence on behalf of HortNZ on the Proposed Water Conservation Order for the Ngaruroro River and Clive River, Hawke's Bay Regional Council Tutaekuri, Ahuriri, Ngaruroro and Karamu (TANK) Plan Change, as well as Block 1 and 2 hearings for the Waikato Regional PC1 in 2018-2019.
6. I have provided expertise in the fields of hydrogeology, water allocation and water quality to a range of local government clients including Bay of Plenty Regional Council and Far North District Council and other organisations such as HortNZ and Waka Kotahi.

7. Of particular relevance for this hearing is my involvement in the Waikato Regional Council PC1 Block 1 and 2 hearings as the HortNZ water quality expert. I presented evidence at both hearings and also attended the Expert Conferencing on Table 3.11.1, contributing to the Joint Witness Statement.
8. I was not involved in the Block 3 hearing due to being on maternity leave during that period. My colleague, Mr Baker, was engaged by HortNZ to provide water quality evidence for the Block 3 hearing.

Expert Witness Code of Conduct

9. I have been provided with a copy of the Code of Conduct for Expert Witnesses contained in the Environment Court's Practice Note dated 1 January 2023. I have read and agree to comply with that Code. This evidence is within my area of expertise, except where I state that I am relying upon the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Involvement in project

10. I have been asked to prepare evidence based on my (and my colleagues) water quality research, assessment, and reporting for HortNZ in support of their key submission points on PC1.
11. Throughout the PC1 hearing process, HortNZ has been concerned that PC1 did not give enough consideration to the fact that horticulture farming systems and operations are unique from other farming systems as outlined in HortNZ's submission and appeal on PC1.¹

¹ [HortNZ Submission](#) and [HortNZ Appeal](#).

Purpose and scope of evidence

12. The purpose of my evidence is to identify:
 - (a) The scale and characteristics of commercial vegetable production (**CVP**) within the Waikato Region, including its contribution to the diffuse discharge of nitrogen, phosphorus, sediment and microbial pathogens in the region;
 - (b) The potential water quality impacts of allowing rotation at the FMU scale rather than the sub-catchment scale;
 - (c) The analysis that supports the areas limits in Rule 3.11.4.8 and proposed by Mr Treblico;
 - (d) Multi contaminant offset and compensation approach and priority contaminant approach; and
 - (e) Capping expansion of commercial vegetable production at catchment, FMU or sub-catchment levels.

THE CONTRIBUTION OF CVP TO THE DIFFUSE DISCHARGES IN THE REGION

13. In total, horticultural land occupies 0.6% of the total area of the Waikato River catchment and is estimated to account for 2.5% of the diffuse Total Nitrogen (**TN**) load and 0.9% of the diffuse Total Phosphorus (**TP**) load in the overall catchment.
14. In addition, horticultural practices contribute very little to negligible amounts of *E. coli* in waterways, with the contribution of CVP to the Waikato River *E. coli* load being less than 3.5% in all sub-catchments.
15. The contribution of horticulture land to sediment loads predicted from each sub-catchment is also very low, particularly when Best Management Practices are implemented.

Analysis to support my assessment of water impact of CVP

16. My evidence draws on the technical analysis that I completed, along with my colleagues, to provide technical support for HortNZ's submission on PC1 and Council Hearings.² A summary of the technical findings that are still relevant to the Decisions Version of PC1 is provided in this evidence.
17. The water quality analysis completed was outlined in two technical reports (Jacobs (2017) and (2018)), which were submitted with HortNZ's original and further submissions.
18. The technical work drew on the existing published science and water quality models developed by NIWA during the PC1 process. I acknowledge that these water quality models have numerous limitations, including in the underlying contaminant yield and land use datasets. However, Jacobs did not seek to review the validity of the modelling undertaken for the PC1 process.
19. I believe this was the correct approach as this enabled the analysis to concentrate on the findings and conclusions, rather than the difference in modelling methodology and input data.
20. HortNZ engaged NIWA to provide a review of the calculations completed within the Jacobs (2017) and (2018) reports, i.e. load calculations by land use and sub-catchment and unattenuated loads, to determine if Jacobs had interpreted the input data provided by NIWA correctly, as well as completed the calculations accurately.
21. Annette Davis from NIWA provided the following comments in a memo dated 31 January 2019 (attached as **Appendix 1**):

