Evidence Received

Proposed Plan Change 9
Tūtaekurī Ahuriri Ngaruroro Karamū
Catchment Area

PART 4

May 2021

HAWKES BAY
REGIONAL COUNCIL
TE KAUNIHERA Ā-ROHE O TE MATAU-A-MĀUI

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List of Evidence Received in Numeric order

Original Sub #	Evidence #	Organisation Name – Individuals Name
PART 1		
12	1	Ministry of Education - Alec Duncan
13	1	Fire and Emergency New Zealand – Alec Duncan
29, 194, 208, & 238	1	Hawke's Bay Winegrowers Association, Gimblett Gravels Winegrowers Association, Villa Maria Estate Limited, Pernod Ricard Winemakers New Zealand Limited (collectively 'The Winegrowers') - Andrew Laughton Dark
	2	Hawke's Bay Winegrowers Association, Gimblett Gravels Winegrowers Association, Villa Maria Estate Limited, Pernod Ricard Winemakers New Zealand Limited (collectively 'The Winegrowers') – Edwin John Massey
	3	Hawke's Bay Winegrowers Association, Gimblett Gravels Winegrowers Association, Villa Maria Estate Limited, Pernod Ricard Winemakers New Zealand Limited (collectively 'The Winegrowers') – Emma Taylor
	4	Hawke's Bay Winegrowers Association, Gimblett Gravels Winegrowers Association, Villa Maria Estate Limited, Pernod Ricard Winemakers New Zealand Limited (collectively 'The Winegrowers') – Fabin Yukich
	5	Hawke's Bay Winegrowers Association, Gimblett Gravels Winegrowers Association, Villa Maria Estate Limited, Pernod Ricard Winemakers New Zealand Limited (collectively 'The Winegrowers') – Mark St Clair
54	1	Apatu Farms Ltd – Anthony Davoren
63 & 207	1	Hastings District Council & Napier City Council – Annette Sweeney
	2	Hastings District Council & Napier City Council – Annette Sweeney (Appendix A)
	3	Hastings District Council & Napier City Council – Brent Chapman
	4	Hastings District Council & Napier City Council – Cameron Drury
	5	Hastings District Council & Napier City Council – Mark Clews
	6	Hastings District Council & Napier City Council – Paulina Wilhelm
	7	Hastings District Council & Napier City Council – Russell Bond

Original Sub #	Evidence #	Organisation Name – Individuals Name
PART 2		
66	1	Ngaruroro Irrigation Society – Anthony Davoren
82	1	Lowe Corporation – Andy Lowe
	2	Lowe Corporation – Gerard Willis
120	1	Ngāti Kahungunu Iwi Incorporated – Grey Wilson
	2	Ngāti Kahungunu Iwi Incorporated – Peter Fraser
PART 3		
132	1	Te Taiwhenua o Heretaunga – Marei Boston Apatu
	2	Te Taiwhenua o Heretaunga – Tank Hearings Presentation
	3	Te Taiwhenua o Heretaunga – Maurice Wayne Black
	4	Te Taiwhenua o Heretaunga – Maurice Wayne Black (Appendix 1)
	5	Te Taiwhenua o Heretaunga – Maurice Wayne Black (Appendix 2)
	6	Te Taiwhenua o Heretaunga – Maurice Wayne Black (Appendix 3)
	7	Te Taiwhenua o Heretaunga – Maurice Wayne Black (Appendix 4)
	8	Te Taiwhenua o Heretaunga – Maurice Wayne Black (Appendix 5)
	9	Te Taiwhenua o Heretaunga – Maurice Wayne Black (Appendix 6)
	10	Te Taiwhenua o Heretaunga – Maurice Wayne Black (Appendix 7)
	11	Te Taiwhenua o Heretaunga – Maurice Wayne Black (Appendix 8)
	12	Te Taiwhenua o Heretaunga – Maurice Wayne Black (Appendix 9)
	13	Te Taiwhenua o Heretaunga – Maurice Wayne Black (Appendix 10)
	14	Te Taiwhenua o Heretaunga – Maurice Wayne Black (Appendix 11)

Original Sub #	Evidence #	Organisation Name – Individuals Name
	15	Te Taiwhenua o Heretaunga – Maurice Wayne Black (Appendix 12)
PART 4		
135	1	Ravensdown – Anna Wilkes
	2	Ravensdown – Carmen Taylor
180	1	Horticulture New Zealand – Andrew Dooney
	2	Horticulture New Zealand – Catherine Sturgeon
	3	Horticulture New Zealand – Damien Farrelly
	4	Horticulture New Zealand – Gill Holmes
	5	Horticulture New Zealand – Michelle Sands
	6	Horticulture New Zealand – Stuart Ford
193	1	Heinz Watties Ltd – Anthony Davoren
195	1	Federated Farmers New Zealand – Rhea Dasent
197	1	Beef + Lamb New Zealand – Gerry Kessels
	2	Beef + Lamb New Zealand – Dr Michael Greer
	3	Beef + Lamb New Zealand – Tom Orchiston
203	1	The Oil Companies – Philip Brown
	2	The Oil Companies – Annexure 1
	3	The Oil Companies - Annexure 2
	4	The Oil Companies - Annexure 3

Original Sub #	Evidence #	Organisation Name – Individuals Name
201	1	Royal Forest and Bird Protection Society of New Zealand Incorporated – Thomas Kay
	2	Royal Forest and Bird Protection Society of New Zealand Incorporated – Thomas Kay (Appendix 1)
	3	Royal Forest and Bird Protection Society of New Zealand Incorporated – Thomas Kay (Appendix 2)
	4	Royal Forest and Bird Protection Society of New Zealand Incorporated – Thomas Kay (Appendix 3)

BEFORE THE HEARING COMMISSIONERS APPOINTED BY THE HAWKE'S BAY REGIONAL COUNCIL

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

AND

IN THE MATTER of Proposed Plan Change 9 - Tūtaekurī, Ahuriri, Ngaruroro and Karamū (**PPC9**)

STATEMENT OF EVIDENCE OF ANDREW GORDON DOONEY (PLANNING) FOR HORTICULTURE NEW ZEALAND

7 MAY 2021

ATKINS | HOLM | MAJUREY

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CONTENTS

SUMMARY STATEMENT

1. This planning evidence addresses the Horticulture New Zealand (**HortNZ**) submission, further submissions and the Hawke's Bay Regional Council's (**HBRC**) Section 42A Report responses to the submissions on Proposed Plan Change 9 (**PPC9**): Regional Resource Management Plan - Tūtaekurī, Ahuriri, Ngaruroro and Karamū (**TANK**) Catchments

2. My planning evidence addresses how I consider that alternative planning provisions would better give effect to, be not inconsistent with, or have regard to (as the case may be) the various relevant planning documents and further assist in developing a robust plan.

3. The evidence of Michelle Sands emphasises and clarifies the regional significance of the horticultural sector in Hawke's Bay for food production, the area of activity, number of operators and the relative contaminant contribution.

4. In my opinion, PPC9 (as notified) rightly provides a planning response to manage water quality and quantity for current and future generations. I also support the general approach of the PPC9 in its submission on the notified plan.

5. Notwithstanding this, I consider the PPC9 framework could be improved by clarifying several issues including water security, the water allocation framework, assessment of water quality effects across all contaminants, freshwater farm plans, and Industry Programmes and collectives.

6. The specific responses to the Section 42A report are summarised below and specifically set out in **Appendix 1**.

INTRODUCTION

Qualifications and experience

1. My full name is Andrew Gordon Dooney. I am a Senior Planner with View Research and Resource Management, a resource management consultancy based in Napier. I have been employed in resource management related positions in local government and the private sector since 2007. I hold a Bachelor of Applied Science - Rural Valuation and Farm Management degree from Massey University, Palmerston North and a Post Graduate Diploma in Environmental Science from the University of Auckland. I am a Full Member of the New Zealand Planning Institute.

2. I have worked in the public sector, where I was employed in consenting roles with Auckland City Environments, Hawke's Bay Regional Council and Wellington Regional Council. The scope of work for the public sector has primarily involved consenting regional council functions for a range of sectors including forestry, residential development, port functions and council flood protection activities.

3. In private practice I regularly advise a range of private clients on statutory planning documents and prepare land use, coastal permit, water permit and discharge permit resource consent applications.

4. I have worked internationally for Jacobs Engineering Ireland on large infrastructure projects including public transport and water supply schemes.

Expert Code of Conduct

5. Although this is a hearing before Hearings Commissioners, I confirm that I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2014. I have complied with the Code of Conduct in preparing this evidence and agree to comply with it while giving oral evidence. 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.

Experience in Freshwater Management

6. Having been brought up in the rural environment of Central Hawke's Bay and with family farming associations there, I have had a continuous involvement with primary production in the region.

7. My most recent experience is ongoing participation in HortNZ's appeal to the Environment Court on Plan Change 1 – Waikato and Waipa River Catchments including efforts to resolve appeal points in Council led mediation.

Involvement in these proceedings

8. I have reviewed the submission made on behalf of HortNZ by my colleague Charlotte Drury.

9. Aside from the changes sought to the submission I support the submission made by Ms Drury.

10. For clarity, in Appendix A I include the table of changes sought in HortNZ's submission with the addition of two columns: one which sets out the S42A treatment of HortNZ's submissions suggestions and one detailing the decision sought by HortNZ at this hearing.

Purpose and scope of evidence

11. I have been engaged by HortNZ to provide evidence in relation to the planning framework for PPC9.

12. This evidence provides a planning assessment of those provisions on which HortNZ submitted and addresses the Section 42A Report prepared by HBRC.

13. The planning framework is well described in both the Section 32 Report and the Section 42A Report provided by the HBRC. I generally agree with the analysis.

14. Given the general agreement I do not repeat the analysis of the applicability of those planning instruments or the compliance of PPC9 with those instruments. Rather this evidence sets out where I depart from the views expressed in the Section 32 or Section 42A Reports, or where I consider that an alternative planning provision would better give effect to, be not inconsistent with, or have regard to (as the case may be), the various relevant documents.

15. The Section 42A Report provides a format within which submissions have been analysed. The topics relevant to HortNZ's submission cover:

    (a) Water Quality Management Framework

    (b) Farm Plans, Industry Programme and Catchment Collectives

    (c) Land Use Change

    (d) Water Quantity

16. To assist the Hearings Panel, I have adopted the same format to address the HortNZ submission.

17. In preparing this evidence I have read and considered the following documents:

    (a) The National Policy Statement for Freshwater Management 2020 (**NPSFM2020**).

    (b) Proposed Plan Change 9: Regional Resource Management Plan - Tūtaekurī, Ahuriri, Ngaruroro and Karamū Catchments. Publication 5550.

    (c) Submissions and further submission of HortNZ on PPC9.

    (d) Other relevant parties' submissions and further submissions to PPC9.

    (e) Hawke's Bay Regional Council Hearing Report on Proposed Plan Change 9 Tūtaekurī Ahuriri Ngaruroro Karamū Catchment Area (**Section 42A Report**)

18. In relation to factual and technical matters pertaining to horticulture I rely on the evidence of:

    - Stuart Ford - Economics and Overseer;
    - Gillian Holmes - Hydrology;
    - Catherine Sturgeon - Water Quality;
    - Damien Farrelly – Industry programme and Farm Planning:
    - Michelle Sands – Corporate.

Scope

19. I consider that the relief sought by HortNZ remains within the scope of the matters addressed in HortNZ's submission and further submission. I do note the changes arising in relation to Objectives 10-14 and 16, as the specific wording changes set out in the table of Appendix 1 were not explicitly sought by HortNZ in their submission.

20. Despite HortNZ not including these specific wording changes in their submission, I consider that the changes sought are within the scope of HortNZ's engagement on this matter as they are not outside the contemplation of, or the general intent and wording of, HortNZ's submission. This matter will be dealt with in more detail, but it is my opinion that the changes sought to these specific objectives do not raise issues of scope.

CONTEXT TO PLANNING PROVISIONS

21. As a primary sector organisation that represents over 300 horticultural growers that grow food within the TANK catchments HortNZ believes that it is critically important that the needs of primary and secondary industry, and the community, are considered thoroughly and appropriately. The food growers that HortNZ speaks on behalf of constitute a large proportion of the primary and secondary industry within the area that would be impacted by PPC9.

22. What is reasonably foreseeable is a change in water demand because of the changing climate. Assuming no other changes, water demand will change because of the changing climate. Innovative responses such as water storage, augmentation schemes and high flow takes may all enable the community to respond to climate change and are necessary to respond to the threats posed by climate change challenges.

23. While the horticulture industry most definitely has growth aspirations for the future, these are tempered by the knowledge that current and future land and water use must be undertaken in a sustainable manner, in an increasingly regulated environment, and within a comprehensive planning framework that cascades down from the NPSFM, to the Regional Policy Statement (**RPS**), the Regional Resource Management Plan (**RRMP**) and the PPC9.

24. As set out in the evidence of Ms Sands and Stuart Ford for HortNZ, the value of horticulture on the Heretaunga Plains is nationally significant. An inability for the needs of the primary and secondary sector to be met is likely to result in significant adverse effects on the community, such that the sustainable management purpose of the RMA would not be achieved.

National Policy Statement for Freshwater Management 2020

25. PPC9 was notified on 2 May 2020. The NPSFM2020 came into force on 3 September 2020. I have included some commentary of the national framework as it provides an important context to the HortNZ position and is relevant to the process for PPC9 moving forward.

26. I agree with the Section 42A Report where it states that if submissions provide scope, PPC9 should be updated to better align with NPSFM 2020.

27. The NPSFM2020 requires Te Mana o te Wai (**TMOTW**) to be given effect to through various means. It represents a change in freshwater policy direction as it prioritises the wellbeing of water bodies, then the essential needs of people, followed by other uses including social, economic, and cultural well-being provision.

28. Section 1.3(5) of the NPSFM2020: Fundamental Concept Te Mana o te Wai provides the hierarchy of obligations that must be met. Below the 'first priority' or health and well-being of water bodies and freshwater ecosystems sits the second priority; the health needs of people. As argued by Ms Sands in her evidence this includes food security i.e. vegetable and fruit production for domestic supply.

29. The NPSFM2020 provides for outcomes to be achieved over time, and for plans to set up a framework for achieving those outcomes, and that is what this PPC9 does by setting values, outcomes and limits.

30. Another plan change will be needed before 2024 for TMOTW vision to be achieved and to fully reflect the NPSFM2020 National Objectives Framework (**NOF**), but in my view PPC9 goes most of the way to implementing NPSFM2020 by setting up a framework for achieving outcomes that reflect freshwater values over time.

31. It is my opinion that the PPC9 framework affords first priority to freshwater wellbeing in the outcomes set. It also recognises

the importance of water for social, cultural, and economic wellbeing in the way target attribute states are set to achieve outcomes over time. Therefore, I consider PC9 consistent with the TMOTW hierarchy and as such I think it provides for sustainable management as per Part 2 of the RMA.

32. OBJ TANK 10-14 and OBJ TANK 16 provide direction as to how activities are carried out in the TANK catchments and groundwater connected to TANK rivers to maintain and enhance mauri, water quality and water quantity. This is to enable environmental health and a range of activities.

33. Based on this, Ms Sands' evidence and my interpretation of NPSFM2020 it is my opinion that not only is there scope, but there is also a requirement that OBJ TANK 10-14 and OBJ TANK 16 can be altered to include provisions for food security.

34. In order to achieve this, I recommend that text on food security be added alongside the bullet points that deal with people and communities safely meeting their domestic water needs. This is set out in Appendix 1.

OVERVIEW OF HORTICULTURE NEW ZEALAND'S SUBMISSION POINTS

35. Before progressing with an analysis of the HortNZ submission points relative to the Section 42A report, I set out my understanding of the HortNZ submission.

36. Firstly, the submission provides an overview of horticulture in the Hawke's Bay and specifically the TANK Catchments. That overview details specific production that occurs in the TANK catchments and the place Hawke's Bay has in the domestic horticultural produce supply chain due to Hawke's Bay's unique climate. It describes the significant investment in post-harvest distribution infrastructure including Heinz Watties and McCains processing facilities and the amount of employment opportunities they provide. It also states the need to support horticultural production to respond to climate change as only 1.4% of the country's agricultural greenhouse gas emissions are produced by horticulture. Supporting land use diversification to allow increased horticulture is critical to New Zealand achieving a transition to a low emission economy.

37. The submission is informed by growers' involvement in the PPC9 collaborative process developing freshwater management regulation; and working with growers to improve environmental practice and achieve environmental and business sustainability. Grower statements are included in

the evidence of Ms Sands which detail specific experiences of growers in the area.

38. In her evidence Ms Sands sets out that HortNZ fundamentally supports the general approach of the PPC9 and believes it strikes a reasonable balance between seeking to improve the quality and quantity of the TANK catchments' freshwater resources through a range of different regulatory requirements and ensuring that those who rely on water can continue to use it. It also allows time for practice changes to be made. However, I agree with some issues identified by HortNZ in the framework developed by the Council and included in PPC9 for horticulture. I explain these issues, and my professional opinion on them, further below.

AREAS OF DISAGREEMENT/AGREEMENT WITH THE SECTION 42A REPORTS

39. The Section 42A Report sets out the Provisions of PPC9 relating to horticulture. I do not repeat that discussion here but note key points below. A complete statement of my position in relation to the Section 42A Report, informed by the opinions of the other experts participating in this matter for HortNZ, can be found in the table in Appendix 1.

40. While HortNZ sought a variety of changes not all of these were accepted in the S42A report – indeed many of the changes HortNZ were seeking were rejected. Following review of the Section 42A Report HortNZ has decided to accept the Section 42A Report's recommendations in certain areas and will not contest these points. The areas where HortNZ accepts the Section 42A report recommendations in lieu of what was sought in the HortNZ submission are set out in the table in Appendix A. I do not address matters where HortNZ agrees with the S42A recommendations.

OVERVIEW OF THE PLAN CHANGE FRAMEWORK RELATING TO HORTNZ'S SUBMISSION

41. I have, as much as possible, used topic headings provided in the Section 42A Report.

42. The focus on this evidence will be on the amended version of PPC9 that accompanied the Section 42A report as Appendix 1, not the notified version of PPC9, unless otherwise stated.

WATER QUALITY MANAGEMENT FRAMEWORK

43. Section 14.2 of the Section 42A Report outlines the provisions related to the water quality management framework i.e. POL TANK 1, 2, 4, 5, 17-20 and Schedule 26 and 28.

44. As stated in the Section 42A Report PPC9 establishes target water quality attribute states and environmental outcomes in Schedule 26 which will provide for the values identified for the different waterbodies in the TANK Catchments. These provisions were drafted to be consistent with the direction in the NPSFM2014 (and as amended 2017).

45. As I have mentioned above it is my opinion that while further plan changes will be required for PPC9 to fully achieve the NPSFM2020 TMOTW vision, as it stands PPC9 is aligned with the policy in the NPSFM2020. This is because PPC9 allows target attribute states to be achieved over time aligned with achieving community values.

46. As detailed in the evidence of Catherine Sturgeon the Section 42a Report states that Council has not yet made a decision on what scale the FMU will operate at. She also states that if the entire TANK catchment is one FMU then this meets the NPSFM2020 definition of FMU in Subpart 2: clause 3.8 of the policy document.

47. Overall, I support the policy intent to establish a priority management approach and provide direction to improve water quality outcomes POL TANK 1, 2, 3 and 4. I also support the adaptive approach to nutrient management and sediment provided by POL TANK 17-20.

48. POL TANK 1-4 allow specific direction to issues facing the catchments and direction to the types of methods that could address those specific issues.

49. I support the amendments to Item e) POL TANK 18 made in the Section 42A Report. These align with HortNZ's submission to clarify how Council will manage land use change and to ensure the policy deals with all contaminants, not just nutrients as was the case in the notified wording. I have made further suggested changes to Pol TANK 18 in the Table in **Appendix 1** in line with the approach to manage all contaminants.

50. As outlined in HortNZ's submission I accept that nitrogen can be used as a trigger for regulating land use change using Rule TANK 5 and 6. As outlined in Mr Ford's evidence and HortNZ's

submission, to be effects based, this trigger should be related to change in nitrogen load and not land use categories. As outlined in the evidence of Ms Sturgeon, changes in nitrogen load should not be the only matter of discretion.

51. Ms Sturgeon states in her evidence that while she supports the amendments to POL TANK 18 she recommends an additional Planning Map for Schedule 28 that shows priority catchments for E.Coli. It is also her opinion that Dissolved Inorganic Nitrogen (**DIN**) and Dissolved Reactive Phosphorus (**DRP**) better align with NPSFM 2020 and Schedule 26.

52. In my opinion this would provide more complete planning maps for all relevant contaminants and allow POL TANK 18 to have broader scope for Council when making decisions on resource consents for land use change.

53. It is also my opinion that the provisions could be improved by using changes to nitrogen load which is a more effects-based trigger than land use. This is covered further the following section.

FARM PLANS, INDUSTRY PROGRAMME AND CATCHMENT COLLECTIVES

54. Section 14.5 of the Section 42A Report outlines the provisions related to Farm Plans, Industry Programmes and Catchment Collectives i.e., POL TANK 23-27, RULES TANK 1 AND 2 AND Schedule 30.

55. As described in the Section 42A Report POL TANK 23 – 27 establish a management approach that addresses the cumulative effects of production land use on water quality and ecosystem health based on farm plans at a property scale but enabling collective management at a catchment scale or via Industry Programmes. They are underpinned by Rule TANK 1 and 2 and Schedule 30 that set out requirements for Freshwater Farm Plans (**FWFP**) and the timeframes for completion (Schedule 28).

56. The overarching goal for this part of PPC9 is to allow Council to implement a "one-to-many" approach to make compliance a possibility via collective catchment scale management or Industry Programmes that meet the requirements of Schedule 30.

57. As stated by Ms Sands in her evidence, the RMA, under Part 9A, signals a greater use of FWFPs to address the impacts of agriculture and horticulture on freshwater. As Ms Sands also

states HortNZ supports the use of FWFP's as a tool in PPC9 to implement water quality limits. I support PPC9 aligning terminology and direction to a national approach to provide consistency to plan users and Council.

58. Overall, I support the policy intent to regulate the primary sector to address cumulative effects on water quality. Rule TANK 1 provides the timelines (via Schedule 28) for a FWFP to be provided to Council. If a FWFP is not provided within the timeframes consent is required under TANK 2 as a Controlled Activity. The Policy framework in TANK POL 23, 24 and 25 is directive and provides clarity as to how Council will approach the requirement for FWFP's to be supplied via individuals, collectives and Industry Programmes.

59. In his evidence Dr Damien Farrelly makes suggested changes to how PPC9 manages FWFP's in relation to Landowner Collectives, Industry Programmes and individual landowners. The suggested changes to Schedule 30 provided in Appendix 1.

60. The changes proposed by Dr Farrelly to the wording of Schedule 30 primarily simplify it. He considers that FWFP requirements in Schedule 30 can be made common to all three routes of requiring one e.g. Landowner Collectives, Industry Programmes and individuals. This allows Section A of Schedule 30 to become extent of common requirements for FWFP requirements. This removes duplication in latter sections of the Schedule.

61. Section C of Dr Farrelly's suggested Schedule 30 is then able to focus on individual FWFP requirements, Section B on Catchment Collectives, Section D on Industry Programmes, and Section E on Auditing and Reporting of Catchment Collectives.

62. One Important suggested change from Dr Farrelly is a pathway under Section C which proposes that Catchment Collectives can belong to an Industry Programme. This allows the Industry Programme to assist with FWFP for collective members if they choose.

63. Section E suggested wording provides for Industry Programmes to better interact with a Council approval process. The suggested changes reflect Dr Farrelly's experience in how roles and responsibilities work for those who are members of an Industry Programme. GAP is

independently audited and therefore should be considered equal to Council audit proposals. In my opinion if Council accepts this position, then they may obtain significant efficiencies in monitoring the performance of members who are part of an Industry Scheme.

64. Dr Farrelly has described in his evidence the GAP schemes that are used by Growers e.g. the NZ Good Agricultural Practice (**NZGAP**) scheme. For details of the scheme and its benefits please refer directly to his evidence. The NZGAP scheme has an Environment Management System (**EMS**) "add on" that directly relates to FWFP's and provides a vehicle for growers to meet nationally consistent industry good management practices (**GMP**) and Regional Council specific requirements. Dr Farrelly explains that GAP is an assurance framework, that can assist, but not replace the Council compliance function. Core focus areas of the NZGAP EMS relate to soil management, irrigation and water management and nutrient management.

65. In my opinion the changes suggested by Dr Farrelly would allow robust FWFPs to be developed at the individual or collective scale, with supported industry programmes and robust auditing processes as suggested by Dr Farrelly in his amended version of Section E of Schedule 30.

66. Mr Ford in his evidence states that changes made to Section A 2.3 of Schedule 30 have improved how it deals with nutrient management.

67. He recommends an amendment to use average annual nitrogen loss rate as a preferred method for freshwater accounting and assessment land use change. It is also essential for freshwater accounting and land use change decisions for crop rotations, that allow the full crop rotation to be assessed over space as well as time. Assessing full crop rotations ensures growers are not prevented from rotating across properties to maintain soil health.

68. Mr Ford also explains in his evidence that for crop rotations, the unit of accounting for managing effects must be the full rotation, not limited to the property scale.

69. In the table attached in Appendix 1 is a tracked change version of Nitrogen Loss Rate, Nitrogen Loss Target and Nitrogen Budget which will assist in the functioning of Schedule 30, with amended definitions for these terms.

70. Mr Ford states that using annual and sub annual crop budgets is better for driving GMP. These budgets can be developed in Nitrogen loss tools like Overseer or tools like the Landwise Nitrogen Budget provided as an example from Apatu Farm in Dr Farrelly's evidence.

71. End-of-year Overseer nitrogen losses or sub-annual crop budget results cannot be compared directly to the long-term average annual results and targets for the same property or rotation. Year to year decisions will respond to the actual climate, crop type and crop age, whereas an average annual estimate uses a long-term climate series and a steady state farm system. It is important to note that it is the careful day-to day decisions that enable nitrogen loss targets to be maintained and/or achieved over-time.

72. As outlined in Mr Ford's evidence the use of nitrogen loss models like Overseer and nitrogen budgets like the Landwise tool is complex for horticulture because of the variety of crops and their changing needs over their growth phases. Care needs to be taken in regulating the use of these decision support tools, so they drive meaningful GMP uptake, and do not drive perverse outcomes for soil health.

73. In my opinion the changes suggested by Mr Ford to the definitions, policies and schedules that refer to nitrogen loss and budgets are important to ensure the focus of the plan is on improving freshwater outcomes.

74. Proposed Schedule 30, Section B: 4 b) ii) refers to how Catchment Collectives will be required to provide information on land use change to ensure it is in accordance with Pol Tank 21 and TANK 5. I agree with the way this is stipulated for reasons that I will raise below in the Land Use section of this evidence. This relates to how Council appears to want to control land use change for Catchment Collectives via the consent pathways of TANK 5 and 6.

75. Overall, I support Dr Farrelly's amendments to how FWFPs are to be provided within Schedule 30. The amendments simplify plan provisions, reduce repetition, and make the plan provisions more accessible to plan users. The suggested changes also make the Schedule 30 requirements more directly relevant to the three relevant pathways of providing a FWFP.

76. It is also my opinion that Dr Farrelly's evidence relating to NZGAP EMS add on and Schedule 30 Section E suggested changes provides the opportunity for Council to implement the PPC9 policy framework, specifically POL TANK 23. Specifically, there is the opportunity to obtain efficiency by enabling Catchment Collective and Industry Programmes to assist in delivering robust and audited FWFPs

77. In summary, I recommend that the Panel adopt the changes sought in Appendix A for the reasons set out above.

Definition of Property and Farm Enterprise

78. Chapter 9 of the Hawke's Bay Regional Resource Management Plan sets out the definition of 'farming enterprise' as:

> 9.84B Farming Enterprise
>
> Means an aggregation of parcels of land within the same Surface Water Allocation Zones identified in Schedule XVI, held in single or multiple ownership (whether or not held in common ownership) that constitutes a single farming operating unit.

79. It is my understanding that farming enterprise includes leased and owned land. This is an important factor when considering the nature of horticultural operations that frequently rotate crops across a combination of owned and leased land.

LAND USE CHANGE

80. Section 14.3 of the Section 42A Report outlines the provisions related to Land Use Change, i.e., POL TANK 21 Schedule 29 Rule TANK 5 AND 6.

81. POL TANK 21, Schedule 29 and Rule TANK 5 and 6 seek to manage the adverse effects of land use change in relation to rates of nitrogen loss. They arose out of concerns about the lack of control over land use change that may create additional risk to meeting water quality objectives.

82. I support the overall direction that the land use change provisions take. This is to ensure that land use change does not result in a decline in water quality. I rely on the evidence of Mr Ford and Ms Sturgeon to propose a framework that is better aligned to:

- The farming systems found in the TANK catchments,

- The water quality constraints in the TANK catchment; and,
- The TMOTW hierarchy of obligations.

TANK rules 5 and 6

83. Rules TANK 5 and 6, as described in the Section 42A Report, are differentiated by the basis of membership. TANK 5 was established as a controlled activity as:

    …."an incentive for Catchment Collectives and to enable collective management by landowners and allows them to find solutions for land use change at a catchment scale." (para 798 of the Section 42A Report)

84. The Section 32 Evaluation Report contains commentary on page 141 that Rule TANK 5 should not relate to individual landowners. This is because Catchment Collectives are in a better position to manage nitrogen loss and land use change collaboratively or within a catchment.

85. Based on this and the resulting rule structure it appears TANK 6 is designed to regulate land use change for non-collectives or individual landowners and has a restricted discretionary activity status.

86. The Section 42A report also states in paragraph [811] that to consent land use change as a Catchment Collective an application would need to be made for a global consent under Rule TANK 6. This would appear, on the face of it, to be contradictory to the intent of Rule TANK 5.

87. To require a global consent under Rule TANK 6 would appear to be at odds with the intent of PC9 provisions for Catchment Collectives as Rule TANK 5 seems designed to be the consent pathway for applications on a collective scale.

88. The Section 42A Report wording of Rule TANK 5 appears to be drafted with a focus on the individual or property scale and not that of a Catchment Collective. This can be seen in item c) which refers to a 10ha land use change per property or farming enterprise area.

89. This, in my opinion, reduces the effectiveness of the Rule TANK 5 in being able to apply to Catchment Collective scale changes in land use.

90. It is my recommendation that Rule TANK 5 be amended to provide the opportunity to consent land use change within

a Catchment Collective at a scale which is reflective of that collective (and consents for individuals would still be able to be sought via Rule TANK 6).

91. Based on the above approach to support a Catchment Collective scale I have suggested a change to the matters for Control/Discretion for Rule Tank 5. This is to matter 3 where the reference is to property. I suggest changes as follows:

> 3) ~~2.~~ Measures to be undertaken ~~on the property~~ which contribute to meeting, ~~including how the effect of the new land use activity on contributing to~~ the water quality objectives ~~is being collectively addressed~~ including by…….

92. Rule TANK 5 has been amended in the Section 42A Report version to include an updated notification clause. The notified version of the rule had a broad "non-notification" clause which is not uncommon for controlled activity rules.

93. The amended notification clause is linked to water quality limits and targets in Schedule 26 and is they are being met in the catchment then the application will be considered non-notified.

94. This change appears to be contrary to the intent to incentivise Catchment Collectives. This is because applicants using the Rule TANK 5 pathway would potentially be unwilling to become involved in a notified consent process due to cost and potential for delays.

95. It is my opinion the matters of control are sufficient for Council to adequately assess the impacts of a Catchment Collective. In particular the link to Pol TANK 21 (to which I make suggested changes to below). On this basis my opinion is that the notification clause is not required, and I recommend this is retained as per the notified version.

96. In addition to this it should be noted that Schedule 30 Section B 4): Information Requirements contains items that will be required from Catchment Collectives. This includes provision of information to Council on land use change and any environmental monitoring amongst other things.

97. It is my opinion that as Rule TANK 5 is a controlled activity, Catchment Collectives are to be enabled by the rule and that Council has policy support to control land use. On this basis Rule TANK 5 would more logically contain a non-notification clause.

98. Rule TANK 5 relies on Schedule 29 so if the land use changes over more than 10ha on a property it will require a resource consent if the land use change is from a lower to a higher level of leaching as shown in Table 1.

99. Mr Ford in his evidence states that Table 1 of Schedule 29 fails to achieve the objective of the Schedule which is to manage nitrogen loss resulting from a change in land use.

100. It is Mr Ford's opinion that an alternative arrangement is required which more accurately ranks land use activities and acts as a better guide for decision makers. Mr Ford and HortNZ prefer the notified version of Schedule 29.

POL TANK 21

101. POL TANK 21 provides the policy basis for decision makers assessing applications under Rule TANK 5 and 6. The policy links land use change to freshwater quality objectives and aligns it with the 2040 freshwater target attribute states.

102. Item d) of Policy 21 requires Council to avoid land use change that will result in increased nitrogen loss where it contributes to water quality target states not being met for dissolved nitrogen in Schedule 26.

103. This wording choice means that item d) has the impact and practical effect of prohibiting some commercial vegetable production (CVP) rotations in TANK catchments. This is because a change in land use to some CVP rotations will typically result in an increase in nitrogen from land use. While the purpose of POL TANK 21 item d) is reduce cumulative increase in nitrogen loss in TANK catchments it does not necessarily provide an effects-based policy direction.

104. As argued by Ms Sands in her evidence, vegetable growing will need to expand in future to meet the domestic needs of a growing population.

105. As stated in the HortNZ submission on PPC9, land use change is important for supporting domestic food supply and climate change adaption. In order for to this to be facilitated some flexibility and increases in some contaminants must be enabled. This relates to third priority obligations of TMOTW where communities are able to provide for their social, economic, and cultural wellbeing.

106. She also states that under Section 1.3(5) of the NPSFM2020 vegetable production may be given priority for resource

allocation under TMOTW to provide for the health needs of people.

107. The above approach acknowledges the need for land use change to first meet priority requirements for the well-being of water bodies and freshwater ecosystems. TMOTW is very clear in this priority order and in achieving second priority obligations there should be no undermining of priority one obligations.

108. In Ms Sturgeon's evidence she recommends that Policy 21 be updated to allow negligible cumulative increases in nitrogen loss to occur at the sub-catchment. This is for sub catchments that are meeting the target attribute state for DIN in Schedule 26.

109. Ms Sturgeon states land use change that has negligible increases in DIN may result in improvements in levels of other contaminants and therefore an overall improvement in water quality in the sub catchment. This is because DIN is not always the contaminant of concern within some sub-catchments so it may not be able to be used a proxy for other contaminants.

110. While I support Council's intention in seeking to avoid the effects of nitrogen loss from land use change, I consider that the current provisions may be inflexible to situations where negligible increases in DIN may be appropriate. An example is where an activity that increases in DIN may result in an improvement in water quality for other contaminants that are contributing to values not being met in the sub catchment.

111. Based on the above evidence I consider that wording changes are required and have made a suggested wording amendment to item d) of POL TANK 21 as follows:

> d) avoid land use change that will result in increased nitrogen loss that contributes to water quality ~~objectives and~~ target attribute states in Schedule 26 for dissolved nitrogen not being met, unless in the sub-catchment, dissolved nitrogen is currently meeting the target attribute states in schedule 26 and the land use change will result in an improvement in one or more target attribute states for e.coli, sediment or phosphorus in the sub-catchment where these contaminants are not meeting target attribute states..

112. I have included a full tracked change for POL TANK 21 in Appendix 1 of this evidence.

113. Overall, it is my opinion that the above suggested amendments will assist in making the land use change suitable at Catchment Collective Scale and flexible enough to allow change where it is appropriate. The suggested changes above, in my opinion, will still allow Council to retain sufficient control in decision making to achieve the objectives of PPC9 while providing the ability for landowners and collectives to adapt as required.

114. Additional flexibility built into POL TANK 21, in my opinion will create a provision that allows a focus on all contaminants and a more balanced approach to their management.

WATER QUANTITY

115. Section 15.1-15.5 of the Section 42A Report outlines the provisions related to Water Quantity, i.e., OBJ TANK 10-13 and 16-18, POL TANK 36-60, Rules TANK 7 to 16 AND Schedules 31, 32 and 33.

116. As described in the Section 42A Report PPC9 utilises four main mechanisms to address over-allocation and the adverse effects of over-allocation and to achieve the objectives:

- avoiding further over-allocation
- enabling the mitigation of stream depletion effects
- enabling water harvesting and storage
- encouraging efficient water use by all permit holders.

Heretaunga Plains Groundwater Levels and Allocation Limits

117. POL TANK 36-42 recognise groundwater in the Heretaunga Plains aquifer is over-allocated and provide a pathway to avoid and phase out over-allocation of groundwater by setting the take limit at Reasonable and Actual use. Council note that all groundwater abstractions are considered to have a stream depleting effect on surface water bodies to some extent. The way that groundwater is managed is treated as having an effect on low flow management of surface water bodies across the Heretaunga Plains.

118. Rule TANK 12 implements POL TANK 36, 37, 38 and 52. It enables Council to avoid and phase out over-allocation.

119. HortNZ submitted in opposition to notified wording of PPC9 due to the rule having a prohibited status and recommended changing to a non-complying status. The submission point was

that a prohibited activity is potentially inflexible and may not achieve the direction of the proposed plan. I support this view.

120. The Section 42a Report version of PPC9 has retained a prohibited status for Rule TANK 12 with the explanation that Rule TANK 12 gives effect to POL TANK 36 and 37. It is my opinion that a Non-Complying status is a preferable activity status as it allows flexibility to unusual instances of of administratively challenging consent applications and the policy support of POL TANK 36, 37 and 38 are sufficient to protect inappropriate allocation of water resources.

121. I have made suggested edits to TANK POL 36, 37 and 38 below which should be read in conjunction with the opinion to make Rule TANK 12 Non-Complying.

122. Overall, I support the "sinking lid" approach taken by PPC9 to address over-allocation of the Heretaunga Plains Aquifer and acknowledge it provides a cornerstone of the plan. However, it is my opinion that within this framework there is the ability to refine the provisions to provide flexibility to realise the innovative approaches that PPC9 promotes.

123. I support POL TANK 36 which recognises the potential adverse effects of groundwater abstractions and seeks to avoid any new allocation of groundwater. The approach is a fundamental issue to management of groundwater in TANK catchments.

124. POL TANK 36 utilises a staged approach to groundwater management which is aligned with NPSFM2020.

125. In the table in Appendix 1 minor edits are suggested to clarify the intent of this policy.

126. POL TANK 37 provides an interim limit that is Council's best estimate of current levels of Actual and Reasonable Use. It is fundamental to the "sinking lid" approach as it provides a basis for the future review directed under POL TANK 42.

127. Item b) of POL TANK 37 states the re-allocation of any water that becomes available should be avoided. As noted above I agree POL TANK 36 is fundamental as it prevents new water being allocated. It is less clear why preventing re-allocation of Actual and Reasonable allocation (within the allocation limit) is also fundamental.

128. Ms Holmes in her evidence supports this position as she states re-allocation of water within the limit, has equivalent environmental effects as transferring water within the limit.

129. On this basis I recommend flexibility be built into POL TANK 37 and suggest item b) be edited as follows:

> b) ~~avoid~~ restrict the re-allocation of any water that might become available within the interim groundwater allocation limit or within the limit of any connected water body to essential municipal uses or primary production purposes on versatile land, or for use in stream flow maintenance and enhancement schemes~~. until there has been a review of the relevant allocation limits within this plan~~.

The wording of this is contained in the table in Appendix 1 of this evidence.

130. POL TANK 38 restricts all re-allocation to holders of permits issued before 2 May 2020 and establishes a timeframe for reviewing all permits. It is designed to act in conjunction with POL TANK 36 and 37 to only allow the re-allocation of groundwater already consented.

131. The Section 42A Report states that impacts of preventing new users from accessing water are understood but not ideal. However, in my opinion there is an issue with this approach where succession planning is impacted for growers looking to retire or implement succession planning. Many growers are small operations, and they need to be able to transfer water on this basis.

132. On this basis I have made suggested changes to POL TANK 38 as follows:

> The Council will restrict the re-allocation of groundwater ~~to holders of permits to take and use water~~ in the Heretaunga Water Management Unit ~~issued before 2 May 2020~~ and will review permits or allocate water according to the plan policies and rules either:
>
> a) upon expiry of the consent; or
>
> b) in accordance with a review of all applicable permits within ten years of <the operative date>.
>
> whichever is the sooner.

133. It is my opinion the amendments to these policies in line with a change in the status of Rule TANK 12 to non-complying will

provide the flexibility to allow growers to effectively re-allocate water within the limit 90 million cubic metres per year as stipulated in POL TANK 37.

134. POL TANK 38, as discussed above restricts groundwater re-allocation. This policy needs to effectively interact with POL TANK 48 which deals with transfers but does not seem to consider the same restrictions as POL TANK 38.

135. I believe that overall a framework should be provided that is not so inflexible that it cannot respond to individual circumstances that require consents to be granted to allocated water. Rule Tank 12 as a non-complying activity will assist with this.

Actual and Reasonable Definition

136. As outlined in the evidence of Ms Holmes the definition of Actual and Reasonable provided in the Section 42A Report creates difficulties as it could impact the volume of water that can be sought via Rules TANK 9,10 and 11.

137. This relates to the amendment to item b) of the definition from "maximum" to "average". This in effect removes the ability for consent holders to seek the maximum amount of water used over the 10-year reference period. The use of "maximum" within the definition is therefore critical to allow growers to access water used in drier years and to be able to adapt to climate variation and to obtain reliable groundwater.

138. Rules TANK 7-10 all contain conditions that require water use to be Actual and Reasonable. Should the definition of Actual and Reasonable remain as it is worded in the Section 42A Report then a significant number of existing water takes, when being renewed, may be unable to meet the Restricted Discretionary conditions of Rules Tank 9 and 10. This would be a result of applicants seeking a volume of water that is greater than what could be expected under the Section 42A Report definition of Actual and Reasonable. Therefore, applicants would fail to be assessed as Discretionary Activity under Rule TANK 11 which is potentially not the intention of the rule framework.

139. It is my opinion that, as recommended by Ms Holmes, the change of wording from 'average' to 'maximum' as per the notified version would create a consent framework, and with the other changes suggested by Ms Holmes will allow growers

better access to water in dry years and more able to adapt to climate variations.

Stream Flow Maintenance

140. PPC9 as notified included provisions which would enable stream flow maintenance and habitat enhancement schemes to maintain stream flows, mitigate delayed and indirect stream depletion effects of collective groundwater takes, and avoid minimum flow restrictions on water takes. Key features of the approach in the PPC9 are:

- water permit holders' obligation to this mitigation scheme would be imposed through resource consent conditions (POL TANK 39 and Rules TANK 9 and 10);
- schemes may be established and managed collectively by permit holders (POL TANK 39 and Schedule 36); and
- the development and implementation of the stream flow solutions is to be rolled out as water permits are replaced or reviewed (POL TANK 39 and Rules TANK 9, 10 and 18).

141. However, the Section 42A Report provides significant changes to this approach including the deletion of Schedule 36. This is discussed further below.

142. As outlined in the evidence of Ms Holmes on Stream Flow Maintenance, the revised Policy 39 contained in the Section 42A Report provides greater clarity on how these schemes will be undertaken. This is aligned with the HortNZ submission point in relation to this policy.

143. The Section 42A Report provides an adapted framework for stream flow maintenance by deleting Schedule 36 which previously sought to control flow maintenance projects and replacing it with a more directive POL TANK 39.

144. While Policy 39 now clarifies Council's role in facilitating stream flow maintenance it is important that the policy still retains support for private schemes to be undertaken. This way water users can facilitate their own schemes without the need for Council to lead the project.

145. Rule TANK 18 has been altered in the Section 42A Report to provide more direction on matters that Council will consider for stream flow maintenance proposals. Primarily the

approach is to split the rule to provide for proposals that do not result in land use change under Rule TANK 5 and 6. Rule 18a has been provided for applications that do require land use change. This rule has as a Discretionary Activity and I support the overall structure as per HortNZ's submission.

146. As discussed above in her evidence Ms Holmes recommends a change in the wording of "Actual and Reasonable" to ensure the consent holder seeks reasonable water for their use but also a quantity specifically for stream flow maintenance purposes.

147. For ease of reference her suggested amendment to the definition relates to item d):

> d) for takes with an associated minimum flow, the quantity required for augmentation during low flow periods, as calculated by the Stream Depletion Calculator.

148. This change in definition would in my opinion clarify the consent framework by providing policy direction as to how applicants are to interact with the stream flow maintenance requirements. It also aligns the framework better with the NPSFM2020 by providing priority to these projects which can benefit stream ecology.

Transfers

149. As described in the Section 42A Report POL TANK 48 outlines matters Council will consider when assessing applications to change a water use, or to transfer a point of take. The ability to change the use of a water take and/or transfer a point of take is important to enable stream flow enhancement schemes, flexible management regimes, and efficient water use.

150. HortNZ supports the amended TANK POL 48 provided in the Section 42A Report. It strengthens the direction to decision makers to ensure water takes are kept for the versatile land of the Heretaunga Plains for primary production.

151. As described by Ms Sands in her evidence this decision aligns TANK POL 48 more with the RPS by recognising versatile land and the proposed National Policy Statement for Highly Productive Land.

152. The updated policy also provides direction that transfers may, in certain circumstances, be away from versatile land for

stream flow maintenance projects which I commented on above.

153. POL TANK 48 gives effect to OBJ TANK 16-18 as it supports primary production on versatile soils and the ability to be flexible and innovative.

154. POL TANK 52 provides policy direction to phase out over-allocation as required by NPSFM2020. I support this policy direction as it directs Council to enable and support permit holders who choose flexible approaches to management and use of allocatable water within a management zone.

155. Specifically, item g) of POL TANK 52 supports Catchment Collectives, water user groups and global consenting arrangements to manage water collectively and therefore be more efficient. This is supported by Ms Holmes in her evidence where she acknowledges the use of other approaches in addition to transfers in over allocated catchments.

156. Overall, it is my opinion that the Section 42A Report wording of POL TANK 48 improves alignment with other planning documents by promoting use of versatile land.

SURFACE WATER LOW FLOW MANAGEMENT

Root Stock Survival

157. HortNZ, as discussed in Ms Sand's evidence, supports Policy 51 and in particular the recognition of the importance of providing horticultural root stock survival water.

158. In Mr Ford's evidence he describes the impact of tree loss to individual growers and the Hawke's Bay economy particularly the lag in production as new root stock is established. Water allocation within PPC9 is critical for root stock survival and the avoidance of these impacts.

159. The council officer clearly states in paragraph [1848] of the Section 42A Report that submission points on root stock survival are accepted in part and that takes that existed before 2 May 2020 have a 20m^3 allocation for this purpose. While the officer does not specifically state that Rule TANK 7 and 8 apply, it is assumed that this is the case.

160. Rules TANK 7 and 8 when read individually do not state that 20m^3 is the permitted volume which in my opinion is confusing

and difficult to interpret. Rule 53 in the RRMP is clear in its wording as it stipulates a limit.

161. Ms Holmes states in her evidence that Section 3.17 (1)(b) of the NPSFM2020 requires a limit to be set. In particular the NPSFM2020 states:

> (1) In order to meet environmental flows and levels, every regional council: …
>
> (b) must include the take limits as rules in its regional plan(s); and …
>
> (2) Take limits must be expressed as a total volume, a total rate, or both a total volume and a total rate, at which water may be:
>
> (a) taken or diverted from an FMU or part of an FMU; or …
>
> (3) Where a regional plan or any resource consent allows the taking, damming, diversion or discharge of water, the plan or resource consent must identify the flows and levels at which:
>
> (a) the allowed taking, damming, or diversion will be restricted or no longer allowed; or …

162. It is my opinion that Rule Tank 7 does set a limit, but if the Rules TANK 7 and 8 rely on permitted surface and groundwater rules in the RRMP, then this is confusing for users of PPC9.

163. I recommend the Section 42A Report wording of Rules TANK 7 and 8 item b) be amended as follows (HortNZ edits in green):

> b) The take ~~does~~ shall not exceed 5 cubic metres per day per ~~any one~~ property except:
>
> (i) Takes existing as at 2 May 2020 may continue to take up to 20m³ per property per day ~~may continue to take up to 20 cubic metres per property per day and to meet the reasonable needs of animals for drinking water~~;
>
> (ii) Takes to meet reasonable domestic needs
>
> (iii) Takes for stock drinking water
>
> (iv) Takes occurring for a period of less than 28 days within any 90-day period, the total volume taken on any property shall not exceed 200 cubic metres per 7 day period.

164. Section 3.17 of NPSFM2020 lists the criteria required to identify a take limit. Specifically, 3.17 (2) states a take limit must be

expressed as a total volume, a total rate or both. In my opinion Rules TANK 7 and 8 achieve this as they include criteria relating to total volume in items b) i) and iv) and an instantaneous rate of take for both rules.

165. It is my opinion that Rule TANK 7 and 8, as permitted activity rules should clearly state the permitted volume for the benefit of plan users in future.

HIGH FLOW ALLOCATION

166. As described in the Section 42A Report POL TANK 54 – 60 enable high flow takes for storage and subsequent use or release in a way that avoids, remedies, or mitigates adverse effects. POL TANK 56 requires Council to recognise the beneficial effects of water storage and augmentation schemes. Benefits listed under this policy include benefits to downstream water bodies and users and improving community resilience to climate change. POL TANK 54-60 help achieve OBJ TANK 16, 17 and 18.

167. HortNZ is supportive of access to high flow allocation for the reasons in Policy 56 in particular POL TANK 56 items b) and c). As detailed in the evidence of Mr Ford, reliability of water is critical to the viability of horticulture in TANK catchments.

168. HortNZ supports POL TANK 54 and 55 in the Section 42A Report. However, as provided in the evidence of Ms Holmes, amendments to Schedule 32 are suggested to align with NPSFM 2020 terminology. The specific wording for these can be found in Appendix 1 of this evidence.

CONCLUSIONS AND RECOMENDATIONS

169. In conclusion I reiterate my support of the general direction of PPC9 and the direction it takes in relation to the management of the quality and quantity of the TANK catchments' freshwater resources through a range of different regulatory requirements.

170. Where I have suggested amendments to PPC9, I have done so using expert advice to assist in the provision of more workable provisions that retain the underlying environmental objectives of the plan.

Andrew Gordon Dooney

7 May 2021

APPENDIX 1 – SPECIFIC RESPONSES TO SECTION 42A REPORT

Appendix 1 – Table comparing HortNZ's submission and current position

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
Obj TANK 3	Support with amendments	HortNZ did not submit on this objective specifically, but did seek consideration of climate change mitigation and adaptation in our submission generally and in TANK Pol 21	The 2020 RMA amendments provides an opportunity for TANK to consider climate change mitigation.	Rejected	Amend as follows: ~~The effects of~~ climate change is ~~are~~ taken into account when ~~in respect of each of the following are taken into account in~~ making decisions about land and water management within the TANK catchments; [~~delete (a) through (d)~~]
Obj TANK 4	Support with amendments	Amend the maps in Schedule 26 to show the location of monitoring sites.	The objective requires monitoring, and it would be clearer if the monitoring sites were identified in Schedule 26.	Accepted in part	Accept S42a, with amendments to Schedule 26 suggested by Ms Sturgeon (and the below terminology corrections, also recommended by Ms Sturgeon): ~~Land and water use, contaminant discharge and nutrient loss activities are carried out so that~~ The quality of the TANK ~~freshwater bodies~~ catchments is maintained where objectives are currently being met, or is improved in degraded waterbodies so that they meet ~~water quality~~ target attribute states in Schedule 26 by 2040 provided that: …
Obj TANK 7	Support with amendment	Amend to say "Land use is carried out in a manner reduces contaminant loss	Industry specific good management	Rejected.	Accept S42a, acknowledging policies include recognition of industry specific good management practices.

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		in accordance with good, or where necessary best management practice, including soil loss…"	practices set out how contaminant loss should be managed, which provides clarity for plan users about how reductions can be achieved, but also recognises that some landowners may not need to make changes to their practices, as they are already operating at good management practice.		Note: The s42A authors recommend that Obj TANK 7 is deleted, however it remains in the Appendix 1A s42A tracked changes. Delete, as per s42A recommendations: ~~Land use is carried out in a manner that reduces contaminant loss including soil loss and consequential sedimentation in freshwater bodies, estuaries and coastal environment~~
Obj TANK 8	Support with amendment	Amend to say 'is improved by ~~appropriate~~ management of riparian margins that ~~to~~: a) reduces effects of contaminant loss from	Clarifies intent of objective	Accepted in part - better expresses the outcomes sought for riparian land	Accept S42a recommendation

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		land use activities etc……'			
Obj TANK 10		HortNZ did not submit on this objective specifically, but we sought consideration of the importance of fruit and vegetables for domestic food supply in our submission generally and in TANK Pol 21	Food security is an essential human health need and a second priority ithin the Te Mana o te Wai Hierarchy	Rejected	Amend to add: e) maintenance of food security; And, as recommended in Ms Sturgeon's evidence an amendment to the terminology used to refer to target attribute states (rather than water quality states): 'In combination with meeting the ~~water quality~~ target attribute states specified ... '
Obj TANK 11		HortNZ did not submit on this objective specifically, but we sought consideration of the importance of fruit and vegetables for domestic food supply in our submission generally and in TANK Pol 21	Food security is an essential human health need and a second priority within the Te Mana o te Wai Hierarchy	Rejected	Amend to add: g) maintenance of food security; And, as recommended in Ms Sturgeon's evidence an amendment to the terminology used to refer to target attribute states (rather than water quality states): 'In combination with meeting the ~~water quality~~ target attribute states specified ... '
Obj TANK 12		HortNZ did not submit on this objective specifically, but we sought consideration of the importance of fruit and	Food security is an essential human health need and a second priority	Rejected	Amend to add: g) maintenance of food security; And, as recommended in Ms Sturgeon's evidence an amendment to the

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		vegetables for domestic food supply in our submission generally and in TANK Pol 21	within the Te Mana o te Wai Hierarchy		terminology used to refer to target attribute states (rather than water quality states): 'In combination with meeting the ~~water quality~~ target attribute states specified ... '
Obj TANK 13		HortNZ did not submit on this objective specifically, but we sought consideration of the importance of fruit and vegetables for domestic food supply in our submission generally and in TANK Pol 21	Food security is an essential human health need and a second priority within the Te Mana o te Wai Hierarchy	Rejected	Amend to add: f) maintenance of food security; And, as recommended in Ms Sturgeon's evidence an amendment to the terminology used to refer to target attribute states (rather than water quality states): 'In combination with meeting the ~~water quality~~ target attribute states specified ... '
Obj TANK 14		HortNZ did not submit on this objective specifically, but we sought consideration of the importance of fruit and vegetables for domestic food supply in our submission generally and in TANK Pol 21	Food security is an essential human health need and a second priority within the Te Mana o te Wai Hierarchy	Rejected	Amend to add: b) maintenance of food security; And, as recommended in Ms Sturgeon's evidence an amendment to the terminology used to refer to target attribute states (rather than water quality states): 'In combination with meeting the ~~water quality~~ target attribute states specified ... '

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
Obj TANK 15	Oppose (g)	Delete specific areas specified in (g) to be restored and created, unless evidence can be provided that shows where these areas are, and that no adverse off-site effects will result from the work.	HortNZ is concerned that the goals of 200ha of restoration and 100ha of creation may not be achievable, taking into account the need for any such work to not have any adverse effects on neighbouring landowners.	Accepted in part	Accept S42a recommendation
Obj TANK 16		HortNZ did not submit on this objective specifically, but we sought consideration of the importance of fruit and vegetables for domestic food supply in our submission generally and in TANK Pol 21	Food security is an essential human health need and a second priority within the Te Mana o te Wai Hierarchy		Amend as follows: ~~a)Water for~~ the ~~essential~~ reasonable domestic needs of people, the maintenance of food security, livestock drinking and fire-fighting supply;
Obj TANK 17	Support with amendment	Amend to clearly state that sub-sections a)-d) are not listed in any order of priority.	Clarifies objective.	Rejected - does not improve clarity (at 1299)	Accept S42a recommendation

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
Obj TANK 18	Support with amendment	Amend to state that sub-sections are in order of priority, and re-order to list as follows: a) Water harvesting and storage; b) Flexible water allocation and management regimes; c) ~~Aquifer recharge and~~ flow enhancement; d) Water conservation, water use efficiency, and innovations in technology and management; e) Water reticulation.	Clarifies objective by explicitly identifying where opportunities genuinely lie to secure the current and foreseeable water needs of future generations.	Rejected - does not improve clarity (at 1314)	Accept s42a, HortNZ accepts that each mechanism will play an important role and PPC9 intentionally allows the potential for innovation in this space. I note that any innovative method and its effects would still be subject to the policies rules, limits and targets as set out in PPC9.
Policy 1	Support with amendments	Amend f) by adding 'and irrigation purposes'.	Recognises that maintenance of water quality is important for irrigation purposes also.	Rejected	Amend, as recommended in Ms Sturgeon's evidence the terminology used to refer to target attribute states: The Council will regulate land use activities and will work with mana whenua, ~~with~~ landowners, local authorities, industry and community groups, ~~mana whenua~~ and

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
					other stakeholders will ~~regulate or~~ to manage land use activities ~~and surface and groundwater bodies~~ so that the 2040 target ~~water quality~~ attribute states described in Schedule 26 ~~attributes~~ are maintained ~~at their current state~~ or where required ~~show an improving trend towards the water quality targets shown in Schedule 26~~ by focussing on: ... a) water quality improvement in priority sub-catchments (as described in Schedule 28) where water quality is not meeting specified ~~freshwater quality targets~~ target attribute states; And, amend f), as per HortNZ's submission: f) the protection of water quality for domestic use and registered drinking water supplies ~~and municipal water supply~~ and irrigation purposes
Policy 2	Support with amendments	Amend by adding 'landowner collectives' to the start of the policy, and add to the end of a)i) 'and biosecurity	Specifically recognises that riparian planting projects need to take into	The S42a recommends the policy is deleted (although its not	Accept S42a, the point on biosecurity and various landownership and management relationship is addressed sufficiently in other policies.

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		requirements of adjacent land use'	account the biosecurity requirements of adjacent land use	deleted on the HBRC website version)	
Policy 4	Support with amendment	Amend by adding definition of 'lower Ngaruroro' and planning map outlining extent of area	Clarifies area to which policy applies.	Accepted	Accept S42a, with improvements to the Planning Maps outlined in the evidence of Ms Sturgeon.
Policy 6	Support with amendment	Amend by adding as subsection (b) 'requiring Registered Drinking Water Suppliers to quantify the vulnerability of the registered drinking water supply to contamination, and then undertake an assessment of options to relocate existing drinking water supplies to less vulnerable locations'.	Ensures that registered drinking water supplies are as appropriately sited as possible – taking into account need to avoid limiting productive land uses on the highly productive soils of the Heretaunga Plains.	Rejected - TANK POL 6 manages for the effects of activities on drinking water sources and is consistent with the National Environmental Standards for Sources of Drinking water.	Accept S42a, on the basis that this policy is primarily about preventing contamination, identifying protection areas and regulating activities within those areas. However, the addition HortNZ sought remains a relevant consideration and we consider it could fit instead in POL 9, as explained in Ms Sand's evidence.
Policy 7	Support with amendment	Amend by adding subsection e) as follows: require applications to include an assessment of	Ensures that registered drinking water supplies are as	Rejected - on the basis that the new Water Services legislation will	This remains a valid consideration for new drinking water supplies even in light of the proposed Water Services Bill. Amend by

	Submission				Hearing
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		the vulnerability of the location to contaminants from existing activities, and sites that are vulnerable are avoided where possible.	appropriately sited as possible – taking into account need to avoid limiting productive land uses on the highly productive soils of the Heretaunga Plains.	address the issues sought through the requirement for source water risk management plans to be prepared by drinking water suppliers' (at 2272)	adding subsection e), as explained in Ms Sand's evidence: When considering applications to take water for a Registered Drinking Water Supply, the Council will: ... e)require applications to include an assessment of the vulnerability of the location to contaminants from existing activities, and sites that are vulnerable are avoided where possible.
Policy 8	Support with amendment	Amend by adding an additional subsection to b) as follows: nature of existing land and water use within Source Protection Zone, existing investment in those activities, and the specific locational needs of those activities.	Ensures that registered drinking water supplies are as appropriately sited as possible – taking into account need to avoid limiting productive land uses on the highly productive soils of the Heretaunga Plains.	Accepted - with amendment (at 2281)	Accept S42a, however the amended provision is not visible (the s42a PC9 version on the HBRC website is incomplete for this policy, missing a,b,c,d provisions) Amend by adding an additional subsection to b) The Council will, when considering applications to discharge contaminants or carry out land or water use activities within: ... b) [missing text] nature of existing land and water use within Source Protection Zone, existing investment in those activities, and

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
					the specific locational needs of those activities.
Policy 9	Support with amendments	HortNZ did not submit on this policy specifically, but did seek consideration of vulnearability of water supplies (and consideration of relocation) in our submission generally and in TANK Pol 6	Takes all options into account and, the need to avoid limiting productive land uses on the highly productive soils of the Heretaunga Plains.	Rejected - (refer to POL 6)	Instead of including the following in POL 6, amend POL 9 by adding subsection (g) ... g) requiring Registered Drinking Water Suppliers to quantify the vulnerability of the registered drinking water supply to contamination, and then undertake an assessment of options to relocate existing drinking water supplies to less vulnerable locations'
Policy 13	Support		HortNZ encourages HBRC to provide information about appropriate riparian planting asap, and to not wait until the provisions of this plan are finalised.	Accepted in part	Support S42a
Policy 16	Support with amendment	Amend by adding a definition of 'flushing flow' to the plan	Clarifies impact of policy.	Rejected	Amend by adding a definition of 'flushing flow' to the plan as detailed below (under definitions).

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
Policy 17	Support with amendments	Amend as follows: 'The Council will achieve or maintain the freshwater targets or freshwater objectives in Schedule 26 by working with landowners, landowner collectives, industry groups, and other stakeholders and will implement the following measures; a) establishing programmes and processes through Farm Environment Plans, ~~Catchment~~ Landowner Collectives and Industry Programmes to ensure land managers; (i) adopt ~~industry~~ good management practice; (ii) identify critical source areas of contaminants at all relevant scales; (iii) adopt effective measures to mitigate or reduce contaminant loss where this is necessary to	Clarifies and refines the policy.	Rejected	Accept S42a, with the amendments suggested to schedule 30 in Dr Farrelly's evidence. And, as recommended in Ms Sturgeon's evidence an amendment to the terminology used to refer to target attribute states: The Council will achieve or maintain the ~~2040 freshwater attribute targets or freshwater objectives~~ target attribute states in Schedule 26 with ...

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		achieve good management practice; (iv) prepare nutrient management plans in catchment not meeting targets for dissolved nitrogen; And a definition of 'critical source area' is added to the glossary.			
Policy 18	Support with amendments	Amend as follows: 'The Council will achieve or maintain the freshwater targets or freshwater objectives in Schedule 26 by… c) regulating land use change to manage contaminant loss across a range of contaminants; e) working with industry groups, collectives, landowners and other stakeholders to undertake research and investigation into; (i) nutrient pathways, concentrations and loads	The community values and freshwater outcomes sought relate to a range of target attributes and contaminants. Regulation of land use should focus on achieving priority outcomes, rather than focusing on one indicator.	Accepted in part	Terminology changes are recommended in Ms Sturgeon's evidence (regarding target attribute states). I also recommend a change to (c) to reflect a multi contaminant approach. Amend as follows: 'The Council will achieve or maintain the 2040 ~~freshwater~~ ~~attribute~~ target~~s~~ attribute states ~~or freshwater objectives~~ in Schedule 26 by… c) regulating land use change to manage ~~where there is a~~ ~~significant risk of increased nitrogen loss~~ contaminant loss across a range of contaminants;

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		in rivers and coastal receiving environments; (ii) nutrient uptake and loss pathways at a property scale; (iii) measures to reduce contaminant losses at a property as well as catchment scale including those delivered through industry programmes and landowner collectives.			
Policy 19	Support with amendments	Amend as follows: 'In catchments that do not meet objectives for dissolved ~~nutrients~~ nitrogen specified in Schedule 26, the Council will ensure landowners, landowner collectives and industry groups have nutrient management plans according to the priority order in Schedule 28.'	Consistent with Policy 17, however then may create inconsistency with Schedule 28 which would need to be addressed.	Rejected	Accept S42a, addressed sufficiently in other policies. The policy is deleted as per s42A report.

Policy 21	Support with amendments	Amend as follows: 'The Council will remedy or mitigate the potential impact of ~~diffuse discharge of nitrogen on freshwater quality objectives by regulating~~ land ~~and water~~ use changes that modelling indicates are likely to result in increased contaminant loss (modelled on an average annual, whole of farm or collective basis) and in making decisions on resource consent applications, the Council will take into account: … a) contaminant losses modelled to result from the land use change, in relation to whether freshwater quality objectives or targets are being met in the catchment where the activity is to be undertaken; ~~and will;~~ ~~d) avoid land use change that will result in increased nitrogen loss that contributes to water~~	In our view the land use change policy should focus on managing all contaminants. In our view the land use change policy should also signal the positive effects that land use change can bring. Land use change is important for domestic food supply, climate change mitigation and climate change adaptation and enabling and promoting it requires some flexibility so increases in some contaminants can occur at the farm scale, provided at the	Rejected – The word 'avoid' is considered critical to the policy so that Council can control land use change where it creates a risk to meeting water quality targets (at 794).	HortNZ considers a multi-contaminant approach is consistent with NPSFM and more applicable to TANK receiving environments and farm systems. HortNZ also considers benefits of Landuse change should be considered, as are benefits of water use elsewhere in the Plan. On the basis of the evidence of Ms Sands, Mr Ford and Ms Sturgeon, I recommend the following changes to POL 21. Amend as Follows: The Council will regulate production land use change to manage the ~~remedy or mitigate~~ the potential impact of increases in diffuse discharges ~~of nitrogen~~ on freshwater quality objectives ~~by regulating land and water use changes that modelling indicates are likely to result in increased nitrogen loss~~ (modelled on an average annual , whole of ~~property or whole of~~ farm enterprise or collective ~~enterprise~~ basis, and including the full crop rotation)and in making decisions on resource consent applications, the Council will take into account: a) whether freshwater quality objectives or target~~s~~ attribute states are being met in the catchment where the activity is to be undertaken as a result of modelled nitrogen losses from the land use change;

		~~quality objectives and targets in Schedule 26 for dissolved nitrogen not being met.~~ e) support crop rotation across highly productive land to maintain the soil health of highly productive land f) Recognise the importance of the TANK catchments for supplying vegetables for domestic food supply g) Support the transition to a low emissions economy by enabling land use change that reduces greenhouse gas emissions, improves sequestration and promotes climate change adaptation,	FMU or collective scale the overall water quality outcomes across a range of values You mibht are achieved.		b) where any relevant TANK Industry Programme or Catchment Collective is in place the extent to which the changed production land use activity is consistent with the Industry Programme or Collective outcomes, mitigation measures and timeframes; c) any mitigation measures required, (including those where model results are not available) and timeframes by which they are to be implemented that are necessary to ensure the actual or potential nitrogen contaminant loss occurring from the property, in combination with other nitrogen contamination losses in the catchment will be consistent with meeting 2040 freshwater ~~quality~~ target attribute states in Schedule 26 ~~objectives~~ , including performance in relation to industry good practice, efficient use of nutrients and minimisation of nutrient losses; d) support crop rotation across highly productive land to maintain the soil health of versatile land e) Recognise the importance of the TANK catchments for supplying vegetables and fruit for domestic food security f) Support the transition to a low emissions economy by enabling land use change that reduces greenhouse gas emissions, improves sequestration and promotes climate change adaptation,

					and will; (~~d~~g) avoid land use change that will result in increased nitrogen loss that contributes to water quality ~~objectives and~~ target attribute states in Schedule 26 for dissolved nitrogen not being met, unless in the sub-catchment, dissolved nitrogen is currently meeting the target attribute states in Schedule 26 and the land use change will result in an improvement in one or more target attribute states for e.coli, sediment or phosphorus in the sub-catchment where these contaminants are not meeting target attribute states.

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
Policy 23	Support with amendments	Amend as follows: 'The Council will support the establishment and operation of ~~Industry Programmes and Catchment~~ landowner Collectives and: ~~a) ensure any relevant information or expertise for making sustainable land management decisions is available to land managers;~~ b) support development and use of ~~catchment scale~~ models that assist in identification and management of critical source areas; c) support ~~catchment~~ collective and farm scale decision making to meet freshwater objectives and encourage local solutions and innovative and flexible responses to water quality issues;…	More accurately reflects the functional capability of industry programmes, and focuses policy at collective scale, rather than unnecessarily focusing at catchment scale.	Rejected	Accept S42a amendments

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
Policy 24	Support with amendments	Amend as follows: 'The Council will continue to work with landowners, industry groups and other stakeholders to manage land ~~and water~~ use activities so that they meet objectives for freshwater/aquatic ecosystems by: a) further supporting the development of Industry Programmes that contribute to meeting applicable freshwater objectives and that; ~~(i) identify practices that contribute to meeting applicable freshwater objectives;~~ ~~(ii) specify timeframes for completion or adoption of measures to mitigate contaminant losses;~~ (iii) ensure individual performance under an Industry Programme is monitored;	More accurately reflects the functional capability of industry programmes.	Accept in part – deleting clauses (a)(i), (ii) and part of (iv) undermines the ability of Industry programs to address cumulative effects of land use at a property and catchment scale.	Accept S42a, with the amendments in Dr Farrelly's evidence below. Amend as follows: ... a) further supporting the development and recognition of Industry Programmes that contribute to meeting applicable freshwater objectives and that; (i) identify practices that contribute to meeting applicable freshwater objectives; (ii) specify timeframes for completion or adoption of measures to reduce ~~mitigate~~ contaminant losses; (iii) ensure individual performance under an Industry Programme is~~monitored~~ audited; (iv) provide annual reports to the Council on progressive implementation of freshwater farm plans ~~measures identified~~ in Industry Programmes established under Schedule 30 ~~and progress towards meeting applicable objectives for water quality~~; (v) promote adoption of good ~~industry~~ management practice;

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		(iv) provide annual reports to the Council on progressive implementation of measures implemented by members ~~identified in Industry Programmes established under Schedule 30 and progress towards meeting applicable objectives for water quality~~; (v) promote adoption of good ~~industry~~ management practice; (vi) ensure that Industry Programmes are consistent with the requirements of Schedule 30; b) supporting landowners to establish ~~Catchment~~ landowner Collectives to develop and implement environmental management plans that contribute to meeting applicable freshwater objectives and that;			(vi) ensure that Industry Programmes are consistent with the requirements of Schedule 30; .... d) Auditing Catchment ~~Landowner~~ Collective ~~or Industry Programmes~~ prepared and approved under Schedule 30 ~~including auditing of member properties~~

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		(i) ~~identify and adopt measures at a property scale and~~ collectively ~~with other land managers that reduce contaminant losses or remedy or~~ mitigate the effects of land use on freshwater objectives; (ii) specify timeframes for completion or adoption of measures to mitigate contaminant losses; (iii) ensure individual performance under a catchment collective is monitored; (iv) provide annual reports to the Council on progressive implementation of measures ~~identified in landowner collectives established under Schedule 30 and progress towards meeting applicable objectives for water quality~~;			

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		(v) promote adoption of good ~~agricultural~~ management practice; (vi) ensure programmes prepared by a collective are consistent with the requirements of Schedule 30; c) Approving any Landowner Collective or Industry Programme developed under Schedule 30; d) Auditing Landowner Collective or Industry Programmes where appropriate'.			
Policy 25		HortNZ did not submit on this policy specifically, but sought a definition of farm, that included farm operators.	Aligns with NESFW, and within horticulture there is significant amount of leased land within farms. The growers not the landlord has the ability and knowledge to	Accept in part	Support s42A

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
			implement practices.		
Policy 26	Support with amendment	Amend as follows': ~~Where individuals are members of a Catchment Collective or Industry Programme but do not undertake their activity in accordance with the approved plan prepared in accordance with Schedule 30, or do not follow the agreed terms of membership the Council will;~~ ~~a) provide a conflict resolution service;~~ ~~b) where an~~ <u>If a property/enterprise owner is not a member of a landowner collective or industry programme</u> ~~individual is no longer, or is deemed through conflict resolution processes not to be, a member~~ the Council will; (i) require the development of a farm	Simplifies policy to make expectations clearer.	Reject	Accept S42a

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		plan for that property within 6 months or; (ii) require an application for a land use consent to be made; c) take appropriate enforcement action.			
Policy 27	Oppose	Move table to Schedule 30, and then delete remainder of policy in its entirety	Outcome sought would not be achieved by mechanism identified.	Rejected	Accept S42a, with the proposed changes to Schedule 30 recommended by Dr Farrelly
Policy 32	Support with amendment	Amend as follows: 'The Council will support the development of an Ahuriri Estuary Integrated Catchment Management Plan by a representative group of stakeholders, that includes (but is not limited to) representatives from the primary sector;	Highlights importance of any plan being put together by a group that includes representatives from all relevant stakeholder groups.	Rejected - not considered necessary to ensure PPC9 meets its objectives (at 2162)	Accept S42a. Note: The Appendix 1A s42A changes are missing the label 'POL TANK 32'.
Policy 34	Support with amendments	Amend as follows: Council will meet regularly with ~~representatives from~~ a TANK stakeholder group~~s~~ that includes representatives from all relevant sectors of the	Ongoing dialogue between the council and the community regarding the implementation	Rejected – causes duplication with POL TANK 35 (at 174)	Accept S42a

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		community, and will discuss (as appropriate) matters relating to: a) ~~review and report on TANK~~ implementation of the TANK plan; b) issues arising within the TANK Catchments that could be addressed by future plan changes; c) progress towards freshwater objectives/targets; d) possible options for consideration at time of plan review. ~~and develop measures to enable their resolution.~~	of the plan change, and possible future approaches to catchment planning is important, and should be required by provisions of the plan, to ensure it occurs.		
Policy 36	Support with amendments	Amend as follows: 'The Council recognises the actual and potential adverse effects of groundwater abstraction in the Heretaunga Plains Water Management Unit on… and will adopt a staged approach to groundwater	Ensures consistency with other sections of the plan.	Rejected - does not give effect to the NPSFM2020 or RPS POL LW 2B (at 1355)	Amend as follows: The Council recognises the actual and potential adverse effects of groundwater abstraction in the Heretaunga Plains Groundwater Quantity Area ~~Water Management Unit~~ on: a) groundwater levels ~~and aquifer depletion~~ b) flows in connected surface waterbodies;

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		management that includes; f) ~~avoiding further adverse effects by not allowing~~ restricting new water use g) encouraging ~~water~~ use efficiency ~~reducing existing levels of water use~~; h) gathering information about actual water use and its effects on stream depletion; ~~h~~i) where practicable mitigating the adverse effects of groundwater abstraction on flows in connected water bodies; i) ~~gathering information about actual water use and its effects on stream depletion;~~ j) monitoring the effectiveness of stream flow maintenance and habitat enhancement schemes; k) including plan review directions to assess			c) flows of the Ngaruroro River; d) groundwater quality through risks of sea water intrusion ~~and water abstraction~~ e) tikanga and mātauranga Māori; and will adopt a staged approach to groundwater management that includes; f) avoiding further adverse effects by not ~~allowing~~ granting new consents to take and use groundwater ~~new water use~~ g) encouraging water use efficiency ~~reducing existing levels of water use;~~ h) where practicable, mitigating the adverse effects of groundwater abstraction on flows in connected water bodies; i) gathering information about actual water use and its effects on stream depletion; j) monitoring the effectiveness of stream flow maintenance and habitat enhancement schemes; k) including plan review directions to assess effectiveness of these measures

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		effectiveness of these measures.			
Policy 37	Support with amendments	Amend as follows: In managing the allocation and use of groundwater in the Heretaunga Plains Water Management Unit, the Council will; a) adopt an interim allocation limit based on reasonable use ~~of 90 million cubic meters per year based on the actual and reasonable water use prior to 2017~~; b) ~~avoid~~ restrict the re-allocation of any water that might become available within the interim groundwater allocation limit or within the limit of any connected water body to primary production purposes, or for use in stream flow maintenance and enhancement schemes~~. until there has been a review of the relevant~~	Avoids the policy being unnecessarily restrictive, given that our knowledge about what a sustainable groundwater limit might be is still incomplete.	Rejected - does not give effect to the NPSFM2020 or RPS POL LW1 2B (at 1379)	Accept S42a, with one amendment: b) ~~avoid~~ restrict the re-allocation of any water that might become available within the interim groundwater allocation limit or within the limit of any connected water body to essential municipal uses or primary production purposes on versatile land, or for use in stream flow maintenance and enhancement schemes~~. until there has been a review of the relevant allocation limits within this plan~~;

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		~~allocation limits within this plan~~; c) manage the Heretaunga Plains Water Management Unit as an over-allocated management unit and prevent any new allocations of groundwater; d) when considering applications in respect of existing consents due for expiry, or when reviewing consents, to; (i) allocate groundwater the basis of the maximum quantity that is able to be abstracted during each year or irrigation season expressed in cubic meters per year; (ii) apply an assessment of ~~actual and~~ reasonable use (using Irricalc) ~~that reflects land use and water use authorised in the ten years up to August~~			

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		~~2017 (except as provided by Policy 50)~~; e) mitigate stream depletion effects on lowland streams by providing for stream flow maintenance and habitat enhancement schemes.			
Policy 38	Support with amendments	Amend as follows: 'The Council will ~~restrict the re-allocation of water to holders of permits to take and use water in the Heretaunga Water Management Unit issued before 2 May 2020~~ and will review permits or allocate water according to the plan policies and rules either: a) upon expiry of the consent; or b) in accordance with a review of all applicable permits within ten years of; whichever is the sooner.'	Avoids unnecessary restriction on who water can be 're-allocated' to.	Rejected – do not align with NPSFM2020 and confuse the planning framework (at 1403). Do not effectively and efficiently achieve the policy intent (at 1405).	Amend as follows: 'The Council will restrict the re-allocation of groundwater ~~to holders of permits to take and use water~~ in the Heretaunga Water Management Unit ~~issued before 2 May 2020~~ and will review permits or allocate water according to the plan policies and rules either: a) upon expiry of the consent; or b) in accordance with a review of all applicable permits within ten years of; whichever is the sooner.'
Policy 39	Support with amendments	Amend as follows: 'When assessing applications to take groundwater in the	Given the uncertainty about how and	Rejected as no longer relevant given	Accept S42a, with an amendment to 39(c)(i) to make it clearer that permit holder can develop their own schemes

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		Heretaunga Plains Water Management Unit the Council will: a) either; (i) require abstraction to cease when an applicable stream flow maintenance scheme trigger is reached; or (ii) enable consent applicants to develop or contribute to stream flow maintenance and habitat enhancement schemes that; 1. contribute flow to lowland rivers where groundwater abstraction is depleting stream flows; and 2. improve oxygen levels and reduce water temperatures; b) assess the relative contribution to stream depletion from groundwater takes and require stream depletion to be off-set equitably by	when stream flow maintenance and habitat enhancement schemes, it is considered prudent to delete some of the unnecessary detail from this policy.	other submissions accepted (at 1444)	collectively as an alternative to the Council led schemes: Amend as follows: (c) develop and implement a funding mechanism that enables the Council to recover the costs of developing, constructing and operating stream flow maintenance and habitat enhancement schemes from permit holders, including where appropriate, (i) management responses that enable permit holders to work collectively to develop and manage local solutions and

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		consent holders while providing for exceptions for the use of water for essential human health; and ~~c) enable permit holders to progressively and collectively through Water User Collectives develop and implement flow maintenance and habitat enhancement schemes as water permits are replaced or reviewed, in the order consistent with water permit expiry dates.~~			
Policy 41	Oppose	Amend as follows: The Council will <u>further consider the option of remedying</u> the stream depletion effects of groundwater takes in the Heretaunga Plains Water Management Unit on the Ngaruroro River, in consultation with mana whenua, land and water users and the wider community through:	Does not unnecessarily commit the TANK community to a scheme that may not be, on balance, in the best interests of the community.	Accept in part – aligns with s5 RMA and recommends consequential amendment to POL 39.	Accept S42a

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		a) further investigating the environmental, technical, cultural, social and economic feasibility of a water storage and release scheme to off-set the cumulative stream depletion effect of groundwater takes;…			
Policy 47	Support with amendments	Amend as follows: 'When considering applications for resource consent, the Council will ensure water is allocated and used efficiently by: a) ensuring that the technical means of ~~using~~ use of water are physically efficient through; (i) allocation of water for irrigation end-uses based on soil, climate and crop needs; (ii) ~~requiring the~~ adoption of good management practice water use technology and processes that minimise the amount of water	Better aligns the policy with terminology as used within the irrigation industry.	Accepted in part - improves clarity (at 1584).	Accept S42a, with definitions added for water efficiency that includes the concepts of application efficiency and distribution uniformity.

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		~~wasted~~ lost from the soil profile; and (iii) the use of water meters; A definition of 'application efficiency' is added that states: "80% of applied water is retained within the crop root zone, after an irrigation event and/or for the irrigation season." A definition of 'distribution uniformity' is added that states: "Distribution uniformity is a measure of how evenly water is applied to the ground. It is calculated using the low quarter distribution uniformity coefficient DUlq"			
Policy 48	Support with amendments	Amend as follows: 'When considering any application to change the water use specified by a water permit, or to transfer a point of take to another	Protects water for primary production uses.	Rejected - do not give effect to NPSFM2020 (at 1604).	Accept S42a

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		point of take, to consider:… g) declining applications for a change of use from frost protection to any other end use <u>except primary production</u>;			
Policy 49	Support with amendments	Amend as follows: 'When making decisions about applications for resource consent to take and use water, the Council will set common expiry dates for water permits to take water in each water management zone, that enables consistent and efficient management of the resource and will set durations that provide a periodic opportunity to review effects of the cumulative water use and to take into account potential effects of changes in: <u>j) except where an application is to take and use water storage</u>	Provides necessary flexibility if large scale water storage is found to be a viable option within the catchment.	Accepted in part – provide consistency and clarity	Accept s42a

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		projects, consent durations of greater than 15 years will be considered and may be granted if a longer consent term is justified on the basis of the quantum of investment required to construct the scheme.			
Policy 51	Support		Recognises the importance of irrigating horticultural tree crops during extended dry periods.	Accept in part - align with OBJ TANK 16 (at 1660)	Accept S42a
Policy 52	Support with amendments	Amend as follows: The Council will phase out over-allocation by; a) preventing any new allocation of water (not including any reallocation in respect of permits issued before 2 May 2020, and high flow water provided for by this plan); b) for applications in respect of existing consents due for expiry or	Ensures that new water from high flow allocations can be accessed, and makes policy more practically appropriate in its application	Accept in part – improve clarity and consistency (at 1677).	Accept S42a

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		when reviewing consents, to; (i) allocate water according to ~~demonstrated actual and~~ reasonable need (except as provided for by Policy 50) (ii) impose conditions that require ~~efficiency gains to be made, including through altering the volume, rate or timing of the take and requesting~~ information to verify efficiency of water use relative to industry good management practice ~~standards~~; c) provide for, within the duration of the consent, meeting water efficiency standards where hardship can be demonstrated; d) reducing the amount of water permitted to be taken without consent, including those provided for by Section 14 (3)(b) of			

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		the RMA, except for authorised uses existing before 2 May 2020; e) encouraging voluntary reductions, site to site transfers (subject to clause (f)) or promoting water augmentation/harvesting; f) prevent site to site transfers of allocated but unused water that does not meet the definition of ~~actual and~~ reasonable use; …			
Policy 53	Support with amendments	Amend as follows: 'When considering applications to take water for frost protection, the Council will avoid, remedy or mitigate actual and potential effects of the take on its own or in combination with other water takes; a) from groundwater in the Heretaunga Plains Water Management Unit on;	More appropriately reflects the limited scope of any effects that do occur as a result of frost protection takes.	Rejected - do not improve clarity, effectiveness or efficiency (at 1701)	Accept S42a

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		(i) neighbouring bores and existing water users;. (ii) ~~connected surface water bodies;~~ ~~(iii) water quality as a result of any associated application of the water onto the ground where it might enter water;~~ b) from surface water on; (i) instantaneous flow in the surface water body; (ii) fish spawning and existing water users; (iii) applicable minimum flows during November to April; ~~(iv) water quality as a result of any associated application of the water onto the ground where it might enter water;~~ By; ~~c) taking into account any stream depletion effects of groundwater takes;~~ d) imposing limits in relation to minimum flows or groundwater levels;			

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		e) requiring water metering, monitoring and reporting use of water for frost protection.			
Policy 54	Support with amendments	Amend as follows: 'When assessing applications to dam water and to take water from the dam impoundment, the Council will avoid, remedy or mitigate adverse effects of; a) ~~potential changes to water quality arising from subsequent changes to land use activities that may occur as a result of water being allocated for take and use from the dam and whether relevant freshwater quality objectives can be met;~~ b) … ~~c) whether there are practicable alternatives; and, except as prohibited by Policy 58, will limit the amount of flow alteration~~	More appropriately reflects the water take focus of the policy.	Rejected - does not give effect to OBJ TANK 4 and 7 (at 1729).	Accept S42A

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		~~so that the damming of surface water either on its own or in combination with other dams or water storage in a catchment does not cumulatively adversely affect the frequency of flows above three times the median flow by more than a minor amount and provided that any dam in combination with other dams or high flow takes shall not cause changes to the river flow regime that are inconsistent with specified flow triggers.~~			
Policy 55	Support with amendments	Amend as follows: 'When assessing applications to take water for off-stream storage or to take water from the impoundment the Council will avoid remedy or mitigate adverse effects of; ~~a) potential changes to water quality arising from subsequent changes to~~	More appropriately reflects the water take focus of the policy, and the fact it relates to off-stream dams, which have less effects than in-stream dams.	Rejected – do not improve clarity or consistency (at 1743)	Accept S42A, but amend (ix) for clarity: ... (viii) the high flow take ceases when the river is at or below the median flow; (ix) such high flow takes do not cumulatively exceed the specified interim allocation limits in schedule 32

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		~~land use activities as a result of water being allocated for take and use from the impoundment and whether relevant freshwater quality objectives can be met;~~ b) the magnitude, frequency, duration and timing of water takes either by itself or cumulatively with other storage structures or dams, on; (i) the uses and values for any water body identified in the objectives; ~~(ii) water levels and flows in connected water bodies, including lakes and wetlands;~~ ~~(iii) water quality, including effects on temperature and management of periphyton in connected water bodies;~~ ~~(iv) river ecology and aquatic ecosystems,~~			

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		~~including passage of fish and eels, indigenous species habitat and riparian habitat, including in relation to the storage impoundment;~~ ~~(v) groundwater recharge;~~ (vi) downstream land, property and infrastructure at risk from failure of the proposed storage structure; (vii) other water users; and will limit the amount of flow alteration so that the taking of surface water does not cumulatively adversely affect the frequency of flows above three times the median flow by more than a minor amount and provided that; (viii) the high flow take ceases when the river is at or below the median flow; (ix) such high flow takes do not cumulatively exceed			

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		the specified allocation limits; (x) any takes to storage existing as at 2 May 2020 will continue to be provided for within new allocation limits and subject to existing flow triggers.			
Policy 59	Support with amendments	Amend as follows: 'The Council will allocate 20% of the total water available at times of high flow in the Ngaruroro or Tūtaekurī River catchments for abstraction, storage and use for the following activities; … ~~c) the use of water for any activity, provided that;~~ ~~(i) it includes contribution to a fund managed by the Council in consultation with mana whenua; and~~	Removes from regional policy financial arrangements that are a private matter.	Rejected – do not give effect to OBJ TANK 2, 17 or 18.	HortNZ support the intent of this policy, but make suggested edits to make it more workable, as explained in Ms Sand's evidence. Amend as follows: The Council will allocate 20 % of the total water available at times of high flow in the Ngaruroro or Tūtaekurī River catchments as specified in Schedule 32, and subject to Policies 54 – 59, for abstraction, storage and use for the following activities; a) contribution to environmental enhancement that contributes is in addition to any conditions imposed on the water storage proposal~~;~~

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		~~(ii) the fund will be used to provide for development of Māori wellbeing;~~ ~~(iii) the contribution to the fund is proportional to the amount of reserved water being taken and any commercial returns resulting from the application~~ …			b) improvement of access to water for domestic use by marae and papakāinga; c) the use of water for any activity, provided that; ~~(i) it includes contribution to a fund managed by the Council in consultation with mana whenua; and (ii) the fund~~ it will ~~be used to~~ provide for development of Māori wellbeing; ~~(iii) the contribution to the fund is proportional to the amount of reserved water being taken and any commercial returns resulting from the application.~~ d) the development of land returned to a Post-Settlement Governance Entity (PSGE) through a Treaty Settlement. Recommended changes to Proposed Plan Change 9 And in making decisions …
Policy 60	Support with amendments	Amend as follows: 'When making decisions about resource consent applications to take and store high flow water <u>in accordance with Policy</u>	Clarifies relevance of policy	Rejected – do not give effect to OBJ TANK 17 and 18 (at 1810)	Accept S42a

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		59, the Council will take into account the following matters:…'			
Policy 61	Support with amendments	This is a new Policy we sought consideration of climate change mitigation and adaptation in our submission generally and in TANK Pol 21	The 2020 RMA amendments to section 66, provides an opportunity for TANK to consider national climate change mitigation and adaption plans.	Rejected	Amend by adding: The Council will require decisions on land and water management to consider: … f) opportunities to reduce climate change emissions, aligned with emissions reductions plans, made in accordance with the Climate Change Response Act 2002. g) opportunities to improve climate change adaptation aligned to a national adaptation plan, made in accordance with the Climate Change Response Act 2002.
TANK 1	Support with amendments	Amend by replacing (throughout plan) terms farm property/farming enterprises with term 'farm.	Improves clarity of plan and aligns definition with NESFW 2020.	Accepted	The RMA definition of Farm has been adopted, not the NESFW definition proposed by HortNZ. The RMA definition is problematic, because it includes the term: a Farm is a Farm. The NESFW definition is useful because it describes what a Farm is, which is similar to the definition of enterprise in the but includes owned and leased parcels.