² In particular, see the evidence statements of Mr Baker and Mr Easton: <https://www.waikatoregion.govt.nz/council/policy-and-plans/healthy-rivers-plan-for-change/the-hearings/submitter-evidence/>

"I can confirm that the calculations of baseline unattenuated nutrient loads generated by each sub-catchment undertaken by Jacobs are correct and match the unattenuated sub-catchment loads calculated by NIWA.

I can also confirm that the calculated cumulative loads with attenuation and point sources for both TP and TN match the cumulative loads calculated by NIWA".

22. Based on the NIWA technical review comments, I am satisfied that the water quality analysis in Jacobs (2017) and (2018), as well as further analysis completed by Mr Easton as presented in his Block 3 and evidence for this hearing, is accurate and can be used to provide technical support for the planning provisions sought by HortNZ.

WATER QUALITY IMPACT OF ROTATION AT THE FMU SPATIAL SCALE

23. I believe allowing the flexibility of rotation across sub-catchments within an FMU will result in negligible effects on water quality.
24. The HortNZ and PVGA appeals seek for growers to have the flexibility to rotate crops at the FMU scale for both existing and new CVP, rather than be restricted to sub-catchments only, as is currently outlined in the Decisions Version of PC1 in Rules 3.11.4.5, 3.11.4.6 or 3.11.4.8.
25. Mr Easton's evidence outlines in Figure 1 that, although at both a sub-catchment and FMU scale the total area of CVP has been static, the location of CVP does change at a business scale. This occurs when growers are moving between parcels of land, which are generally already cultivated. This evidence, along with evidence from Mr Ford and growers (Brent Wilcox and Stuart Davis) shows that there is a need for a pathway to rotate across sub-catchments within the same FMU.

26. As outlined in the evidence of Mr Easton, rotation at the FMU would provide for the 97 Ha CVP that has rezoned urban in Waikato Region to rotate onto new land. Mr Easton has estimated a net reduction in FMU N load (-0.03% of the Lower Waikato FMU load) due to the lower loss rate of urban land compared to suitable CVP land currently in pasture that would be ultimately replaced within the FMU. I consider this replacement of urbanised land to result in a negligible change in water quality risk.
27. With regards to existing CVP, rotation was permitted prior to PC1 at any scale across the Waikato Region. The request for rotation within an FMU does restrict the rotations more than currently and as such, from a water quality perspective, keeps the potential effects of the activity at status quo.
28. With regards to new CVP expansion under Rule 3.11.4.8, the Hearing Commissioners were concerned allowing rotation at the FMU scale would be inconsistent with HortNZ's acceptance that some sub-catchments are overloaded with N and no increase in N should be provided for.³
29. I acknowledge the Hearing Commissioners' concerns, however an assessment of effects of a proposed expansion/land use under Rule 3.11.4.8 will be required on a case-by-case basis. The assessment will need to include assessments at three scales: farm, sub-catchment and river. It would be at the Council's discretion as to whether the effects are acceptable with regards to the proposed rotation within an FMU with regards to Policy 5.
30. In addition, the evidence of Mr Easton (paragraphs 24 and 25) has shown that the risk of changes in water quality associated with the scale of crop rotation (either FMU or crop rotation) is

³ The Hearing Panel's Recommendation Report, paragraph 1171.

very low, with growers generally rotating on existing vegetable growing land.