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
					As an alternative to amending the definition of farm (from the RMA Part 9A definition to the NESFM 2020 definition), the already defined term 'farming enterprise' would be more appropriate. a) The farming enterprise ~~property or farming enterprise land~~ areas has less than 75% plantation forest cover ... c) Where a farming enterprise is in a high priority sub-catchment for total nitrogen concentration or nitrogen yield ...
TANK 2					For consistency (and accuracy) Ms Sturgeon's evidence recommends: 1. The freshwater water quality objectives and target attribute states in Schedule 26 for the sub-catchment where the activity is being undertaken
TANK 3	Support with amendments	Add definition of 'active formed channel' to plan	Improves clarity of plan	Rejected	Accept S42a (deleted)

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
TANK 5	Support with amendments	Amend as follows: 'a) Any change to the production land use activity commencing after 2 May 2020 is over more than 10% of the ~~property or farming enterprise~~ total area of land managed by the landowner collective'. Matter for control (1) is amended as follows: Modelling using Overseer, or alternative model approved by Council to demonstrate the change in land use activity will be consistent with avoiding land use change that will result in increased annual average nitrogen loss that contributes to water quality objectives and targets in Schedule 26 for dissolved nitrogen not being met. Additional Matter for control is added: (8) The crop rotation and spatial	Genuinely incentivises landowners to join collectives, and also improves clarity of the plan. \ Vegetable rotations need to be consented as a crop rotation area that can move across the FMU Assessments must be for the average annual discharge load over the full duration and including the full sequence of crops and pasture. For commercial vegetable rotations we have proposed a 5 year rotation	Accepted in part – the alternatives suggested were considered and discounted during plan development and reported in the s32 report (801). It is appropriate that cropping is a regulated activity (at 817)	The evidence of Mr Ford prefers the notified approach to Schedule 29 (land use change), as a result this would negate the s42A new (a) condition proposed by the s42A authors. Amend the matter of control/discretion: 3) ~~2.~~ Measures to be undertaken ~~on the property~~ which contribute to meeting, ~~including how the effect of the new land use activity on contributing to~~ the water quality objectives ~~is being collectively addressed~~ including by……. And as recommended in Ms Sturgeon's evidence: If ~~water quality limits and~~ target attribute states in Schedule 26 are being met in the sub-catchment, consent applications in that catchment will be considered without public notification and without the need to, obtain written approval of affected persons.

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		extent of the rotation with the FMU. A definition of 'production land use change' is also added.	for the baseline assessment. For land use change, the assessment could be over a longer rotation, if that is what the activity requires.		And retain the notified clause relating to notification: Consent applications will generally be considered without notification and without the need to obtain written approval of affected persons
TANK 6	Support with amendments	Amend Condition b) by adding the following to the end of the condition: 'per farm or cumulatively for collectives. Add a new condition: b) or an increase in area of the existing commercial vegetables growing area by up to 10%, assessed at either the farm or collective scale. Additional Matter for control is added: (10) The crop rotation and spatial	Where farmers and or growers are operating within collectives, we propose they should be able to combine the load allowance per farm to provide greater flexibility for collectives. Enables a small expansion of vegetable rotations aligned with population	Accepted in part - the alternatives suggested were considered and discounted during plan development and reported in the s32 report (at 801)	As recommended in Ms Sturgeon's evidence: 3. Whether ~~water quality limits and~~ target~~s~~ attribute states in Schedule 26 are being met in the catchment where the new activity is to be undertaken. 10. The collection, recording, monitoring and provision of information including Overseer or alternative model files If ~~water quality limits and~~ target~~s~~ attribute states in Schedule 26 are being met in the sub-catchment, consent applications in that catchment will be considered without public notification and without the need to, obtain written approval of affected persons.

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		extent of the rotation with the FMU.	growth that is not subject to the nitrogen loss criteria within Schedule 29, which is important to help secure the domestic vegetable supply.		
TANK6A	Support	Insert new rule that provides a clear consenting pathway for activities that don't comply with TANK6. The activity status for this should be discretionary.	A discretionary pathway is required to provide for land use change that doesn't comply with the other land use rules. land use change that would result in an increase in nitrate that exceed schedule 29, should be assessed as discretionary activity, and	Accepted in part	Amend Plan to add a new rule, to make it clear that a discretionary pathway is required to provide for land use change that doesn't comply with the other land use rules.

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
			could be approved if it was consistent with the overall policy, for example resulted in significant reductions in greenhouse gas emissions and *E. coli*, and did not prevent outcomes associated with nitrate discharges being achieved.		
TANK 7 & 8	Support with amendment	Amend to include a specific exemption for the ongoing abstraction of up to 20m³ if water is abstracted for the purpose of assisting the survival of permanent horticultural crops.	Critical to ensure survival of permanent horticultural crops.	Accepted in part – are already provided for by rules TANK 7 and 8.	Amend to make it clearer that a RSS take limit is provided for. TANK 7 b) (i) Takes existing as at 2 May 2020 may continue to take up to 20m³ per property per day ~~may continue to take up to 20 cubic metres per property per day and to meet the reasonable~~

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
					~~needs of animals for drinking water~~; (ii) TANK 8 b) … (i) Takes existing as at 2 May 2020 may continue to take up to 20m³ per property per day ~~may continue to take up to 20 cubic metres per property per day and to meet the reasonable needs of animals for drinking water~~;
TANK 9 &10	Support with amendments	All references to 'actual and reasonable' are amended to just be to 'reasonable'. An additional matter of discretion is added as follows: 'The effects of any take and use for root stock survival on flows in connected surface water bodies.	Consistency with rest of plan	Reject – do not provide clarity or consistency (at 1889)	Accept S42a, with the amendment to the definition of Actual and Reasonable use, as described in the evidence of Ms Holmes

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
TANK 12	Oppose	Amend status to be 'non-complying'	Provides an opportunity for applications to be considered on a case by case basis, and decided on their merits.	Rejected - does not implement the policies of PPC9 (at 1992).	Amend status to be 'non-complying' from current 'Prohibited'
TANK 18	Oppose	Amend status to be 'restricted discretionary'	Provides greater clarity about matters to be considered in processing applications, and also incentives development of schemes more effectively.	Accept in part – helps to achieve OBJ TANK 18 and POL TANK 10 (at 2002)	Accept S42a
TANK 20					For consistency (and accuracy) Ms Sturgeon's evidence recommends: … to assist in meeting Schedule 26 target attribute states including: …
TANK 22					For consistency (and accuracy) Ms Sturgeon's evidence recommends:

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
					… to assist in meeting Schedule 26 target attribute states including …
RRMP 7	Support with amendments	Add exclusions to rule that allow the clearance of indigenous vegetation where it is required for biosecurity purposes, and also allow cultivation within setbacks where it is intermittently required for soil health and operational needs.	Enables intermittent activities that are critical to growing operations to continue to occur unimpeded.	Rejected	Accept S42a
RRMP 13	Support with amendments	Amend by adding 'at any one time' to end of (j).	Clarifies rule.	Rejected	Accept S42a
RRMP 32 & 33	Oppose	Amendments to 32 and 22 are deleted	Will enable information to be gathered that can inform decisions about need for any (future) regulation.	Accepted in part - This is because it enables other plan provisions to become effective in managing water quality, and also allows for the necessary research to be carried out, it recognises the difficulties in managing drainage water across	Accept S42a

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
				property boundaries and being able to manage water quality where there is no control over land use.	
RRMP 62a	Support with amendments	Amend by deleting (d)(i) (related to groundwater takes in HPWMU). Delete (f). (h) is amended to refer only to 'reasonable'	Improves clarity of rule.	Accepted – improve clarity, consistency, effectiveness and efficiency (at 2042) but then doubles up with submission point 180.66 and rejects because it doesn't implement POL TANK 48 (at 2045)	Accept S42a
Schedule 26	Support with amendments	Add the location of the monitoring and information on the existing state.	Improves understanding on whether the target attribute state is seeking to be maintained or improved	Accepted	Support S42a with the amendments suggested in the evidence of Ms Sturgeon.
Schedule 28	Support with amendments	Amend by deleting '~~5. A source Protection Zone'.~~ Amend catchment names to make clear the relationship of these catchments to other	Improves coherence and clarity of schedule.	Accepted in Part	Amendments as proposed in the evidence of Ms Sturgeon: This schedule sets out the thresholds used to determine the priority sub-catchments or places. The priority sub-catchments

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		catchments identified in the plan Amend catchment maps to ensure that contaminant loads discharged from upstream are not double counted, and the land that is captured by the risk categories represents the contribution of catchment to loads at the sub-catchment and whole of catchment scales.			identified using these thresholds are shown on the Schedule 28 Planning Maps 1 – 4 and Schedule 35 Planning Maps 1 - 2. The priority sub-catchments are determined according to the following water quality attributes and risks that are where there is;
Schedule 29	Support with amendments	Amend by adding definition of 'production land use change' to plan. State single N loss load applicable to all land uses and locations, however if current approach is maintained, update kiwifruit and vegetable rotation numbers and other crops, in accordance with evidence HortNZ will submit at hearing.	Improves clarity of schedule, and accuracy of triggers specified. Adopting single permitted load would reduce the complexity of the approach and is not warranted from an effects perspective.	Accepted in Part	Amendments as proposed in the evidence of Mr Ford (preferring the notified schedule)

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
Schedule 30	Support with amendments	Amend by redrafting and splitting out requirements for landowner collectives and industry programmes. Whose responsibility it is for completing farm plans is made explicitly clear.	Clarifies requirements relating to farm plans.	Accepted in Part - as it is a viable alternative but not consistent with how the schedule is currently written. Recommended to make Pol 27 more directive as well.	Amendments as proposed in the evidence of Dr Farrelly
Schedule 31	Support with amendments	Amend minimum flow for Tutaekuri River to 2,000l/s. Delete Note 2. Add volume with root stock survival volume/allocation that can be abstracted below minimum flow.	Proposed increase is not justified from an environmental effects perspective, nor is change in location of monitoring point Addition of root stock survival allocation will enable protection of valuable permanent horticultural crops during periods of low flows.	Accepted in Part - improves clarity and consistency (at 1529)	Accept S42a – with minor suggested amendment for clarity: The minimum flow is the flow at which surface water and Zone 1 groundwater consented takes must cease

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
Schedule 32	Support with amendments	Amend by adding allocation frameworks for the Karamu and possibly Ahuriri Catchments (depending on feasibility), and revisit allocation for Ngaruroro.	Improves clarity of schedule.	Rejected – do not seek specific relief (at 1827)	Accept S42a, with terminology changes to align with NPSFM.
Schedule 34B					For consistency (and accuracy) Ms Sturgeon's evidence recommends terminology changes to sub-catchment.
Schedule 36	Support with amendments	Amend schedule by deleting substantial amount of detail	Ensures schedule will retain flexibility necessary to enable establishment of schemes, in range of contexts	Rejected – recommends deleting schedule 36 (at 1487).	Accept S42a (deleted)
Definition of 'actual and reasonable'	Oppose	Amend by just referring to 'reasonable' - and in relation to applications to take and use water is the lesser of: a) the quantity specified on the permit due for renewal or any	Reliance on water data is fraught with innumerable problems, therefore the simplest and fairest approach is, with this first	Rejected – do not give effect to NPSFM2020 (at 2076)	The evidence of Ms Holmes recommends the following: b) the ~~maximum average~~ maximum annual amount as measured by accurate (as specified by the Resource Management (Measurement and Reporting of Water Takes) Amendment

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		lesser amount applied for; or b) for irrigation takes, the quantity required to meet the modelled crop water demand for the irrigated area with an efficiency of application of no less than 80% as specified by the IRRICALC water demand model (if it is available for the crop and otherwise an equivalent method) and to a 95% reliability of supply.	stage of improvements to freshwater management, move all water permit holders to the lesser volume of either their expiring permit, or Irricalc volume. This is fair and equitable. The current definition can and should be reinstated at the time of plan review in 10 years when everyone will have water meter records that are reliable, and at that time, reductions can and should be made if only small amounts of allocated volumes have		Regulations 2020) water meter data ~~in the ten years preceding 2 May 2020~~ over a period of sufficient length to provide the 9/10 year reliability preceding 2 May 2020. ~~if accurate water meter data is available. (If insufficient or no accurate data is available either clause a) or c) will apply)~~ d) for takes with an associated minimum flow, the quantity required for augmentation during low flow periods, as calculated by the Stream Depletion Calculator.

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
			been taken (taking into account development phases, and climate).		
New definition added for 'baseline commercial vegetable growing area'	Support	Insert definition as follows: 'Means the maximum total aggregated area of land used for a commercial vegetable growing operation, including the full sequence of crops and pasture used as part of a rotation, in any 12 month consecutive period within the period of 1 May 2015 to 1 May 2020 and under the control (owned or leased) of a single farm'.	Required to support amendments sought to TANK6.	Rejected	Accept S42a, we have sought to provide for food security in Objectives 10 – 14 and Policy 21, rather than in the Rules.
New definition added for 'commercial vegetable growing rotation	Support	Insert definition as follows: ' is a sub-set of horticultural land use, and means a crop rotation where the predominate purpose is growing, for the purpose of commercial gain, vegetable crops for	Required to support amendments sought to TANK6.	Rejected	Accept S42a, we have sought to provide for food security in Objectives 10 – 14 and Policy 21, rather than in the Rules. However a new definition of Crop rotation is still required to support the calculation of Nitrogen loss in policy 21, TANK 1, 2, 5 and 6 and Schedule 30. We proposed the

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
		human consumption, on one or more parcels of land held in single or multiple ownership (whether or not held in common ownership) that constitutes a single operating unit but excludes vegetable crops grown under cover, and includes the full sequence of crops and pasture used as part of that rotation.			definition in Horizons Plan Change 2 Decision, which achieves the same the outcome sought in the definition proposed in submission. Crop rotation: Crop Rotation is the systematic planting of different crops in sequence over multiple years within the same growing space, or across changing and parcels, and often includes a pasture phase. This process helps maintain nutrients in the soil, reduce soil erosion, and prevents plant diseases and pests.
New definition added for 'farm'	Support	Insert definition as follows: 'a landholding whose activities include agriculture'.	Consistency with national definition.	Rejected	Accept S42a
Definition of 'Farming enterprise'	Oppose	Delete and replace with term 'farm as defined above.	Consistency with NESFW 2020 .	Rejected	Accept S42a
New definition added for 'land holding'	Support	Insert definition as follows: 'one or more parcels of land (whether or not they are contiguous) that are managed as a single operation'.	Consistency with NESFW 2020	Rejected	Accept S42a

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
New definition added for 'nitrogen losses from production land'	Support	Insert definition as follows: 'The modelled estimate of average annual nitrogen load, calculated for each farm. For a commercial vegetable growing rotation, the nitrogen loss estimate must include the full sequence of crops and pasture used as part of that rotation'.	Aids clarity of land use provisions.	Rejected – however s42A recommend introduction of definitions for 'nitrogen loss rate' and 'nitrogen loss target'	Amend new definitions of nitrogen loss rate and nitrogen loss target, as explained in Stuart Ford's evidence: **Nitrogen loss rate** means the modelled average annual nitrogen loss rate for a property, or full crop rotation, using Overseer (or similar alternative nutrient loss ~~budget~~ model approved by the Hawke's Bay Regional Council) **Nitrogen loss target** means the modelled average annual nitrogen loss rate using Overseer (or similar alternative nutrient loss ~~budget~~ model approved by the Hawke's Bay Regional Council) for a property, or full crop rotation, which; a) adopts all industry good practice measures for managing nutrient losses and/or b) adopts additional mitigation measures to meet applicable water quality targets or objectives for dissolved nutrients. The Nitrogen loss rate and the nitrogen loss target may be the same for any property, or crop rotation. (The effects of some nutrient mitigation measures cannot be modelled within Overseer. This provision also reflects that some properties are already adopting

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
					good industry practice – but that this may change over time) And include a new definition for nitrogen budget, as follows: **Nitrogen Budget** a calculation that compares plant nutrient demand and supply to assist with appropriate nutrient applications and nutrient management. The budget can be crop specific or at the property scale.
New definition added for 'production land'	Support	Insert definition as follows: 'A farm where all or part of the farm is (a) arable land use; or (b) horticultural land use; or (c) pastoral land use; or (d) other agricultural land use prescribed in regulations made under section 217M(1)(b); or (e) any combination of the above'.	Clarifies what production land is.	Rejected	Accept S42A
New definition added for	Support	Insert definition as follows: 'Any change from or to, arable, horticulture,	Clarifies application of	Rejected	Addressed through changes sought to Schedule 29 in Mr Ford's evidence .

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
'production land use change'		pastoral or other agricultural land use, that is greater than 10ha, compared with the area of the farming activity at May 2020. Land use change does not include a change in the location of crop rotation where the baseline growing area is not exceeded within a Freshwater Quality Management Unit'.	Sched ule 29.		
Definition of 'TANK Industry Programme or TANK Catchment Collective'	Support with amendments	Amend by separating definitions, and aligning with redrafted Schedule 30.	Clarifies definitions.	Rejected	Addressed through amendments to Schedule 30, described in the evidence of Dr Farrelly
New Definition: **Flushing flows**		In Policy 16 a new definition was sought	Clarifies Pol TANK 16	Rejected	Add definition: Flushing Flows: flows regimes are managed so the frequency of flows three times the median flow (FRE3) is not reduced by more than 10% when compared to the naturalised flow, due to abstraction or damming.

	Submission				Hearing
Provision	**Support/oppose**	**Decision sought**	**Reason**	**S42A Report treatment of HortNZ suggestions**	**Decision Sought**
New Definition: Water efficiency		In Policy 47 new definition was sought	Clarifies Pol TANK 47	Accepted in part	Amend as Water efficiency has two components, application efficiency and distribution uniformity Application efficiency is defined as: "80% of applied water is retained within the crop root zone, after an irrigation event and/or for the irrigation season." Distribution uniformity is defined as: a measure of how evenly water is applied to the ground. It is calculated using the low quarter distribution uniformity coefficient DUlq"

Changes sought to schedules.

Schedule 26 Freshwater Quality Objectives	The evidence of Catherine Sturgeon recommends edits to the terminology to align with NPSFM language.
Schedule 28 Priority Catchments	Consequential minor change sought to refer to 'sub-catchments' as per recommendation of Catherine Sturgeons evidence. Catherine Sturgeon also recommends changes to the priority maps in Schedule 28 (notes these maps are included in Ms Sturgeons' evidence)
Schedule 29 Land use change	The evidence of Stuart Ford prefers the notified version of Schedule 29 – note that schedule this is <u>not</u> included below.
Schedule 30 Catchment Collective, Industry Programme and Freshwater Farm Plan	The evidence of HortNZ recommends a number of edits to this schedule – as explained in the evidence of Damien Farrelly, Catherine Sturgeon and Stuart Ford.
Schedule 31 Flows, Levels and Allocation Limits	Minor change to add 'consented' for clarity.
Schedule 32 High Flow Allocation	Edits to the terminology to align with NPSFM language.
Schedule 34B Integrated Catchment Management Plan	Consequential minor change sought to refer to 'sub-catchments' as per recommendation of Catherine Sturgeons evidence.

SCHEDULE 26: Freshwater Quality Objectives

Schedules 26 and 27 are re-presented to align with the NOF framework in the NPS-FM.
210.4, 120.17, 120.104, 123.127, 126.32, 127.14, 120.146, 120.150, 123.123, 210.113, 194.102, 120.147, 123.22, 210.118, 123.134, 120.161, 123.125, 120.149, 132.108, 132.172, 210.112, 210.113, 210.117, 132.156, 132.108 132.66, 132.4, 132.19, 123.126, 194.101, 210.114, 58.36, 120.152, 210.115

Replace Schedules 26 and 27 with the following:

Introduction to Schedule 26 Freshwater Quality Objectives

For water quality management, the TANK catchments have been divided into 5 separate areas:

1. Tūtaekurī Catchment
2. Ahuriri Catchment
3. Ngaruroro Catchment
4. Karamū Catchment
5. Ahuriri Estuary / Te Whanganui-a-Orotū and Waitangi Estuary

Maps

Refer to Schedule 26 Index Map and Schedule 26.1 – 26.5 Planning Maps.

Baseline data

Baseline data in Schedule has been obtained from the reports listed below unless otherwise specified in the Schedules:

Haidekker, S., Uytendaal, A., Hicks, A., Wade, Wade, H., Lyon, Madarasz-Smith, A.L., 2016. *Ngaruroro, Tutaekuri, Karamu River and Ahuriri Estuary Catchments: State and Trends of River Water Quality and Ecology (No. 4787)*. Hawke's Bay Regional Council, Napier.

Haidekker, S. (2021) Unpublished data.

Madarasz-Smith, A., Shanahan, B., 2020. *State of the Hawke's Bay Coastal Marine Environment: 2013 to 2018 (No. 5425)*. Hawke's Bay Regional Council, Napier.

Madarasz-Smith, A.L., 2018. *Proposed trigger levels for TANK estuaries Waitangi and Ahuriri Estuaries (No. 5027)*. Hawke's Bay Regional Council, Napier.

Madarasz-Smith, A.L., Shanahan, B., Ellmers, J., 2019. *Recreational Water Quality in Hawke's Bay State of the Environment: 2013 - 2018 (No. 5403)*. Hawkes Bay Regional Council, Napier.

Schedules 26.1 – 26.5

Insert Schedules as follows.

SCHEDULE 26.1: TŪTAEKURĪ CATCHMENT

Refer to Planning Map Schedule 26.1

Vision
<to be drafted through Kotahi Review process>

Outcomes
<This sits in the body of the plan. Refer to relevant TANK objectives>

TABLE 26.1.1a: Ecosystem Health (Water quality)

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
DIN (mg/L)	Median 5 years All flows	Headwaters (Upper Tūtaekurī)	Default	No/Insufficient data	< 0.05	< 0.05	**Refer to water quality objective OBJ TANK 12 for outcome description.** **Blue:** (≤ 0.05) Very low risk of algal growth. **Green**: (≤ 0.05 and < 0.15) Low risk of algal growth. **Yellow**: (≤ 0.15 and < 0.3) Moderate risk of algal growth. **Red:** (> 0.3) High risk of algal growth.	Algal growth	• Uu • Waimaori • Mauri • Mahinga kai, taonga/tohu species • Estuary ecosystem health • Recreation • Aquifer recharge • Natural character • Abstractive uses • Drinking water
			Lawrence Hut	0.016	Maintain	Maintain			
		Main stem (Lower Tūtaekurī)	Default	No/Insufficient data	<0.15	<0.15			• Uu • Waimaori • Mauri • Mahinga kai, taonga/tohu species • Aquifer recharge • Estuary ecosystem health • Recreation • Natural character • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use
			u/s Mangaone River	0.182	<0.15	<0.15			
			Brookfields Bridge / Puketapu	0.172	<0.15	<0.15			
		Hill country tributaries	Default	No/Insufficient data	< 0.3	< 0.3			• Uu • Waimaori • Mauri • Mahinga kai, taonga/tohu species • Estuary ecosystem health • Recreation • Aquifer recharge • Natural character • Abstractive uses • Drinking water
			Mangatutu Stream	0.45	< 0.3	< 0.3			
			Mangaone River (Rissington)	0.326	< 0.3	< 0.3			
Ammonia (mg NH_4-N/L) NOF Table 5	1. Annual median 2. Annual max Unionised ammonia based on pH at 20°C All flows	Headwaters	Default	No/Insufficient data	Median ≤ 0.03 Max ≤ 0.05	Median ≤ 0.03 Max ≤ 0.05	**Refer to water quality objective OBJ TANK 12 for outcome description.** **A band** (blue)**:** (Median ≤ 0.03; Max ≤ 0.05) 99% species protection level, no observed effect on any species tested. **B band** (green)**:** (Median > 0.03 and ≤ 0.24; Max >0.05 and ≤ 0.40) 95% species protection; starts impacting occasionally on the 5% most sensitive species. **C band:** (red, below national bottom line): (Median > 0.24 and ≤ 1.30; Max > 0.40 and ≤ 2.20)	Toxicity	• Waimaori • Mauri • Indigenous taonga/tohu species habitat and spawning, ahu moana • Aquifer recharge • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use
			Lawrence Hut	Med 0.002 A Max 0.006 A	Maintain	Maintain			
		Main stem	Default	No/Insufficient data	Median ≤ 0.03 A Max ≤ 0.05 A	Median ≤ 0.03 A Max ≤ 0.05 A			
			u/s Mangaone River	Med 0.007 A Max 0.017 A	Maintain	Maintain			
			Brookfields Bridge	Med 0.012					

							80% species protection; starts impacting regularly on the 20% most		

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
			/ Puketapu	A			sensitive species (Reduced survival of most sensitive species). **D band** (purple, below national bottom line): (Median > 1.30; Max > 2.20) Starts approaching acute impact level (that is, risk of death) for sensitive species.		
				Max 0.024 A					
		Hill country tributaries	Default	No/Insufficient data	Median ≤ 0.03 A	Median ≤ 0.03 A			
					Max ≤ 0.05 A	Max ≤ 0.05 A			
			Mangatutu Stream	Med 0.005 A	Maintain	Maintain			
				Max 0.043 A					
			Mangaone River (Rissington)	Med 0.006 A					
				Max 0.04 A					
Nitrate (mg NO_3-N/L) NOF Table 6	1. Annual median 2. Annual 95th percentile Hazen method All flows	Headwaters	Default	No/Insufficient data	Median ≤ 1.0 A	Median ≤ 1.0 A	**Refer to water quality objective OBJ TANK 12 for outcome description.** **A band** (blue)**:** (Median ≤ 1.0; 95th percentile ≤ 1.5) High conservation value system. Unlikely to have adverse effects, even on sensitive species. **B band** (green)**:** (Median > 1.0 and ≤ 2.4; 95th percentile > 1.5 and ≤ 3.5) 95% species protection; some growth effects on up to 5% of species. **C band:** (red, below national bottom line) (Median > 2.4 and ≤ 6.9; 95th percentile > 3.5 and ≤ 9.8) Growth effects on up to 20% of species; (mainly sensitive species such as fish). No acute effects. **D band** (purple, below national bottom line) (Median > 6.9; 95th percentile > 9.8). Impacts on growth of multiple species, and starts approaching acute impact level (that is, risk of death) for sensitive species at higher concentrations (> 20 mg/L).	Toxicity	• Waimaori • Mauri • Indigenous taonga/tohu species habitat and spawning, ahu moana • Aquifer recharge • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use
					95th percentile ≤ 1.5 A	95th percentile ≤ 1.5 A			
			Lawrence Hut	Med 0.008 A	Maintain	Maintain			
				95th percentile 0.025 A					
		Main stem	Default	No/Insufficient data	Median ≤ 1.0 A	Median ≤ 1.0 A			
					95th percentile ≤ 1.5 A	95th percentile ≤ 1.5 A			
			u/s Mangaone River	Med 0.18 A	Maintain	Maintain			
				95th percentile 0.397 A					
			Brookfields Bridge / Puketapu	Med 0.21 A					
				95th percentile 0.536 A					
		Hill country tributaries	Default	No/Insufficient data	Median ≤ 1.0 A	Median ≤ 1.0 A			
					95th percentile ≤ 1.5 A	95th percentile ≤ 1.5 A			
			Mangatutu Stream	Med 0.4 A	Maintain	Maintain			
				95th percentile 0.848 A					
			Mangaone River (Rissington)	Med 0.34 A					

				95th percentile 0.767					

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
				A					
DRP (mg/L) NOF Table 20	1. Median 2. 95th percentile All flows	Headwaters	Default	No/Insufficient data	Median ≤ 0.006 A	Median ≤ 0.006 A	**Refer to water quality objective OBJ TANK 12 for outcome description.** **A band** (blue): (Median ≤ 0.006; 95th percentile ≤ 0.021) Ecological communities and ecosystem processes are similar to those of natural reference conditions. No adverse effects attributable to dissolved reactive phosphorus (DRP) enrichment are expected. **B band** (green): (Median >0.006 and ≤ 0.010; 95th percentile >0.021 and≤0.030) Ecological communities are slightly impacted by minor DRP elevation above natural reference conditions. If other conditions also favour eutrophication, sensitive ecosystems may experience additional algal and plant growth, loss of macroinvertebrate taxa and higher respiration and decay rates. **C band** (orange): (Median >0.01 and ≤ 0.018; 95th percentile >0.030 and ≤0.054) Ecological communities are impacted by moderate DRP elevation above natural reference conditions. If other conditions also favour eutrophication, DRP enrichment may cause increased algal plant growth, loss of sensitive macro-invertebrate and fish taxa, and high rates of respiration and decay. **D band** (red): (Median > 0.018; 95th percentile > 0.054) Ecological communities impacted by substantial DRP elevation above natural reference conditions. In combination with other conditions favouring eutrophication, DRP enrichment drives excessive primary production and significant changes in macroinvertebrate and fish communities, as taxa sensitive to hypoxia are lost.	Algal growth	• Uu • Waimaori • Mauri • Mahinga kai, taonga/tohu species • Estuary ecosystem health • Recreation • Aquifer recharge • Natural character • Abstractive uses
					95th percentile ≤ 0.21 A	95th percentile ≤ 0.21 A			
			Lawrence Hut	Med 0.004 A	Maintain	Maintain			
				95thpercentile0.006 A	Maintain	Maintain			
		Main stem	Default	No/Insufficient data	Median ≤ 0.01 B	Median ≤ 0.01 B			
					95th percentile ≤ 0.03 B	95th percentile ≤ 0.03 B			
			u/s Mangaone River	Med 0.014 C	Med ≤ 0.01 B	Med ≤ 0.01 B			
				95thpercentile0.02 B	Maintain	Maintain			
			Brookfields Bridge / Puketapu	Med 0.02 D	Med ≤ 0.018 C	Med ≤ 0.01 B			
				95thpercentile0.031 C	95thpercentile ≤ 0.03 B	95thpercentile ≤ 0.03 B			
		Hill country tributaries	Default	No/Insufficient data	Median ≤ 0.01 B	Median ≤ 0.01 B			
					95th percentile ≤ 0.03 B	95th percentile ≤ 0.03 B			
			Mangatutu Stream	Med 0.02 D	Med ≤ 0.018 C	Med ≤ 0.01 B			
				95thpercentile0.023 B	Maintain	Maintain			
			Mangaone River (Rissington)	Med 0.026 D	Med ≤ 0.018 C	Med ≤ 0.01 B			
				95thpercentile0.036 C	95thpercentile ≤ 0.03 B	95thpercentile ≤ 0.03 B			
Suspended fine sediment Visual clarity (m) NOF Table 8	**Trout fishery**: Visual clarity Median Below median flow **NOF**: Visual clarity Median	Headwaters	Default	No/Insufficient data	≥ 5	≥ 5	**Refer to water quality objective OBJ TANK 12 for outcome description.** **Trout fishery:** **Bright blue** ≥ 5 meets outstanding trout fishery values. **Light green** ≥ 3.75 and < 5 meets significant trout fishery. **Russet** <3.75 does not meet significant trout fishery values.	Trout fishery - outstanding	• Recreation • Mauri • Natural character • Uu • Indigenous biodiversity and mahinga kai, taonga and tohu species and habitat • Amenity natural character • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use
					<Kotahi Review>	*<Kotahi Review>*			
			Lawrence Hut (Class 1)	7.6	Maintain	Maintain			
				6.9 *A*	*<Kotahi Review>*	*<Kotahi Review>*			

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
	Monthly samples Minimum 5 years Suspended Sediment (Classes 1 – 4)	Main stem	Default	No/Insufficient data	≥ 3.75	≥ 3.75	**NOF Attribute** *<Kotahi Review>* **A band** (Class 1 ≥ 1.78; Class 2 ≥ 0.93) Minimal impact of suspended sediment on instream biota. Ecological communities are similar to those observed in natural reference conditions. **B band** (Class 1: < 1.78 and ≥ 1.55; Class 2: < 0.93 and ≥ 0.76) Low to moderate impact of suspended sediment on instream biota. Abundance of sensitive fish species may be reduced. **C band** (Class 1: < 1.55 and ≥ 1.34, Class 2: < 0.76 and ≥ 0.61) Moderate to high impact of suspended sediment on instream biota. Sensitive fish species may be lost. **D band** (below national bottom line) (Class 1: < 1.34; Class 2: < 0.61) High impact of suspended sediment on instream biota. Ecological communities are significantly altered, and sensitive fish and macroinvertebrate species are lost or at risk of being lost.	Trout fishery - significant	
					<Kotahi Review>	*<Kotahi Review>*			
			u/s Mangaone River (Class 1)	3.4	Improving trend	≥ 3.75			
				2.54 *A*	*<Kotahi Review>*	*<Kotahi Review>*			
			Brookfields Bridge / Puketapu	3.35	Improving trend	≥ 3.75			
				2 *A*	*<Kotahi Review>*	*<Kotahi Review>*			
		Hill country tributaries	Default	No/Insufficient data	≥ 3.75	≥ 3.75			
					<Kotahi Review>	*<Kotahi Review>*			
			Mangatutu Stream (Class 1)	1.85	Improving trend	≥ 3.75			
				1.5 *C*	*≥ 1.78* *A*	*≥ 1.78* *A*			
			Mangaone River (Rissington) (Class 2)	2.3	Improving trend	≥ 3.75			
				2.15 *A*	*<Kotahi Review>*	*<Kotahi Review>*			
Deposited fine sediment (%)	% fine sediment cover Monthly samples Minimum 5 years 95th percentile	Headwaters		No/Insufficient data	<20%	<20%	**Refer to water quality objective OBJ TANK 12 for outcome description.** **Light green** < 20% protects stream biodiversity and fish (native and trout) habitat. **Russet:** ≥ 20% doesn't meet protection of stream biodiversity and fish (native and trout) habitat.	Biodiversity	• Uu • Waimaori • Mauri • Natural character • Kaitiakitanga- ahu whenua mahinga kai, he aha haere, taonga/tohu species habitat and spawning, cultural practices, wetlands and lakes, maori land, marae/hapū, indigenous biodiversity
		Main stem		No/Insufficient data	<20%	<20%			
		Hill country tributaries		No/Insufficient data	<20%	<20%			
Deposited fine sediment (%) NOF Table 16	% fine sediment cover Median Monthly samples Minimum 5 years				*<Kotahi Review>*				

TABLE 26.1.1b: Ecosystem Health (Aquatic life)

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR

						TERM			
Fish index of Biotic Integrity (F-IBI) NOF Table 13					*<Kotahi Review>*				
Macroinvertebrates	1. MCI	Headwaters	Default	No/Insufficient	MCI ≥ 130	MCI ≥ 130	**Refer to water quality objective OBJ TANK 12 for outcome description.** **A band (**blue**):**	Ecosystem	• Waimaori

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
MCI QMCI NOF Table 14 ASPM NOF Table 15	Macroinverte-brate Community Index Average Below median flow 2. QMCI Quantitative Macroinverte-brate Community Index 3. ASPM Macroinverte-brate average score per metric			data	QMCI ≥ 6.5	QMCI ≥ 6.5	(MCI ≥ 130; QMCI ≥ 6.5; ASPM ≥ 0.6) Macroinvertebrate community indicative of pristine conditions with almost no organic pollution or nutrient enrichment. Macroinvertebrate communities have high ecological integrity, similar to that expected in reference conditions. **B band** (green): (MCI ≥ 110 and < 130; QMCI ≥ 5.5 and < 6.5; ASPM <0.6 and ≥ 0.4) Macroinvertebrate community indicative of mild organic pollution or nutrient enrichment. Largely composed of taxa sensitive to organic pollution/nutrient enrichment. Macroinvertebrate communities have mild-to-moderate loss of ecological integrity. **C band** (orange)**:** (MCI ≥ 90 and < 110; QMCI ≥ 4.5 and < 5.5; ASPM <0.4 and ≥ 0.3) Macroinvertebrate community indicative of moderate organic pollution or nutrient enrichment. There is a mix of taxa sensitive and insensitive to organic pollution/nutrient enrichment. Macroinvertebrate communities have a moderate-to-severe loss of ecological integrity. **D band** (red): (below national bottom line) (MCI < 90; QMCI < 4.5; ASPM < 0.3) Macroinvertebrate community indicative of severe organic pollution or nutrient enrichment Communities are largely composed of taxa insensitive to organic pollution/enrichment. Macroinvertebrate communities have severe loss of ecological integrity.	health	• Mauri • Kaitiakitanga, whakapapa, taonga/tohu species habitat and spawning • Natural character • Indigenous biodiversity • Trout
					ASPM ≥ 0.6	ASPM ≥ 0.6			
			Lawrence Hut	MCI 129 B	MCI ≥ 130 A	MCI ≥ 130 A			
				QMCI 6.7 A	Maintain	Maintain			
				ASPM 0.64 A	Maintain	Maintain			
		Main stem	Default	No/Insufficient data	MCI ≥ 110	MCI ≥ 110			
					QMCI ≥ 5.5	QMCI ≥ 5.5			
					ASPM ≥ 0.4	ASPM ≥ 0.4			
			u/s Mangaone River	MCI 104 C	Improving trend	MCI ≥ 110 B			
				QMCI 4.9 C	Improving trend	QMCI ≥ 5.5 B			
				ASPM 0.39 C	Improving trend	ASPM ≥ 0.4 B			
			Brookfields Bridge / Puketapu	MCI 93 C	Improving trend	MCI ≥ 110 B			
				QMCI 4.8 C	Improving trend	QMCI ≥ 5.5 B			
				ASPM 0.30 C	Improving trend	ASPM ≥ 0.4 B			
		Hil country tributaries	Default	No/Insufficient data	MCI ≥ 110	MCI ≥ 110			
					QMCI ≥ 5.5	QMCI ≥ 5.5			
					ASPM ≥ 0.4	ASPM ≥ 0.4			
			Mangatutu River	MCI 120 B	Maintain	Maintain			
				QMCI 5.2 C	Improving trend	QMCI ≥ 5.5 B			
				ASPM 0.42 B	Maintain	Maintain			
			Mangaone River (Rissington)	MCI 116 B	Maintain	Maintain			
				QMCI 6 B	Maintain	Maintain			
				ASPM 0.55 B	Maintain	Maintain			

TABLE 26.1.1c: Ecosystem Health (ecological processes)

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
Periphyton (Trophic state) (mg Chl-*a*/m^2) NOF Table 2	Max 8% exceedance over 3 years monthly observations	Main stem	Puketapu	B	*<Kotahi Review>*	Maintain	Refer to water quality objective OBJ TANK 12 for outcome description. **A band:** (≤ 50 less than 8%) Rare blooms reflecting negligible nutrient enrichment and/or alteration of the natural flow regime. **B band**: (Exceeds >50 and ≤ 120 less than 8%) Occasional blooms reflecting negligible nutrient enrichment and/or alteration of the natural flow regime. **C band:** (Exceeds >120 and ≤ 200 less than 8%). Periodic short -duration nuisance blooms reflecting moderate enrichment and/or moderate alteration of the natural flow regime or habitat **D band:** (exceeds national bottom line) (> 200 less than 8%) Regular and/or extended-duration nuisance blooms reflecting high nutrient enrichment and/or significant alteration of the natural flow regime or habitat	Ecosystem health	
Periphyton cover (median of annual max %PeriWCC)	Monthly observations All year 3 years monthly observations	Headwaters	Default	No/Insufficient data	≤ 20	≤ 20	Refer to water quality objective OBJ TANK 12 for outcome description. **Blue**: (≤ 20) Ecological condition excellent and maintains recreation/aesthetics values. **Green**: (> 20 and ≤ 30) Ecological condition good and maintains recreation/aesthetics values. **Yellow**: (> 30 and ≤ 40) Ecological condition good and doesn't meet recreation/aesthetics values. **Orange**: (> 40 and ≤ 55) Ecological condition fair and doesn't meet recreation/aesthetics values. **Red**: (> 55) Ecological condition poor and doesn't meet recreation/aesthetics values.	Ecosystem health	• Uu • Waimaori • Mauri • Kaitiakitanga, he aha haere, taonga/tohu species habitat and spawning, mahinga kai, nohoanga, cultural practices, tauranga waka, maori land, marae/hapū • Natural character • Indigenous biodiversity • Abstractive uses including stock drinking
			Lawrence Hut	12 (2012-15)	Maintain	Maintain			
		Main stem	Default	No/Insufficient data	≤ 30	≤ 30			
			u/s Mangaone River	28 (2012-15)	Maintain	Maintain			
			Brookfields Bridge / Puketapu	34 (2012-15)	Improving trend	≤ 30			
		Upland tributaries	Default	No/Insufficient data	≤ 30	≤ 30			
			Mangatutu Stream	14 (2012-15)	Maintain	Maintain			
			Mangaone River (Rissington)	1.7 (2012-15)	Maintain	Maintain			
Dissolved Oxygen (mg/L) NOF Table 7	Below point source 7-day mean min Summer 1 Nov – 30 Apr		Consent related		No change from background levels	No change from background levels	Refer to water quality objective OBJ TANK 12 for outcome description.		
Dissolved Oxygen (mg/L or %) NOF Table 17	Continuous data 7-day mean minimum	Headwaters		No/Insufficient data	≥ 8 (7-d mean min) ≥ 7.5 (1-d min) ≥ 80% saturation	≥ 8 (7-d mean min) ≥ 7.5 (1-d min) ≥ 80% saturation	Refer to water quality objective OBJ TANK 12 for outcome description. **A band** (blue)**:** (7-day mean minimum ≥ 8.0;	Ecosystem health	• Waimaori • Natural character • Mauri • Kaitiakitanga, whakapapa, indigenous taonga/tohu species
		Main stem		No/Insufficient data					

	1-day minimum Summer period (Nov-April)	Hill country tributaries		No/Insufficient data	A	A	1-day min ≥ 7.5) No stress caused by low dissolved oxygen on any aquatic organisms that are present at matched reference (near-pristine) sites. **B band** (green): (7-day mean minimum ≥ 7.0 and < 8.0; 1-day min ≥ 5.0 and < 7.5) Occasional minor stress on sensitive organisms caused by short periods (a few hours a day) of lower dissolved oxygen.		• Indigenous biodiversity • Trout

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
							Risk of reduced abundance of sensitive fish and macroinvertebrate species. **C band** (orange): (7-day mean minimum ≥ 5.0 and < 7.0; 1-day min ≥ 4.0 and < 5.0) Moderate stress on a number of aquatic organisms caused by dissolved oxygen levels exceeding preference levels for periods of several hours each day. Risk of sensitive fish and macroinvertebrates being lost. **D band** (red, (below national bottom line) (7-day mean minimum < 5; 1-day min< 4.0) Significant persistent stress on a range of aquatic organisms caused by dissolved oxygen exceeding tolerance levels. Likelihood of local extinctions of keystone species and loss of ecological integrity.		
BOD ($ScBOD_5$)	Below median flow		Consent related		<2 mg/L	<2 mg/L	Aquatic organisms are not subject to risk from low dissolved oxygen conditions.	Ecosystem health	
Ecosystem Metabolism ($gO_2m^{-2}d^{-1}$) NOF Table 21	7-day min (Dec-Mar) Young *et al.* method				*<Kotahi Review>*		**Refer to water quality objective OBJ TANK 12 for outcome description.**		
Temperature (°C) 5-day CRI	Cox-Rutherford-Index Continuous measurement Hottest 5 consecutive days All flows	Headwaters		No/Insufficient data	*<Kotahi Review>*	≤ 1^0 C increment from reference state A	**Refer to water quality objective OBJ TANK 12 for outcome description.** **A band** (blue)**:** (≤ 1°C increment compared to reference site) No thermal stress on any aquatic organisms that are present at matched reference (near-pristine) sites. **B band** (green): (≤ 2°C increment compared to reference site) Minor thermal stress on occasion (clear days in summer) on particularly sensitive aquatic organisms such as certain insects or fish. **C band** (orange): (≤ 3°C increment compared to reference site) Some thermal stress on occasion, with elimination of certain sensitive insects and absence of certain sensitive fish. **D band** (red): (> 3°C increment compared to reference site) Significant thermal stress on a range of aquatic organisms. Risk of local elimination of keystone species with loss of ecological integrity.		• Waimaori • Mauri • Kaitiakitanga • Whakapapa, taonga/tohu species, ahumoana, ahuwhenua, mahinga kai • Natural character • Indigenous biodiversity • Trout
		Main stem		No/Insufficient data	*<Kotahi Review>*	≤ 2^0 C increment from reference state B			
		Hill country tributaries		No/Insufficient data	*<Kotahi Review>*	≤ 2^0 C increment from reference state B			
		Lowland tributaries		No/Insufficient data	*<Kotahi Review>*	≤ 2^0 C increment from reference state B			• Waimaori • Mauri • Kaitiakitanga • Whakapapa, taonga/tohu species, ahumoana, ahuwhenua, mahinga kai • Natural character • Indigenous biodiversity
pH	At all times, 95th percentile				*<Kotahi Review>*		**Refer to water quality objective OBJ TANK 12 for outcome description.**		

Heavy metals & metalloids, pesticides & organic contaminants, radioactive contaminants	As required		As required	No/Insufficient data	95% species protection at all times	95% species protection at all times	**Refer to water quality objective OBJ TANK 12 for outcome description.** Greater than 95% of species are protected.	Ecosystem health	

TABLE 26.1.2: Human Contact

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
Cyanobacteria (benthic cover %)	Monthly observations, All year	All hard bottomed streams	As required	No/Insufficient data	< 20%	< 20%	**Refer to water quality objective OBJ TANK 12 for outcome description.** **Light Green** < 20% benthic cover **Orange** ≥ 20% and <50% benthic cover **Red** >50% benthic cover	Recreation	• Uu • Waimaori • Mauri • Kaitiakitanga, he aha haere, taonga/tohu species habitat and spawning, mahinga kai, nohoanga, cultural practices, tauranga waka, maori land, marae/hapū, • Natural character • Abstractive uses including stock drinking
Escherichia coli (E.coli) (cfu/100 mL) NOF Table 9	All year All flows Overall band determined over 4 numeric attribute states – details see NOF Table 9	Headwaters	Default	No/Insufficient data	A	A	**Refer to water quality objective OBJ TANK 12 for outcome description.** **A band (Blue)** For at least half the time, the estimated risk is <1 in 1,000 (0.1% risk). The predicted average infection risk is 1%. **B band (Green)** For at least half the time, the estimated risk is <1 in 1,000 (0.1% risk). The predicted average infection risk is 2%. **C band (Yellow)** For at least half the time, the estimated risk is <1 in 1,000 (0.1% risk). The predicted average infection risk is 3%. **D band (Orange)** 20-30% of the time the estimated risk is ≥50 in 1000 (>5% risk). The predicted average infection risk is >3%. **E band (Red)** For more than 30% of the time the estimated risk is ≥50 in 1000 (>5% risk). The predicted average infection risk is >7%.	Uu Recreation Human health	• Waimaori • Mauri • Kaitiakitanga, he aha haere • Ahuwhenua mahinga kai, nohoanga, cultural practices, tauranga waka, maori land, marae/hapū connections • Aquifer recharge • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use
			Lawrence Hut	A	Maintain	Maintain			
		Main stem	Default	No/Insufficient data	B	B			
			u/s Mangaone River	B	Maintain	Maintain			
			Brookfields Bridge / Puketapu	B	Maintain	Maintain			
		Hill country tributaries	Default	No/Insufficient data	B	B			
			Mangatutu Stream	D	B	B			
			Mangaone River (Rissington)	D	B	B			
Escherichia coli (E.coli) (cfu/100 mL) NOF Table 22	95th percentile of *E.coli per 100 mL*	Lowland	Tūtaekurī River at Guppy Road	308 Fair	*<Kotahi Review>*		**Refer to water quality objective OBJ TANK 12 for outcome description.** **Excellent** ≤ 130 Estimated risk of *Campylobacter* infection has a <0.1% occurrence, 95% of the time. **Good** >130 and ≤ 260 Estimated risk of *Campylobacter* infection has a 0.1 – 10% occurrence, 95% of the time. **Fair** >260 and ≤ 540 Estimated risk of *Campylobacter* infection has a 1 - 5% occurrence, 95% of the time. **Poor** >540 (below national bottom line) Estimated risk of *Campylobacter* infection has a >5% occurrence, 95% of the time.	Uu Recreation Human health	• Waimaori • Mauri • Kaitiakitanga, he aha haere • Ahuwhenua mahinga kai, nohoanga, cultural practices, tauranga waka, maori land, marae/hapū connections • Aquifer recharge • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use

TABLE 26.1.3: Groundwater (Water Use)

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
Any aesthetic determinand (Drinking Water Standards for New Zealand)	As required	Groundwater – all areas	*<Kotahi review>*	*<Kotahi review>*	Within guidelines specified in the Drinking Water Standards for New Zealand	Within guidelines specified in the Drinking Water Standards for New Zealand	**Refer to water quality objective OBJ TANK 14 for outcome description**	Human Health	
E. coli (cfu / 100ml)	Maximum concentration As required	Groundwater – all areas	*<Kotahi review>*	*<Kotahi review>*	< 1	< 1	**Refer to water quality objective OBJ TANK 14 for outcome description**	Human Health	
Nitrate-nitrogen (mg $N\text{-}NO_3$ /l)	95th percentile 5 years	Groundwater – all areas	*<Kotahi review>*	*<Kotahi review>*	< 1	< 1	**Refer to water quality objective OBJ TANK 14 for outcome description**	Ecosystem health	
All other determinands (Drinking Water Standards for New Zealand)	As required	Groundwater – all areas	*<Kotahi review>*	*<Kotahi review>*	Within guidelines specified in the Drinking Water Standards for New Zealand	Within guidelines specified in the Drinking Water Standards for New Zealand	**Refer to water quality objective OBJ TANK 14 for outcome description**	Human Health	

Notes:

The attributes are as measured in groundwater at 10m below ground level.

Some aesthetic determinands including iron, manganese and hardness are affected by geological conditions and will affect natural water quality.

TABLE 26.1.4: Threatened Species
<Insert through Kotahi process>

TABLE 26.1.5: Mahinga Kai
<Insert through Kotahi process>

TABLE 26.1.6: Mātauranga Maori
<Insert through Kotahi process>

TABLE 26.1.7: Wetlands and Lakes
<Insert through Kotahi process>

SCHEDULE 26.2: AHURIRI CATCHMENT

Refer to Planning Map Schedule 26.2

Vision
<to be drafted through Kotahi Review process>

Outcomes
<This sits in the body of the plan. Refer to relevant TANK objectives>

TABLE 26.2.1a: Ecosystem Health (Water quality)

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
DIN (mg/L)	Median 5 years All flows	Lowland	Default	No/Insufficient data	≤ 0.444	≤ 0.444	**Refer to water quality objective OBJ TANK 10 for outcome description** **Light Green**: (≤ 0.444) Below ANZECC default guideline value, unlikely to be concerning. **Orange:** (> 0.444) Above ANZECC default guideline value, investigation/ management recommended.	Esturay ecosytem health	• Uu • Waimaori • Mauri • Mahinga kai, taonga/tohu species • Recreation • Natural character • Abstractive uses including for domestic, farm and community water supply, primary production, industrial and commercial use
			Taipo Stream	0.356	Maintain	Maintain			
			Wharerangi Stream	No/Insufficient data	≤ 0.444	≤ 0.444			
Ammonia (mg NH_4-N/L) NOF Table 5	1. Annual median 2. Annual max Unionised ammonia at a pH of 8 and temperature of 20^0C All flows	Lowland	Default	No/Insufficient data	Median ≤ 0.03 A	Median ≤ 0.03 A	**Refer to water quality objective OBJ TANK 10 for outcome description** **A band** (blue)**:** (Median ≤ 0.03; Max ≤ 0.05) 99% species protection level, no observed effect on any species tested. **B band** (green)**:** (Median > 0.03 and ≤ 0.24; Max >0.05 and ≤ 0.40) 95% species protection; starts impacting occasionally on the 5% most sensitive species. **C band:** (red, below national bottom line): (Median > 0.24 and ≤ 1.30; Max > 0.40 and ≤ 2.20) 80% species protection; starts impacting regularly on the 20% most sensitive species (Reduced survival of most sensitive species). **D band** (purple, below national bottom line): (Median > 1.30; Max > 2.20) Starts approaching acute impact level (that is, risk of death) for sensitive species.	Toxicity	• Waimaori • Mauri • Indigenous taonga/tohu species habitat and spawning, ahu moana • Aquifer recharge • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use
					Max ≤ 0.05 A	Max ≤ 0.05 A			
			Taipo Stream	Median 0.016 A	Maintain	Maintain			
				Max 0.119 B	Max ≤ 0.05 A	Max ≤ 0.05 A			
			Wharerangi Stream	No/Insufficient data	Median ≤ 0.03 A	Median ≤ 0.03 A			
					Max ≤ 0.05 A	Max ≤ 0.05 A			
Nitrate (mg NO_3-N/L) NOF Table 6	1. Annual median 2. Annual 95th percentile Hazen method All flows	Lowland	Default	No/Insufficient data	Median ≤ 1.0 A	Median ≤ 1.0 A	**Refer to water quality objective OBJ TANK 10 for outcome description** **A band** (blue)**:** (Median ≤ 1.0; 95th percentile ≤ 1.5) High conservation value system.	Toxicity	• Waimaori • Mauri • Indigenous taonga/tohu species habitat and spawning, ahu moana • Aquifer recharge • Abstractive uses including for domestic, farm and community water supply, primary production and food
					95th percentile ≤ 1.5 A	95th percentile ≤ 1.5 A			

							Unlikely to have adverse effects, even on sensitive species.		production, industrial and commercial use
			Taipo Stream	Median 0.131 A	Maintain	Maintain	**B band** (green)**:** (Median > 1.0 and ≤ 2.4; 95th percentile > 1.5 and ≤ 3.5)		

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
				95th percentile 0.66 A	Maintain	Maintain	95% species protection; some growth effects on up to 5% of species. **C band:** (red, below national bottom line) (Median > 2.4 and ≤ 6.9; 95th percentile > 3.5 and ≤ 9.8) Growth effects on up to 20% of species; (mainly sensitive species such as fish). No acute effects. **D band** (purple, below national bottom line) (Median > 6.9; 95th percentile > 9.8). Impacts on growth of multiple species, and starts approaching acute impact level (that is, risk of death) for sensitive species at higher concentrations (> 20 mg/L).		
			Wharerangi Stream	No/Insufficient data	Median ≤ 1.0 A	Median ≤ 1.0 A			
					95th percentile ≤ 1.5 A	95th percentile ≤ 1.5 A			
DRP (mg/L) NOF Table 20	1. Median 2. 95th percentile All flows	Lowland	Default	No/Insufficient data	Maintain or improving trend	Median ≤ 0.010 B	**Refer to water quality objective OBJ TANK 10 for outcome description** **A band** (blue): (Median ≤ 0.006; 95th percentile ≤ 0.021) Ecological communities and ecosystem processes are similar to those of natural reference conditions. No adverse effects attributable to dissolved reactive phosphorus (DRP) enrichment are expected. **B band** (green): (Median >0.006 and ≤ 0.010; 95th percentile >0.021 and ≤0.030) Ecological communities are slightly impacted by minor DRP elevation above natural reference conditions. If other conditions also favour eutrophication, sensitive ecosystems may experience additional algal and plant growth, loss of macroinvertebrate taxa and higher respiration and decay rates. **C band** (orange): (Median >0.01 and ≤ 0.018; 95th percentile >0.030 and ≤0.054) Ecological communities are impacted by moderate DRP elevation above natural reference conditions. If other conditions also favour eutrophication, DRP enrichment may cause increased algal plant growth, loss of sensitive macro-invertebrate and fish taxa, and high rates of respiration and decay. **D band** (red): (Median > 0.018; 95th percentile > 0.054) Ecological communities impacted by substantial DRP elevation above natural reference conditions. In combination with other conditions favouring eutrophication, DRP enrichment drives excessive primary production and significant changes in macroinvertebrate and fish communities, as taxa sensitive to hypoxia are lost.	Ecosystem health	• Uu • Waimaori • Mauri • Mahinga kai, taonga/tohu species • Aquifer recharge • Natural character • Abstractive uses
						95th percentile ≤ 0.030 B			
			Taipo Stream	Median 0.25 D	Improving trend	Median ≤ 0.010 B			
				95th percentile 0.59		95th percentile ≤ 0.030 B			
			Wharerangi Stream	No/Insufficient data	Improving trend	Median ≤ 0.010 B			
						95th percentile ≤ 0.030 B			

Suspended fine sediment	**Recreation/ aesthetics**	Lowland	Default	No/Insufficient data	> 1.6	> 1.6	**Refer to water quality objective OBJ TANK 10 for outcome description** **Recreation /Aesthetics** **Very Light Green**:	Recreation/ Aesthetics	• Recreation • Mauri

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
Visual clarity (m) NOF Table 8	Visual clarity Median Monthly samples Minimum 5 years **NOF**: Visual clarity Median Monthly samples Minimum 5 years Suspended Sediment (Classes 1 – 4)				*<Kotahi Review>*	*<Kotahi Review>*	> 1.6 meets recreation/aesthetics values. **Light Russet** ≤ 1.6 doesn't meet recreation/aesthetics values. **NOF Attribute** *<Kotahi Review>* **A band** (Class 1 ≥ 1.78; Class 2 ≥ 0.93) Minimal impact of suspended sediment on instream biota. Ecological communities are similar to those observed in natural reference conditions. **B band** (Class 1: < 1.78 and ≥ 1.55; Class 2: < 0.93 and ≥ 0.76) Low to moderate impact of suspended sediment on instream biota. Abundance of sensitive fish species may be reduced. **C band** (Class 1: < 1.55 and ≥ 1.34, Class 2: < 0.76 and ≥ 0.61) Moderate to high impact of suspended sediment on instream biota. Sensitive fish species may be lost. **D band** (below national bottom line). (Class 1: < 1.34; Class 2: < 0.61) High impact of suspended sediment on instream biota. Ecological communities are significantly altered, and sensitive fish and macroinvertebrate species are lost or at risk of being lost.		• Uu • Indigenous biodiversity and mahinga kai, taonga and tohu species and habitat • Natural character • Amenity natural character • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use
			Taipo Stream (class 2)	0.40	Improving trend	> 1.6			
				0.40 D	*<Kotahi Review>*	*<Kotahi Review>*			
			Wharerangi Stream (class 2) (	No/Insufficient data	> 1.6	> 1.6			
					<Kotahi Review>	*<Kotahi Review>*			
Deposited fine sediment (%) NOF Table 16	Median % fine sediment cover Monthly samples Minimum 5 years				*<Kotahi review>*		**Refer to water quality objective OBJ TANK 10 for outcome description**		

TABLE 26.2.1b: Ecosystem Health (Aquatic life)

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
Fish index of Biotic Integrity (F-IBI) NOF Table 13				No/Insufficient data	*<Kotahi review>*		**Refer to water quality objective OBJ TANK 10 for outcome description**		
Macroinvertebrates MCI	1. MCI (sb-MCI where relevant) Macroinverte-	Lowland	Default	No/Insufficient data	Maintain or improve	MCI ≥ 90 C	**Refer to water quality objective OBJ TANK 10 for outcome description**	Ecosystem health	• Waimaori • Mauri • Kaitiakitanga, whakapapa, taonga/tohu species habitat and

QMCI NOF Table 14 ASPM	brate Community Index Average Below median					QMCI ≥ 4.5 C	**A band (**blue**):** (MCI ≥ 130; QMCI ≥ 6.5; ASPM ≥ 0.6) Macroinvertebrate community indicative of pristine conditions with almost no organic pollution or nutrient enrichment.		spawning • Natural character • Indigenous biodiversity

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
NOF Table 15	flow 2. QMCI (sb-QMCI where relevant) Quantitative Macroinverte-brate Community Index 3. ASPM Macroinverte-brate average score per metric					ASPM ≥ 0.3 C	Macroinvertebrate communities have high ecological integrity, similar to that expected in reference conditions. **B band** (green): (MCI ≥ 110 and < 130; QMCI ≥ 5.5 and < 6.5; ASPM <0.6 and ≥ 0.4) Macroinvertebrate community indicative of mild organic pollution or nutrient enrichment. Largely composed of taxa sensitive to organic pollution/nutrient enrichment. Macroinvertebrate communities have mild-to-moderate loss of ecological integrity. **C band** (orange)**:** (MCI ≥ 90 and < 110; QMCI ≥ 4.5 and < 5.5; ASPM <0.4 and ≥ 0.3) Macroinvertebrate community indicative of moderate organic pollution or nutrient enrichment. There is a mix of taxa sensitive and insensitive to organic pollution/nutrient enrichment. Macroinvertebrate communities have a moderate-to-severe loss of ecological integrity. **D band** (red, (below national bottom line) (MCI < 90; QMCI < 4.5; ASPM < 0.3) Macroinvertebrate community indicative of severe organic pollution or nutrient enrichment Communities are largely composed of taxa insensitive to organic pollution/enrichment. Macroinvertebrate communities have severe loss of ecological integrity.		
			Taipo Stream	MCI 57.2 D	Improving trend	MCI ≥ 90 C			
				QMCI 1.8 D	Improving trend	QMCI ≥ 4.5 C			
				ASPM 0.1 D	Improving trend	ASPM ≥ 0.3 C			
			Wharerangi Stream	No/Insufficient data	Maintain or impove	MCI ≥ 90 C			
						QMCI ≥ 4.5 C			
						ASPM ≥ 0.3 C			
Macrophytes (max % CAV)	Monthly All year observations	Lowland	Default	No/Insufficient data	≤ 50 %	≤ 50 %	**Refer to water quality objective OBJ TANK 10 for outcome description** **Light Green** ≤ 50 % maintains ecological condition / flow conveyance / recreation values. **Russet** > 50% doesn't meet ecological condition / flow conveyance / recreation values.	Ecosystem health	• Uu • Waimaori • Mauri • Kaitiakitanga, he aha haere, taonga/tohu species, mahinga kai, nohoanga, cultural practices • Natural character • Indigenous biodiversity • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use
			Taipo Stream	No/Insufficient data	≤ 50 %	≤ 50 %			
			Wharerangi Stream	No/Insufficient data	≤ 50 %	≤ 50 %			

TABLE 26.2.1c: Ecosystem Health (ecological processes)

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
Dissolved Oxygen (mg/L or %) NOF Table 17	Continuous data 7-day mean minimum 1-day minimum	Lowland	Default	No/Insufficient data	≥ 5 (7-d mean min) ≥ 4 (1-d min) ≥ 80% saturation C	≥ 7 (7-d mean min) ≥ 5 (1-d min) ≥ 80% saturation B	**Refer to water quality objective OBJ TANK 10 for outcome description** **A band** (blue)**:** (7-day mean minimum ≥ 8.0; 1-day min ≥ 7.5)	Ecosystem health	• Waimaori • Mauri • Kaitiakitanga, whakapapa, indigenous taonga/tohu species • Natural character • Indigenous biodiversity

							No stress caused by low dissolved oxygen on any aquatic organisms that are present at		

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
	Summer period (Nov-April)		Taipo Stream	No/Insufficient data	≥ 5 (7-d mean min) ≥ 4 (1-d min) ≥ 80% saturation C	≥ 7 (7-d mean min) ≥ 5 (1-d min) ≥ 80% saturation B	matched reference (near-pristine) sites. **B band** (green): (7-day mean minimum ≥ 7.0 and < 8.0; 1-day min ≥ 5.0 and < 7.5) Occasional minor stress on sensitive organisms caused by short periods (a few hours a day) of lower dissolved oxygen. Risk of reduced abundance of sensitive fish and macroinvertebrate species. **C band** (orange): (7-day mean minimum ≥ 5.0 and < 7.0; 1-day min ≥ 4.0 and < 5.0) Moderate stress on a number of aquatic organisms caused by dissolved oxygen levels exceeding preference levels for periods of several hours each day. Risk of sensitive fish and macroinvertebrates being lost. **D band** (red, below national bottom line) (7-day mean minimum < 5; 1-day min< 4.0) Significant persistent stress on a range of aquatic organisms caused by dissolved oxygen exceeding tolerance levels. Likelihood of local extinctions of keystone species and loss of ecological integrity.		
			Wharerangi Stream	No/Insufficient data	≥ 5 (7-d mean min) ≥ 4 (1-d min) ≥ 80% saturation C	≥ 7 (7-d mean min) ≥ 5 (1-d min) ≥ 80% saturation B			
Dissolved Oxygen (mg/L) NOF Table 7	Below point source 7-day mean min Summer 1 Nov – 30 Apr		Consent related		No change from background levels	No change from background levels	Refer to water quality objective OBJ TANK 10 for outcome description No increased risk from point source.	Ecosystem health	• Waimaori • Mauri • Kaitiakitanga, whakapapa, indigenous taonga/tohu species • Natural character • Indigenous biodiversity
BOD ($ScBOD_5$)	Below median flow		Consent related		<2 mg/L	<2 mg/L	Refer to water quality objective OBJ TANK 10 for outcome description Aquatic organisms are not subject to risk from low dissolved oxygen conditions.	Ecosystem health	
Ecosystem Metabolism ($gO_2m^{-2}d^{-1}$) NOF Table 21	7-day min (Dec-Mar) Young et al method	Lowland			*<Kotahi review>*	*<Kotahi review>*	Refer to water quality objective OBJ TANK 10 for outcome description		
Temperature (°C) 5-day CRI	Continuous measurement Cox-Rutherford-Index Averaged over 5 hottest days of summer period	Lowland		No/Insufficient data	*<Kotahi review>*	≤ 2°C increment from reference state B	Refer to water quality objective OBJ TANK 10 for outcome description **A band** (blue)**:** (≤ 1°C increment compared to reference site) No thermal stress on any aquatic organisms that are present at matched reference (near-pristine) sites. **B band** (green): (≤ 2°C increment compared to reference site) Minor thermal stress on occasion (clear days in summer) on particularly sensitive aquatic	Ecosystem health	• Waimaori • Mauri • Kaitiakitanga, whakapapa, taonga/tohu species, ahumoana, ahuwhenua mahinga kai • Indigenous biodiversity • Natural character

							organisms such as certain insects or fish. **C band** (orange): (≤ 3°C increment compared to reference site)		

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
							Some thermal stress on occasion, with elimination of certain sensitive insects and absence of certain sensitive fish. **D band** (red): (> 3°C increment compared to reference site) Significant thermal stress on a range of aquatic organisms. Risk of local elimination of keystone species with loss of ecological integrity.		
pH	At all times, 95th percentile				*<Kotahi review>*				
Heavy metals & metalloids, pesticides & organic contaminants, radioactive contaminants	As required		As required	No/Insufficient data	95% species protection at all times	95% species protection at all times	**Refer to water quality objective OBJ TANK 10 for outcome description** Greater than 95% of species are protected.	Ecosystem health	

TABLE 26.2.2: Human Contact

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
Escherichia coli (E.coli) (cfu/100 mL) NOF Table 9	All year All flows Refer to NOF Table 9 for a description of how to measure the 4 metrics for this attribute	Lowland	Default	No/Insufficient data	B	B	**Refer to water quality objective OBJ TANK 10 for outcome description** **A band (Blue)** For at least half the time, the estimated risk is <1 in 1,000 (0.1% risk). The predicted average infection risk is 1%. **B band (Green)** For at least half the time, the estimated risk is <1 in 1,000 (0.1% risk). The predicted average infection risk is 2%. **C band (Yellow)** For at least half the time, the estimated risk is <1 in 1,000 (0.1% risk). The predicted average infection risk is 3%. **D band (Orange)** 20-30% of the time the estimated risk is ≥50 in 1000 (>5% risk). The predicted average infection risk is >3%. **E band (Red)** For more than 30% of the time the estimated risk is ≥50 in 1000 (>5% risk). The predicted average infection risk is >7%.	Uu Recreation Human health Uu Recreation Human health	• Waimaori • Mauri • Kaitiakitanga, he aha haere, ahu moana, ahuwhenua mahinga kai, nohoanga, cultural practices, tauranga waka, maori land, marae/hapū connections, • Aquifer recharge • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use
			Taipo Stream	E	B	B			
			Wharerangi Stream	No/Insufficient data	B	B			

TABLE 26.2.3: Groundwater (Water Use)

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR

Any aesthetic determinand (Drinking Water Standards for New Zealand)	As required	Groundwater – all areas	*<Kotahi review>*	*<Kotahi review>*	Within guidelines specified in the Drinking Water Standards for New Zealand	Within guidelines specified in the Drinking Water Standards for New Zealand	**Refer to water quality objective OBJ TANK 14 for outcome description**	Human Health	
E. coli (cfu / 100ml)	Maximum concentration As required	Groundwater – all areas	*<Kotahi review>*	*<Kotahi review>*	< 1	< 1	**Refer to water quality objective OBJ TANK 14 for outcome description**	Human Health	

Nitrate-nitrogen (mg N-NO_3/l)	95th percentile 5 years	Groundwater – all areas	*<Kotahi review>*	*<Kotahi review>*	<!	< 1	**Refer to water quality objective OBJ TANK 14 for outcome description**	Ecosystem health	
All other determinands (Drinking Water Standards for New Zealand)	As required	Groundwater – all areas	*<Kotahi review>*	*<Kotahi review>*	Within guidelines specified in the Drinking Water Standards for New Zealand	Within guidelines specified in the Drinking Water Standards for New Zealand	**Refer to water quality objective OBJ TANK 14 for outcome description**	Human Health	

Notes:

- The attributes are as measured in groundwater at 10m below ground level.
- Some aesthetic determinands including iron, manganese and hardness are affected by geological conditions and will affect natural water quality.

TABLE 26.2.3: Threatened Species
<Insert through Kotahi process>

TABLE 26.2.4: Mahinga Kai
<Insert through Kotahi process>

TABLE 26.2.5: Matauranga maori
<Insert through Kotahi process>

TABLE 26.2.6: Wetlands and Lakes
<Insert through Kotahi process>

SCHEDULE 26.3: NGARURORO CATCHMENT

Refer to Planning Map Schedule 26.3

Vision
<to be drafted through Kotahi Review process>

Outcomes
<This sits in the body of the plan. Refer to relevant TANK objectives>

TABLE 26.3.1a: Ecosystem Health (Water quality)

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
DIN (mg/L)	Median 5 years All flows	Headwaters (Upper Ngaruroro)	Default	No/Insufficient data	< 0.05	< 0.05	**Refer to water quality objective OBJ TANK 11 for outcome description** **Blue:** (≤ 0.05) Very low risk of algal growth. **Green**: (≤ 0.05 and < 0.15) Low risk of algal growth. **Yellow**: (≤ 0.15 and < 0.3) Moderate risk of algal growth. **Red:** (> 0.3) High risk of algal growth.	Algal growth	• Uu • Waimaori • Mauri • Mahinga kai, taonga/tohu species • Estuary ecosystem health • Recreation • Aquifer recharge • Natural character • Abstractive uses • Drinking water
			Kuripapango	0.01	Maintain	Maintain			
			Whanawhana	0.027	Maintain	Maintain			
		Main stem (Lower Ngaruroro)	Default	No/Insufficient data	< 0.15	< 0.15			• Uu • Waimaori • Mauri • Mahinga kai, taonga/tohu species • Aquifer recharge • Estuary ecosystem health • Natural character • Recreation • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use
			d/s HB Dairies	0.086	Maintain	Maintain			
			Fernhill	0.106	Maintain	Maintain			
			Chesterhope	0.08	Maintain	Maintain			
		Hill country tributaries	Default	No/Insufficient data	< 0.3	< 0.3			• Uu • Waimaori • Mauri • Mahinga kai, taonga/tohu species • Aquifer recharge • Estuary ecosystem health • Recreation • Natural character • Abstractive uses • Drinking water
			Ohara Stream	No/Insufficient data	< 0.3	< 0.3			
			Poporangi Stream	0.548	< 0.3	< 0.3			
			Maraekakaho Stream	0.231	Maintain	Maintain			
		Lowland tributaries	Default	No/Insufficient data	≤ 0.444	≤ 0.444	**Refer to water quality objective OBJ TANK 11 for outcome description** **Light green:** (≤ 0.444) Below ANZECC lowland guideline value, unlikely to be concerning. **Orange:** (> 0.444) Above ANZECC lowland guideline value, investigation/ management recommended.	Estuary ecosystem health	• Uu • Waimaori • Mauri • Mahinga kai, taonga/tohu species • Recreation • Aquifer recharge • Natural character • Abstractive uses including for domestic, farm and community water supply, primary production, industrial and commercial use
			Waitio Stream	0.219	Maintain	Maintain			
			Ohiwia Stream	0.468	≤ 0.444	≤ 0.444			
			Tutaekuri-Waimate Stream	0.243	Maintain	Maintain			
Ammonia (mg NH_4-N/L) NOF Table 5	1. Annual median 2. Annual max Unionised ammonia based on pH at 20°C	Headwaters	Default	No/Insufficient data	Median ≤ 0.03 A	Median ≤ 0.03 A	**Refer to water quality objective OBJ TANK 11 for outcome description** **A band** (blue)**:** (Median ≤ 0.03; Max ≤ 0.05)	Toxicity	• Waimaori • Mauri • Indigenous taonga/tohu species habitat and spawning, ahu moana • Aquifer recharge • Abstractive uses including for domestic, farm and community water supply, primary production and food
					Max ≤ 0.05 A	Max ≤ 0.05 A			
			Kuripapango	Median 0.0025 A	Maintain	Maintain			

	All flows			Max 0.005 A			99% species protection level, no observed effect on any species tested. **B band** (green)**:** (Median > 0.03 and ≤ 0.24; Max >0.05 and ≤ 0.40)		production, industrial and commercial use

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
			Whanawhana	Median 0.002 A Max 0.01 A			~~95% species protection; starts impacting~~ occasionally on the 5% most sensitive species. **C band:** (red, below national bottom line): (Median > 0.24 and ≤ 1.30; Max > 0.40 and ≤ 2.20) 80% species protection; starts impacting regularly on the 20% most sensitive species (Reduced survival of most sensitive species). **D band** (purple, below national bottom line): (Median > 1.30; Max > 2.20) Starts approaching acute impact level (that is, risk of death) for sensitive species.		
		Main stem	Default	No/Insufficient data	Median ≤ 0.03 A Max ≤ 0.05 A	Median ≤ 0.03 A Max ≤ 0.05 A			
			d/s HB Dairies	Median 0.002 A Max 0.17 A	Maintain	Maintain			
			Fernhill	0.003 A Max 0.036 A					
			Chesterhope	Median 0.004 A Max 0.008 A					
		Hill country tributaries	Default	No/Insufficient data	Median ≤ 0.03 A Max ≤ 0.05 A	Median ≤ 0.03 A Median ≤ 0.03 A			
			Ohara Stream	No/Insufficient data	Median ≤ 0.03 A Max ≤ 0.05 A	Max ≤ 0.05 A Median ≤ 0.03 A			
			Poporangi Stream (Big Hill Rd)	Median 0.0025 A Max 0.01 A	Maintain	Max ≤ 0.05 A Maintain			
			Maraekakaho Stream	Median 0.003 A Max 0.017 A					
		Lowland tributaries	Default	No/Insufficient data	Median ≤ 0.03 A Max ≤ 0.05 A	Median ≤ 0.03 A Median ≤ 0.03 A			
			Waitio Stream	Median 0.002 A Max 0.017 A	Maintain	Max ≤ 0.05 A Maintain			
			Ohiwia Stream	Median 0.006 A Max 0.034 A					
			Tutaekuri-Waimate Stream	Median 0.008 A Max 0.028 A					

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
Nitrate (mg NO_3-N/L) NOF Table 6	1. Annual median 2. Annual 95th percentile Hazen method All flows	Headwaters	Default	No/Insufficient data	Med ≤ 1 A	Med ≤ 1 A	**Refer to water quality objective OBJ TANK 11 for outcome description** **A band** (blue)**:** (Median ≤ 1.0; 95th percentile ≤ 1.5) High conservation value system. Unlikely to have adverse effects, even on sensitive species. **B band** (green)**:** (Median > 1.0 and ≤ 2.4; 95th percentile > 1.5 and ≤ 3.5) 95% species protection; some growth effects on up to 5% of species. **C band:** (red, below national bottom line) (Median > 2.4 and ≤ 6.9; 95th percentile > 3.5 and ≤ 9.8) Growth effects on up to 20% of species; (mainly sensitive species such as fish). No acute effects. **D band** (purple, below national bottom line) (Median > 6.9; 95th percentile > 9.8). Impacts on growth of multiple species, and starts approaching acute impact level (that is, risk of death) for sensitive species at higher concentrations (> 20 mg/L).	Toxicity	• Waimaori • Mauri • Indigenous taonga/tohu species habitat and spawning, ahu moana • Aquifer recharge • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use
					95th percentile ≤ 1.5 A	95th percentile ≤ 1.5 A			
			Kuripapango	Median 0.0075 A	Maintain	Maintain			
				95th percentile 0.029 A					
			Whanawhana	Med 0.017 A					
				95th percentile 0.106 A					
		Main stem	Default	No/Insufficient data	Med ≤ 1 A	Med ≤ 1 A			
					95th percentile ≤ 1.5 A	95th percentile ≤ 1.5 A			
			d/s HB Dairies	Med 0.072 A	Maintain	Maintain			
				95th percentile 0.26 A					
			Fernhill	Med 0.094 A					
				95th percentile 0.35 A					
			Chesterhope	Med 0.093 A					
				95th percentile 0.292 A					
		Hill country tributaries	Default	No/Insufficient data	Med ≤ 1 A	Med ≤ 1 A			
					95th percentile ≤ 1.5 A	95th percentile ≤ 1.5 A			
			Ohara Stream	No/Insufficient data	Med ≤ 1 A	Med ≤ 1 A			
					95th percentile ≤ 1.5 A	95th percentile ≤ 1.5 A			
			Poporangi Stream (Big Hill Rd Bridge)	Med 0.585 A	Maintain	Maintain			
				95th percentile 0.857 A					
			Maraekakaho Stream	Med 0.335 A					
				95th percentile 1.431 A					

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
		Lowland tributaries	Default	No/Insufficient data	Med ≤ 1 A	Med ≤ 1 A			
					95th percentile ≤ 1.5 A	95th percentile ≤ 1.5 A			
			Waitio Stream	Med 0.23 A	Maintain	Maintain			
				95th percentile 0.54 A					
			Ohiwia Stream	Med 0.66 A					
				95th percentile 0.92 A					
			Tutaekuri-Waimate Stream	Med 0.25 A					
				95th percentile 0.52 A					
DRP (mg/L) NOF Table 20	1. Median 2. 95th percentile All flows	Headwaters	Default	No/Insufficient data	Med ≤ 0.006 A	Med ≤ 0.006 A	**Refer to water quality objective OBJ TANK 11 for outcome description** **A band** (blue): (Median ≤ 0.006; 95th percentile ≤ 0.021) Ecological communities and ecosystem processes are similar to those of natural reference conditions. No adverse effects attributable to dissolved reactive phosphorus (DRP) enrichment are expected. **B band** (green): (Median >0.006 and ≤ 0.010; 95th percentile >0.021 and ≤0.030) Ecological communities are slightly impacted by minor DRP elevation above natural reference conditions. If other conditions also favour eutrophication, sensitive ecosystems may experience additional algal and plant growth, loss of macroinvertebrate taxa and higher respiration and decay rates. **C band** (orange): (Median >0.01 and ≤ 0.018; 95th percentile >0.030 and ≤0.054) Ecological communities are impacted by moderate DRP elevation above natural reference conditions. If other conditions also favour eutrophication, DRP enrichment may cause increased algal plant growth, loss of sensitive macro-invertebrate and fish taxa, and high rates of respiration and decay. **D band** (red): (Median > 0.018; 95th percentile > 0.054) Ecological communities impacted by substantial DRP elevation above natural reference conditions. In combination with other conditions favouring eutrophication,	Algal growth	• Uu • Waimaori • Mauri • Mahinga kai, taonga/tohu species Estuary ecosystem health • Recreation • Aquifer recharge • Natural character • Abstractive uses
					95th percentile ≤ 0.021 A	95th percentile ≤ 0.021 A			
			Kuripapango	Med 0.002 A	Maintain	Med ≤ 0.002 A			
				95thpercentile 0.003 A		95thpercentile ≤ 0.003 A			
			Whanawhana	Med 0.002 A		Med ≤ 0.002 A			
				95thpercentile 0.004 A		95thpercentile ≤ 0.004 A			
		Main stem	Default	No/Insufficient data	Med ≤ 0.01 B	Med ≤ 0.01 B			
					95th percentile ≤ 0.03 B	95th percentile ≤ 0.03 B			
			d/s HB Dairies	Med 0.005 A	Maintain	Med ≤ 0.005 A			
				95thpercentile 0.009 A		95thpercentile ≤ 0.009 A			
			Fernhill	Med 0.008 B	Maintain	Med ≤ 0.008 B			
				95thpercentile 0.020 A	Maintain	95thpercentile ≤ 0.020 A			
			Chesterhope	Med 0.007 B	Maintain	Med ≤ 0.007 B			
				95thpercentile 0.014	Maintain	95thpercentile ≤ 0.014			

							DRP enrichment drives excessive primary production and significant changes in macroinvertebrate and fish communities, as		

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
				A		A	taxa sensitive to hypoxia are lost.		
		Hill country tributaries	Default	No/Insufficient data	Med ≤ 0.01 B	Med ≤ 0.01 B			
					95th percentile ≤ 0.03 B	95th percentile ≤ 0.03 B			
			Ohara Stream	No/Insufficient data	Maintain or improve	Med ≤ 0.01 B			
						95thpercentile ≤ 0.03 B			
			Poporangi Stream (Big Hill Rd Bridge)	Med 0.026 D	Improving trend	Med ≤ 0.01 B			
				95thpercentile 0.035 C		95thpercentile ≤0.03 B			
			Maraekakaho Stream	Med 0.024 D		Med ≤ 0.01 B			
				95thpercentile 0.071 D		95thpercentile ≤0.03 B			
		Lowland tributaries	Default	No/Insufficient data	Improving trend	Med ≤ 0.01 B		Estuary ecosystem health	• Uu • Waimaori • Mauri • Aquifer recharge • Mahinga kai, taonga/tohu species • Natural character • Abstractive uses
						95th percentile ≤ 0.03 B			
			Waitio Stream	Med 0.024 D	Improving trend	Med ≤ 0.01 B			
				95th81percentile 0.081 D		95thpercentile ≤0.03 B			
			Ohiwia Stream	Med 0.117 D		Med ≤ 0.01 B			
				95thpercentile 0.21 D		95thpercentile ≤0.03 B			
			Tutaekuri-Waimate Stream	Med 0.03 D		Med ≤ 0.01 B			
				95thpercentile 0.049 D		95thpercentile ≤0.03 B			
Suspended fine sediment Visual clarity (m) NOF Table 8	**Trout fishery:** Median Below median flow **Recreation/ aesthetics** Visual clarity Median Monthly samples Minimum 5 years **NOF:**	Headwaters	Default	No/Insufficient data	≥ 5	≥ 5	**Refer to water quality objective OBJ TANK 11 for outcome description** **Trout fishery:** **Bright blue** ≥ 5 meets outstanding trout fishery values. **Light green** ≥ 3.75 and < 5 meets significant trout fishery. **Russet** <3.75 does not meet significant trout fishery values. **Recreation /aesthetics**	Trout fishery - outstanding	• Mauri • Uu • Indigenous biodiversity and mahinga kai, taonga and tohu species and habitat • Natural character • Recreation • Amenity natural character • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use
					<Kotahi Review>	*<Kotahi Review>*			
			Kuripapango (Class 1)	5.7	Maintain	Maintain			
				5.7 A	*<Kotahi Review>*	*<Kotahi Review>*			
			Whanawhana (Class 1)	4.5	Improving trend	≥ 5			
				1.94 A	*<Kotahi Review>*	*<Kotahi Review>*			

							Very light green:		

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	OUTCOME ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
	Visual clarity Median Monthly samples Minimum 5 years Suspended Sediment (Classes 1 – 4)	Main stem	Default	No/Insufficient data	≥ 3.75	≥ 3.75	> 1.6 meets recreation/aesthetics values. **Light russet:** ≤ 1.6 doesn't meet recreation/ aesthetics values. **NOF Attribute** *<Kotahi Review>* **A band** (Class 1 ≥ 1.78 and Class 2 ≥ 0.93) Minimal impact of suspended sediment on instream biota. Ecological communities are similar to those observed in natural reference conditions. **B band** (Class 1: < 1.78 and ≥ 1.55; Class 2: < 0.93 and ≥ 0.76) Low to moderate impact of suspended sediment on instream biota. Abundance of sensitive fish species may be reduced. **C band** (Class 1: < 1.55 and ≥ 1.34, Class 2: < 0.76 and ≥ 0.61) Moderate to high impact of suspended sediment on instream biota. Sensitive fish species may be lost. **D band** (below national bottom line) (Class 1: < 1.34; Class 2: < 0.61). High impact of suspended sediment on instream biota. Ecological communities are significantly altered, and sensitive fish and macroinvertebrate species are lost or at risk of being lost.	Trout fishery - significant	
			d/s HB Dairies (Class 1)	3.31	*<Kotahi Review>*	*<Kotahi Review>*			
				0.95	Improving trend	≥ 3.75			
			Fernhill (Class 1)	D 2.74	*<Kotahi Review>*	*<Kotahi Review>*			
				0.65	Improving trend	≥ 3.75			
			Chesterhope (Class 1)	D 2.1	*<Kotahi Review>*	*<Kotahi Review>*			
				1.58	Improving trend	≥ 3.75			
		Hill country tributaries	Default	D No/Insufficient data	*<Kotahi Review>*	*<Kotahi Review>*			
					≥ 3.75	≥ 3.75			
			Ohara Stream (Class 3)	No/Insufficient data	*<Kotahi Review>*	*<Kotahi Review>*			
					≥ 3.75	≥ 3.75			
			Poporangi Stream (Class 1)	No/Insufficient data	*<Kotahi Review>*	*<Kotahi Review>*			
					≥ 3.75	≥ 3.75			
			Maraekakaho Stream	3.74	*<Kotahi Review>*	*<Kotahi Review>*			
				3.2	≥ 3.75	≥ 3.75			
		Lowland tributaries	Default	A No/Insufficient data	*<Kotahi Review>*	*<Kotahi Review>*		Recreation /aesthetics	• Uu • Mauri • Indigenous biodiversity and mahinga kai, taonga and tohu species and habitat • Natural character • Amenity natural character • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use
					> 1.6	> 1.6			
			Waitio Stream (Class 2)	4.45	*<Kotahi Review>*	*<Kotahi Review>*			
					Maintain	Maintain			
			Ohiwia Stream (Class 2)	3.15	*<Kotahi Review>*	*<Kotahi Review>*			
					Maintain	Maintain			
					<Kotahi Review>	*<Kotahi Review>*			
			Tutaekuri-Waimate Stream (Class 1)	1.58	> 1.6	> 1.6			
					<Kotahi Review>	*<Kotahi Review>*			
Deposited fine sediment (%)	% fine sediment cover Monthly samples Minimum 5 years	Headwaters Main stem		Hill country	No/Insufficient data	No/Insufficient data	No/Insufficient	<20% <20%	<20%