31. One exception to rotating across the Lower Waikato FMU, would be with regards to the Whangamarino Wetland catchments. The Whangamarino wetland is degraded and is internationally significant. I have previously supported, through the Joint Witness Statement for Table 3.11-1, additional attributes being included for the sub-catchment as well changing the boundaries to better reflect inputs, and to include additional monitoring.
32. Given its significance, I support the establishment of the separate Restricted Discretionary Activity for activities proposed for the Whangamarino wetland catchment. This RDA allows for the specific management and environmental effects solely related to this catchment to be taken into consideration during the consenting process.

DESCRIBING THE ANALYSIS THAT SUPPORTS THE AREAS LIMITS IN RULE 3.11.4.8 AND PROPOSED BY MR TREBLICO

33. I do not support the area limits outlined in Table 1 of Rule 3.11.4.8 within the Decision Version of PC1 or the amendments to those area limits proposed in the evidence of Mr Treblico.
34. Rule 3.11.4.8 provides the matters for which activities must meet in order to be considered discretionary and includes Table 1. Table 1 is based on the recommendations by my colleague Mr Baker in Block 3 hearing, and analysis undertaken by Mr Easton.⁴
35. Mr Easton completed a technical assessment that identified a maximum area cap for CVP that allows for both population growth and compensates for land lost to urban expansion. Mr

⁴ See the evidence statements of Mr Baker and Mr Easton: <https://www.waikatoregion.govt.nz/council/policy-and-plans/healthy-rivers-plan-for-change/the-hearings/submitter-evidence/>

Baker used this assessment to determine the potential water quality effects of increasing CVP area by 716 ha.

36. Mr Baker provided a methodology for defining which sub-catchments are not suitable for new CVP based on the existing water quality state as follows:
 - (a) Any sub-catchment currently in, or below the National Objectives Framework (**NOF**) C band for nitrate are excluded;
 - (b) Sub-catchments containing sensitive lake environments should be excluded.
37. It should be noted that the analysis Mr Easton completed for Block 3 only assessed the potential for expansion within the Waikato District. My understanding on this decision was that was not for any water quality reasons. Mr Easton has since updated his analysis for the HortNZ appeal and EIC for this hearing to include all sub-catchments within the region.
38. The Hearing Commissioners accepted the methodology proposed by Mr Baker and included the list of sub-catchments as Table 1 in Rule 3.11.4.8.⁵ However, the Commissioners reduced the number of catchments put forward by Mr Baker (a reduction of 11 sub-catchments).
39. The reduction in sub-catchments has further reduced the area cap potential for new CVP from 716 ha to 395 ha (as given in Rule 3.11.4.8 Table 1 in Mr Treblico's evidence). This area does not provide for sufficient area to account for future population growth and CVP land lost to urban expansion in the Waikato Region, as outlined in paragraph 26 of Mr Easton's evidence.

⁵ The Hearing Panel's Recommendation Report, paragraph 1202.

40. I consider the analysis undertaken by Mr Easton to support Mr Baker's analysis in Block 3 is correct, and I support the logic of Mr Baker's water quality assessment in Block 3, as at the time, the Hearing Version of PC1 did not include Policy 5 and Table 3-11.2.
41. The inclusion of Policy 5 within the Decisions Version of PC1, has meant that the area limits proposed in Rule 3.11.4.8 and the priority catchments in Table 3.11-2 both need to be taken into consideration. Four of the sub-catchments (totally 30 ha) in Rule 3.11.4.8 are listed as N priority in Table 3.11-2. This would require any expansion in these catchments to be fully offset with regards to nitrogen.
42. As stated in Mr Ford's evidence (paragraph 88), it is economically unlikely for CVP to expand if it needs to offset nitrogen using the Policy 5a pathway. This would mean that the likely maximum CVP expansion potential provided in Rule 3.11.4.8 would further reduce to 365 Ha.
43. I believe that Table 3.11-2 performs the same function as intended by the assessment that supported Table 1 in Rule 3.11.4.8 and provides a more robust assessment for the priority catchment contaminants.