<20% <20% <20%	**Light green:** < 20% protects stream biodiversity and fish (native and trout) habitat. **Russet**:	Biodiversity	• Uu Waimaori Mauri • Kaitiakitanga-ahuwhenua mahingakai, heahaahaere, taonga/tohu species habitat and spawning, cultural practices, wetlands and lakes, maori land, mara e/hapū	

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
	95th percentile	tributaries		data			≥ 20% doesn't meet protection of stream biodiversity and fish (native and trout) habitat.		• Natural character • Indigenous biodiversity
		Lowland tributaries	Hard bottom streams	No/Insufficient data	<20%	<20%			
Deposited fine sediment (%) NOF Table 16	% fine sediment cover Median Monthly samples Minimum 5 years				*<Kotahi Review>*		**Refer to water quality objective OBJ TANK 11 for outcome description**		

TABLE 26.3.1b: Ecosystem Health (Aquatic life)

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
Fish index of Biotic Integrity (F-IBI) NOF Table 13					*<Kotahi Review>*		**Refer to water quality objective OBJ TANK 11 for outcome description**		
Macroinvertebrates MCI QMCI NOF Table 14 (Action Plan required) ASPM NOF Table 15 (Action Plan required)	1. MCI (sb MCI where relevant) Macroinverte-brate Community Index Average Below median flow 2. QMCI (sb QMCI where relevant) Quantitative Macroinverte-brate Community Index 3. ASPM Macroinverte-brate average score per metric	Headwaters	Default	No/Insufficient data	Improving trend	MCI ≥ 130 A	**Refer to water quality objective OBJ TANK 11 for outcome description** **A band (**blue**):** (MCI ≥ 130; QMCI ≥ 6.5; ASPM ≥ 0.6) Macroinvertebrate community indicative of pristine conditions with almost no organic pollution or nutrient enrichment. Macroinvertebrate communities have high ecological integrity, similar to that expected in reference conditions. **B band** (green): (MCI ≥ 110 and < 130; QMCI ≥ 5.5 and < 6.5; ASPM <0.6 and ≥ 0.4) Macroinvertebrate community indicative of mild organic pollution or nutrient enrichment. Largely composed of taxa sensitive to organic pollution/nutrient enrichment. Macroinvertebrate communities have mild-to-moderate loss of ecological integrity. **C band** (orange)**:** (MCI ≥ 90 and < 110; QMCI ≥ 4.5 and < 5.5; ASPM <0.4 and ≥ 0.3) Macroinvertebrate community indicative of moderate organic pollution or nutrient enrichment. There is a mix of taxa sensitive and insensitive to organic pollution/nutrient enrichment. Macroinvertebrate communities have a moderate-to-severe loss of ecological integrity. **D band** (red): (below national bottom line)	Ecosystem health	• Waimaori • Mauri • Kaitiakitanga, whakapapa, taonga/tohu species habitat and spawning • Natural character • Indigenous biodiversity • Trout
						QMCI ≥ 6.5 A			
						ASPM ≥ 0.6 A			
			Kuripapango	MCI 117 A	Improving trend	MCI ≥ 130 A			
				QMCI No/Insufficient data		QMCI ≥ 6.5 A			
				ASPM No/Insufficient data		ASPM ≥ 0.6 A			
			Whanawhana	MCI 117 B	Improving trend	MCI ≥ 130 A			
				QMCI 5.2 C	Improving trend	QMCI ≥ 6.5 A			
				ASPM 0.52 B	Improving trend	ASPM ≥ 0.6 A			
		Main stem	Default	No/Insufficient data	Maintain or improve	MCI ≥ 110 B			
						QMCI ≥ 5.5 B			
						ASPM ≥ 0.4 B			
			d/s HB Dairies	MCI 111 B	Maintain	MCI ≥ 111 B			
				QMCI 5.5 B	Maintain	QMCI ≥ 5.5 B			
				ASPM 0.46 B	Maintain	ASPM ≥ 0.46 B			
			Fernhill	MCI 100 C	Improving trend	MCI ≥ 110 B			
				QMCI 5.3	Improving trend	QMCI ≥ 5.5			

							(MCI < 90; QMCI < 4.5; ASPM < 0.3)		

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
				C		B	Macroinvertebrate community indicative of severe organic pollution or nutrient enrichment. Communities are largely composed of taxa insensitive to organic pollution/enrichment Macroinvertebrate communities have severe loss of ecological integrity.		
				ASPM 0.43 B	Maintain	ASPM ≥ 0.4 B			
			Chesterhope	MCI 107.1 C	Improving trend	MCI ≥ 110 B			
				QMCI No/Insufficient data		QMCI ≥ 5.5 B			
				ASPM No/Insufficient data		ASPM ≥ 0.4 B			
		Hill country tributaries	Default	No/Insufficient data	Maintain or improve	MCI ≥ 110 B			
						QMCI ≥ 5.5 B			
						ASPM ≥ 0.4 B			
			Ohara Stream	MCI No/Insufficient data	Maintain or improve	MCI ≥ 110 B			
				QMCI No/Insufficient data		QMCI ≥ 5.5 B			
				ASPM No/Insufficient data		ASPM ≥ 0.4 B			
			Poporangi Stream	MCI 117 B	Maintain	MCI ≥ 117 B			
				QMCI 6 B	Maintain	QMCI ≥ 6 B			
				ASPM 0.6 A	Maintain	ASPM ≥ 0.6 A			
			Maraekakaho Stream	MCI 86 D	Improving trend	MCI ≥ 110 B			
				QMCI 4.5 C	Improving trend	QMCI ≥ 5.5 B			
				ASPM 0.30 C	Improving trend	ASPM ≥ 0.4 B			
		Lowland tributaries	Default	No/Insufficient data	Maintain or improve	MCI ≥ 90 C			• Waimaori • Mauri • Kaitiakitanga, whakapapa, taonga/tohu species habitat and spawning • Natural character • Indigenous biodiversity
						QMCI ≥ 4.5 C			
						ASPM ≥ 0.3 C			
			Waitio Stream	MCI 98.1 C	Maintain	MCI ≥ 98.1 C			
				QMCI 4.5 C	Maintain	QMCI ≥ 0.3 C			
				ASPM 0.48 B	Maintain	ASPM ≥ 0.4 B			
			Ohiwia Stream	MCI 80.3 D	Improving trend	MCI ≥ 90 C			
				QMCI 3.1	Improving trend	QMCI ≥ 4.5			

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
				D		C			
				ASPM 0.22 D	Improving trend	ASPM ≥ 0.3 C			
			Tutaekuri-Waimate Stream	MCI 75.8 D	Improving trend	MCI ≥ 90 C			
				QMCI 3.1 D	Improving trend	QMCI ≥ 4.5 C			
				ASPM 0.16 D	Improving trend	ASPM ≥ 0.3 C			
Macrophytes (max % CAV)	Monthly All year observations	Lowland tributaries		No/Insufficient data	≤ 50 %	≤ 50 %	Refer to water quality objective OBJ TANK 11 for outcome description **Light green** ≤ 50 % maintains ecological condition / flow conveyance / recreation values. **Russet** > 50% doesn't meet ecological condition / flow conveyance / recreation values.	Ecosystem health	• Uu • Waimaori • Mauri • Kaitiakitanga, he aha haere, taonga/tohu species, mahinga kai, nohoanga, cultural practices, tauranga waka • Natural character • Indigenous biodiversity • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use

TABLE 26.3.1c: Ecosystem Health (ecological processes)

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
Periphyton (mg/m^2) (Trophic state) NOF Table 2	Max exceedance < 8% of samples exceedances over 3 years monthly observations	Main stem	Fernhill	C	B	B	Refer to water quality objective OBJ TANK 11 for outcome description **A band:** (≤ 50 less than 8%) Rare blooms reflecting negligible nutrient enrichment and/or alteration of the natural flow regime. **B band**: (Exceeds >50 and ≤ 120 less than 8%) Occasional blooms reflecting negligible nutrient enrichment and/or alteration of the natural flow regime. **C band:** (Exceeds >120 and ≤ 200 less than 8%). Periodic short -duration nuisance blooms reflecting moderate enrichment and/or moderate alteration of the natural flow regime or habitat **D band:** (exceeds national bottom line) (> 200 less than 8%) Regular and/or extended-duration nuisance blooms reflecting high nutrient enrichment and/or significant alteration of the natural flow regime or habitat	Ecosystem health	• Uu • Waimaori • Natural character • Mauri • Kaitiakitanga, he aha haere, taonga/tohu species habitat and spawning, mahinga kai, nohoanga, cultural practices, tauranga waka, maori land, marae/hapū • Indigenous biodiversity
Periphyton cover	Monthly observations	Headwaters	Default	No/Insufficient data	≤ 20	≤ 20	Refer to water quality objective OBJ TANK 11 for outcome description	Ecosystem health	• Uu • Waimaori

(median of annual max %PeriWCC)	All year		Kuripapango	No/Insufficient data	≤ 20	≤ 20	**Blue**: (≤ 20) Ecological condition excellent and maintains recreation/aesthetics values. **Green**: (> 20 and ≤ 30)		• Mauri • Kaitiakitanga, he aha haere, taonga/tohu species habitat and spawning, mahinga kai, nohoanga, cultural practices, tauranga waka, maori land, marae/hapū • Natural character • Indigenous biodiversity
			Whanawhana	27 (2012-2015)	≤ 20	≤ 20			

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE* ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
		Main stem	Default	No/Insufficient data	≤ 30	≤ 30	Ecological condition good and maintains recreation/aesthetics values. **Yellow**: (> 30 and ≤ 40) Ecological condition good and doesn't meet recreation/aesthetics values. **Orange**: (> 40 and ≤ 55) Ecological condition fair and doesn't meet recreation/aesthetics values. **Red**: (> 55) Ecological condition poor and doesn't meet recreation/aesthetics values.		• Abstractive uses including stock drinking
			d/s HB Dairies	39 (2012-2015)	≤ 30	≤ 30			
			Fernhill	41 (2012-2015)	≤ 30	≤ 30			
			Chesterhope	No/Insufficient data	≤ 30	≤ 30			
		Upland tributaries	Default	No/Insufficient data	≤ 30	≤ 30			
			Ohara Stream	No/Insufficient data	≤ 30	≤ 30			
			Poporangi Stream	No/Insufficient data	≤ 20	≤ 20			
			Maraekakaho Stream	80 (2012-2015)	≤ 30	≤ 30			
		Lowland tributaries	Default (hard bottom streams)	No/Insufficient data	≤ 30	≤ 30			
			Waitio Stream	22 (2012-2015)	≤ 22	≤ 22			
			Ohiwia Stream	49 (2012-2015)	≤ 40	≤ 30			
Dissolved Oxygen (mg/L) NOF Table 7	Below point source 7-day mean min Summer 1 Nov – 30 Apr		Consent related		No change from background level	No change from background level	**Refer to water quality objective OBJ TANK 11 for outcome description** No increased risk from point source	Ecosystem health	• Waimaori • Mauri • Kaitiakitanga, whakapapa, indigenous taonga/tohu species • Natural character • Indigenous biodiversity • Trout
Dissolved Oxygen (mg/L or %) NOF Table 17	Continuous data 7-day mean minimum 1-day minimum Summer period (Nov-April)	Headwaters		No/Insufficient data	A	≥ 8 (7-d mean min) ≥ 7.5 (1-d min) ≥ 80% saturation A	**Refer to water quality objective OBJ TANK 11 for outcome description** **A band** (blue)**:** (7-day mean minimum ≥ 8.0; 1-day min ≥ 7.5) No stress caused by low dissolved oxygen on any aquatic organisms that are present at matched reference (near-pristine) sites. **B band** (green): (7-day mean minimum ≥ 7.0 and < 8.0; 1-day min ≥ 5.0 and < 7.5) Occasional minor stress on sensitive organisms caused by short periods (a few hours a day) of lower dissolved oxygen. Risk of reduced abundance of sensitive fish and macroinvertebrate species.	Ecosystem health	• Waimaori • Mauri • Kaitiakitanga, whakapapa, indigenous taonga/tohu species • Natural character • Indigenous biodiversity • Trout
		Main stem		No/Insufficient data					
		Hill country tributaries		No/Insufficient data					
		Lowland tributaries		No/Insufficient data	≥ 5 (7-d mean min) ≥ 4 (1-d min) ≥ 80% saturation C	≥ 7 (7-d mean min) ≥ 5 (1-d min) ≥ 80% saturation B			• Waimaori • Mauri • Natural character • Kaitiakitanga, whakapapa, indigenous taonga/tohu species • Indigenous biodiversity

							C band (orange): (7-day mean minimum ≥ 5.0 and < 7.0; 1-day min ≥ 4.0 and < 5.0) Moderate stress on a number of aquatic organisms caused by dissolved oxygen levels exceeding preference levels for periods of several hours each day. Risk of sensitive fish and macroinvertebrates being lost. **D band** (red): (below national bottom line) (7-day mean minimum < 5;		

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE* ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
							1-day min< 4.0) Significant persistent stress on a range of aquatic organisms caused by dissolved oxygen exceeding tolerance levels. Likelihood of local extinctions of keystone species and loss of ecological integrity.		
BOD ($ScBOD_5$)	Below median flow		Consent related		<2 mg/l	<2 mg/l	**Refer to water quality objective OBJ TANK 11 for outcome description** Aquatic organisms are not subject to risk from low dissolved oxygen conditions.		
Ecosystem Metabolism ($gO_2m^{-2}d^{-1}$) NOF Table 21	7-day min (Dec-Mar) Young et al method				*<Kotahi review>*	*<Kotahi review>*	**Refer to water quality objective OBJ TANK 11 for outcome description**		
Temperature (^{o}C) 5-day CRI	Continuous measurement Cox-Rutherford-Index Averaged over 5 hottest days of summer period	Headwaters		No/Insufficient data	*<Kotahi review>*	≤ 1^0 C increment from reference state A	**Refer to water quality objective OBJ TANK 11 for outcome description** **A band** (blue)**:** (≤ 1°C increment compared to reference site) No thermal stress on any aquatic organisms that are present at matched reference (near-pristine) sites. **B band** (green): (≤ 2°C increment compared to reference site) Minor thermal stress on occasion (clear days in summer) on particularly sensitive aquatic organisms such as certain insects or fish. **C band** (orange): (≤ 3°C increment compared to reference site) Some thermal stress on occasion, with elimination of certain sensitive insects and absence of certain sensitive fish. **D band** (red): (> 3°C increment compared to reference site) Significant thermal stress on a range of aquatic organisms. Risk of local elimination of keystone species with loss of ecological integrity.	Ecosystem health	• Waimaori • Mauri • Kaitiakitanga, whakapapa, taonga/tohu species, ahumoana, ahuwhenua mahinga kai • Natural character • Indigenous biodiversity • Trout
		Main stem		No/Insufficient data	*<Kotahi review>*	≤ 2^0 C increment from reference state B			
		Hill country tributaries		No/Insufficient data	*<Kotahi review>*	≤ 2^0 C increment from reference state B			
		Lowland tributaries		No/Insufficient data	*<Kotahi review>*	≤ 2^0 C increment from reference state B			• Waimaori • Natural character • Mauri • Kaitiakitanga, whakapapa, taonga/tohu species, ahumoana, ahuwhenua mahinga kai • Indigenous biodiversity
pH	At all times, 95th percentile				*<Kotahi Review>*	*<Kotahi Review>*	**Refer to water quality objective OBJ TANK 11 for outcome description**		
Heavy metals & **metalloids, pesticides & organic contaminants, radioactive contaminants**	As required		As required	No/Insufficient data	95% species protection at all times	95% species protection at all times	**Refer to water quality objective OBJ TANK 11 for outcome description** Greater than 95% of species are protected.	Ecosystem health	

TABLE 26.3.2: Human Contact

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
Cyanobacteria (benthic cover %)	Monthly observations, All year	All hard bottomed streams	As required	No/Insufficient data	< 20%	< 20%	Refer to water quality objective OBJ TANK 11 for outcome description **Light green** < 20% benthic cover. **Orange** ≥ 20% and <50% benthic cover. **Red** >50% benthic cover.	Recreation	• Uu • Waimaori • Mauri • Kaitiakitanga, he aha haere, taonga/tohu species habitat and spawning, mahinga kai, nohoanga, cultural practices, tauranga waka, maori land, marae/hapū, • Ecosystem health • Natural character • Abstractive uses including stock drinking
Escherichia coli (E.coli) (cfu/100 mL) NOF Table 9	All year All flows Refer to NOF Table 9 for a fuller description of how to measure these attributes	Headwaters	Default	No/Insufficient data	A	A	Refer to water quality objective OBJ TANK 11 for outcome description **A band (Blue)** For at least half the time, the estimated risk is <1 in 1,000 (0.1% risk). The predicted average infection risk is 1%. **B band (Green)** For at least half the time, the estimated risk is <1 in 1,000 (0.1% risk). The predicted average infection risk is 2%. **C band (Yellow)** For at least half the time, the estimated risk is <1 in 1,000 (0.1% risk). The predicted average infection risk is 3%. **D band (Orange)** 20-30% of the time the estimated risk is ≥50 in 1000 (>5% risk). The predicted average infection risk is >3%. **E band (Red)** For more than 30% of the time the estimated risk is ≥50 in 1000 (>5% risk). The predicted average infection risk is >7%.	Uu Recreation Human health	• Waimaori • Mauri • Kaitiakitanga, he aha haere, ahuwhenua mahinga kai, nohoanga, cultural practices, tauranga waka, maori land, marae/hapū connections • Aquifer recharge • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use
			Kuripapango	A	Maintain	Maintain			
			Whanawhana	A	Maintain	Maintain			
		Main stem	Default	No/Insufficient data	B	B			
			d/s HB Dairies	A	Maintain	Maintain			
			Fernhill	B	Maintain	Maintain			
			Chesterhope	B	Maintain	Maintain			
		Hill country tributaries	Default	No/Insufficient data	B	B			
			Ohara Stream	No/Insufficient data	B	B			
			Poporangi Stream	No/Insufficient data	B	B			
			Maraekakaho Stream	D	B	B			
		Lowland tributaries	Default	No/Insufficient data	B	B			
			Waitio Stream	B	Maintain	Maintain			
			Ohiwia Stream	D	B	B			
			Tutaekuri-Waimate Stream	D	B	B			
Escherichia coli (E.coli) (cfu/100 mL) NOF Table 22	95th percentile of *E.coli per 100 mL*	Lowland	Ngaruroro at Chesterhope Bridge	308 Fair	*<Kotahi review>*		Refer to water quality objective OBJ TANK 11 for outcome description **Excellent** ≤ 130 Estimated risk of *Campylobacter* infection has a <0.1% occurrence, 95% of the time. **Good** >130 and ≤ 260 Estimated risk of *Campylobacter* infection has a 0.1 – 10% occurrence, 95% of the time. **Fair** >260 and ≤ 540 Estimated risk of *Campylobacter* infection has a 1 - 5% occurrence, 95% of the time. **Poor** >540 (below national bottom line) Estimated risk of *Campylobacter* infection has a >5% occurrence, 95% of the time.	Primary contact	• Waimaori • Mauri • Kaitiakitanga, he aha haere, ahu moana, ahuwhenua mahinga kai, nohoanga, cultural practices, tauranga waka, maori land, marae/hapū connections • Aquifer recharge • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use

TABLE 26.3.3: Groundwater (Water Use)

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
Any aesthetic determinand (Drinking Water Standards for New Zealand)	As required	Groundwater – all areas	*<Kotahi review>*	*<Kotahi review>*	Within guidelines specified in the Drinking Water Standards for New Zealand	Within guidelines specified in the Drinking Water Standards for New Zealand	Refer to water quality objective OBJ TANK 14 for outcome description	Human Health	
E. coli (cfu / 100ml)	Maximum concentration As required	Groundwater – all areas	*<Kotahi review>*	*<Kotahi review>*	< 1	< 1	Refer to water quality objective OBJ TANK 14 for outcome description	Human Health	
Nitrate-nitrogen (mg N-NO_3/l)	95th percentile 5 years	Groundwater – all areas	*<Kotahi review>*	*<Kotahi review>*	< 1	< 1	Refer to water quality objective OBJ TANK 14 for outcome description	Ecosystem health	
All other determinands (Drinking Water Standards for New Zealand)	As required	Groundwater – all areas	*<Kotahi review>*	*<Kotahi review>*	Within guidelines specified in the Drinking Water Standards for New Zealand	Within guidelines specified in the Drinking Water Standards for New Zealand	Refer to water quality objective OBJ TANK 14 for outcome description	Human Health	

Notes:
- The attributes are as measured in groundwater at 10m below ground level.
- Some aesthetic determinands including iron, manganese and hardness are affected by geological conditions and will affect natural water quality.

TABLE 26.3.4: Threatened Species
<Insert through Kotahi process>

TABLE 26.3.5: Mahinga Kai
<Insert through Kotahi process>

TABLE 26.3.6: Mātauaranga Maori
<Insert through Kotahi process>

TABLE 26.3.7: Wetlands and Lakes
<Insert through Kotahi process>

SCHEDULE 26.4: KARAMŪ CATCHMENT

Refer to Planning Map Schedule 26.4

Vision
<to be drafted through Kotahi Review process>

Outcomes
<This sits in the body of the plan. Refer to relevant TANK objectives>

TABLE 26.4.1a: Ecosystem Health (Water quality)

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
DIN (mg/L)	Median 5 years All flows	Karamū (Lowland)	Default	Insufficient/no data	≤ 0.444	≤ 0.444	**Refer to water quality objective OBJ TANK 13 for outcome description** **Light Green**: (≤ 0.444) Below ANZECC default guideline value, unlikely to be concerning. **Orange:** (> 0.444) Above ANZECC default guideline value, investigation/ management recommended.	Estuary ecosystem health	• Uu • Waimaori • Mauri • Mahinga kai, taonga/tohu species • Recreation • Aquifer recharge • Natural character • Abstractive uses including for domestic, farm and community water supply, primary production, industrial and commercial use
			Raupare Stream	0.284	Maintain	Maintain			
			Ruahapia Stream	Insufficient/no data	≤ 0.444	≤ 0.444			
			Irongate Stream	Insufficient/no data	≤ 0.444	≤ 0.444			
			Karewarewa Stream	1.119	≤ 0.444	≤ 0.444			
			Awanui Stream	0.994	≤ 0.444	≤ 0.444			
			Poukawa Stream	0.088	Maintain	Maintain			
			Herehere Stream	0.13	Maintain	Maintain			
			Mangarau Stream (Te Aute)	Insufficient/no data	≤ 0.444	≤ 0.444			
			Clive River	0.445	≤ 0.444	≤ 0.444			
Ammonia (mg NH_4-N/L) NOF Table 5	1. Annual median 2. Annual max Unionised ammonia based on pH at 20^{0}C All flows	Karamū (Lowland)	Default	Insufficient/no data	Median ≤ 0.03 A Max ≤ 0.05 A	Median ≤ 0.03 A Max ≤ 0.05 A	**Refer to water quality objective OBJ TANK 13 for outcome description** **A band** (blue)**:** (Median ≤ 0.03; Max ≤ 0.05) 99% species protection level, no observed effect on any species tested. **B band** (green)**:** (Median > 0.03 and ≤ 0.24; Max >0.05 and ≤ 0.40) 95% species protection; starts impacting occasionally on the 5% most sensitive species. **C band:** (red, below national bottom line): (Median > 0.24 and ≤ 1.30; Max > 0.40 and ≤ 2.20) 80% species protection; starts impacting regularly on the 20% most sensitive species (Reduced survival of most sensitive species). **D band** (purple, below national bottom line):	Toxicity	• Waimaori • Mauri • Indigenous taonga/tohu species habitat and spawning, ahu moana • Aquifer recharge • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use
			Raupare Stream	Median 0.009 A Max 0.035 A	Maintain Maintain	Maintain Maintain			
			Ruahapia Stream	Insufficient/no data	Median ≤ 0.03 A Max ≤ 0.05 A	Median ≤ 0.03 A Max ≤ 0.05 A			
			Irongate Stream	Insufficient/no data	Median ≤ 0.03 A Max ≤ 0.05 A	Median ≤ 0.03 A Max ≤ 0.05 A			
			Karewarewa Stream	Median 0.021 A Max 0.091 C	Maintain Improving trend	Maintain Max ≤ 0.05 A			
			Awanui Stream	Median 0.012 A	Maintain	Maintain			

				Max 0.083	Improving trend	Max ≤ 0.05	(Median > 1.30; Max > 2.20) Starts approaching acute impact level (that is, risk of death) for sensitive species.		

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
				C		A			
			Poukawa Stream	Median 0.002 A	Maintain	Maintain			
				Max 0.01 A	Maintain	Maintain			
			Herehere Stream	Median 0.008 A	Maintain	Maintain			
				Max 0.053 B	Max ≤ 0.05 A	Max ≤ 0.05 A			
			Mangarau Stream (Te Aute)	Insufficient/no data	Median ≤ 0.03 A	Median ≤ 0.03 A			
					Max ≤ 0.05 A	Max ≤ 0.05 A			
			Clive River	Median 0.013 A	Maintain	Maintain			
				Max 0.126 B	Max ≤ 0.05 A	Max ≤ 0.05 A			
Nitrate (mg NO_3-N/L) NOF Table 6	1. Annual median 2. Annual 95th percentile Hazen method All flows	Karamū (Lowland)	Default	Insufficient/no data	Median ≤ 1 A	Median ≤ 1 A	**Refer to water quality objective OBJ TANK 13 for outcome description** **A band** (blue)**:** (Median ≤ 1.0; 95th percentile ≤ 1.5) High conservation value system. Unlikely to have adverse effects, even on sensitive species. **B band** (green)**:** (Median > 1.0 and ≤ 2.4; 95th percentile > 1.5 and ≤ 3.5) 95% species protection; some growth effects on up to 5% of species. **C band:** (red, below national bottom line) (Median > 2.4 and ≤ 6.9; 95th percentile > 3.5 and ≤ 9.8) Growth effects on up to 20% of species; (mainly sensitive species such as fish). No acute effects. **D band** (purple, below national bottom line) (Median > 6.9; 95th percentile > 9.8). Impacts on growth of multiple species, and starts approaching acute impact level (that is, risk of death) for sensitive species at higher concentrations (> 20 mg/L).	Toxicity	• Waimaori • Mauri • Indigenous taonga/tohu species habitat and spawning, ahu moana • Aquifer recharge • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use
					95th percentile ≤ 1.5 A	95th percentile ≤ 1.5 A			
			Raupare Stream	Median 0.255 A	Maintain	Maintain			
				95th percentile 0.830 A	Maintain	Maintain			
			Ruahapia Stream	Insufficient/no data	Median ≤ 1.0 A	Median ≤ 1.0 A			
					95th percentile ≤ 1.5 A	95th percentile ≤ 1.5 A			
			Irongate Stream	Insufficient/no data	Median ≤ 1 A	Median ≤ 1 A			
					95th percentile ≤ 1.5 A	95th percentile ≤ 1.5 A			
			Karewarewa Stream	Median 1.25 B	Median ≤ 1 A	Median ≤ 1 A			
				95th percentile 4.4 C	Improving trend	95th percentile ≤ 1.5 A			
			Awanui Stream	Median 1.2 B	Median ≤ 1 A	Median ≤ 1 A			
				95th percentile 3.17 B	95th percentile ≤ 1.5 A	95th percentile ≤ 1.5 A			
			Poukawa Stream	Median 0.086 A	Maintain	Maintain			
				95th percentile 0.618 A	Maintain	Maintain			
			Herehere Stream	Median 0.194 A	Maintain	Maintain			

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
				95th percentile 0.941 A	Maintain	Maintain			
			Mangarau Stream (Te Aute)	Insufficient/no data	Median ≤ 1 A	Median ≤ 1 A			
					95th percentile ≤ 1.5 A	95th percentile ≤ 1.5 A			
			Clive River	Median 0.61 A	Maintain	Maintain			
				95th percentile 1.832 B	95th percentile ≤ 1.5 A	95th percentile ≤ 1.5 A			
DRP (mg/L) NOF Table 20	1. Median 2. 95th percentile All flows	Karamū (Lowland)	Default	Insufficient/no data	Maintain or improving trend	Median ≤ 0.01	**Refer to water quality objective OBJ TANK 13 for outcome description** **A band** (blue): (Median ≤ 0.006; 95th percentile ≤ 0.021) Ecological communities and ecosystem processes are similar to those of natural reference conditions. No adverse effects attributable to dissolved reactive phosphorus (DRP) enrichment are expected. **B band** (green): (Median >0.006 and ≤ 0.010; 95th percentile >0.021 and ≤0.030) Ecological communities are slightly impacted by minor DRP elevation above natural reference conditions. If other conditions also favour eutrophication, sensitive ecosystems may experience additional algal and plant growth, loss of macroinvertebrate taxa and higher respiration and decay rates. **C band** (orange): (Median >0.01 and ≤ 0.018; 95th percentile >0.030 and ≤0.054) Ecological communities are impacted by moderate DRP elevation above natural reference conditions. If other conditions also favour eutrophication, DRP enrichment may cause increased algal plant growth, loss of sensitive macro-invertebrate and fish taxa, and high rates of respiration and decay. **D band** (red): (Median > 0.018; 95th percentile > 0.054) Ecological communities impacted by substantial DRP elevation above natural reference conditions. In combination with other conditions favouring eutrophication, DRP enrichment drives excessive primary production and significant changes in macroinvertebrate and fish communities, as taxa sensitive to hypoxia are lost.	Estuary ecosystem health	• Uu • Waimaori • Mauri • Mahinga kai, taonga/tohu species • Aquifer recharge • Natural character • Abstractive uses
						95th percentile ≤ 0.03 B			
			Raupare Stream	Median 0.027 D	Improving trend	Median ≤ 0.01 B			
				95th percentile 0.038 C	Improving trend	95th percentile ≤0.03 B			
			Ruahapia Stream	Insufficient/no data	Improving trend	Median ≤ 0.01 95th percentile ≤ 0.03 B			
			Irongate Stream	Insufficient/no data					
			Karewarewa Stream	Median 0.122 D					
				95th percentile 0.275 D					
			Awanui Stream	Median 0.16 D					
				95th percentile 0.387 D					
			Poukawa Stream	Median 0.154 D					
				95th percentile 0.365 D					
			Herehere Stream	Median 0.064 D					
				95th percentile 0.104 D					

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
			Mangarau Stream (Te Aute)	Insufficient/no data					
			Clive River	Median 0.09 D					
				95th percentile 0.23 D					
Suspended fine sediment Visual clarity (m) NOF Table 8	**Recreation/ Aesthetics** Visual clarity Median Monthly samples Minimum 5 years **NOF**: Visual clarity Median Monthly samples Minimum 5 years Suspended Sediment (Classes 1 – 4)	Karamū (Lowland)	Default	Insufficient/no data	> 1.6	> 1.6	**Refer to water quality objective OBJ TANK 13 for outcome description** **Recreation/ aesthetics** **Very Light Green**: > 1.6 meets recreation/aesthetics values. **Light Russet** ≤ 1.6 doesn't meet recreation/aesthetics values. **NOF Attribute** *<Kotahi Review>* **A band** (Class 1 ≥ 1.78 and Class 2 ≥ 0.93) Minimal impact of suspended sediment on instream biota. Ecological communities are similar to those observed in natural reference conditions. **B band** (Class 1: < 1.78 and ≥ 1.55; Class 2: < 0.93 and ≥ 0.76) Low to moderate impact of suspended sediment on instream biota. Abundance of sensitive fish species may be reduced. **C band** (Class 1: < 1.55 and ≥ 1.34, Class 2: < 0.76 and ≥ 0.61) Moderate to high impact of suspended sediment on instream biota. Sensitive fish species may be lost. **D band** (below national bottom line) (Class 1: < 1.34; Class 2: < 0.61) High impact of suspended sediment on instream biota. Ecological communities are significantly altered, and sensitive fish and macroinvertebrate species are lost or at risk of being lost.	Recreation/ aesthetics	• Uu • Mauri • Indigenous biodiversity and mahinga kai, taonga and tohu species and habitat • Natural character • Recreation • Amenity natural character • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use
					<Kotahi Review>	*<Kotahi Review>*			
			Raupare Stream (class1)	1.75	Maintain	Maintain			
				1.75 B	*<Kotahi Review>*	*<Kotahi Review>*			
			Ruahapia Stream (class 1)	Insufficient/no data	> 1.6	> 1.6			
					<Kotahi Review>	*<Kotahi Review>*			
			Irongate Stream (class 1)	Insufficient/no data	> 1.6	> 1.6			
					<Kotahi Review>	*<Kotahi Review>*			
			Karewarewa Stream (class 2)	2.15	Maintain	Maintain			
				2.15 A	*<Kotahi Review>*	*<Kotahi Review>*			
			Awanui Stream (class 2)	1.5	Improving trend	> 1.6			
				1.5 A	*<Kotahi Review>*	*<Kotahi Review>*			
			Poukawa Stream (class 2)	2.02	Maintain	Maintain			
				2.02 A	*<Kotahi Review>*	*<Kotahi Review>*			
			Herehere Stream (class 2)	2.35	Maintain A	Maintain A			
				2.35 A	*<Kotahi Review>*	*<Kotahi Review>*			
			Mangarau Stream (Te Aute) (class 2)	Insufficient/no data	> 1.6	>1.6			
					<Kotahi Review>	*<Kotahi Review>*			
			Clive River (class 1)	0.85	Improving trend	≥ 1.6			
				0.85 D	*<Kotahi Review>*	*<Kotahi Review>*			

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
Deposited fine sediment (%)	% fine sediment cover Monthly samples Minimum 5 years 95th percentile	Karamū (Lowland)	Hard-bottomed streams	Insufficient/no data	<20%	<20%	Refer to water quality objective OBJ TANK 13 for outcome description **Light green:** < 20% protects stream biodiversity and fish (native and trout) habitat. **Russet:** ≥ 20% doesn't meet protection of stream biodiversity and fish (native and trout) habitat.	Biodiversity	• Uu • Waimaori • Mauri • Kaitiakitanga- ahu whenua mahinga kai, he aha haere, taonga/tohu species habitat and spawning, cultural practices, wetlands and lakes, maori land, marae/hapū • Natural character • Indigenous biodiversity
Deposited fine sediment (%) NOF Table 16	% fine sediment cover Monthly samples Minimum 5 years				*<Kotahi Review>*	*<Kotahi Review>*	Refer to water quality objective OBJ TANK 13 for outcome description		

TABLE 26.4.1b: Ecosystem Health (Aquatic life)

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
Fish index of Biotic Integrity (F-IBI) NOF Table 13				*< Kotahi review>*			Refer to water quality objective OBJ TANK 13 for outcome description		
Macroinvertebrates MCI QMCI NOF Table 14 ASPM NOF Table 15	1. MCI (sb-MCI where relevant) Macroinverte-brate Community Index Average Below median flow 2. QMCI (sb-QMCI where relevant) Quantitative Macroinverte-brate Community Index 3. ASPM Macroinverte-brate average score per metric	Karamū (Lowland)	Default	MCI Not available	Improving trend	MCI ≥90 C	Refer to water quality objective OBJ TANK 13 for outcome description **A band (**blue**):** (MCI ≥ 130; QMCI ≥ 6.5; ASPM ≥ 0.6) Macroinvertebrate community indicative of pristine conditions with almost no organic pollution or nutrient enrichment. Macroinvertebrate communities have high ecological integrity, similar to that expected in reference conditions. **B band** (green): (MCI ≥ 110 and < 130; QMCI ≥ 5.5 and < 6.5; ASPM <0.6 and ≥ 0.4) Macroinvertebrate community indicative of mild organic pollution or nutrient enrichment. Largely composed of taxa sensitive to organic pollution/nutrient enrichment. Macroinvertebrate communities have mild-to-moderate loss of ecological integrity. **C band** (orange)**:** (MCI ≥ 90 and < 110; QMCI ≥ 4.5 and < 5.5; ASPM <0.4 and ≥ 0.3) Macroinvertebrate community indicative of	Ecosystem health	• Waimaori • Mauri • Kaitiakitanga, whakapapa, taonga/tohu species habitat and spawning • Natural character • Indigenous biodiversity
				QMCI not available	Improving trend	QMCI ≥ 4.5 C			
				ASPM not available	Improving trend	ASPM ≥ 0.3 C			
			Raupare Stream	MCI 62.7 D	Improving trend	MCI ≥90 C			
				QMCI 3.1 D	Improving trend	QMCI ≥ 4.5 C			
				ASPM 0.12 D	Improving trend	ASPM ≥ 0.3 C			
			Ruahapia Stream	MCI 53 D	Improving trend	MCI ≥90 C			
				QMCI 3.5	Improving trend	QMCI ≥ 4.5 C			
				ASPM 0.09 D	Improving trend	ASPM ≥ 0.3 C			
			Irongate Stream	MCI Not available	Improving trend	MCI ≥90 C			
				QMCI not available	Improving trend	QMCI ≥ 4.5 C			
				ASPM not available	Improving trend	ASPM ≥ 0.3 C			
			Karewarewa Stream	MCI 55.9 D	Improving trend	MCI ≥90 C			

				QMCI 2.5 D	Improving trend	QMCI ≥ 4.5 C	moderate organic pollution or nutrient enrichment. There is a mix of taxa sensitive and insensitive to organic pollution/nutrient enrichment. Macroinvertebrate communities have a moderate-to-severe loss of ecological integrity.		
				ASPM 0.09 D	Improving trend	ASPM ≥ 0.3 C			

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
			Awanui Stream	MCI 52 D	Improving trend	MCI ≥90 C	**D band** (red, (below national bottom line) (MCI < 90; QMCI < 4.5; ASPM < 0.3) Macroinvertebrate community indicative of severe organic pollution or nutrient enrichment Communities are largely composed of taxa insensitive to organic pollution/enrichment. Macroinvertebrate communities have severe loss of ecological integrity.		
				QMCI 2.7 D	Improving trend	QMCI ≥ 4.5 C			
				ASPM 0.09 D	Improving trend	ASPM ≥ 0.3 C			
			Poukawa Stream	MCI 56.3 D	Improving trend	MCI ≥90 C			
				QMCI 3.2 D	Improving trend	QMCI ≥ 4.5 C			
				ASPM 0.09 D	Improving trend	ASPM ≥ 0.3 C			
			Herehere Stream	MCI 60.7 D	Improving trend	MCI ≥90 C			
				QMCI 2.4 D	Improving trend	QMCI ≥ 4.5 C			
				ASPM 0.12 D	Improving trend	ASPM ≥ 0.3 C			
			Mangarau Stream (Te Aute)	MCI Not available	MCI ≥90 C	MCI ≥90 C			
				QMCI not available	Improving trend	QMCI ≥ 4.5 C			
				ASPM not available	Improving trend	ASPM ≥ 0.3 C			
			Clive River	MCI 51.4 D	MCI ≥90 C	MCI ≥90 C			
				QMCI 2.5 D	Improving trend	QMCI ≥ 4.5 C			
				ASPM 0.09 De	Improving trend	ASPM ≥ 0.3 C			
Macrophytes (max % CAV)	Monthly All year observations	Karamū (Lowland)		Insufficient/no data	≤ 50 %	≤ 50 %	**Refer to water quality objective OBJ TANK 13 for outcome description** **Light Green** ≤ 50 % maintains ecological condition / flow conveyance / recreation values. **Russet** > 50% doesn't meet ecological condition / flow conveyance / recreation values.	Ecosystem health	• Uu • Waimaori • Mauri • Kaitiakitanga, he aha haere, taonga/tohu species, mahinga kai, nohoanga, cultural practices, tauranga wak • Natural character • Indigenous biodiversity • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use

TABLE 26.4.1c: Ecosystem Health (ecological processes)

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
Dissolved Oxygen (mg/L) NOF Table 7	Below point source 7-day mean min Summer 1 Nov – 30 Apr		Consent related		No change from background levels	No change from background levels	Refer to water quality objective OBJ TANK 13 for outcome description No increased risk from point source.	Ecosystem health	• Waimaori • Mauri • Kaitiakitanga, whakapapa, indigenous, toanga/tohu species • Natural character • Indigenous biodiversity
Dissolved Oxygen (mg/L or %) NOF Table 17	Continuous data 7-day mean minimum 1-day minimum Summer period (Nov-April)	Karamū (Lowland)	Default	No/Insufficient data	≥ 5 (7-d mean min) ≥ 4 (1-d min) ≥ 80% saturation C	≥ 7 (7-d mean min) ≥ 5 (1-d min) ≥ 80% saturation B	Refer to water quality objective OBJ TANK 13 for outcome description **A band** (blue)**:** (7-day mean minimum ≥ 8.0; 1-day min ≥ 7.5) No stress caused by low dissolved oxygen on any aquatic organisms that are present at matched reference (near-pristine) sites. **B band** (green): (7-day mean minimum ≥ 7.0 and < 8.0; 1-day min ≥ 5.0 and < 7.5) Occasional minor stress on sensitive organisms caused by short periods (a few hours a day) of lower dissolved oxygen. Risk of reduced abundance of sensitive fish and macroinvertebrate species. **C band** (orange): (7-day mean minimum ≥ 5.0 and < 7.0; 1-day min ≥ 4.0 and < 5.0) Moderate stress on a number of aquatic organisms caused by dissolved oxygen levels exceeding preference levels for periods of several hours each day. Risk of sensitive fish and macroinvertebrates being lost. **D band** (red, below national bottom line) (7-day mean minimum < 5; 1-day min< 4.0) Significant persistent stress on a range of aquatic organisms caused by dissolved oxygen exceeding tolerance levels. Likelihood of local extinctions of keystone species and loss of ecological integrity.	Ecosystem health	• Waimaori • Natural character • Mauri • Kaitiakitanga, whakapapa, indigenous taonga/tohu species • Indigenous biodiversity • Trout
BOD ($ScBOD_5$)	Below median flow		Consent related		<2 mg/l	<2 mg/l	Refer to water quality objective OBJ TANK 13 for outcome description Aquatic organisms are not subject to risk from low dissolved oxygen conditions.	Ecosystem health	• Waimaori • Mauri • Kaitiakitanga, whakapapa, indigenous taonga/tohu species • Natural character • Indigenous biodiversity
Ecosystem Metabolism ($gO_2m^{-2}d^{-1}$) NOF Table 21	7-day min (Dec-Mar) Young et al method	Karamū (Lowland)			*<Kotahi review>*	*<Kotahi review>*	Refer to water quality objective OBJ TANK 13 for outcome description		
Temperature regime (°C) 5-day CRI	Continuous measurement Cox-Rutherford-	Karamū (Lowland)		No/Insufficient data	*<Kotahi Review>*	≤ 2°C increment from reference state B	Refer to water quality objective OBJ TANK 13 for outcome description **A band** (blue)**:** (≤ 1°C increment compared to reference site) No thermal stress on any aquatic organisms	Ecosystem health	• Waimaori • Mauri • Kaitiakitanga, whakapapa, taonga/tohu species, ahumoana, ahuwhenua mahinga kai • Natural character • Indigenous biodiversity

	Index Averaged over 5 hottest days of summer period						that are present at matched reference (near-pristine) sites. **B band** (green): (≤ 2°C increment compared to reference site)		

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
							Minor thermal stress on occasion (clear days in summer) on particularly sensitive aquatic organisms such as certain insects or fish. **C band** (orange): (≤ 3°C increment compared to reference site) Some thermal stress on occasion, with elimination of certain sensitive insects and absence of certain sensitive fish. **D band** (red): (> 3°C increment compared to reference site) Significant thermal stress on a range of aquatic organisms. Risk of local elimination of keystone species with loss of ecological integrity.		
pH	At all times, 95th %ile	Karamū (Lowland)			*<Kotahi review>*		**Refer to water quality objective OBJ TANK 13 for outcome description**		
Heavy metals & metalloids, pesticides & organic contaminants, radioactive contaminants	As required		As required		99% species protection at all times	99% species protection at all times	**Refer to water quality objective OBJ TANK 13 for outcome description** Greater than 99% of species are protected.	Ecosystem health	

TABLE 26.4.2: Human Contact

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
Escherichia coli (E.coli) (cfu/100 mL) NOF Table 9	All year All flows Overall band determined over 4 numeric attribute states – details see NOF Table 9	Karamū (Lowland)	Raupare Stream	E	B	B	**Refer to water quality objective OBJ TANK 13 for outcome description** **A band (Blue)** For at least half the time, the estimated risk is <1 in 1,000 (0.1% risk). The predicted average infection risk is 1%. **B band (Green)** For at least half the time, the estimated risk is <1 in 1,000 (0.1% risk). The predicted average infection risk is 2%. **C band (Yellow)** For at least half the time, the estimated risk is <1 in 1,000 (0.1% risk). The predicted average infection risk is 3%. **D band (Orange)** 20-30% of the time the estimated risk is ≥50 in 1000 (>5% risk). The predicted average infection risk is >3%. **E band (Red)** For more than 30% of the time the estimated	Uu Recreation Human health	• Waimaori • Mauri • Kaitiakitanga, he aha haere • Ahu moana, ahuwhenua mahinga kai, nohoanga, cultural practices, tauranga waka, maori land, marae/hapū connections • Aquifer recharge • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use
			Ruahapia Stream	No/Insufficient data	B	B			
			Irongate Stream	No/Insufficient data	B	B			
			Karewarewa Stream	E	B	B			
			Awanui Stream	E	B	B			
			Poukawa Stream	B	Maintian	Maintain			
			Herehere Stream	E	B	B			
			Mangarau Stream (Te Aute)	No/Insufficient data	B	B			
			Clive River	D	B	B			
			Other river reaches	E	B	B			

							risk is ≥50 in 1000 (>5% risk). The predicted average infection risk is >7%.		
Escherichia coli (E.coli)	95th percentile of *E.coli per 100 mL*	Karamū	Clive River at Boat Ramp	576 D	*<Kotahi Review>*		**Refer to water quality objective OBJ TANK 13 for outcome description** **Excellent** ≤ 130	Uu Recreation	• Waimaori • Mauri • Kaitiakitanga, he aha haere

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
(cfu/100 mL) NOF Table 22							Estimated risk of *Campylobacter* infection has a <0.1% occurrence, 95% of the time. **Good** >130 and ≤ 260 Estimated risk of *Campylobacter* infection has a 0.1 – 10% occurrence, 95% of the time. **Fair** >260 and ≤ 540 Estimated risk of *Campylobacter* infection has a 1 - 5% occurrence, 95% of the time. **Poor** >540 (below national bottom line) Estimated risk of *Campylobacter* infection has a >5% occurrence, 95% of the time.	Human health	• Ahu moana, ahuwhenua mahinga kai, nohoanga, cultural practices, tauranga waka, maori land, marae/hapū connections • Aquifer recharge • Abstractive uses including for domestic, farm and community water supply, primary production and food production, industrial and commercial use

TABLE 26.4.3: Groundwater (Water Use)

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
Any aesthetic determinand (Drinking Water Standards for New Zealand)	As required	Groundwater – all areas	*<Kotahi review>*	*<Kotahi review>*	Within guidelines specified in the Drinking Water Standards for New Zealand	Within guidelines specified in the Drinking Water Standards for New Zealand	**Refer to water quality objective OBJ TANK 14 for outcome description**	Human Health	
E. coli (cfu / 100ml)	Maximum concentration As required	Groundwater – all areas	*<Kotahi review>*	*<Kotahi review>*	< 1	< 1	**Refer to water quality objective OBJ TANK 14 for outcome description**	Human Health	
Nitrate-nitrogen (mg N-NO_3/l)	95th percentile 5 years	Groundwater – all areas	*<Kotahi review>*	*<Kotahi review>*	< 1	< 1	**Refer to water quality objective OBJ TANK 14 for outcome description**	Ecosystem health	
All other determinands (Drinking Water Standards for New Zealand)	As required	Groundwater – all areas	*<Kotahi review>*	*<Kotahi review>*	Within guidelines specified in the Drinking Water Standards for New Zealand	Within guidelines specified in the Drinking Water Standards for New Zealand	**Refer to water quality objective OBJ TANK 14 for outcome description**	Human Health	

Notes:
- The attributes are as measured in groundwater at 10m below ground level.
- Some aesthetic determinands including iron, manganese and hardness are affected by geological conditions and will affect natural water quality.

TABLE 26.4.4: Threatened Species
<Insert through Kotahi process>

TABLE 26.4.5: Mahinga Kai
<Insert through Kotahi process>

TABLE 26.4.6: Mātauranga Maori
<Insert through Kotahi process>

TABLE 26.4.7: Wetlands and Lakes
<Insert through Kotahi process>

SCHEDULE 26.5: AHURIRI ESTUARY / TE WHANGANUI-A-OROTŪ& WAITANGI ESTUARY

Refer to Planning Map Schedule 26.5

Vision
<to be drafted through Kotahi Review process>

Outcomes
<This sits in the body of the plan. Refer to relevant TANK objectives>

TABLE 26.5.1 AHURIRI ESTUARY/TE WHANGANUI-A-OROTŪ Ecosystem Health (Water quality)

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET[1] ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM[1]	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
Water column dissolved oxygen (mg/L)	Summer monitoring data for discrete specified periods: 1. 7-day mean 2. 7-day min 3. 1-day min	Ahuriri Estuary	Ahuriri Estuary on Woolshed Road	No/Insufficient data	*<Kotahi Review>*	7 day mean ≥ 7.0	Refer to water quality objective OBJ TANK 10 for outcome description Dissolved oxygen in the water column is sufficient to support ecosystem health and life supporting capacity	Kaitiakitanga Ecosystem Health	• Mauri • Mahinga kai, taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana
					<Kotahi Review>	7 day minimum ≥ 6.0			
					<Kotahi Review>	1 day minimum ≥ 5.0			
Enterococci (cfu/100 mL)	Summer bathing season	Ahuriri Estuary	Pandora Pond at Waka Ama	95th percentile 44	*<Kotahi Review>*	95th percentile 41-200	Refer to water quality objective OBJ TANK 10 for outcome description 1-5% gastrointestinal illness risk 0.3- <1.9% acute febrile respiratory illness risk MAC B grade – Mfe/MoH, 2003	Kaitiakitanga Recreation Mahinga kai	• Uu • Mauri • Taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana
Esherichia coli (*E. coli*) (cfu/100 mL)	Summer bathing season	Ahuriri Estuary	Pandora Pond at Waka Ama	95th percentile 540	*<Kotahi Review>*	95th percentile 260-540	Refer to water quality objective OBJ TANK 10 for outcome description Estimated risk of *Campylobacter* infection has a 1-5% occurrence, 95% of the time MAC C grade – Mfe/MoH, 2003	Kaitiakitanga Recreation Mahinga kai	• Uu • Mauri • Taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana
Water Temperature (°C)	Summer maxima	Ahuriri Estuary	Ahuriri Estuary on Woolshed Road	No/Insufficient data	Not more than 3◦C difference compared to reference site	Not more than 3◦C difference compared to reference site	Refer to water quality objective OBJ TANK 10 for outcome description Water temperature is maintained for ecosystem health	Kaitiakitanga Ecosystem Health	• Mauri • Mahinga kai, taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana
pH	Daily summer maxima	Ahuriri Estuary	Ahuriri Estuary on Woolshed Road	No/Insufficient data	pH is greater than 7.0 and less than 8.5	pH is greater than 7.0 and less than 8.5	Refer to water quality objective OBJ TANK 10 for outcome description pH range is maintained for ecosystem health and life-supporting capacity	Kaitiakitanga Ecosystem Health	• Mauri • Mahinga kai, taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana
Nitrate toxicity (mg/L)	1. Annual median 2. Annual 95th percentile (Hazen)	Ahuriri Estuary	Ahuriri Estuary on Woolshed Road	Median 0.007	Maintain	Maintain	Refer to water quality objective OBJ TANK 10 for outcome description **Low risk:** (Median ≤ 2.4 mg/L; and 95th % ile ≤ 3.5 mg/L) **High risk:** (Median >2.4 mg/L; and 95th % ile >3.5 mg/L)	Kaitiakitanga Ecosystem health	• Mauri • Mahinga kai, taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana
				95th percentile 0.45					
Ammonia toxicity (mg/L)	Annual maxima for a 12-month period when corrected for pH and temperature	Ahuriri Estuary	Ahuriri Estuary on Woolshed Road	TBC	95% species protection	95% species protection	Refer to water quality objective OBJ TANK 10 for outcome description **99% of species protection:** (<0.16 mg/L) **95% of species protection:** (<0.46 mg/L)	Kaitiakitanga Ecosystem health	• Mauri • Mahinga kai, taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana

Toxicants in water (as described in ANZG)	As required	Ahuriri Estuary		No/Insufficient data	Does not exceed 95% level of protection in ANZG, 2018.	Does not exceed 95% level of protection in ANZG, 2018	**Refer to water quality objective OBJ TANK 10 for outcome description**	Kaitiakitanga Ecosystem health Mahinga kai	• Mauri • Taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana
Nitrogen in water (mg/L)	Annual median of no less than 8 samples in a 12-month period	Ahuriri Estuary	Ahuriri Estuary on Woolshed Road	Nitrate - Nitrogen 0.007	Where nutrient levels exceed trigger values there is an improving trend by 2040	*<Kotahi Review>*	**Refer to water quality objective OBJ TANK 10 for outcome description** **Trigger values** Nitrate-Nitrogen 0.05 Total Nitrogen 0.11	Kaitiakitanga Ecosystem health	• Mauri • Ecosystem health • Mahinga kai, taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana
				Total Nitrogen: 0.41	Where nutrient levels exceed trigger values there is an improving trend	*<Kotahi Review>*			

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET[1] ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM[1]	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
					by 2040				
Phosphorus in water (mg/L)	Annual median of no less than 8 samples in a 12-month period	Ahuriri Estuary	Ahuriri Estuary on Woolshed Road	Dissolved Reactive Phosphorus: 0.10	Where nutrient levels exceed trigger values there is an improving trend by 2040	*<Kotahi Review>*	**Refer to water quality objective OBJ TANK 10 for outcome description** **Trigger Values** Dissolved Reactive Phosphorus 0.015 Total Phosphorus 0.05	Kaitiakitanga Ecosystem health	• Mauri • Ecosystem health • Mahinga kai, taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana
				Total Phosphorus: 0.14	Where nutrient levels exceed trigger values there is an improving trend by 2040	*<Kotahi Review>*			
Nuisance macroalgae cover	TBC	Ahuriri Estuary	TBC	No/Insufficient data		*<Kotahi Review>*	**Refer to water quality objective OBJ TANK 10 for outcome description**	Kaitiakitanga Ecosystem health	• Uu • Mauri • Recreation • Natural Charater • Mahinga kai, taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana
Water column Chlorophyll *a* (mg/L)	Annual median of no less than 8 samples in a 12-month period	Ahuriri Estuary	Ahuriri Estuary on Woolshed Road	0.002	Maintain	Maintain	**Refer to water quality objective OBJ TANK 10 for outcome description** **Low risk:** **(0.004 mg/L)** The risk of excessive phytoplankton growth is low	Kaitiakitanga Ecosystem health	• Mauri • Mahinga kai, taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana
Sediment Mud content (% composition)	Spatial analysis of estuary grain size	Ahuriri Estuary	Estuary to Taipo confluence	TBC	The areal extent of soft mud[2] substrate in the estuary should not increase from its current extent	The areal extent of soft mud[2] substrate in the estuary should not increase from its current extent	**Refer to water quality objective OBJ TANK 10 for outcome description** No increase in areas where sediment stress may be impacting the health of the estuary	Kaitiakitanga Ecosystem health Mahinga kai	• Mauri • Taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana • Natural character
Toxicants in sediments (mg/kg)	Annual median of site replicates at Estuarine Ecology Monitoring Sites	Ahuriri Estuary	Estuarine Ecology Monitoring Sites	TBC	Does not exceed interim sediment quality guidelines (ISQG) - High	Does not exceed interim sediment quality guidelines (ISQG) - Low	**Refer to water quality objective OBJ TANK 10 for outcome description** **Rare adverse effects:** (≤ ISQG – Low) **Occasional adverse effects:** (≤ ISQG – High) **Frequent adverse effects:** (>ISQG - High)	Kaitiakitanga Ecosystem health Mahinga Kai	• Mauri • Taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana

Notes

1. The 2040 target and long term outcome are applicable to all estuary waters and are monitored at the specified sites.
2. Soft mud refers to the proportion of the substrate that is less than 63 microns.

Note re monitoring and default value

TABLE 26.5.2: WAITANGI ESTUARY Ecosystem Health (Water quality)

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET[1] ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM[1]	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
Water column dissolved oxygen (mg/L)	Summer monitoring data for discrete specified periods	Waitangi Estuary	Waitangi Estuary	No/Insufficient data	*<Kotahi Review>*	7 day mean ≥ 7.0	**Refer to water quality objective OBJ TANK 11, 12 and 13 for outcome description** Dissolved oxygen in the water column is sufficient to support ecosystem health and life supporting capacity	Kaitiakitanga Ecosystem Health	• Mauri • Mahinga kai, taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana • Natural character
					<Kotahi Review>	7 day minimum ≥ 6.0			
					<Kotahi Review>	1 day minimum ≥ 5.0			
Water Temperature (°C)	Summer maxima	Waitangi Estuary	Waitangi Estuary	No/Insufficient data	Not more than 3◦C difference compared to reference site	Not more than 3◦C difference compared to reference site	**Refer to water quality objective OBJ TANK 11, 12 and 13 for outcome description** Water temperature is maintained for ecosystem health	Kaitiakitanga Ecosystem Health	• Mauri • Mahinga kai, taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana
pH	Daily summer maxima	Waitangi Estuary	Waitangi Estuary	No/Insufficient data	pH is greater than 7.0 and less than 8.5	pH is greater than 7.0 and less than 8.5	**Refer to water quality objective OBJ TANK 11, 12 and 13 for outcome description** pH range is maintained for ecosystem health and life-supporting capacity	Kaitiakitanga Ecosystem Health	• Mauri • Mahinga kai, taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana
Nitrate toxicity (mg/L)	1. Annual median 2. Annual 95th percentile (Hazen)	Waitangi Estuary	Waitangi Estuary	Median 0.26	Maintain	Maintain	**Refer to water quality objective OBJ TANK 11, 12 and 13 for outcome description** **Low risk:** (Median ≤ 2.4 mg/L; and 95th % ile ≤ 3.5 mg/L) **High risk:** (Median >2.4 mg/L; and 95th % ile >3.5 mg/L)	Kaitiakitanga Ecosystem health	• Mauri • Mahinga kai, taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana
				95th percentile 0.57					
Ammonia toxicity (mg/L)	Annual maxima for a 12-month period when corrected for pH and temperature	Waitangi Estuary	Waitangi Estuary	No/Insufficient data	95% species protection	95% species protection	**Refer to water quality objective OBJ TANK 11, 12 and 13 for outcome description** **99% of species protection:** (<0.16 mg/L) **95% of species protection:** (<0.46 mg/L)	Kaitiakitanga Ecosystem health	• Mauri • Mahinga kai, taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana
Toxicants in water (as described in ANZG)	As required	Waitangi Estuary	Waitangi Estuary	No/Insufficient data	Does not exceed 95% level of protection in ANZG, 2018.	Does not exceed 95% level of protection in ANZG, 2018	**Refer to water quality objective OBJ TANK 11, 12 and 13 for outcome description** Does not exceed 95% level of protection in ANZG, 2018	Kaitiakitanga Ecosystem health Mahinga kai	• Mauri • Taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana
Nitrogen in water (mg/L)	Annual median of no less than 8 samples in a 12-month period	Ahuriri Estuary	Ahuriri Estuary on Woolshed Road	Nitrate - Nitrogen 0.26	Where nutrient levels exceed trigger values there is an improving trend by 2040	*<Kotahi Review>*	**Refer to water quality objective OBJ TANK 11, 12 and 13 for outcome description** **Trigger values** Nitrate-Nitrogen 0.05 Total Nitrogen 0.11	Kaitiakitanga Ecosystem health	• Mauri • Ecosystem health • Mahinga kai, taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana
				Total Nitrogen: 0.45	Where nutrient levels exceed trigger values there is an improving trend by 2040	*<Kotahi Review>*			
Phosphorus in water (mg/L)	Annual median of no less than 8 samples in a 12-month period	Ahuriri Estuary	Ahuriri Estuary on Woolshed Road	Dissolved Reactive Phosphorus 0.02	Where nutrient levels exceed trigger values there is an improving trend by 2040	*<Kotahi Review>*	**Refer to water quality objective OBJ TANK 11, 12 and 13 for outcome description** **Trigger Values**	Kaitiakitanga Ecosystem health	• Mauri • Ecosystem health • Mahinga kai, taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana

				Total Phosphorus 0.04	Where nutrient levels exceed trigger values there is an improving trend by 2040	*<Kotahi Review>*	Dissolved Reactive Phosphorus 0.015 Total Phosphorus 0.05		
Nuisance macroalgae cover	TBC	Waitangi Estuary	TBC	No/Insufficient data	*<Kotahi Review>*	*<Kotahi Review>*	**Refer to water quality objective OBJ TANK 11, 12 and 13 for outcome description**	Kaitiakitanga Ecosystem health	• Uu • Mauri • Recreation

ATTRIBUTE	MEASURING SYSTEM	WATER QUALITY AREA	MONITORING SITE	BASELINE ATTRIBUTE STATE	TARGET[1] ATTRIBUTE STATE 2040	~~OUTCOME~~ TARGET ATTRIBUTE STATE LONG TERM[1]	OUTCOME DESCRIPTION	CRITICAL VALUE	CRITICAL VALUE ALSO PROVIDES FOR
									• Natural Character • Mahinga kai, taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana
Water column Chlorophyll *a* (mg/L)	Annual median of no less than 8 samples in a 12-month period	Waitangi Estuary	Waitangi Estuary	0.001	Maintain	Maintain	Refer to water quality objective OBJ TANK 11, 12 and 13 for outcome description **Low risk:** **(0.004 mg/L)** The risk of excessive phytoplankton growth is low	Kaitiakitanga Ecosystem health	• Mauri • Mahinga kai, taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana
Sediment Mud content (% composition)	Spatial analysis of estuary grain size	Waitangi Estuary	TBC	TBC	The areal extent of soft mud[2] substrate in the estuary should not increase from its current extent	The areal extent of soft mud[2] substrate in the estuary should not increase from its current extent	Refer to water quality objective OBJ TANK 11, 12 and 13 for outcome description No increase in areas where sediment stress may be impacting the health of the estuary	Kaitiakitanga Ecosystem health Mahinga kai	• Mauri • Taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana • Natural character
Toxicants in sediments (mg/kg)	Annual median of site replicates at Estuarine Ecology Monitoring Sites	Waitangi Estuary	Estuarine Ecology Monitoring Sites	TBC	Does not exceed interim sediment quality guidelines (ISQG) - High	Does not exceed interim sediment quality guidelines (ISQG) - Low	Refer to water quality objective OBJ TANK 11, 12 and 13 for outcome description **Rare adverse effects:** (≤ ISQG – Low) **Occasional adverse effects:** (≤ ISQG – High) **Frequent adverse effects:** (>ISQG - High)	Kaitiakitanga Ecosystem health Mahinga Kai	• Mauri • Taonga/tohu species, indigenous taonga/tohu species habitat and spawning, ahu moana •

Notes

1. The 2040 target and long term outcome are applicable to all estuary waters and are monitored at the specified sites.
2. Soft mud refers to the proportion of the substrate that is less than 63 microns.

Schedule 28: Priority Sub-Catchments

Refer to Rule TANK 1.

This schedule sets out the thresholds used to determine the ~~list of~~ priority sub-catchments or places. The priority sub-catchments identified using these thresholds are shown on the Schedule 28 Planning Maps 1 – 4 and Schedule 35 Planning Maps 1 - 2.

The priority sub-catchments are determined according to the following water quality attributes and risks ~~that are where there is~~;

1. Risk of sediment loss in ~~is higher than 500~~t/km²/year (as modelled by SedNet)
2. ~~SOE monitoring shows the freshwater objectives for n~~Nitrogen concentrations for water quality based on SOE monitoring and ~~are not being met~~
3. Risk of significant contribution of high nitrogen loads to the estuary ~~Probability that dissolved nutrients do not meet freshwater objectives for nitrogen~~ (as modelled by SOURCE and using Overseer data)
4. The level of dissolved oxygen (specific for lowland streams with slope <2 m/km)
5. ~~A~~ Source water areas ~~Protection Zones~~ for municipal drinking water supply.

The priority order assigned in relation to each of these water quality issues is as follows;

	High priority	Medium priority	Low priority	Long term
Sediment yield (SedNet)	>500 t/km²/year	350 - 500 t/km²/year	250 - 350 t/km²/year	<250 t/km²/year
TN concentrations (all flows, median)	> 2 mg/L	> 1.2 mg/L	> 1 mg/L	<1 mg/L
TN yield (modelled) (all flows, average per sub-catchment)	> 10kg/ha/yr	> 3.5 kg/ha/yr	> 1.2 kg/ha/yr	≤1.2 kg/ha/yr
Dissolved Oxygen levels Class A streams (and /or where stream gradient <2m/km	anoxia (periods of little or no oxygen)	< 3 mg/L daily minimum and/or DO saturation <30%	< 4mg/L daily minimum and/or DO saturation < 40%	< 6 mg/L daily minimum and/or DO saturation <60%
Drinking Water Supply	**Production land in SPZs** (See Planning Maps 1 and 2 for Schedule 35)			

The Planning Maps 1 – 4 and Schedule 35 Planning Maps 1 – 2 show~~ing~~ the spatial extent and location of the priority areas. ~~are available as part of this plan change but are not included as planning maps. This is because the thresholds for priority will remain fixed, however the status of catchments will change over time as work is completed within the catchment.~~

Farm Environment and Catchment Collective Plans and Industry Programmes are to be completed in the following priority order; High, Medium and Low Priority over the first 3, 6 and 9 years respectively following <the operative date> of the plan (although work can commence at any time and farmers will be encouraged to start with their own programme as soon as possible).

207.47, 210.138, 135.61 127.16, 123.146, 120.22, 120.92, 120.109, 120.118, 116.7

[And add maps that are included in the evidence of Catherine Sturgeon – '*ATTACHMENT A: DIN, E. coli, and DRP concentration priority maps*']

Note: s42A report recommended changes are in black. HortNZ proposed changes in green.

Schedule 30: ~~Landowner~~ Catchment Collective, Industry Programme and Freshwater Farm ~~Environment~~ Plan

The TANK Plan provides for an **Industry Programme** ~~**Group**~~ or a **Catchment Collective** to work ~~collectively on behalf of~~ with their members to meet local water quality and environmental objectives, through **Freshwater Farm Plans**.

Alternatively, landowners may also prepare an individual **Freshwater Farm** ~~**Environment**~~ **Plan.** This schedule sets out the requirements for:

a) Freshwater Farm Plan content requirements.
b) Tthe establishment of a ~~TANK Industry Group or~~ TANK Catchment Collective, their operation and the preparation of their environment plan in order for them to be approved by the Hawke's Bay Regional Council.

~~(c) It also sets out the requirements for Freshwater Farm Environment Plans.~~

c) Individual Freshwater Farm Plans
d) Industry Programmes
e) Auditing

~~**Heretaunga Plains Water Management Unit**~~

~~In the Heretaunga Plains Water Management Unit, requirements for stream flow enhancement will be imposed through conditions of a water permit. Management of a stream flow enhancement scheme is not required to be done by water permit holders acting collectively, however, an Environmental Management Plan can address collective management of any flow enhancement scheme and also address water quality issues according to Sections A and B at the same time.~~

~~**Industry Groups and Catchment Collectives**~~

~~A TANK Industry Group or a TANK Catchment Collective must meet the requirements set out in Section A below.~~ ~~**Industry Programme or Catchment Collective Programme**~~

~~Each TANK Industry or TANK Catchment Collective must prepare an **Industry Programme** or **Catchment Collective Programme** that meets the requirements set out in Section B below. This programme The Freshwater Plans and Industry Programmes must identify the key water quality and water quantity management issues identified in this Plan that are relevant to;~~

~~• The catchment(s)~~

~~1. the modelled or measured water quality as indicated in Schedule 26, 28 or the Council's SOE reports, or local water quality measured using comparable water quality monitoring methods in the applicable catchment(s)~~
~~2. other water quality monitoring may be used as a guide to measure progress towards water quality targets.~~
~~3. the nature of the land and water use activities carried out within that catchment~~
4. ~~the scale of the effects on water quality or water quantity from the land and water use activities in that catchment. The Programme will describe an environmental management strategy relevant to the freshwater water management objectives where the member properties are located. An Industry Programme can be based on existing good agricultural practice industry [52] programmes, and will in addition need to address local water quality and quantity issues.~~

~~A summary of the Programme objectives and outputs will be made publicly available through the Council website.~~

~~Any TANK Freshwater Farm Plan Programme prepared in accordance with Schedule 30 may include or contribute to other initiatives or objectives (such as in relation to farm production, pest control, biodiversity or other land management issue) as desired by the Catchment Collective or Industry Programme. These aspects are not subject to the Council's approval, but may be a means of enabling integrated land and water management for a wider range of management objectives.~~

~~**Catchment Collectives**~~

Suggested change to more closely align with how industry programmes (refer to Evidence of Dr Farrelly) and catchment collectives work to deliver outcomes.

Amendments are sought to reflect changes that are sought to the structure of Schedule 30 (refer to Evidence of Dr Farrelly)

As set out in the evidence of Dr Farrelly, HortNZ seeks that the content of Schedule 30 be re-order. The green strike out content has been re-positioned in proposed Section A.

~~A TANK Catchment Collective must meet the requirements set out below.~~

~~Farm Environment Plan~~

~~The requirements of the Farm Environment Plan are set out in Section C below.~~

~~Programme Requirements~~

[52]~~This refers to existing industry programmes such as Hort NZ GAP, Sustainable Winegrowing, Fonterra Clean Stream etc.~~

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[NEW] Section A: Freshwater Farm Plan content requirements

~~The~~ Freshwater Farm Plans ~~and Industry Programmes~~ must identify the key water quality and water quantity management issues identified in this Plan that are relevant to;

- ~~The catchment(s)~~

1. the modelled or measured water quality as indicated in Schedule 26, 28 or the Council's SOE reports, or local water quality measured using comparable water quality monitoring methods in the applicable river catchment or sub-catchment(s)
2. other water quality monitoring may be used as a guide to measure progress towards water quality targets.
3. the nature of the land and water use activities carried out within that river catchment or sub- catchment
4. the scale of the effects on water quality or water quantity from the land and water use activities in that river catchment or sub-catchment

1. Requirements for Freshwater Farm Plans

1.1 A Farm Environment Plan must;

a) ~~be submitted to the Council to ensure it complies with the requirements of this Schedule and Schedule 28.~~

b) contain the following information;

(i) physical address;

(ii) details about ownership and property managers including contact details for the person responsible for the implementation of the Plan.

c) be accompanied by maps or aerial photograph at a scale to clearly show;

(i) property boundaries;

(ii) locations or activities likely to result in contaminant loss or at risk from contaminant loss including;

i. areas at risk of sediment loss;

ii. the location of drains (including subsurface drains), streams, rivers, wetlands and other water bodies;

iii. the location of any Source Protection Zone or Extent for any Registered Drinking Water Supply that any properties ~~in the programme area~~ are located in, plus the contact details of the water supply manager (*Note Maps included with this plan show the locations of the SPZs and Extents for any Registered Drinking Water Supplies. Contact information for the supply manager is available on the Council website.*

iv. activities at particular risk of nutrient loss;

v. contaminant discharge activities.

d) ~~meet the requirements of Clauses 2 and 4 in Section AB of this Schedule as applicable for the property, its location and the land use activities being carried out~~.

2. Environmental Outcomes

2.1 The Plan must include statements about the;

a) specified water quality outcomes in Schedule 26 of this Plan relevant to the location of the property (or for Catchment Collectives, Members' properties)

b) measures or practices needed to minimise and mitigating the cumulative environmental effects of land use that will enable the specified water quality objectives to be met.

c) timeframes for when each of the actions or mitigations at a property or river catchment or sub-catchment scale are to be implemented and which are consistent with ~~meeting the timeframes specified for relevant water quality objectives and~~ milestones specified in ~~the~~ TANK Pol 27. ~~Plan~~

2.2 The Plan must address where appropriate;

d) managing contaminant losses (especially sediment, nutrients and bacteria) to waterways including efficient use of nutrients and good management practice

HortNZ seek that Schedule 30 is restructured so all FEP content requirements (common to all three pathways of delivery) are in one place and consistent for plan users.

Note: In proposed Section A, Black text has been re-ordered from elsewhere in the schedule – new content/changes proposed are in green.

This is a process requirement that is not required to be stated here.

This cross-referencing is no longer required in a restructured schedule – as the content has been moved into the relevant section.

including when carrying out land disturbance activities and ~~especially~~ in relation to management of critical contaminant source areas.

e) where water quality does not meet standards in Schedule 26, identifying how there will be reductions in losses that contribute to meeting the specified water quality including, where appropriate, reference to;
   (i) in relation to industry specified benchmarks or good practice for nitrogen and phosphorus management ~~loss;~~
   (ii) LUC (Land Use Capability) and soil type;
   (iii) Olsen P levels in soil;
   (iv) Stock management including rates and densities of different classes of stock;
   (v) Application of fertilisers;
   (vi) Application of collected animal effluent;
   (vii) Cultivation, soil disturbance or vegetation clearance activities

f) Management of riparian margins and hillslope erosion , including to meet the outcomes specified in TANK Pol 11 and maintaining or improving the physical and biological condition of soils in a manner consistent with TANK Pol 20 and RRMP Rule 7 in order to avoid, remedy or mitigate problems arising from;
   (i) Loss of topsoil by wind or water erosion;
   (ii) Movement of soils and contaminants into waterways;
   (iii) Damage to soil structure and health;
   (iv) Mass movements of soil;

Change recommended in Catherine Sturgeons evidence

g) wetland management including to meet the outcomes specified in TANK Pol 14 and 15;

h) management of animal effluent to avoid contamination of ground and surface waters;

i) measures required to reduce risk of contamination of the source water for any Registered Drinking Water Supply;

j) management of stock, including in relation to river or stream crossings and exclusion from waterways in a manner that complies with the Resource Management (Stock Exclusion) Regulations (2020)~~is consistent with Policy 22 and Rules TANK 1 or 3;~~

k) **in the Karamū and ~~Lake~~ Poukawa Catchments ;** the identification of opportunities to provide shading of the adjacent waterway or improvements to riparian margin values as specified in TANK Pol 2 and 11.

2.3 The Plan must include measures to address **Nutrient Management** in any catchment ~~or programme area~~ where water quality objectives for nitrogen concentrations as detailed in Schedule 26 are not being met, including;

a) development of an inventory of the current average annual nitrogen loss rate (kg/ha/year) for every property, or full crop rotation as determined by application of Overseer (or an alternative nutrient budget model approved by the Hawke's Bay Regional Council) and a target nitrogen loss rate that demonstrates industry good practice ~~by a suitably qualified independent practitioner~~;

Change recommended in Stuart Ford's evidence

b) a description of any mitigation measures identified as necessary to meet water quality objectives on those properties or within the relevant river catchment or sub-catchment;

Terminology change, as per Catherine Sturgeon's evidence.

c) annual recording and reporting of nutrient input and export data, including annual **nitrogen budgets**, which may be at the property or crop level.

A Freshwater Farm Plan may be prepared on through a Catchment Collective (that meets the requirements in Section B below), on an individual basis (Section C) or through an Industry Programme (that is recognised through the process in Section D).

Change recommended in Stuart Ford's evidence

Any TANK Freshwater Farm Plan ~~Programme~~ prepared in accordance with this ~~S~~schedule ~~30~~ may include or contribute to other initiatives or objectives (such as in relation to farm production, pest control, biodiversity or other land management issue) as desired by the Catchment Collective or Industry Programme. These aspects are not subject to the Council's approval, but may be a means of enabling integrated land and water management for a wider range of management objectives.

Clarification that a Freshwater Farm Plan can be delivered by various means (the specific requirements of which are then set out in subsequent sections). Correction of terminology

Section ~~A~~B: ~~Industry Groups and~~ Catchment Collectives ~~Governance and Management~~

The s42A author accepts submission point seeking industry programmes are split out, but reference in hearing remains

A TANK Catchment Collective must meet the requirements set out below.

< moved from above. Intent of this section.

1. Governance and Management

Applications for approval of a catchment collective shall be lodged with the Hawke's Bay Regional Council, and shall include information that demonstrates how the following requirements are met. The Hawke's Bay Regional Council may request further information or clarification on the application as it sees fit.

Approval will be at the discretion of the Chief Executive of the Hawke's Bay Regional Council subject to the Chief Executive being satisfied that the scheme will meet the standards set out below.

This content is proposed to be duplicated from the industry programmes – we consider it also relevant to Catchment Collectives, for additional clarity/rigour.

1.1 Each Catchment Collective ~~or Industry Group must undertake to carry out the requirements of Sections A and B and must specify in writing the manner in which it will carry this out. This~~ must address the following ~~: Details relating to the~~ governance and management arrangements of the ~~Programme~~ Catchment Collective including**:**

a) How decisions are to be made and how the requirements of Section B will be carried out including obligations by members to carry out the property specific requirements

b) Conditions of membership of the ~~Programme~~ Catchment Collective by individual land managers (the 'Members' who commit to the Catchment Collective ~~Programme~~), including the circumstances and terms of membership, sanctions or removal from the Collective ~~or Industry Programme~~ including in relation to unreasonable non-performance of actions identified in clause 2 below.

c) The process for assessing performance at an individual property level compared to agreed actions at the river catchment or sub- catchment scale.

Note 1: the Catchment Collective ~~or Industry Programme~~ may prepare its own terms of reference as well as manage their own decision making processes and administration. This may include appointing a spokesperson or secretary to ensure recording and reporting work is completed as necessary. ~~Note 2:~~ If a membership is lapsed, refused or discontinued, the Council will require the landowner to comply with ~~r~~Rule TANK 1.

1.2 Information and management systems and processes to ensure:

a) Competent and consistent performance in meeting the requirements of this s~~S~~chedule

b) Robust data management, including up-to-date registers of ~~Programme~~ Catchment Collective Members

c) Timely provision of suitable quality data and information required under the following clauses to Hawke's Bay Regional Council

d) Conditions of membership of the Catchment Collective ~~Programme~~ by individual land managers (the 'Members') who commit to the Catchment Collective ~~Programme~~ including provision of information to enable reporting requirements to be met.

Correction required to refer to Catchment Collective (legacy reference to Programme)

1.3 A description of the Catchment Collective ~~Programme~~ area including:

a) locations and maps,

b) land uses,

c) locations of ;

(i) drains (including subsurface drains), streams, rivers, wetlands and other water bodies,

(ii) any Source Protection Zone or Extent for any Registered Drinking Water Supply that any properties in the programme area are located in, plus the contact details of the water supply manager (Note – Maps included with this plan show the locations of the SPZs and Extent for any Registered

Drinking Water Supplies. Contact information for the supply manager is available on the Council website),

d) activities at particular risk of nutrient loss,
e) property boundaries,
f) up-to-date details about ownership and property managers,
g) up-to-date contact details of individual land managers and landowners within the Catchment Collective ~~Programme~~ (the 'Members').

~~Section B:~~ Catchment Collective Freshwater Plan Requirements

A Catchment Collective must prepare a Freshwater Environment Plan that meets the requirements of Section A.

HortNZ seeks that all farm plan requirements (which are common across the three delivery pathways)

~~This section sets out the requirements for the Freshwater environment pPlan for each Catchment Collective or Industry Programme~~

~~The Programme summary report will be made publicly available through the Council website.~~

This content has been moved to a common Freshwater Farm Plan requirement section.

~~**2. Environmental Outcomes**~~

~~2.1 The Plan must include statements about the;~~

~~i. specified water quality outcomes in Schedule 26 of this Plan relevant to the location of Members' properties~~

~~ii. measures or practices needed to minimise and mitigating the cumulative environmental effects of land use that will enable the specified water quality objectives to be met.~~

~~2.2 timeframes for when each of the actions or mitigations at a property or catchment scale are to be implemented and which are consistent with meeting the timeframes specified for relevant water quality objectives and milestones specified in the TANK Pol 27. PlanThe Plan must address where appropriate;~~

~~iii. managing contaminant losses (especially sediment, nutrients and bacteria) to waterways including efficient use of nutrients and good management practice including when carrying out land disturbance activities and especially in relation to management of critical contaminant source areas.~~

~~iv. where water quality does not meet standards in Schedule 26, identifying how there will be reductions in losses that contribute to meeting the specified water quality including, where appropriate, reference to;~~

~~1. in relation to industry specified benchmarks or good practice for nitrogen and phosphorus management loss;~~
~~2. LUC (Land Use Capability) and soil type;~~
~~3. Olsen P levels in soil;~~
~~4. Stock management including rates and densities of different classes of stock;~~
~~5. Application of fertilisers;~~
~~6. Application of collected animal effluent;~~
~~7. Cultivation, soil disturbance or vegetation clearance activities~~

~~v. Management of riparian margins, including to meet the outcomes specified in TANK Pol 11 and maintaining or improving the physical and biological condition of soils in a manner consistent with TANK Pol 20 and RRMP Rule 7 in order to avoid, remedy or mitigate problems arising from;~~

~~1. Loss of topsoil by wind or water erosion;~~
~~2. Movement of soils and contaminants into waterways;~~
~~3. Damage to soil structure and health;~~
~~4. Mass movements of soil;~~

~~vi. wetland management including to meet the outcomes specified in~~

TANK Pol 14 and 15;

vii. management of animal effluent to avoid contamination of ground and surface waters;

viii. measures required to reduce risk of contamination of the source water for any Registered Drinking Water Supply;

ix. management of stock, including in relation to river or stream crossings and exclusion from waterways in a manner that complies with the Resource Management (Stock Exclusion) Regulations (2020)is consistent with Policy 22 and Rules TANK 1 or 3;

x. **in the Karamū and Lake Poukawa Catchments ;** the identification of opportunities to provide shading of the adjacent waterway or improvements to riparian margin values as specified in TANK Pol 2 and 11.

2.3 The Plan must include measures to address **Nutrient Management** in any catchment or programme area where water quality objectives for nitrogen concentrations as detailed in Schedule 26 are not being met, including;

xi. development of an inventory of the current nitrogen loss rate (kg/ha/year) for every property as determined by application of Overseer (or an alternative nutrient budget model approved by the Hawke's Bay Regional Council) and a target nitrogen loss rate that demonstrates industry good practice by a suitably qualified independent practitioner;

xii. a description of any mitigation measures identified as necessary to meet water quality objectives on those properties or within the relevant catchment;

xiii. annual recording and reporting of nutrient input and export data, including annual nitrogen loss rates.

2.4 A Catchment Collective member may adopt or integrate a plan or documentation developed as part of an Industry Good Agricultural Practice programme, provided that the Plan or documentation is consistent with the requirements of the Catchment Collective Programme

3. Approval

a. The Catchment Collective Freshwater Pplan or Industry Programme will be submitted for approval by the HBRC no later than by the end of the relevant year specified for that sub-catchment in Schedule 28. In making decisions to approve the Plan rogramme the Council will take into account;

i. whether the requirements of this Schedule are met;

ii. whether the programme is consistent with the policies, water quality objectives and milestones that are relevant for that Catchment Collective or Industry Programme

iii. whether the Plan rogramme was appropriately informed by person(s) with the necessary professional qualifications knowledge to make assessments about the contaminant loss risk and mitigation measures

iv. whether the governance and management systems are in place to enable the implementation of the Plan programme

b. Where approval is not given, it means the requirements of Rule TANK 1 are not able to be met and land use is therefore subject to either Rule TANK 1 (b)2 or Rule TANK 2.

4. Information Requirements

a. The Catchment Collective or Industry programme must prepare a statement of the data and information that will be collected in order to monitor implementation and report to Council.

b. Information will be required where appropriate about:

i. changes to programme area and membership;

ii. nature and significance of any land use change in accordance with TANK Pol 22~~1~~ and Rule TANK 5 ~~or 6~~ and based on land uses at 2 May 2020.

iii. the results of any environmental monitoring carried out by the Catchment Collective ~~or Industry Programme~~;

iv. the mitigation measures or practices carried out to reduce contaminant loss (consistent with what is industry ~~agreed~~ good management practice) that will be adopted by the property owners or managers and as detailed in clause A1.1;

v. data, which may be aggregated across a river catchment or sub-catchment, about nitrogen loss in A 1.3 a and any changes in losses in respect of clause 1.3. c

This was highlighted in s42A version - land use change outside of the catchment collective is not relevant to report on. POL 22 has been deleted.

5. Reporting and Review

5.1 A summary report on the implementation of the Freshwater Plan ~~Programme~~ shall be submitted annually to the Hawke's Bay Regional Council or less frequently as determined by Council if all agreed mitigations have been completed, water quality objectives are being met and there is no land use change exceeding the thresholds in TANK 5 in ~~10ha of~~ the Catchment Collective ~~programme~~ area (unless a resource consent has been sought for that land use change).

5.2 The report will be supplied in the format specified by Council.

5.3 The report will include;

a) information collected under section 4;

b) any amendments to the programmed mitigation measures plus any changes made to them and reasons for them (including any adverse events such as severe weather, earthquakes etc);

c) issues or matters that require input or direction from the Council, including the management of activities outside the Catchment Collective which may be adversely affecting the achievement of the of Catchment Collective ~~programme~~ objectives, including identification of additional information/support from HBRC that would assist in the achievement of the objectives of the Catchment Collective ~~programme~~.

5.4 Every 5 years the annual report shall provide information about;

a) adoption of any new mitigation or good practice measures identified by the Catchment Collective ~~industry;~~

b) identification of opportunities for improvements to the Catchment Collective ~~programme~~ including, where necessary, amending performance standards, and in relation to nutrient management in clause 2.3.

As above – correction of consistent reference to Catchment Collective.

Consequential change.

The Catchment Collective~~Programme~~ summary report will be made publicly available through the Council website.

6 Auditing

6.1 Auditing will be carried out as described in Section ~~D~~E.

Section ~~B~~C: Individual Freshwater Farm Plans

If a property is not subject to a TANK Catchment Collective ~~prepared under~~ (Section A~~B~~B) or a TANK Industry Programme (Section D) ~~prepared under Schedule D~~C ~~of this Schedule~~ a Freshwater Farm ~~Environment~~ Plan must be prepared in accordance with Section A~~B~~C and must be submitted to the Council to ensure it complies with the requirements of this Schedule and Schedule 28.

HortNZ seek changes consistent with a restructure of Schedule 30; this would clarify the requirements specific for individuals.

~~Section C: **Freshwater Farm Plan Requirements**~~

~~**1. Requirements for Freshwater Farm Plans**~~

Freshwater Farm Plan content has been consolidated in one section in HortNZ's proposed restructure. This section can cover off specific requirements for individuals, with regard to reporting, review and audit.

~~1.1 A Farm Environment Plan must;~~

~~) be submitted to the Council to ensure it complies with the requirements of this Schedule and Schedule 28.~~

~~a) contain the following information;~~

~~(i) physical address;~~

~~(ii) details about ownership and property managers including contact details for the person responsible for the implementation of the Plan.~~

~~b) be accompanied by maps or aerial photograph at a scale to clearly show;~~

~~(i) property boundaries;~~

~~(ii) locations or activities likely to result in contaminant loss or at risk from contaminant loss including;~~

~~i. areas at risk of sediment loss;~~

~~ii. the location of drains (including subsurface drains), streams, rivers, wetlands and other water bodies;~~

~~*iii.* the location of any Source Protection Zone or Extent for any Registered Drinking Water Supply that any properties in the programme area are located in, plus the contact details of the water supply manager (*Note Maps included with this plan show the locations of the SPZs and Extents for any Registered Drinking Water Supplies. Contact information for the supply manager is available on the Council website.*~~

~~iv. activities at particular risk of nutrient loss;~~

~~v. contaminant discharge activities.~~

~~c) meet the requirements of Clauses 2 and 4 in Section A~~B ~~of this Schedule as applicable for the property, its location and the land use activities being carried out.~~

2. Reporting and Review

2.1 The Freshwater Farm ~~Environment~~ Plan will be submitted to the HBRC no later than by the end of the relevant year specified in Schedule 28 for the sub-catchment(s) the property is located in.

2.2 Where annual reporting is required under Section A 2.3, the report will be in the format specified by Council.

The content in 'Reporting and Review' appear to be irrelevant to an individual preparing a Freshwater Farm Plan, or at least it is unclear what 'report' is being referred to

2.3 The report will include:

a) information collected under Clause 4 of Section A~~B~~

b) any amendments to the programmed mitigation measures plus any changes made to them and reasons for them (including any adverse events such as severe weather, earthquakes etc)

2.4 Every 5 years the annual report shall provide information about;

a) adoption of any new mitigation or good practice measures identified by industry,

b) identification of opportunities for improvements in relation to nutrient management in clause ~~2.3~~ 1.3 of Section A~~B~~.