MULTI CONTAMINANT OFFSET AND COMPENSATION APPROACH AND PRIORITY CONTAMINANT APPROACH

44. I support the multi-contaminant offset and compensation approach provided in Policy 5 and Table 3.11-2.
45. The Hearing Commissioners introduced a new Policy 5 which provides for offsetting and compensation that better achieves the objectives of Te Ture Whaimana.
46. The Hearing Commissioners have stated the "*we find that giving effect to the objectives and Te Ture Whaimana may be better achieved by seeking significant reductions in (say) E.*

*coli but a marginal increase in N in sub-catchments where N is not 'over-allocated.'"*⁶

47. This policy reflects my preference for a multi-contaminant approach to managing water quality effects, by which the objectives of PC1 can still be achieved through a decrease in one contaminant (e.g. *E. coli*), while allowing a minor increase in another (e.g. N).
48. My colleagues and I previously completed a review on the three core values within PC1: human health for recreation, ecosystem health, and mahinga kai, and identified the impact that relevant water quality attributes would have on these values, as summarised below:
 - (a) Human Health for Recreation – measured against concentrations of *E. coli* (in lakes, river and lake-fed rivers), chlorophyll a (lakes and lake-fed rivers), and levels of clarity (lakes, rivers and lake fed rivers). Note the key contributors to visual clarity are considered to be yellow substance, phytoplankton and fine sediment.
 - (b) Ecosystem Health – measured against trophic state indicators such as concentrations of chlorophyll-a (lake and lake-fed rivers) and planktonic cyanobacteria (lakes only), TP and TN concentrations (lakes and lake-fed rivers), and nitrate-N and ammoniacal N (as toxicants in rivers and lake-fed rivers).
 - (c) Mahinga kai – measured against concentrations of *E. coli* (in lakes, rivers, and lake-fed rivers) and

⁶ The Hearing Panel's Recommendation Report, paragraph 1627.

chlorophyll-a (lakes and lake-fed rivers) and planktonic cyanobacteria (lakes only).

49. This review indicates that while all four contaminants identified as important in PC1 relate to set core values, some contaminants, such as *E. coli*, can be used as a direct measure for multiple core values.
50. Many sub-catchments in the Waikato have poor water quality due to *E. coli*. *E. coli* is a direct measure of two of the core values within PC1 (as outlined above), while nitrogen is a direct measure of only one core value. Therefore, the focus on nitrogen, originally proposed in PC1, was unlikely to achieve the fulfilment of these core values.
51. The importance of decreasing *E. coli* in sub-catchments is further supported by updated water quality results (for the period 2018-2022) outlined in paragraph 101 of Dr Scarsbrook's evidence for WRC (dated 26 May 2023), which shows an increase in *E. coli* since the 2010-2014 data period.
52. Two sub-catchment specific examples of how new CVP production will result in minimal increase in nitrogen, while also providing considerable improvements in other contaminants, such as *E. coli* are summarised below.
53. The sub-catchments, Mangaonua and Mangakotukutuku, both have baseline TN concentrations lower than many of the other sub-catchments. However, the Mangaonua sub-catchment has a median *E. coli* concentration that is much higher than all other 74 sub-catchments in the Waikato Region, while the Mangakotukutuku sub-catchment has the highest baseline 95th percentile *E. coli* concentrations (12,600 *E. coli*/100 ml) and the highest baseline TP concentrations (0.415 mg/m³).
54. Both sub-catchments also have sufficient LUC I or II land which is favourable for CVP currently not utilised for CVP, and hence

there is potential for CVP increases in these sub-catchments. The conclusion was made that a reduction in *E. coli* and TP as a result of expansion of CVP would benefit towards the progression of all three core values within PC1.