3. Auditing

3.1 Auditing will be carried out as described in Section ~~D~~E.

Section ~~C~~D: Industry Programmes

The purpose of this schedule is to set out the minimum standards for Industry Programmes. Industry programmes can assist with the individual and collective farm plans

Applications for approval of an Industry Programme shall be lodged with the Hawke's Bay Regional Council, and shall include information that demonstrates how the following requirements are met. The Hawke's Bay Regional Council may request further information or clarification on the application as it sees fit.

Approval will be at the discretion of the Chief Executive of the Hawke's Bay Regional Council subject to the Chief Executive being satisfied that the scheme will meet the standards set out below.

HortNZ support the s42A accepting the submission to provide for industry programmes separately.

1. Governance and management

1.1 Industry Programmes must include:

a) A description of the governance arrangements of the programme

b) The contractual arrangements between the programme and its members;

c) A description of the process for gaining and ceasing membership;

d) A description of the programme area, including

(i) land uses,

(ii) key environmental issues and measures to address them,

(iii) property boundaries and

(iv) ownership details of members' properties;

e) A procedure for keeping records including up-to-date registers of programme members and provision of data to the HBRC

f) Details including procedures agreed with the HBRC about how requirements of this Section are to be met.

2. Preparation of Freshwater Farm Plans

Amendment to reflect nature of GAP schemes, as discussed in the evidence of Dr. Farrelly

2.1 Industry Programmes must include:

a) A statement of the programme's capability and capacity to deliver certified ~~for preparing and certifying that~~ Freshwater Farm Plans meet the requirements of this Schedule, including;

(i) The requirements of Section A~~2~~ of this Schedule

~~(ii) The qualifications and experience of any personnel employed by or otherwise contracted to the programme to prepare or certify Freshwater Farm Plans;~~

(iii) The process for certification of FW-FPs

3. Implementation of Freshwater Farm Plans

3.1 Industry Programmes must include:

a) A statement of the programme's capability and capacity for monitoring and assessing the implementation of Freshwater Farm Plans, including the qualifications and experience of any personnel employed by or otherwise contracted to the programme to monitor or assess

implementation of Freshwater Farm Plans;

b) A description of the expectations and agreements around landowner and property record-keeping;

c) A strategy for identifying and managing poor performance in implementing Freshwater Farm Plans.

The audit frequency is set out in the industry programmes – which is approved by Council.

4. Audit

4.1 Industry Programmes must include a description of an ~~annual~~ audit process to be conducted by an independent body, including:

a) A process for assessing the accreditation ~~performance~~ of the programme and any personnel employed by or otherwise contracted to the scheme to prepare, certify, and audit the implementation of Farm Environment Plans;

b) A process for auditing FW-FPs

c) A statement of how audit results of collective or individual audit FW-FP results will be shared with the programme's members and the wider community;

d) A summary audit report must be submitted to the Hawke's Bay Regional Council annually

Section ~~D~~E Auditing and Reporting

1. The HBRC will;

   a) Publicly report on the implementation of requirements for TANK Freshwater Farm Plans (including ~~and~~ Catchment Collective Plans and Industry Programme Plans);

   b) Undertake audits of TANK ~~Industry or Catchment Collective Programmes~~ Freshwater Farm Plans (who are not part of an Industry Programme) including on member properties in relation to ~~individual and programme~~ implementation of planned actions~~rogrammed works~~, adoption of identified good management practices, and ~~including~~ nutrient management budgets where required.

~~*Note 2: that if the conditions of any applicable RRMP Rule 7 for specified activities are not being complied with by a landowner or manager, there must be information as outlined in section B2 above of the Catchment Collective or Industry Programme to show how the relevant contaminant loss risks are to be managed to a similar level of performance.*~~

2. ~~The HBRC will;~~

   a) ~~Publicly report on the implementation of TANK Freshwater Farm Environment Plan requirements~~

   b) ~~Undertake audits of properties in relation the Freshwater Farm Environment Plan implementation of programmed works, adoption of identified good management practices, including nutrient management budgets where required~~.

Duplication of 1(b)

Schedule 31: Flows, Levels and Allocation Limits

Minimum and Trigger Flows and Allocation Limits

Refer to Rules TANK 9-11. This Schedule specifies the amount of water that may be authorised for abstraction from the specified water quantity areas ~~management units~~ and the flows at which water abstraction is subject to restrictions or requirements.

The minimum flow is the flow at which surface water and Zone 1 groundwater consented takes must cease where there is no appropriate stream flow maintenance scheme, or a water user does not participate in a stream flow maintenance scheme.

The flow maintenance trigger is the flow which stream flow maintenance schemes must maintain for participating water users to continue taking water.[123.149]

The allocation limits do not apply to water abstraction that is enabled by the release of water ~~from water~~ taken at times of high flow and stored for later release ~~(refer to Schedule 32)~~.[123.149, 210.141]

The location and spatial extent of the water quantity areas are ~~management units is~~ shown on the Planning Maps Schedule 31A – 31E.

Water ~~Management Units (quantity)~~ Quantity areas and includes any tributaries of the named river	Water bodies	~~Minimum flow/flow maintenance~~ Flow management site	Minimum Flow (litres/second)	Flow maintenance trigger (litres/second)	Allocation limit (litres/second for surface water and zone 1 and ^{3}/per year for groundwater)
Ahuriri	All surface water	n/a	n/a	n/a	Existing use only[1]
	All groundwater	n/a	n/a	n/a	Existing use only[1]
Karamū/ Clive River	Awanui Kawerawera-Paritua	The Flume	120	120	Total not to exceed 30 l/s
		Pakipaki		75	
	Irongate	Clarks Weir[2]	100	100	
	Louisa Stream	Te Aute Rd	30	30	
	Mangateretere Stream	Napier Rd	100	100	
	Karamū River	Floodgates	1100	1100	
	Raupare Stream	Ormond Rd	300	300	70 l/sec
	Poukawa incl Lake Poukawa Groundwater	n/a	n/a	n/a	Existing use only[1]
	Poukawa incl Lake Poukawa Surface water	At Douglas Rd[2]	20	n/a	Existing use only[1]
Ngaruroro River s/w and g/w	Maraekakaho River	Tait Rd	109	n/a	36 l/sec
	Tūtaekurī -Waimate	Goods Bridge	1200	n/a	607 l/sec
	Ngaruroro River (surface and Zone 1)	Fernhill[2]	2400		1300 l/sec
	Ngaruroro Groundwater	N/a	n/a	n/a	Existing use only[1]
Tūtaekurī River s/w and g/w	Mangatutu Stream	Puketapu	3800		120 l/sec
	Mangaone River	Puketapu	2500		140 l/sec
	Tūtaekurī (surface plus Zone1)	Puketapu	2500		1140 l/sec
	Tūtaekurī groundwater	n/a	n/a		Existing use only[1]

Heretaunga Plains Groundwater ~~Management Unit~~ Quantity Area	Heretaunga Plains groundwater	n/a	n/a		Existing use only[1]
Note 1; Allocation limit is the ~~reflects~~ total amount allocated to ~~existing~~ consents ~~that were~~ granted prior to 2 May 2020 or a lesser amount ~~as relevant~~ where water is allocated subject to ~~a~~Actual and ~~r~~Reasonable use ~~for takes in the Heretaunga Plains Water Management Unit~~. ~~Note 2; The location of the Clarke's Weir monitoring site may be changed to provide better representation of sub-catchment flows.~~[180.71]					

Schedule 32: High Flow Allocation

Refer to Rules TANK 13-16. This Schedule specifies the amount of water that may be authorised for abstraction from the specified water management units and the flows at which water abstraction is subject to restrictions or requirements. They apply to water abstraction that is enabled by the damming and release of water taken or dammed at times of high flow and stored for later release.

(a) River Name	(B) Flow Management Site	(C) Environmental flow rate trigger	(D) ~~High Flow Allocation~~ Interim take limit	(E) Amount of interim take limit reserved for Māori development and environmental enhancement subject to POL TANK 59	(F) ~~Limits for Damming~~ Environmental flow variability outcome
Ngaruroro ~~R~~	Fernhill	20 m^3/sec	8,000litres per second* This includes; the 2 m^3/sec allocation allocated in consents existing at 2 May 2020 • the amount taken from high flow in any tributary of the Ngaruroro • the amount specified in column (E).	1,600 litres per second.	Damming on mainstem of Ngaruroro River is prohibited.
		All Trigger flows above 5000 l/sec	Abstraction of up to 1 m^3/sec authorised in consents existing as at 2 May 2020. Included in the 1m^3/sec is abstraction of up to 400l/sec which is solely available to be discharged into the Paritua Stream to provide for stream enhancement.		n/a
		Trigger flows above 2400l/sec	200 l/sec which is solely available to be discharged into the Paritua Stream to provide for stream enhancement.		
Ngaruroro and Tūtaekurī Tributaries		Median flow	The high flow allocation from the tributary is proportional to its contribution to the mainstem. It is part of the total allocation for the mainstem high flow allocation.	20% of any high flow allocation from any tributary.	No change of more than 10% to FRE_3 in the mainstem of the applicable River. Damming on the mainstem of the Taruarau Omahaki, Mangaone and Mangatutu is prohibited.
Tūtaekurī	Puketapu	8,000 litres per second	2,500 litres per second This includes: • the amount taken from high flow in • any tributary of the Tūtaekurī • the amount specified in column (E).	500 litres per second.	Damming on the mainstem of the Tūtaekurī River is prohibited.

Schedule 34B: Integrated Catchment Management Plan [129.4]

Refer to Rule TANK 21. An application for resource consent for network discharges must include an integrated catchment management plan that includes:

1. A monitoring programme to assess existing stormwater discharge quality and level of impact on receiving water quality standards

2. Identification of the spatial extent of the stormwater network to which the application for consent relates

3. Identification of the ~~priority streams or~~ sub-catchments where stormwater discharges currently result in receiving water quality below the standards specified in Schedule 26

4. A programme of mitigation measures including timeframes and milestones for the enhancement of streams identified in (3)

5. Identification of any industrial or trade sites, that use, store or produce the discharge of any contaminant of concern (as defined in Table 3.1 of Hawke's Bay Waterway Guidelines Industrial Stormwater Design)

6. Identification of sites within sub-catchments that have a high risk of contaminants entering the stormwater network or land where it might enter surface or groundwater, including industrial and trade premises and areas subject to new urban development.

7. For sites identified in (6), a programme to ensure Urban Site Specific Stormwater Management Plans are prepared and implemented so that stormwater quality risks are managed. (Schedule 34A)

8. Identification of areas at risk of flooding, and where levels of service to protect communities from flooding are not being met provide information about how this will be managed.

9. The potential effects of climate change on infrastructure capacity and a description of any planned mitigation measures including the identification of secondary flow paths and the capacity of the receiving environment.

10. Identification of measures to demonstrate how discharges shall not cause scouring or erosion of land or any water course beyond the point of discharge

11. Where the stormwater network (or part thereof) or discharge locations are situated within a Source Protection Zone of a registered drinking water supply, a description of measures to prevent or minimise adverse effects on the quality of the source water for the registered drinking water supply or any increase in the risk of unsafe drinking water being provided to persons and communities from the drinking water supply

12. Description of measures to demonstrate how the discharge shall not contain hazardous substances or contaminants (including wastewater) and shall not cause any of the following to occur after reasonable mixing:

    i. production of conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
    ii. any emission of objectionable odour;
    iii. Any conspicuous change in colour or visual clarity of the receiving water;
    iv. any freshwater becoming unsuitable for consumption by farm animals;

the destruction or degradation of any habitat, mahinga kai, plant or animal in any water body or coastal water

BEFORE THE HEARING COMMISSIONERS APPOINTED BY THE HAWKE'S BAY REGIONAL COUNCIL

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

AND

IN THE MATTER of Proposed Plan Change 9 - Tūtaekurī, Ahuriri, Ngaruroro and Karamū **(PC9)**

STATEMENT OF EVIDENCE OF CATHERINE JEAN STURGEON (WATER QUALITY) FOR HORTICULTURE NEW ZEALAND

7 MAY 2021

ATKINS | HOLM | MAJUREY

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CONTENTS

SUMMARY

1. I have been asked to prepare evidence based on my research and assessment for Horticulture New Zealand **(HortNZ)** in support of their key submission points on Proposed Plan Change 9 **(PC9).**

2. The focus of my water quality evidence is the provisions within PC9 that set the limits and actions for achieving the proposed water quality outcomes over time.

3. I support the overall approach of PC9, however PC9 is not adequately aligned with NPSFM 2020 when it comes to providing limits on resource use for the multiple contaminants in NPSFM 2020 Appendix 2A.

4. In NPSFM 2020 "limit" means 'either a limit on resource use or a take limit'. A water quality limit will be a limit on resource use. The water quality limits within PC9 are considered to be the freshwater farm plans (FW-FP) (Rule TANK 1 and 2, and POL TANK 17) and the land-use change rule (Rule TANK 5, and POL TANK 21) that prevents an increase in nitrogen (N) loss.

5. The effectiveness of FW-FP in giving an improvement in water quality and meeting the water quality objectives of the plan relies on the priority maps to have been created correctly and cover the contaminants of concern in each sub-catchment.

6. A review of the data used to create the priority maps has led me to make the following recommendations for the priority maps:

   (a) Remove the TN concentration priority map from Schedule 28 and replace with a DIN concentration priority map.

   (b) Update the TN yield priority map to match the HBRC provided data or provide clarity over how this map was created.

   (c) Add in a DRP concentration and *E. coli* NOF band priority maps using Schedule 26 baseline data.

7. Spatial analysis using the sediment yield data from the sediment priority map shows that hillslope erosion is significant in the TANK catchments. I recommend that the FW-FP criteria in Schedule 30 needs to include reference to managing

hillslope erosion to ensure it responds to activities that contribute significant sediment loads.

8. Priority maps in Schedule 28 also need clarity to improve their usability :

   (a) I recommend the addition of an overarching priority map that shows the priority level regardless of the contaminant.

   (b) Sub-catchments should be labelled.

   (c) Water quality areas should be overlaid.

   (d) Monitoring locations should be added.

   (e) The titles of each map should be changed from 'priority catchments to 'priority sub-catchments', and the Nitrate Yield title should be changed to TN Yield.

   (f) The Ahuriri water quality area and the Poukawa sub-catchment should be added to the TN yield priority map.

9. I recommend that references to spatial units throughout the plan are clarified:

   (a) I recommend that Catchment Collectives can be implemented at any scale from sub-catchment through to the river catchment scale.

   (b) FW-FP are either at the farm enterprise, or in the case of the Catchment Collective at the scale of the collective.

10. The S42a report outlined that the reason for N being the focus of POL TANK 21 was because N is a contaminant of particular concern, with freshwater concentrations exceeding target attribute states (**TAS**) in many places within the TANK catchments. My evidence shows that sediment, phosphorus and *E. coli* are also key water quality issues within many of the sub-catchments, and the attributes least likely to meet the TAS with the way the current plan is worded.

11. The FW-FP addresses water quality on a multi-contaminant level and therefore acts as a limit for all water quality attributes that need limits (as outlined in the NPSFM 2020). POL TANK 21 uses land use change as a limit in the plan, however land use

change is only assessed based on N losses and therefore conceivably allows an increase in other contaminants (e.g. a land use change from commercial vegetation crops to beef is permitted, but would result in an increase in *E. coli* losses from the farm). In my opinion, a multi-contaminant approach would result in better water quality outcomes overall. Therefore I recommend that the wording of POL TANK 21 be amended to enable land use change that results in negligible cumulative increases in N at the sub-catchment scale in:

- sub-catchments that are meeting the dissolved inorganic nitrogen (**DIN**) target attribute state; and
- if the land use change results in water quality improvements for attributes that are currently not met in the sub-catchment (e.g *E. coli*, phosphorus), for which limits are also required within NPSFM 2020 Appendix 2A.

INTRODUCTION

Qualifications and experience

1. My full name is Catherine Jean Sturgeon.

2. I am employed by Pattle Delamore Partners (PDP), an environmental consulting firm. I am contracted to provide water quality expertise on the Proposed Plan Change 9 - Tūtaekurī, Ahuriri, Ngaruroro and Karamū (PC9) to Horticulture New Zealand (HortNZ).

3. I hold a Bachelor of Science (Technology) in Earth and Ocean Sciences (2010) and a Master of Science Degree in Earth and Ocean Sciences (2013) from the University of Waikato.

4. I have eight years' experience in the field of water quality and water resources. I started my career at Jacobs New Zealand Limited (Jacobs) and worked for them between 2013 and 2019 before joining PDP in 2020.

5. I regularly provide expertise in the fields of water quality and water resources to a range of primary industry clients including HortNZ and Pamu (previously Landcorp), district councils including Selwyn District Council, and a number of industrial clients such as Air New Zealand and Fletcher Construction.

6. I hold a certificate in Sustainable Nutrient Management in New Zealand Agriculture – Intermediate Short Course from Massey University and have experience in Overseer and nutrient budgeting.

7. I am familiar with Plan Change processes through writing technical reports to support HortNZ's submissions with regards to water quality on the Proposed Waikato Regional Plan Change 1 – Waikato and Waipa River Catchments, and supporting the expert witnesses for HortNZ and providing additional technical guidance.

Expert Witness Code of Conduct

8. Although this is a hearing before Hearings Commissioners, I confirm that I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2014. I have complied with the Code of Conduct in preparing this evidence and agree to comply with it while giving oral evidence. 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 these proceedings

9. I have been asked to prepare evidence based on my research and assessment for HortNZ in support of their key submission points on PC9.

10. I also rely on spatial analysis and mapping prepared by Stu Easton from Jacobs. I had oversight of these assessments.

Purpose and scope of evidence

11. The focus of my water quality evidence is the provisions within PC9 that set the limits and actions for achieving the proposed water quality outcomes over time. To do this I will discuss the following points:

    (a) A discussion on the current water quality state across the TANK catchments;

    (b) A discussion on the water quality objectives, policies and rules within the plan and NPSFM 2020;

    (c) Activities influencing water quality within the TANK catchments;

    (d) A review of the effectiveness of the Schedule 28 priority maps and freshwater farm plans (FW-FP) in meeting the objectives of PC9 with regard to:

        i. Sediment yield;

        ii. Total nitrogen (TN) yield;

        iii. TN concentration;

        iv. *E. coli; and*

        v. Dissolved Reactive Phosphorus (DRP).

    (e) Recommendation for the amendment of POL TANK 21 to provide for a multi-contaminant assessment approach;

(f) A discussion on plan usability, specifically on the terminology used throughout PC9 and the need for consistency of terms;

i. Includes recommendations for terminology changes and what scale the Schedule 30 'catchments' should be set to;

(g) A discussion on the need for consistent and clear planning priority maps in PC9.

12. In preparing my evidence, I have reviewed the following documents and evidence:

(a) The notified PC9.

(b) S42a report and appendices.

(c) Palmer *et al.*, 2016. SedNetNZ modelling to estimate sediment sources from the TANK, South Coast, and Porangahau catchments. Landcare Research. HBRC Report No. RM18-19 – 5003.

(d) WWAL, 2018. SOURCE Model Build Report, Report Reference WWA00018/Rev. 5, Williamson Water Advisory Limited.

(e) Haidekker, S. & Madarasz-Smith, A. 2020. Ngaruroro, Tūtaekurī, Karamū River and Ahuriri Estuary Catchments: State and Trends of River Water Quality and Ecology. HBRC Report No. 5422.

(f) Haidekker, S. 2019. Supporting Water Quality Information for the Development of Limits and Targets by the TANK Group: Rivers and Streams June 2019 HBRC Report No. RM19-252.

(g) New Zealand National Policy Statement for Freshwater Management 2020. New Zealand Government.

(h) The evidence of HortNZ.

13. The focus of this evidence will be on the amended PC9 that accompanied the S42a report as Appendix 1A, not the notified version of PC9, unless otherwise stated.

CONTEXT TO FRESHWATER QUALITY STATE AND FRESHWATER QUALITY OUTCOMES

14. The following section is a summary of the water quality trends within sub-catchments in the TANK catchments. This information has been mainly sourced from the Ngaruroro, Tūtaekurī, Karamū River and Ahuriri Estuary Catchments: State and Trends of River Water Quality and Ecology report by Haidekker & Madarasz-Smith (2020). The Haidekker & Madarasz-Smith (2020) report outlines the state of the environment (SOE) monitoring for the period 2012 to 2018. I have limited my discussion to nitrogen, phosphorus, sediment and *E. coli*.

15. Monitoring from 2012 to 2018 showed that the Ngaruroro mainstem was generally in excellent condition in the upper to middle catchment. However, water clarity decreased and turbidity increased from upstream to downstream, with clarity below contact guidelines in the mid to lower mainstem. All Ngaruroro tributaries (other than the Ohara Stream) were enriched in nutrients, especially phosphorus which was always above guideline levels. *Escherichia coli* (*E. coli*) levels were very low in the Ngaruroro catchment.

16. The influence of nutrient loads coming from the tributaries into the mainstem had only a minor effect on the water quality in the mainstem Ngaruroro, because large volumes of water with high water quality from the pristine upper catchment dilutes the influence of the tributaries. However these nutrient loads have an important cumulative effect on loads in the Waitangi Estuary receiving environment.

17. The Ngaruroro River at Kuripapango (Ngaruroro headwaters) was one of the two sites with the greatest water clarity measurements for all SOE sites, with median black disc viewing distances greater than 5 m. When flow reaches the lower mainstem however, water clarity decreases so much that at the Fernhill and Chesterhope monitoring sites (in the lowlands), black disc results rank in the bottom 10 SOE sites regionally.

18. Tūtaekurī mainstem and tributaries showed enrichment in nutrients from upstream to downstream, particularly phosphorus. Phosphorus was always above guidelines in the lower mainstem sites and mostly above guidelines in the

tributaries. *E. coli* levels were very low in the Tūtaekurī catchment.

19. Similar to the Ngaruroro, the Tūtaekurī at Lawrence Hut was one of the two monitoring sites with the clearest water of all SOE sites. In the Tūtaekurī River between Lawrence Hut and upstream of the confluence with the Mangaone River, water clarity decreased from 7 m to 2.5 m. In both the Ngaruroro and Tūtaekurī Rivers, the most pronounced reduction in water clarity was in the upper reaches just after the water comes out of the area predominantly in native vegetation.

20. Haidekker & Madarasz-Smith (2020) attributes the reduction in water clarity measurements to steep topography holding sediment in suspension due to turbulent water. Upper Ngaruroro has steep cliffs that line the mainstem and sediment may come from slips and stock access in the upper Ngaruroro catchment. There is also sediment input from runoff and stream bank erosion from the tributaries.

21. Nutrient concentrations were generally high at the Karamū and Ahuriri SOE sites. TN and dissolved inorganic nitrogen (DIN) concentrations were variable, with some sites below trigger values and others up to 10 times higher. TP and DRP concentrations were always above the ANZECC trigger values at all sites (up to 16 times higher than guideline levels). Both catchments experienced *E. coli* concentrations that were not suitable for primary contact recreation (except for Poukawa Stream). High *E. coli* was not limited to rainfall and high flow events.

22. The water quality in the lowland sub-catchments in the Ahuriri and Karamū catchments reflect the cumulative discharges that occur upstream. Sites in Ahuriri and Karamū are without the large volumes of pristine water (in comparison to the upper Ngaruroro catchment) to dilute contaminant concentrations. Lowland and mainstem sites are influenced by the flood protection scheme (resulting in bank erosion and sediment inputs) and drainage (within the Karamū catchment) and abstractions, particularly across the lowland plains.

23. The report by Haidekker (2019) outlined information on the nutrient limitation study that was conducted in the TANK catchment. It showed that nutrient limitation changed over time, and algal growth rates were predominantly co-limited in

the Ngaruroro River and co-limited to N limited in the Tūtaekurī River. The Waitangi Estuary, the receiving environment downstream of the three catchments Ngaruroro, Tūtaekurī and Karamū, was also co-limited. This therefore means that any increase of N or P being discharged to rivers in the upstream catchments risks increased algal growth rates and eutrophication of the estuary.

24. The 2020 SOE report shows that the water quality issues across the TANK catchments are not solely based on nitrogen enrichment. Phosphorus appears to be a water quality issue affecting most monitoring sites across the TANK catchments. *E. coli* is a contaminant of concern in the Karamū and Ahuriri catchments. Water clarity decreases sharply downstream of predominant native vegetation areas. The SOE report shows that there are additional contaminants other than nitrogen, such as phosphorus, sediment and *E. coli,* which are impacting water quality and resulting in a reduction in catchment values.

WATER QUALITY OBJECTIVES, POLICIES AND NPSFM 2020

25. The National Policy Statement for Freshwater Management 2020 (NPSFM 2020) sets out the objectives and policies for freshwater management under the Resource Management Act 1991. It came into effect on 3 September 2020 and replaced the National Policy State for Freshwater Management 2014 (amended 2017).

26. I have reviewed the water quality objectives, and associated water quality policies and rules to check the consistency of PC9 to NPSFM 2020.

27. Recommendations from the S42a report has led to the amendment of Schedule 26 so that the TAS within the TANK catchments are consistent with the NPSFM 2020. Overall, I consider that these amendments have made, in majority, PC9 more aligned to NPSFM 2020. PC9 however does not include all the attributes and target attribute states required in the new National Objectives Framework (**NOF**) and therefore another plan change ahead of 2024 will be required.

28. Even though it is acknowledged that the Council are still in the process of defining Freshwater Management Units, I believe that the TANK catchment would be appropriate to be defined as an FMU given its interconnectedness of the surface

water bodies and groundwater, and the connection of the river catchments to the receiving environments, namely the Waitangi Estuary (for the Tūtaekurī, Ngaruroro and Karamū catchments).

29. In addition, I support the water quality objectives as they set the target attribute states for PC9 (OBJ TANK 4), with PC9 outcomes stated in 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, and as such they are consistent with NPSFM 2020.

30. The water quality policies POL TANK 1 – 21, including the non-point source discharge policies POL TANK 17 – 21, and the associated rules and schedules set the limits which are consistent with NPSFM 2020.

31. However, PC9 is not adequately aligned with NPSFM 2020 when it comes to providing limits on resource use for the multiple contaminants in NPSFM 2020 Appendix 2A.

32. NPSFM 2020 outlines limits to mean 'either a limit on resource use or a take limit'. A water quality limit will be a limit on resource use. The water quality limits within PC9 are considered to be the freshwater farm plans (FW-FP) (Rule TANK 1 and 2, and POL TANK 17) and the land-use change rule (Rule TANK 5, and POL TANK 21) that prevents an increase in nitrogen (N) loss.

33. FW-FP are considered to address and reduce the loss of multiple contaminants from farms, and therefore are considered a limit for multiple contaminants. However, Rule TANK 5, which refers to POL TANK 21, provides a limit only on the loss of N.

34. The NPSFM 2020 Appendix 2A lists the water quality attributes that require limits on resource use. These limits must be expressed as a rule in the regional plan. The water quality attributes in NPSFM 2020 Appendix 2A are as follows:

    (a) Phytoplankton (trophic state) (lakes)

    (b) Periphyton (trophic state)

    (c) TN (trophic state) (lakes)

    (d) TP (trophic state) (lakes)

    (e) Ammonia (toxicity)

(f) Nitrate (toxicity)

(g) Dissolved oxygen

(h) Suspended fine sediment

(i) *E. coli*

(j) Cyanobacteria (planktonic) (lakes and lake fed rivers)

35. The above attributes, apart from those that are for lakes, are provided as target attribute states (TAS) in Schedule 26 of PC9. However the limits in PC9 are not adequate to address all of the attributes, due to the focus on managing N.

36. As discussed above in Paragraph 25 to 35, N isn't necessarily the key contaminant of concern within some of the TANK sub-catchments and therefore N may not be able to be used as a proxy for other contaminants, as it is intended to be used in POL TANK 21.

WATER QUALITY PRESSURES

37. The following section discusses drivers in water quality that are not addressed in PC9.

Natural Contaminant Losses

38. Natural erosion processes can result in the loss of sediment to waterways. Hill country can have high rates of erosion even under native bush. Rainfall, geology and topography have an influence on sediment yield, and in some studies, as reviewed by Basheer (2013)[1] at large-catchment to national scale, vegetation cover appears to be a secondary influence. As discussed in the SedNet report, highly erodible land occurs mostly on the steeper headwaters of the western and northern tributaries of the TANK catchments. Soft rocks in the catchment increase erosion risk and sediment is entering Ngaruroro from tributaries as well as the riparian margin of the mainstem.

[1] Basher, L. R. 2013. Erosion processes and their control in New Zealand. In Dymond JR ed. Ecosystem services in New Zealand – conditions and trends. Manaaki Whenua Press, Lincoln, New Zealand.

Abstractions in the Low-lands, and Link to Augmentation

39. Surface water abstractions reduce flow rates available to assimilate contaminant concentrations. Implementation of a robust water allocation framework would decrease take rates and increase flow volumes. As discussed in Rutherford (2009)[2], surface water quality in many Hawke's Bay rivers is sensitive to groundwater inflows during summer, and hence to groundwater and surface water abstractions. Groundwater is likely to be a source of nitrate to Hawke's Bay rivers during summer low flows when rivers become N limited.

40. Flow augmentation increases flow rates in rivers during dry periods when flows are usually at their lowest. This would increase the assimilation capacity of the lowland streams and could be an important element in achieving the TAS at these lowland sites.

Flood Protection

41. Flow management and flood protection of the Ngaruroro River is important for productive land as well as for the towns of Hastings and Flaxmere. However naturally the river would spill during flood events and flood the plains; instead it is contained within the channel by a significant network of stopbanks and protection systems. Through the constriction of water within the channel, greater water velocities and consequently greater energy, is created. Within the channel, this can lead to increased potential for bank erosion, reducing water quality in terms of sediment.

42. The waterways in the Karamū catchment have also been extensively modified for flood protection purposes. As part of the Heretaunga Plains Flood Protection scheme, the Ngaruroro River was diverted to the north, leaving the Karamū and Ruapare Streams to feed the lower Karamū Stream (Haidekker & Madarasz-Smith, 2020). With the diversion of Ngaruroro River, this would result in reduced flow rates and a reduced assimilation capacity in the Karamū sub-catchment.

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[2] Rutherford, K. 2009. Catchment sensitivity, nutrient limits, nutrient spiralling and forecasting future landuse impacts in Hawke's Bay. NIWA Client report: HAM2009-001

Limits in PC9

43. Diffuse discharges from land uses such as horticulture and farming also influence water quality. They can influence water quality through diffuse contaminant losses of N, P, *E. coli* (for farms with animals) and sediment. However, these contaminants are managed through PC9 through limits, such as the development of FW-FP and POL TANK 21 which limits land use change to a higher intensity use. This is effectively about managing the loads entering the rivers and streams. However, instream concentrations of contaminants are the TAS within PC9, and meeting the TAS will require a combination of managing both the quality and quantity of water.

44. Solely managing discharges from farms (and stormwater) will not achieve PC9 outcomes on their own as there are other influences on water quality as discussed in Paragraph 33 to 38. Improvements in water quality will also depend on the water take limits and augmentation in the lowland streams (water quantity). Regardless, the NPSFM 2020 requires the setting of resource use limits which PC9 does in the form of FW-FP and land use change rules. This evidence discusses whether the limits set by PC9 will lead to an improvement in water quality and a trend towards achieving the TAS and the water quality outcomes of the plan.

WATER QUALITY LIMITS WITHIN THE PC9 AND THE DEGREE TO WHICH THEY ALIGN TO ACHIEVING THE SCHEDULE 26 TAS AND WATER QUALITY OUTCOMES

Effectiveness of Priority Maps

45. Rule TANK 1 and POL TANK 1, 17, 27 and 35 refer to Schedule 28 (Priority Catchments). Schedule 28 is a series of maps which display the priority order of sub-catchments. FW-FP, Catchment Collective Plans and Industry Programmes are to be completed in the following priority order; High, Medium and Low Priority over the first 3, 6 and 9 years respectively following the date that PC9 becomes operative.

46. The effectiveness of FW-FP in resulting in an improvement in water quality and meeting the water quality objectives of the plan relies on the priority maps to have been created correctly and cover the contaminants of concern in each sub-catchment.

47. The sections below describe how the Schedule 28 priority maps were created and provides a discussion on whether the priority maps and the associated rules and policies link and whether I believe they will be effective at meeting the objectives within PC9. Sediment yield, total nitrogen (**TN**) concentrations and TN yield are discussed, with a recommendation for the inclusion of an *E. coli* and a DRP priority map.

Sediment Yield

48. Schedule 28 states that the sediment yield priority map was created from the risk of sediment loss in t/km^2/year as modelled by SedNet. The report by Palmer *et al*. (2016) describes the SedNet modelling which included surficial erosion, landslide, earthflow, gullying, streambank and deposition (as a negative 'source'). Yields were summarised at the scale of the sub-catchments.

49. The target attribute (suspended fine sediment, measured as water clarity) in Schedule 26 relates to instream sedimentation problems that may develop further downstream than the source. SedNet has been used to predict the source of the sediment, which may be in areas that are indicated as good condition by the NOF attribute in Schedule 26 (Haidekker, 2021, Appendix 9 of s42a report).

50. Jacobs have recreated the sediment yield priority map using sediment loss data downloaded from the HBRC Open Data Portal[3] (TANK_28_Sediment Loss) (Figure 1), which matches the priority map except for the Poporangi and Omahaki sub-catchments (both are low priority in the map by Jacobs and long term priority in the PC9 map).

[3] https://hbrcopendata-hbrc.opendata.arcgis.com/datasets/fe8239e1b3cb46f3a6d73c90f87838bc_17

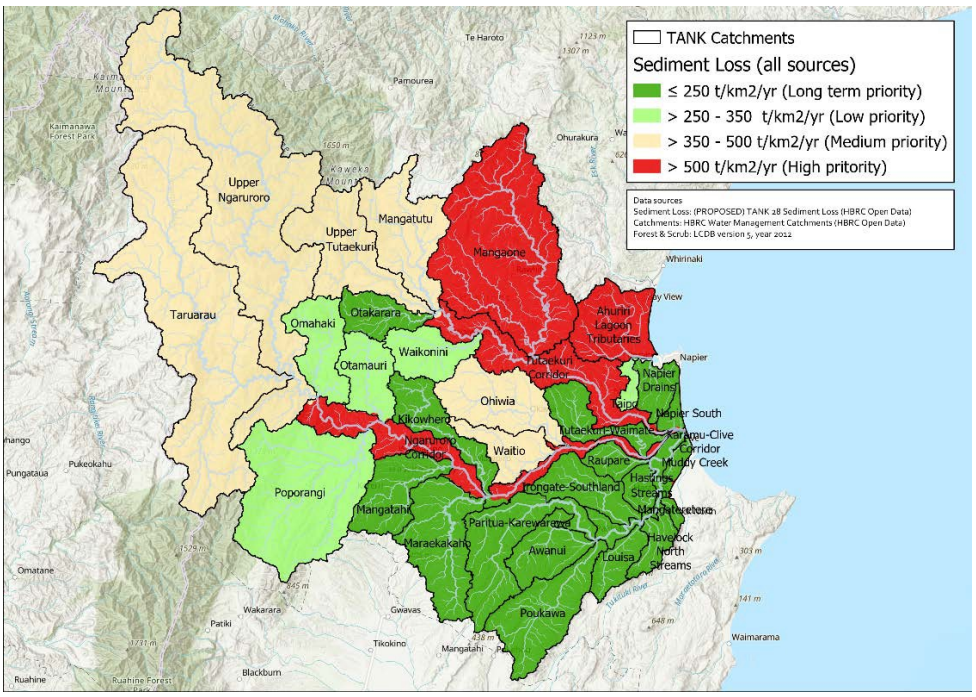

Figure 1: Sediment loss priority map, recreated by Jacobs using HBRC webportal data. This figure matches the PC9 sediment yield priority map except for the Poporangi and Omahaki sub-catchments.

51. The Ngaruroro corridor is shown as high priority in Figure 1. The sediment data from the HBRC Open Data Portal shows that 85% of the sediment yield for the Ngaruroro corridor is from streambank erosion, driven by the main river.

52. Bank erosion in the SedNet model is estimated from the product of the bank migration rate, bank height and the stream segment length. The calculation of stream bank migration is based on a relationship (R^2 of 0.40) between mean annual flood discharge and bank migration from a national data set, and the calculation for bank height is based on a relationship (R^2 of 0.27) between bank height and discharge from Ruamahanga River data. This effectively means that the larger the river, the greater the bank erosion and this value is then summed across the sub-catchment that contains the Ngaruroro River corridor. The mapped Ngaruroro River corridor sub-catchment can be over 5 km wide in some places (Figure 1), however the whole area has been assigned the bank erosion sediment yield value.

53. Flow management and flood protection is important with regard to the Ngaruroro River. Naturally the river would have spilled during flood events and flooded the plains. Instead it is contained within the channel and greater energy within the channel can lead to bank erosion. Bank management (such

as fencing and planting along the bank) will reduce streambank sediment yield. However, as the Ngaruroro River corridor is over 5 km wide in some places, the sub-catchment covers a large area of flat land on which no on-farm mitigation strategy can be applied in order to prevent this bank erosion. This means that the requirement to do FW-FP as a high priority will not lead to an improvement in water quality towards the TAS, within river corridors, outside of the riparian margins.

54. Jacobs have created an alternate priority map that omits the streambank erosion proportion of the sediment yield (Figure 2). The priorities have been mapped based on quantiles (as without the streambank proportion no sub-catchment gets above the 500 t/km^2/yr threshold for 'high priority').

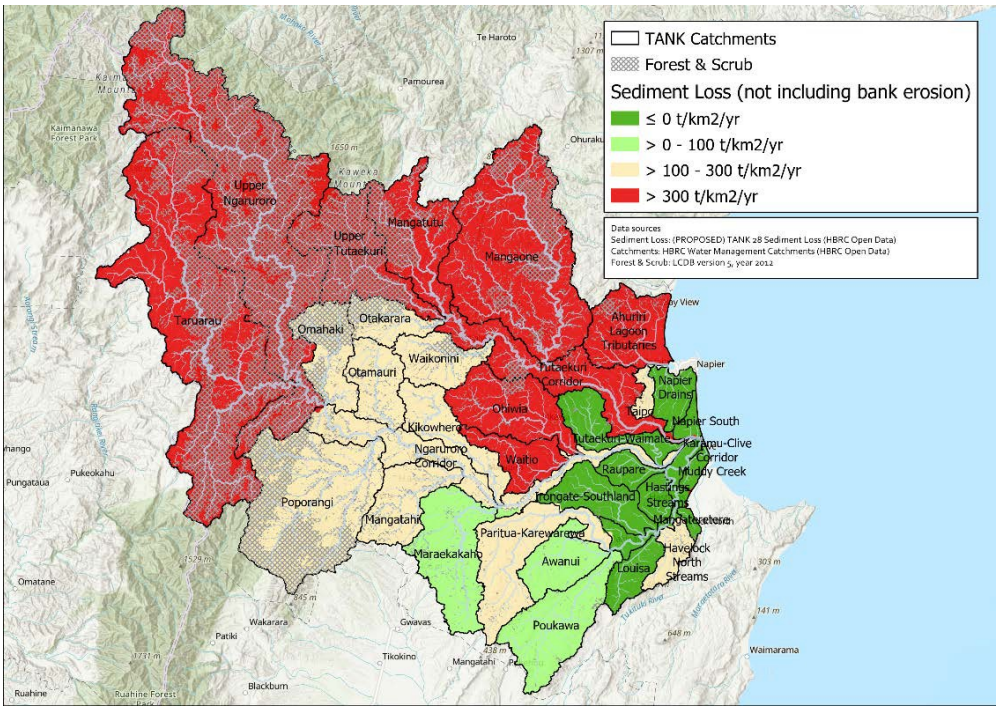

Figure 2: Sediment yield priority map, not including bank erosion and with forest and scrub overlaid, created by Jacobs.

55. For the high priority sub-catchments in Figure 2 that are largely unforested, landslide processes are the main proportion of total erosion. The percentage of the total sediment load from landslides for each sub-catchment is displayed below:

(a) Ahuriri Lagoon tributary (106% of total sediment load is from landslides)*

(b) Mangaone (83%)

(c) Mangatutu (69%)

(d) Ohiwia (97%)

(e) Tūtaekurī Corridor (82%)

(f) Waitio (102%)*

* note these sub-catchments are where deposition occurs leading to > 100%.

These erosion processes would only occur on steeper slopes where certain land uses, such as horticulture, would not occur.

56. Appendix 9 of the S42a report is a technical memo on the water quality attributes in Schedule 26 (Haidekker, 2021). Further information from the SedNet model is presented that shows contemporary hillslope erosion compared with pre-human hillslope erosion. The pre-human sediment load excludes net bank erosion, therefore the comparison is only made on hillslope erosion types (such as landslide, earthflow, gully, surficial). SedNet predicts approximately 230% increase in sediment loads from hillslope processes across the TANK catchments post-human settlement. In the Ngaruroro tributaries the model results show there is a loss of more than 4 times and up to 7 times the amount of sediment from hillslope erosion compared to pre-human times. This indicates that hillslope erosion is significant in the TANK catchments.

57. The FW-FP criteria in Schedule 30 has provisions for riparian margin management. Riparian margin management is very important in terms of influencing channel and bank stability, minimising sediment loss to streams and excluding stock from streams. It is important that this criterion remains in the FW-FP. However Jacobs have shown that when the sub-catchments are re-prioritised without bank erosion, then hillslope erosion processes are an important risk for sediment contribution into rivers. However FW-FP do not have a provision for the management of hillslope erosion.

58. Given that there is a lack of mitigation priority set in the upper catchment (hill country) where there is a significant sediment input, it is not clear if the proposed Schedule 26 sediment targets would be actually achievable, i.e. sediment management priorities set by PC9 are focussed on the wrong sub-catchments. Some hill country tributaries may not have to do FW-FP to address sediment for another 6 to 9 years, in

which case sediment losses may have caused water quality to deteriorate. Therefore the PC9 limits would not have led to the required outcome.

59. I proposed that the FW-FP criteria in Schedule 30 is updated to include provisions for the management of hillslope erosion, in conjunction with riparian margin management.

60. I also recommend given the S42a proposes relying on RMA stock exclusion regulations 2020 for managing bank erosion, that the priority map is updated to target sources of hillslope erosion which can be managed through FW-FPs.

TN Concentration

61. Schedule 28 states that the TN concentration priority sub-catchments were based on nitrogen concentrations from SOE monitoring. It indicates high priority sub-catchments are those with median TN of >2 mg/L. This is shown in Table 1.

Table 1: Priority table from Schedule 28.

	High priority	Medium priority	Low priority	Long term
Sediment yield (SedNet)	>500 t/km²/year	350 - 500 t/km²/year	250 - 350 t/km²/year	<250 t/km²/year
TN concentrations (all flows, median)	> 2 mg/L	> 1.2 mg/L	> 1 mg/L	<1 mg/L
TN yield (modelled) (all flows, average per sub-catchment)	> 10kg/ha/yr	> 3.5 kg/ha/yr	> 1.2 kg/ha/yr	≤1.2 kg/ha/yr
Dissolved Oxygen levels Class A streams (and /or where stream gradient <2m/km	anoxia (periods of little or no oxygen)	< 3 mg/L daily minimum and/or DO saturation <30%	< 4mg/L daily minimum and/or DO saturation < 40%	< 6 mg/L daily minimum and/or DO saturation <60%
Drinking Water Supply	**Production land in SPZs** (See Planning Maps 1 and 2 for Schedule 35)			

62. The TN concentration data downloaded from the HBRC Open Data Portal (TANK_28_TNitrogen Concentrations) shows that there are two TN concentration data sets, one from 2009 – 2013, and one from 2011 – 2015. It is most likely that the data set from 2011 – 2015 has been used, however when this data is mapped (Figure 3) it does not look like the TN concentration priority map (provided as Map 2 in Schedule 28). It should be made clear where the data has come from to create the TN concentration priority map.

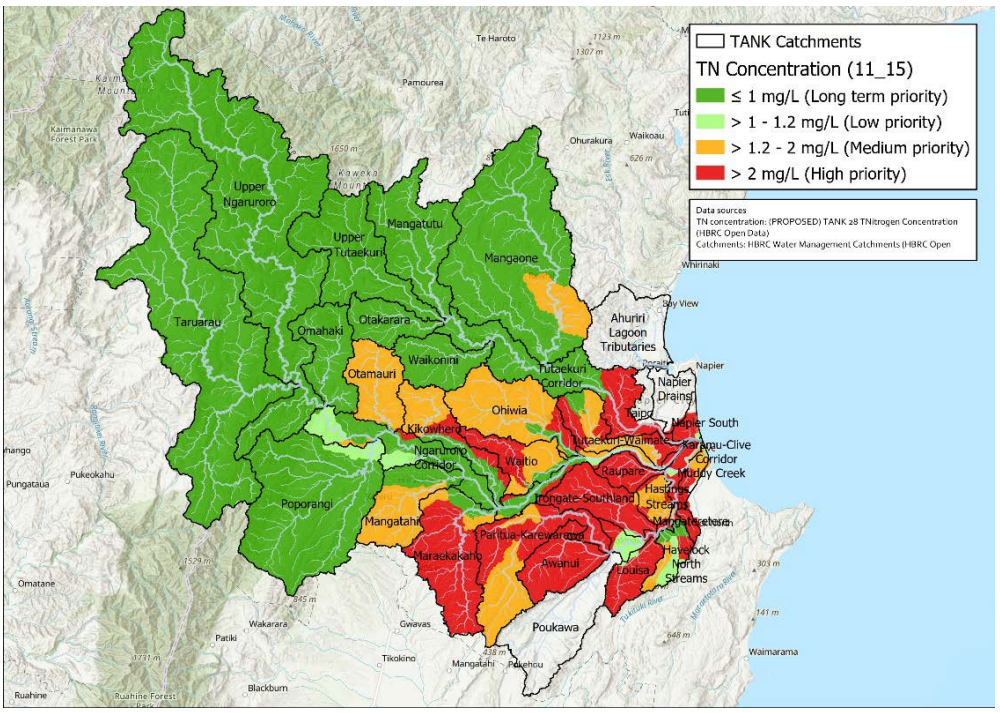

Figure 3: TN concentration priority map created by Jacobs using the data provided in HBRC Open Data Portal. This figure is quite different to the PC9 TN concentration priority map.

63. TN concentrations have been provided for each sub-catchment, regardless of whether there is a SOE monitoring station within the sub-catchment or not. This implies that the TN concentration priority map data was actually derived from the SOURCE model. The TN concentration priority map is therefore likely to be the TN concentration produced by the model after calibration to SOE data. A review of the SOURCE model report indicates that modelled TN concentrations were overestimated at many of the monitoring sites when compared to the measured TN concentrations after calibration. This would have implications for the creation of the priority map and would lead to over-estimations of TN concentration in the priority map for certain sites.

64. The TN concentration priority map (Figure 4) also shows that there are areas within the Karamū catchment that are high priority (>2 mg/L). However, the 2020 SOE report (in Table 2 and Figure 5) shows that all median TN concentrations within this catchment are below the >2 mg/L threshold. Which means that these areas should be classified as medium priority and some even as long-term priority.

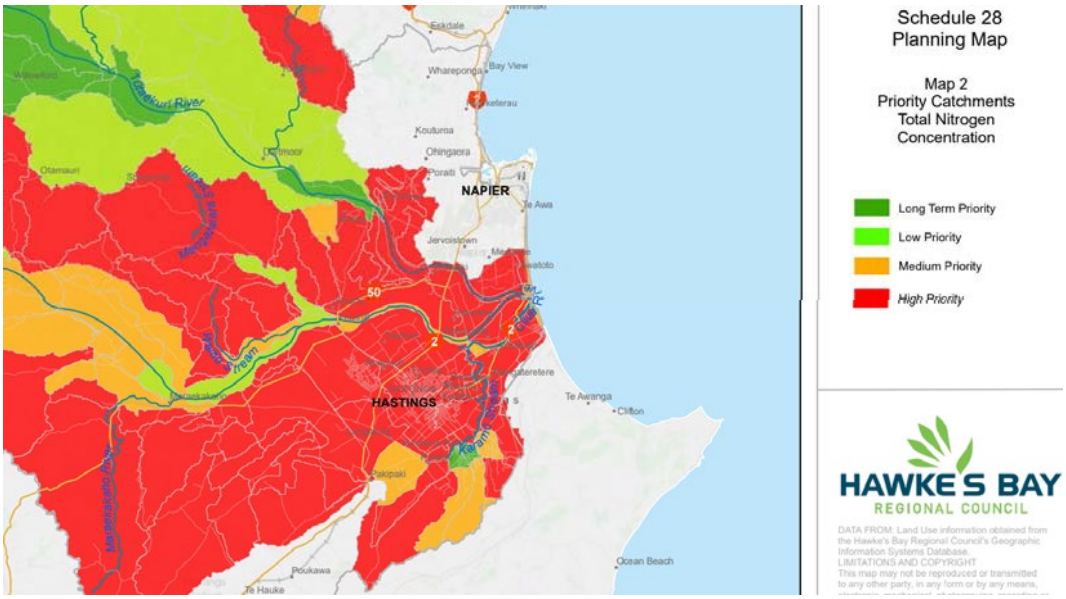

Figure 4: Total Nitrogen concentration priority map from PC9.

Table 2: Trend analysis results for TN and TP at Karamū and Ahuriri SOE sites period 2012 to 2018, from Table 3-1 in 2020 SOE report.

Site	Total Nitrogen		
	Median	P value	Per cent Annual Change
Karewarewa Strm	1.983	0.16	-6.83
Awanui Strm	1.985	0.76	-1.255
Poukawa Strm	1.435	1.00	0.26
Herehere Strm	0.485	0.24	3.63
Clive Rv	0.755	0.22	4.327
Taipo Strm	0.94	0.16	5.725

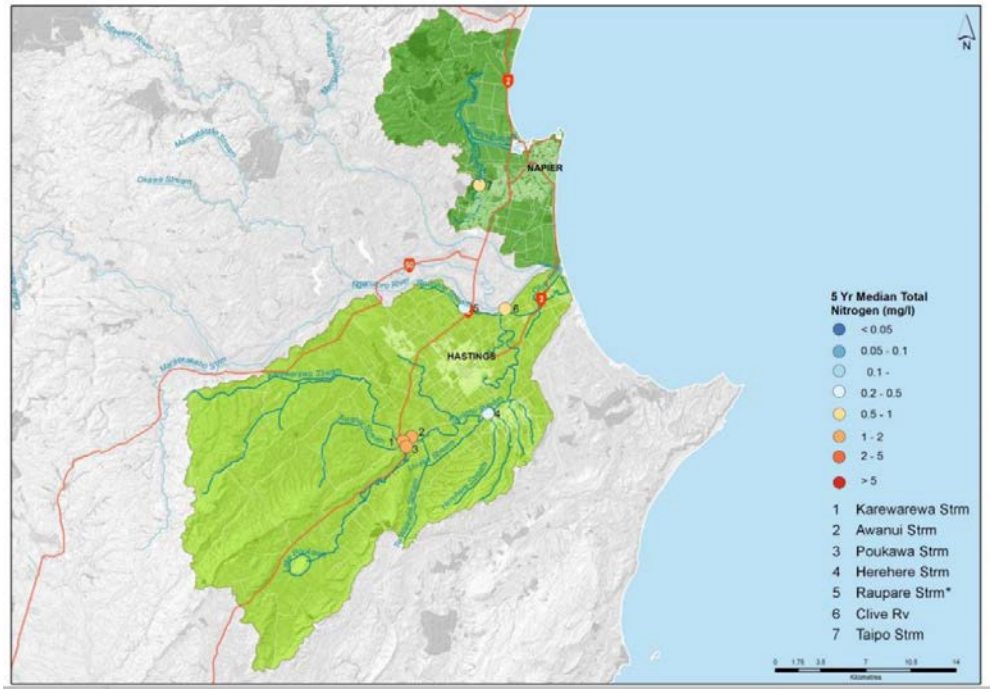

Figure 5: SOE monitoring sites.

65. Appendix 9 of the s42a report (Haidekker, 2021) states that most of the baseline data used in the plan development was based on data between 2008 – 2013. However the amended Schedule 26 (Freshwater Quality Objectives) now implies that baseline data is based on the latest available data as there is a reference to Haidekker, S. (2021) Unpublished data, and the 2020 SOE report for 2013 – 2018. There is therefore a discrepancy between the time period of data presented in the TN concentration maps and the time period of data provided as the baseline data in Schedule 26.

66. The DIN guidelines for hill country, mainstem and headwater sites in Schedule 26 have been sourced from Matheson *et al*. (2016)[4] for algal growth (recreation < 30% algae cover) and are not provided in the NPSFM 2020. DIN concentrations greater than 0.3 mg/L are considered a high risk of algal growth. The 2020 SOE sampling report states that the Poporangi Stream (a hill country tributary) has a median annual DIN of 0.548 mg/L. This concentration is in the high risk for algal growth from Schedule 26. However the 2020 SOE report also shows that the median TN concentration in Poporangi is 0.7 mg/L which is low priority in Schedule 28 TN

[4] MATHESON, F., QUINN, J. M. & UNWIN, M. 2016. Instream plant and nutrient guidelines. Review and development of an extended decision-making framework Phase 3. Hamilton, New Zealand: National Institute of Water and Atmospheric Research. No. CHC2013-122.

concentration and the TN yield priority map. Some clarity again is needed as to how different catchments are looked at and assessed to be of low or high priority, e.g. is the plan wanting to prioritise TN or DIN concentration? DIN would match the Schedule 26 attributes.

67. Another example is the Mangatutu sub-catchment which is one of the Tūtaekurī hill country tributaries. The Mangatutu sub-catchment is split into either long term or low priority for both TN concentration and TN yield. The 2020 SOE report shows that the median TN concentration in Mangatutu is 0.56 mg/L which would be low priority in Schedule 28. However Schedule 26 shows that the Mangatutu has a median DIN concentration of 0.45 mg/L which would result in a high risk of algal growth. This again demonstrates the disconnect between Schedule 26 attributes and the TN concentration priority map.

68. In terms of nutrients there is little correlation between water quality target attributes when a comparison is made between Schedule 26, Schedule 28 and Schedule 28 priority planning maps. The priority planning maps uses TN concentrations and TN yields to determine priority sub-catchments whereas there is no TN in Schedule 26 target attribute states, only DIN, nitrate and ammonia.

69. I therefore recommend that the TN concentration map is removed from Schedule 28 and replaced with a DIN concentration priority map to improve consistency within the plan. Jacobs have created a DIN concentration priority map based on Schedule 26 baseline concentrations as displayed in Figure A.1 in Attachment A.

<u>Nitrogen Yield</u>

70. Schedule 28 states that the TN yield priority sub-catchments are based on the risk of significant contribution of high nitrogen loads to the estuary, as modelled by SOURCE and using Overseer data. PC9 defines a high priority sub-catchment as those with an average modelled TN yield (from SOURCE) of >10kg/ha/year.

71. Schedule 28 Map 3 is called Nitrate Yield Priority Catchments. Nitrate concentrations or yields are not discussed in the text of Schedule 28, so it is likely this map is in fact TN yield rather than nitrate yield. From looking at the SOURCE model it seems that

only TN and TP were modelled for these sub-catchments and there is no reference to nitrates. It would be good to have clarity around how the different priority sub-catchments were determined for nitrate, or whether this is in fact TN yield.

72. The SOURCE Model Report[5] indicates that 62 different functional units were developed using land use, rainfall and soil types (Figure 6). It appears that these are the sub-catchments overlain on the priority maps. However the loads developed by the SOURCE model and outlined in the report (Table F1, pg 182) do not seem to correlate with the TN yield priority map.

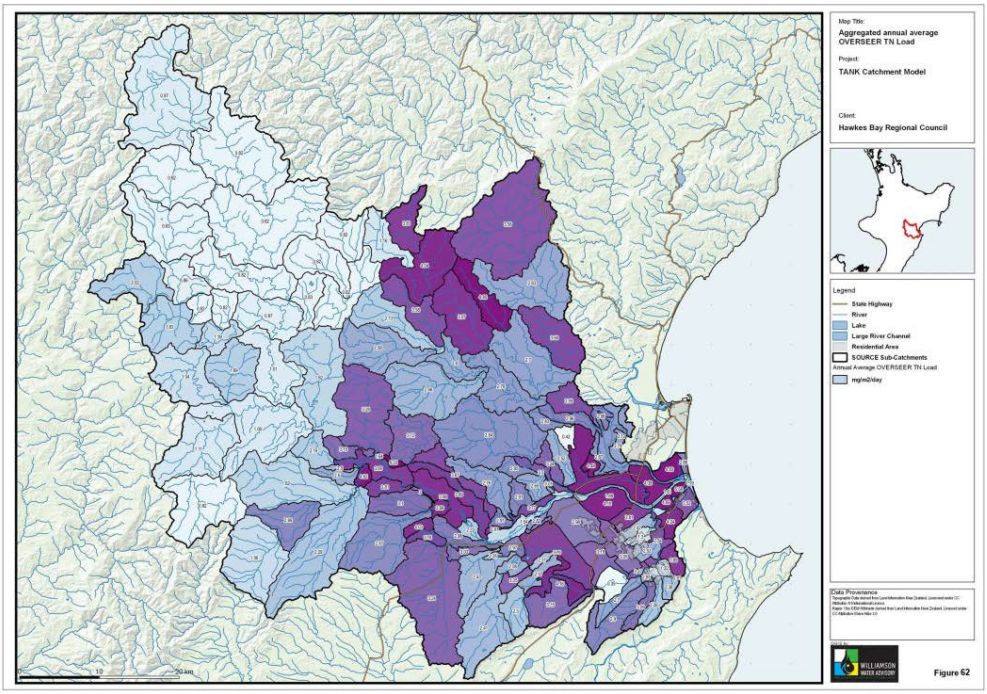

Figure 6: Figure from WWAL (2018) showing sub-catchments.

73. The TN yield data and shapefile was requested from HBRC (TANK_28_TNitrogen Yield). The TN yield data appears to be for the time period 2011 – 2015. The TN mass in kg/day was divided by catchment area (x 365 days) to give the catchment area yield in kg/ha/yr. Jacobs have used this data and mapped the TN yield map (Figure 7), however the data is still slightly different to the TN yield priority map in Schedule 28, the changes being that large areas of the

[5] WWAL, 2018. SOURCE Model Build Report, Report Reference WWA00018/Rev. 5, Williamson Water Advisory Limited.

Ngaruroro and Tutaekuri River catchments have been changed from low priority to medium priority.

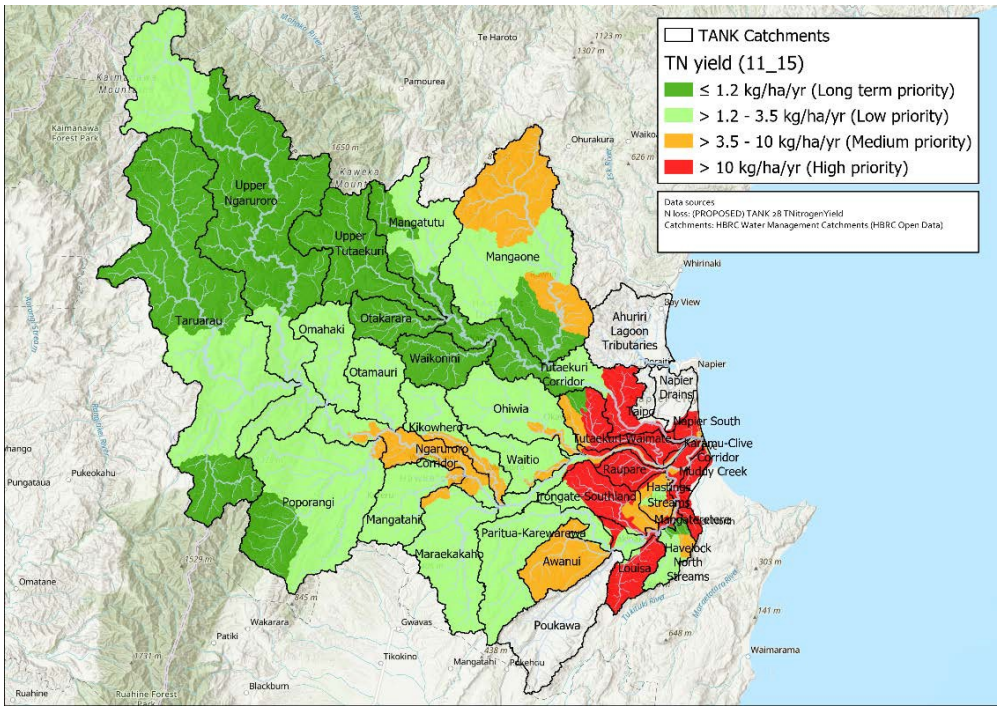

Figure 7: TN yield priority map created by Jacobs using the data provided by HBRC. This figure is similar to the PC9 TN yield priority map, however large areas of the Ngaruroro and Tutaekuri River catchments have changed from low priority in the Jacobs map to medium priority in PC9.

74. It is unclear if the time period 2011-2015 is a marker for a time period for the model results or a model version calibrated to this time period (with results from a longer and/or different time period). The SOURCE model report says the model run time was up to May 2015, so it may be an average of the last 4 years of data from the model. As the Jacobs map (in Figure 7) using HBRC data does not match the TN Yield priority map, it looks like the priority maps (both TN concentration and TN yield) have been made with updated data. I think that some clarity needs to be given as to how the TN yield priority map was created and why the priority of certain sub-catchments may have been changed from the data provided by HBRC.

75. Jacobs have also mapped unattenuated TN load per land use activity and provided the following table (Table 3). This was mapped by visually matching priority sub-catchments to the schedule maps. Please note, the SOURCE model data does not cover the Poukawa or Ahuriri Lagoon Estuary sub-catchments and these areas have a priority level for sediment yield but not TN yield or concentration from the Schedule 28 maps.

Table 3: Summary of N load per land use and area in high priority sub-catchments.

Land Use Category	Total area (ha)	Area (% of total)	TN load (unattenuated Source load) (kg)	TN load (% of total)	High priority area (Sediment, TN yield, or TN concentration) (ha)	Percentage of landuse in high priority area
Other_Land_Cover	164,851	51%	494,552	18%	26,398	16%
Beef	14,948	5%	298,791	11%	11,998	80%
Cropping	7,583	2%	181,404	7%	6,614	87%
Sheep_Beef_Deer	117,244	36%	1,333,295	49%	80,599	69%
Orchard_Vineyard	13,372	4%	173,196	6%	11,794	88%
Dairy	7,021	2%	224,664	8%	4,606	66%
Total	**325,019**		**2,705,902**		**142,009**	**44%**

E. coli

76. There has not been an *E. coli* priority map created for PC9. I note that following the S42a report, terminology in POL TANK 18 e) i) has changed from "nutrient pathways and losses" to "contaminant pathways and losses". I support this change as it will help address the deteriorating water quality, from faecal bacteria (*E. coli* as an indicator).

77. Haidekker (2019) states that during the PC9 discussions on objective, limit, and target settings, the "*Management options were discussed in their relation to groups of attributes that are simultaneously covered. For example, sediment management is a key contaminant pathway that also addresses phosphorus and bacteria losses. Depending on management methods, nitrogen (DIN) management can also address nitrate and ammonia toxicity problems*." POL TANK 1 b) states "*sediment management as a key contaminant pathway to also address phosphorus and bacteria losses*;".

78. However the sediment priority map does not prioritise those sub-catchments where *E. coli* and DRP are significant water quality issues. Therefore these contaminants need to be addressed separately. There are a number of sub-catchments that are long term or low to medium term priority in the sediment priority map, but in the D NOF band for DRP and *E. coli* in Schedule 26. Many of these are lowland sub-catchments (such as the Taipo Stream in the Ahuriri catchment, and the Waitio Stream, Ohiwia Stream and the Tūtaekurī-Waimate Stream in the Ngaruroro catchment) and these lowland catchments are likely to require FW-FP within 3 years due to being in the high priority zone for TN yield. But there are two hill country tributaries, the Poporangi Stream (Ngaruroro catchment) and the Mangatutu Stream (Tūtaekurī catchment), in the D NOF band for DRP and *E. coli.* These hill country tributaries are medium to low priority for both TN yield and TN concentration. This means that DRP and *E. coli* may not be considered an issue in these sub-catchments and FW-FP in these sub-catchments are not required to be implemented for 6 to 9 years. It is important that these sub-catchments and the requirement to undertake FW-FP as a high priority are captured in additional priority maps for *E. coli* and DRP.

79. As discussed in Paragraph 17, *E. coli* is a significant water quality issue especially in the Karamū and Ahuriri catchments, and I therefore recommend that an *E. coli* priority map is created as part of Schedule 28. Sub-catchments that are high priority for *E. coli* will have the requirement to implement a FW-FP, Catchment Collective Plan, or Industry Programme within the next 3 years (as outlined in Schedule 28) to address water quality issues that arise from faecal bacteria contamination. The *E. coli* priority map should only be relevant to those land uses that farm animals, where *E. coli* would be generated.

80. Jacobs have created an *E. coli* concentration priority map based on Schedule 26 NOF bands as displayed in Figure A.2 in Attachment A.

<u>DRP</u>

81. There have not been DRP priority maps created for PC9. As discussed in Paragraphs 11, 14, 17 and 19, DRP is a significant water quality issue in the TANK catchments. If the priority maps do not include the attributes that are causing water quality issues, such as phosphorus and *E. coli*, then FW-FP will not be prioritized in sub-catchments that require it. I therefore recommend that a DRP priority map is created as part of Schedule 28.

82. This will ensure that limits are being set in PC9 that cover multiple contaminants rather than the focus on N. The production of both an *E.coli* and a DRP priority map will be more aligned with achieving the TAS in all sub-catchments. Jacobs have created a DRP concentration priority map based on Schedule 26 baseline concentrations as displayed in Figure A.3 in Attachment A.

<u>Summary of Changes Required to Priority Maps</u>

83. The FW-FP needs to include reference to managing hillslope erosion, as we have shown using the sediment yield data that this contribution is significant (Figure 2).

84. Remove the TN concentration priority map from Schedule 28 and replace with DIN concentration priority map.

85. Update the TN yield priority map to match the HBRC provided data or provide clarity over how this map was created.

86. The FW-FP addresses water quality on a multi-contaminant level, so it is a limit for all the attributes that need limits (as required by the NPSFM 2020), however if the priority maps have been created incorrectly then FW-FP will not be implemented early enough in some sub-catchments to make progress towards the TAS. I therefore recommend that DRP concentration and *E. coli* NOF band priority maps are added to PC9 using Schedule 26 baseline data.

Amendment to Policy 21 to provide for a multi-contaminant approach

87. POL TANK 21 states the following:

> "The Council will regulate production land use change to manage the potential impact of increases in diffuse discharge of nitrogen on freshwater quality objectives (modelled on an annual, whole of farm or collective basis) and in making decisions on resource consent applications, the Council will take into account:
>
> a) whether freshwater quality objectives or targets are being met in the catchment where the activity is to be undertaken as a result of modelled nitrogen losses from the land use change;
>
> b) where any relevant TANK Industry Programme or Catchment Collective is in place the extent to which the changed production land use activity is consistent with the Industry Programme or Collective outcomes, mitigation measures and timeframes;
>
> c) any mitigation measures required, (including those where model results are not available) and timeframes by which they are to be implemented that are necessary to ensure the actual or potential nitrogen contaminant loss occurring from the property, in combination with other nitrogen contamination losses in the catchment will be consistent with meeting 2040 freshwater target attribute states in Schedule 26, including performance in relation to industry good practice, efficient use of nutrients and minimisation of nutrient losses; and will;
>
> d) avoid land use change that will result in increased nitrogen loss that contributes to water quality target attribute states in Schedule 26 for dissolved nitrogen not being met."

88. The S42a report outlined that the reason for N being the focus of POL TANK 21 was because N is a contaminant of particular concern with freshwater concentrations exceeding TAS in

many places, and nutrient enrichment is occurring in the receiving estuaries. The water quality states as outlined in Paragraphs 25 – 35, show that sediment, phosphorus and *E. coli* are also key water quality issues within many of the sub-catchments, and the attributes least likely to meet the TAS with the way the current plan is worded.

89. As discussed previously, the FW-FP addresses water quality on a multi-contaminant level and therefore acts as a limit for all water quality attributes that need limits (as outlined in the NPSFM 2020). POL TANK 21 uses land use change as a limit in the plan, however land use change is only assessed based on N losses and therefore conceivably allows an increase in other contaminants (e.g. a land use change from commercial vegetation crops to beef is permitted but would result in an increase in *E. coli* losses from the farm).

90. I recommend that the wording of POL TANK 21 is amended to enable land use change that results in negligible cumulative increases in N loss at the sub-catchment scale, in sub-catchments that are meeting the DIN TAS, if the activity results in water quality improvements for attributes that are currently not met in the sub-catchment, for which limits are also required within NPSFM 2020 Appendix 2A.

PLAN USEABILITY

Terminology

91. A review of the terminology used throughout PC9 was undertaken. There is a discrepancy between terms that are used throughout PC9. The Terminology Table in Appendix 4 of the S42a report outlines a change in terminology throughout the plan to be more consistent (Table 4). However the terminology throughout the updated PC9 is still inconsistent. The table effectively recommends the naming of two different units "Water Quality Area" and "Surface Water Quality Area" (highlighted yellow in Table 4), however these are the same and are also referred to as "TANK freshwater bodies" throughout PC9.

Table 4: Excerpt from Appendix 4: Terminology Table of the s42a report.

Terminology from PC9	**Terminology in recommended changes to PC9**
Freshwater Quality Management Area (quality)	Water Quality Area
Freshwater management unit (quantity)	Water Quantity Area
Surface Water areas	Surface Water Quality Area
Freshwater sub unit	Water Quantity Sub Area

92. I have proposed changes to terminology used in PC9, and included a definition to make clear the scale of each term.

93. Appendix 6 of the S42a report (pp 26) states "*it is important to highlight that the Council has not yet made a final decision on how many FMUs are in TANK. It is understood that Council staff are currently favouring a regional approach to FMUs and will soon be requesting a determination from its Regional Planning Committee accordingly. If this regional approach is endorsed, all TANK Areas will constitute a single FMU, and the Freshwater Quality Management units set out in Schedule 26 will likely become "parts of this FMU"*." This indicates the scale of the FMU/river catchments/sub-catchments within TANK. The TANK catchments are collectively one "freshwater management unit" (**FMU**); the FMU is made up of "river catchments"; the river catchments are made up of "Water Quality Areas" and the Water Quality Areas are comprised of "sub-catchments" which have been used in the priority planning maps in Schedule 28. Sub-catchments are comprised of farms. This hierarchy should be made clear in PC9.

94. PC9 also has seven different ways that "target attribute state" is referred to. This needs to be amended. A detailed table showing the locations of amendments is attached to this evidence (Attachment B).

Table 5: Proposed terminology changes to PC9.

Terminology in amended PC9 from the s42a report	**Change to terminology to be consistent with NPSFM 2020 and ensure consistency throughout PC9**	**Definition of term to match NPSFM 2020 or for clarity in PC9**
TANK catchments or TANK catchment or Tūtaekurī, Ahuriri, Ngaruroro and Karamū catchments	Change to TANK FMU if the regional approach is endorsed. TANK catchments have been retained in Attachment B for now.	*As defined in NPSFM 2020, FMU means all or any part of a water body or water bodies, and their related catchments, that a regional council determines under clause 3.8 of the NPSFM 2020 is an appropriate unit for freshwater management and accounting purposes. This FMU is the entire area that PC9 covers.
N/A (This is a new term to be added).	River catchment	The catchment area of the whole river catchment. There are five river catchments: 1. Tūtaekurī Catchment 2. Ahuriri Catchment 3. Ngaruroro Catchment 4. Karamū Catchment 5. Ahuriri Estuary / Te Whanganui-a-Orotu and Waitangi Estuary
Water Quality Area; Surface Water Quality Area; is also referred to as TANK freshwater bodies or catchment	Water quality area	There are nine water quality areas that are made up of aggregated sub-catchments. The name of the areas within each river catchment is outlined below: 1. Tūtaekurī Catchment i) Headwaters ii) Main stem iii) Hill country tributaries 2. Ahuriri Catchment iv) Lowland 3. Ngaruroro Catchment v) Headwaters vi) Main stem vii) Hill country tributaries viii) Lowland tributaries 4. Karamū Catchment ix) Lowland 5. Ahuriri Estuary / Te Whanganui-a-Orotu and Waitangi Estuary x) Ahuriri Estuary xi) Waitangi Estuary
Sub-catchments also referred to as: Priority catchments, priority sub-catchments	Sub-catchment and priority sub-catchment	These are sub-catchments within a whole river catchment where contaminant modelling was conducted. These are displayed on the priority planning maps.

Terminology in amended PC9 from the s42a report	Change to terminology to be consistent with NPSFM 2020 and ensure consistency throughout PC9	Definition of term to match NPSFM 2020 or for clarity in PC9
Catchment referred to in Schedule 30	River catchment or sub-catchment	See above for definition
Farm	Farm	A landholding whose activities include agriculture
Target attribute state, also referred to as: Water quality attribute states, Water quality states, Target, target water quality attribute states, 2040 freshwater attribute targets, 2040 freshwater target attribute states	Target attribute state	*As defined in the NPSFM 2020
Outcome	Delete with reference to Schedule 26	The NPSFM 2020 defines outcome in Section 3.9. In PC9 the outcomes are water quality objectives described in OBJ 4-15. Reference to the relevant objective number should be included within Schedule 26. The outcome description could be restated e.g. for the Ahuriri refer to OBJ TANK 10, for the Ngaruroro refer to OBJ TANK 11, for the Tūtaekurī refer to OBJ TANK 12, for the Karamū refer to OBJ TANK 13.
Water quality limit	Delete with reference to Schedule 26	NPSFM 2020 definition of limit means either a limit on resource use or a take limit. Schedule 26 includes values, and TAS, not limits. Water quality limits are expressed as the policies and rules, specifically POL TANK 1-21, and for the non-point source discharges POL TANK 17 – 21 and the associated rules and schedules.
Notes: * means that the definition as developed based on NSPFM definition		

Clarifying Spatial Scale Provisions

95. The TANK Plan provides for a Catchment Collective to work on behalf of their members to meet local water quality and environmental objectives. There is ambiguity over the scale at which Catchment Collectives can operate with the term 'catchment' used throughout Schedule 30 Section A, rather than a more prescriptive term such as river catchment, water quality area or sub-catchment.

96. In order to allow for flexibility and offsetting within a Catchment Collective, I recommend that Catchment Collectives are to be implemented at any scale from sub-catchment through to the river catchment scale.

97. FW-FP are prioritised at the sub-catchment scale as the Schedule 28 priority maps are created at the sub-catchment scale and this drives the time frame for completion of the FW-FP. Schedule 30 is not clear on the scale of the implementation of the FW-FP. I recommend that this is either at the farm enterprise, or in the case of the Catchment Collective at the scale of the collective. However the implementation of the FW-FP could be staged, so for farms with non-contiguous properties, properties with higher risk can be progressed first. Many horticultural farms are made up on non-contiguous properties.

Visual amendments to Priority Planning Maps

98. The following section outlines how the priority maps in Schedule 28 should be updated to enable usability to access important information. It is unclear how the spatial extent of the priority sub-catchments identified in Schedule 28 relates to the spatial extent of the water quality areas delineated in Schedule 26.

99. There is no current ability to overlay maps to see areas where more than one priority applies i.e. you cannot tell if an area is a priority for sediment yield, nitrogen yield and total nitrogen. I recommend that an overarching priority map is created that shows the priority level regardless of the contaminant.

100. Sub-catchments should be clearly labelled on the priority maps to enable clarity, or numbered and listed on the map or on a separate document, with the sub-catchment labelled in

terms of priority. This will provide clarity on what water body is associated to each sub-catchment and the priority level.

101. Currently the priority planning maps in Schedule 28 do not have the water quality areas overlaid. This needs to be updated. The priority maps should clearly identify boundaries and overlays of the different river catchments, water quality areas and sub-catchments so that landowners/managers know exactly where the areas are and can see the extent of each and every scale at which provision will apply.

102. Maps should include monitoring locations in which the target attribute states need to be achieved and the baseline attribute state at those sites, so it is clearer whether the outcomes sought are to maintain or improve water quality, and where this is required. Jacobs have provided updated DIN, *E. coli*, and DRP priority maps as an example (Attachment A).

103. The title of the priority planning maps needs to change. "Priority Catchments" should be changed to "Priority Sub-catchments".

104. Map 3 is called Nitrate Yield, however this needs to be updated to be called TN Yield to match the table within Schedule 28, as discussed in Paragraph 67.

105. The Ahuriri water quality area, and the Poukawa sub-catchment (in the Karamū water quality area) are missing from Map 3 (Nitrate Yield) priority maps. This needs to be included, as discussed in Paragraph 86.

CONCLUSIONS AND RECOMMENDATIONS

106. I support the overall approach of PC9, however I recommend the following improvements to the plan:

(a) Revise the priority maps:

i. Remove the TN concentration priority map from Schedule 28 and replace with a DIN concentration priority map based on Schedule 26 baseline data;

ii. Update the TN yield priority map to match the HBRC provided data or provide clarity over how this map was created;

(b) Add in a DRP concentration and *E. coli* concentration priority maps using Schedule 26 baseline data;

(c) Add matters to sediment management within FW-FP to ensure it responds to activities that contribute the most significant sediment loads. The FW-FP needs to include reference to managing hillslope erosion, as Jacobs have shown using the sediment yield data that this is significant;

(d) Clarify priority maps to improve usability;

i. I recommend the addition of an overarching priority map that shows the priority level regardless of the contaminant;

ii. Sub-catchments should be labelled;

iii. Water quality areas should be overlaid;

iv. Monitoring locations should be added;

v. The titles of each map should be changed from 'priority catchments to 'priority sub-catchments', the Nitrate Yield title should be changed to TN Yield;

vi. The Ahuriri water quality area and the Poukawa sub-catchment should be added to the TN yield priority map.

(e) Tighten up references to spatial units throughout the plan;

i. I recommend that Catchment Collectives can be implemented at any scale from sub-catchment through to the river catchment scale; and

ii. FW-FP are either at the farm enterprise, or in the case of the Catchment Collective at the scale of the collective.

(f) Amendments to the wording of POL TANK 21, to enable land use change that results in negligible cumulative increases in N at the sub-catchment scale, in the sub-catchments that are meeting the DIN TAS if the activity results in water quality improvements

for attributes that are currently not met in the sub-catchment, for which limits are also required within NPSFM 2020 Appendix 2A.

Catherine Jean Sturgeon

7 May 2021

ATTACHMENT A: DIN, *E. COLI*, AND DRP CONCENTRATION PRIORITY MAPS

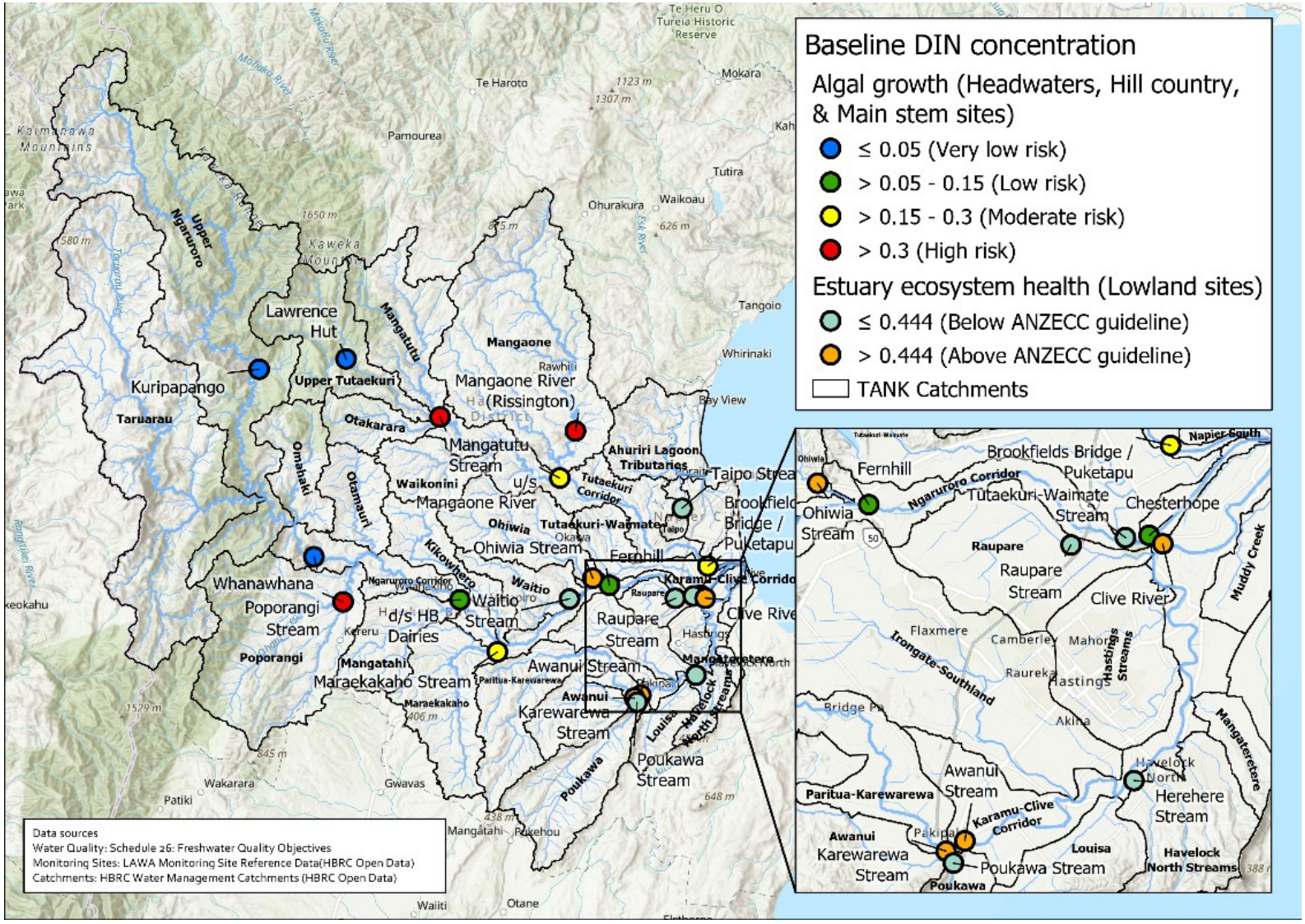

Figure A.1: DIN concentration priority map created by using baseline DIN concentrations from Schedule 26.

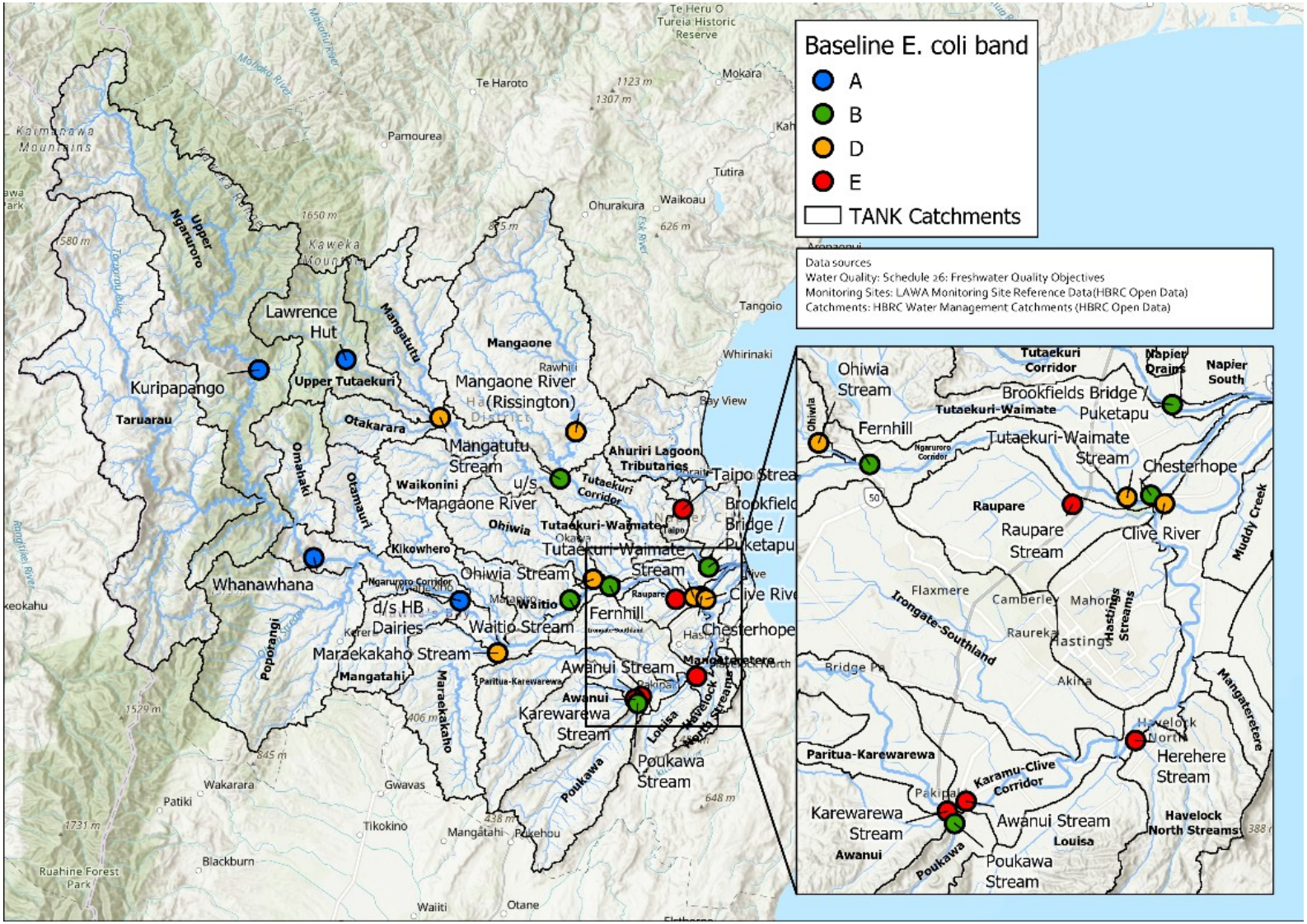

Figure A.2: E. coli priority map created by using baseline E. coli NOF bands from Schedule 26.

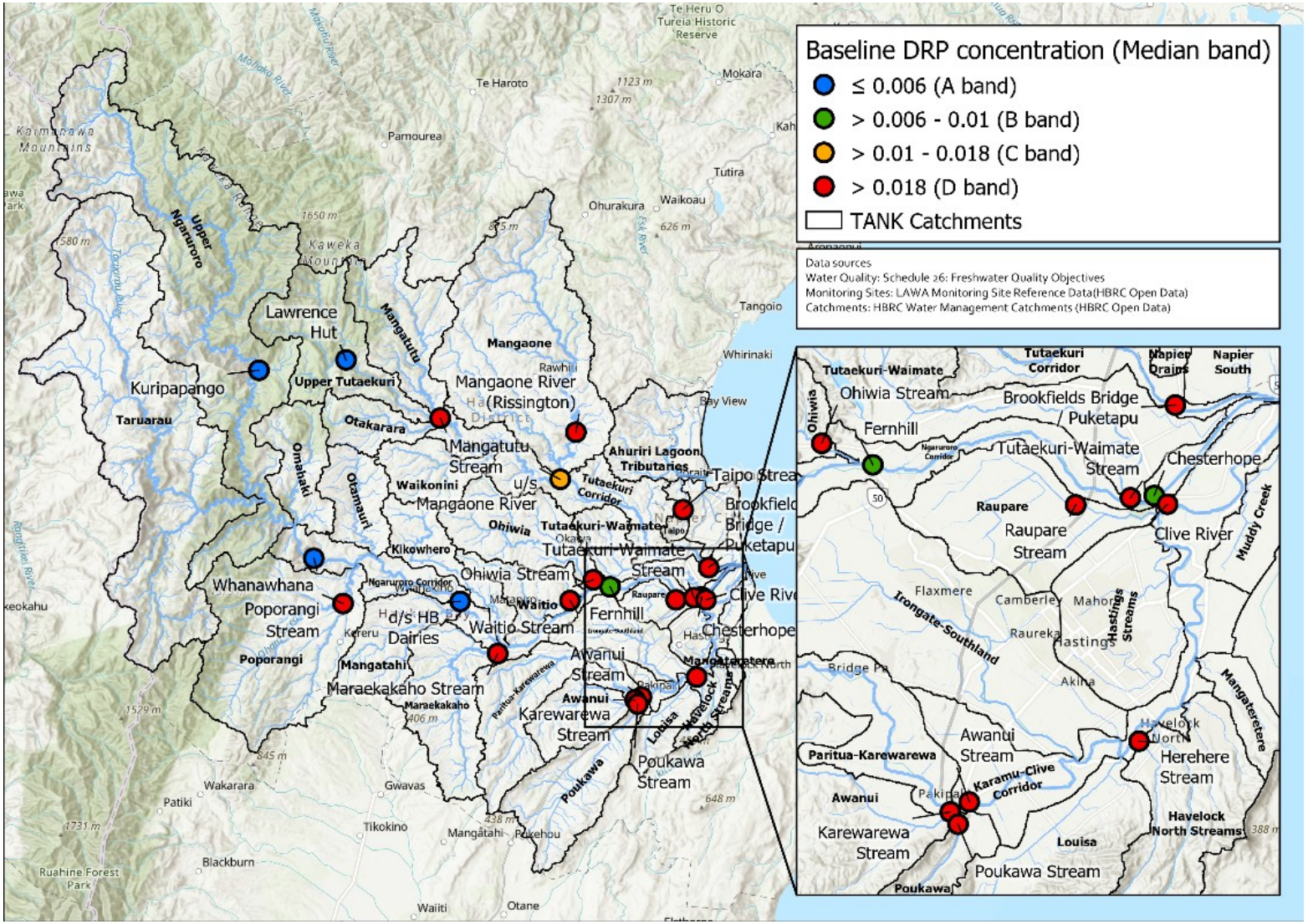

Figure A.38: DRP concentration priority map created by using baseline DRP concentrations from Schedule 26.