55. I acknowledge that both the Mangaonua and Mangakotukutuku sub-catchments have now been included within Table 3.11-2 with nitrogen as a priority contaminant and as such even a minimal increase in nitrogen would not be accepted. However, the concept discussed in these examples is still valid in my opinion.
56. Further analysis was undertaken by Mr Easton as part of his Block 3 evidence and summarised in paragraph 77 of his EIC, the modelling predicted for approximately 1,000 Ha of CVP, a -0.2% decreases in *E. coli* and a reduction of 226 tonnes of annual sediment load.
57. I acknowledge the discussion by the Commissioners around not allowing the 'gains' to the health and wellbeing of the Waikato and Waipa Rivers from the actions of one sector to offset the 'losses' of another sector.⁷ Therefore, I agree with the Commissioners that offsetting and compensation should be undertaken in narrow, carefully controlled circumstances.
58. To control the circumstances in which the offsetting and compensation can be undertaken, the Hearing Commissioners reference Table 3.11-2 in Policy 5, which restricts any increases of a contaminant that Table 3.11-2 identifies as a priority for reduction in that sub-catchment.
59. I support the inclusion of this table as it provides clear guidance on the water quality priorities of individual sub-catchments.

⁷ The Hearing Panel's Recommendation Report, paragraphs 1207.

60. The reference to this table in Policy 5 also helps inform whether offsetting and compensation can occur for any CVP under Rule 3.11.4.8. As such, in my opinion, the function of Table 3.11-2 as referenced in Policy 5 has the same effect as Table 1 in Rule 3.11.4.8 as it restricts catchments in which new CVP would be granted consent. Table 3.11-2 essentially means that the multi-contaminant approach to offsetting and compensation cannot be used when the activity would result in an increase in a priority contaminant.
61. As outlined in the evidence of Mr Ford (paragraph 88), offsetting to achieve no increase or reduced nitrogen for CVP is unlikely to be economically viable, and therefore, CVP expansion in sub-catchments identified in Table 3.11-2 as nitrogen priority is likely to be non-complying.
62. Mr Easton (paragraph 54 and Table 6) tested a scenario using the NIWA model where CVP expansion results in up to a maximum increase in N of 1% at the sub-catchment level, excluding all nitrogen priority sub-catchments identified in Table 3.11-2. This scenario indicates that a total of 1,446 Ha of CVP may be able to expand using the pathway in Policy 5 b.
63. I note that the 1% threshold is an indicative threshold developed by Mr Baker for his Block 3 evidence and while this analysis is useful for informing a water quality assessment, it is not appropriate for setting fixed numeric regulatory limits, as outlined in Mr Easton's evidence (paragraphs 38 -43).
64. Overall, I believe using Policy 5 and Table 3.11-2 as the tools to determine effects of new CVP is a robust water quality assessment process.

CAPPING EXPANSION OF COMMERCIAL VEGETABLE PRODUCTION AT CATCHMENT, FMU OR SUBCATCHMENT LEVELS

65. I would recommend a CVP expansion cap related to population growth be outlined in Rule 3.11.4.8, as well as a

restriction included in Rule 3.11.4.8 to provide for new CVP on highly productive land.

66. The CVP expansion cap could be done either through:
- (a) updating Table 1 to be at an FMU scale, as outlined in Table 4 of Mr Easton's evidence; or
 - (b) replacing Table 1 with a Waikato River Catchment cap (1,877 Ha) as calculated by Mr Easton (paragraph 25) and relying on the multi-contaminant approach to CVP expansion contained in Policies 3 and 5.
67. Table 4 of Mr Easton's evidence has provided an assessment of the predicted change in nitrogen load at the FMU scale for CVP expansion of 1,877 ha. The predicted nitrogen load increase varied between 1.7% in the Lower Waikato FMU to 0.1% in the Upper Waikato FMU, with an overall total increase in nitrogen load of 0.5%. This assessment distributed CVP expansion proportionally across FMUs to existing CVP.
68. In my opinion, this calculated increase in nitrogen load would have a negligible effect on the water quality of the Waikato River catchments, particularly when consideration is given to the potential improvements in other contaminants.
69. Further, in my opinion, there is minimal difference in the water quality risks between setting a FMU or sub-catchment CVP expansion limit, given that any expansion will be subject to assessment against Policy 3 and 5.