ATTACHMENT B: TERMINOLOGY AMENDMENTS TO PC9

Terminology changes are struck through and new text is added in red.

Location in amended PC9 in s42a report	Amendment
OBJ TANK 4	The quality of the TANK ~~freshwater bodies~~ catchments is maintained where objectives are currently being met, or is improved in degraded waterbodies so that they meet ~~water quality~~ target attribute states in Schedule 26 by 2040 provided that:
OBJ TANK 10	In combination with meeting the ~~water quality states~~ target attribute states specified in Schedule 26, the use and development of land, the discharge of contaminants and nutrients, and the taking, using damming and diverting of freshwater is carried out in the **Ahuriri** freshwater catchments so that the mauri, water quality and water quantity are maintained and enhanced where necessary to enable:
OBJ TANK 11	In combination with meeting the ~~water quality states~~ target attribute states specified in Schedule 26, the use and development of land, the discharge of contaminants and nutrients, and the taking, using, 29.53 damming and diverting of freshwater is carried out in the **Ngaruroro River catchment** so that the mauri, water quality and water quantity are maintained in the mainstem above the Whanawhana Cableway and in the Taruarau River, and are improved in the tributaries and lower reaches where necessary to enable;
OBJ TANK 12	In combination with meeting the ~~water quality states~~ target attribute states specified in Schedule 26, the use and development of land, the discharge of contaminants and nutrients, and the taking, using damming and diverting of freshwater is carried out in the **Tūtaekurī River** catchment so that the mauri, water quality and water quantity are maintained in the upper reaches of the mainstem and are improved in the tributaries and lower reaches where necessary to enable:
OBJ TANK 14	In combination with meeting the ~~water quality states~~ target attribute states specified in Schedule 26, the use and development of land, the discharge of contaminants and nutrients, and the taking and using of freshwater is

	carried out so that the mauri, water quality, water quantity and groundwater levels are maintained in the **Groundwater** connected to the Ngaruroro, Tūtaekurī and Karamū rivers and their tributaries is managed to enable;
POL TANK 1	The Council will regulate land use activities and will work with mana whenua, landowners, local authorities, industry and community groups, and other stakeholders to manage land use activities so that the ~~2040 target~~ ~~water quality~~ ~~attribute states~~ target attribute states described in Schedule 26 are maintained or where required by focussing on: a) water quality improvement in priority–sub-catchments (as described in Schedule 28) where water quality is not meeting specified ~~freshwater quality targets~~ target attribute states;
POL TANK 17	The Council will achieve or maintain the ~~2040 freshwater attribute targets~~ target attribute states Schedule 26 with landowners, industry groups, and other stakeholders and will implement the following measures;
POL TANK 18	The Council will achieve or maintain the ~~2040 freshwater attribute targets~~ target attribute states in Schedule 26 by
POL TANK 21	a) whether freshwater quality objectives or target attribute states are being met in the catchment where the activity is to be undertaken as a result of modelled nitrogen losses from the land use change;
TANK 1 Rule	c) Where a farm is in a high priority ~~catchment~~ sub-catchment for total nitrogen concentration or nitrogen yield as shown on the Planning Maps for Schedule 28 the freshwater farm plan shall include in accordance with Schedule 30
TANK 2 Rule	1. The freshwater water quality objectives–and target attribute states in Schedule 26 for the sub-catchment where the activity is being undertaken and any measures required to reduce the actual or potential contaminant loss occurring from the property, taking into account their costs and likely effectiveness and including performance in relation to industry good practice and requirements for;
TANK 5 Rule *	8. The collection, recording, monitoring and provision of information including Overseer or alternative model files, If ~~water quality limits and targets~~ target attribute states in Schedule 26 are being met in the sub-catchment, consent applications in that catchment will be considered without

	public notification and without the need to, obtain written approval of affected persons.
TANK 6 Rule *	3. Whether ~~water quality limits~~ and target attribute states in Schedule 26 are being met in the sub-catchment where the new activity is to be undertaken 10. The collection, recording, monitoring and provision of information including Overseer or alternative model files If ~~water quality limits and~~ target attribute states in Schedule 26 are being met in the sub-catchment, consent applications in that catchment will be considered without public notification and without the need to, obtain written approval of affected persons.
TANK 20 rule	11. When required, the efficacy of a Stormwater Management Plan (Schedule 34) including measures adopted to minimise the risk of contaminants of concern entering stormwater to assist in meeting Schedule 26 target attribute states including:
TANK 22 rule	1. The efficacy of the Stormwater Management Plan (Schedule 34) including measures adopted to minimise the risk of contaminants of concern entering stormwater to assist in meeting Schedule 26 target attribute states including
Schedule 26	Schedule 26 Tables: Baseline Attribute State Target Attribute State 2040 ~~Outcome~~ Target Attribute State Long Term The addition of objective numbers under "Outcome Description".
Schedule 28: Priority Sub-Catchments	This schedule sets out the thresholds used to determine the priority sub-catchments or places. The priority sub-catchments identified using these thresholds are shown on the Schedule 28 Planning Maps 1 – 4 and Schedule 35 Planning Maps 1 - 2. The priority sub-catchments are determined according to the following water quality attributes and risks that are where there is;
Schedule 30	1. the modelled or measured water quality as indicated in Schedule 26, 28 or the Council's SOE reports, or local water quality measured

	using comparable water quality monitoring methods in the applicable river catchment or sub-catchment(s) 2. other water quality monitoring may be used as a guide to measure progress towards water quality targets. 3. the nature of the land and water use activities carried out within that river catchment or sub-catchment 4. the scale of the effects on water quality or water quantity from the land and water use activities in that river catchment or sub-catchment.
Schedule 30 Section A	1.1 c. The process for assessing performance at an individual property level compared to agreed actions at the river catchment or sub-catchment scale. 2.1 c. timeframes for when each of the actions or mitigations at a property or river catchment or sub-catchment scale are to be implemented and which are consistent with 2.3 b. a description of any mitigation measures identified as necessary to meet water quality objectives on those properties or within the relevant river catchment or sub-catchment; 3.1 … will be submitted for approval by the HBRC no later than by the end of the relevant year specified for that sub-catchment 4.2 e. data, which may be aggregated across a river catchment or sub-catchment, about nitrogen loss and any changes in losses in respect of clause 2.3.
Schedule 30 Section B	2.1 … will be submitted to the HBRC no later than by the end of the relevant year specified in Schedule 28 for the sub-catchment(s) the property is located in
Schedule 34B: 3 & 6	3. Identification of the priority ~~streams or catchments~~ sub-catchments where stormwater discharges currently result in receiving water quality below the standards specified in Schedule 26 6. Identification of sites within ~~catchments~~ sub-catchments that have a high risk of contaminants entering the stormwater network or land where it might enter surface or groundwater, including industrial and trade premises and areas subject to new urban development.

BEFORE THE HEARING COMMISSIONERS APPOINTED BY THE HAWKE'S BAY REGIONAL COUNCIL

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

AND

IN THE MATTER of Proposed Plan Change 9 - Tūtaekurī, Ahuriri, Ngaruroro and Karamū (**PC9**)

STATEMENT OF EVIDENCE OF DAMIEN JOHN FARRELLY (NEW ZEALAND GOOD AGRICULTURAL PRACTICE) FOR HORTICULTURE NEW ZEALAND

7 MAY 2021

ATKINS | HOLM | MAJUREY

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CONTENTS

SUMMARY

1. I support the provision of Industry Programmes as a pathway for development and audit of Freshwater Farm Plans in TANK catchments.

2. I have provided a detailed review of schedule 30 to address a number of issues with terminology, structure of the section, Freshwater Farm Plan content, Catchment Collectives, Industry Programmes, auditing and reporting (**Appendix H**). This is identical to the Schedule 30 appendixed to the evidence of Andrew Dooney, and is replicated here for ease of access.

3. I propose that horticulture Industry Programmes meet schedule 30 provisions for development and certification of FWFPs including provisions for nutrient management.

4. I propose a reversion to the FWFP audit processes as in the previous version of schedule 30, which outlined 3 pathways (the how) to develop and implement a FWFP:

    i. Individual Freshwater Farm Plan (direct via council)

    ii. Catchment Collective

    iii. Industry Programme

INTRODUCTION

Qualifications and experience

1. My full name is Damien John Farrelly. I am the New Zealand Good Agricultural Practice **(NZGAP)** Manager at Horticulture New Zealand **(HortNZ)**. I have five and a half years of experience in the development and implementation of Good Agricultural Practice **(GAP)** standards in New Zealand horticulture.

2. I have primary responsibility for development, acceptance and implementation of the NZGAP Environment Management System **(EMS)**, an add-on which provides growers with a pathway to demonstrate compliance with Regional Council requirements for independently audited Farm Environment Plans **(FEP)** and Freshwater Farm Plans **(FWFP).**

3. I have previously worked as the Quality Systems Manager for NZGAP where I developed extensive knowledge in relevant regional and central government policy, FWFPs, environmental compliance and quality systems for environment, food safety and social practice.

4. I have a Bachelor of Engineering and PhD in Biosystems Engineering, where I specialised in environmental science and the biological mitigation of carbon dioxide emissions from point sources.

Expert Witness Code of Conduct

5. Although this is a hearing before Hearings Commissioners, I confirm that I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2014. I have complied with the Code of Conduct in preparing this evidence and agree to comply with it while giving oral evidence. 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 these proceedings

6. I have provided input on Industry Programmes into the HortNZ submission to the notified plan in May 2020.

Purpose and scope of evidence

7. This evidence is to support the submission by HortNZ that enables growers to develop and implement their FWFP via industry assurance schemes like NZGAP and GLOBALG.A.P.

8. This evidence describes key elements of the assurance framework which GAP schemes, independent auditors and certified growers operate within.

9. This evidence provides an overview of Good Agricultural Practice (GAP) Schemes, the GAP assurance framework, independent audits and certification requirements, including a detailed insight into the components of the NZGAP EMS add-on.

10. This evidence gives an overview of nutrient management in horticultural FWFPs, and how this meets the requirements in PC9.

11. This evidence provides insight into national and regional recognition of the EMS including Environment Canterbury and Gisborne District Council, while highlighting the issues which prevented recognition for Plan Change 6 to the Hawke's Bay Regional Plan (Tukituki River Catchment).

12. This evidence provides completed documentation from two detailed case studies to provide insight into the content and process for development, audit and certification of a FWFP via the NZGAP EMS add-on.

13. In preparing this evidence I have read the following:

    (a) the Section 42a Hearing Report; and

    (b) Appendix 1A Recommended Changes to PPC; and

    (c) Appendix 1B Schedules; and

    (d) the evidence of HortNZ.

CONTEXT TO PC9 PROVISIONS

14. POL TANK 23 – 26 and Schedule 30 set out a farm planning approach to managing water quality impacts from farming activities.

15. The horticulture sector uses GAP farm plans. This evidence describes how the GAP schemes could deliver robust Freshwater Farm Plans to achieve the outcomes sought in

PC9, and recommends changes to PC9 to enable the GAP programmes to assist growers and collectives to deliver Freshwater Farm plans.

INDUSTRY PROGRAMMES IN HORTICULTURE – GOOD AGRICULTURAL PRACTICE (GAP) SCHEMES

16. GAP schemes are independently audited self-management assurance schemes which provide a pathway for members to demonstrate compliance with regulatory and market requirements via independent audit of recognised standards (**Appendix A**).

17. GAP schemes are already recognised by New Zealand regulators as meeting equivalent compliance outcomes. The primary example is Food Act 2014 where the Ministry for Primary Industries has approved the GAP (NZGAP and GLOBALG.A.P.) assurance framework, standards, auditors, and processes so that growers can demonstrate compliance with that Act in an effective way via their GAP audit and existing food safety system.

18. Growers who meet GAP standards are able to demonstrate that required practices are in place for the production of New Zealand fresh produce to meet local and international regulatory and market requirements. GAP certification enables customers to buy with confidence in the product's safety and sustainability.

19. GAP standards in New Zealand horticulture are benchmarked to internationally recognised standards including GLOBALG.A.P. Integrated Farm Assurance (**IFA**).

20. GAP standards are benchmarked to market, regulatory and industry standards, and are supported by guidelines and codes of practice which are underpinned by regulatory and industry funded research.

Auditing in GAP Schemes

21. GAP certified growers operate in an assurance framework which requires independent audits by Joint Accreditation System of Australia and New Zealand (**JAS-ANZ**) accredited certification bodies, and growers must continuously meet requirements of GAP standards to maintain certification (**Appendix A**).

22. Certified growers are required to provide a significant amount of evidence of their practices during the audit process (including records, certificates, documentation and observations) to demonstrate that they are implementing standards as required.

23. GAP auditors use triangulation techniques to assess grower compliance including the grower interview, records/documentation checks and observation of implementation/actions and progress towards objectives (**Appendix B**).

24. The credibility and trust in the system, and in the horticulture sector, is underpinned by the benchmarking and acceptance of its standards by regulators and markets, plus the demonstration of implementation and progress towards objectives via robust independent audit of members.

25. The GAP audit identifies any issues in an FWFP as well as robustness of relevant components (e.g. nutrient management plan).

26. Any issues identified during a GAP audit must be resolved within a certain time period (generally 28 days), otherwise certification can be suspended or cancelled. Critical issues must be resolved immediately to maintain certification, and serious issues can be escalated to the relevant regulatory body if required.

CASE STUDY INDUSTRY PROGRAMME: NEW ZEALAND GOOD AGRICULTURAL PRACTICE (NZGAP)

27. NZGAP is an industry assurance scheme administered by Horticulture New Zealand Incorporated (HortNZ) on behalf of all growers.

28. NZGAP certified growers have demonstrated via an independent audit framework that appropriate systems and processes are in place to meet regulatory and market requirements (**Appendix A**, **Appendix C**).

29. NZGAP is fully funded by its members, and is governed by a sub-committee of the HortNZ board.

30. NZGAP's vision is to be the world's most trusted food assurance system.

31. The purpose of NZGAP certification is to provide assurance for the safe and sustainable production of fruit and vegetables in New Zealand.

32. The scope of NZGAP certification standards is food safety, social practice and environment.

33. NZGAP certification is applied to a management unit (**Appendix A**, **Appendix C**) of owned and leased land under the following management categories:

    (a) Individual – a single legal entity with centrally managed production practices.

    (b) Multi-site (enterprise) – a single legal entity with centrally managed production practices of multiple business units or other legal entities.

    (c) Grower Group – a single legal entity with centrally managed assurance systems of multiple legal entities which operate under a central Quality Management System.

34. NZGAP's values are:

    (a) Integrity: we provide credible assurance and back up our claims.

    (b) Engagement: we are part of a community of farm assurance schemes in NZ and overseas.

    (c) Relevance: our standards describe NZ horticulture's continually improving practices and assurance systems.

    (d) Accessibility: we are an open scheme for all horticulture operations who meet our standards.

    (e) Effective: we are an integrated assurance system, focused on outcomes.

    (f) Responsibility: we are committed to looking after our people, the environment, and food.

NZGAP Environment Management System (EMS) add-on

35. The EMS add-on has been developed primarily as a pathway for growers to meet Regional Council requirements for Farm Environment Plans which deliver on the objectives and outcomes desired in the regional plan.

36. The EMS is available to all NZGAP or GLOBALG.A.P. certified growers. EMS certified growers are able to demonstrate a commitment to sustainability and environmental responsibility.

37. Certification of a farm plan via the EMS means that growers have met the requirements of the programme via an independent audit system (**Appendix C**). To meet the requirements, growers must demonstrate that they have a robust FWFP in place, are progressing towards Good Management Practice (**GMP**) / Best Management Practice (**BMP**), and are minimising nutrient losses from their system. If not, corrective actions must be completed within a short time period (generally 28 days).

38. The EMS is comprised of numerous system components which work together to deliver the programme:

    (a) EMS add-on scheme rules[1]: includes requirements to become certified, audit process, auditor competency, reporting to regulators (e.g. regional councils).

    (b) EMS audit and self-assessment checklist[2]: the requirements that must be met in order to attain certification.

    (c) EMS Implementation Guideline[3]: provides guidance for growers, auditors and advisers on expectations and how to meet the requirements in the EMS audit and self-assessment checklist including links with other guidelines and codes of practice.

    (d) EMS Farm Environment Plan Template[4]: includes environmental risk assessments, a toolbox of GMPs and BMPs, and an environmental action plan.

    (e) EMS Regional Guide[5]: a guideline for growers, auditors and advisers which includes benchmarking of EMS to region and catchment specific requirements for FWFPs (**Appendix D**).

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1 NZGAP: www.nzgap.co.nz/EMS
2 NZGAP: www.nzgap.co.nz/EMS
3 NZGAP: www.nzgap.co.nz/EMS
4 NZGAP: www.nzgap.co.nz/EMS
5 NZGAP: www.nzgap.co.nz/EMS

39. The EMS add-on provides growers with a system and pathway to demonstrate that they are operating at GMP or BMP by developing and implementing a FWFP as required by Regional Councils across New Zealand.

40. The core focus areas of the EMS are soil management, nutrient management, irrigation and water management, waterbody management, and biodiversity management. These are outlined in FWFP requirements of land and water regional plans and the Resource Management Act, through the National Policy Statement for Freshwater Management 2020 and the Resource Management (National Environmental Standard for Freshwater) Regulations 2020.

41. The EMS add-on has been developed for New Zealand horticulture growing systems. It empowers growers to systemise complex environmental issues by mitigating identified risks with appropriate control measures outlined in industry and council developed guidelines and codes of practice (e.g. HortNZ Code of Practice for Nutrient Management[6], Soil Erosion and Sediment Control Guideline[7], Industry-agreed Good Management Practices relating to water quality[8]).

42. The EMS add-on and its associated guidelines adopt a risk-based approach to environmental management and implementation of GMP and BMP.

43. Not all GMPs are appropriate for all situations and all land uses, so the EMS enables growers to select appropriate practices from a 'toolbox' of GMPs and BMPs to mitigate the environmental risks of their operation. Enabling growers to adopt a tailored combination of practices is a highly effective and practical way to make progress on the ground and achieve the desired environmental outcomes.

44. The EMS add-on assurance processes guide growers through the robust and credible certification process from FWFP

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[6] HortNZ: https://www.hortnz.co.nz/compliance/grower-resources/

[7] HortNZ: https://www.hortnz.co.nz/compliance/grower-resources/

[8] Environment Canterbury: https://www.ecan.govt.nz/your region/farmers-hub/farming-resources/useful-information-and-documents/

development through to certification and implementation (**Appendix K**).

Links to science and research

45. The industry guidelines and codes of practices (which the EMS is based on) are periodically updated with new approaches, information, practices and mitigations based on the latest relevant environmental science and research.

46. Relevant Erosion and Sediment Control Research projects:

    (a) Franklin Sustainability Project

    (b) Don't Muddy The Water

47. Relevant Nutrient Management research projects:

    (a) Rootzone Reality

    (b) Measure it and Manage it

    (c) Future Proofing Vegetable Production

    (d) Sustainable Vegetable Systems

Nutrient Management using the EMS

48. The Nutrient Management area of the EMS has been developed based on the HortNZ Code of Practice for Nutrient Management[2].

49. The HortNZ Code of Practice for Nutrient management is a risk-based approach to nutrient management which is designed for growers to understand and implement good and best management practices for nutrient use with a particular focus on nitrogen.

50. The code is based on a risk assessment approach with five steps (**Appendix E**):

    i. Understanding how nutrients loss occurs and the potential risks;

    ii. Having appropriate information on which to base decisions to address the risk;

    iii. Assessing the risks within a specific situation;

iv. Identifying and implementing appropriate management practices to address the identified risks; and

v. Maintaining records to verify how the management practices have been implemented.

51. The good and best management practices are grouped according to the stage of the crop cycle for annual crops:

(a) Pre planting

(b) Planting

(c) Post planting

(d) Harvesting and Post-harvest

52. The Nutrient Management area is divided into two sections:

(a) Practices: undertaking a risk assessment, maximising nutrient uptake, minimising nutrient loss, adoption of GMPs/BMPs, development of action plan.

(b) Nutrient Budget: assessment of nutrient budget robustness, baseline nutrient loss rate, target nutrient loss rate, compliance of nutrient budget with regulatory requirements.

53. EMS Practices: (**Section 3.1 - Appendix I**)

(a) The EMS templates link growers to a toolbox of GMPs and BMPs outlined in industry guidelines including planning nutrient requirements, managing applications and relative plant predicted uptake, using side dressing, and avoiding water bodies.

(b) The EMS requires nutrient applications to be informed by available information on fertiliser recommendations (e.g. 'Nutrient Management for Vegetable Crops in New Zealand[9]') so growers plan fertiliser inputs in line with scientifically proven crop demand.

(c) Nutrient Management is highly dependent on Good Soil Management, so the EMS also includes a section

[9] Horticulture New Zealand: https://www.hortnz.co.nz/compliance/grower-resources/

on assessing and improving soil quality, health and fertility.

54. EMS Nutrient Budget: (**Section 2.2 - Appendix I, Section 2.2 - APPENDIX J**):

(a) The EMS can link with any nutrient budget used by growers including Overseer, APSIM, NCheck, and Landwise.

(b) The evidence of Stuart Ford outlines the types of nutrient budgets used in horticulture and the issues associated with the use of Overseer for vegetable growers in particular.

(c) The evidence of Stuart Ford recommends the approval of nutrient budgets which are more practical for use in Horticulture (e.g. Landwise). A proxy loss rate for each rotation, like N-CHECK in Canterbury, could also provide a baseline N loss rate for the purposes of Council's catchment budget calculation.

(d) The Landwise tool is an effective and practical crop level nutrient management decision support tool for growers (**Section 2.2 - APPENDIX J**).

(e) The EMS audit process assesses if the tool used is approved by the regional council (e.g. Overseer, APSIM, NCheck, Landwise).

(f) The EMS audit process assesses the robustness of the nutrient budget (e.g. checks of data inputs and assumptions).

(g) The EMS collects output data from nutrient budgets (e.g. current loss rate, baseline loss rate, target loss rate).

(h) The EMS assesses the nutrient budget against regulatory requirements (e.g. consent limit, catchment limit).

55. The EMS meets PC9 schedule 30 requirements for Nutrient Management including:

(a) Current and target nutrient loss rate (EMS audit and self-assessment checklist - Nutrient budget, pages 2 and 10)

(b) Mitigation measures (EMS Farm Environment Plan Template - Section 7, pages 11-14)

(c) Recording and reporting (EMS audit and self-assessment checklist – Nutrient budget, page 2, question 7.5 - page 9, and question 7.11 – page 10)

EMS Translation to Traditional Chinese

56. HortNZ and NZGAP co-funded the translation of the EMS checklist (audit and self-assessment), FWFP templates and FWFP certification process into traditional Chinese characters.

57. The translated checklist and FWFP templates are freely available to download from the NZGAP website, and aim to support Chinese growers across NZ for whom English is a second language.

NZGAP EMS Data Management and Reporting

58. NZGAP acts as a conduit between growers, auditors, regulators, markets and other organisations for the secure storage and disclosure of certification data where it assists the goals of NZGAP and benefits grower interests.

59. NZGAP benchmarks the EMS to reporting criteria, and transforms data into the required format. An example of this benchmarking is the conversion of NZGAP audit results to Environment Canterbury audit grade as outlined in the EMS scheme rules[1].

60. NZGAP establishes agreements with the organisations and individuals that it shares data with, and requires all users of data provided by NZGAP to acknowledge the source of the data and to abide by the terms and conditions under which the data is provided.

61. NZGAP advocates for outcomes-based reporting, meaning high level reporting of assurance outcomes, rather than detailed operational farm data. Operational farm level data is sighted during the EMS audit, so regulators can have confidence that relevant outcomes are being achieved (**Appendix L**).

EMS 'Joining the Dots' Sustainability Reporting Case study - Horowhenua

62. Joining the Dots is a structured approach to making progress on key issues from problem recognition, through research and guideline development, implementation, audited mitigations, and benchmarked sustainability reporting (**Appendix F**).

63. In late 2018, NZGAP engaged with Agrilink to scope out a project which was subsequently co-funded by the Vegetable Research and Innovation Board (VR&I), and Potatoes NZ.

64. The initial project aimed to establish the framework and system for development, implementation, and reporting to demonstrate FEP implementation and effectiveness in horticulture, with a focus on soil erosion and sediment control (**Appendix L**).

65. The project explored the potential for collection, aggregation, analysis and presentation of national and regional scale metrics via the EMS add-on. Individualised benchmarking reports were also generated for growers to inform future decision making and prioritisation of action planning. Aggregated environmental metrics have been analysed to report on the industry's sustainability progress over time, using growers in the Lake Horowhenua as a case study.

66. In July 2020 NZGAP and HortNZ commissioned a project with Agrilink to implement the 'Joining the Dots' approach using a case study group of growers in Horowhenua (**Appendix F**). This resulted in the generation of individualised benchmarking reports for growers to inform future decision making and prioritisation of action planning. Aggregated environmental metrics have been analysed to report on the industry's sustainability progress over time.

67. Data reported in the pilot case study has been sourced from independently audited FWFPs, and has been collated, analysed and reported independently by Agrilink.

68. Key findings from the Joining the Dots case study include:

    (a) 90% of short rotation cropland area in Hokio 1a catchment has an FEP developed via the EMS.

    (b) 82% of growers currently at GMP, with 100% at GMP by 2025.

    (c) 48% of growers currently at BMP.

(d) Current practice is reducing soil loss by 720 tonnes/year compared to unmitigated loss rates across 1090 hectares of vegetable cropping land.

(e) Enhanced practices (at GMP) will reduce soil loss by a further 400 tonnes/year across the same 1090 hectares.

(f) Unmitigated sediment loss would average 0.8 tonnes/hectare/year, with enhanced practice reducing this to 0.2 tonnes/hectare/year.

(g) All growers are conducting soil tests at least every 3-5 years and almost a third are testing annually.

(h) Reductions in N leaching from 7 percent to 46 percent depending on the crop rotation, and the application of GMP, BMP and systems change.

Links to National Farm Environment Plan planning processes

69. HortNZ expect to see a pathway for recognition of GAP schemes for the delivery and compliance monitoring of freshwater farm plans in upcoming regulations as proposed in the Resource Management Act Amendment Bill 2020.

70. The EMS add-on is aligned with the Good Farming Practice (**GFP**) Action Plan for Water Quality 2018.

Recognition of the EMS add-on by Environment Canterbury

71. The EMS add-on has already been official recognised by Environment Canterbury (**ECan**). In April 2019 the Chief Executive of Canterbury Regional Council, Bill Bayfield, announced the recognition of the NZGAP scheme under Plan Change 5 of the Land and Water Regional Plan (**Appendix G**).

72. On 18 December 2019, Mr Bayfield also approved the NZGAP FEP template as meeting the requirements for Farm Environment Plans in Schedule 7 of Plan Change 7 of the Land and Water Regional Plan.

73. A regional guide has been developed for the EMS to incorporate regional and catchment specific requirements, similar to the regional guide developed for Plan Change 6 to the Hawke's Bay Regional Plan - Tukituki River Catchment (**Appendix C**).

74. ECan have recognised the NZGAP independent auditors employed by AsureQuality and SGS NZ Ltd as FEP auditors.

75. NZGAP and the EMS add-on is now recognised as a pathway for growers to demonstrate compliance with ECan's requirements for an independently audited FEP.

76. NZGAP and Synlait Lead with Pride are the only programmes which have been approved by the Council as ISO accredited audit programmes.

77. The approval of the EMS add-on in Canterbury empowers growers to demonstrate that they are operating at GMP to minimise their environmental impact.

Recognition of the EMS add-on by Gisborne District Council

78. On 24th February 2021, Nedine Thatcher Swann (Chief Executive of Gisborne District Council) approved the EMS as a pathway for growers to meet the Tairāwhiti Resource Management Plan requirements for Farm Environment Plans.

79. The EMS has been approved to meet the Appendix H20 requirements for contents of a Farm Environment Plan.

80. EMS can be used by vegetable and annual cropping growers in Gisborne to meet the 1 May 2021 requirements to develop and implement an FEP, plus the 1 July 2021 requirements for cultivation setbacks from drains and waterways.

81. A regional guide has been developed to align the EMS with the Tairāwhiti Resource Management Plan requirements for Farm Environment Plans, similar to the regional guide developed for Plan Change 6 to the Hawke's Bay Regional Plan - Tukituki River Catchment (**Appendix C**).

Issues with EMS recognition pathway for Plan Change 6 to the Hawke's Bay Regional Plan – Tukituki River Catchment

82. A regional guide has been developed to align the EMS with Plan Change 6 to the Hawke's Bay Regional Plan - Tukituki River Catchment (**Appendix C**).

83. The requirements for development and implementation of FEPs in Plan Change 6 to the Hawke's Bay Regional Plan - Tukituki River Catchment, were not in alignment with the NZGAP assurance framework, therefore the EMS could not be approved as a pathway for growers to develop and implement their FEP.

84. The FEP development, implementation and reporting processes of PC6 were centred on the utilisation of advisers ('a person with the appropriate professional qualifications') who liaise directly with the Council rather than the approval of an entire industry scheme like NZGAP which delivers on the outcomes with different processes.

85. The requirements of a plan developed for a property which is part of an Industry Programme were greatly in excess of the requirements of a plan developed for an individual property.

86. The comparatively large requirements of Industry Programmes compared to an individual plan, meant that Industry Programmes were not being recognised as equivalent to the direct council pathway. The associated system development, costs, and complexities with the Industry Programme pathway mean that NZGAP would not be able to provide value to members, therefore NZGAP did not pursue recognition of the EMS for PC6.

87. PC6 needed to recognise the robust assurance framework of industry schemes like NZGAP as equivalent (or exceeding) council criteria, so that programmes like the EMS add-on could be used by growers to deliver on the objectives and outcomes in the regional plan.

88. NZGAP supports HortNZ in seeking a recognition pathway in PC9 which delivers on the same environmental outcome by recognising the standards, assurance framework, systems and processes as an alternative to the direct council pathway for development and implementation of a FWFP.

DETAILED REVIEW OF THE PLAN CHANGE PROVISIONS

89. A review of Policies 23-26 has been undertaken, and I support the policy recognition of Industry Programmes (e.g. GAP assurance schemes) within the policy framework, however consider that some minor edits could be made to better reflect the nature of these programmes (as distinct from Catchment Collectives). It is important that recognition of these programmes flows through to Schedule 30.

90. I recommend changes to Policy 24, to ensure that the way in which Industry Programmes are recognised/provided for in Schedule 30 is consistent with the policy (and the role/nature of these programmes) (**Appendix H**).

91. A detailed review of Schedule 30 has been undertaken to address a number of issues with terminology, structure of the section, Freshwater Farm Plan content, Catchment Collectives, Industry Programmes, auditing and reporting (**Appendix H**).

Consistent use of terminology:

92. As a general point, the Section 42A report changes, alongside the notified plan provisions, introduces a number of inconsistencies in the terms used – for plan useability and coherence, it is sought that these are amended throughout (to consistently refer to the term recommended by the S42A authors in response to submissions, 'Freshwater Farm Plan'). There is a range of terms used throughout the TANK plan (S42A recommended changes version), including:

(a) Farm Environment Plan (including in the definitions chapter, this remains the defined term)

(b) Freshwater Farm Plan

(c) Freshwater Plan

(d) TANK Freshwater Plan

(e) Catchment Collective Freshwater Plan

(f) Catchment Collective Plan

Policy

93. I support the policy recognition of Industry Programmes (e.g. GAP assurance schemes) within the policy framework, however consider that some minor edits could be made to better reflect the nature of these programmes (as distinct from Catchment Collectives). It is important that recognition of these programmes flows through to Schedule 30.

I recommend changes to Policy 24, to ensure that the way in which Industry Programmes are recognised/provided for in Schedule 30 is consistent with the policy (and the role/nature of these programmes).

Schedule 30

94. HortNZ's submission sought that the requirements for Landowner Collectives and Industry Programmes be separated out, and that the farm plan requirements (the

"what") should be consistent across all three avenues (the "how").

95. While improvements have been made through the S42A recommendations, Schedule 30 remains somewhat complex and difficult to follow. I make the following recommendations in order to achieve what I consider would be a clearer schedule/ set of requirements:

(a) The freshwater farm plan content requirements are common to all three pathways and set out on one discrete section (rather than cross-referencing to various other sections, as presently is the case).

(b) Then, clearly set out the requirements specific to each pathway – Catchment Collectives, Industry Programmes, individuals.

96. I explain below, the tracked change detailed revision of the plan change provisions in Schedule 30 (**Appendix H**).

(a) Paragraph 1: **"~~on behalf of~~ with their members" … "through Freshwater Farm Plans":**

i. This more accurately reflects (particularly for Industry Programmes, such as NZGAP) that it is more about providing a framework for growers, rather than undertaking the work required to meet water quality and environmental objectives 'on behalf' of growers. GAP schemes provide a pathway for growers to demonstrate compliance with Regional Council requirements for independently audited Farm/Freshwater Environment Plans.

ii. For Industry Programmes (and Catchment Collectives) – the Freshwater Farm Plan remains the tool by which growers work towards meeting water quality/environmental objectives, but via a specific pathway (i.e. NZGAP framework including independent audit).

(b) Paragraph 3: **"This schedule sets out requirements for …"**

i. It would be preferable to number the list consistent with the following sections (e.g. Section A, …) as opposed to bullet points.

ii. HortNZ's submission seeks that the FEP requirements (the "what") are set out first and foremost, followed by the specific requirements of Catchment Collectives etc. (the "how"). A change is recommended to reflect this. The following uses these section headings to explain the rationale for the changes sought, in order to better reflect the outcomes sought by HortNZ's submission.

(c) Proposed Section A – Freshwater Farm Plan content requirements: The proposed amendments simply consolidate (from the existing provisions) the content requirements of a Freshwater Farm Plan, as I consider that these are common to all three pathways (i.e Catchment Collective, an individual farm plan, or a farm plan delivered through an Industry Programme).

i. The requirement to submit a Freshwater Farm Plan to Council (1.1 (a)) is a process, rather than content requirement, so is deleted from this section but duplicated in Section B (Individual Freshwater Farm Plans).

ii. Clause 1.1 (d) is no longer necessary as a cross-reference when all of the relevant FEP content requirement sits in one place.

iii. Clause 2.3 (a) is not relevant to individual freshwater farm plans as it refers to Catchment Collectives.

(d) Proposed Section B - Catchment Collectives: I support the S42A author's recommended changed to separate out Industry Programmes and Catchment Collectives, however a few references to Industry Programmes remain (I assume this is an error). I also recommend consistent reference to 'Catchment Collective' as opposed to programmes.

i. Catchment Collectives may opt to use an Industry Programme for development and implementation of FWFPs for their members,

so I have proposed that this pathway is also available to them.

ii. I also consider that, akin to the requirements for Industry Programmes, Catchment Collectives should be required to lodge applications for approval with the Council, and propose that these equivalent sections are added.

(e) Proposed Section C - Individual Freshwater Farm Plans

i. I suggest amendments to the first paragraph, to clarify that this section applies to those who are not part of a Catchment Collective or Industry Programme, and therefore must submit their own Freshwater Farm Plan.

ii. The content in 'Reporting and Review' (2.3 and 2.4) appears to be irrelevant to an individual preparing a Freshwater Farm Plan, or at least it is unclear what 'report' is being referred to. 2.3a refers to Clause 4 of section A (proposed section B), which is exclusive to Catchment Collectives.

(f) Section D - Industry Programmes: I largely support the S42A report author's amendments to provide a separate section for Industry Programmes, however recommend minor changes:

i. The focus of an audit should be on the programme members rather than on the Industry Programme. In addition to Council approval, the Industry Programme may also be accredited by an independent body (e.g. JAS-ANZ) to demonstrate credibility and robustness of assurance processes in certification of FWFPs.

ii. To 2.1(a), to make it clearer around the role of Industry Programmes, in delivering certified Freshwater Farm Plans (they may not necessarily prepare them) and an additional requirement that relates to a process for certification of FWFP, in lieu of requirements for qualifications etc. (which is already stated in 4.1)

iii. To 4.1, removal of the requirement for an 'annual' audit, as the frequency will be set out within the Industry Programme, on a risk basis (i.e. low performance by growers or progress towards objectives leads to higher audit frequency).

(g) Section E: Auditing and Reporting: I largely support the S42A report author's amendments in respect of Section E, however propose some minor wording amendments to make the section clearer, especially regarding the roles and responsibilities in auditing between Council and Industry Programmes.

i. I have provided clarity on the roles and responsibilities for auditing based on whether a farmer is an individual, part of a Catchment Collective, or part of an industry scheme.

ii. GAP schemes have credible audit standards and processes which should be recognised by HBRC as equivalent to Council audit processes, given the comprehensive approval process for the scheme. I generally understand that this is how these schemes are recognised in Schedule 30, however recommend an amendment to 1 (b) to clarify this.

(h) Reporting: I have not proposed specific changes to the wording around reporting, however recommend that reporting requirements and expectations are better defined in schedule 30 to provide clarity for individuals, Catchment Collectives and industry schemes. The spectrum of reporting regarding FWFPs is considerable (**Appendix L**), however the wording in schedule 30 is currently vague 'e.g. the report will be supplied in the format specified by the Council'. Data collection, analysis, storage management and reporting, is a potentially massive undertaking for industry and Council, therefore it needs to be clearly defined. By defining the expectations up front, Council will have better alignment across the reporting programme, thus will be in a much better position to publicly report on implementation on TANK with minimal administration and confusion.

CONCLUSIONS AND RECOMMENDATIONS

97. I support the recognition of industry schemes (e.g. GAP schemes) as a pathway for growers to demonstrate compliance with requirements for Farm Environment Plans to monitor, manage and minimise loss of contaminants from the growing operation.

98. I support a more practical approach to nutrient management planning, which is more focused on the tangible adoption of Good and Best Management Practices, the monitoring of inputs and outputs from the system, and minimising loss of contaminants from the system using practical crop level tools (e.g. Landwise Nutrient Budget).

99. I recommend the specification of reporting requirements.

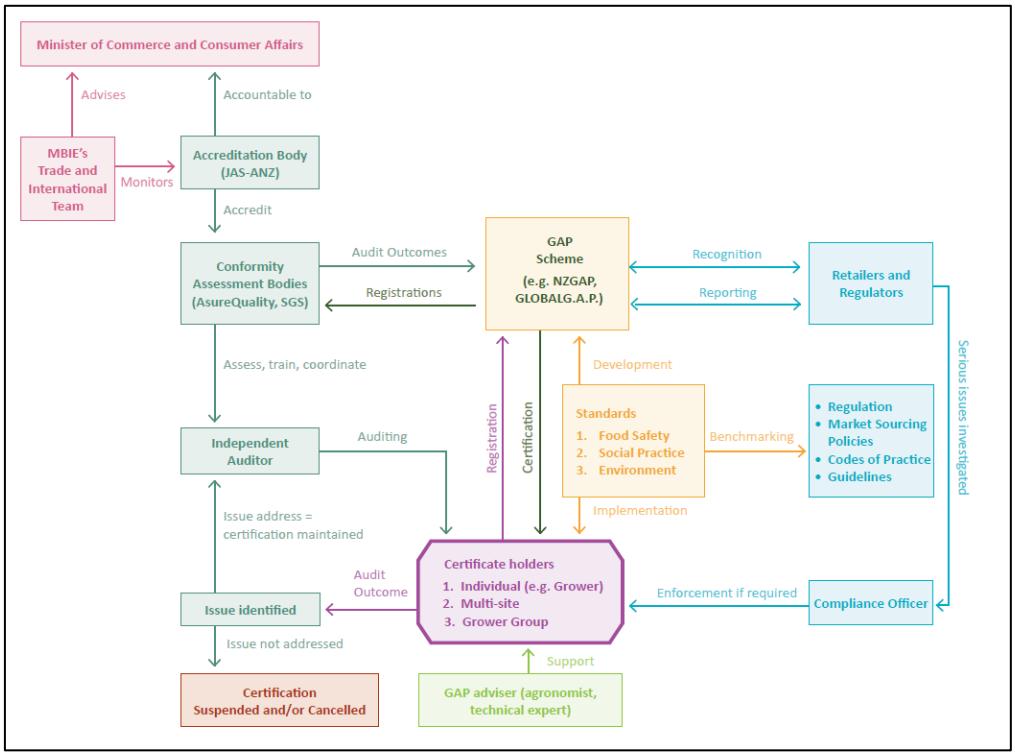
100. I recommend recognition of a GAP certified FWFP (e.g. EMS add-on) as supporting evidence for the grower's consent application, and as a pathway for growers to demonstrate that they are operating at Good/Best Management Practice, or making acceptable progress towards Good/Best Management Practice as required by the Regional Plan and their resource consent conditions.

101. I propose that specific reporting requirements (e.g. annual number of FWFPs developed) and acceptable formats (e.g. .csv) are better defined in schedule 30 to provide clarity of expectations for individual FWFPs, Catchment Collectives and Industry Programmes.

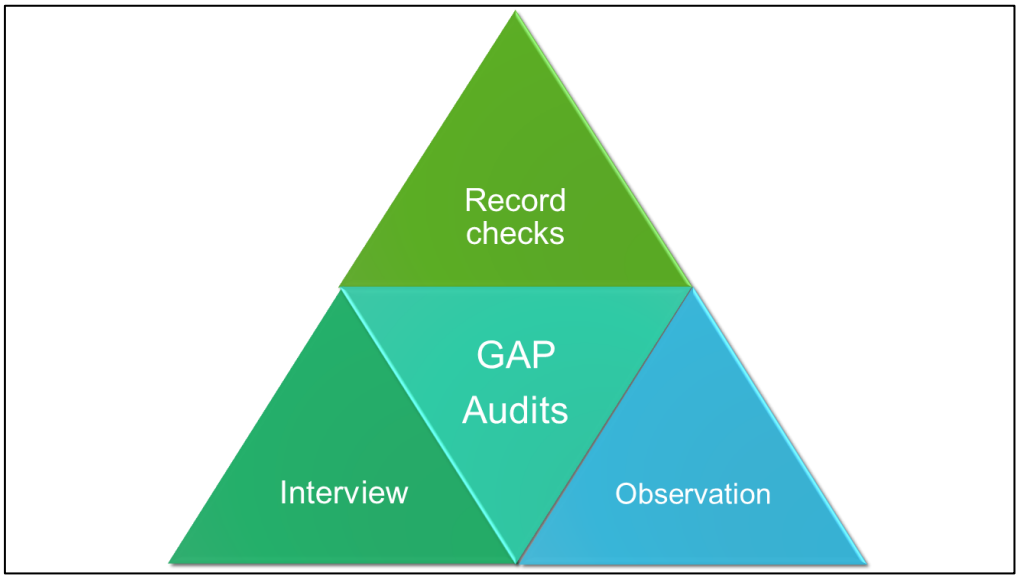
Damien John Farrelly

7 May 2021

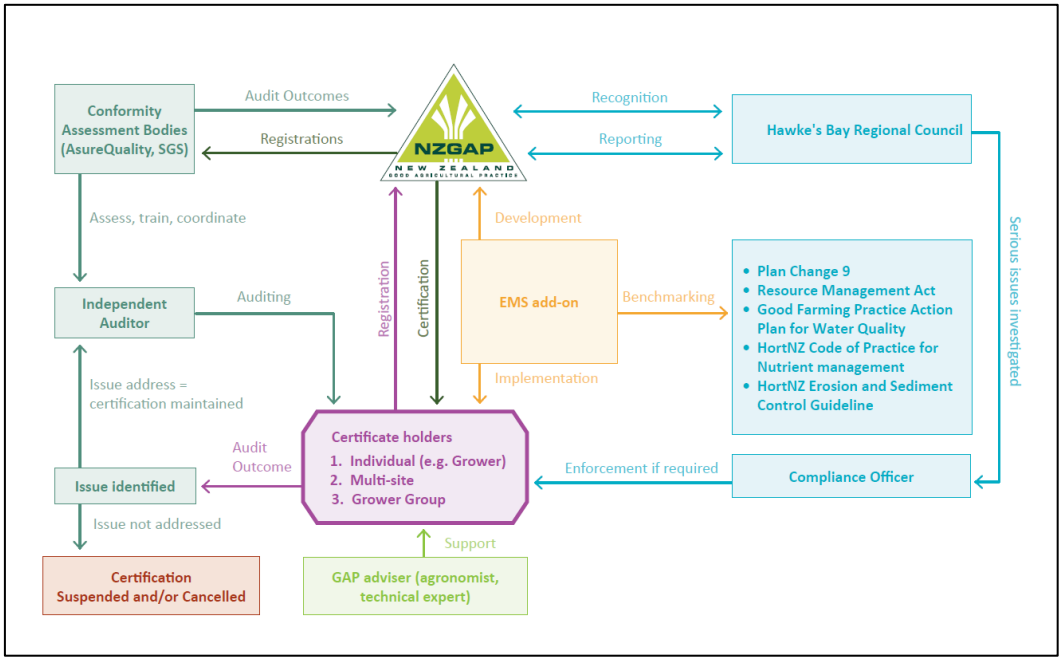
APPENDIX A: NEW ZEALAND CONFORMANCE FRAMEWORK FOR GAP CERTIFICATION



APPENDIX B: TRIANGULATED ASSURANCE VIA GAP AUDITS



APPENDIX C: NZGAP ASSURANCE FRAMEWORK FOR FARM ENVIRONMENT PLAN



APPENDIX D: NZGAP GUIDE FOR PLAN CHANGE 6 TO THE HAWKE'S BAY REGIONAL RESOURCE MANAGEMENT PLAN (TUKITUKI RIVER CATCHMENT)

NZGAP Guide for

Plan Change 6 to the

Hawke's Bay Regional Resource Management Plan

(Tukituki River Catchment)

(Version 1.2 – March 2020)

1 Relevant Documents

- NZGAP EMS add-on checklist (current version or v1.6 Nov 2019) – i.e. Farm Environment Plan (FEP) compliance checklist
- NZGAP EMS add-on Implementation Guideline (current version or v1.6 Nov 2019)
- NZGAP Environment Management System Templates (current version or v1.6 Nov 2019)
- NZGAP Environment Management System Registration Form (v4 Feb 2019)
- Plan Change 6 to Hawke's Bay Regional Resource Management Plan – Tukituki River Catchment (HBRC Report No. SD 15-08-4767)

2 Glossary

- NZGAP – New Zealand Good Agricultural Practice
- EMS – Environment Management System
- FEP – Farm Environment Plan
- Checklist – NZGAP EMS add-on checklist
- Templates – NZGAP Environment Management System templates
- HBRC – Hawke's Bay Regional Council

3 Purpose

This guide is for NZGAP growers, NZGAP auditors, and regulators in the Hawke's Bay Tukituki River Catchment. This guide demonstrates alignment of the New Zealand Gap (NZGAP) Environment Management System (EMS) add on with:

• **Plan Change 6 to Hawke's Bay Regional Resource Management Plan – Tukituki River Catchment**
• Schedule XXII: Requirements for Farm Environmental Management

The EMS provides the assurance framework within which growers operate to meet the minimum standards as defined in Schedule XXII and the EMS (whichever is greater). Where Schedule XXII provides additional or more detailed requirements than the EMS, the requirement is highlighted in yellow.

4 Schedule XXII: Requirements for Farm Environment Plans

A Farm Environmental Management Plan shall be prepared and implemented in accordance with either **A** or **B** below by a person with the appropriate professional qualifications. 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. The farm environmental management plan must clearly identify how the assigned industry 'good practices' and/or property nutrient allowances will be achieved. The plan requirements will apply to:

1. A plan prepared for an individual property or farming enterprise; or
2. A plan prepared for an individual property which is part of a farming enterprise or a collective of farm properties, including an irrigation scheme, an Industry Certification Scheme, or catchment club.

A Farm Environmental Management Plans prepared for individual farm properties or a farming enterprise that **are part of an industry managed programme** that has been approved by the Hawke's Bay Regional Council that includes the following attributes:

(a) A requirement for a farm management plan that includes as a minimum:

(I)The matters set out in B(1),B(2), B(3),B(4), B(5) and B(6)below;

(ii) Specified actions (if necessary) to address the risks to water quality associated with the major farming activities on the property and how the identified risks will be managed;

(iii) Measurement of nutrient losses or modelling using the OVERSEER™ Nutrient Budget model(or an alternative model approved by Hawke's Bay Regional Council), for each of the identified land management unit and the overall farm property in accordance with POL TT4;

(iv) Performance measures that are capable of being audited;

(b) A methodology that will enable the development of a plan that will identify the risks to water quality associated with the major farming activities on the property;

(c) Advice and technical support (including, for example, guidelines and templates) for the development and implementation of farm environmental plans;

(d) An audit system that audits the implementation of specific components of plans on a random sample basis across the Tukituki River catchment and on the basis of targeting farming operations that pose a high risk to water quality;

(e) A system of actions and/or consequences, for a farm property if and when an audit reveals non-compliance by that farm property with the A(a)(iv) performance measures

B Farm Environmental Management Plans prepared for individual farm properties or a farming enterprise that **are not part of an industry managed programme**. The plan shall contain as a minimum:

Schedule XXII Requirements	Schedule XXII Sub-ref	Schedule XXII Sub-Requirements	EMS Ref	EMS Requirements	EMS source
1. Property details	(a)	Physical address	-	Physical address	Checklist
	(b)	Description of ownership and name of a contact person	-	Owner, Responsible Manager, Contact Person	Checklist
	(c)	Legal description of the land and farm identifier	-	Business Name, Legal Descriptions	Checklist
2. A map(s) or aerial photograph at a scale that clearly shows:	(a)	The boundaries of the property	5A	Property boundaries (currently owned and leased properties)	Templates
	(b)	The boundaries of the main land management units on the property	5A	Land management units (e.g. cropped areas)	Templates
	(c)	The location of permanent or intermittent rivers, streams, lakes, drains, ponds or wetlands	5A	Permanent or intermittent rivers, streams, lakes, ponds, drains and wetlands	Templates
	(d)	The location of riparian vegetation and fences adjacent to water bodies	5A	Riparian vegetation and barriers/fences adjacent to waterbodies	Templates
	(e)	The location of storage facilities, offal or refuse disposal pits, feeding or stock holding areas, effluent blocks, raceways, tracks and crossings.	5A	Potential critical sources (point and area) for contaminants (e.g. erosion risk, fertiliser storage)	Templates
	(f)	The location of any areas within or adjoining the property that are identified in a District Plan as 'significant indigenous biodiversity'	5A	Any significant areas as defined by the local authority (e.g. significant indigenous biodiversity areas, cultural landscape values management area)	Templates

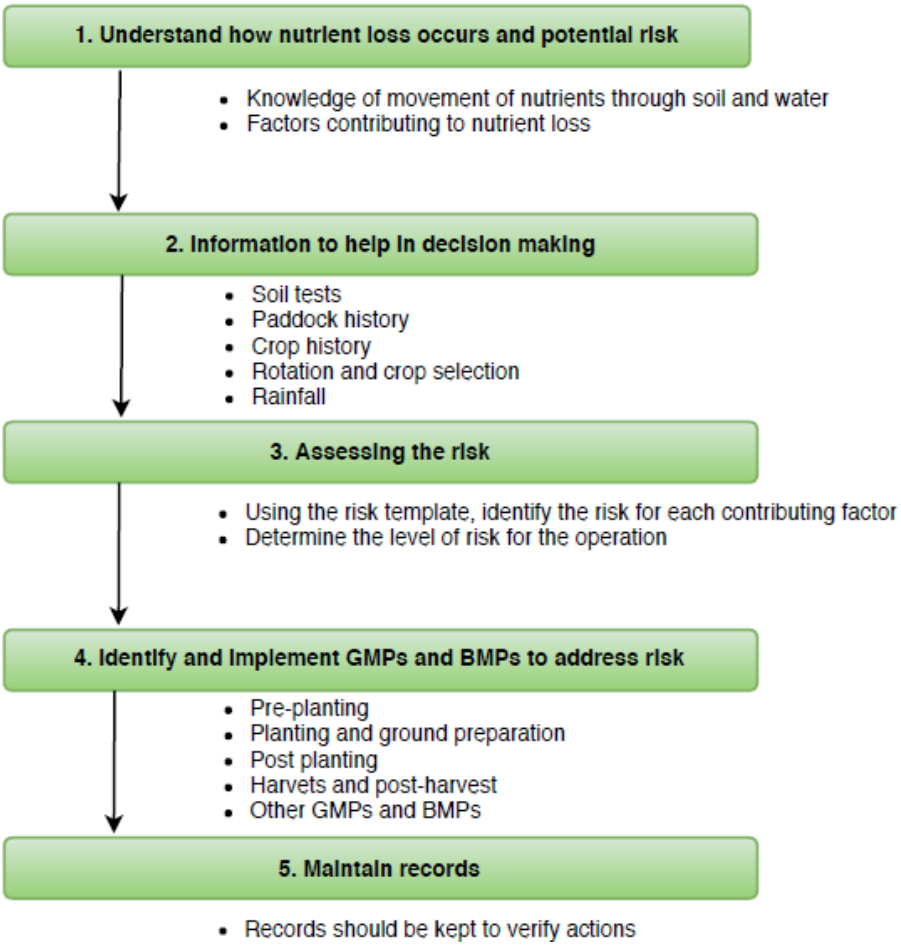
Schedule XXII Requirements	Schedule XXII Sub-ref	Schedule XXII Sub-Requirements	EMS Ref	EMS Requirements	EMS source
	(g)	Map of the LUC classifications within the farm and the areas within each LUC	5A	*Part of the map package returned to growers after sending their property maps to NZGAP*	Maps
3. An assessment of the risks to water quality associated with the major farming activities on the property and how the identified risks will be managed	-	-	6, 7, 8, 9, 10A	SOIL, NUTRIENTS, WATER and IRRIGATION, MAHINGA KAI and BIODIVERSITY: Assessment, Control Measures and Action Plan. ENVIRONMENTAL ACTION PLAN	Templates
4. A Phosphorous Management Plan as defined in the Glossary	-	-	6A, 7A, 10A	SOIL: Soil Quality, Health and Fertility – Assessment NUTRIENTS: Nutrient loss risk ENVIRONMENTAL ACTION PLAN	Templates
5. A description of how each of the following management objectives will, where relevant, be met. The plan shall include for each management objective: (a) user defined measurable targets that clearly set a pathway and timeframe for	(a)	Nutrient management: To minimise nutrient losses to water and achieve the Tukituki LUC Natural Capital; Nitrogen Leaching Rates in Table 5.9.1D on a whole of farm property or whole of farming enterprise basis.	7A, 7B, 7C, 10A	NUTRIENTS: Assessment, Control Measures and Action Plan. ENVIRONMENTAL ACTION PLAN.	Templates
	(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 (including deficit irrigation and consideration of the use of precision irrigation).	8A, 8B, 10A	WATER and IRRIGATION: Assessment, Control Measures and Action Plan. ENVIRONMENTAL ACTION PLAN.	Templates

Schedule XXII Requirements	Schedule XXII Sub-ref	Schedule XXII Sub-Requirements	EMS Ref	EMS Requirements	EMS source
achievement of the objective. (b) a description of the good management practices together with actions required to achieve the objective and targets. (c) the records for measuring performance and achievement of the target.	(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 waterbodies.	6A, 6B, 6C, 6D, 6E, 6F, 6G, 10A	SOIL: Assessment, Control Measures and Action Plan. ENVIRONMENTAL ACTION PLAN.	Templates
	(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.	9B, 10A	WATER and IRRIGATION: Assessment, Control Measures and Action Plan. ENVIRONMENTAL ACTION PLAN.	Templates
	(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.	n/a	n/a	n/a
	(f)	Livestock management: To manage wetlands and water bodies so that stock are excluded from water in accordance with Rule TT1, to avoid damage to the bed and margins of a water body, and to avoid the direct input of nutrients, sediment, and microbial pathogens.	n/a	n/a	n/a

Schedule XXII Requirements	Schedule XXII Sub-ref	Schedule XXII Sub-Requirements	EMS Ref	EMS Requirements	EMS source
6. Nutrient Budgets prepared using the OVERSEER™ Nutrient Budget model (or an alternative model approved by the Hawke's Bay Regional Council), for each of the identified land management units and the overall farm property in accordance with POL TT4.	-	-	7.8	Has a current nutrient budget been prepared for the property, where required, using a tool approved by the local authority (e.g. OVERSEER™, Ncheck)?	Checklist

C Farm Environmental Management Plans shall be updated at three yearly intervals from 1 June 2018.

APPENDIX E: RISK BASED APPROACH TO NUTRIENT MANAGEMENT



APPENDIX F: JOINING THE DOTS

Joining the Dots – Horowhenua Case Study

Problem Recognition, Research, Guidelines, Farm Environment Plans, Implementation, Reporting and Assurance using the NZGAP Environment Management System add-on

March 2021

Prepared for:

NZGAP and HortNZ

Prepared by:

Andrew Barber and Henry Stenning

AGRILINK

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Table of Contents

1 Overview

Joining the Dots is a structured approach to progressing from problem recognition, through research and supported guidelines, to the use of Farm Environment Plans (FEP) that provide a time bound structure for implementing mitigations. Assurance is provided through third party auditing. Through a centralised database a range of qualitative and quantitative metrics can track and report progress. Individualised benchmarking reports also supports a feedback loop to growers, which in turn can lead to problem recognition and links through to existing industry guides or identify areas for further research.

Farm Environment Plans (FEPs) that are audited under the New Zealand Good Agricultural Practice (NZGAP) Environmental Management System (EMS) add-on, provide assurance to regional councils that the outdoor fresh vegetable industry is undertaking continuous improvement with the goal of increasing sustainability.

As part of the work to date, Agrilink NZ, commissioned by the Vegetable Research and Innovation Board (VR&I), Potatoes NZ, and NZGAP, have stepped individual growers and now grower catchments through their FEPs', auditing, and reporting. This included the collection, aggregation, analysis, and display of national and regional scale metrics via NZGAP EMS. These metrics and dashboards can be used to report on the industry's sustainability progress over time. Individualised benchmarking reports were also generated for growers to inform future decision making and priority management areas.

This report incorporates the experiences from Levin where 1,090 ha, comprising of 22 operations and 263 paddocks progressed through to an audited FEP. Consequently, a range of qualitative and quantitative metrics have been developed that tell a very powerful story about where these growers have come from, where they are currently, and their trajectory towards implemented good and best management practice.

The next priority area is Gisborne where vegetable growers are currently working through to an FEP audit ready deadline of 1 May 2021.

2 Problem Recognition

The first step towards improved practice is problem recognition. Without recognition and consequently motivation to change, none of the steps described in Joining the Dots through to implementation are likely to occur.

Vegetable production needs to minimise its environmental impact primarily in the areas of sediment and nitrogen loss. The extent to which this is an issue is location specific. Therefore, a paddock risk assessment forms the first step in an operation's Farm Environment Plan (FEP).

In our example problem recognition came in the form of a major storm in May 1996, resulting in sediment and stormwater flooding parts of Pukekohe. Grower members of the Pukekohe Vegetable Growers Association needed to find a way of reducing the effects of erosion. The Franklin Sustainability Project (FSP) was born.

The path to implementation was described in the final FSP report (Barber, 2004) and is shown in the diagram below.

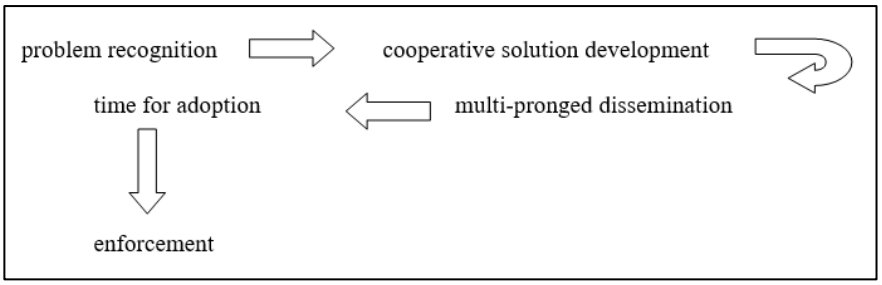


Figure 1. The path to implementation proposed by FSP in 2004.

3 Research

NZGAPs EMS takes their good and best management practices from industry developed guidelines and codes of practice. These have been built upon years of CRI and grower research and practice.

We have used erosion and sediment control to demonstrate the research component of Joining the Dots. Sediment discharge is a significant issue, particularly in the vegetable industry where the ground is cultivated. Hence it has been an area of significant work for many years. Therefore, it provides a great example to follow through from problem recognition, through research, guidelines, and now incorporation into FEPs and implementation.

3.1 Erosion and Sediment Control

Cultivated vegetable cropping research into erosion and sediment control included trials as part of the Franklin Sustainability Project in the mid '90s and later the MPI SFF / HortNZ project Don't Muddy the Water.

Don't Muddy the Water (2015-2019) was conducted to quantify the effectiveness of several sediment mitigation measures on cultivated horticultural land. The research was conducted by Agrilink NZ, NIWA, and Landcare Research. The primary focus was quantifying the effectiveness of sediment retention ponds (SRPs) and vegetated buffer strips. Trial details and results can be found in the final report (Barber et. al., 2019).

The most effective sediment reduction mitigation measure on flat cultivated land is well installed vegetated buffer strips. The assumptions and modelling behind this mitigation are included in the paper *Factors and Assumptions Used in the Don't Muddy the Water Erosion and Sediment Rate Calculator* [accessed through the DMTW app http://agrilink.co.nz/wp-content/uploads/2020/02/Factors-and-Assumptions-for-DMTW-App.pdf]. The greatest impact on effectiveness is the degree of channelising.

Don't Muddy the Water built upon previous research on erosion control, including the use of cover crops and wheel track ripping.

On-going research includes MPI and FARs effectiveness of vegetated buffer strip trials.

This body of research over the past 25 years has either helped develop or later supported the *Erosion & Sediment Control Guidelines for Vegetable Production* (Barber, 2014) https://www.nzgap.co.nz/NZGAP_Public/Growers/Guidelines.aspx.

3.2 Nitrogen Leaching

The other significant issue is nitrogen leaching. While this to has been a focus of research over many years, it is now an industry wide MPI supported project called Sustainable Vegetable Systems. Collecting the data and modelling the system are key workstreams in this four-year project (2020/21 to 2023/24) and places it at a similar point that sediment was in in 2015 when Don't Muddy the Water was established.

3.2.1 Nutrient Management for Vegetable Crops in NZ

The primary source of information on the nutrient management of vegetable crops is the recently released *Nutrient Management for Vegetable Crops in NZ* (Reid and Morton, 2019). This built upon the 1986 MAF published *Fertiliser Recommendations for Horticultural Crops*. The nutrient use in the Reid & Morton guide takes into account 30 years of subsequent research since the MAF publication.

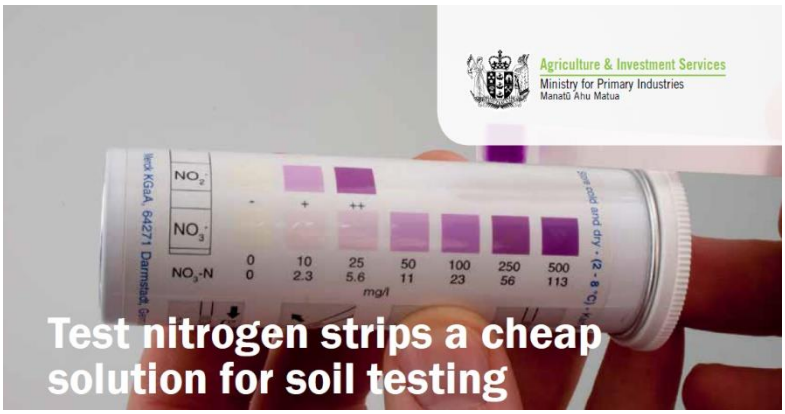
3.2.2 Sustainable Vegetable Systems

The four-year Sustainable Vegetable Systems (SVS) project is an MPI and industry funded project with the outcome of achieving greater understanding of vegetable crop nitrogen management in order to reduce the risk of nitrate leaching. Just like Don't Muddy the Water, SVS is focused on collecting robust data that in turn can be used to support Overseer and other crop nutrient models.

The modelling workstream aims to provide a tool or suite of tools to help growers implement good management practice and provide leaching assessments to regulators.

This project will review current tools, and if suitable develop a tool(s) for a wide range of vegetable crops across different locations and land use practices. Modelling will include OverseerFM and APSIM and their calibration and validation against Plant and Food Research trials, as well as regional monitoring sites. Alternative tools that can be integrated into guides like Nutrient Management for Vegetable Crops in NZ (Reid and Morton, 2019) are also being developed.

3.2.3 Quick-N Test



A recently completed MPI SFF project with industry partners has tested and refined the use of Quick Test nitrogen strips.

The testing process involves collecting and mixing soil samples in a calcium chloride

solution. The test strip is dipped in and a colour change on the strip shows the current nitrate level in the soil.

While the gold standard is a laboratory test, it is hoped that these quicker turnaround lower cost tests will result in more soil testing and fine tuning of side dressings.

3.2.4 Future Proofing Vegetable Production

This MPI SFF project is being delivered by LandWISE. The project draws on and supplements recent and current research to develop and disseminate good fertiliser management practices. This includes Quick-N test and precision application - ensuring the prescribed rate of fertiliser is applied.

3.2.5 Hot Water Nitrogen Test

Mineralisable N to improve on-farm N management is a MPI SFF project (2019) being conducted by Plant & Food Research. This project is running on-farm demonstration trials in arable and vegetable cropping systems to validate use of a new laboratory test (published 2017) to predict in-field N mineralisation. Trials will demonstrate the benefits of the new test in minimising unnecessary fertiliser N use and reducing the risk of N losses to the environment.

The overarching goal is to provide agronomists and growers with a tool that can provide more confidence in the wise use of nitrogen fertilisers for both production and environmental stewardship goals.

The test has been shown to predict Potentially Mineralisable Nitrogen (PMN) i.e. nitrogen likely to be mineralised from organic matter, that can then be taken up by crops over a growing season.

4 Guidelines and COPs

4.1 Erosion and Sediment Control Guidelines

The Erosion & Sediment Control Guidelines for Vegetable Production[10] was prepared in 2014 and specifies the four-step process needed to conduct a risk assessment and to generate an E&S Control Plan. The guidelines details a large array of E&S control measures suitable for cultivated horticultural land. Measures in the guideline include vegetated buffers, sediment retention ponds (SRPs), cultivation practices, interception drains, and wheel track ripping amongst many others.

FOUR STEPS TO MINIMISING SOIL EROSION & SEDIMENT LOSS

1. Paddock assessment

Map and describe the paddock (slope, area, history)

Identify where water is coming from

Identify where water leaves the paddock

2. Implement control measures for stopping or controlling water entering the paddock

Interception drains

Correctly sized culverts

Benched headlands

Bunds

Grassed swales
(controlled overland flow through the paddock)

3. Implement erosion control measures to keep soil on the paddock

Cover crops

Wheel track ripping / Wheel track dyking

Contour drains

Using short row lengths

Cultivation practices including minimising passes

Harvest management – timing / all-weather facilities

Post-harvest field management

Wind break crops (wind erosion)

4. Implement sediment control measures to manage the water and suspended solids that move off the paddock

Ensure access ways are not at the lowest point

Raised access ways / Bunds

Vegetated buffers / Riparian margins / Hedges

Super silt fences

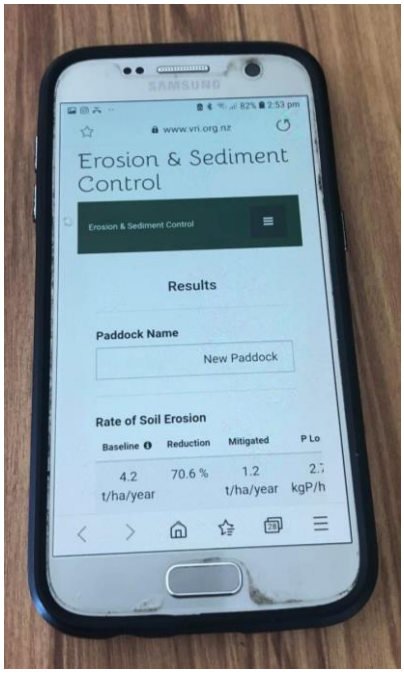
Stabilised discharge points and drains

Decanting earth bunds and silt traps

Version 1.1 - 2014 7

[10] Barber, A. 2014. Erosion & Sediment Control Guidelines for Vegetable Production. Prepared for Horticulture New Zealand. Prepared by Agrilink NZ, Kumeu.

4.1.1 Don't Muddy the Water App



A key tool developed as part of the Don't Muddy the Water project, and later refined through grower use and feedback, was the DMTW app.

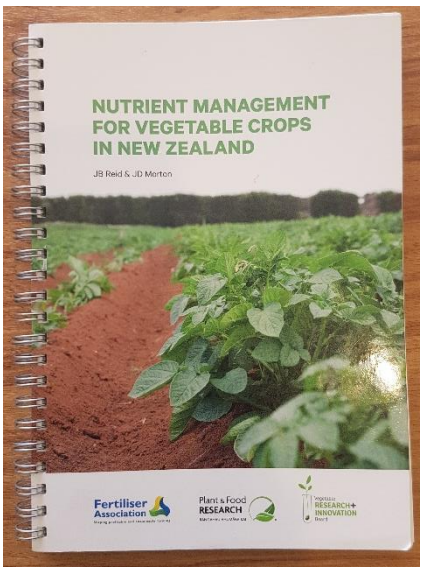
Growers and regional authorities now have an app that estimates a range of sediment loss rates for a paddock, including unmitigated, current practice and enhanced future practice. This research and app has been used to aggregate paddock losses to estimate catchment sediment loads.

The app allows growers to do a paddock risk assessment and subsequently prioritise their actions as part of their Farm Environment Plan.

This allows growers to provide robust evidence to support consent applications, proving to regional authorities that their mitigation measures are effective. In turn this helps growers to make better decisions about how to control erosion and sediment entering New Zealand waterways.

Specifically, the app quantifies the impact of various mitigation practices for reducing sediment and phosphorus loss. The user enters factors such as soil type, slope, and location to establish the unmitigated baseline. Erosion mitigations, such as cover crops and wheel track ripping, can be added. Sediment mitigations, such as vegetated buffer strips and sediment retention ponds can then be added to assess the impact of these practices.

4.2 Nutrient Management Guidelines and Budget Template



The culmination of years of nutrient research has been synthesised into the publication *Nutrient Management for Vegetable Crops in NZ*. This has been distributed to growers and has a dissemination programme associated with it, albeit currently being revised in the new covid-19 environment.

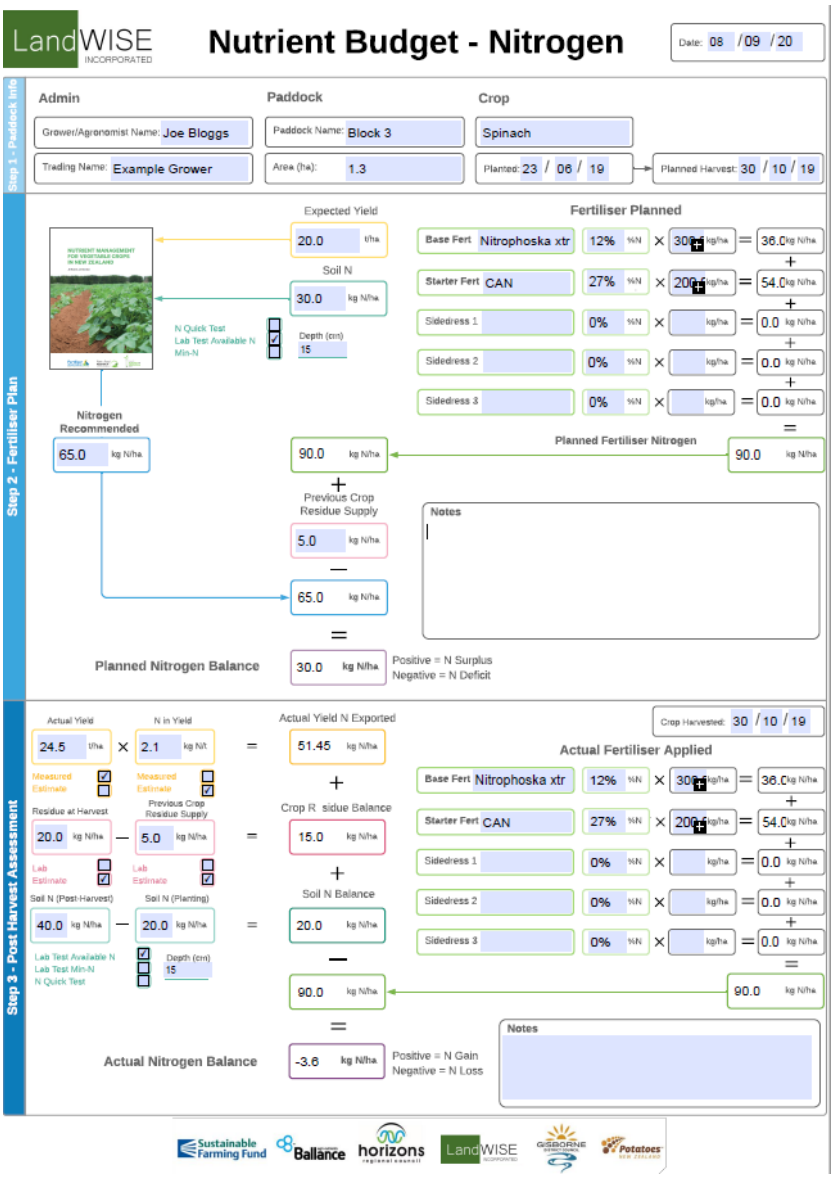
For those crops covered by the guide they provide the most up-to-date synthesis of current crop nutrient research and modelling.

4.3 Nutrient Budget

The LandWISE project, Future Proofing Vegetable Production, has developed single page nitrogen and phosphorus budgets that integrate with the nutrient management guide and soil testing –laboratory, quick-N test, and hot water N.

An example is given below. This template provides evidence that a process has been followed that involves reference to the industry guide and does it in a way that documents on a single page the fertiliser plan.

The nutrient budget has both a planning (step 2) and review or assessment of performance (step 3) components.



The planning step documents what may have previously occurred informally between a fertiliser adviser and the grower prior to placing an order.

The crop type, target yield, and soil nitrogen availability prior to planting is used to determine the crop nitrogen requirements. This plus a target surplus at the end of the crop determines the nitrogen fertiliser requirement.

Two key drivers are the guideline crop requirements and the level of risk reflected in the planned nitrogen surplus at the end of the crop. A low surplus assumes very little leaching, which runs a higher risk of crop failure. A high surplus has an elevated leaching potential and possible crop quality issues. The guidelines provide an average, tuned against a range of factors such as soil mineral nitrogen levels, yields, and location. They should however not be used as a maximum, and naturally can not account for seasonal variability.

In the nutrient budget, Step 2- Fertiliser Plan can be used as evidence in the NZGAP FEP (Nutrients: 7C – 1 Plan fertiliser inputs for the crop).

7C. NUTRIENTS: ***Implement measures to improve nutrient uptake and minimise nutrient loss***

Ref	Good/Best Management Practices	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
	Pre-planting								
1	Plan fertiliser inputs for the crop								GMP

Most crop fertiliser decisions are made pre-planting. Changes to the plan can be made around side dressings based on the climate and how the crop is performing. However, this tends to be more tweaks than significant changes.

The post-harvest review in Step 3, is where all of the uncertainties of growing and the markets come in. The actual nitrogen gain or loss is the reality of growing in an unpredictable climate. While from a continual learning perspective it is important to review the season, estimated nitrogen losses in this review step should not be a point of compliance. Potentially a grower could have leaching losses due to factors outside their control such as high rainfall, crop disease, or there being no market for their crop at the time of harvest. Clearly these scenarios are not envisaged when the fertiliser plan was prepared in Step 2.

Nevertheless, a review is important for both planning the next crop - including soil testing and crop residue carry over, and to record why there was a deviation from the plan (e.g. high rainfall, crop or market failure). However, there are a lot of unknowns in this review step, including how to determine residue levels and their associated nitrogen contribution and release timing.

Consequently, many aspects of the review step have become the focus of current research. This includes better understanding of crop residues such as estimating the quantity, availability, and nutrient release timing. Likewise, the research described in Section 3.2 includes new soil nitrogen testing such as Quick-N and hot water laboratory analysis. While research being conducted by SVS is developing better understanding of crop growth models and soil nitrogen dynamics.

5 Farm Environment Plans

The NZGAP EMS has developed a Farm Environment Plan (FEP) Template.

There are 5 management areas, with multiple sub sections:

1. Property Plan (map)
2. Soil
3. Nutrients
4. Water and Irrigation
5. Mahinga Kai and Biodiversity

The FEP process for each management area:

1. Assess the environmental risks
2. Identify GMPs (and BMPs if applicable) currently completed/implemented
3. Identify GMPs (and BMPs if applicable) yet to be completed/implemented and set target date for completion/implementation
4. Make progress towards GMP (and BMP if applicable)
5. Actions and improvement will be assessed during your next EMS audit

The FEP Template has been developed and refined over the past few years. One of the biggest benefits is that it documents the timeline for the implementation of GMPs and BMPs. It collates the suite of practices and if a practice is not being used it requires a justification for a No response or a timeframe for its implementation. Likewise, where practices are being used the grower must provide evidence of such.

The risk assessment and GMP / BMP assessment is then used to assemble a timebound Action Plan.

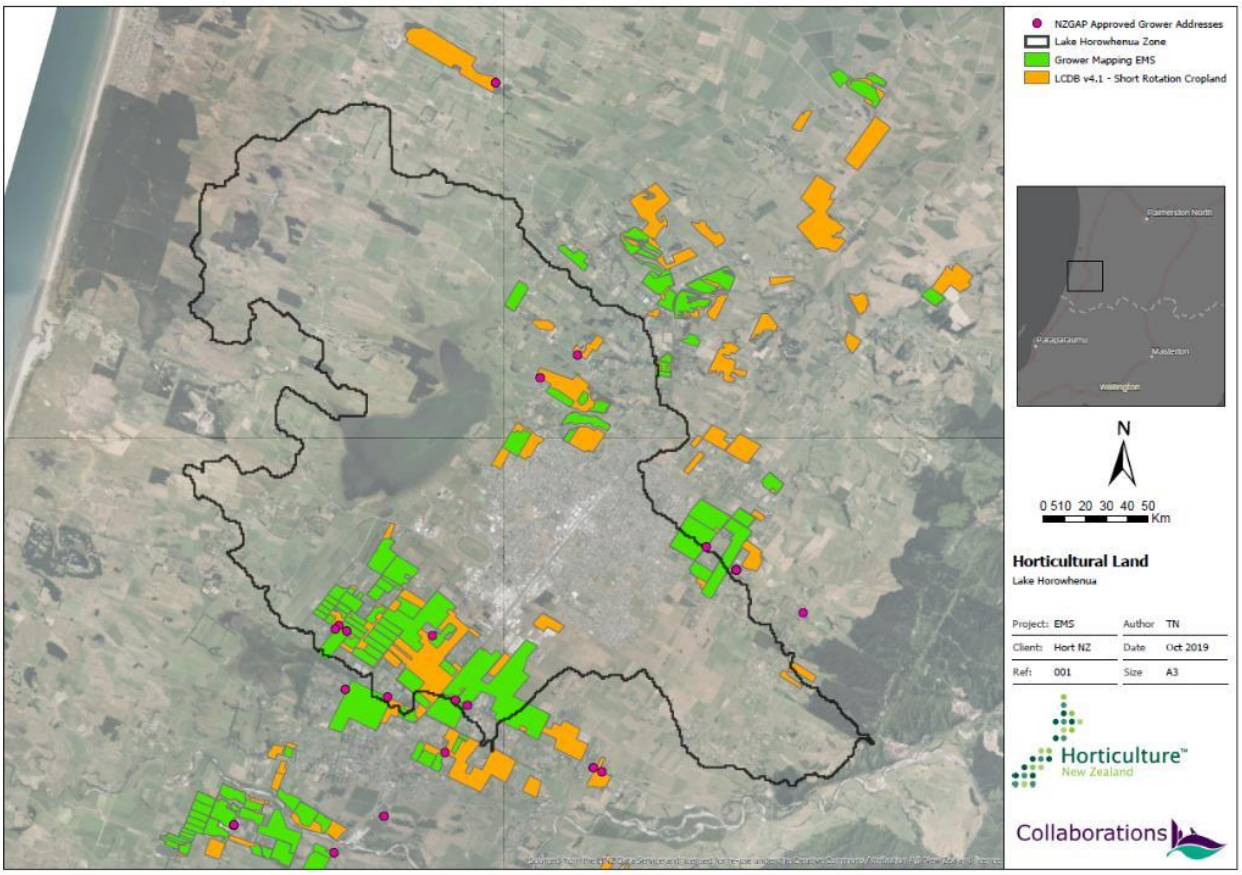
6 Implementation – Growers

An enormous amount of work has recently gone into implementing NZGAP's EMS across the industry. To date over a dozen workshops have been held in four regions, with 5 in Levin, 2 in Pukekohe, 1 in Taupo, 2 in Gisborne, and 3 in Canterbury. A stronger emphasis is also being placed on regional and crop specific case studies to give growers a relatable point of focus.

6.1 Pioneering the EMS in the Horowhenua

The Levin horticultural hub was selected as the first area to collectively go through the EMS. This was due to several factors, including Horizons Regional Council's Plan Change 2. The introduction of the EMS was a good opportunity to prove to the regional council that the local industry was taking its environmental obligations seriously. The second major factor was the environmental focus and small catchment size of Lake Horowhenua. This allowed for a catchment scale approach to the issue and acted as a good first example for the potential of data aggregation and presentation of metrics.

Maps act as a foundation for describing many of the risks and mitigations identified in an FEP. They are the first section of an FEP and while they can be prepared using a variety of tools, in this instance they were prepared in Google MyMaps, and then imported into ArcGIS. This ensured growers had access to a free mapping tool while also giving the industry the ability to conduct catchment level analysis. The maps, in conjunction with the Don't Muddy the Water App, were used to calculate erosion rates across 1,090 ha, comprising of 22 operations and 263 paddocks. Likewise, they were used to model the catchment nutrient load.



Vegetable cropping land in Levin with a complete or partial EMS in green and the balance of the vegetable cropping land in orange

Based on the data collected through the maps it is possible to calculate unmitigated erosion rates and estimated current and projected erosion rates using enhanced mitigation practices. This method of aggregating erosion rate data in conjunction with mapping, provides a powerful tool in telling an industry story for the Levin area.

Results from this analysis are shown in Table 1. Where a grower had not yet completed their EMS, it was assumed no mitigations were installed and any known buffer strips were 50% effective. For enhanced practice we assumed 5m wide buffer strips, that were between 80% and 90% effective. We also tested the impact of including a cover crop in the rotation.

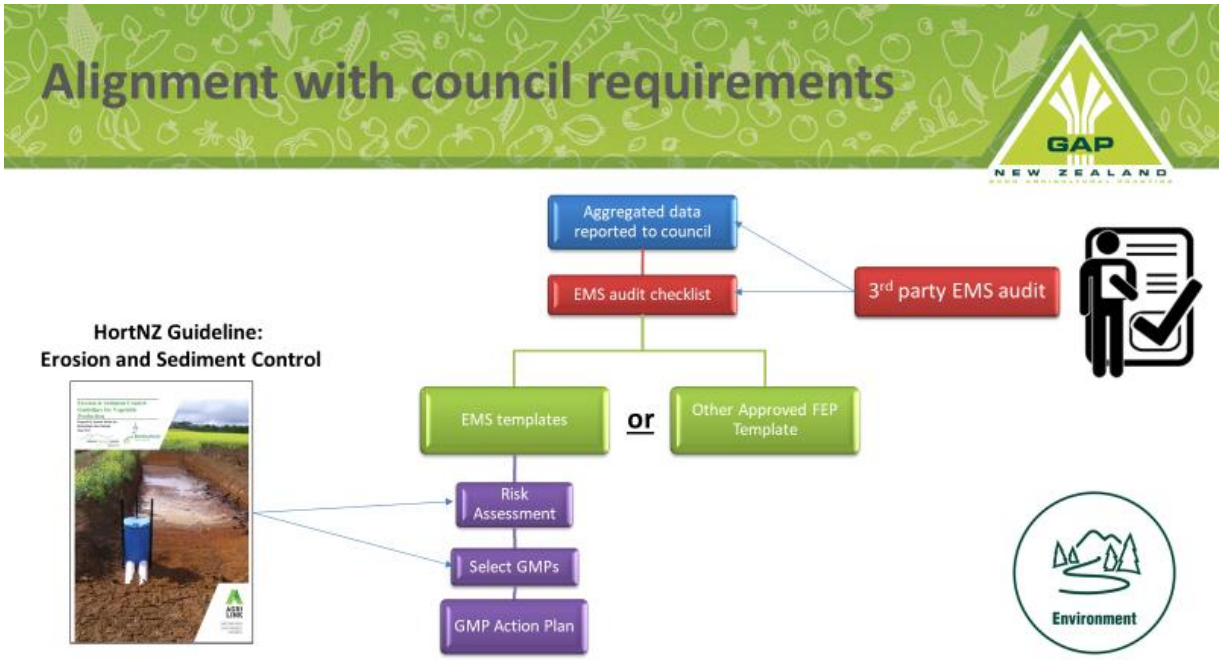
Table 1. Aggregated erosion rates and mitigation practice impacts across 1,090 ha of vegetable cropping land in Levin

Levin	Unmitigated	Current practice	Enhanced practice
Average erosion rate (t/ha/yr)	1.4	0.7	0.3
Total erosion rate (t)	1,480	760	360
Reduction compared to unmitigated (t)	-	720	1,120

7 Assurance – NZGAP

The horticultural industry has a well-established quality assurance programme through New Zealand Good Agricultural Practice (NZGAP). This is a self-assessment and an independently externally audited program. Currently, NZGAP has mostly been involved in food safety, health and safety, and workplace management auditing; however, it has recently added an Environmental Management System (EMS) to empower growers to adopt environmentally sustainable growing practices. The audit is practice based against good and best management practices and environmental outcomes.

Growers are externally audited against a Checklist of requirements.



The structure of NZGAPs EMS.

8 Grower and industry reporting

With centralised and audited FEPs, there is a lot of data that is being collected that could be used to help drive practice-based change and tell the industry's story. A regional dashboard for Manawatu-Wanganui has been develop phase, with the first prototype and metrics shown below (Section 8.2.1).

Practice change through the use of benchmarking reports has been used for many years in the wine industry where the NZ Sustainability Dashboard Project developed individualised energy, water, and plant protection reports. Growers and wineries can now assess themselves against tuned benchmarks (e.g. by winery size, vineyard location). These individualised benchmarking reports have been used to track progress and link Sustainable Winegrowing NZ members to learning resources when they are engaged in an issue through seeing their own performance.

A similar approach is being used in the onion industry for plant protection reporting and could equally be applied to the wider vegetable industry, with a soil erosion and nitrogen loss focus.

8.1 Data Collection

Maps are the first Template (5A) with the need to identify areas and key features. Like all Templates a response is required about the level of completeness, which is supported by evidence or in the case of Partial's and No's an associated time bound action.

5A Property Plan (Map): Features to be included on the property plan (i.e. map)

Ref	Map Features	Complete? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No' for GMPs. Justify if 'n/a')	Evidence (e.g. map or description)	Level
		Y	P	N	n/a				
1	Property boundaries (currently owned and leased properties)	●	○	○				Supporting Evidence (SE) 1.1 (Maps)	GMP
2	Land management units (e.g. cropped areas)	●	○	○				SE 1.1 (Maps)	GMP
3	Potential critical sources (point and area) for contaminants (e.g. erosion risk, fertiliser storage)	●	○	○				SE 1 (Maps)	GMP

Growers' generally prepare their maps in Google MyMaps, which are then exported to NZGAPs centralised ArcGIS system. Location and area details are incorporated into the metrics described below.

A grower works through their FEP, recording all their responses in each section to the list of good and best management practices. Responses are either Yes, Partial, No, or Not Applicable. Any Partial's, No's, or N/A's need a comment and potentially an action recorded in the Action List.

By way of example in the Nutrients Template (7C) the first GMP is that all fertiliser inputs are planned. In the case study below the grower recorded Yes and commented that they referred to the Nutrient Management book, and their evidence included their application records and calculations. Evidence of this planning could include the LandWISE Nutrient Budget (Section 4.2), OverseerFM, or their nutrient application records against crops and nutrient requirement lookup tables.

The next question asks do you "Take into account any organic manures". In this case the answer was N/A, with the explanation that they did not include organic manure. Had they used organic manure, but didn't account for them in their nutrient budget, then they would of answered No. Consequently their agreed action may have been to stop using organic manures or to take them into account in their next nutrient budget, with an associated date of when that will be complete by. This action would also have been picked up in the Action Plan (10A) and would be the subject of the next audit where evidence would need to be produced. In this case a nutrient budget that recorded the quantity of organic manure applied, its nutrient content, and availability.

7C. NUTRIENTS: ***Implement measures to improve nutrient uptake and minimise nutrient loss***

Ref	Good/Best Management Practices	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
	Pre-planting								
1	Plan fertiliser inputs for the crop	●	○	○	○		Code of best practice used.	SE 3.1 (Nutrient application records)	GMP
2	Take into account any organic manures used	○	○	○	●		No organic manures in rotation.		GMP

Other data sources include the auditors' Checklist and auditor reports.

Based on the maps and good and best management responses other modelling is completed, including erosion and sediment loss rates, and nutrient leaching. Examples of these metrics at both an operation and catchment level are shown below.

8.2 Horowhenua FEPs

Starting in mid-2019 the Horowhenua growers were the first to work together, as a whole catchment, on their FEPs. The first FEP grower workshop was held in Levin in September 2019.

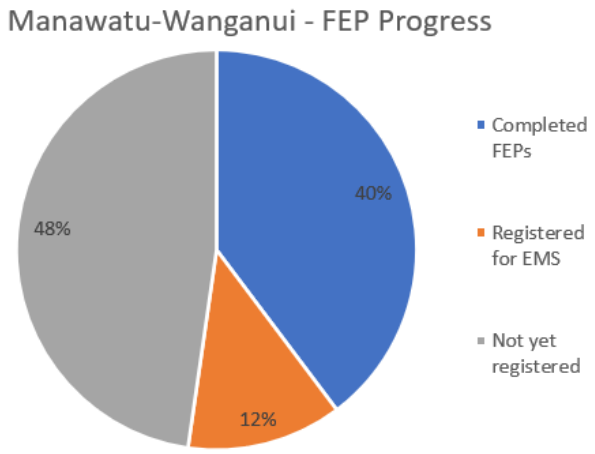
8.2.1 FEP Dashboard

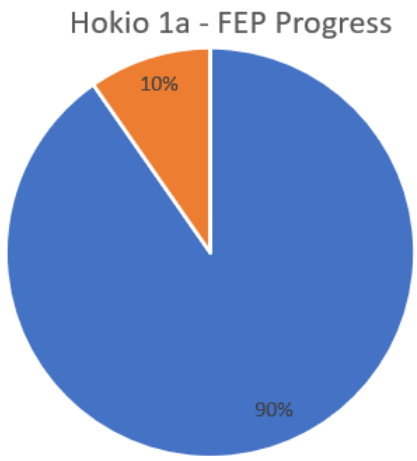
A prototype dashboard has been developed to track and report progress.

8.2.1 FEP Progress

There is approximately 3,600 ha of vegetable cropping land in the Horizons region (FreshFacts 2019). Approximately 40% of the area (1,449 ha) have completed FEPs. A further 12% (458 ha) have registered for the NZGAP EMS and are in the process of working through their FEP towards their audit.

Hokio 1a (Lake Horowhenua) catchment is recognised by Horizons as a Target Water Management Subzone. Seven growers, representing 90% of the area, have completed their FEPs. A further 6 growers that cover the remaining 10% of the area are currently working through their FEPs.





FEP progress in Manawatu-Wanganui

8.2.2 Current GMP & BMP

Across the NZGAP FEP there are 106 questions and mitigations, comprising of 65 GMPs and 41 BMPs. A summary of the responses from the 9 completed FEPs is shown in Table 1 and the Figure below.

Just over half of the assessed practices (55%) were either at the level of GMP or BMP. The 16% of n/a's are practices that do not apply to a particular property, such as in the example above where fertiliser management needing to take into account organic manures where none are used – hence that question would be answered n/a. Almost all of the blanks referred to the catchall question in each section "other practices".

Excluding n/a's and blanks, 82% of practices are currently implemented at the level of GMP's. This increased to 88% when analysed on an area basis. By count 48% of BMP's are currently being implemented, which increases to 63% when weighted by area.

Table 1. Currently implemented BMP & GMP

Practice	Response rate		GMP [1]		BMP [1]	
	Incl. n/a & blanks	Excl. n/a & blanks	By Co.	By area	By Co.	By area
Yes	55%	70%	82%	88%	48%	63%
Partial	5%	7%	4%	3%	10%	8%
No	18%	14%	9%	9%	41%	29%
n/a	16%	-	-	-	-	-
Blank	6%	-	-	-	-	-

1. excluding n/a and blanks.

All Partial and No responses to GMPs (and BMPs in some catchments) requires an explanation, and where appropriate a time bound action recorded in the Action Plan.

Of the 7 completed FEPs in the Hokio 1A catchment, 33 actions were identified. The breakdown of these is shown in Table 2.

Table 2. FEP identified actions

Total number of actions	33
Average number of actions per operation	4.7
Actions addressing soil management or E&S control	18
Actions addressing nutrient management	11
Actions addressing water & irrigation management	4

When viewed out to 2025, 69% of the actions are to be implemented before the end of 2021.

Table 3. Action implementation timeframe

	Actions to be completed		
Ongoing	2	7%	7%
2020	7	24%	31%
2021	11	38%	69%
2022	2	7%	76%
2023	5	17%	93%
2024	1	3%	97%
2025	1	3%	100%

Across the 7 FEPs there were 17 Partial's and 52 No responses to GMP questions (69 in total). These each need an explanation and where appropriate an action included in the Action Plan.

Further guidance has been developed around responding as No or NA. For example, the use of sediment retention ponds on flat land is often not applicable, with vegetated buffer strips being more appropriate. This question was answered with a mixture of Yes (1), No (3) and NA (3). Most likely the 3 No's should have also been NA's, with no associated action required.

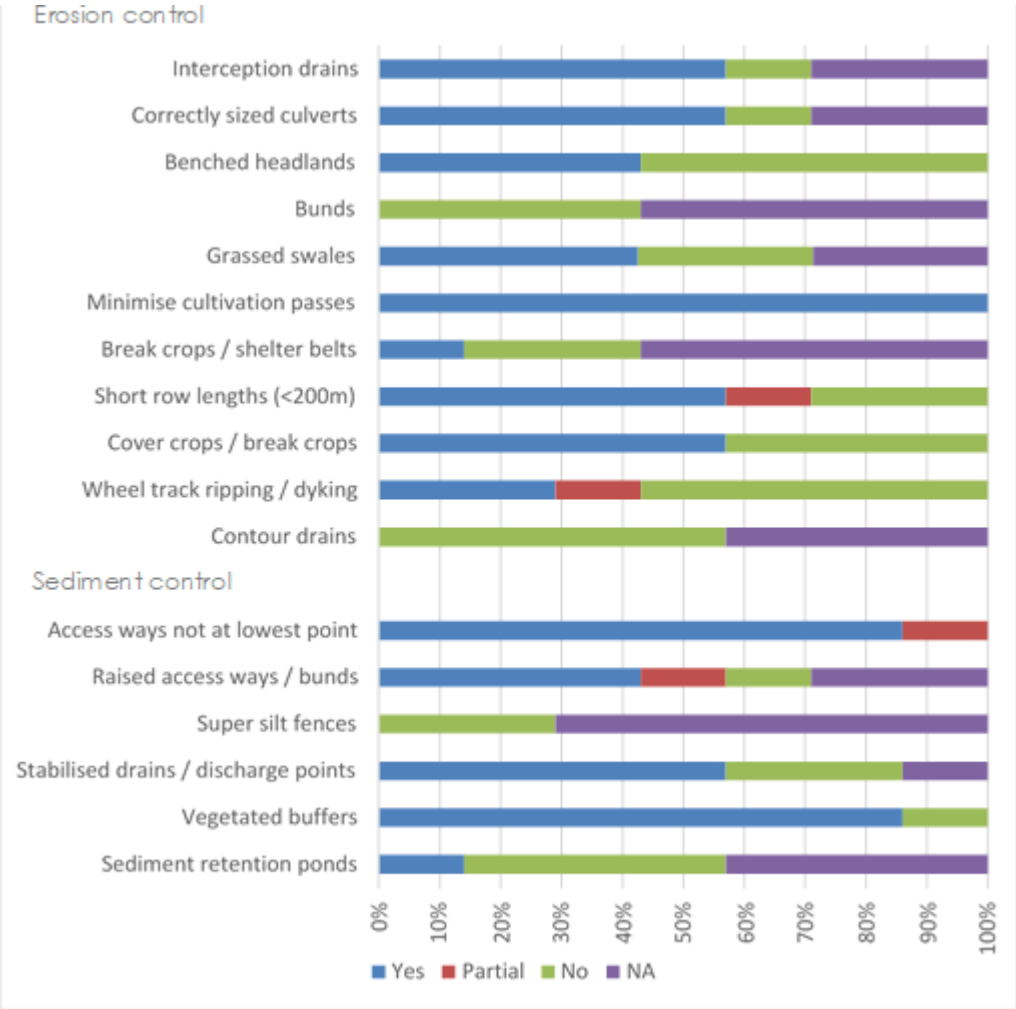
8.2.3 Erosion and Sediment Control

There is now the ability to aggregate and report growers' current practices by sediment control and nutrient management.

Not surprisingly given the generally flat topography the paddock risk assessment for sediment loss was rated low (Figure below). Other regions, such as Pukekohe, will have a very different risk profile.

Paddock risk assessment - sediment

These risk assessments then feed into the selection of mitigation measures (Figure below).



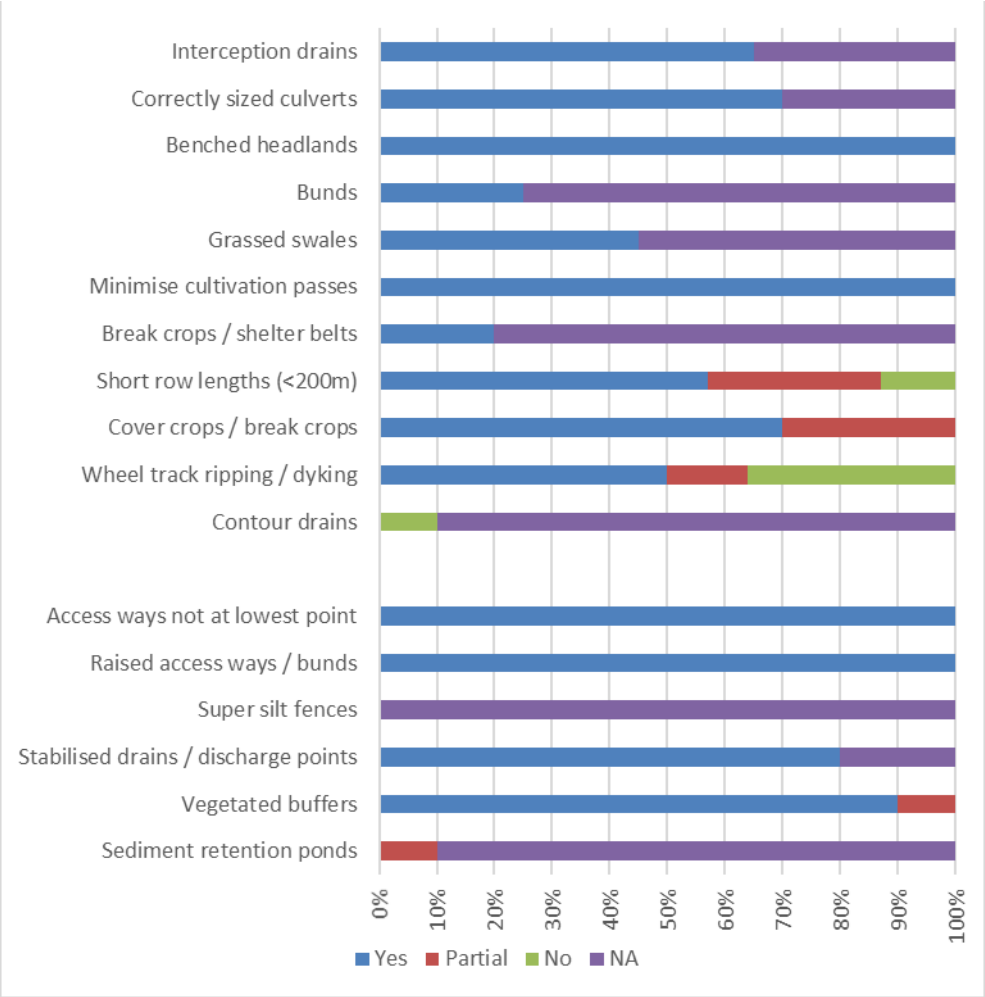
Current - Erosion and sediment control mitigation measures

Having established the baseline of current practice, as more GMPs and BMPs are implemented then the proportion of Yes's will increase. Taking for example the first mitigation measure, interception drains, 57% of operations used these, while 29% identified them as not applicable (possibly no overland flow paths from catchments above). One operation recorded No, and then would have an action to install an interception drain. This was 1 of the 18 erosion and sediment control actions shown in Table 2.

The list of mitigation measures is a suite of tools, so at no point in the future would it be appropriate to have implemented them all. For example, in Levin there is very little use of decanting earth bunds or sediment retention ponds. This reflects both the low erosion risk (Figure above) and that SRPs need sufficient outfall to drain, which often is not possible on flat paddocks.

All paddocks require some form of sediment control. At some point in the crop cycle erosion control measures are either not going to be present or enough, hence sediment control is required to minimise soil movement off the paddock. Without SRPs we can see that the main sediment control measure is vegetated buffer strips, recorded as Yes in 86% of FEPs.

The 2025 projections, figure below, highlight that the FEP approach is to list the full toolbox of mitigations, and that even once implemented that does not mean Yes for everything. For example, contour drains do not suite flat land, hence n/a. Even where a paddock may suite them it could be a No as other mitigations are used instead e.g. short row lengths, or wheel track ripping, all practices designed to reduce erosion rates.



2025 - Erosion and sediment control mitigation measures

Erosion and sediment control is extremely well researched, with the latest Don't Muddy the Water app being able to estimate average sediment loss rates based on a range of factors and mitigation measures (Section 4.1.1). This app has been deployed across all of the completed FEPs, with the results shown in Table 4.

Table 4. Sediment loss rates across the completed FEPs

	Average sediment loss (t/ha/yr)
Unmitigated	0.8
Current Practice - Low Efficiency	0.5

Current Practice - High Efficiency	0.3
Enhanced Practice	0.2

Unmitigated sediment loss averages 0.8 t/ha/yr. Enhanced practice is defined as having implemented all appropriate erosion and sediment control measures to a high standard. At which point sediment loss drops to 0.2 t/ha/yr. Based on the current practices recorded in the FEPs sediment loss is somewhere between 0.3 to 0.5 t/ha/yr. The range reflects the level of implementation. Not all vegetated buffer strips are equally effective, with the extent of channelised flow affecting their efficiency.

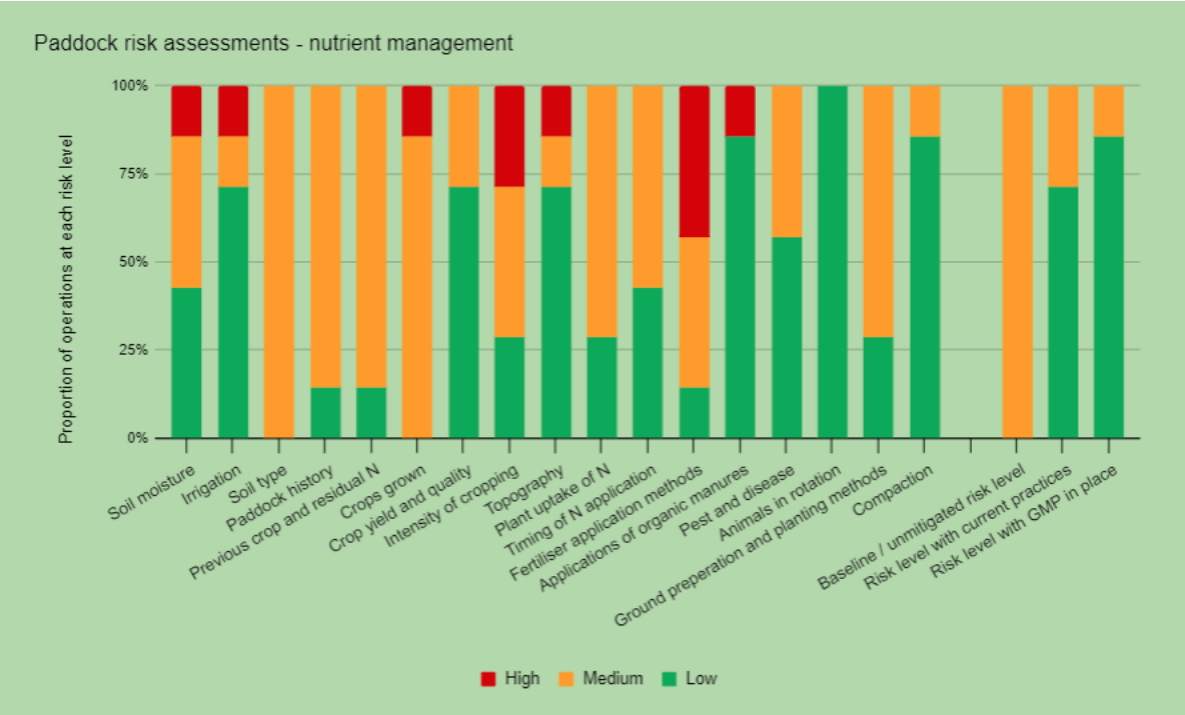
8.2.4 Response Improvements

Having worked through multiple FEPs there were considerable lessons. Scanning across erosion and sediment control above and nutrient practice below, you would expect more 'partial' responses. The fact that there are no partials to the vegetated buffer mitigation suggests that every paddock has a vegetated buffer, with the exception of the one operation that responded with a no. This is extremely unlikely and more realistically probably reflects that most operations have at least 1 buffer and hence answered Yes. Part of the future work programme will involve assessing the grower and auditor responses and developing dissemination programmes around those findings. This may include better FEP response guidance. Likewise, these sorts of metrics will help target workshops and other extension activities. In this case on installing effective buffer strips.

8.2.5 Nutrient Management

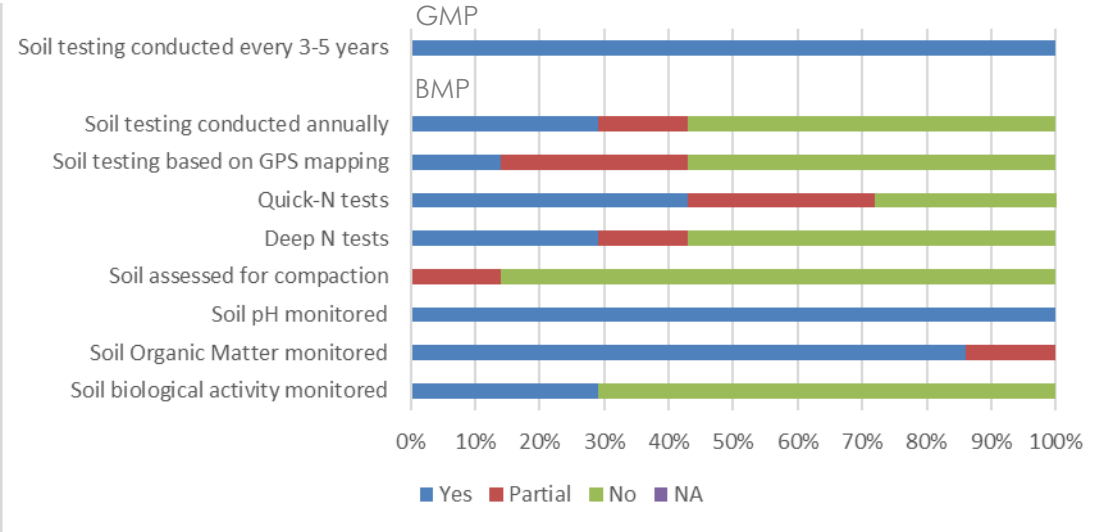
An assessment of the paddock risk assessment for nutrient management is summarised in the Figure below. Through a self-assessment process all growers considered leaching to carry a medium level of risk. With current practice 71% of grower considered the risk became low, which became 86% once all GMPs were implemented.

From the perspective of problem recognition, it shows the growers' considered the application method to be one of the highest risk points. This type of information can then be used to develop dissemination material based around grower recognised need. Paddock history and crop residue are also seen as medium risk factors by almost 90% of operations. This has already been reflected in current research through the Future Proofing Vegetable Systems project, the LandWISE nutrient budget, and new Sustainable Vegetable System project (Section 3.2).



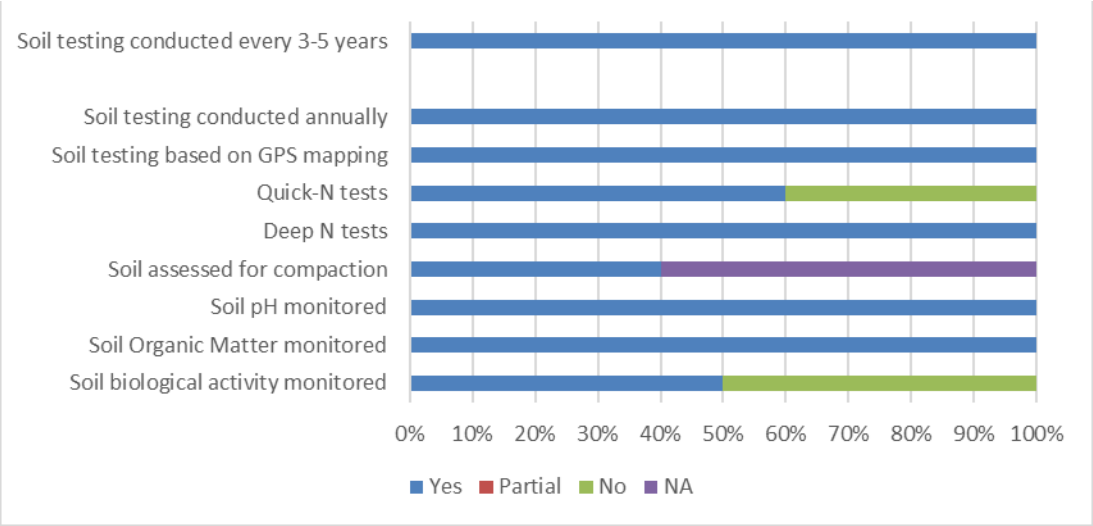
Nutrient loss risk assessment

The current level of nutrient management activity is shown in the Figure below. This can be used to track progress. Currently all growers conduct soil tests at least every 3-5 years, with almost a third in an annual cycle. With greater emphasis on nutrient budgeting - which incorporates soil nutrient testing, plus annual testing being a BMP, we expect to see this annual testing increase. Likewise, with FEPs making mapping more integrated into an operations practices and documentation the proportion of growers linking soil testing to GPS mapping will increase.



Current - Nutrient management practices

Similarly, as we look across the BMP practices, like Quick-N tests, deep N tests, compaction assessment, and soil biological activity, we can track progress on their implementation. The figure below shows the projections by 2025 in Hokio 1a.



2025 - Nutrient management practices

As described previously this is a suite of practices, so not all of them are appropriate in all situations. Quick-N tests for example may not be used if a grower uses laboratory-based nitrogen testing instead. Soil compaction may not be an issue on some properties with deep friable soils, hence the n/a responses. Soil biological monitoring is just in its infancy. While listed in the BMPs a No response could be justified.

Predicted nitrogen loss reductions

Rotation	Leaching Rate (pre- 2019) (kg/N/ha/yr)	Leaching Rate (post- 2019) (kg/N/ha/yr)	Reduction from pre-2019 to post-2019 practice (%)
Intensive	81.0	44.0	-46%
Brassica	92.9	83.2	-10%
Potato/Onion	30.9	28.8	-7%

The implementation of Good Management Practice (GMP), Best Management Practice (BMP), and elements of system change (e.g. retirement of land) by growers in the Horowhenua has resulted in a decrease in predicted N loss, reflected by the reduction in N loss rate from pre- to post-2019 in the Table above. The table above shows that the intensive rotation was predicted to reduce N leaching by 46% following the adoption of both GMP and BMP with system change, while improvements for the brassica and potato/onion rotations are only 10% and 7%, respectively for GMP and BMP adoption.

8.3 Individualised Benchmarking Reports

Taking the lessons learnt from the wine industry on individualised reporting, it may be possible to take the data supplied through the nutrient budgets or DMTW app to create individualised benchmarking reports.

These reports become a learning resource that engage growers by benchmarking their performance against tuned benchmarks. The example given below is factitious, however it compares nutrient inputs to the guidelines, accounts for the current season's rainfall and leaching, tracks previous seasons, and benchmarks nutrient inputs to tuned benchmarks using all other growers' data.

The report links to learning resources (top right box). This example shows that very little leaching occurred while the crop was growing (September planting), with most of the leaching risk occurring prior to planting when the ground was fallow. Lessons from this may be around previous crop management and post-harvest nitrogen levels, or simply that the July storm that resulted in over 60mm of drainage was unusual.

This type of report can also direct research projects towards the hot spots and mitigations around crop residues, post-harvest target N levels, and cover crops.

Nutrient Management Report - Onions

Season	**2018/19**		
Farm Name	**Farm A**		
NZGAP Number	**1**	**Farm ID**	**AK1**
Region	**Auckland / Upper Waikato**		

How does this affect me?

Nutrient leaching and runoff is an important issue in New Zealands horticulture and wider agriculture industry. Leaching into aquifers and runoff into groundwater can lead to large decreases in freshwater quality and can be destructive to the freshwater environment.

In the horticulture industry, fertilisers are often applied in large quantities as they are relatively cheap, and underapplication carries such a large degree of risk. There are nevertheless opportunities to enhance nutrient inputs to reduce the risk of excessive leaching and runoff.

Horticulture New Zealand has published a guideline on best practices for nutrient management, which can be accessed via the link below:
http://www.hortnz.co.nz/assets/Uploads/Code-of-Practice-for-Nutrient-Management-v-1-0-28-Aug-2014.pdf

1 Nutrient inputs

Farm average

Crop	Inputs: Average N applied (kgN/ha)	Inputs: Average phosphorous application (kg/ha)	Inputs: Average potassium application (kg/ha)	Guideline crop requirements: Nitrogen requirement (kg/ha)	Guideline crop requirements: Phosphorous requirement (kg/ha)	Guideline crop requirements: Potassium requirement (kg/ha)
Onion - long keeper	200	60	10	100	70	0
Onion - sweet, red and white	60	30	20	40	0	0

2018/19 season average

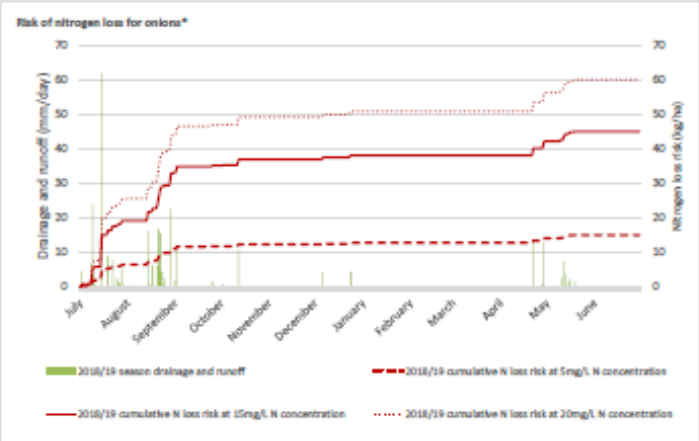
Crop	Inputs: 2018/19 nitrogen application (kg/ha)	Inputs: 2018/19 phosphorous application (kg/ha)	Inputs: 2018/19 potassium application (kg/ha)	Guideline crop requirements: Nitrogen requirement (kg/ha)	Guideline crop requirements: Phosphorous requirement (kg/ha)	Guideline crop requirements: Potassium requirement (kg/ha)
Onion - long keeper	180	120	40	100	70	0
Onion - sweet, red and white	50	20	40	40	0	0

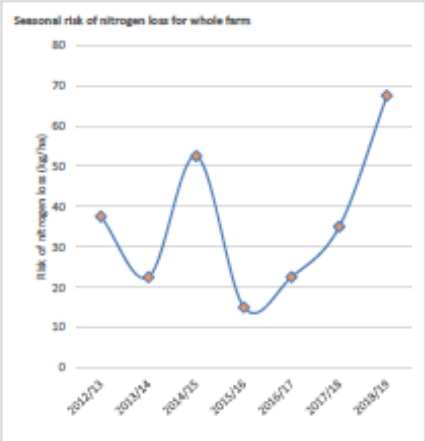
2 Drainage

*Note - The drainage model is based on a number of large assumptions and so should be used as a rough guideline only

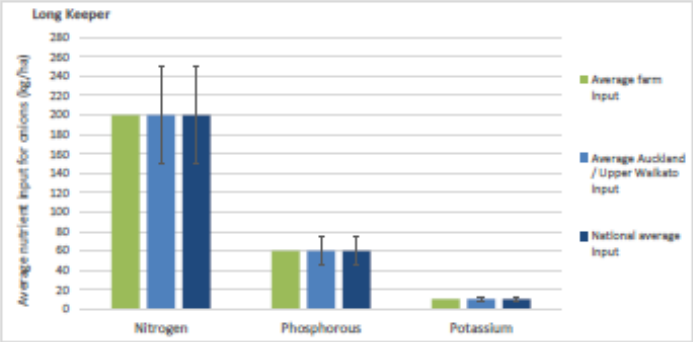
Closest weather station	Pukekohe
Estimated nitrogen drainage and runoff (kg/ha) during crop growth period (September 2018 - May 2019) (at 15mg/L N concentration in drainage water)*	9
Estimated risk of nitrogen runoff and drainage (kg/ha) based on nutrient input above crop requirements	45

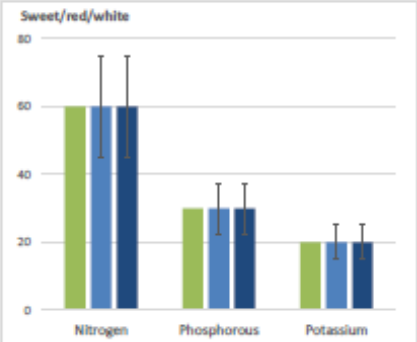
Your nutrient input is higher than guideline values even when drainage is accounted for.





3 National benchmarks





Prepared by:
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The AgriBusiness Group
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Version: Nutrient metrics report - Onions(ab2) [redacted]

APPENDIX G: ENVIRONMENT CANTERBURY APPROVAL OF NZGAP EMS

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

ISO ACCREDITED AUDIT PROGRAMME APPROVAL

NZGAP

is approved as an ISO Accredited Audit Programme under the Canterbury Land & Water Regional Plan

Certification valid from: 1 April 2019 To: 1 April 2022

Date 11 April 2019

Bill Bayfield
Chief Executive

APPENDIX H: DETAILED REVISION OF THE PLAN CHANGE PROVISIONS IN SCHEDULE 30

Note: s42A report recommended changes are in black. HortNZ proposed changes in green.

Schedule 30: ~~Landowner~~ Catchment Collective, Industry Programme and Freshwater Farm ~~Environment~~ Plan

The TANK Plan provides for an **Industry Programme** ~~**Group**~~ or a **Catchment Collective** to work ~~collectively on behalf of~~ with their members to meet local water quality and environmental objectives, through **Freshwater Farm Plans**.

Alternatively, landowners may also prepare an individual **Freshwater Farm** ~~**Environment**~~ **Plan.** This schedule sets out the requirements for:

a) Freshwater Farm Plan content requirements.
b) Tthe establishment of a ~~TANK Industry Group or~~ TANK Catchment Collective, their operation and the preparation of their environment plan in order for them to be approved by the Hawke's Bay Regional Council.

~~(c) It also sets out the requirements for Freshwater Farm Environment Plans.~~

c) Individual Freshwater Farm Plans
d) Industry Programmes
e) Auditing

~~**Heretaunga Plains Water Management Unit**~~

~~In the Heretaunga Plains Water Management Unit, requirements for stream flow enhancement will be imposed through conditions of a water permit. Management of a stream flow enhancement scheme is not required to be done by water permit holders acting collectively, however, an Environmental Management Plan can address collective management of any flow enhancement scheme and also address water quality issues according to Sections A and B at the same time.~~

~~**Industry Groups and Catchment Collectives**~~

~~A TANK Industry Group or a TANK Catchment Collective must meet the requirements set out in Section A below.~~ ~~**Industry Programme or Catchment Collective Programme**~~

~~Each TANK Industry or TANK Catchment Collective must prepare an **Industry Programme** or **Catchment Collective Programme** that meets the requirements set out in Section B below. This programme The Freshwater Plans and Industry Programmes must identify the key water quality and water quantity management issues identified in this Plan that are relevant to;~~

~~• The catchment(s)~~

~~1. the modelled or measured water quality as indicated in Schedule 26, 28 or the Council's SOE reports, or local water quality measured using comparable water quality monitoring methods in the applicable catchment(s)~~
~~2. other water quality monitoring may be used as a guide to measure progress towards water quality targets.~~
~~3. the nature of the land and water use activities carried out within that catchment~~
4. ~~the scale of the effects on water quality or water quantity from the land and water use activities in that catchment. The Programme will describe an environmental management strategy relevant to the freshwater water management objectives where the member properties are located. An Industry Programme can be based on existing good agricultural practice industry [52] programmes, and will in addition need to address local water quality and quantity issues.~~

~~A summary of the Programme objectives and outputs will be made publicly available through the Council website.~~

~~Any TANK Freshwater Farm Plan Programme prepared in accordance with Schedule 30 may include or contribute to other initiatives or objectives (such as in relation to farm production, pest control, biodiversity or other land management issue) as desired by the Catchment Collective or Industry Programme. These aspects are not subject to the Council's approval, but may be a means of enabling integrated land and water management for a wider range of management objectives.~~

~~**Catchment Collectives**~~

Suggested change to more closely align with how industry programmes (refer to Evidence of Dr Farrelly) and catchment collectives work to deliver outcomes.

Amendments are sought to reflect changes that are sought to the structure of Schedule 30 (refer to Evidence of Dr Farrelly)

As set out in the evidence of Dr Farrelly, HortNZ seeks that the content of Schedule 30 be re-order. The green strike out content has been re-positioned in proposed Section A.

~~A TANK Catchment Collective must meet the requirements set out below.~~

~~Farm Environment Plan~~

~~The requirements of the Farm Environment Plan are set out in Section C below.~~

~~Programme Requirements~~

[52]~~This refers to existing industry programmes such as Hort NZ GAP, Sustainable Winegrowing, Fonterra Clean Stream etc.~~

.

[NEW] Section A: Freshwater Farm Plan content requirements

~~The~~ Freshwater Farm Plans ~~and Industry Programmes~~ must identify the key water quality and water quantity management issues identified in this Plan that are relevant to;

- ~~The catchment(s)~~

1. the modelled or measured water quality as indicated in Schedule 26, 28 or the Council's SOE reports, or local water quality measured using comparable water quality monitoring methods in the applicable river catchment or sub-catchment(s)
2. other water quality monitoring may be used as a guide to measure progress towards water quality targets.
3. the nature of the land and water use activities carried out within that river catchment or sub- catchment
4. the scale of the effects on water quality or water quantity from the land and water use activities in that river catchment or sub-catchment

1. Requirements for Freshwater Farm Plans

1.1 A Farm Environment Plan must;

a) ~~be submitted to the Council to ensure it complies with the requirements of this Schedule and Schedule 28.~~

b) contain the following information;

(i) physical address;

(ii) details about ownership and property managers including contact details for the person responsible for the implementation of the Plan.

c) be accompanied by maps or aerial photograph at a scale to clearly show;

(i) property boundaries;

(ii) locations or activities likely to result in contaminant loss or at risk from contaminant loss including;

i. areas at risk of sediment loss;

ii. the location of drains (including subsurface drains), streams, rivers, wetlands and other water bodies;

iii. the location of any Source Protection Zone or Extent for any Registered Drinking Water Supply that any properties ~~in the programme area~~ are located in, plus the contact details of the water supply manager (*Note Maps included with this plan show the locations of the SPZs and Extents for any Registered Drinking Water Supplies. Contact information for the supply manager is available on the Council website.*

iv. activities at particular risk of nutrient loss;

v. contaminant discharge activities.

d) ~~meet the requirements of Clauses 2 and 4 in Section AB of this Schedule as applicable for the property, its location and the land use activities being carried out~~.

2. Environmental Outcomes

2.1 The Plan must include statements about the;

a) specified water quality outcomes in Schedule 26 of this Plan relevant to the location of the property (or for Catchment Collectives, Members' properties)

b) measures or practices needed to minimise and mitigating the cumulative environmental effects of land use that will enable the specified water quality objectives to be met.

c) timeframes for when each of the actions or mitigations at a property or river catchment or sub-catchment scale are to be implemented and which are consistent with ~~meeting the timeframes specified for relevant water quality objectives and~~ milestones specified in ~~the~~ TANK Pol 27. ~~Plan~~

2.2 The Plan must address where appropriate;

d) managing contaminant losses (especially sediment, nutrients and bacteria) to waterways including efficient use of nutrients and good management practice

HortNZ seek that Schedule 30 is restructured so all FEP content requirements (common to all three pathways of delivery) are in one place and consistent for plan users.

Note: In proposed Section A, Black text has been re-ordered from elsewhere in the schedule – new content/changes proposed are in green.

This is a process requirement that is not required to be stated here.

This cross-referencing is no longer required in a restructured schedule – as the content has been moved into the relevant section.

including when carrying out land disturbance activities and ~~especially~~ in relation to management of critical contaminant source areas.

e) where water quality does not meet standards in Schedule 26, identifying how there will be reductions in losses that contribute to meeting the specified water quality including, where appropriate, reference to;
   (i) in relation to industry specified benchmarks or good practice for nitrogen and phosphorus management ~~loss;~~
   (ii) LUC (Land Use Capability) and soil type;
   (iii) Olsen P levels in soil;
   (iv) Stock management including rates and densities of different classes of stock;
   (v) Application of fertilisers;
   (vi) Application of collected animal effluent;
   (vii) Cultivation, soil disturbance or vegetation clearance activities

f) Management of riparian margins and hillslope erosion , including to meet the outcomes specified in TANK Pol 11 and maintaining or improving the physical and biological condition of soils in a manner consistent with TANK Pol 20 and RRMP Rule 7 in order to avoid, remedy or mitigate problems arising from;
   (i) Loss of topsoil by wind or water erosion;
   (ii) Movement of soils and contaminants into waterways;
   (iii) Damage to soil structure and health;
   (iv) Mass movements of soil;

Change recommended in Catherine Sturgeons evidence

g) wetland management including to meet the outcomes specified in TANK Pol 14 and 15;

h) management of animal effluent to avoid contamination of ground and surface waters;

i) measures required to reduce risk of contamination of the source water for any Registered Drinking Water Supply;

j) management of stock, including in relation to river or stream crossings and exclusion from waterways in a manner that complies with the Resource Management (Stock Exclusion) Regulations (2020)~~is consistent with Policy 22 and Rules TANK 1 or 3;~~

k) **in the Karamū and ~~Lake~~ Poukawa Catchments ;** the identification of opportunities to provide shading of the adjacent waterway or improvements to riparian margin values as specified in TANK Pol 2 and 11.

2.3 The Plan must include measures to address **Nutrient Management** in any catchment ~~or programme area~~ where water quality objectives for nitrogen concentrations as detailed in Schedule 26 are not being met, including;

a) development of an inventory of the current average annual nitrogen loss rate (kg/ha/year) for every property, or full crop rotation as determined by application of Overseer (or an alternative nutrient budget model approved by the Hawke's Bay Regional Council) and a target nitrogen loss rate that demonstrates industry good practice ~~by a suitably qualified independent practitioner~~;

Change recommended in Stuart Ford's evidence

b) a description of any mitigation measures identified as necessary to meet water quality objectives on those properties or within the relevant river catchment or sub-catchment;

Terminology change, as per Catherine Sturgeon's evidence.

c) annual recording and reporting of nutrient input and export data, including annual **nitrogen budgets**, which may be at the property or crop level.

A Freshwater Farm Plan may be prepared on through a Catchment Collective (that meets the requirements in Section B below), on an individual basis (Section C) or through an Industry Programme (that is recognised through the process in Section D).

Change recommended in Stuart Ford's evidence

Any TANK Freshwater Farm Plan ~~Programme~~ prepared in accordance with this ~~S~~schedule ~~30~~ may include or contribute to other initiatives or objectives (such as in relation to farm production, pest control, biodiversity or other land management issue) as desired by the Catchment Collective or Industry Programme. These aspects are not subject to the Council's approval, but may be a means of enabling integrated land and water management for a wider range of management objectives.

Clarification that a Freshwater Farm Plan can be delivered by various means (the specific requirements of which are then set out in subsequent sections). Correction of terminology

Section ~~A~~B: ~~Industry Groups and~~ Catchment Collectives ~~Governance and Management~~

The s42A author accepts submission point seeking industry programmes are split out, but reference in hearing remains

A TANK Catchment Collective must meet the requirements set out below.

< moved from above. Intent of this section.

1. Governance and Management

Applications for approval of a catchment collective shall be lodged with the Hawke's Bay Regional Council, and shall include information that demonstrates how the following requirements are met. The Hawke's Bay Regional Council may request further information or clarification on the application as it sees fit.

Approval will be at the discretion of the Chief Executive of the Hawke's Bay Regional Council subject to the Chief Executive being satisfied that the scheme will meet the standards set out below.

This content is proposed to be duplicated from the industry programmes – we consider it also relevant to Catchment Collectives, for additional clarity/rigour.

1.1 Each Catchment Collective ~~or Industry Group must undertake to carry out the requirements of Sections A and B and must specify in writing the manner in which it will carry this out. This~~ must address the following ~~: Details relating to the~~ governance and management arrangements of the ~~Programme~~ Catchment Collective including**:**

a) How decisions are to be made and how the requirements of Section B will be carried out including obligations by members to carry out the property specific requirements

b) Conditions of membership of the ~~Programme~~ Catchment Collective by individual land managers (the 'Members' who commit to the Catchment Collective ~~Programme~~), including the circumstances and terms of membership, sanctions or removal from the Collective ~~or Industry Programme~~ including in relation to unreasonable non-performance of actions identified in clause 2 below.

c) The process for assessing performance at an individual property level compared to agreed actions at the river catchment or sub- catchment scale.

Note 1: the Catchment Collective ~~or Industry Programme~~ may prepare its own terms of reference as well as manage their own decision making processes and administration. This may include appointing a spokesperson or secretary to ensure recording and reporting work is completed as necessary. ~~Note 2:~~ If a membership is lapsed, refused or discontinued, the Council will require the landowner to comply with ~~r~~Rule TANK 1.

1.2 Information and management systems and processes to ensure:

a) Competent and consistent performance in meeting the requirements of this s~~S~~chedule

b) Robust data management, including up-to-date registers of ~~Programme~~ Catchment Collective Members

c) Timely provision of suitable quality data and information required under the following clauses to Hawke's Bay Regional Council

d) Conditions of membership of the Catchment Collective ~~Programme~~ by individual land managers (the 'Members') who commit to the Catchment Collective ~~Programme~~ including provision of information to enable reporting requirements to be met.

Correction required to refer to Catchment Collective (legacy reference to Programme)

1.3 A description of the Catchment Collective ~~Programme~~ area including:

a) locations and maps,

b) land uses,

c) locations of ;

(i) drains (including subsurface drains), streams, rivers, wetlands and other water bodies,

(ii) any Source Protection Zone or Extent for any Registered Drinking Water Supply that any properties in the programme area are located in, plus the contact details of the water supply manager (Note – Maps included with this plan show the locations of the SPZs and Extent for any Registered

Drinking Water Supplies. Contact information for the supply manager is available on the Council website),

d) activities at particular risk of nutrient loss,
e) property boundaries,
f) up-to-date details about ownership and property managers,
g) up-to-date contact details of individual land managers and landowners within the Catchment Collective ~~Programme~~ (the 'Members').

~~Section B:~~ Catchment Collective Freshwater Plan Requirements

A Catchment Collective must prepare a Freshwater Environment Plan that meets the requirements of Section A.

HortNZ seeks that all farm plan requirements (which are common across the three delivery pathways)

~~This section sets out the requirements for the Freshwater environment pPlan for each Catchment Collective or Industry Programme~~

~~The Programme summary report will be made publicly available through the Council website.~~

This content has been moved to a common Freshwater Farm Plan requirement section.

~~**2. Environmental Outcomes**~~

~~2.1 The Plan must include statements about the;~~

~~i. specified water quality outcomes in Schedule 26 of this Plan relevant to the location of Members' properties~~

~~ii. measures or practices needed to minimise and mitigating the cumulative environmental effects of land use that will enable the specified water quality objectives to be met.~~

~~2.2 timeframes for when each of the actions or mitigations at a property or catchment scale are to be implemented and which are consistent with meeting the timeframes specified for relevant water quality objectives and milestones specified in the TANK Pol 27. PlanThe Plan must address where appropriate;~~

~~iii. managing contaminant losses (especially sediment, nutrients and bacteria) to waterways including efficient use of nutrients and good management practice including when carrying out land disturbance activities and especially in relation to management of critical contaminant source areas.~~

~~iv. where water quality does not meet standards in Schedule 26, identifying how there will be reductions in losses that contribute to meeting the specified water quality including, where appropriate, reference to;~~

~~1. in relation to industry specified benchmarks or good practice for nitrogen and phosphorus management loss;~~
~~2. LUC (Land Use Capability) and soil type;~~
~~3. Olsen P levels in soil;~~
~~4. Stock management including rates and densities of different classes of stock;~~
~~5. Application of fertilisers;~~
~~6. Application of collected animal effluent;~~
~~7. Cultivation, soil disturbance or vegetation clearance activities~~

~~v. Management of riparian margins, including to meet the outcomes specified in TANK Pol 11 and maintaining or improving the physical and biological condition of soils in a manner consistent with TANK Pol 20 and RRMP Rule 7 in order to avoid, remedy or mitigate problems arising from;~~

~~1. Loss of topsoil by wind or water erosion;~~
~~2. Movement of soils and contaminants into waterways;~~
~~3. Damage to soil structure and health;~~
~~4. Mass movements of soil;~~

~~vi. wetland management including to meet the outcomes specified in~~

TANK Pol 14 and 15;

vii. management of animal effluent to avoid contamination of ground and surface waters;

viii. measures required to reduce risk of contamination of the source water for any Registered Drinking Water Supply;

ix. management of stock, including in relation to river or stream crossings and exclusion from waterways in a manner that complies with the Resource Management (Stock Exclusion) Regulations (2020)is consistent with Policy 22 and Rules TANK 1 or 3;

x. **in the Karamū and Lake Poukawa Catchments ;** the identification of opportunities to provide shading of the adjacent waterway or improvements to riparian margin values as specified in TANK Pol 2 and 11.

2.3 The Plan must include measures to address **Nutrient Management** in any catchment or programme area where water quality objectives for nitrogen concentrations as detailed in Schedule 26 are not being met, including;

xi. development of an inventory of the current nitrogen loss rate (kg/ha/year) for every property as determined by application of Overseer (or an alternative nutrient budget model approved by the Hawke's Bay Regional Council) and a target nitrogen loss rate that demonstrates industry good practice by a suitably qualified independent practitioner;

xii. a description of any mitigation measures identified as necessary to meet water quality objectives on those properties or within the relevant catchment;

xiii. annual recording and reporting of nutrient input and export data, including annual nitrogen loss rates.

2.4 A Catchment Collective member may adopt or integrate a plan or documentation developed as part of an Industry Good Agricultural Practice programme, provided that the Plan or documentation is consistent with the requirements of the Catchment Collective Programme

3. Approval

a. The Catchment Collective Freshwater Pplan or Industry Programme will be submitted for approval by the HBRC no later than by the end of the relevant year specified for that sub-catchment in Schedule 28. In making decisions to approve the Plan rogramme the Council will take into account;

i. whether the requirements of this Schedule are met;

ii. whether the programme is consistent with the policies, water quality objectives and milestones that are relevant for that Catchment Collective or Industry Programme

iii. whether the Plan rogramme was appropriately informed by person(s) with the necessary professional qualifications knowledge to make assessments about the contaminant loss risk and mitigation measures

iv. whether the governance and management systems are in place to enable the implementation of the Plan programme

b. Where approval is not given, it means the requirements of Rule TANK 1 are not able to be met and land use is therefore subject to either Rule TANK 1 (b)2 or Rule TANK 2.

4. Information Requirements

a. The Catchment Collective or Industry programme must prepare a statement of the data and information that will be collected in order to monitor implementation and report to Council.

b. Information will be required where appropriate about:

i. changes to programme area and membership;

ii. nature and significance of any land use change in accordance with TANK Pol 22~~1~~ and Rule TANK 5 ~~or 6~~ and based on land uses at 2 May 2020.

iii. the results of any environmental monitoring carried out by the Catchment Collective ~~or Industry Programme~~;

iv. the mitigation measures or practices carried out to reduce contaminant loss (consistent with what is industry ~~agreed~~ good management practice) that will be adopted by the property owners or managers and as detailed in clause A1.1;

v. data, which may be aggregated across a river catchment or sub-catchment, about nitrogen loss in A 1.3 a and any changes in losses in respect of clause 1.3. c

This was highlighted in s42A version - land use change outside of the catchment collective is not relevant to report on. POL 22 has been deleted.

5. Reporting and Review

5.1 A summary report on the implementation of the Freshwater Plan ~~Programme~~ shall be submitted annually to the Hawke's Bay Regional Council or less frequently as determined by Council if all agreed mitigations have been completed, water quality objectives are being met and there is no land use change exceeding the thresholds in TANK 5 in ~~10ha of~~ the Catchment Collective ~~programme~~ area (unless a resource consent has been sought for that land use change).

5.2 The report will be supplied in the format specified by Council.

5.3 The report will include;

a) information collected under section 4;

b) any amendments to the programmed mitigation measures plus any changes made to them and reasons for them (including any adverse events such as severe weather, earthquakes etc);

c) issues or matters that require input or direction from the Council, including the management of activities outside the Catchment Collective which may be adversely affecting the achievement of the of Catchment Collective ~~programme~~ objectives, including identification of additional information/support from HBRC that would assist in the achievement of the objectives of the Catchment Collective ~~programme~~.

5.4 Every 5 years the annual report shall provide information about;

a) adoption of any new mitigation or good practice measures identified by the Catchment Collective ~~industry;~~

b) identification of opportunities for improvements to the Catchment Collective ~~programme~~ including, where necessary, amending performance standards, and in relation to nutrient management in clause 2.3.

As above – correction of consistent reference to Catchment Collective.

Consequential change.

The Catchment Collective~~Programme~~ summary report will be made publicly available through the Council website.

6 Auditing

6.1 Auditing will be carried out as described in Section ~~D~~E.

Section ~~B~~C: Individual Freshwater Farm Plans

If a property is not subject to a TANK Catchment Collective ~~prepared under~~ (Section A~~B~~B) or a TANK Industry Programme (Section D) ~~prepared under Schedule D~~C ~~of this Schedule~~ a Freshwater Farm ~~Environment~~ Plan must be prepared in accordance with Section A~~B~~C and must be submitted to the Council to ensure it complies with the requirements of this Schedule and Schedule 28.

HortNZ seek changes consistent with a restructure of Schedule 30; this would clarify the requirements specific for individuals.

~~Section C: **Freshwater Farm Plan Requirements**~~

~~**1. Requirements for Freshwater Farm Plans**~~

Freshwater Farm Plan content has been consolidated in one section in HortNZ's proposed restructure. This section can cover off specific requirements for individuals, with regard to reporting, review and audit.

~~1.1 A Farm Environment Plan must;~~

~~) be submitted to the Council to ensure it complies with the requirements of this Schedule and Schedule 28.~~

~~a) contain the following information;~~

~~(i) physical address;~~

~~(ii) details about ownership and property managers including contact details for the person responsible for the implementation of the Plan.~~

~~b) be accompanied by maps or aerial photograph at a scale to clearly show;~~

~~(i) property boundaries;~~

~~(ii) locations or activities likely to result in contaminant loss or at risk from contaminant loss including;~~

~~i. areas at risk of sediment loss;~~

~~ii. the location of drains (including subsurface drains), streams, rivers, wetlands and other water bodies;~~

~~*iii.* the location of any Source Protection Zone or Extent for any Registered Drinking Water Supply that any properties in the programme area are located in, plus the contact details of the water supply manager (*Note Maps included with this plan show the locations of the SPZs and Extents for any Registered Drinking Water Supplies. Contact information for the supply manager is available on the Council website.*~~

~~iv. activities at particular risk of nutrient loss;~~

~~v. contaminant discharge activities.~~

~~c) meet the requirements of Clauses 2 and 4 in Section A~~B ~~of this Schedule as applicable for the property, its location and the land use activities being carried out.~~

2. Reporting and Review

2.1 The Freshwater Farm ~~Environment~~ Plan will be submitted to the HBRC no later than by the end of the relevant year specified in Schedule 28 for the sub-catchment(s) the property is located in.

2.2 Where annual reporting is required under Section A 2.3, the report will be in the format specified by Council.

The content in 'Reporting and Review' appear to be irrelevant to an individual preparing a Freshwater Farm Plan, or at least it is unclear what 'report' is being referred to

2.3 The report will include:

a) information collected under Clause 4 of Section A~~B~~

b) any amendments to the programmed mitigation measures plus any changes made to them and reasons for them (including any adverse events such as severe weather, earthquakes etc)

2.4 Every 5 years the annual report shall provide information about;

a) adoption of any new mitigation or good practice measures identified by industry,

b) identification of opportunities for improvements in relation to nutrient management in clause ~~2.3~~ 1.3 of Section A~~B~~.

3. Auditing

3.1 Auditing will be carried out as described in Section ~~D~~E.

Section ~~C~~D: Industry Programmes

The purpose of this schedule is to set out the minimum standards for Industry Programmes. Industry programmes can assist with the individual and collective farm plans

Applications for approval of an Industry Programme shall be lodged with the Hawke's Bay Regional Council, and shall include information that demonstrates how the following requirements are met. The Hawke's Bay Regional Council may request further information or clarification on the application as it sees fit.

Approval will be at the discretion of the Chief Executive of the Hawke's Bay Regional Council subject to the Chief Executive being satisfied that the scheme will meet the standards set out below.

HortNZ support the s42A accepting the submission to provide for industry programmes separately.

1. Governance and management

1.1 Industry Programmes must include:

a) A description of the governance arrangements of the programme

b) The contractual arrangements between the programme and its members;

c) A description of the process for gaining and ceasing membership;

d) A description of the programme area, including

(i) land uses,

(ii) key environmental issues and measures to address them,

(iii) property boundaries and

(iv) ownership details of members' properties;

e) A procedure for keeping records including up-to-date registers of programme members and provision of data to the HBRC

f) Details including procedures agreed with the HBRC about how requirements of this Section are to be met.

2. Preparation of Freshwater Farm Plans

Amendment to reflect nature of GAP schemes, as discussed in the evidence of Dr. Farrelly

2.1 Industry Programmes must include:

a) A statement of the programme's capability and capacity to deliver certified ~~for preparing and certifying that~~ Freshwater Farm Plans meet the requirements of this Schedule, including;

(i) The requirements of Section A~~2~~ of this Schedule

~~(ii) The qualifications and experience of any personnel employed by or otherwise contracted to the programme to prepare or certify Freshwater Farm Plans;~~

(iii) The process for certification of FW-FPs

3. Implementation of Freshwater Farm Plans

3.1 Industry Programmes must include:

a) A statement of the programme's capability and capacity for monitoring and assessing the implementation of Freshwater Farm Plans, including the qualifications and experience of any personnel employed by or otherwise contracted to the programme to monitor or assess

implementation of Freshwater Farm Plans;

b) A description of the expectations and agreements around landowner and property record-keeping;

c) A strategy for identifying and managing poor performance in implementing Freshwater Farm Plans.

The audit frequency is set out in the industry programmes – which is approved by Council.

4. Audit

4.1 Industry Programmes must include a description of an ~~annual~~ audit process to be conducted by an independent body, including:

a) A process for assessing the accreditation ~~performance~~ of the programme and any personnel employed by or otherwise contracted to the scheme to prepare, certify, and audit the implementation of Farm Environment Plans;

b) A process for auditing FW-FPs

c) A statement of how audit results of collective or individual audit FW-FP results will be shared with the programme's members and the wider community;

d) A summary audit report must be submitted to the Hawke's Bay Regional Council annually

Section ~~D~~E Auditing and Reporting

1. The HBRC will;

   a) Publicly report on the implementation of requirements for TANK Freshwater Farm Plans (including ~~and~~ Catchment Collective Plans and Industry Programme Plans);

   b) Undertake audits of TANK ~~Industry or Catchment Collective Programmes~~ Freshwater Farm Plans (who are not part of an Industry Programme) including on member properties in relation to ~~individual and programme~~ implementation of planned actions~~rogrammed works~~, adoption of identified good management practices, and ~~including~~ nutrient management budgets where required.

~~*Note 2: that if the conditions of any applicable RRMP Rule 7 for specified activities are not being complied with by a landowner or manager, there must be information as outlined in section B2 above of the Catchment Collective or Industry Programme to show how the relevant contaminant loss risks are to be managed to a similar level of performance.*~~

2. ~~The HBRC will;~~

   a) ~~Publicly report on the implementation of TANK Freshwater Farm Environment Plan requirements~~

   b) ~~Undertake audits of properties in relation the Freshwater Farm Environment Plan implementation of programmed works, adoption of identified good management practices, including nutrient management budgets where required~~.

Duplication of 1(b)

APPENDIX I: TANK CASE STUDY 1: INDUSTRY PROGRAMME FRESHWATER FARM PLAN (NZGAP EMS ADD-ON)

Horticulture's Good Agricultural Practice Industry Programme

Freshwater Farm Plan Summary

Business name:

Case Study 1

Year:
2020

Assurance Programme:
GLOBALG.A.P.

Farm planning module:
NZGAP Environment Management System (EMS) add-on v1.6

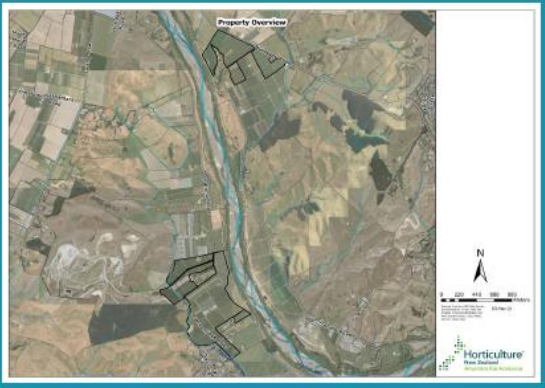
GLOBALG.A.P. number:
12345

Audit result:
Compliant

Certification status:
Certified
(Expires 15/09/2021)

Orchard information

Growing region(s)	**Hawkes Bay**
Orchard area (total)	**81ha**
Orchard area (production)	**81ha**
% leased versus owned land for production	**46% owned 54% leased**
List crops currently grown	**Apples**
List other land uses and area, e.g. arable, dairy, dry stock	**None**



TANK Proposed Plan Change 9 rule

Rule TANK 1 Use of Production Land

The use of production farm land where:	Measures in place to meet rule?	What measures are in place to meet rule?
(a) 20 or more hectares of the farm is arable land use	n/a	
(b) 5 or more hectares of the farm is horticultural land use	n/a	
(c) 20 or more hectares of the farm is pastoral land use	n/a	
(d) 20 or more hectares of the farm is a combination of any 2 or more of the land uses	✓	FW-FP developed via NZGAP EMS add-on

Environmental action plan

Ref.	Management area and risk addressed (e.g. soil erosion)	Action to be completed	Location	Person responsible	Expected Date of Completion	Actual Date of Completion	Evidence to be Provided (e.g. records, photo)
8B.2	Develop long-term irrigation plan.	Document irrigation practices and long-term irrigation management in a written plan.	Sample Rd, Home block	Orchard Manager	December 2021		Copy of management plan on file.

Contents

CASE STUDY BACKGROUND INFORMATION

Regulation and resource consents

Applicable regulation and existing resource consents

Hawke's Bay Regional Council
Proposed TANK Plan Change 9 ***(as written in amended PPC9 that accompanied the s42a report as Appendix 1A**, not the notified version of PPC9**)***

Rule TANK 1 Use of Production Land (Permitted Activity),
The use of a farm where:
(a) 20 or more hectares of the farm is arable land use; or
(b) 5 or more hectares of the farm is horticultural land use; or
(c) 20 or more hectares of the farm is pastoral land use; or
(d) 20 or more hectares of the farm is a combination of any 2 or more of the land uses described above.

Permitted Activity Standards

- (a) The farm area has less than 75% plantation forest cover,
- (b) Either;
  - (i) The farm operator is either a member of a TANK Industry Programme or a member of a TANK Catchment Collective within the timeframes specified in Schedule 28 and accordance with the requirements of Schedule 30;
  - (ii) The farm operator shall prepare a Freshwater Farm Plan in accordance with the requirements of Schedule 30 and within the timeframes specified in Schedule 28; and the Freshwater Farm Plan is being implemented and;
    1. the Council shall be provided with the Freshwater Farm Plan upon request;
    2. information about the implementation of the mitigation measures identified for the farm shall be supplied to the Council on request.
- (c) Where a farm is in a high priority catchment for total nitrogen concentration or nitrogen yield as shown on the Planning Maps for Schedule 28 the freshwater farm plan shall include in accordance with Schedule 30 the
  - (i) The nitrogen loss rate (kg/ha/hr) and
  - (ii) Nitrogen loss rate target.

Orchard description

Orchard information

Growing region(s)	Hawke's Bay
Orchard area (total) in hectares	85 hectares
Orchard area (production) in hectares	80.5 hectares
% leased versus owned land for production	46% owned, 54% leased
List crops currently grown	Fruit
List other land uses and area, e.g. arable, dairy, dry stock.	None
Orchard description	See below

TANK Case Study 1 is a fruit orchard with approximately 85 ha of trees spread over seven blocks alongside the Tutaekuri river in Hawke's Bay. All blocks are in the Tutaekuri Corridor Water Management Catchment.

The Tutaekuri river running along the eastern boundary of the property and the western boundary of Parenga, and the Opokohino stream running along the western boundary of the property have been identified slightly downstream from the orchards as a fish spawning habitat for Rainbow Trout (Oncorhynchus mykiss).

The property has a low risk of environmental impact due to the absence of animals, long term tree cover, infrequent cultivation, targeted fertiliser use based on soil tests, targeted irrigation based on soil moisture monitoring and the flat topography.

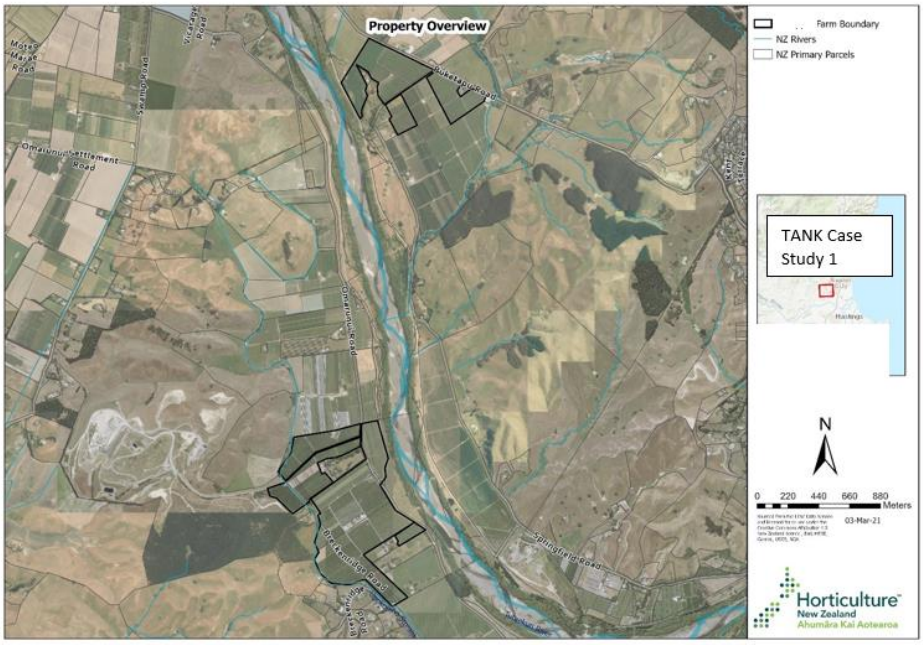


Figure 1: Overview map of TANK Case Study 1 enterprise.

Catchment assessment

The catchment assessment considers the catchment context of the activity based on the nature of the farming activity and the suitability of that activity to the land, and the current water quality status in the receiving environment(s).

Catchment and surrounding information

Catchment(s):	Tūtaekurī River
Nearest downstream water quality monitoring site(s):	Tūtaekurī at Brookfields Bridge At the Brookfields Bridge the Tūtaekurī River valley has widened and flattened, and the river has taken a more semi-braided morphology. The Tūtaekurī catchment supports a regionally significant brown and rainbow trout fishery. The Tūtaekurī catchment also supports significant ecological values associate with the aquatic and riparian ecosystems and significant habitats of indigenous fauna and flora. (Source: LAWA website)

Screening measures and farm plan information

Activity and land use capability	
Current farming activity: Land use capability class(es):	Horticulture – established commercial fruit orchard. LUC 1,2 and 3 (see Maps in following Section FWFP Evidence)
Receiving water quality status	
PPC9 Schedule 28 Planning Maps 1-4 ***(As they appear in Appendix 2 of the s42a report)***	The property is located in a priority catchment for: Sediment yield: High priority Total nitrogen yield: High priority Nitrate yield: High priority *(Note comments of Ms Sturgeon on 'Amendments to Planning Maps')*

Screening assessment and outcome

Suitability of activity for land use	
Outcome:	95% of land used for fruit orchard production in LUC 1-4. Land use deemed suitable for commercial horticulture.
Receiving water quality status relating to management regime	
See environmental vulnerability assessment on the following page.	

Environmental vulnerability assessment

To determine the level of ambition in their FWFP, growers must assess the overall risk of their activity to freshwater and freshwater ecosystems based on the level of vulnerability of their receiving environment, and the magnitude of their discharge(s).

The **level of vulnerability** of the receiving environment is the degree to which the system is susceptible to, or unable to cope with, adverse effects of farming activities. The level of vulnerability in this FWFP is based on the TANK Priority Catchments in Schedule 28 (*of Appendix 2 of the s42a report*) in the screening assessment above.

The **magnitude of the discharge** from farming activities on the receiving environment(s) is determined through the FWFP farm scale risk assessment (see detailed farm plan in Section 3).

Risk = Magnitude * Vulnerability

	Catchment Vulnerability		
Magnitude of Discharge	Low	Medium	High
Low	**GMP**	**GMP**	**GMP**
Medium	**GMP**	**BMP**	**BMP**
High	**BMP**	**BMP**	**BMP**

Growers can set the level of ambition in their farm plan for each management area based on this assessment.

The table on the following page steps through this process for the case study farm.

Risk / management information	Catchment Vulnerability	Discharge Magnitude	RISK Outcome
Erosion and sediment control			
There is no cultivated or bare soil at any time of the year. There is no erosion prone land on the property.	Activity situated in high priority catchment for sediment. Catchment is assessed as **HIGH vulnerability**	Erosion and soil loss is assessed as **LOW Magnitude**	**Medium risk MAINTAIN at GMP**, as per FWFP
Nutrient management			
Low leaching activity managed with GMP and BMP.	Activity situated in high priority catchment for Total Nitrogen and Nitrate. Catchment is assessed as **HIGH vulnerability**	Nutrient loss is assessed as **LOW magnitude**	**Medium risk MAINTAIN at BMP**, as per FWFP
Irrigation and water use management			
Irrigation and rainfall monitoring. Targeted irrigation (volume, timing) based on soil moisture monitoring and soil type. Need documented irrigation management plan.	Flow Regime is unassessed, treat as **HIGH vulnerability**	Irrigation loss is assessed as **MEDIUM Magnitude**	**Medium Risk IMPROVE to BMP**, and document in Action Plan

Nutrient Management

PCC9 Schedule 30, Environmental Outcome 2.3[11] states:

The Freshwater Farm Plan must include measures to address Nutrient Management in any catchment or programme area where water quality objectives for nitrogen concentrations as detailed in Schedule 26 are not being met, including:

a) *development of an inventory of the current nitrogen loss rate (kg/ha/year) for every property as determined by application of Overseer (or an alternative nutrient budget model approved by the Hawke's Bay Regional Council) and a target nitrogen loss rate that demonstrates industry good practice by a suitably qualified independent practitioner;*
b) *a description of any mitigation measures identified as necessary to meet water quality objectives on those properties or within the relevant catchment; c) annual recording and reporting of nutrient input and export data, including annual nitrogen loss rates.*

Fertiliser recommendations at Case Study 1 farm are made by expert advisors at Fruitfed on the basis of crop requirements and soil and foliage tests. Testing is undertaken every three years, or as required during block development. To manage nitrogen loss from this property, the following actions will be undertaken:

Objective	Action	Measure
Nutrient management	Maintain fertiliser and cropping at a level that achieves the N limit	Overseer FM nutrient budget
Nutrient management	Apply fertiliser on the basis of expert recommendations, informed by crop requirements, soil and foliage tests	Soil and foliage tests

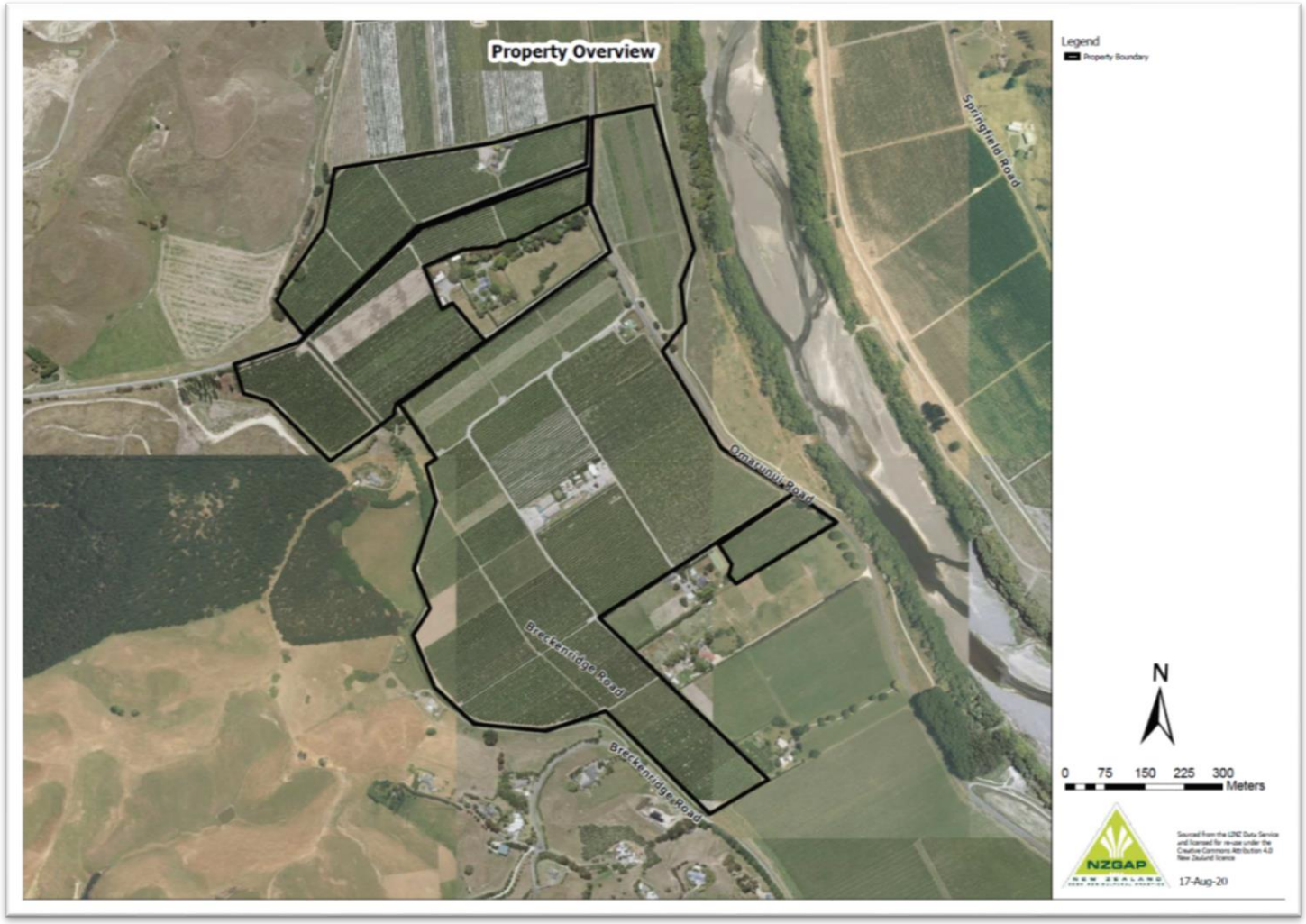
TANK Case Study 1 have modelled nitrogen losses from this property using OverseerFM. The following "FWFP Evidence (NZGAP EMS Add-on)" section contains modelled outputs.

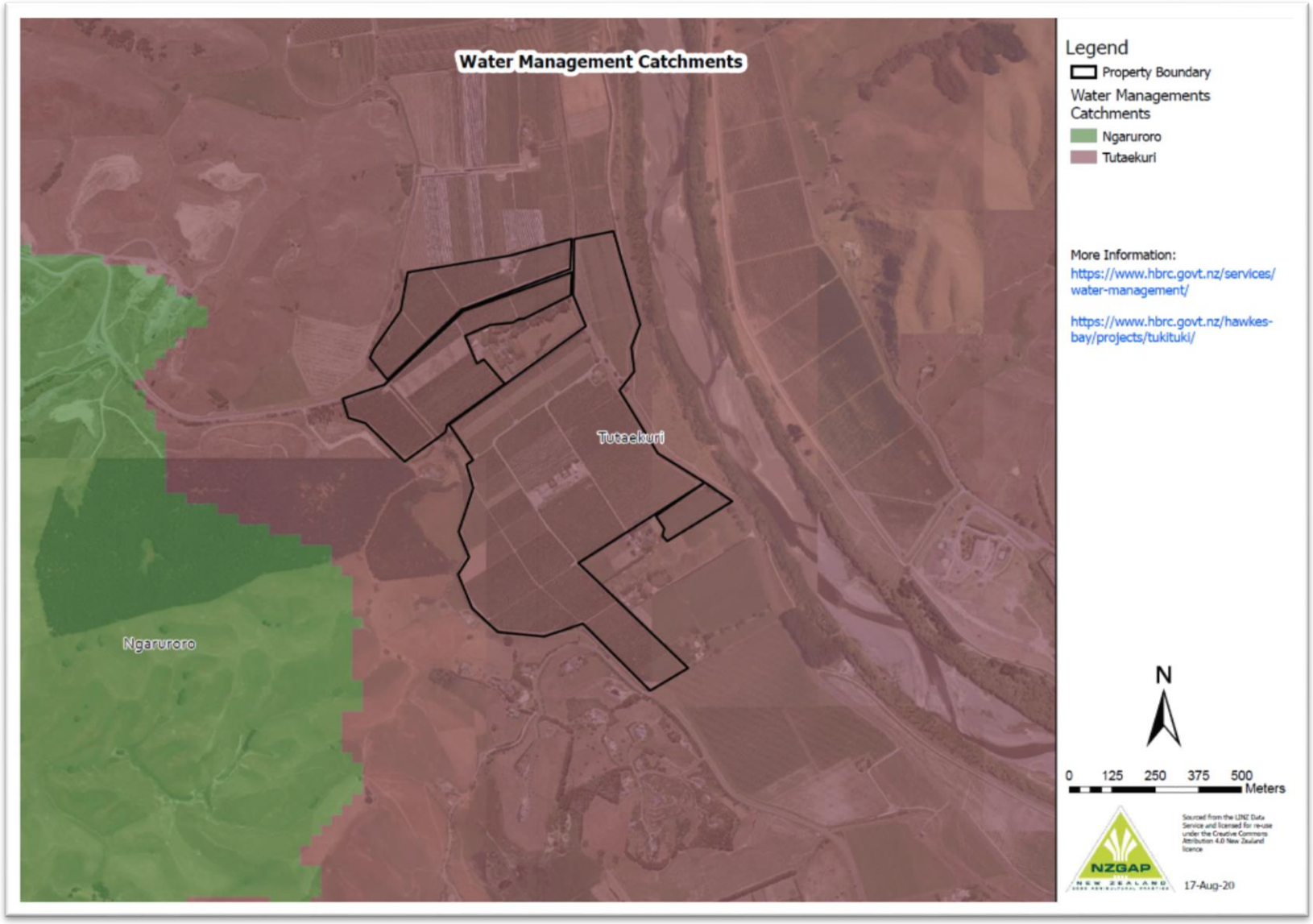
In summary, the 2019-20 modelled **N loss is 9 N kg/ha/yr** based on implemented industry good practice. TANK Case Study 1 is an established fruit orchard, currently operating at GMP. This target could increase or decrease in future years to provide flexibility in orchard good management practice to respond to changes in crop needs. A target N loss rate for the property has not yet been set, however, an N loss rate target for an established orchard like the case study property could be., for example, 'less than 15 N kg/ha/yr'. Such a target would deliver a balance between achieving long term environmental outcomes and providing flexibility in orchard management to adjust future N applications to suit crop needs based on soil and foliage testing.

11 Reference: TANK Proposed Plan Change 9, Section 42A Report, Appendix 1B Schedules: Schedule 30, Section A: Industry Groups and Catchment Collectives Governance and Management.