GILLIAN MARGARET HOLMES

28 July 2023

APPENDIX 1

Memo

From	Annette Semadeni-Davies
To	Catherine Sturgeon
CC	Michelle Sands
Date	31 January 2019
Subject	Peer review of Hort NZ reports for Healthy Rivers
File path (right click to update)	<i>Document2</i>

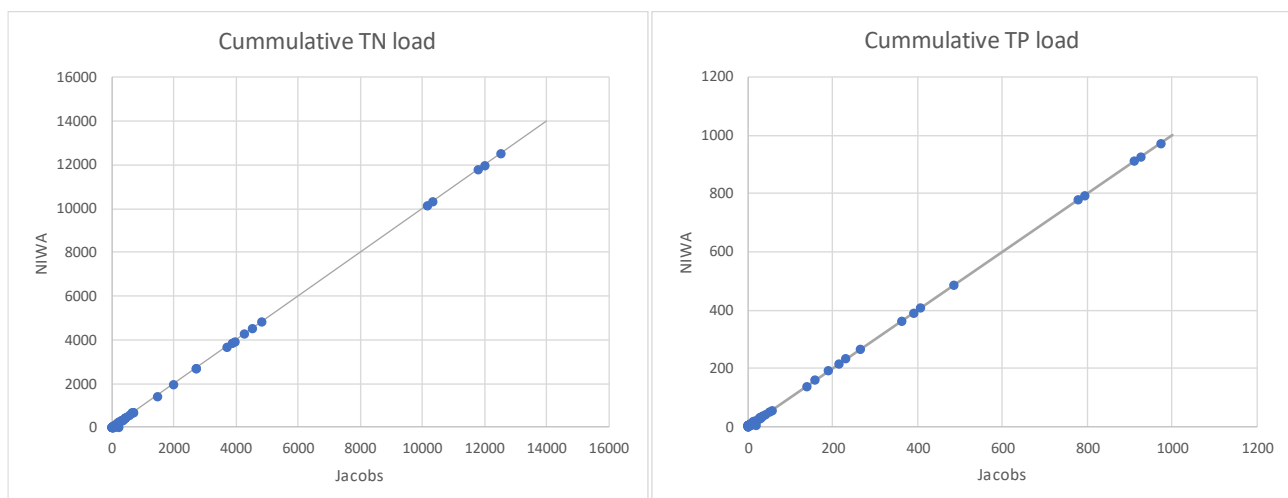
Hi Catherine

This memo is in response to the email you sent to me on 29th January 2019.

1. I can confirm that the yields for nutrients (TP and TN) that were used by NIWA for nutrient load modelling were supplied to Michelle Sands, then at Jacobs in December 2016, and the *E. coli* yield were sent in April 2017. The nutrient yields were supplied to us by Graeme Doole and were derived from Overseer Modelling undertaken by him while he was working at the University of Waikato. The *E. coli* yields were derived from our own modelling.

Please note that NIWA did not undertake the sediment load modelling – this was undertaken by Landcare Research using NZEEM. NIWA did however review the model results.

2. I can confirm the calculations of baseline unattenuated nutrient loads generated by each sub-catchment undertaken by Jacobs are correct and match the unattenuated subcatchment loads calculated by NIWA.
3. I can also confirm that the calculated cumulative loads with attenuation and point sources for both TP and TN match the cumulative loads calculated by NIWA. Please refer to the scatter charts below; the line is the 1:1 line.



Note that on your instruction on the phone (31 January 2019), I have not yet made a comparison of Jacob's *E. coli* load estimates.