FWFP EVIDENCE (NZGAP EMS ADD-ON)

Maps




Water Management Catchments
Tutaekuri
Ngaruroro
Legend
Property Boundary
Water Managements Catchments
Ngaruroro
Tutaekuri
More Information:
https://www.hbrc.govt.nz/services/water-management/
https://www.hbrc.govt.nz/hawkes-bay/projects/tukituki/
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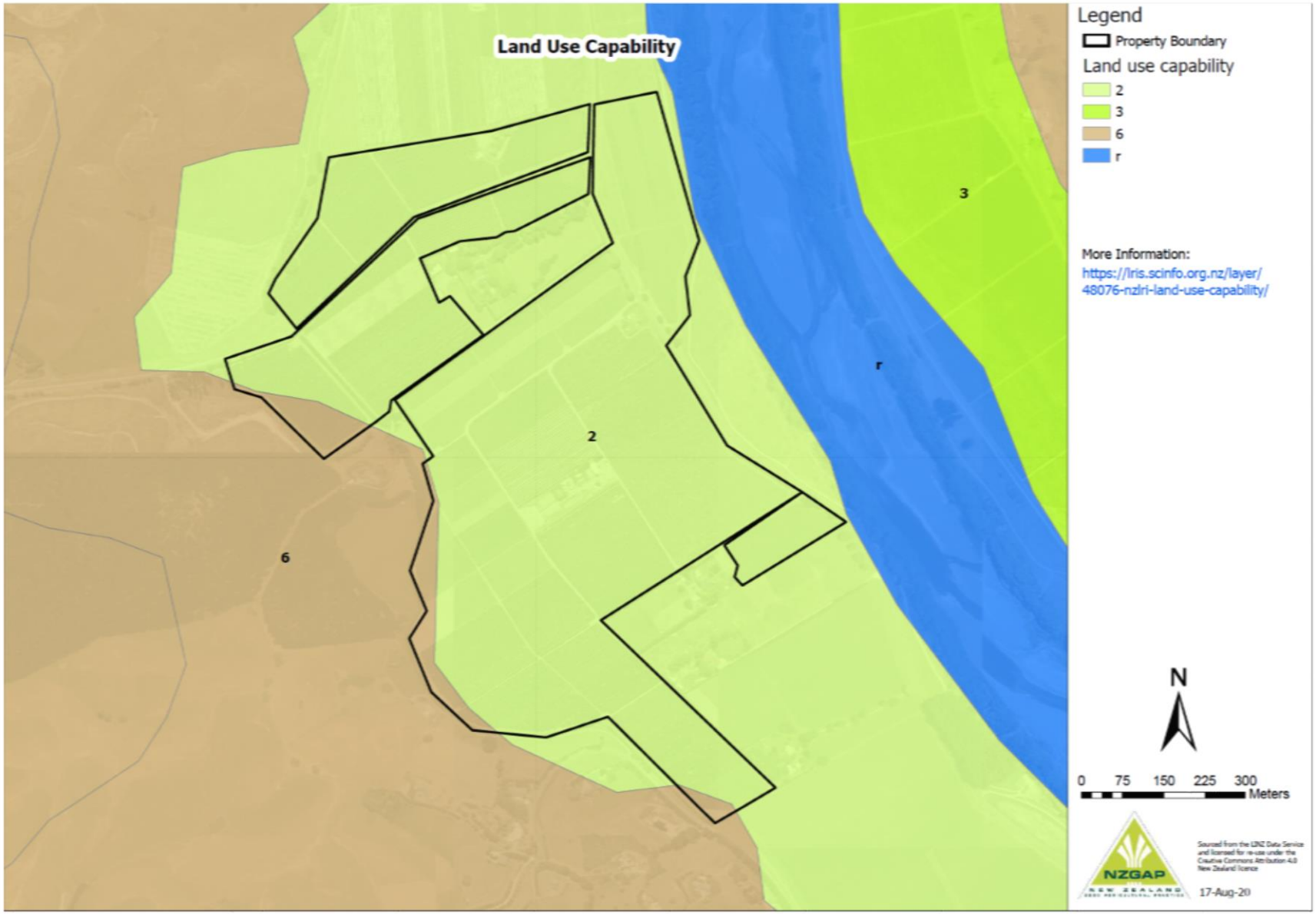
Land Use Capability
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Property Boundary
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More Information:
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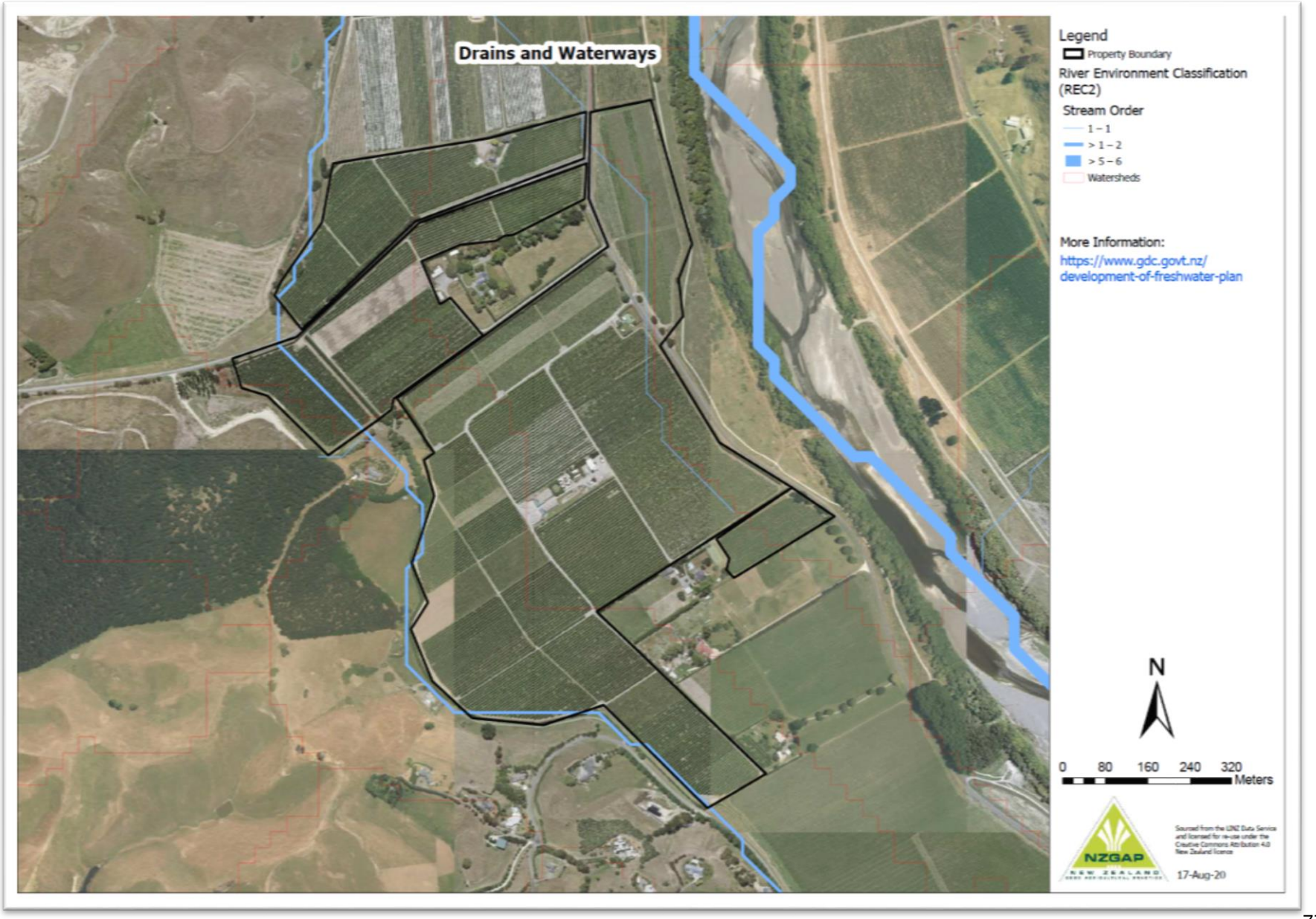
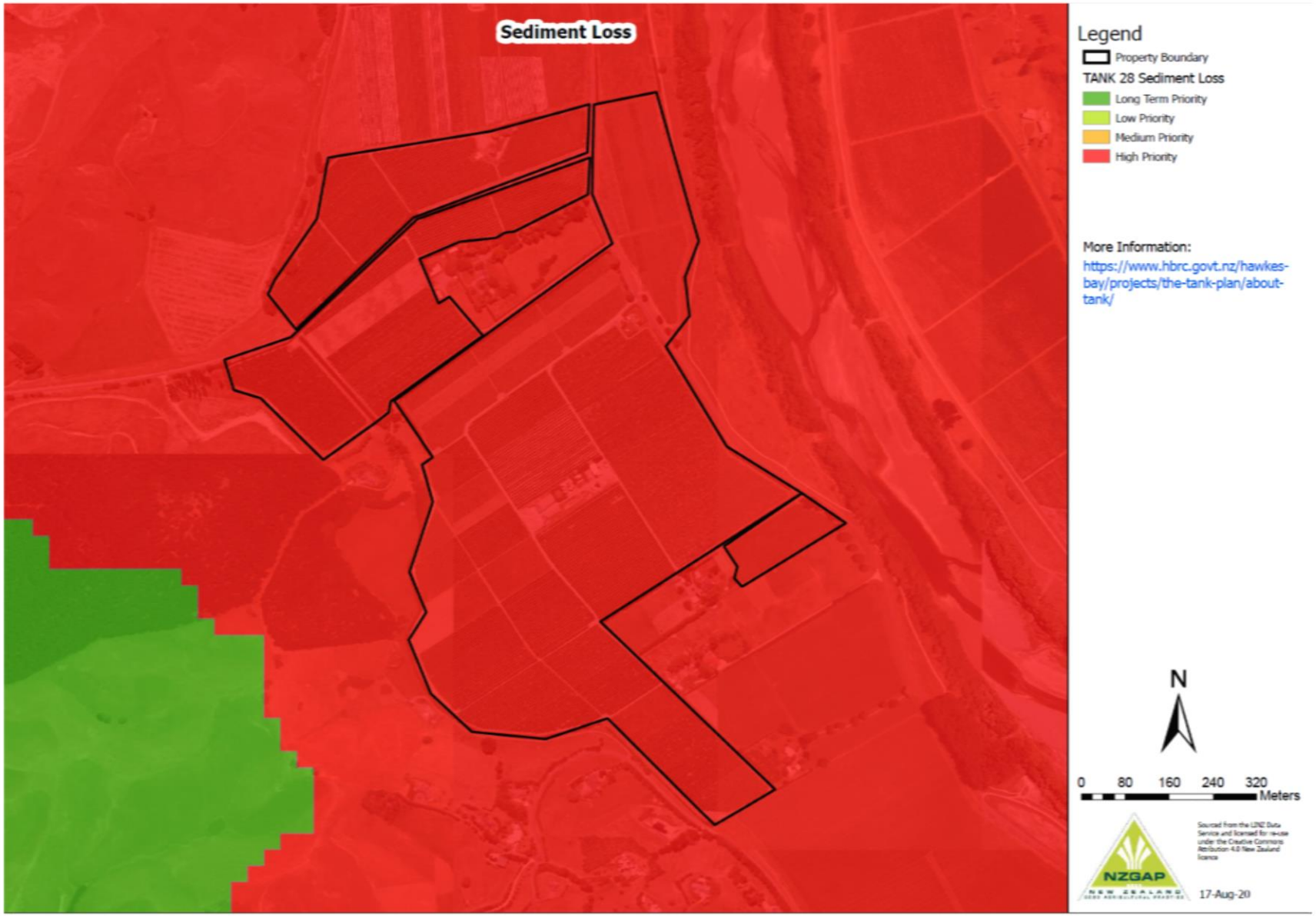
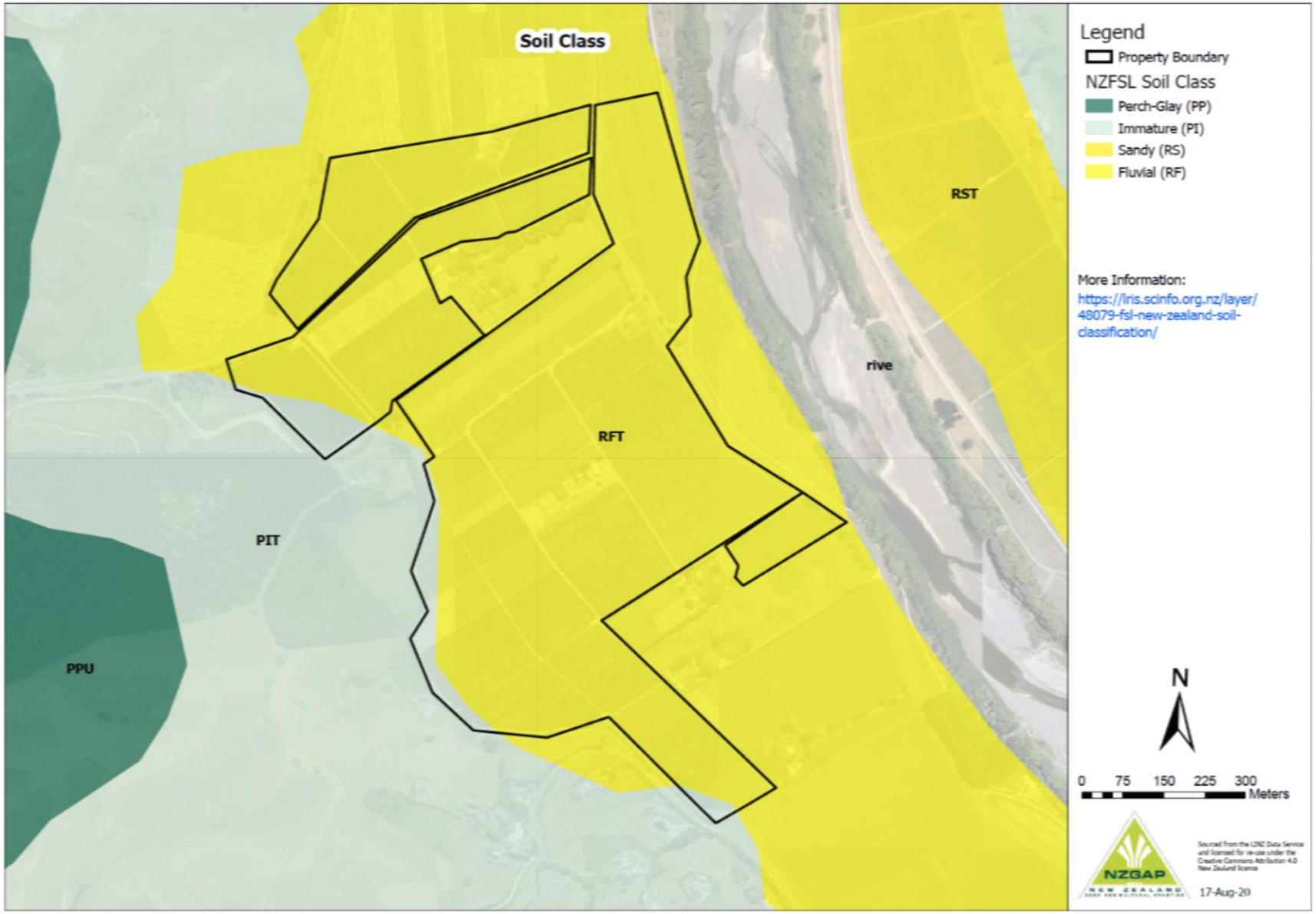
2
6

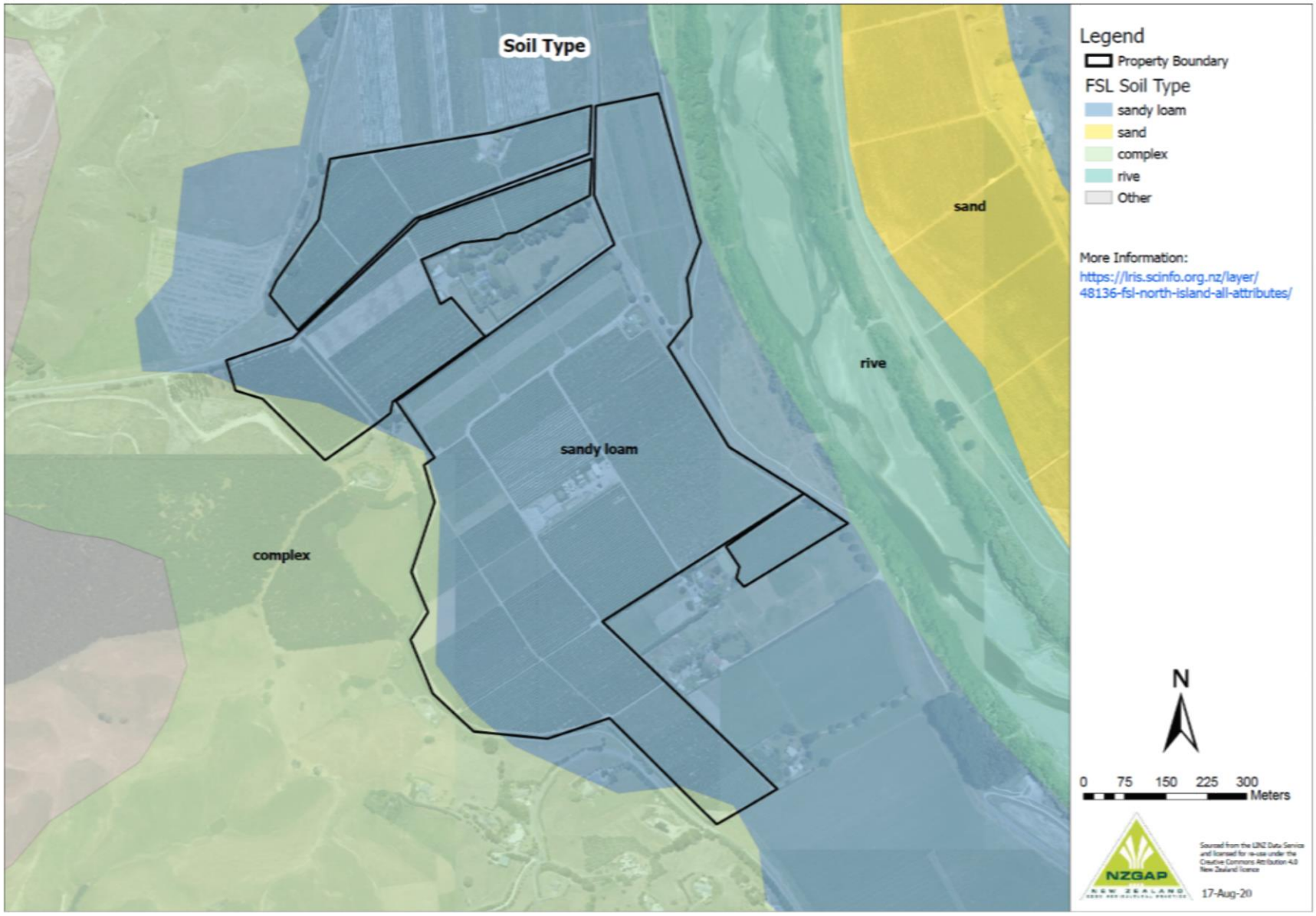

Drains and Waterways
Legend
Property Boundary
River Environment Classification (REC2)
Stream Order
1 – 1
> 1 – 2
> 5 – 6
Watersheds
More Information:
https://www.gdc.govt.nz/development-of-freshwater-plan
N
0 80 160 240 320
Meters
NZGAP
17-Aug-20

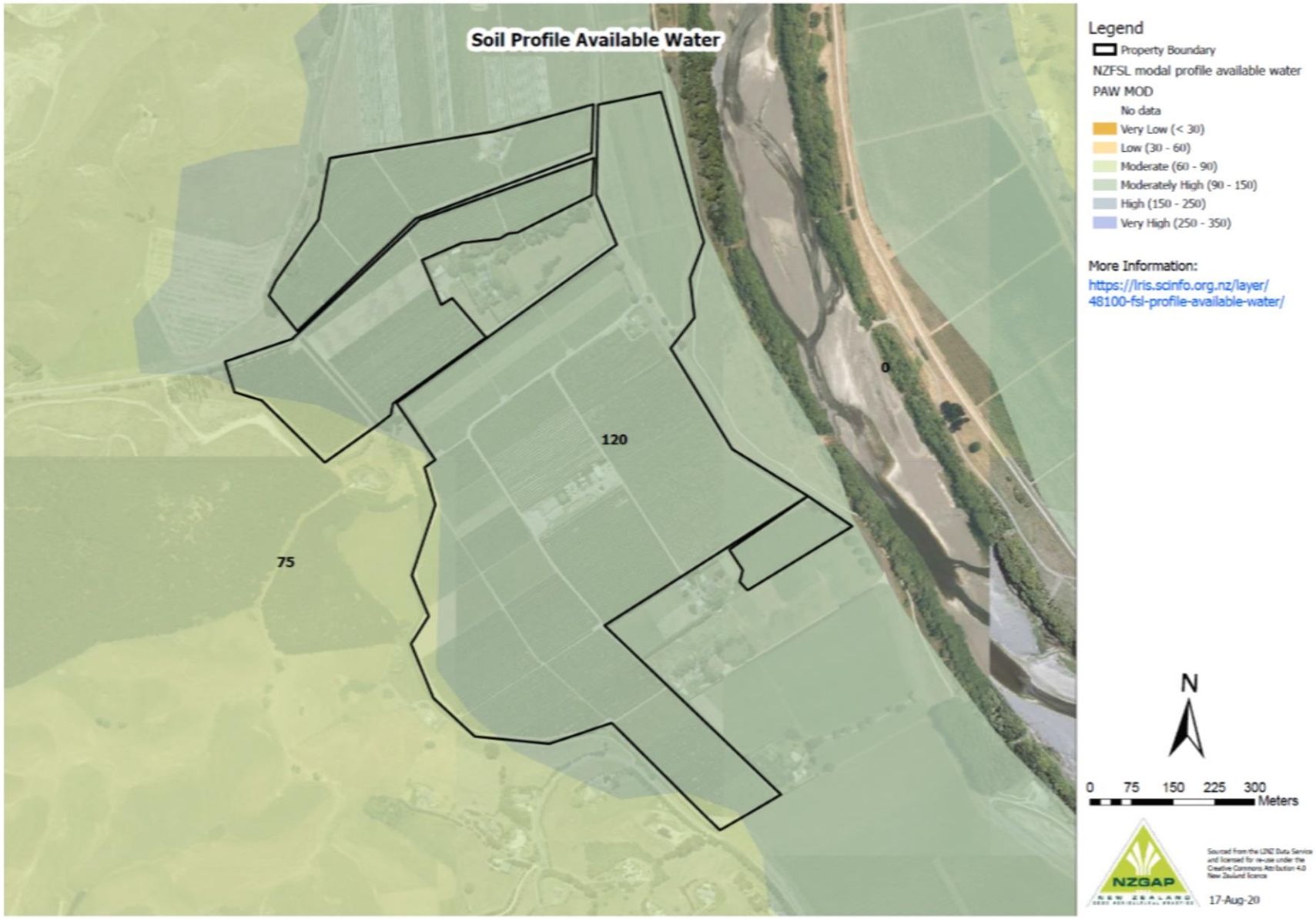

Source Protection Zone
Legend
Property Boundary
TANK 35 SPZ Awatoto
TANK 35 SPZ Hastings
TANK 35 SPZ Taradale
More Information:
https://www.hbrc.govt.nz/hawkes-bay/projects/the-tank-plan/about-tank/
N
0 80 160 240 320
Meters
NZGAP
17-Aug-20

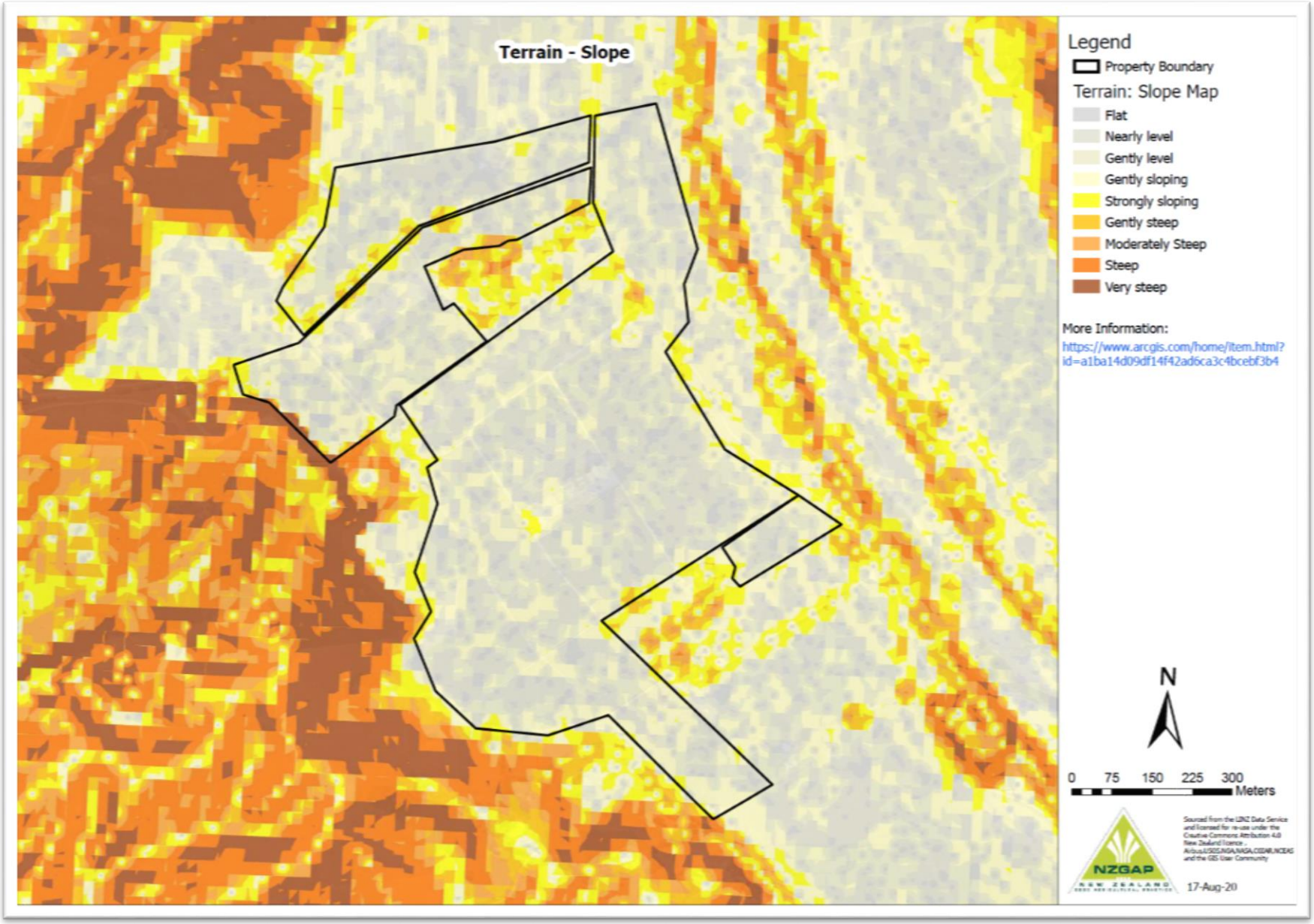

Sediment Loss
Legend
Property Boundary
TANK 28 Sediment Loss
Long Term Priority
Low Priority
Medium Priority
High Priority
More Information:
https://www.hbrc.govt.nz/hawkes-bay/projects/the-tank-plan/about-tank/
N
0 80 160 240 320
Meters
NZGAP
17-Aug-20


Dissolved Oxygen
Legend
Property Boundary
TANK 28 Dissolved Oxygen
High Priority
Medium Priority
Low Priority
Long Term Priority
More Information:
https://www.hbrc.govt.nz/hawkes-bay/projects/the-tank-plan/about-tank/
N
0 80 160 240 320
Meters
NZGAP
17-Aug-20


Soil Class
RST
rive
RFT
PIT
PPU
Legend
Property Boundary
NZFSL Soil Class
Perch-Glay (PP)
Immature (PI)
Sandy (RS)
Fluvial (RF)
More Information:
https://lris.scinfo.org.nz/layer/48079-fsl-new-zealand-soil-classification/
N
0 75 150 225 300
Meters
NZGAP
17-Aug-20


Soil Type
sand
rive
sandy loam
complex
Legend
Property Boundary
FSL Soil Type
sandy loam
sand
complex
rive
Other
More Information:
https://lris.scinfo.org.nz/layer/48136-fsl-north-island-all-attributes/
N
0 75 150 225 300
Meters
NZGAP
17-Aug-20


Soil Profile Available Water
120
75
0
Legend
Property Boundary
NZFSL modal profile available water
PAW MOD
No data
Very Low (< 30)
Low (30 - 60)
Moderate (60 - 90)
Moderately High (90 - 150)
High (150 - 250)
Very High (250 - 350)
More Information:
https://lris.scinfo.org.nz/layer/48100-fsl-profile-available-water/
N
0 75 150 225 300
Meters
NZGAP
17-Aug-20


Terrain - Slope
Legend
Property Boundary
Terrain: Slope Map
Flat
Nearly level
Gently level
Gently sloping
Strongly sloping
Gently steep
Moderately Steep
Steep
Very steep
More Information:
https://www.arcgis.com/home/item.html?id=a1ba14d09df14f42ad6ca3c4bcebf3b4
N
0 75 150 225 300
Meters
NZGAP
17-Aug-20

Nutrient Budget (OverseerFM)

[redacted] 2019-2020

OverseerFM

Analysis type	Scenario
Is publication	No
Application version	3.2.0.4
Printed date	14 Sep, 2020, 11:31AM
Model version	6.3.4

Farm details

N: 760 N/ha: 9 P: 69 P/ha: 0.8 GHG/ha: 1,583 NCE: 60% v6.3.4

Total area	85 ha
Productive block area	80.50 ha
Nitrogen conversion efficiency (NCE)	60%
N Surplus	15 kg/ha
Nearest town	Napier

INDUSTRY PROGRAMME FWFP (NZGAP EMS ADD-ON)

EMS FEP Template

NZGAP

Environment Management System

(EMS) add-on

v1.6 November 2019

Environment

Farm Environment Plan

(FEP) Template

SOIL NUTRIENTS IRRIGATION WATERWAYS BIODIVERSITY

Prepared by:	
Date:	01/09/2020
Review Dates:	

NZGAP EMS add-on – Farm Environment Plan Templates (v1.6 November 2019)

Page 1 of 19

Overview

These templates are to be used in conjunction with the EMS Audit Checklist and Guidelines to ensure that all environmental requirements are met

Glossary:

EMS = Environment Management System
FEP = Farm Environment Plan
GMP = Good Management Practice **(Required where applicable)**
BMP = Best Management Practice **(Recommended where applicable)**
Y = Yes (already complete/implemented – provide evidence)
P = Partial (partially complete/implemented – agree and set date for completion)
N = No (not complete/implemented – agree and set target date for completion/implementation)
n/a = Not applicable (justify why n/a)

FEP process for each management area:

1. Assess the environmental risks
2. Identify GMPs (and BMPs if applicable) currently completed/implemented
3. Identify GMPs (and BMPs if applicable) yet to be completed/implemented and set target date for completion/implementation
4. Make progress towards GMP (and BMP if applicable)
5. Actions and improvement will be assessed during your next EMS audit

Relevant Guidelines: (available in "guidelines" section on NZGAP website)

- HortNZ Erosion and Sediment Control Guideline 2014
- HortNZ Code of Practice for Nutrient Management 2014
- Nutrient Management for Vegetable Crops in NZ 2019
- Fertiliser Association Code of Practice for Nutrient Management 2013
- Vegetable Washwater Discharge Code of Practice 2017
- Mahinga kai Guideline for Selwyn farmers 2018

5A Property Plan (Map): Features to be included on the property plan (i.e. map)

Ref	Map Features	Complete? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No' for GMPs. Justify if 'n/a')	Evidence (e.g. map or description)	Level
		Y	P	N	n/a				
1	Property boundaries (currently owned and leased properties)	●	○	○				Key features map	GMP
2	Land management units (e.g. cropped areas)	●	○	○				LMU map	GMP
3	Potential critical sources (point and area) for contaminants (e.g. erosion risk, fertiliser storage)	●	○	○				Chemical storage and fuel storage all bunded and controls in place	GMP
4	Permanent or intermittent rivers, streams, lakes, ponds, drains and wetlands	●	○	○				Key features map, IMP, orchard maps	GMP
5	Riparian vegetation and barriers/fences adjacent to waterbodies	●	○	○				Key features map	GMP
6	Any significant areas as defined by the local authority (e.g. significant indigenous biodiversity areas, cultural landscape values management area)	○	○	○	●				GMP
7	The location of any spring heads, wetlands or spring-fed streams have been identified where required by the local authority	○	○	○	●		All waterways are permanently flowing and marked on maps		GMP
8	Soil maps and/or descriptions	●	○	○				Soils map - HBRC	GMP
9	Flow path of surface water entering and leaving each block/paddock (on cultivated land)	○	○	○	●		The topography is flat and drainage is good. Overland flow is uncommon		GMP
10	Environmental actions/mitigations	●	○	○	○			IMP	BMP
11	Other features (please specify):	○	○	○	○				BMP

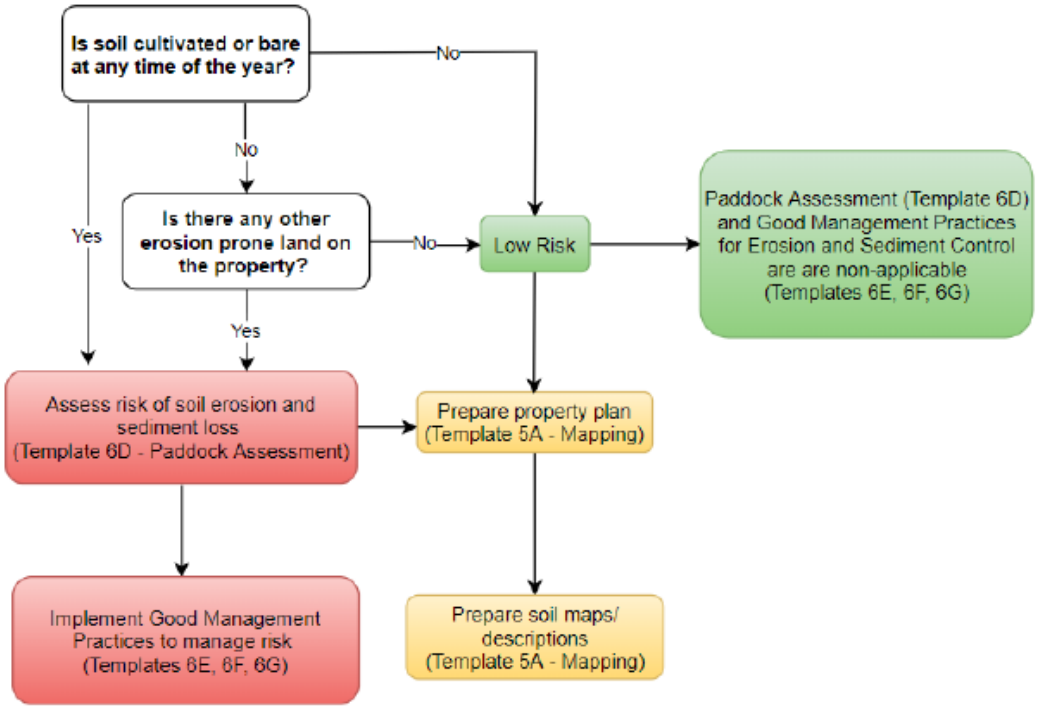
6A SOIL: Soil Quality, Health and Fertility – Assessment

Ref	Good/Best Management Practices	Complete? (Yes, Partial, No, n/a) Y	P	N	n/a	Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence (e.g. record, photo, observation)	Level
1	Soil type, structure, texture and profile is assessed	●	○	○				Irrigation is targeted based on soil type - Fruition	GMP
2	Soil drainage is assessed (poor/moderate/well drained)	●	○	○				Irrigation is targeted based on soil type - Fruition	GMP
3	Soil nutrient testing is conducted on each paddock every 3 – 5 years (Nitrogen, phosphorus, magnesium, potassium)	●	○	○				Soil tests - Fruitfed Analysis	GMP
4	Soil testing is completed using a uniform or representative collection pattern (e.g. 'W' pattern)	○	○	○					GMP
5	Soil testing is conducted on each paddock every year when a crop is going to be planted	●	○	○	○				BMP
6	Soil testing is conducted every year based on GPS mapping	○	○	○	●		No GPS mapping used at this stage		BMP
7	N-Quick test and tool is used to inform decisions on nitrogen applications	○	○	●	○		Hill Laboratories		BMP
8	Deep N tests are taken to determine the level of residual N that remains in the soil	●	○	○	○		Hill Laboraties	Evidence	BMP
9	Soil is assessed for compaction (e.g. using a penetrometer)	●	○	○	○			Visual assessment - timesheet	BMP
10	Soil pH is monitored	●	○	○	○			Soil tests	BMP
11	Soil Organic Matter (OM) is monitored	○	○	○	○				BMP
12	Soil biological activity is monitored	○	○	●	○		Permanent cover/grassing		BMP
13	Other (specify):	○	○	○	○				BMP

6B SOIL: Soil Health and Fertility – Control Measures and Action Plan

Ref	Good/Best Management Practices	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
1	Choose appropriate crops *(for soil, climate, disease, and maximum uptake of nutrients from previous crop)*	○	○	○	●		Apples only - no crop rotation		GMP
2	Use cover crops to enhance soil structure and organic matter, plus absorb excess nutrients	○	○	○	●		Cultivation is only undertaken prior to tree replanting		GMP
3	Incorporate crop residues where possible	●	○	○	○			Prunings/dropped apples mulched	GMP
4	Cultivate soil when conditions appropriate	○	○	○	●		Permanent crop - only when redeveloping small blocks		GMP
5	Minimise soil tillage as much as practicable	○	○	○	●		Cultivation is only undertaken prior to tree replanting		GMP
6	Minimise fallow periods between crops	○	○	○	●		Cultivation is only undertaken prior to tree replanting		GMP
7	Use crop rotation	○	○	○	●		Long term tree crops		GMP
8	Retire or actively manage marginal land to ensure soil conservation measures are in place	●	○	○	○			Permanent grassing so soil not disturbed + soil tests	GMP
9	Use controlled trafficking	●	○	○	○			Alternate rows used in harvest to avoid compaction	BMP
10	Adopt new technologies *e.g.* use of sub-soil aerator will allow roots deeper into soil	○	○	○	●		Mr Apple are "root ripping"		BMP
11	Other (specify):	○	○	○	○				BMP

6C SOIL: Risk of soil erosion and sediment loss – *Property Assessment*



6D. SOIL: Risk of soil erosion and sediment loss – *Paddock Assessment (for cultivated and bare soils)*

Paddocks assessed (names/IDs):	All blocks
Description of property slope:	Flat (Note: <1 degree = Low erosion risk, >1 degree = Medium/High erosion risk)

Ref	**Good Management Practices** (for individual paddock or summary of all paddocks)	Complete? (Yes, Partial, No, n/a) Y	P	N	n/a	Date to be completed (if 'Partial' or 'No')	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence (e.g. map or description)	Level
1	Identify site specific risks of this paddock (e.g. soil type, slope, proximity to waterways, critical source areas)	●	○	○				See FEMP	GMP
2	Describe paddock management risks (e.g. paddock use, previous use, crop type, crop coverage, cultivation technique)	●	○	○				See FEMP	GMP
3	Assess the risk of soil erosion prior to carrying out all field operations	●	○	○				See FEMP	GMP
4	Identify where surface water is entering paddocks (map or description)	●	○	○			Topography is flat and well drained	See FEMP	GMP
5	Identify where surface water leaves paddocks (map or description)	●	○	○			Topography is flat and well drained	See FEMP	GMP

Baseline / Unmitigated Risk Level (i.e. without any GMPs in place):	High ○	Medium ○	Low ●
Risk Level with current practices in place (Template 6E, 6F, 6G):	High ○	Medium ○	Low ●
Risk level with GMP in place (Template 6E, 6F, 6G, 10):	High ○	Medium ○	Low ●

Other identified risks:

6E. SOIL: Soil erosion and sediment loss - ***Implement and maintain measures for stopping or controlling surface water entering the paddock*** *(for cultivated and bare soils)*

Ref	Good/Best Management Practices	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
1	Interception drains	○	○	○	●		Flat topography		GMP
2	Correctly sized culverts	●	○	○	○			Photos - implementation has to be council approved	GMP
3	Benched headlands	○	○	○	●				GMP
4	Bunds	●	○	○	○			Bunded storage/spray sheds and any fertilizers	GMP
5	Grassed swales (control overland flow through the paddock)	○	○	○	●		Flat topography		GMP
6	Other (specify):	○	○	○	○				BMP

6F. SOIL: Soil erosion and sediment loss - *Implement and maintain erosion control measures to reduce or minimise the risk of soil erosion* *(for cultivated and bare soils)*

Ref	Good/Best Management Practices	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
1	Minimise cultivation passes	●						Cultivation is only undertaken prior to tree replanting	GMP
2	Break crops / shelter belts (wind erosion)	●						See FEMP	GMP
3	Using short row lengths (>1 degree slope) (<200m recommended)				●			Cultivation is only undertaken prior to tree replanting	GMP
4	Cover crops / break crops (>1 degree slope)				●			Cultivation is only undertaken prior to tree replanting	GMP
5	Wheel track ripping / Wheel track dyking (>1 degree slope)				●			Cultivation is only undertaken prior to tree replanting	GMP
6	Contour drains (>1 degree slope)				●			Topography is flat	GMP
7	Other (specify):								BMP

6G. SOIL: Soil erosion and sediment loss – *Implement and maintain sediment control measures to manage the water and suspended solids that move off the paddock* *(for cultivated and bare soils)*

Ref	Good/Best Management Practices	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
1	Access ways are not at the lowest point of the paddock	●	○	○	○			Topography is flat	GMP
2	Raised access ways / Bunds	○	○	○	●			Topography is flat	GMP
3	Vegetated buffers / Riparian margins / Hedges	●	○	○	○			See FEMP	GMP
4	Super silt fences	○	○	○	●			Not required	GMP
5	Stabilised drains and discharge points	○	○	○	●			Not required	GMP
6	Decanting earth bunds	○	○	○	●			Not required	GMP
7	Sediment retention ponds	○	○	○	●			Not required	GMP
8	Other (specify):	○	○	○	○				BMP

7A. NUTRIENTS: Process for addressing risks of Nutrient Loss

1. Understand how nutrient loss occurs and potential risk

- Knowledge of movement of nutrients through soil and water
- Factors contributing to nutrient loss

2. Information to help in decision making

- Soil tests
- Paddock history
- Crop history
- Rotation and crop selection
- Rainfall

3. Assessing the risk

- Using the risk template, identify the risk for each contributing factor
- Determine the level of risk for the operation

4. Identify and implement GMPs and BMPs to address risk

- Pre-planting
- Planting and ground preparation
- Post planting
- Harvets and post-harvest
- Other GMPs and BMPs

5. Maintain records

- Records should be kept to verify actions

7B. NUTRIENTS: Assessing the risk of Nutrient Loss

Ref	Contributing factor	Assessing extent of risk	Level of risk		
			High	Med	Low
1	Soil moisture	Applications of N when soils that are saturated - high risk. Applications when soils are not saturated – lower risk *Note*: It is important to assess the soil moisture status before an application to ensure that the potential for leaching is minimised. Use of foliar applications can reduce the risk	○	○	●
2	Irrigation	Use of irrigation – high risk *Note*: Risk can be reduced by ensuring that irrigation is used to maintain soil moisture at target levels and applications of N timed accordingly.	○	○	●
3	Soil type	Light soils – High risk. Medium soils – Medium risk. Heavy soils – Low risk	●	○	○
4	Paddock history	Quantities of N applied not based on fertiliser recommendations or assessment of crop residues – high risk. Applications take into account fertiliser recommendations and crop residues to ensure that appropriate levels of N are applied - lower risk	○	○	●
5	Previous crop planted and residual N in the soil	High residue crop – high risk. Crop failure or lower than anticipated yield – high risk Removal of previous residue – lower risk	○	○	●
6	Crops being grown	Shallow root vegetables – higher risk	○	○	●
7	Crop yield and quality	Nitrogen is used to achieve desired yield and quality. Inappropriate or excessive use can create quality issues and increase the risk of leaching – high risk	○	○	●
8	Intensity of cropping	Repeated cropping – higher risk	○	○	●
9	Topography	Sloped ground – higher risk of run off	○	○	●
10	Plant uptake of nitrogen	Low plant uptake - high risk High plant uptake - lower risk *Note:* There are a range of factors that contribute to the plant uptake of nitrogen and hence reduce the N in the soil able to be leached – e.g time of years, growth stage, type and form of nitrogen, rooting depth. The combination of factors need to be assessed to determine uptake for each crop.	○	○	●
11	Timing of nitrogen application	High level of base dressing at planting – high risk Applications split and matched to crop needs – lower risk	○	○	●
12	Fertiliser application methods	Broadcast application – higher risk Application only to the row – reduced risk . Foliar applications – low risk	○	○	●
13	Applications of organic manures	Organic manures applied; but not taken into account for N balance – High risk, Taken into account for N balance – Lower risk	○	○	●
14	Pest and disease	Crop failure or lower than anticipated yield due to pest and disease – high risk	○	○	●
15	Animals in the rotation	Animals included in the rotation – higher risk. No animals – lower risk	○	○	●
16	Ground preparation and planting methods	Direct drilling and reduced tillage – lower risk Presence of fines post cultivation – higher risk	○	○	●
17	Compaction	Compacted soil will prevent roots being able to penetrate and access nitrogen. Compacted soil presents a higher risk.	○	○	●
Baseline / Unmitigated Risk Level (i.e. without any GMPs in place):			○	○	●
Risk Level with current practices in place (Template 7C):			○	○	●
Risk level with GMP in place (Template 7C):			○	○	●

Other identified risks:

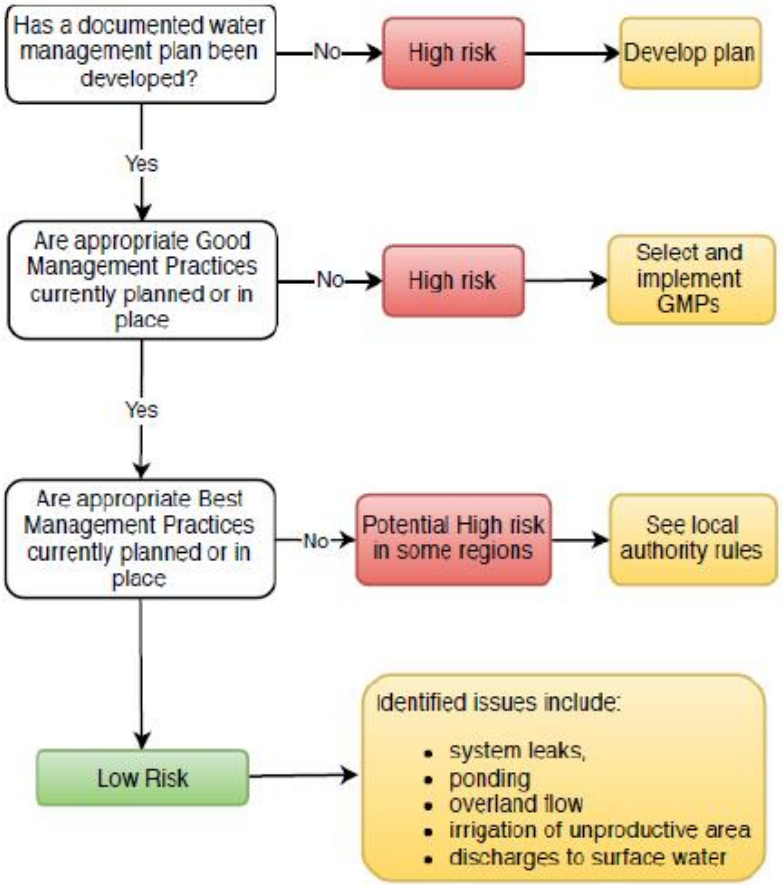
7C. NUTRIENTS: ***Implement measures to improve nutrient uptake and minimise nutrient loss***

Ref	Good/Best Management Practices	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
	Pre-planting								
1	Plan fertiliser inputs for the crop	○	○	○	●		Fertiliser applied post-planting		GMP
2	Take into account any organic manures used	○	○	○	●		No manures used		GMP
3	Take into account any animals in the rotation	○	○	○	●		No aminals used		GMP
4	Manage applications of nutrients taking into account rainfall, field capacity and soil saturation levels	●	○	○	○			Fertiliser use based on expert recommendations (Fruition)	GMP
5	Obtain advise from a nutrient advisor or agronomist	●	○	○	○			Fertiliser use based on expert recommendations (fruitfed + Hill Lab analysis)	BMP
	Planting								
6	Nutrient applications are informed by available information or fertiliser recommendations	●	○	○	○			Fertiliser use based on expert recommendations (fruitfed + Hill Lab analysis)	GMP
7	Fertiliser applications are applied relative to the predicted uptake levels of the plant from planting to maturity	●	○	○	○			Fertiliser use based on expert recommendations (fruitfed + Hill Lab analysis)	GMP
8	Improved fertiliser technology is used where appropriate (e.g. prills/coatings)	○	○	○	●		Fertiliser is targeted to the row, minimal use, only foliar and ground spread		BMP
9	Controlled traffic farming technology is used to increase application efficiency	○	○	○	●				BMP
10	Crop calculators are used if available and practical for local conditions	○	○	○	●		Only apples		BMP
11	Other (specify):	○	○	○	○				BMP

7C. NUTRIENTS (*Continued*): *Implement measures to improve nutrient uptake and minimise nutrient loss*

Ref	Good/Best Management Practices	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
	Post-planting								
12	Side dressings are used	●	○	○	○		Granules?		GMP
13	Operators follow instructions for application, including avoiding spreading into water bodies	●	○	○	○		Ground base spreading	All based on analysis	GMP
14	GPS is used to monitor operator performance	○	○	●	○		Row spreading		BMP
15	Nutrient levels are managed (and informed by soil tests) according to rainfall / irrigation, and will match likely yield and quality goals	●	○	○	○			Fertigation records (when/how/recommendation)	BMP
16	Leaf tests are conducted	●	○	○	○			Annually - Fruitfed/Hill Rd Lab	BMP
	Harvest/Post-harvest								
17	As much harvestable crop as possible is removed	●	○	○	○			No piles of waste visible	GMP
18	Crop residues are incorporated where possible	●	○	○	○			Prunings/left apples mulched, Mr Apple also has residue testing in place	GMP
	Other:								
19	Spreadmark accredited contractors are used	●	○	○	○			Accreditation is checked	BMP
20	AIRCARE™ accredited aerial operators are used if applicable	○	○	○	●		No fertilising by air		BMP
21	Machinery is upgraded to be more efficient/accurate	●	○	○	○			Tractor upgrades underway and annual calibrations/machinery maintenance	BMP
22	Other (specify):	○	○	○	○				BMP

8A. WATER and IRRIGATION: Assessing the environmental risk of water use



8B. WATER and IRRIGATION: Water use – *Implement measures to improve water use efficiency and minimise risk of nutrient loss*

Ref	Good/Best Management Practices	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
	Pre-planting								
1	Plan irrigation requirements	●	○	○	○			Irrigation future assessed	GMP
2	Develop long-term irrigation plan	●	○	○	○			Irrigation future assessed	GMP
	Post-planting								
3	Volumes applied informed by relevant factors (e.g. Plant growth phase / soil type / water holding capacity and climatic conditions)	●	○	○	○		Fruition - neutron probes	Soil moisture monitoring/soil type/timing	GMP
4	Water is applied to maintain soil moisture between the wilting point and field capacity where possible	●	○	○	○		Fruition - neutron probes	Soil moisture monitoring/soil type/timing	GMP
5	Irrigation applied allows achievement of the yield target for fertiliser applied	○	○	○	●		Irrigation isn't applied based on fert apps		GMP
6	Irrigation efficiency is measurable at greater than 80% (>80% of irrigation water is retained in root zone / target area)	●	○	○	○		Fruition - neutron probes	Soil moisture monitoring/soil type/timing	BMP
7	Water use is metered	●	○	○	○			Telemetry	BMP
8	Irrigation scheduling is undertaken using a crop model or tied into a soil moisture monitoring system	●	○	○	○			Fruition soil monitoring	BMP
9	On site soil moisture monitoring is conducted	●	○	○	○			Fruition soil monitoring	BMP
10	Irrigation is variably applied within the paddock to maximise efficiency	●	○	○	○			Isolated watering mechanisms	BMP
11	Highly automated irrigation systems that allow more frequent applications of less water are used to maximise efficiency	○	○	○	●		Not highly automated but do have options to use less water more frequently with timing		BMP
	Other:								
12	Non-irrigation water is used efficiently (e.g. wash water)	●	○	○	○			Used to wash down sprayers/tractors, safe drainage, within council consent	GMP
13	Other (specify)	○	○	○	○				BMP

9A MAHINGA KAI and BIODIVERSITY: Assessment

(Checklist question 9.4) Mahinga kai species largely relate to indigenous plant, bird and fish species and their ecosystems and habitats. Mahinga kai includes things such as species, natural habitats, materials and practices used for harvesting food, and places where food or resources are, or were, gathered. This includes:

- All waterways, drains (with water), wetlands, and springs
- Native vegetation and riparian areas
- Areas with specific mahinga kai species and their habitats.

Ref	Mahinga kai and biodiversity assessment	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
1	On-farm mahinga kai values have been identified (e.g. map of native vegetation, waterways, wetlands)	●	○	○	○			IMP plan	GMP
2	Any key risks to mahinga kai have been identified (e.g. clearance of vegetation, drain maintenance)	●	○	○	○			IMP plan	GMP
3	Ways to enhance on-farm biodiversity have been identified	●	○	○				IMP plan	GMP
4	Other (specify):	●	○	○	○		Non-cropped areas planted with native plants to encourage bird/wildlife populations. Applies to residential housing on apple blocks		BMP

9B MAHINGA KAI and BIODIVERSITY: ***Implement measures to protect and enhance Mahinga kai values and biodiversity***

Ref	Mahinga kai and biodiversity assessment	Currently Implemented? (Yes, Partial, No, n/a)				Date to be completed? (if Partial or No)	Comment/Agreed Action (if 'Partial' or 'No'. Justify if 'n/a')	Evidence provided (e.g. record, photo, observation)	Level
		Y	P	N	n/a				
1	Mahinga kai values are considered when implementing other environmental actions (e.g. erosion and sediment control, riparian areas)	●	○	○	○			IMP plan	GMP
2	Native vegetation and/or habitats are protected	●	○	○	○			IMP plan	GMP
3	Waterway, drain management and vegetation clearance is carried out following good management practice	●	○	○				IMP plan	GMP
4	Planting of native vegetation in shelterbelts or riparian areas	●	○	○	○			Native vegetation planted as hedges	BMP
5	Constructed wetlands developed for treating contaminants (e.g. nutrient run-off) to promote biodiversity and enhance mahinga kai values	○	○	○	●		No wetlands		BMP
6	Pests are managed according to local authority rules	●	○	○	○			Contract pest-control if needed. Wild cats.	BMP
7	Other (specify): (e.g. Local council requirements)	○	○	○	○				BMP

10A ENVIRONMENTAL ACTION PLAN: Other Actions

Ref.	Management area and risk addressed (e.g. soil erosion)	Action to be completed	Location	Person responsible	Expected Date of Completion	Actual Date of Completion	Evidence to be Provided (e.g. records, photo)
8B.2	Develop long-term irrigation plan	Document irrigation practices and long-term irrigation management in a written plan			Dec 2021	-	Copy of mngt plan on file

NZGAP

Environment Management System (EMS) Add–On

Audit Checklist

v1.6 November 2019

Business Details	
NZGAP Number:	Not issued
Business Name (Legal Entity):	TANK Case Study 1
Business owner (s):	TANK Case Study 1
Physical address (main site):	Hastings
Responsible manager:	farmer
Certification Body Details	
Certification Body (tick):	AsureQuality ○ SGS ●
Auditor Name:	auditor x
Audit date:	4th November 2020

Assessment Summary (complete after the assessment – See Section 11. Corrective Action Summary)		Total Number of Questions:
Total number of non-compliances:	0	53
Total number of initial Major "C" non-compliances:	0	15
Total number of initial Major "M" non-compliances:	0	25
Total number of initial Recommendations "R" not met:	0	13
Corrective actions to be completed before (date):		
Signature of Auditor:		
Signature of Responsible Manager:		

Audit Checklist for Horticulture
Farm Environment Plan (FEP)

Environment

NZGAP NEW ZEALAND GOOD AGRICULTURAL PRACTICE

NZGAP Environment add-on checklist (v1.6 Nov 2019)

Page 1 of 14

EMS Audit checklist

GAP/ Farm Environment Plan Adviser:

Adviser (s) Details (complete if an external or certified adviser has helped with the development of this EMS)						Council Approved (required in some regions)		
Name:	Areas of expertise*	Relevant Qualifications:	Business Name:	Phone	Email	Y	N	NA
adviser 1	Certified Nutrient Management Advisor/GHG ad	Advanced SMNA PGDip Env Planning	Soter Rural Compliance	027 12345678	email@	●	○	○
						○	○	○
						○	○	○

*Examples of environmental advisers are: farm environment plan adviser, nutrient management adviser, agronomist, irrigation consultant

Nutrient Budget:

Nutrient Budget Information (complete only if nutrient budget is required and has been completed)	
Nutrient budget name and version (e.g. NCheck)	R1234 2019
Nutrient Loss for current year (kg/ha/yr)	9
Nitrogen Loss for previous year (kg/ha/yr)	N/A
Nutrient Loss Target (kg/ha/yr)	
Nutrient Baseline (kg/ha/yr)	
Nutrient Limit (kg/ha/yr)	N/A

Farm / Property Details

Total Area Owned (ha): 42.2 **Total Area Leased (ha):** 56.3

Legal Descriptions: (if required for consent application. Attach list if more space needed)

Block Name	Owned (tick)	Leased (tick)	Property Title Legal Description (see Land Information NZ)	Total Area (ha)	Effective/Productive Area (ha)
a	●	○		3.7	3.7
b	○	●		8	8
c	○	●		4.7	4.7
d	●	○		21	21
e	○	●		22.5 (1.3)	22.5
f	○	●		11.1	11.1
g	○	●		8	8
h	○	●		8.4	8.4

Resource Consents held: (if required for resource consent application. Attach list if more space needed)

Property/Block Name	Consent type: (e.g. Water take/use, Land use, nutrient discharge)	Consent number:
a	Water	WP1234
b	Water	WP1235
c	Water	WP1236
d	Water	WP1237
e	Water	WP1238

CHECKLIST GUIDANCE	
Question Categories	Questions to achieve and maintain certification are categorised into 3 levels: 'C' – is a critical non–compliance. All 'C's must be met within 7 days of the assessment 'M' – is a major non– compliance and applicable 'M's must be met within 28 of the assessment 'R' – is a recommendation only There is no limit to the number of non-conformances that can be accumulated during an assessment, however all non- conformances must be closed out before certification is achieved. The occurrence of non-conformances may also result in follow up action such as targeted audits.
Compliance	Y = Complaint N = Non–compliance issued with comments N/A = Not applicable for this assessment. Grower must comment to explain why a question is not applicable Y | N | NA **"NO N/A" DENOTES A REQUIREMENT WHERE 'NOT APPLICABLE' DOES NOT APPLY**
Comments	Auditor comments are required for all Critical and Major non-conformances and these shall be reflected in the assessment report.
Assessment Report	A copy of the assessment report shall be provided to the grower after completion. A copy of the assessment report may also be provided to NZGAP. The grower shall make the previous assessment report available for the current assessment.
Implementation Guideline	This checklist is accompanied by the Environment Management System Add-on Implementation Guideline which outlines what action/evidence is required to comply with each question, and where more relevant information can be found (e.g. industry guidance).
Farm Environment Plan (FEP)	Evidence for this assessment is supported by a Farm Environment Plan which identifies the environment risks of the activity, plus the Good Management Practices (GMPs) and Best Management Practices (BMPs) in place or planned to manage and reduce risks to the environment.
NZGAP Regional Guide	A guide for NZGAP growers, NZGAP auditors, and regulators in each region. This guide demonstrates alignment of the New Zealand GAP (NZGAP) Environment Management System (EMS) add-on with Farm Environment Plan requirements of each regional and sub-regional plan.

1. Organisation and Management							
Ref	Question	Y	N	NA	Comment	Evidence Provided	Level
1.1	Does top management demonstrate leadership and commitment to effectively implement this Environment Management System?	●	○		Commitment demonstrated	Company CEO has signed Environmental Impact Management Policy -31/08/20	C
1.2	Have interested parties (e.g. community, local authority) been determined and have their relevant needs and expectations been identified?	●	○		Neighbours consulted	Property Spray plans in place	R
1.3	Has an Environment Policy Statement been established and implemented?	●	○		As above	Company CEO has signed Environmental Impact Management Policy -31/08/20	R

2. Planning and Objectives							
Ref	Question	Y	N	NA	Comment	Evidence Provided	Level
2.1	Has the scope of this assessment (i.e. current land use and location) been determined?	●	○		Current land use is apple orchard production	Farm maps and the FEMP detail the current land use	C
2.2	Have the environmental aspects (e.g. soil management) to be covered by this EMS been determined?	●	○		Soil management is determined	Soil management plan, soil maps, FEMP completed	C
2.3	Have short and long-term environmental objectives been established for the relevant environmental aspects?	●	○		Determined for the specific and current land use	Integrated Management Plans for the production areas include IPM, maintenance of existing and planned plantings	M
2.4	Have targets been set/adopted to reduce environmental impact and enhance the surrounding environment?	●	○		Integrated Management Plan and FEMP set targets	Wildlife audits of production areas, annual review of the site IMP's.	M

3. Support for Implementation of the EMS							
Ref	Question	Y	N	NA	Comment	Evidence Provided	Level
3.1	Has the Farm Environment Plan been prepared by an approved adviser where required by the local authority?	●	○	○	Prepared by Soter Rural Compliance	Adviser x completed 1st September 2020	C
3.2	Is advice on nutrient, soil and irrigation management obtained from an adviser or agronomist, and can they illustrate their competence by providing evidence of appropriate training and/or qualifications? If advice is not obtained from an adviser, is the grower's experience complemented by evidence of technical knowledge?	●	○	○	Internal competence is partial and ongoing with competent agronomist used Soter Rural Compliance.	Adviser x has the required competencies and is recognised by the Hawkes Bay Regional Council dated 1st August 2016. Competent Nutrient management advisor programme graduate 2017. Fruit Fed Ltd horticultural consultants hold relevant competencies.	C
3.3	If a nutrient budget has been prepared for the property, has it been completed by a certified nutrient management adviser where required?	●	○	○	Overseer is used.	Overseer is used, completed by Adviser x	C
3.4	Have environmental training needs of relevant staff been identified and has training been provided or planned where necessary?	●	○	○	Ongoing training and building of internal competence required and planned.	Internal staff are trained in GAP, hold diplomas and Bachelor qualifications in Fruit production and Horticultural Science	M
3.5	Are appropriate elements of the EMS (e.g. environmental risks, mitigations and actions) communicated to relevant staff and/or contractors?	●	○	○	Site visits by Soter Rural Compliance and the internal team with orchard managers	FEMP is available to orchard managers and discussed at on site meetings. Manager engagement is an integral part of the commitment to the EMS.	M

4. Resource Consents							
Ref	Question	Y	N	NA	Comment	Evidence Provided	Level
4.1	Does the grower hold current **water extraction and use** consents, or other local authority approvals (e.g. permitted activity), where required?	●	○	○	Current water consents are issued and on file.	Register of current water consents issued by the Hawkes Bay Regional Council on file and listed on page 3 of this document	R
4.2	Does the business hold current **land use** consents, or other local authority approvals (e.g. permitted activity), where required?	○	○	●	Not required		R
4.3	Does the grower hold current **discharge** consents (air/land/water) or other local authority approvals (e.g. permitted activity), where required?	○	○	●	No current water discharge consents required		R

5. Property Plan (Map)							
Ref	Question	Y	N	NA	Comment	Evidence Provided	Level
5.1	Has an up to date property plan (e.g. map) been prepared which details important site features as required by the local authority (Template 5A)?	●	○		Comprehensive Google based property maps are on file	Maps detail soil type, land use, water source and natural waterways, tracks, shelter trees , fertiliser and PPP storage	C

6. Soil Management

Ref	Question	Y	N	NA	Comment	Evidence Provided	Level
Soil quality, health, structure and fertility							
6.1	Has a soil assessment been completed to determine soil quality, health, structure and fertility (Template 6A)?	●	○		Annual soil tests in rotation across the production areas. New developments have mandatory soil test.	Form 6A competed with required details. Fruit Fed Ltd provide independent soil sampling and nutrient recommendations	C
6.2	Have techniques been used to maintain or improve soil quality, health, structure and fertility (Template 6B)?	●	○		Flat sites, no erosion risks, no historic flood risks	Form 6a completed. No crop rotation, no cultivation, tree prunings are mulched	M
Erosion and Sediment control (cultivated, bare or erosion prone soil)							
6.3	Has the risk of soil erosion and sediment loss been assessed for the property (Template 6C) and paddocks (Template 6D – cultivated or bare soil)?	●	○		Assess ed in the IMP and FEMP and form 6C completed.	Flat sites, grassed down between rows, No surface water, culverts in place, root ripping, alternate row spraying practices all contribute to soil risk management	C
6.4	Are appropriate measures implemented (or planned) and maintained to stop or control surface water entering the paddock (Template 6E)?	●	○	○	Flat sites, controlled waterways, flood control banks., tile drained sites.	FEMP pages 34-37 addresses this and maps detail waterways, culverts and natural rivers streams etc	M
6.5	Are appropriate measures implemented (or planned) and maintained to reduce or minimise the risk of soil erosion (Template 6F)?	●	○	○	Form 6F completed	Flat sites, grassed down between rows, new cultivated sites are grassed down ASAP	M
6.6	Are appropriate measures implemented (or planned) and maintained to reduce or minimise sediment loss (Template 6G)?	●	○	○	Form 6G completed	Flat sites, grassed down sites, no surface water	M
6.7	Are records kept for cultivations, sowing, planting, and other relevant field operations (e.g. wheel track ripping)?	●	○	○	Annual production registrations, SOP new plantings	Permanent tree crop, SOP for preparation and planting of new developments on file	M
6.8	Do any newly adopted mitigations/measures meet the minimum design and operation requirements outlined in relevant industry guidance and codes of practice (e.g. sediment retention ponds)?	○	○	●	No new mitigations required		M

7. Nutrient Management							
Ref	Question	Y	N	NA	Comment	Evidence Provided	Level
7.1	Has the risk of nutrient loss been assessed for the property (Template 7A) and growing activity (Templates 7B)?	●	○		Forms &a and B completed. FEMP completed 1st September 2020	Overseer used. Light fertile soils require minimal nutrient inputs	C
7.2	Are measures implemented (or planned) to improve nutrient uptake and minimise nutrient loss to the environment (Template 7C)?	●	○	○	Form 7C completed	Minimal nutrient inputs. No measures are required or being considered.	M
7.3	Are fertilisers handled, stored and used to minimise the risk of spillage and contamination of the environment?	●	○	○	Dedicated fertiliser on site stores	Fertiliser stores have concrete floors, located away from water ways and supplies. Liquid nutrients are sored in bunded area	C
7.4	Is all fertiliser spreading equipment calibrated so that it can accurately deliver the recommended treatment?	●	○	○	Annual calibration	Annual sprayer and fertiliser spreader calibration by independent service providers	M
7.5	Is there an appropriate system in place for recording the application of organic and inorganic nutrients and conditioners (including both soil and foliar applications)?	●	○	○	Initial nutrient recommendations from consultants,	Fertlisers (solid and foliar) application instructions also provided record of application, signed and dated.	M
7.6	Is water used in nutrient solutions stored and discharged according to industry guidance local authority rules where required (Guideline for Greenhouse Nutrient Solution Discharge)?	○	○	●	Not applicable	Not applicable	M
7.7	Have measures been taken to recycle nutrients where feasible and appropriate (e.g. hydroponics)?	○	○	●	Not applicable	Not applicable	R

7. Nutrient Management							
Ref	Question	Y	N	NA	Comment	Evidence Provided	Level
Nutrient budget: (Note: Level for questions 7.8-7.11 is "Critical" if required by resource consent or local authority rules)							
7.8	Has a current nutrient budget been prepared for the property, where required, using a tool approved by the local authority (e.g. Overseer, NCheck)?	●	○	○	Overseer budget prepared for property	Overseer records show 9kg N/year/ha	R
7.9	Has an assessment of the nutrient budget been completed and has it been determined to be robust and accurate?	●	○	○	Overseer completed by Soter Rural Compliance consultant	Overseer completed by Soter Rural Compliance consultant	R
7.10	Has a Nutrient Loss Baseline been calculated for the property where required by the local authority?	●	○	○	Overseer used.	Overseer records show 9kg N/year/ha	R
7.11	Does the current nutrient budget show compliance with regulatory limits (e.g. local limit or resource consent limit)?	●	○	○	Overseer used. Limit not yet set by the HB Regional Council for horticulture in the region.	Overseer records show 9kg N/year/ha	R

8. Irrigation and Water Management

Ref	Question	Y	N	NA	Comment	Evidence Provided	Level
8.1	Has an environmental risk assessment been completed for all water uses (Template 8A)?	●	○		Compliant	Weekly soil moisture monitoring using Neutron probes by Fruition Horticulture Services Ltd. Readings are emailed.	C
8.2	Are measures implemented or planned to ensure that water use is optimised and risks to the environment are minimised (Template 8B)?	●	○	○	Mini sprinklers and drippers are installed for under tree irrigation providing efficient application.	Mini sprinklers and drippers are installed for under tree irrigation providing efficient application.	M
8.3	Is the irrigation system assessed, maintained, calibrated and evaluated to ensure optimal performance?	●	○	○	Mini sprinklers and drippers are installed for under tree irrigation providing efficient application. Annual preseason maintenance	Ag First Ltd irrigation consultants calibrate the irrigation system annually	M
8.4	Are appropriate records of irrigation applications kept?	●	○	○	Neutron probe weekly monitoring results and telemetric water meter readings	Neutron probe weekly monitoring results and telemetric water meter readings	M
8.5	Has major new irrigation infrastructure been designed and installed in accordance with industry standards and codes of practice? Have new irrigation systems been commissioned to meet the INZ Piped Irrigation System Design and Installation Codes of Practice and standards?	○	○	●	None to date		R
8.6	Is water used for floatation, washing and cleaning disposed of in accordance with industry guidance and local authority rules where required (e.g. Vegetable Washwater Discharge Code of Practice)?	○	○	●	Not used on orchard.		M
8.7	If identified as feasible (considering impacts on food safety), have measures been taken to collect and/or recycle water?	○	○	●	Not used on orchard		R

9. Water Body Management							
Ref	Question	Y	N	NA	Comment	Evidence Provided	Level
9.1	Has an environmental assessment of waterways, drains and point sources (e.g. waste storage) been undertaken to determine if there are any risks of contamination from the property?	●	○		IMP for each site, FEMP completed	IMP for each site, FEMP completed includes waterways on site and adjacent to the orchards, fish activities, drainage, run-off	C
9.2	Are measures in place to protect waterways from contamination using appropriate containment, barriers, setbacks, buffers or riparian planting?	●	○	○	Buffers zones created	Buffers zones created, headlands, shelter belts and plantings of trees and shrubs	M
9.3	If livestock are part of cropping rotations, are they excluded from applicable waterways where required?	○	○	●	No livestock on orchard		M
9.4	Are waterways and drains managed to protect and enhance biodiversity and mahinga kai values (traditional value of food resources) (Template 9A and 9B)?	●	○	○	Ongoing feasibility of continued plantings around waterways on site and adjacent to the orchards as part of the IMP and FEMP.	Buffers zones created, headlands, shelter belts and plantings of trees and shrubs alongside waterways where possible.	M

10. Environmental Actions and Continuous Improvement							
Ref	Question	Y	N	NA	Comment	Evidence Provided	Level
10.1	Has an adequate environmental action plan been developed which includes short-term and long-term actions (Template 10A and/or Templates 6B, 6E, 6F, 6G, 7C, 8B, and 9B)?	●	○		IMP and FEMP for the production areas, Forms 10A, 6B, E,F,G,7C,8B and 9B completed	IMP and FEMP for the production areas detail ongoing action and planning for continued improvement.	C
10.2	Have processes been established to ensure that the actions identified in the environmental action plan are undertaken?	●	○	○	Staff and Case Study 1 culture is one of commitment to ongoing improvement and development of habitat, waterways and bio diversity.	IMP and FEMP for the production areas detail ongoing action, maintenance of existing habitat and planning for continued improvement.	M
10.3	Have identified actions been completed to an acceptable standard in accordance with the timelines in the environmental action plan?	●	○	○	Staff and Case Study 1culture is one of commitment to ongoing improvement and development of habitat, waterways and bio diversity.	Annual checks of each site, IMP review, wildlife audits and commitment to continual improvement.	M
10.4	Are existing environmental mitigations managed and maintained to ensure their ongoing effectiveness?	●	○	○	Staff and Case Study 1 culture is one of commitment to ongoing improvement and development of habitat, waterways and bio diversity.	Annual checks of each site, IMP review, wildlife audits and commitment to continual improvement.	M
10.5	Have any aspirational environmental actions or enhancements been implemented (i.e. Best Management Practice)?	●	○	○	Staff and Case Study 1 culture is one of commitment to ongoing improvement and development of habitat, waterways and bio diversity.	Commitment to ongoing reduction in waste from each site, Ag Recovery, plastics, paper, glass, fuels, fertiliser and PPP's.	R
10.6	Has the EMS been reviewed at planned intervals (at least annually), to support continuous improvement and ensure its continuing suitability, adequacy and effectiveness?	●	○		First year 1st September 2020	Annual orchard manager meetings to review site IMP's and plan continued improvements. CEO signed Environmental Impact Management Policy - 31/08/20	C

11. Corrective Action Summary					
Question Reference	Question Level (C, M, R)	Audit findings	Required Action	Due Date	Actual Close Out Date

EMS Audit report

Audit Report for NZGAP

Environment Management System (EMS) Add-on

Business Details	
NZGAP Number:	1234
Business Name (Legal Entity):	TANK Case Study 1
Business owner (s):	TANK Case Study 1
Physical address (main site):	Hastings, New Zealand
Responsible manager:	Grower x
Conformity Assessment Body Details	
Auditor Name:	Auditor X
Audit date:	4th November 2020
Audit Scope	
Standard:	NZGAP EMS add-on version 1.6 Nov 2019
Crop groups:	Horticultural production - Fruit
Properties:	Property 1
Years in programme:	One

Non-compliances – *all corrective actions should be completed within agreed timeframes. If not completed within 28 days, then certification may be suspended. If the suspension is not resolved, then certification may be cancelled plus the relevant regulator may be notified.*

Details of Non-Compliances and Agreed Corrective actions

Question Ref	Level/ Category (C, M, R)	Audit findings	Required Action	Agreed Due Date	Actual Close Out Date	Auditor Sign off
		No Non-Compliances Identified				

Auditor Sign-off			
Follow Up Visit Required?	No	**Due date (if yes):**	
Signed:	x	**Report Date:**	09th March 2021

Disclaimer: All commercially sensitive information obtained during this assessment or containment in this report remains confidential to the Client and the Conformity Assessment Body. The scope of this assessment is limited to the NZGAP standard. This assessment does not absolve the business assessed from any Statutory requirements under which the business is legally registered or licensed. This report will be shared with NZGAP.

EMS Certificate

Valid until

January 2022

Certificate

This is to certify that

Case Study 1

Has met the assessment requirements
of NZGAP and is certified as a:

Environment Management System
(EMS) add-on

Environment

NZGAP Signatory

NZGAP Number:	1234
Date of Issue:	09/03/2021
This certificate is valid until:	18/01/2022

Unless otherwise stated at www.nzgap.co.nz/checkregister

NZGAP
NEW ZEALAND
GOOD AGRICULTURAL PRACTICE

New Zealand Good Agricultural Practice
www.nzgap.co.nz

NZGAP, PO Box 10232,
The Terrace, Wellington, 6143, New Zealand

APPENDIX J: TANK CASE STUDY 2: – INDUSTRY PROGRAMME FRESHWATER FARM PLAN (NZGAP EMS ADD-ON)

Horticulture's Good Agricultural Practice Industry Programme

Freshwater Farm Plan Summary

Business name:
Case Study 2

Year:
2020

Assurance Programme:
GLOBALG.A.P.

Farm planning module:
NZGAP Environment Management System (EMS) add-on v1.6

GLOBALG.A.P. number:
12345

Audit result:
Compliant

Certification status:
Certified
(Expires 15/09/2021)

Farm information

Growing region(s)	**Hawkes Bay**
Orchard area (total)	**46.5ha**
Orchard area (production)	**46.5ha**
% leased versus owned land for production	**76% owned 24% leased**
List crops currently grown	**Fruit, processed and fresh veges**
List other land uses and area, e.g. arable, dairy, dry stock	**Livestock**

TANK Proposed Plan Change 9 rule

Rule TANK 1 Use of Production Land

The use of production farm land where:	Measures in place to meet rule?	What measures are in place to meet rule?
(a) 20 or more hectares of the farm is arable land use	n/a	
(b) 5 or more hectares of the farm is horticultural land use	n/a	
(c) 20 or more hectares of the farm is pastoral land use	n/a	
(d) 20 or more hectares of the farm is a combination of any 2 or more of the land uses	✓	FW-FP developed via NZGAP EMS add-on

Environmental action plan

Ref.	Management area and risk addressed (e.g. soil erosion)	Action to be completed	Location	Person responsible	Expected Date of Completion	Actual Date of Completion	Evidence to be Provided (e.g. records, photo)
6A.8	Nutrient soil test	Record Deep N test	All	Fertiliser Manager	Ongoing		Copy of test results on file
8B.6	Irrigation calibration	Record the calibration process	All	Operations Manager	Dec 2021		Calibration records on file
	Personnel training	Environmental training needs analysis and develop training plan	All	People Manager	Jan 2022		Evidence of staff trained

Contents

The contents of this FWFP case study are limited to the background information and example evidence, and does not include a copy of the NZGAP EMS add-on templates: FEP Template and Audit Checklist.

CASE STUDY BACKGROUND INFORMATION

Regulation and resource consents

Applicable regulation and existing resource consents

Hawke's Bay Regional Council
Proposed TANK Plan Change 9 *(as written in amended PPC9 that accompanied the s42a report as Appendix 1A, not the notified version of PPC9)*

Rule TANK 1 Use of Production Land (Permitted Activity),
The use of a farm where:
(a) 20 or more hectares of the farm is arable land use; or
(b) 5 or more hectares of the farm is horticultural land use; or
(c) 20 or more hectares of the farm is pastoral land use; or
(d) 20 or more hectares of the farm is a combination of any 2 or more of the land uses described above.

Permitted Activity Standards

- (d) The farm area has less than 75% plantation forest cover,
- (e) Either;
  - (i) The farm operator is either a member of a TANK Industry Programme or a member of a TANK Catchment Collective within the timeframes specified in Schedule 28 and accordance with the requirements of Schedule 30;
  - (ii) The farm operator shall prepare a Freshwater Farm Plan in accordance with the requirements of Schedule 30 and within the timeframes specified in Schedule 28; and the Freshwater Farm Plan is being implemented and;
    1. the Council shall be provided with the Freshwater Farm Plan upon request;
    2. information about the implementation of the mitigation measures identified for the farm shall be supplied to the Council on request.
- (f) Where a farm is in a high priority catchment for total nitrogen concentration or nitrogen yield as shown on the Planning Maps for Schedule 28 the freshwater farm plan shall include in accordance with Schedule 30 the
  - (i) The nitrogen loss rate (kg/ha/hr) and
  - (ii) Nitrogen loss rate target.

Current resource consents

Farm description

Farm information

Growing region(s)	Hawke's Bay
Farm area (total) in hectares	46.5 hectares
Farm area (production) in hectares	46.5 hectares
% leased versus owned land for production	76% owned, 24% leased
List crops currently grown	Fruit, Fresh Vegetables, Process vegetables
List other land uses and area, e.g. arable, dairy, dry stock.	wine grapes, pasture, lucerne, livestock
Applicable regulatory requirement and resource consents	See above
Farm description	See below

With fertile lands nestled across the Heretaunga plains flanking the Ngaruroro river, TANK Case Study 2 is blessed with rich soils to grow our produce and business since 1966.

The focus of this FEP summary report is TANK Case Study 2, situated in the Ahuriri River catchment. Processed and fresh vegetables are grown on these blocks.

Figure 1 below provides an overview map of the property.

Figure 2: Overview map of TANK Case Study 2.

Catchment assessment

The catchment assessment considers the catchment context of the activity based on the nature of the farming activity and the suitability of that activity to the land, and the current water quality status in the receiving environment(s).

Catchment and surrounding information

Catchment(s):	Ahuriri River
Nearest downstream water quality monitoring site(s):	Taipo Stream at Church Rd The Taipo Stream at Church Road site is a HBRC freshwater quality and ecology monitoring site. Downstream an enhancement project has naturalised the stream bed, and created a wetland area with plantings. (Source: LAWA website)

Screening measures and farm plan information

Activity and land use capability	
Current farming activity: Land use capability class(es):	Horticulture – established fresh and processed vegetable farm. LUC 2 (see Maps in following Section FWFP Evidence)
Receiving water quality status	
PPC9 Schedule 28 Planning Maps 1-4 *(As they appear in Appendix 2 of the s42a report)*	The TANK Case Study 2 is located in a priority catchment for: Sediment yield: High priority Total nitrogen yield: High priority *(Note comments of Ms Sturgeon on 'Amendments to Planning Maps')*

Screening assessment and outcome

Suitability of activity for land use	
Outcome:	Land used for commercial vegetable growing in LUC 2. Land use deemed suitable for commercial horticulture.
Receiving water quality status relating to management regime	
See environmental vulnerability assessment on the following page.	

Environmental vulnerability assessment

To determine the level of ambition in their FW-FP, growers must assess the overall risk of their activity to freshwater and freshwater ecosystems based on the level of vulnerability of their receiving environment, and the magnitude of their discharge(s).

The **level of vulnerability** of the receiving environment is the degree to which the system is susceptible to, or unable to cope with, adverse effects of farming activities. The level of vulnerability in this FWFP is based on the TANK Priority Catchments in Schedule 28 (*of Appendix 2 of the s42a report*) in the screening assessment above.

The **magnitude of the discharge** from farming activities on the receiving environment(s) is determined through the FW-FP farm scale risk assessment (see detailed farm plan in Section 2).

Risk = Magnitude * Vulnerability

	Catchment Vulnerability		
Magnitude of Discharge	Low	Medium	High
Low	**GMP**	**GMP**	**GMP**
Medium	**GMP**	**BMP**	**BMP**
High	**BMP**	**BMP**	**BMP**

Growers can set the level of ambition in their farm plan for each management area based on this assessment.

The table on the following page steps through this process for TANK Case Study 2 blocks.

Risk / management information	Catchment Vulnerability	Discharge Magnitude	RISK Outcome
Erosion and sediment control			
Land is cultivated for vegetable growing. Average paddock slope is less than one degree therefore erosion risk is low. Cover crops are used between crops in rotation to minimise sediment loss. Edge-of-field mitigations suitable for flat land installed where most needed.	Activity situated in high priority catchment for sediment. Catchment is assessed as **HIGH vulnerability**	Erosion and soil loss is assessed as **LOW Magnitude**	**Medium risk MAINTAIN at BMP**, as per FW-FP
Nutrient management			
High leaching activity, managed with GMP and BMP. A small contribution to the catchment load attributable to vegetable growing.	Activity situated in high priority catchment for Total Nitrogen and Nitrate. Catchment is assessed as **HIGH vulnerability**	Nutrient loss is assessed as **LOW magnitude**	**Medium risk MAINTAIN at BMP**, as per FW-FP
Irrigation and water use management			
Rainfall and irrigation monitoring. Targeted irrigation (volume, timing) based on soil moisture sensor monitoring, soil type, and external hydro advisory services.	Flow Regime is unassessed, treat as **HIGH vulnerability**	Irrigation loss is assessed as **MEDIUM Magnitude**	**Medium Risk IMPROVE to BMP**, and document in Action Plan

Nutrient Management (LandWISE nutrient budget example)

PCC9 Schedule 30, Environmental Outcome 2.3[12] states:

The Freshwater Farm Plan must include measures to address Nutrient Management in any catchment or programme area where water quality objectives for nitrogen concentrations as detailed in Schedule 26 are not being met, including:

c) development of an inventory of the current nitrogen loss rate (kg/ha/year) for every property as determined by application of Overseer (or an alternative nutrient budget model approved by the Hawke's Bay Regional Council) and a target nitrogen loss rate that demonstrates industry good practice by a suitably qualified independent practitioner;

d) a description of any mitigation measures identified as necessary to meet water quality objectives on those properties or within the relevant catchment; c) annual recording and reporting of nutrient input and export data, including annual nitrogen loss rates.

TANK Case Study 2 implements a range of industry good practices to plan nutrient inputs for each crop, including using external nutrient advisers, crop calculators and nutrient budget tools, regular soil tests, soil moisture sensor data, and selecting appropriate fertiliser types.

To manage nitrogen loss from this property, the following actions will be undertaken:

Objective	Action	Measure
Nutrient management	Use of crop specific nutrient budgets to decide appropriate fertiliser requirements based on crop guide and soil tests.	LandWISE nutrient budget templates

TANK Case Study 2 has not modelled nitrogen loss using OverseerFM because the model does not accurately represent vegetable rotations for reasons stated in Stuart Ford's evidence.

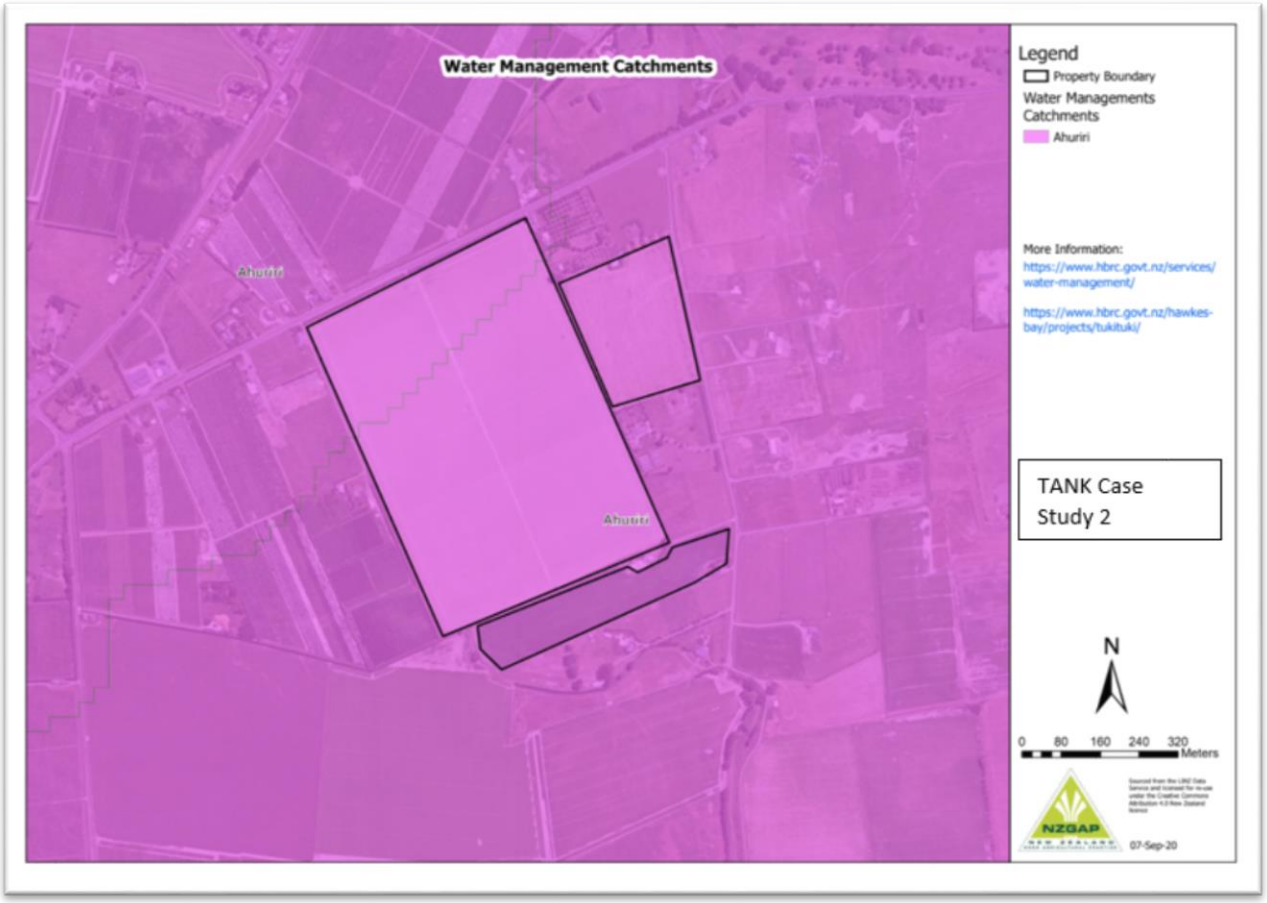
A proxy loss rate for each rotation, like N-CHECK in Canterbury, would provide a baseline N loss rate for the purposes of Council's catchment budget calculation.

At the farm scale, TANK Case Study 2 uses decision support tools to plan and review their nutrient use, such as the LandWISE Nutrient Budgets. An example Nitrogen Budget for one sweetcorn crop is provided in the following Section 2 "FWFP Evidence (NZGAP EMS Add-on)". The nutrient budgets enable TANK Case Study 2 to calculate how much nitrogen is needed for a crop, and allows them to compare their nutrient use to industry recognised good practice.

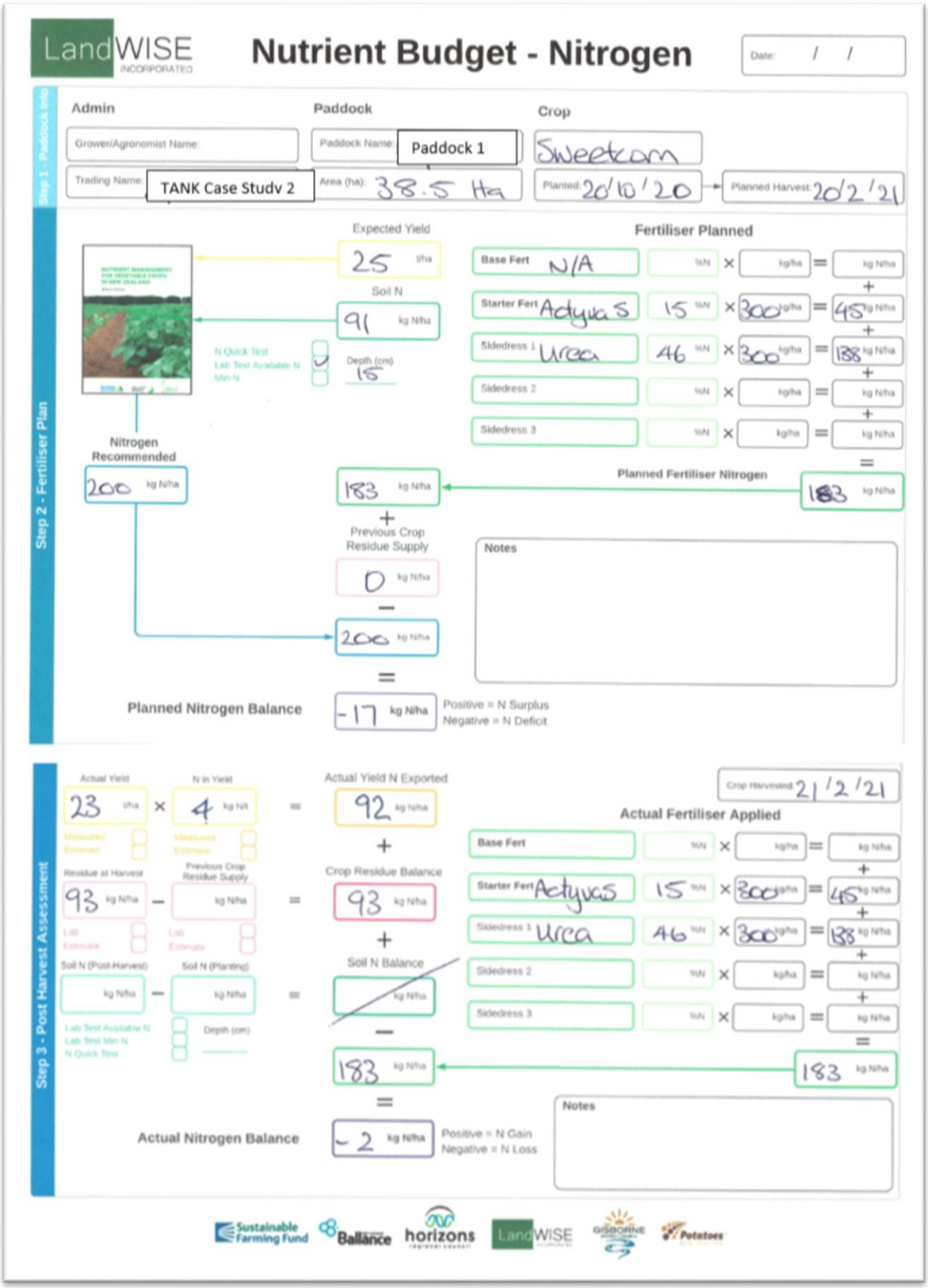
12 Reference: TANK Proposed Plan Change 9, Section 42A Report, Appendix 1B Schedules: Schedule 30, Section A: Industry Groups and Catchment Collectives Governance and Management.

FWFP EVIDENCE (NZGAP EMS ADD-ON)

Maps (catchment only)



Nutrient Budget (Landwise)



LandWISE INCORPORATED

Nutrient Budget - Nitrogen

Date: / /

Step 1 - Paddock Info

Admin	Paddock	Crop
Grower/Agronomist Name:	Paddock Name: Paddock 1	Sweetcorn
Trading Name: TANK Case Studv 2	Area (ha): 38.5 Ha	Planted: 20/10/20 → Planned Harvest: 20/2/21

Step 2 - Fertiliser Plan

Expected Yield: 25 t/ha

Soil N: 91 kg N/ha

N Quick Test / Lab Test Available N / Min-N — Depth (cm): 15

Nitrogen Recommended: 200 kg N/ha

183 kg N/ha + Previous Crop Residue Supply: 0 kg N/ha − 200 kg N/ha =

Planned Nitrogen Balance: -17 kg N/ha — Positive = N Surplus, Negative = N Deficit

Fertiliser Planned

Base Fert	N/A	%N	× kg/ha	= kg N/ha	
Starter Fert	Actyva S	15 %N	× 300 kg/ha	= 45 kg N/ha	+
Sidedress 1	Urea	46 %N	× 300 kg/ha	= 138 kg N/ha	+
Sidedress 2		%N	× kg/ha	= kg N/ha	+
Sidedress 3		%N	× kg/ha	= kg N/ha	+

Planned Fertiliser Nitrogen: 183 kg N/ha =

Notes

Step 3 - Post Harvest Assessment

Actual Yield: 23 t/ha × N in Yield: 4 kg N/t = Actual Yield N Exported: 92 kg N/ha

Residue at Harvest: 93 kg N/ha − Previous Crop Residue Supply: kg N/ha = Crop Residue Balance: 93 kg N/ha

Soil N (Post-Harvest): kg N/ha − Soil N (Planting): kg N/ha = Soil N Balance: kg N/ha

183 kg N/ha =

Actual Nitrogen Balance: -2 kg N/ha — Positive = N Gain, Negative = N Loss

Crop Harvested: 21/2/21

Actual Fertiliser Applied

Base Fert		%N	× kg/ha	= kg N/ha	
Starter Fert	Actyva S	15 %N	× 300 kg/ha	= 45 kg N/ha	+
Sidedress 1	Urea	46 %N	× 300 kg/ha	= 138 kg N/ha	+
Sidedress 2		%N	× kg/ha	= kg N/ha	+
Sidedress 3		%N	× kg/ha	= kg N/ha	+

183 kg N/ha =

Notes

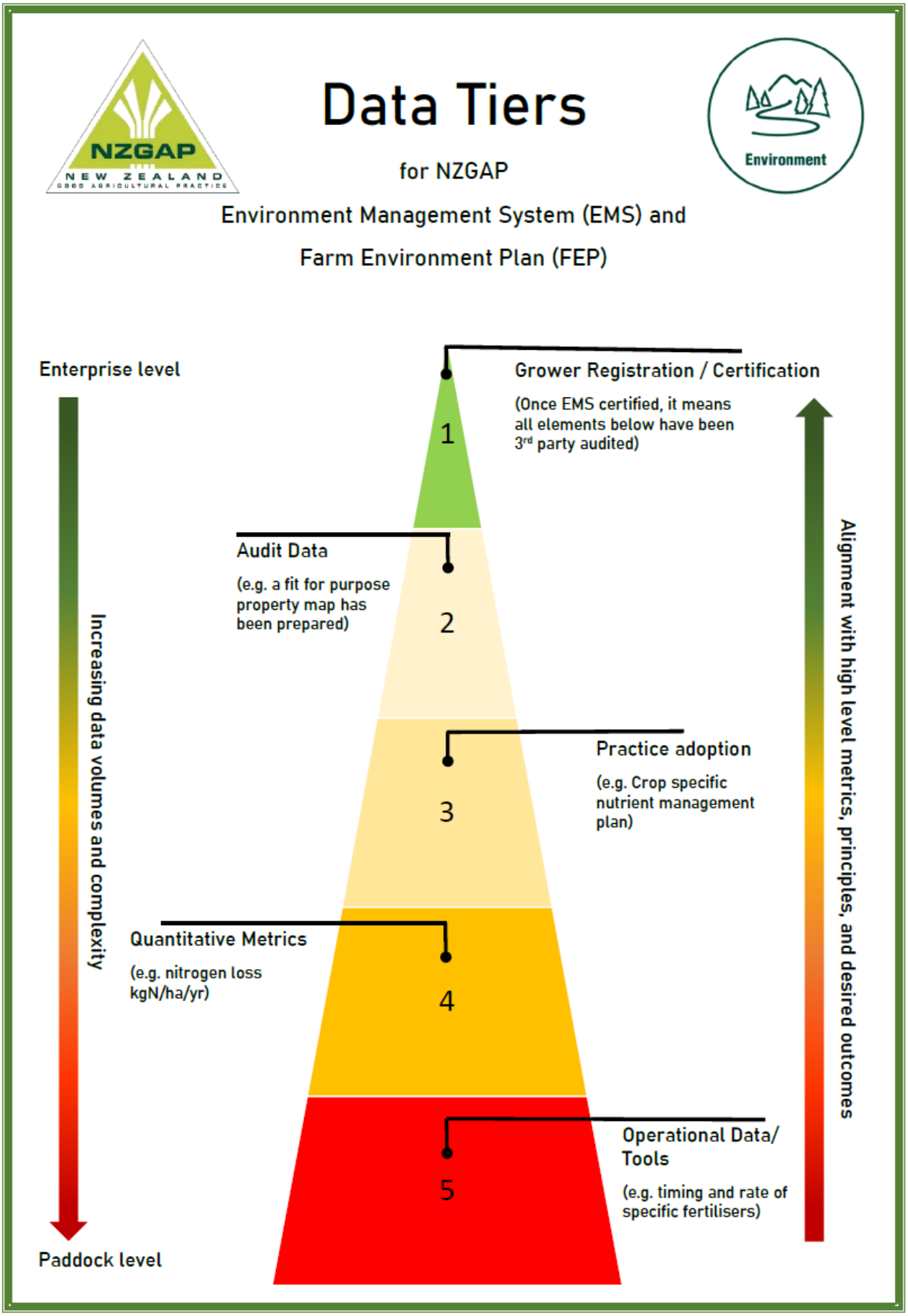
Sustainable Farming Fund · Ballance · horizons · LandWISE · Gisborne · Potatoes

APPENDIX K – STEPS TO MEET FEP REQUIREMENTS VIA NZGAP EMS ADD-ON

Steps for growers to meet FEP requirements via NZGAP EMS add-on

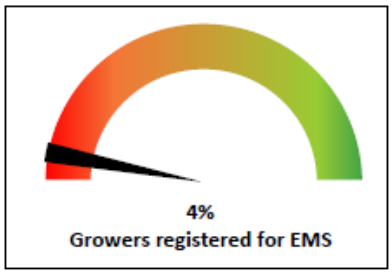
No.	Task	Sub-task	Complete (tick)	Who
1.	Register for NZGAP (or GLOBALG.A.P.)	a. Complete NZGAP (or GLOBALG.A.P.) registration form and pay registration fee	☐	Grower
2.	Register for the EMS add-on Link to EMS registration form	b. Complete EMS registration form, submit to NZGAP (nzgapmap@gmail.com) and pay registration fee	☐	Grower
		c. Receive EMS manual via post and/or download from NZGAP	☐	NZGAP
3.	Map your farm	a. Map your property boundary (owned and leased land) link to mapping guide	☐	Grower
		b. **Share map with NZGAP** nzgapmap@gmail.com (scanned, electronic or Google MyMap	☐	Grower
		c. Get relevant map layers from NZGAP (catchment, LUC, Soil type, soil class, streams)	☐	NZGAP
		d. Draw property details on your map (see EMS Template 5A for list of required details)	☐	Grower
4.	Develop your Farm Environment Plan (EMS Templates) • Risk assessment • Identify current practices • Develop action plan	a. Soil Management (EMS Templates 6A & 6B)	☐	Grower
		b. Erosion and Sediment Control (EMS Templates 6C to 6G)	☐	Grower
		c. Nutrient Management (EMS Templates 7A to 7C)	☐	Grower
		d. Irrigation and Water Management (EMS Templates 8A & 8B)	☐	Grower
		e. Waterbody and Biodiversity Management (EMS Templates 9A & 9B)	☐	Grower
5.	Measure/Quantify your farm's environmental impact	a. Nutrient loss	☐	If applicable
		b. Soil erosion and sediment loss (DMTW App - See VR&I Board website, or ask NZGAP)	☐	NZGAP
6.	Complete EMS checklist self-assessment	Complete EMS Checklist self-assessment in preparation for audit (largely supported by EMS Templates). Sections: • Organisation and Management, Planning and Objectives Support for Implementation, Resource Consents - Mapping - Soil Management - Nutrient Management - Irrigation Management - Waterbody and Biodiversity Management • Environmental Actions and Continuous Improvement	☐	Grower
7.	FEP Review	a. A high level desktop review and feedback on your FEP	☐	NZGAP Grower
8.	Get an EMS audit	Alongside next GAP audit or as a standalone	☐	Grower / Auditor
9.	Make corrective actions	Take required corrective actions and report to your auditor	☐	Grower
10.	Implement Continuous improvement	Continue to implement GMP and improve environmental performance between now and your next EMS audit	☐	Grower

APPENDIX L: DATA TIERS FOR FARM ENVIRONMENT PLAN REPORTING VIA NZGAP



1st Tier – Registration / Certification Data

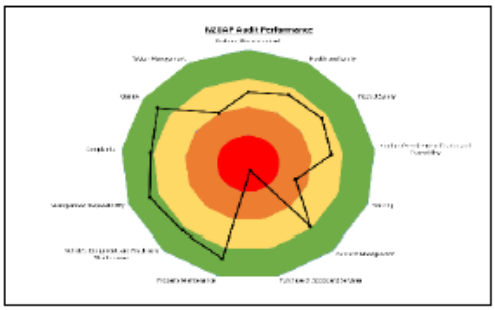
The highest level of data, describing the numbers and proportions of growers who have registered for and/or become certified with the EMS.
Business name, location, crops, areas. Can be aggregated by region. Provides 3rd party audited assurance that all approved EMS requirements have been met.



Data source: NZGAP database

2nd Tier – Audit Data

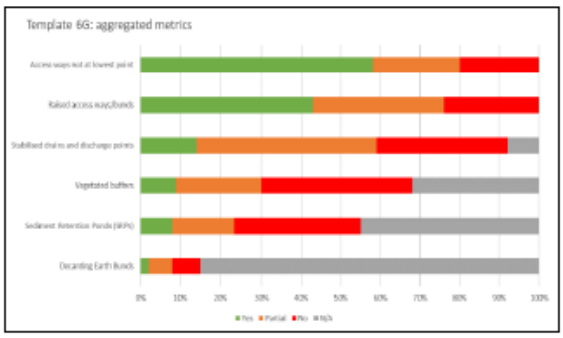
Data gathered from EMS audits by 3rd party independent auditors. Can be used to measure adoption of industry guidelines by measuring the proportion of non-compliances for each question.



Data source: Auditor data from EMS Checklist.

3rd Tier – Practices

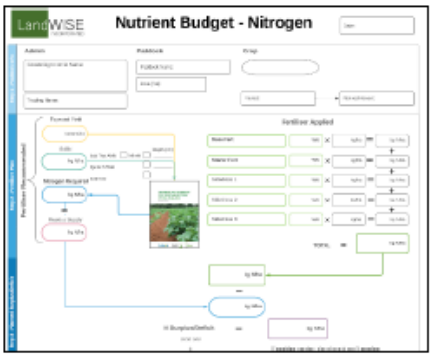
The data collected from the EMS Templates that can be used to measure the numbers and proportions of growers implementing specific practices (e.g. vegetated buffer strips, use of soil moisture probes).



Data source: EMS FEP Templates.

4th Tier – Quantitative Metrics

Data collected as part of the evidence supporting EMS implementation. Estimated total and average erosion rates, calculated nitrogen loss etc. Aggregation of individual quantitative metrics can be used to tell an industry story and demonstrate change.



Data source: Varied, includes ArcGIS (mapping), DMTW Erosion & Sediment app, and nutrient budget calculators.

5th Tier – Operational Data

The most granular level of data, examples include daily weather, when and where agrichemicals and fertilisers are applied, and management practices as and when they are used.

Sensor networks can be used to provide live operational data. Spray diaries can be analysed and presented as management tools.

Data source: Varied, includes agrichemical spray diaries, telemetered sensors, and operations logs.

Prepared by:

AGRILINK

BEFORE THE HEARING COMMISSIONERS APPOINTED BY THE HAWKE'S BAY REGIONAL COUNCIL

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

AND

IN THE MATTER of Proposed Plan Change 9 - Tūtaekurī, Ahuriri, Ngaruroro and Karamū (**PC9**)

STATEMENT OF EVIDENCE OF GILLIAN MARGARET HOLMES (WATER QUANTITY) FOR HORTICULTURE NEW ZEALAND

7 MAY 2021

ATKINS | HOLM | MAJUREY

Helen Atkins/Nicole Buxeda
PO Box 1585
Shortland Street
AUCKLAND 1140

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CONTENTS

SUMMARY

1. My evidence will address the approach taken by Horticulture New Zealand **(HortNZ)**, and particularly focuses on reviewing and assessing how PC9 Plan Provisions will allow growers to be able to continue to take and use water reliably within the TANK catchments in the future, as well as assessing whether PC9 is consistent with the NPSFM 2020.

2. The main points of my evidence are outlined below.

Water Quantity Objectives

3. I have reviewed the Water Quantity Objectives, and associated water quantity Policies and Rules to check the consistency to NPSFM 2020.

4. Even though it is acknowledged that the Council is still in the process of defining Freshwater Management Units, I believe that the TANK catchment would be appropriate to be defined as an FMU given its interconnectedness of the surface water bodies and groundwater.

5. In addition, I support the Water Quantity Objectives as they set the limits, targets and flow regimes for PC9 (OBJ TANK 16), with PC9 outcomes stated in OBJ TANK 17 and 18 and as such they are consistent with NPSFM 2020.

Lowland Stream Augmentation

6. Overall, I support the concept of stream flow maintenance and habitat enhancement schemes in the TANK catchments to maintain stream flows, mitigate stream depletion effects and to avoid minimum flow restrictions.

7. However, I do not agree with the wording in POL TANK 39 and Schedule 36 in the notified PC9 as it relies on consent applicants developing the stream augmentation schemes, with limited or no Council involvement. I believe it is important for Council to play some role in these schemes given they hold the environmental knowledge and data which would feed into the implementation of these schemes.

8. I believe Council's role in these schemes can vary dependent on the parties involved in the schemes, as some parties may wish to take a lead role in the scheme with Council taking a

role of ensuring sufficient progress is being made, while others may wish Council to lead the process.

9. I agree with the deletion of Schedule 36 and also agree with the changes proposed to Policy 39, as recommended in the S42A report, as I believe this provides greater clarity on how the stream augmentation schemes will be undertaken, specifically stating Council's role in these schemes, while also retaining the ability for consent holders to manage local schemes themselves (as provided for under POL TANK 39c)(i).

10. However, one addition that I believe would further increase the clarify with regards to augmentation would be to change the current definition of Actual and Reasonable in relation to applications to take and use water, and to include an augmentation quantity.

Minimum Flow

11. In their submission on PC9, HortNZ opposed the proposed increase to Tutaekuri River in Schedule 31 due to the potential for this to impact growers' water use in the future.

12. I have reviewed the recorded flows in the Tutaekuri River at Puketapu (data provided by HBRC) between December 1968 and March 2021 (with one 3 day restriction occurring in 1986), as well as the results of the SOURCE modelling scenarios (HBRC, 2018c), with no modelled restrictions as a result of the 2,500 L/s minimum flow. As such, I agree with the increased minimum flow of the Tutaekuri River.

13. With regards to the Ngaruroro River, I agree with the minimum flow remaining at the existing limit of 2,400 L/s. The results of the SOURCE modelling showed that the number of days of restrictions would increase with increased minimum flows, putting further pressure on water users in the TANK catchments.

14. However, it should be noted that this agreement with minimum flows in Schedule 31 is contingent on the current wording of Rule TANK 7 and 8 remaining as stated in the S42A Report, as this incorporates the root stock protection water requirement that is vital for growers.

Water Permit Transfers

15. I support the use of transfers as one of a range of approaches that can be undertaken to improve water use efficiency in

catchments that are fully allocated, as is the case for ground water in the TANK catchments.

16. I have reviewed the recommended changes to POL TANK 48 and Rules RRMP 62a and 62b outlined in the S42A report. I agree with the recommended changes as they provide further clarity on what can be undertaken as a transfer and they have also been designed to manage the spatial risk of transferring water permits.

17. In addition to the use of transfers in fully allocated catchments, I also support the use of other approaches to using the available water, including catchment collectives, water user groups, global water permits (as supported by POL TANK 52).

18. HortNZ has sought that water can be re-allocated in some circumstances under POL 37. I support the wording in Mr Dooney's evidence regarding this re-allocation because this would be within the interim groundwater limit provided in PC9, and therefore hydrologically equivalent to transfers.

High Flow Allocation

19. HortNZ had requested high flow allocation to be included for both the Ahuriri and Karamū catchments in Schedule 32, as well as revisiting the current high flow allocations. I do not think that these catchments should be included in Schedule 32 at this time, given the current lack of data in the Ahuriri catchment as well as the fact that both catchments are small lowland catchments. However, it is possible that a future plan change may identify a volume of water that could be harvested from these catchments.

20. Although I agree that the high flow allocation framework does provide a robust framework for allocation, I believe that the specific allocation limit for the Ngaruroro River stated in Schedule 32 (8,000 L/s) could be increased in the future.

21. The current allocation limit for the Ngaruroro River was set at 8,000 L/s based on the assumed future use of water. Modelling indicates the maximum take limit that would still achieve the environmental flow may be larger, and as such this limit does not fully implement 3.17 of the NPSFM 2020, which envisages take limits are set that meet environmental flows and levels.

22. As such, I believe the current limit of 8,000 L/s should be stated as an interim limit. This approach would be consistent with the

interim groundwater allocation limit specified in Policy 37 of PC9. I have recommended this change be made to the terminology outlined in Schedule 32 as outlined in Mr Dooney's evidence.

Root Stock Protection Water

23. Root stock protection water is the water required to maintain survival of permanent horticultural crops during drought and following minimum flow restrictions being imposed on surface water and groundwater takes.

24. Given the numbers of days of restrictions on the Ngaruroro River, HortNZ submission sought the inclusion of a priority allocation for root stock protection water as a limit rather than just the priority order specified in POL TANK 51.

25. I agree with the root stock protection water being covered by the permitted activity rule Rules TANK 7 and TANK 8, and I believe the restriction of the take up to 20 m^3/day in Rule TANK 7and 8 (based on the existing use before 2 May 2020) complies with NPSFM 2020 as an assigned limit and there are still restrictions on the take as outlined in the remaining components of Rule TANK 7 and 8.

Actual and Reasonable Use

26. I support defining Actual and Reasonable Use for consented water use as it forms a limit which allows Council to reduce the risk of over-allocation, drives the consent holders to use their water efficiently and to consider improvements in how existing water takes are undertaken. In addition, this information will aid the Council in fully understanding the actual water use in the TANK catchment and will provide accurate information to be used in future water allocation decisions.

27. However, I have concerns and recommendations on how the current definition is worded in PC9, in particular:

    (a) the lack of definition of "accurate" water meter data as there may be differing opinions on accurate;

    (b) the replacement of "maximum annual amount" with "average annual amount", and I support that maximum remains in this definition in order to provide for reliability to consent holders during dry years; and

(c) a change in the wording regarding the length of water meter record (10 years). I do not fully support the length of water meter record specified in this definition (10 years). Although, a long record such as 10 years will provide a reliable assessment of maximum water use, many consent holders may have less than 10 years of data collected. This data is still an important indication of actual and reasonable water use of the specific property. I believe that as long as the consent holder can demonstrate that the length of water meter data record covers periods of large drought events (in order to provide the 9/10 year reliability), then this water meter data volume should be considered valid as the Actual and Reasonable Use on the consent. In addition, a shorter length of water meter data record can be used in conjunction with IRRICALC, as a calibration of the calculations. This would enable all site specific components of water use to be considered under the Actual and Reasonable consented water volume.

INTRODUCTION

Qualifications and experience

1. My full name is Gillian Margaret Holmes.

2. I am employed by Jacobs New Zealand Ltd (Jacobs), an engineering and environmental consulting firm. I am contracted to provide hydrogeology/hydrology expertise on the Proposed Plan Change 9 - Tūtaekurī, Ahuriri, Ngaruroro and Karamū (PC9) 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 17 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 and joined Sinclair Knight Merz (now Jacobs) in 2007.

5. I have previously acted as an Expert Witness in groundwater related consent hearings and numerous hearings associated with Plan Changes throughout New Zealand. In addition, I was involved as an Expert Witness on the Proposed Water Conservation Order for the Ngaruroro River and Clive River on behalf of HortNZ.

6. I regularly provide expertise in the fields of hydrogeology and groundwater quality to a range of local government clients including Bay of Plenty Regional Council and other organisations such as HortNZ and Waka Kotahi New Zealand Transport Agency.

7. I am familiar with Plan Change processes through:

   (a) Providing technical support for expert witnesses for Variation 6 of the Waikato Regional Plan.

   (b) Supporting the expert witnesses for HortNZ on Hawke's Bay Regional Council's Tukituki River Catchment Plan Change 6.

   (c) Appearing as an Expert Witness for the Proposed Waikato Regional Plan Change 1 – Waikato and Waipa River Catchments on behalf of HortNZ.

Expert Witness Code of Conduct

28. Although this is a hearing before Hearings Commissioners, I confirm that I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2014. I have complied with the Code of Conduct in preparing this evidence and agree to comply with it while giving oral evidence. 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 these proceedings

29. I have been asked to prepare evidence based on my research and assessment for HortNZ in support of their key submission points on PC9.

Purpose and scope of evidence

30. My evidence will address the approach taken by Horticulture New Zealand **(HortNZ)**, and particularly focuses on reviewing and assessing how PC9 Plan Provisions will allow the growers to be able to continue to take and use water reliably within the TANK catchments in the future, as well as assessing whether PC9 is consistent with the NPSFM 2020.

31. The following specific matters have been identified as being key to assuring continued reliability to water users within the TANK catchments (note the PC9 references below relate to the notified version of PC9 rather than the S42a version):

    (a) Lowland stream augmentation and how Policies 39, 40 and the information included within Schedule 36, will enable stream augmentation to be undertaken successfully.

    (b) Allowing water permit transfers and other flexible approaches to water quantity management (Policy 37, 48, Policy 52(g) RRMP Rules 62a and 62b).

    (c) High flow allocation and how the volumes identified in Schedule 32 will enable additional water supply for users within the TANK catchments; and

    (d) The requirement for a specific volumetric limit for root stock protection water under minimum flow conditions

until storage or stream augmentation is provided for in the catchment (Policy 51, TANK 7 and 8).

(e) The Actual and Reasonable Use definition.

32. In preparing my evidence I have reviewed the following documents and evidence:

(a) AgFirst 2018. Modelling Restrictions and Nutrient Losses for Horticulture in the TANK catchment – An Economic Analysis. Prepared for Hawke's Bay Regional Council. Leander Archer and Jonathan Brookes, May 2018.

(b) HBRC 2021a. Hearing Report on Proposed Plan Change 9 Tūtaekurī, Ahuriri, Ngaruroro and Karamū Catchment Area, Hawke's Bay Regional Council Publication No 5550.

(c) HBRC 2021b. Stream Depletion Calculator, https://ahmedelwan.shinyapps.io/stream_depletion_calculator/.

(d) HBRC 2020. Proposed Plan Change 9 - Tūtaekurī, Ahuriri, Ngaruroro and Karamū Catchments, Strategic Development Group, HBRC Publications No. 5456, Hawke's Bay Regional Council.

(e) HBRC 2018a. Heretaunga Aquifer Groundwater Model – Development Report, Resource Management Group, HBRC Publication No. 4997, Hawke's Bay Regional Council.

(f) HBRC 2018b. Heretaunga Aquifer Groundwater Model-Scenarios Report, Resource Management Group, HBRC Publication No. 5018, Hawke's Bay Regional Council.

(g) HBRC 2018c. Surface Water Quantity Scenario Modelling in the Tūtaekurī, Ahuriri, Ngaruroro and Karamū Catchments, Greater Heretaunga and Ahuriri Plan Change (PC9), Resource Management Group Technical Report, HBRC Report No. 5013 – RM 18-28. Hawke's Bay Regional Council.

(h) Harkness, M. 2010. Ngaruroro River High Flow Allocation: June to November Period, MWH New Zealand Limited.

(i) McKay, P, 2020. Section 32 Evaluation Report – TANK Catchments Plan Change to Regional Resource

Management Plan Change 9, Report Reference No. MDL000487, Mitchell Daysh Limited.

(j) New Zealand National Policy Statement for Freshwater Management 2020. New Zealand Government.

(k) Rajanayaka, C. and Fisk, L. 2018. Irrigation Water Demand and Land Surface Recharge Assessment for Heretaunga Plains. Document number C16053\1, Aqualinc Research Limited.

(l) TANK Collaborative Stakeholder Group 2017a. TANK Collaborative Stakeholder Group Meeting No. 36, 38, Meeting Notes, Hawke's Bay Regional Council.

(m) TANK Collaborative Stakeholder Group 2018, Discussion Document for TANK meeting 38, High and Low Flow Allocation, Hawke's Bay Regional Council.

(n) WWAL, 2018. SOURCE Model Build Report, Report Reference WWA00018/Rev. 5, Williamson Water Advisory Limited.

(o) The evidence of HortNZ.

CONTEXT TO WATER QUANITY PROVISIONS

33. Numerous investigations have been undertaken into the groundwater and surface water within the TANK catchment as part of the PC9 process as summarised in Appendix 11 of the Section 42A report.

34. The main investigations and modelling work completed that have relevance to my evidence are as follows:

a) Development of a SOURCE model (WWLA 2018) and subsequent scenario running using calibrated SOURCE model (HBRC, 2018 c);

b) Development of a groundwater model of the Heretaunga Plains groundwater (HBRC, 2018a) and subsequent scenario modelling (HBRC, 2018b); and

c) Development of stream flow depletion calculator (HBRC, 2021b).

DETAILED REVIEW OF THE PLAN CHANGE PROVISIONS

35. In this section of my evidence I provide a detailed review of the water quantity plan change provisions as they relate to HortNZ. The provisions are discussed in the same order as they are outlined in the Section42A report.

36. The relevant parts of the S42A report that relate to Water Quantity and points raised in HortNZ's submissions are in Section 15. Specific sections that I will cover in my evidence are outlined below, along with statements of agreement and disagreement.

Water Quantity Objectives

37. Section 15.2 of the S42A report outlines the three Objectives related to Water Quantity – OBJ TANK 16, OBJ TANK 17 and OBJ TANK 18.

38. I have reviewed these objectives, and associated water quantity Policies and Rules to check the consistency to NPSFM 2020.

39. Even though it is acknowledged that the Council are still in the process of defining Freshwater Management Units **(FMU)**, I believe that the TANK catchment would be appropriate to be defined as an FMU given its interconnectedness of the surface water bodies and groundwater.

40. This interconnectedness means that even though the provisions of PC9 are divided into main rivers, tributaries and a defined groundwater aquifer, collectively managing these catchments will achieve the overall outcome of the FMU.

41. In addition, I support the Water Quantity Objectives as they set the limits, targets and flow regimes for PC9 (OBJ TANK 16), with PC9 outcomes stated in OBJ TANK 17 and 18 and as such they are consistent with NPSFM 2020.

Lowland Stream Augmentation

42. Section 15.3 of the S42A report outlines the provisions related to the Heretaunga Plains groundwater and allocation limits, with Section 15.3.6 and 15.3.7 discussing the flow maintenance provisions within the plan, i.e. POL TANK 39, Rules TANK 9 and 10, and Schedule 36.

43. Overall, I support the concept of stream flow maintenance and habitat enhancement schemes in the TANK catchments to maintain stream flows, mitigate stream depletion effects and to avoid minimum flow restrictions.

44. However, I do not agree with the wording in POL TANK 39 and Schedule 36 in the notified PC9 as it relies on consent applicants developing the stream augmentation schemes, with limited or no Council involvement. I believe it is important for Council to play some role in these schemes given they hold the environmental knowledge and data which would feed into the implementation of these schemes.

45. I believe Council's role in these schemes can vary dependent on the parties involved in the schemes, as some parties may wish to take a lead role in the scheme with Council taking a role of ensuring sufficient progress is being made, while others may wish Council to lead the process.

46. Concerns around the implementation of the POL TANK 39 and Schedule 36 were identified by HBRC in their submission on PC9, and as such the S42A report has recommended the deletion of Schedule 36 and an updated Policy 39.

47. I agree with the deletion of Schedule 36 and also agree with the changes proposed to Policy 39 as I believe this provides greater clarity on how the stream augmentation schemes will be undertaken specifically stating Council's role in these schemes, while also retaining the ability for consent holders to manage these schemes themselves (as provided for under POL TANK 39c)(i)).

48. However, one addition that I believe would give further clarification with regards to augmentation would be to change the current definition of Actual and Reasonable in relation to applications to take and use water to include an augmentation quantity.

49. Given PC9 has an emphasis on augmentation, I consider the required volume for augmentation should be considered under the actual and reasonable use for each consent. I have proposed the following wording, which would be included under d) of the current definition:

d) for takes with an associated minimum flow, the quantity required for augmentation during low flow periods, as calculated by the Stream Depletion Calculator.

50. With the inclusion of this definition, when an applicant goes to renew their consent, they would have to show Actual and Reasonable use for irrigation, either using water meter data (as specified under b) of the definition) or using IrriCalc (as is currently required under c) of the definition) and then also assess the volume of water required for augmentation using the Stream Depletion Calculator. The renewed consent would then have two separate volumes of water on their consent – one for irrigation and one for augmentation (with the specific requirements of when augmentation water can be used).

51. I believe by including this volume in the consent, this would provide greater clarity to both consent holder and Council on the volumes of water to be used in augmentation schemes in specific locations.

52. Note I discuss further changes to the definition of Actual and Reasonable use in paragraph 96 to 108 of my evidence.

Minimum Flows

53. Section 15.4 of the S42A report discusses the surface water low flow management, with Schedule 31 discussed in Section 15.4.3 and the priority order of water allocation (POL TANK 51) discussed in Section 15.4.12.

54. Schedule 31 outlines the assigned minimum flows for the TANK catchment main rivers. As Council are still in the process of defining the FMU's for the TANK catchment, as previously outlined in paragraph 39 of my evidence, these minimum flows may not meet the requirement of Section 3.16 (2) of the NPSFM 2020.

55. However, I believe these minimum flows do meet the requirement of Section 13.6 2 (b), as they have been set and can be adapted over time (i.e. in future plan changes) to take a phased approach to achieving environmental outcomes and long-term visions.

56. This phased approach is consistent with other areas of PC9, including Actual and Reasonable use of groundwater to an interim limit, storage and augmentation schemes; and combined together will work towards achieving the long term environmental flow outcomes.

57. With regards to specific minimum flows in river, HortNZ, in their submission on PC9, opposed the proposed increase to

Tutaekuri River in Schedule 31 due to the potential for this to impact growers' water use in the future, while they agreed with the minimum flow of the Ngaruroro River remaining at the existing limit of 2,400 L/s.

58. With regards to the Tutaekuri River minimum flow, the S42A report has outlined that the proposed increased minimum flow of 2,500 L/s will remain in Schedule 31.

59. I have reviewed the recorded flows in the Tutaekuri River at Puketapu (data provided by HBRC) between December 1968 and March 2021. These data indicate that the Tutaekuri River would have fallen below the 2,500 L/s at one time – 3 days in 1986.

60. In addition, I have reviewed the results of the SOURCE modelling scenarios (HBRC, 2018c), and found that based on the increased minimum flow of 2,500 L/s, no days were modelled in which abstractions would be restricted. As such, I agree with the increased minimum flow of the Tutaekuri River.

61. With regards to the Ngaruroro River, I agree with the minimum flow remaining at the existing limit of 2,400 L/s. The results of the SOURCE modelling showed that the number of days of restrictions would increase with increased minimum flows, putting further pressure on water users in the TANK catchments,

62. However, it should be noted that this agreement with minimum flows in Schedule 31 is contingent on the current wording of Rule TANK 7 and 8 remaining as stated in the S42A Report, as this incorporates the root stock protection water requirement that is vital for growers.

Water Permit Transfers

63. Section 15.4 of the S42A report discusses the surface water low flow management, with transfers discussed in Section 15.4.8.

64. I support the use of transfers as one of a range of approaches that can be undertaken to improve water use efficiency in catchments that are fully allocated, as is the case for groundwater in the TANK catchments.

65. I believe that the transfer of water to a new location within the same water quantity unit should be granted, as long as the effects of the new use are less or no greater than would have occurred at the existing location. This could mean less or no

increase in drawdown effects on the new neighbouring groundwater users and/or less or no greater effect on surface water bodies.

66. In addition, I believe in some cases that transfers between different water quantity units should also be considered as some may have an overall environmental benefit. For example, it may be determined that abstracting groundwater would have less effects on surface water bodies than continuing to abstract surface water. As such this transfer should be considered as an option, as is indicated under POL TANK 48.

67. I have reviewed the recommended changes to POL TANK 48 and Rules RRMP 62a and 62b outlined in the S42A report. I agree with the recommended changes as they provide further clarity on what can be undertaken as a transfer and also have been designed to manage the spatial risk of transferring water permits.

68. I support the deletion of "no change to the nature and scale of drawdown effects" and the inclusion of "no increase to the nature and scale of drawdown effects". This acknowledges that there will be some change to the effects, such as which groundwater bores or surface water bodies that may be affected by the new take, however it is the scale of effect which is the most important consideration in the assessment.

69. In addition to the use of transfers in fully allocated catchments, I also support the use of other approaches to using the available water, including catchment collectives, water user groups, global water permits. As such, I support with POL TANK 52 which states that Council will enable and support permit holders to develop such options.

70. I also support the changes sought by Mr Dooney to POL 37 to provide for re-allocation of water within the interim groundwater limit in some circumstances. Re-allocation within the limit is hydrologically equivalent to transfer within the limit.

High Flow Allocation

71. Section 15.5 of the S42A report discusses the high flow allocation provisions within PC9, with Section 15.5.10 discussing the submissions (including HortNZ) which requested high flow allocation to be included for both the Ahuriri and Karamū

catchments in Schedule 32, as well as revisiting the current high flow allocations.

72. The S42A report stated that *high flow allocations are not considered feasible or desirable in the Ahuriri and Karamū Catchments because they are small lowland catchments. In the case of the Ahuriri Catchment, we have little current understanding of water use and resource limits in the catchment* (paragraph 1818).

73. I have reviewed the technical reports and flow gauge data available for the Karimū catchment and agree that given the current lack of data in the Ahuriri catchment as well as the fact that both catchments are small lowland catchments, high flow allocation volumes should not be included in Schedule 32 for these catchments at this time. However, it is possible that a future plan change may identify a volume of water that could be harvested from these catchments.

74. With regards to the specified allocation limits for high flow allocation stated in Schedule 32, the Section 42A report supports the current allocation volumes in Schedule 32 as "*I consider that the high flow allocation framework, which includes Rules 13-17, allocation limits in Schedule 32, and the considerations of POL TANK 54-56, 59 and 60, establishes a sufficiently robust framework which enables decision-makers to consider a range of adverse and beneficial effects …*" (paragraph 1817).

75. Although I agree that the high flow allocation framework does provide a robust framework for allocation, I believe that the specific allocation limit for the Ngaruroro River stated in Schedule 32 (8,000 L/s) could be increased in the future.

76. I have made this statement based on the results of the SOURCE modelling outlined in HBRC 2018c. This modelling selected four different allocation scenarios, of which 8,000 L/s was the highest, and compared the effect on the FRE3 events within the Ngaruroro River. Previous work outlined in MWH (2010) that an environmental limit could be set as long as there was not a reduction in FRE3 events of greater than 10%.

77. The SOURCE modelling indicated that taking 8,000 L/s from the Ngaruroro River would only affect FRE3 events by 5% (as shown in Table 7-2 from HBRC 2018c below), and as such this indicates

that further allocation would be available before the environmental limit is reached.

Table 7-2: FRE_3 calculated for each high flow allocation scenario. Statistics are based on the analysis of calendar years (Jan-Dec) from 2016 to 2031.

Scenario	High flow allocation (l/s)	FRE_3 (no. of 3x median flow events per year)	Change from HFA Zero	% Change from HFA Zero
HFA Zero	0	12.6	-	-
HFA 1	2000	12.4	-0.19	**-1.5%**
HFA 2	4000	12.4	-0.19	**-1.5%**
HFA 3	6000	12.1	-0.44	**-3.5%**
HFA 4	8000	11.9	-0.63	**-5.0%**

78. I understand the current allocation limit for Ngaruroro River was set at 8,000 L/s based on the assumed future use of water (predominantly 3,5000 ha of irrigation in the catchment). However, by selecting the limit based on a water need rather than an environmental limit, it does not fully implement 3.17 of the NPSFM 2020, which envisages take limits are set that meet environmental flows and levels.

79. As such, I believe the current limit of 8,000 L/s should be stated as an interim limit. This approach would be consistent with the interim groundwater allocation limit specified in Policy 37 of PC9. I have recommended this change be made to the terminology outlined in Schedule 32 as outlined in Mr Dooney's evidence.

Root Stock Protection Water

80. Root stock protection water is the water required to maintain survival of permanent horticultural crops during drought and following minimum flow restrictions being imposed on surface water and groundwater takes.

81. This water is important to growers and the economic viability of horticultural operations as during drought conditions horticultural operations cannot make significant changes to their operations once crops are in the ground. This differs from other water users who may be able to bring in feed or shift stock out of the region during drought conditions.

82. The economic effects of irrigation restrictions on horticultural crops is discussed in the evidence of Mr Stuart Ford.

83. As a general rule, it is assumed that soil can retain sufficient moisture to meet crop water demand for a period of 4-5 days, after which the crops would become stressed, resulting in a loss of production, and potentially death of a crop reliant on routine irrigation. Hence any minimum flow restriction greater than 4-5 days would have an effect on horticultural operations.

84. HBRC (2018c) completed cease flow trigger flow scenario modelling, which modelled the number of days of minimum flow restrictions that will occur in the future (2015-2032) for the Tutaekuri River (Table 4-3) and Ngaruroro River (Table 4-4).

85. Overall, the results of this modelling provided the following data:

Flow Record Statistics	**Tutaekuri River at Puketapu (minimum flow 2,500 L/s)**	**Ngaruroro River at Fernhill (minimum flow 2,400 L/s)**
Average no. days restrictions per year	0	5.9
Full record recurrence of >3 consecutive days restrictions (years)	0	3.4
Full record recurrence of >10 consecutive days restrictions (years)	0	17
Dry year no. days restrictions	0	52
Dry year recurrence of >3 consecutive days restrictions (years)	0	3
Dry year recurrence of >10 consecutive days restrictions (years)	0	2

86. The table above shows that no days of restrictions were modelled to occur in the Tutaekuri River. However, the modelling clearly showed that takes from or close to the Ngaruroro River would have occurrences when root stock protection water would be required. This would be particularly important in the interim period while stream augmentation or high flow storage schemes and options are explored, constructed and implemented throughout the TANK catchment.

87. Given this information, in order to mitigate the potential for long term environmental flow and level restrictions impacting on crop survival, HortNZ submission sought the inclusion of a priority allocation for root stock protection water.

88. POL TANK 51 outlines the priority order for water shortage directions and includes the survival of horticultural tree crops. I support the inclusion of horticultural survival water (or root stock protection) in PC9, however I believe in order to comply with the NPSFM 2020 (3.17 Identifying take limits), the water requirement for root stock protection is required to be included within PC9 within a Rule and be assigned a specific volume (limit).

89. The Section 42A report states that root stock protection water is included within PC9 Rule TANK 7, with the following statement made "*I recommend points seeking a specific exemption for takes to assist the survival of horticultural crops are accepted in part because takes existing at 2 May 2020 may continue to take up to 20m^3 per day. If takes to assist the survival of horticultural crops existed before 2 May 2020, then they may continue. If these takes did not exist before 2 May 2020 then they are subject to a 5m^3 per day limit*" (paragraph 1848).

90. I believe the restriction of the take up to 20 m^3/day in Rule TANK 7 and 8 (based on the existing use before 2 May 2020) complies with NPSFM 2020 as an assigned take limit and there are still restrictions on the take as outlined in the remaining components of Rule TANK 7 and 8.

91. The NPSFM 2020 requires take limits to be designed to meet environmental flows. Therefore, in providing for a root stock protection water take limit, the impact on environmental flows of this take limit need to be considered. The environmental effects of the permitted activity abstractions have been deemed by Council to be less than minor.

92. HBRC completed several modelling scenarios using the SOURCE model (HBRC, 2018 c) in which an emergency water allocation of 10% of consented abstraction (167 L/s) was abstracted from the Ngaruroro River. The uses for emergency water was to provide for a variety of uses required under water shortage directions, as outlined in POL TANK 51.

93. Although no specific conclusions were made regarding the overall environmental impact of this abstraction, modelling indicated that at the PC9 minimum flow of 2,400 L/s, the river flows in the Ngaruroro River would be reduced by 13% during these abstractions. In addition, the figures indicated that once minimum flow restrictions ceased, there were no further days of

restrictions because of abstracting the emergency water allocation.

94. As the volume of water required for root stock protection is a sub-set of what was modelled, the potential effects from this abstraction would be reduced from that modelled.

95. In addition, under Rules TANK 7 and 8, the activity is required to have been already occurring prior to 2 May 2020. As such permitting the root stock protection water under Rule TANK 7 and 8 would not have any additional effects on environmental flows

Actual and Reasonable Use

96. Section 15.6.17 of the S42A report discusses the definitions included within PC9, with the discussion on the Actual and Reasonable use definition stating from paragraph 2061.

97. I support defining Actual and Reasonable Use for consented water use, as it forms a limit which allows Council to reduce the risk of over-allocation, drives the consent holders to use their water efficiently and to consider improvements in how existing water takes are undertaken. In addition, this information will aid the Council in fully understanding the actual water use in the TANK catchment and will provide accurate information to be used in future water allocation decisions.

98. However, I have concerns and recommendations on how the current definition is worded in PC9, in addition to what I have already discussed in paragraph 20-22 of my evidence.

99. Firstly, there is no definition of "accurate" in reference to water meter data. I believe Council need to be clearer as to what accurate water meter data entails, e.g. linked to Resource Management (Measurement and Reporting of Water Takes) Amendment Regulations 2020, which state "accurate" to be +/- 5%, as everyone may have a different definition of accurate.

100. In addition, it would be good to know how regularly Council would be checking compliance on this water meter data in order to determine the role both Consent Holder and Council have in ensuring accurate water meter readings.

101. My experience with water meter data is that in some cases the data is not reviewed once submitted to Council, and neither

the Consent Holder or Council have identified an issue with the meter readings until a long period of time has lapsed, meaning valuable actual water meter data is lost.

102. Secondly, I do not agree with the recommended change to clause a) to refer to "average" annual amount as measured by accurate water meter data instead of "maximum". I believe the maximum annual amount is still required to be considered under this definition in order to provide water users the reliability they require for their operations.

103. I acknowledge that the S42A report (paragraph 2064) states that the 2019-2020 water year was a significant drought event which would be covered in most consent holders water meter records. But I do not agree with the argument that this water use should be averaged with the water use of 2016 and 2017 (average years) and 2018 (lower water use) as this average would equate to the interim groundwater limit of 90 Mm^3.

104. Averaging the annual amount of the water meter data collected to date would not provide consent holders the reliability for future drought events and also does not take into consideration such factors of the timing of drought. The effect of drought on growers will depend on what crops they have in the ground, and at what stage the crops are at – with younger crops having higher water requirements.

105. I believe that enabling the maximum annual amount to be incorporated on consents would not result in further water being taken, particularly as there is a clause which states that "no more than the quantity specified on the permit due for renewal or any lesser amount applied for".

106. Finally, I do not fully support the length of water meter record specified in this definition (10 years). Although, a long record such as 10 years will provide a reliable assessment of maximum water use, many consent holders may have less than 10 years of data collected. This data is still an important indication of actual and reasonable water use of the specific property.

107. I believe that as long as the consent holder can demonstrate that the length of water meter data record covers periods of large drought events (in order to provide the 9/10 year reliability), then this water meter data volume should be considered valid as the Actual and Reasonable Use on the consent.

108. In addition, shorter length of water meter data record can be used in conjunction with IRRICALC, as a calibration of the calculations. This would enable all site-specific components of water use to be considered under the Actual and Reasonable consented water volume. As such, I would recommend rewording the definition as follows:

> b) the maximum annual amount as measured by accurate (as specified by the Resource Management (Measurement and Reporting of Water Takes) Amendment Regulations 2020) water meter data over a period of sufficient length to provide the 9/10 year reliability preceding 2 May 2020.

Gillian Margaret Holmes

7 May 2021

BEFORE THE HEARING COMMISSIONERS APPOINTED BY THE HAWKE'S BAY REGIONAL COUNCIL

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

AND

IN THE MATTER of Proposed Plan Change 9 - Tūtaekurī, Ahuriri, Ngaruroro and Karamū (**PC9**)

STATEMENT OF EVIDENCE OF MICHELLE KATHLEEN SANDS (CORPORATE) FOR HORTICULTURE NEW ZEALAND

7 May 2021

ATKINS | HOLM | MAJUREY

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CONTENTS

SUMMARY

1. The Heretaunga Plains are exceptional for horticulture.

2. For the most part HortNZ supports Plan Change 9 (**PC9**). PC9 prioritises the wellbeing of water and seeks to achieve integrated, social, cultural and economic results over time.

3. Our key recommendations are as follows:

   (a) We accept a Reasonable and Actual use groundwater limit, but the limit must provide reliability for existing activities.

   (b) We support transfers and the recognition of the value of the versatile soils of the Heretaunga Plains. Flexibility for individual and collective water users is essential to drive efficient water use within environmental limits.

   (c) We support surface water take limits provided across the flow regime which are designed to achieve environmental flow variability outcomes over time. These take limits include rootstock survival water limits and high flow harvesting limits.

   (d) We support augmentation and water harvesting. These schemes must be designed to achieve environmental and cultural outcomes and to provide water to support existing and new irrigation.

   (e) We support collective and individual Freshwater Farm Planning (**FWFP**) approaches to managing water quality impacts.

   (f) We seek workable provisions for crop rotation and land use change.

   (g) We seek recognition that land use change can have benefits, including for climate change and food security.

   (h) We urge decision makers to align PC9 industry programme requirements with horticulture's Good Agricultural Practice (**GAP**) schemes, so growers can deliver integrated farm plans efficiently.

4. With HortNZ's recommendations included, we consider the freshwater outcomes PC9 seeks are ambitious but achievable.

INTRODUCTION

Qualifications and experience

1. My name is Michelle Kathleen Sands. I am the Environment Manager at Horticulture New Zealand (**HortNZ**). I manage HortNZs Environment Policy team who are involved in national, regional, and district planning processes across New Zealand. I have been in this role since May 2018.

2. I hold a Bachelor of Science (Honours) from Victoria University (1995). I am a member of the New Zealand Hydrology Society and a Certified Environmental Practitioner with the Environment Institute of Australia and New Zealand. I have over 20 years of post-graduate experience in environmental management. During this time, I have worked in local government, the voluntary sector, research, consultancy and currently for the horticulture industry.

3. My experience includes providing expert witness testimony on water quality and hydrology issues at council hearings, Board of Inquiry and Environment Court processes.

4. Since beginning my role at HortNZ, I have met with growers across New Zealand to better understand their horticultural operations and how resource management issues impact them.

5. I have led HortNZ involvement and consultation on the development of the proposed National Policy Statement for Freshwater Management (**NPSFM**) and National Environmental Standard for Freshwater (**NESFW**). I provide technical oversight for water planning processes that HortNZ is engaged with currently which includes processes in Otago, Canterbury, Wellington, Manawatu, Hawke's Bay, Gisborne, Bay of Plenty, Waikato and Northland regions. I led HortNZ's involvement in climate change policy and am on the Steering Group for He Waka Eke Noa – the primary sector partnership for climate change.

6. While I am a qualified and experienced hydrologist and water quality scientist, I am not appearing in the capacity of an expert in this hearing. My role in this hearing is as HortNZ's representative and advocate.

Involvement in the proceedings

7. When I joined HortNZ in May 2018, I took on the role of HortNZ lead for the organisation's role in these proceedings.

8. I have had regular meetings and conversations with local growers since 2018, seeking information to support the production of the HortNZ submission and evidence.

9. In preparing my evidence I have read :

   (a) The notified PC9 and section 32a report.

   (b) S42a report and appendices.

   (c) New Zealand National Policy Statement for Freshwater Management 2020.

   (d) The evidence of the HortNZ team.

   I have also worked with Council providing information and analysis to support the development of the TANK Plan Change (Plan Change 9), through its various draft iterations.

PURPOSE AND SCOPE

10. HortNZ is the industry good body for the horticulture sector, representing growers who pay levies on fruit and vegetables sold either directly or through a post-harvest operator, as set out in the Commodity Levies (Vegetables and Fruit) Order 2013.

11. HortNZ is affiliated with two key local associations representing growers within the Hawke's Bay region: the Hawke's Bay Fruit Gowers Association and the Hawke's Bay Vegetable Growers Association. Alongside these local associations, a number of Product Groups representing specific product categories are also affiliated to HortNZ. These Product Groups have their own commodity levies (for example, New Zealand Apples & Pears).

12. My evidence describes the horticulture sector in the Hawke's Bay region, starting with:

   (a) The scale and key components of the Hawke's Bay horticultural production sector; and its national significance;

(b) A description of natural resources that underpin the sector, including matters relating to:

i. water abstraction;

ii. discharges to land and water;

iii. soils; and

iv. climate and climate change.

(c) A discussion of the environmental effects of horticulture;

(d) A summary of the HortNZ position on PC9.

HORTICULTURE IN HAWKE'S BAY

Primary Production

13. There is an estimated 20,600 hectares of horticultural land in Hawke's Bay, representing 15% of the total area of horticultural land in New Zealand.[1]

14. In the TANK catchments there is an estimated 16,800 ha of irrigated commercial fruit and vegetable production (including grapes) undertaken on the Heretaunga Plains (based on 2017 data). [2] The proportion of different crops which make up this area are represented below in Figure 1.

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[1] Statistics New Zealand 2019 data (https://www.stats.govt.nz/indicators/agricultural-and-horticultural-land-use)

[2] AgFirst (2018). Modelling Water Restrictions and Nutrient Losses for Horticulture.

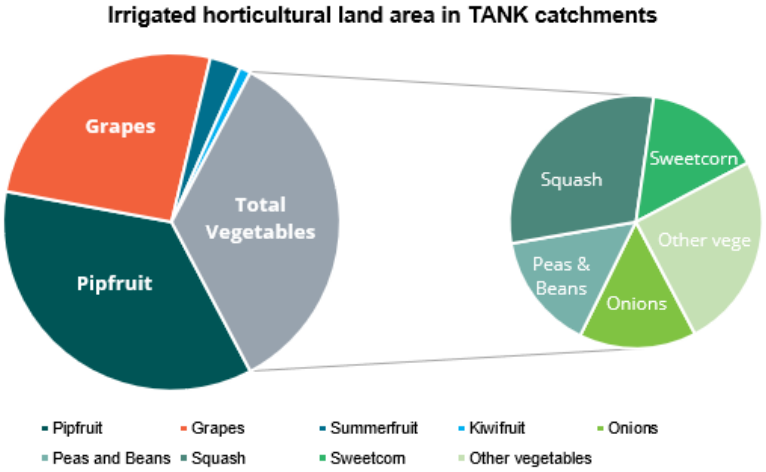

Figure 1: Irrigated horticultural land by crop type[3]

15. The area covered by the TANK catchments represents a substantial proportion of the total area in horticulture in Hawke's Bay.

16. The region has a high degree of crop diversity - pipfruit, summerfruit, green beans, sweet corn, squash and onions are significant crops within the region, in addition to other crops including kiwifruit, berries, potatoes, citrus, and leafy greens.

17. Specialised post-harvest pack houses add significant value after the farm gate and many growing organisations are now integrated into the post-harvest chain.

<u>Pipfruit</u>

18. Pipfruit (particularly apples) is a significant crop within the region.

19. Hawke's Bay is New Zealand's largest apple and pear producing region. There is also significant post-harvest infrastructure (including cool stores and packhouses) that has been invested in the region.

20. New Zealand Apples and Pears estimate that the region accounts for approximately 66% of New Zealand's apple and pear planted area (of an estimated 10,400 hectares nationally). The industry has been growing at a 3.5% Compound Annual Growth Rate in area and 13% in value over the past 8 years. The industry continues to have strong

[3] Using figures from the Agfirst report referenced above.

growth prospects (e.g., as described in the submissions of Rockit and T&G on PC9).

21. New Zealand is one of the most efficient producers of apples in the world – producing 61 tonnes per hectare (compared to an international average of 23.4 tonnes per hectare).[4] Approximately 67% of New Zealand's apple crop is exported each year.

Summerfruit

22. Hawke's Bay is the second largest summerfruit growing area in New Zealand (behind Central Otago), accounting for approximately 30% of the planted area (based on 2016 figures).

23. Statistics NZ data from 2017 indicates that there is approximately 600 hectares of summer fruit in the region, including (in order of area) - peaches (208 ha), nectarines (159 ha), plums (133 ha), apricots (97 ha) and cherries (12 ha).

Kiwifruit

24. In Hawke's Bay there are 204 producing hectares of kiwifruit. Kiwifruit returned $32m to growers in the 2019/20 season.

Fresh vegetables

25. The main fresh vegetables grown in the region are onions, squash (which both have an export component) and some green vegetables which contribute to domestic supply.

26. Hawke's Bay is New Zealand's largest squash producing region, accounting for 63% of the planted area in 2019. The region accounts for approximately 16% of onion planted area in New Zealand.

27. A 2017 KPMG report, which looked at the 10 staple vegetable crops in New Zealand, found that the Hawke's Bay produced 16% of New Zealand's onions, 4% of carrots & parsnips and 3% of potatoes.[5]

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[4] World Apple Review 2018 data (https://www.tupu.nz/en/fact-sheets/apples-and-pears)

[5] KPMG, 2017 New Zealands domestic vegetable production: the growing story

Process Vegetables

28. The Hawke's Bay region produces over 30% of New Zealand's processed vegetables. The main process vegetable crops include peas, beans, corn, beetroot and tomatoes, grown in rotations.

Processing facilities

29. Food processing is part of the supply chain for some of the fruit and vegetables grown in Hawke's Bay. There are two significant international fruit and vegetable processing facilities located in Hastings:

    (a) Heinz Wattie's - who have also made a submission on the TANK plan change - purchase approximately $20 million of fruit and vegetables from local growers annually. Heinz Wattie's have two manufacturing facilities in Hastings. They have recently invested over $100 million in upgrading factories at both King Street and Tomoana.

    (b) McCain Foods has invested over $70 million in factory facilities including a $19 million plant upgrade in 2011.

30. In addition, we have seen new processing investment in the region with Apollo apples investing $30 million in a new apple juice processing factory, opened in 2018.

Research

31. Hawke's Bay is the base of a significant amount of industry research.

32. Crown Research Institute, Plant and Food, have significant research facilities located near Havelock North. Plant and Food has extensive research trials relating to all facets of growing and production. The research facilities employ more than 60 staff. The facility includes a modern purpose-built laboratory and over 60 ha of research orchards and research areas for field crops. Plant and Food's areas of research include breeding, bio protection, plant pathology, entomology, post and pre-harvest production systems, research into soil, water and the environment, and systems modelling.

Economic Contribution

33. Horticulture in the TANK catchments makes a sizeable contribution to the regional economy. Approximately $761 million in GDP can be attributed to the area of irrigated horticultural land within the TANK catchments, which is 10.3% of the total GDP for the region (based on total GDP in 2017). There is also considerable flow in contribution in both economic activity and employment.[6]

34. Horticulture provides a range of permanent jobs in production, post-harvest, corporate services, and seasonal jobs.

35. The horticulture industry directly (in growing itself) employs approximately 6,700 people in the region.[7] For the 2020 year, this was broken down by:

    - 530 employees in 'A012 Mushroom and Vegetable Growing'. Predominately this was in outdoor vegetable growing (70%), followed by mushroom growing and under cover vegetable growing.

    - 6200 employees in 'A013 Fruit and Tree Nut Growing. Predominately this was in apples (69%), berries (18%), followed by grapes, stonefruit and kiwifruit.

36. There is also a flow-on effect in related employment, including for example Heinz Wattie's and McCain Foods, which combined employ over 1800 people in the region.

37. Submissions by industry on the TANK plan change also help to illustrate the importance of horticulture to the local economy and regional employment, for example:

    (a) A 2014 report commissioned by New Zealand Apples and Pears found that the pipfruit industry in the Hawke's Bay contributed $370.5 million to regional GDP and employed 3,110 staff.

    (b) T&G employs approximately 200 permanent employees and 900 seasonal workers in the Hawke's

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[6] Statement of Stuart John Ford (2020), submitted to the Environment Court as part of proceedings relating to the Water Conservation Order on the lower Ngaruroro River.

[7] http://nzdotstat.stats.govt.nz/wbos/Index.aspx?DataSetCode=TABLECODE7601#

Bay region and pays approximately $28 million in wages and salaries annually. It also engages third party contractors as part of the production process at an annual cost of approximately $1 million.

(c) Heinz Wattie's contribute up to 20% of Hawke's's Bays GDP, amounting to $1.25 billion annually.

(d) Johnny Appleseed Holdings employ approximately 360 full time employees.

(e) Mr Apple NZ employs over 2,200 individuals during peak harvest.

38. The horticulture industry has growth potential in the Hawke's Bay, particularly in apples, and also kiwifruit and onions. There is also a need to continue to ensure that New Zealand can supply our own domestic food needs, accounting for population growth.

39. Growth of the horticultural industry will continue to enhance economic and employment outcomes in the region – for example, Rockit state in their submission on the TANK plan change that planned orchard expansion will deliver 30-40 full time on-orchard employees once complete, as well as additional positions in their processing and packing facility (340 operational staff and 50 management staff).

Significance within NZ

40. Horticultural regions function as part of a national food system, with different crops being harvested at different times in different regions.

41. Hawke's Bay harvests kiwifruit before Bay of Plenty and apples before South Island growing regions. This rolling harvest season enables New Zealand producers to secure access to export markets.

42. Similarly, for domestic markets, summer fruit such as nectarines and peaches grown in Hawke's Bay supply New Zealand consumers before later season fruit becomes available from the South Island. This regional food system supports a resilient and reliable domestic food system.

43. Within this national food system, the Heretaunga Plains stands out as being without doubt nationally significant for horticultural food production.

ENVIRONMENT OF HERETAUNGA PLAINS

44. Horticulture, like all food systems is dependent on natural resources. The production of fruit and vegetables occurs on a year-round basis in the region, owing to the soil, water availability and climate. The key advantages of soil fertility, water availability, and climate create what is referred to as versatile land. The Heretaunga Plains are a nationally significant source of versatile land.[8]

Soil

45. The Heretaunga Plains has an unusual proportion of its land being of very high value for primary production. Almost 90% of land outside urban areas fits within Land Use Capability Classes. These soils are recognised as those with the most productive potential and versatility for food production.[9]

46. Significant protection of this land has been regulated within district and regional planning tools due to pressures from urbanisation. Aside from their productive value, soils also provide ecosystem services.

47. The draft National Policy Statement on Highly Productive Land proposes to require councils to plan to manage this land for its productive capacity and recognise its value.

Water

48. Reliable, good quality water is fundamental to growing. Horticultural production requires significant investment, and it is commonly accepted that water reliability in excess of 95% is required to sustainably provide for these investments.

Climate

49. The Hawke's Bay has over 1700 grow days above 10 degrees, and over 2000 hours of bright sunshine. This warm, sunny climate along with versatile soils are ideal for growing.

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[8] Bloomer, D. 2011: Versatile Soils - Productive Land

[9] Bloomer, D. 2011: Versatile Soils - Productive Land.

However, the Heretaunga Plains has about 95 days between November and April when there is insufficient soil moisture to maintain plant growth without irrigation.[10]

MANAGING ENVIRONMENTAL EFFECTS OF HORTICULTURE

Crop Rotation

50. Crop rotation is an inherent part of sustainable and regenerative commercial vegetable growing. It is a practice which is essential for maintaining soil health and the natural capital of highly productive land.

51. Growing the same crop in the same location results in poor crop performance, because soil nutrients are depleted over time. Crops with deep roots open channels deeper in the subsoil. A pasture phase improves soil structure by adding organic matter to the soil. Rotating crops breaks pest and disease cycles by removing host material and reducing pest populations. Some crops and their residues can act as soil bio-fumigants. In New Zealand there are certain sorghum and brassica species used in this way.

52. Crop rotations are both temporally and spatially dynamic. Crop rotations are a sequence of crops rotated on the same piece of land over time. The location of the ground the vegetables grow on also shifts over time as lease arrangements change, and to provide for the arable and pasture phases of rotations.

53. It is important that crop rotation is provided for within the structure of regional plan rules that apply to commercial vegetable growing. Gareth Holder, in **Appendix A** to my evidence, describes the importance of crop rotation (across leased land) to his vegetable growing operation.

Water Quality Impacts

54. Horticulture is a diverse sector, different crops have different nutrient requirements and different nutrient leaching risks. For the most part, horticulture land uses have lesser water quality

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[10] NIWA 2013. The climate and weather of Hawke's Bay.

impacts than most other land uses, certainly for pathogens, and in many cases for nutrients and sediment.[11]

55. Contaminant discharges from fruit production are generally lower than other land uses on equivalent land. The modelling presented in Mr Ford's evidence estimates a nitrogen leaching range for pipfruit from 5kg/ha/yr to 11 kg/ha/yr and for kiwifruit from 3kg/ha/yr to 12 kg/ha/yr.

56. Vegetable growing includes a wide range of crop rotations. The modelling presented in the evidence of Mr Ford indicates the range of nitrogen leaching for vegetable rotations in the TANK catchment varies from 8kg/ha/yr to 60 kg/ha/yr with an average of 20 kg/ha/yr. The range is not related to implementation of good management practices, but rather, soil, climate and the combination of vegetables within the rotation.

57. Growers are making improvements to their practices to reduce the impact of their growing on freshwater. A key tool for this is FWFP.

58. The vegetable sector is working on research on sustainable vegetable systems. The process vegetable sector is undertaking research into process vegetable rotations, related to managing environmental effects through the sequence and timing of crops.

59. The water quality of water for irrigation is also important for food safety reasons, so the sector has a vested interest in maintaining a good standard of water quality.

Water Use of Horticultural Crops

60. Horticultural crops are parsimonious uses of water, with horticultural crops using less water than irrigated pasture most or all of the time.[12] Some crops require more water for a period within their annual growing cycle than irrigated pasture. [13]

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[11] Williamson Water 2018 TANK catchment Source model build report.

[12] Aqualinc 2018 Irrigation Water demand and land surface recharge assessment for Heretaunga plains, prepared for HBRC.

[13] Allen RG, Pereira LS, Raes D, Smith M 1998. Crop Evapotranspiration. Guidelines for computing crop water requirements. FAO Irrigation and Drainage Paper No. 56. Food and Agriculture Organization of the United Nations, Rome, 301 pp.

61. Irrigation serving horticulture is typically more efficient than irrigation for pasture because of the delivery systems, predominantly drip or sprinkler systems. [14] This is particularly true of newer developments which make use of more efficient and precise technology and equipment.

62. Water storage will have a role to play in providing resilience for water users in a changing climate and can improve degraded freshwater regimes by increasing low flows through augmentation.

PLAN CHANGE 9

63. PC9 establishes a framework that sets values, and outcomes through the objectives that are linked to achieving water quantity levels and flow regimes and water quality target attributes states.

64. The water quantity and quality limits within the policies and rules in the plan are linked to maintaining or achieving the water quantity level, flow regimes and target attribute states over time.

65. The policies and rules build a foundation for improved water and contaminant management, and drive action linked to achieving the outcomes over time.

66. The HortNZ team of experts make recommendations on how to improve the alignment of PC9 with NPSFM 2020, and how to improve the links between outcomes and limits.

67. For the most part HortNZ supports PC9. In our view the staged approach within the PC9 is ambitious but achievable. PC9 is largely consistent with the process outlined within the NPSFM 2020 and with the concept of sustainable management within Part 2 of the RMA.

Collaborative Process

68. As outlined in the S42A assessment the community process through the TANK Group and the decision making that occurred through the RPC and Council, was comprehensive. In my opinion the outcomes of this process should remain the

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[14] Ford S. , Memorandum to HortNZ NESFW, 2019

foundation of PC9. The evidence Lesley Wilson, in **Appendix A** to my evidence, describes the commitment she made as a grower, and at that time president of the Hawke's Bay Fruit Growers Association, to participate in the TANK Group over six years.

General Objectives

Te Mana o te Wai

69. The NSPFM sets out a framework for freshwater management with one over-arching objective – Te Mana o te Wai. The definition of Te Mana o Te Wai has been further refined to include a hierarchy of obligations and clearer role for Tangata Whenua. Te Mana o te Wai includes six principles that guide decision making.

70. The NPSFM 2020 includes a process for establishing a Te Mana o te Wai vision. This process, and any subsequent changes in values, outcomes and limits will have to be implemented through a future RPS and Plan Change.

71. The HortNZ submission provides scope to better align priorities within PC9 with the Te Mana o Te Wai hierarchy of obligations.

<u>Te Mana o Te Wai and Domestic Food Supply</u>

72. Healthy food, in particular a reliable supply of reasonably priced vegetables and fruit for New Zealanders, is an essential human health need.

73. As outlined above, The TANK catchments provide a vital role in New Zealand's domestic food system.

74. The benefits of fruit and vegetable consumption are well established, particularly their role in preventing general micronutrient-deficiencies and chronic diseases. The Institute for Health Metrics and Evaluation (**IHME**) carry out the Global Burden of Disease study. The study estimated that almost 800 deaths were caused by low vegetable intake in New Zealand in 2017, as well as the quality of life lost due to morbidity.

75. Data from the New Zealand Health Survey indicates that in 2018/19, only 53.1 percent of adults in New Zealand met the vegetable intake guidelines (3+ servings per day), and this has been decreasing over time.

76. The price of meeting micronutrient requirements is very expensive in New Zealand compared to other countries. Without changing the land use, the situation is unlikely to get better and could get worse.[15] Affordability is a key factor in why people eat less than the recommended intake of fruit and vegetables. If fruit and vegetable growing cannot expand to meet the growing demand with an increased population, the reduced availability of vegetables and an increased price would impact on the health of the most vulnerable people.[16]

77. Otago University has recently modelled the potential health impacts of increased vegetable prices related to freshwater regulation. This study found that using the health costs of an increased in vegetable prices of 43 - 58 percent,[17] would be a loss of 58,300 – 72,800 Quality Adjusted Life Years and health costs of $490 -$610 million across the population. [18]

78. HortNZ argue vegetables and fruit for domestic supply should be afforded priority in resource allocation decisions, as a second priority under the Te Mana o Te Wai framework.

79. The value of domestic food supply in resource allocation decision making, has been recognised within a series of policy instruments including: NPSFM 2020 specified vegetable growing areas; Waikato PC1 Policy 3; Horizons PC2 Policy 14-6; and Canterbury PC7 section 42a reply, Policy 4.36A.

80. HortNZ's submission sought that this matter be addressed though a provisional allowance for the expansion of vegetables for domestic supply. As outlined in the evidence of Mr Dooney, he suggests this priority be reflected in the objectives and policies of PC9 in a manner consistent with the Te Mana o te Wai hierarchy of obligations.

81. In my opinion the second priority under Te Mana o te Wai should be reflected with natural resource reliability and for these uses the cost of achieving first-priority outcomes must

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[15] Moore, D., Barton, B., & Young , M. (2019). The value of local vegetable production. Sapere.

[16] Ibid.

[17] 2018 Deloitte The New Zealand Food Story, Pukekohe Hub

[18] Cleghorn, Cristina. 2020. The health and health system costs of increasing vegetable prices over time. Wellington: University of Otago, 2020.

not be prohibitive. I do not consider having second priority in the Te Mana o te Wai hierarchy of obligations provides immunity to second priority uses – including uses to provide for food security and drinking water - from contributing to the costs of achieving first-priority outcomes.

82. I consider that all third priority uses should contribute to the costs of achieving the first priority outcomes, proportionate to their effect, and in manner and over a timeframe that also enables the values associated with those uses to be provided for as far as possible within environmental limits.

83. As outlined in the evidence of Mr Dooney, he recommends Objectives 10, 11, 12, 13, 14 and 16 reflect the importance of food security along with drinking water as matters that are both provided for under the second priority of Te Mana o Te Wai. Mr Dooney also recommends that POL 21 includes the ability of Council to consider food security in land use change consenting decisions.

Climate change

84. The RMA Amendment Act 2020 removed the current barriers in the RMA to considering greenhouse gas emissions (effective from 31 December 2021). Included in this suite of amendments is the requirement to have regard to emissions reduction plans and national adaptation plans under the Climate Change Response Act 2002 when making and amending regional policy statements, regional plans and district plans[19]. The draft Climate Change Commission budget is out for consultation now. While the notification of TANK pre-dates these changes, they are relevant context in the broader discussion around climate change mitigation and adaptation and the need to not frustrate these efforts.

85. In the HortNZ submission we sought that PC9 recognise climate mitigation, specifically in POL 21. In my view the amendments to the RMA support the HortNZ submission. In Mr Dooney's evidence, informed by expert opinion, he recommends the following changes:

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[19] See the RMA Amendment Act 2020 section 18 amending section 66 of the RMA.

(a) Support Objective 3, but recommend it is expanded to include both climate change and adaptation.

(b) Acknowledging the recognition of the link between sequestration and sediment erosion in POL 20, and seeking greater emphasis on managing sediment from hillslope erosion Schedule 28 and Schedule 30.

(c) Alignment of Schedule 30 to support integrated farm plans delivered by industry programmes for freshwater and climate change mitigation and adaptation.

(d) Include consideration of greenhouse gas mitigation in land use change decision under POL 21.

86. The details of recommendations are included within the evidence of Mr Dooney (in his Appendix 1), the justification is described below.

Adaptation

87. Climate change is expected to bring warmer weather and changes in rainfall seasonality to Hawke's Bay.[20] Growers are very aware of the changing climate and the potential for more frequent droughts, such as the drought experienced this year. This will require mitigation and adaption – including through means such as planting breeding (more heat/drought resistant varieties), land use change and water storage to enhance resilience.

88. Ms Holmes recommends changing the proposed S42a definition of Actual and Reasonable use, to ensure allocation accounts for climatic variation.

Sequestration and sediment

89. The Climate Change Commissions draft budget indicates that sequestration is critical to achieving NZ emissions budgets and that native vegetation is the most effective form of sequestration.

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[20] https://www.mfe.govt.nz/climate-change/likely-impacts-of-climate-change/how-could-climate-change-affect-my-region/gisborne#:~:text=Temperature,temperatures%20exceed%2025%CB%9AC

90. POL 20 recognises the benefits of tree planting for mitigating climate change effects. Trees also have an important role in offsetting greenhouse gases through sequestration.

91. PC9 can play a role in supporting on-farm sequestration through promoting planting riparian margins, retiring highly erodible land, and planting trees to reduce hill country erosion. These activities also support achieving water quality outcomes. Ms Sturgeon recommends updating the catchment priorities in Schedule 28 and the provisions in Schedule 30 to put greater emphasis on reducing hillslope erosion through FWFPs.

Low emissions economy and horticulture

92. Approximately 50% of NZ's greenhouse gas emissions are produced by agriculture, but only 1% of agricultural emissions are produced by horticulture.[21] The BERG report found that very large-scale diversification into horticulture could be as effective as a methane vaccine in tackling New Zealand's greenhouse gas emissions[22].

93. Supporting land use diversification to enable increased horticulture is critical to New Zealand achieving a transition to a low emission economy in line with the Climate Change Response (Zero Carbon) Amendment Act 2019.[23] New Zealand will not achieve its 2050 emissions reduction target without reductions of emissions from agriculture.

94. This was an issue canvased in the Climate Change Commissions recent draft advice to Government, which included conversion of 2,000ha to horticulture annually between 2025 and 2035 (and noted that land use change would need to play a larger role than this if new technologies to reduce livestock emissions do not eventuate).[24]

95. In their evidence Ms Holmes and Mr Ford support the POL 39 augmentation policy, which will increase the resilience of the low land streams and enable ongoing horticultural use on the Heretaunga plans. Ms Holmes and Mr Ford and supports POL

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[21] BERG 2018 Report of Biological Emissions Reference Group.
[22] https://www.mpi.govt.nz/dmsdocument/32125-BERG-Report-FINAL-for-release-6-Dec
[23] BERG 2018 Report of Biological Emissions Reference Group.
[24] Climate Change Commission 2021 Draft Advice for Consultation at 3.8.6 Agriculture

48, which provides for transfer and maintaining water reliability on the versatile land of Heretaunga plains.

96. The modelling presented in Mr Ford's evidence indicates that opportunities for Hawke's Bay farmers to diversify into crops that feed humans rather than animals can be achieved with neutral impacts on nutrient loss. In my opinion land use diversification into horticulture that can occur within environmental limits should be encouraged not constrained by PC9.

He Waka Eke Noa Farm Plans

97. The Climate Change Response Act sets out the primary sector's commitment to achieving New Zealand's climate change budget through the He Waka Eke Noa programme. This programme requires farmers and growers to develop farm plans and to know their greenhouse gas emissions number. This work is underway and will be complete by 2025.

98. Industry programmes have a critical role in delivering the He Waka eke Noa milestones. If PC9 FWFPs are aligned with He Waka Eke Noa it will enable farmers to develop an integrated farm plan for climate change and freshwater, using assurance frameworks provided though industry schemes.

99. Dr Farrelly recommends changes to Schedule 30 to support the use of existing industry programmes, such as GAP.

100. If the changes suggested by Dr Farrelly are made the FWFP delivery times for PC9 will be able to leverage off the He Waka Eke Noa programme and it is likely that farm planning can be achieved more quickly (than the 9-year time frame within PC9) for all land uses.

Water Quality

Objectives and Schedule 26

101. As outlined in the evidence of Ms Sturgeon she supports the FMU for the PC9 being set at the TANK catchment scales, and objectives in PC9 being equivalent to outcomes in the NPSFM 2020.

102. In the evidence of Ms Sturgeon she outlines amendments to align PC9 with NPSFM terms. Ms Sturgeon supports Schedule

26 and explains a future plan changes prior to 2024 will be required to completely align Schedule with the NPSFM 2020 NOF.

Management Framework

103. Ms Sturgeon consider the multi-contaminant approach to managing water quality risks as proposed in the HortNZ submission and in Mr Dooney's evidence are consistent with the approach within the NPSFM 2020, where freshwater limits are required across a range of contaminants not just nitrogen.

Priority Catchments

104. In the HortNZ submission we support the concept of priority sub catchments. As outlined the evidence of Ms Sturgeon she considers there are some issues with the way sub catchments have been prioritised. These issues include affording low priority to some catchments with notable water quality constraints and affording no priority to the management of *E. coli*, even though there are several values associated with this attribute and there are a number of surface water bodies that are well below the target attribute state for *E. coli*. The changes proposed by Ms Sturgeon are designed to achieve improved water quality outcomes.

Water Quality Limits

105. Freshwater limits are set in PC9 through the policies and rules, and implemented through FWFPs that seek to improve discharges from existing land uses by using good management practice (with a priority focus on sub-catchments experiencing poorer water quality), and by controlling increases in discharges associated with land uses change.

<u>Existing land use</u>

106. HortNZ supports the PC9 approach to managing existing land use, with recommended amendments in Ms Sturgeon and Mr Ford's evidence which are designed to improve the link between the limits within policy and the implementation within the FWFPs.

107. Dr Farrelly provides two examples of freshwater farm plans for growers within the TANK catchments. He also describes

groups of horticultural growers who have implemented the NZGAP Environmental Management System (**NZGAP EMS)** in other regions. FWFPs, particularly those delivered via industry schemes where all growers are subject to the same standards, are achieving real benefits across New Zealand.

108. We support the acknowledgement of the need for crops to rotate onto different land as contained in Schedule 29. This approach is critical to enabling crop rotations and protecting the health of soils, as discussed in this evidence above. Mr Dooney recommends a new definition for crop rotation which is supported by Mr Ford. In Mr Ford's evidence he recommends amendments to enable reasonable nitrogen loss calculations for crop rotations and useful nitrogen budgeting to support decision-making.

Land use change

109. As outlined in the evidence of Ms Sturgeon, the attribute states in Schedule 26 demonstrate that sediment, phosphorus, and *E. coli* are the attributes least likely to meet the target attribute states. Ms Sturgeon supports a multi-contaminant approach to managing land use change in TANK POL 21.

110. Nitrogen has been used as a proxy for other contaminants in Canterbury, Horizons and Waikato. In these catchments dairy farming is the dominant source of nitrogen load. For dairy farming, when nitrogen increases so do does sediment and *E. coli*. This relationship does not hold for other land uses, for example horticulture which has relatively low *E. coli* discharges or sheep and beef with relatively high sediment discharges.

111. In Ms Sturgeon's evidence she presents the nitrogen load attributed to various land uses. Of the total nitrogen load discharged across all of the TANK catchments, 60 percent is from red meat farming, 8 per cent from dairy farming, 7 percent from cropping including vegetables and 6 percent from orchards.

112. The S42a, in supporting Schedule 29, inexplicably draws on literature values from elsewhere in New Zealand to assess the relativity of nitrogen loss from various land uses, instead of using the Hawke's Bay farm systems modelling data that was used in the Section 32a analysis and Source Modelling. Mr

Ford presents updated Overseer modelling of horticultural activities which highlights the issues with the land use classification proposed in Schedule 29. Mr Ford's evidence raises concerns about the process for assessing land use change in Schedule 29.

113. Mr Ford prefers the approach for regulating land use change proposed in Schedule 29 of the notified plan, which was related to increases in nitrogen load. The approach in the notified plan, was more aligned to effects than the approach proposed in the S42a.

114. Mr Dooney (in his Appendix 1) recommends amendments to POL 21, to reflect a multi-contaminant limit approach and to reflect the potential benefits of land use change.

Farm Plans, Catchment Collective and Industry programmes.

115. As outlined in the HortNZ submission, we consider farm plans, catchment collectives, and industry programmes to be three distinct matters. HortNZ supports the use of the use of FWFP, catchment collectives and the opportunity to use industry programmes to offer a means of supporting farmers and growers to deliver robust FWFPs and to support farmers and growers with catchment collectives and including collective FWFPs.

116. I am concerned that the FWFP provisions within PC9 look to other regions and the draft national approach, which is strongly influenced by the process that is provided by Fonterra for dairy farmers. The GAP farm planning process is markedly different from the Fonterra farm planning process. Fonterra develop farm plans for their farmers. The GAP schemes do not develop farm plans, they provide independent assurance against approved standards.

117. Over 90 per cent of horticultural growers participate in GAP schemes, and 88 per cent of horticultural land is captured in the high priority TANK catchments.

118. I strongly urge decision makers to consider the land use in the TANK catchments, and to design FWFP provisions that are fit for purpose for the horticulture sector – which is a significant land use within the priority catchments.

<u>RMA Part 9A Freshwater Farm Plans</u>

119. The RMA signals a greater use of FWFP in the management of effects of farming on freshwater. I consider the approach in PC9 to be aligned with this direction. HortNZ supports the use of FWFPs as a critical method of implementing freshwater quality limits within the PC9.

120. Like Hawke's Bay Regional Council, HortNZ is also involved in consultations processes associated with the development of the regulations that will underpin Part 9A of the RMA. HortNZ is strongly advocating that these regulations build on existing assurance frameworks and use internationally established assurance definitions and processes.

GMP implemented through of Freshwater Farm Plans

121. In Dr Farrelly's evidence, he describes the "join the dots" process which is the link between research, codes of practice, GAP standards, and assurance that underpin the NZGAP EMS. This process provides confidence that FWFPs delivered through GAP will be robust and will drive improvements in water quality in the TANK catchments.

122. As outlined in the evidence of Mr Ford, when using Overseer for crop rotations, it is essential that long-terms averages are reported that account for the full rotation. Year to year results are unreliable because of the inter-annual variability of loss rates in rotations. Long-term-term average annual loss rates are useful for assessing the effects of land use change and can be used for freshwater accounting purposes.

123. As outlined in the evidence of Mr Ford, annual and sub-annual crop nitrogen budgets are an effective method for driving efficient fertiliser use for horticultural activities.

124. HortNZ seeks provisions that differentiate between long term average annual modelling of nitrogen loss for setting limits for freshwater accounting and land use change assessments, and nitrogen budgets which guide day-to-day good management practice decisions within freshwater farm plans. The changes recommended are included within the evidence of Mr Dooney.

Collective management

125. As outlined in the HortNZ submission we support the approach for catchment collectives, and consider catchment

collectives an effective method to enable growers and farmers to work together to achieve freshwater outcomes.

126. The horticultural levy bodies are not structured in a manner that is likely to provide a leadership role in the establishment or management of catchment collectives. HortNZ and product groups could provide a support role to catchment collectives established by growers.

127. In Dr Farrelly's evidence, he explains that GAP schemes are assurance programmes. The programmes provide a framework for the delivery and assurance of FWFP and can report the uptake of Good Management Practices (**GMP**) at a range of spatial scales. This would provide a useful tool for a catchment collective of growers. However, the GAP schemes are not structured to set up and manage catchment collectives.

128. Growers self-organise in collective organisations such as the Hawke's Bay Fruit Growers Association – as described in the evidence of Richard Pentreath and Hawke's Bay Vegetable Growers Association, and as described in the evidence of Scott Lawson, in **Appendix A** of my evidence. The Twyford Water User Groups – described in the submission of Jeff Van Beek - is another example of a horticultural collective that has worked together for mutual benefit and improved environmental outcomes.

129. HortNZ sees industry bodies playing a support role in catchment collectives, but catchment collectives are likely to be established and run by growers, not horticultural industry programmes or bodies.

Industry Programmes

130. In Dr Farrelly's evidence he recommends changes to Schedule 30, to align with the GAP schemes to enable the Industry to assist growers to implement robust freshwater farm plans. GAP can support individual growers, groups of growers, or growers within catchment collectives. These changes are included in Mr Dooney's evidence (in his Appendix 1).

131. Growers in Hawke's Bay are already adopting the NZGAP EMS to deliver on freshwater and climate change outcomes. It is efficient to align the provisions in PC9 with GAP, and to enable integrated farm plans that leverage off grower's market

requirements and climate change obligations to deliver robust FWFPs efficiently and quickly. Integrated farm plans using the GAP assurance framework will have much lesser costs to rate-payers and growers, but with equivalent or more assurance, and no delegation of enforcement powers.

Water Quantity

Objectives

132. As outlined in the evidence of Ms Holmes she supports the FMU for the PC9, being set at the TANK catchment scales and flow and water level objectives in PC9 being equivalent to the outcomes in the NPSFM 2020.

Actual and Reasonable limit

133. HortNZ accepts reasonable and actual use as the groundwater take limit in this PC9. In my view this approach, reduces the risk of possible over allocation, and will result in improvements associated with improved efficiency and improved data and understanding required for future plan changes.

134. Ms Homes proposes an amended definition for Actual and Reasonable to account for climatic variation. If the amendment of the definition in the S42a is accepted it will undermine the reliability of ground water for existing activities and, as outlined in the evidence of Mr Ford, water reliability is critical to the economic viability of the horticulture sector.

135. HortNZ accepts that no new water will be allocated under POL 36. However, as outlined in Ms Holmes evidence, re-allocation of water in POL 37 is within the take limit. As outlined in Mr Dooney's evidence he does not consider re-allocation within the groundwater take limit needs to be avoided.

Augmentation

136. HortNZ recognises augmentation schemes are critical to maintain the reliability of water for irrigators.

137. Both Ms Holmes and Mr Ford support the changes to POL 38 to provide a greater role for Council in the establishment of augmentation schemes. It is also important that the option for

irrigators to form their own scheme is retained. Mr Dooney recommends a minor amendment to POL 38 in his evidence (Appendix A).

Transfers

138. HortNZ support transfers, and we consider transfers important to enable growers to work together collectively to achieve efficient water use.

139. As outlined in the evidence of Ms Holmes she supports the provisions that enable transfers in POL 48. Mr Ford supports the provisions for transfers as they provide for the efficient use of water.

Primary production on Highly productive land

140. HortNZ supports POL 48, recognising the importance of the versatile land on the Heretaunga plains. Versatile land is recognised in the RPS. The importance of highly productive land and the need to manage this natural resource strategically is recognised by the Government in its proposed National Policy Statement for Highly Productive Land (**NPSPHL**), which was consulted on in August 2019. The 'Valuing Highly Productive Land' discussion document[25] summarised the pressures facing productive land and the current limitations in its strategic management, including that the lack of clarity under the RMA means highly productive land is given inadequate consideration by local government.

141. The recently released Our Land 2021 report also emphasises that not all land is equal – highly productive land enables less irrigation and fertiliser to be used in order to grow food, compared to less suitable land. [26]

Permit Duration

142. HortNZ accepts the permit durations in POL 49. We understand the permit duration is a tool for managing risk and enabling limits to adapt to achieve freshwater outcomes over time, will still providing for values associated with water use.

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[25] Valuing Highly Productive Land: A discussion document on a proposed national policy statement for highly productive land, Ministry for Primary Industries, August 2019.

[26] https://environment.govt.nz/assets/Publications/our-land-2021.pdf

143. HortNZ supports the amendment to POL 49, to enable the durations of water storage to be aligned to the scale of the infrastructure.

Surface Water Low Flow Management

144. HortNZ supports POL 51, and in particular the recognition of the importance of providing horticultural root stock survival water.

145. In my view providing for emergency water in low flows is consistent with the concept of Te Mana o the Wai. Providing for these values in drought years is essential to gain the benefits associated with these activities in the good years. Emergency water does not provide the optimum amount of water for these activities, but the bare minimum. This approach reflects the first priority of the health of water, but also recognises that Te Mana o te Wai is about restoring and preserving the balance between the water, the wider environment, and the community.

Root Stock Survival Water

146. Root stock survival water is provided for in a number of Regional Plans, including the Tukituki and in the recent Environment Court decision on the Northland Regional Plan.

147. As outlined in Ms Holmes evidence, the rootstock survival water provisions in PC9 meet the requirements of the NPSFM 2020. The rootstock survival limit includes both a flow trigger for achieving environmental flow outcomes - the minimum flow - where irrigation water must be significantly reduced, and a volumetric take limit provided for in the permitted activity rule.

148. The NPSFM 2020 does not stipulate that surface water quantity limits must include flows or levels where all takes cease, but rather that take limits are set along with flow and level triggers designed to achieve environmental flow regimes which provide for all freshwater values, with priority afforded to the health of water.

149. Ms Holmes discusses the Source modelling undertaken to test the effect of the emergency water on Ngaruroro environmental flows. The provision for root stock survival water is a small proportion of the emergency water provision.

150. Mr Ford discusses the level reliability associated with Ngaruroro and the economic impact on horticulture if growers were prevented from using root stock survival water when the Ngaruroro falls below the minimum flow trigger.

High Flow Allocation

151. HortNZ supports high flow take limits. As outlined in the evidence of Ms Holmes the proposed take limit of 8000l/s is not the environmental limit, but an estimated limit to provide for foreseeable increase in irrigation and some flow enhancement. Ms Holmes considers that a larger take limit may also be able to provide for the environmental flow variability outcome in the PC9. Ms Holmes has recommended the high flow take limit in Schedule 32 is described as an interim take limit.

Water use that supports cultural values.

152. HortNZ supports POL 59, which reserves some of the high flow take limit for uses that support cultural values. In our submission we made recommendations to this policy because we are concerned its complexity may undermine its effectiveness in supporting uses that provide for cultural values. A suggestion of more simplified wording (with the intention of making the policy more workable) is provided in Appendix A of Mr Dooney's evidence

Source Protection Zones

153. HortNZ's submission sought that changes be made the framework of policies applying to Registered Drinking Water Supplies, in summary:

(a) HortNZ sought provisions in POL 6 to require that Registered Drinking Water Suppliers quantify their vulnerability to contamination, and then undertake an assessment of options to relocate existing drinking water supplies to less vulnerable locations;

(b) In TANK POL 7, inclusion of provisions that would require applications to include a similar assessment (as that described above) and avoid vulnerable sites where possible; and

(c) In TANK POL 8, inclusion of provisions to include a clause relating to the nature of existing land and water within the Source Protection Zone, existing investment in those activities, and the specific locational needs of those activities.

154. This was all sought by HortNZ to avoid limiting productive land uses on the versatile soils of the Heretaunga Plains.

155. HortNZ accepts no substantive change to POL 6 (as recommended by the s42A authors) but considers that the addition sought remains a valid consideration/management option which would be appropriate to include within POL 9 (because POL 9 relates to non-regulatory measures that sit alongside the other policies). Assessing vulnerability and if necessary, considering moving to a less vulnerable option is a valid management option.

156. HortNZ continues to seek changes to POL 7 – the policy which sets out the criteria for considering applications by a Registered Drinking Water Supply to take water. I disagree with the Section 42A author (at para 2272) that the Water Services Bill negates the requirement for new drinking water supplies to consider the vulnerability of the location at which they establish. The obligations in the Water Services Bill apply once you are a drinking water supplier, and therefore this remains a valid consideration at the consent application stage, as the first step should be to avoid risks where possible. Without this consideration there is a risk of creating a 'reverse sensitivity' situation for existing land uses, particularly those located on the versatile soils of the Heretaunga Plains.

157. The S42A author accepts HortNZ's submission on POL 8, however the full wording has not been included. These words are included in Mr Dooney's evidence (in his Appendix 1).

CONCLUSION

158. The Heretaunga Plains are exceptional for horticultural production. Horticulture is dependent on irrigation. PC9 clearly signals that in the future allocation of water on the Heretaunga Plains will need to change to meet environmental outcomes. In addition, the climate is changing, which will result in changes to freshwater within the catchments

159. For the most part HortNZ supports PC9. The plan prioritises the wellbeing of water and seeks to achieve integrated, social, cultural and economic results over time.

160. I consider the limits and actions in PC9 will reduce risks of further adverse effects and result in improvements in water quality and flow regimes. The water quantity and quality limits will improve understanding of the effects of existing activities to inform future plan changes. Importantly PC9 will drive investment in measures to reduce effects and improve environmental outcomes over time.

161. With the recommendations of the HortNZ expert team included, I consider freshwater outcomes sought in PC9 are ambitious but achievable.

Michelle Kathleen Sands

7 May 2021

APPENDIX A: GROWERS' STATEMENTS

Name: Gareth Holder (Redloh Horticulture Ltd)

Location: Own/lease land across the Heretaunga Plains – including in the Ahuriri, Ngaruroro and Tūtaekurī Catchments.

Background:

Redloh Horticulture was established in 2009 and is owned and managed by Gareth and Anneliese Holder. Gareth has been involved in the horticultural industry since finishing his horticulture studies at university in the early 2000's and was awarded Young Grower of the Year in 2010, and is currently Vice Chair of the Hawkes Bay Vegetable Growers Association.

Redloh Horticulture grows a variety of crops year-round across 150 hectares on the Heretaunga Plains for domestic, process & export markets, which includes:

- Leafy salad greens for supermarket and food service industry
- Vegetables for McCains
- Export squash
- Some arable cropping – maize and cereals

The majority (approx. 98%) of this is undertaken on leased land; with the majority being longer term leases (3-5 years) and some shorter term leases (summer crops, back into typically grass or orchard development).

FOCUS TOPIC

I have been asked by HortNZ to describe an example of a vegetable growing operation on the Heretaunga Plains – including crop rotation and water use.

We focus on growing high quality produce using sustainable production methods. Our point of difference is that we aim to grow produce using a biological approach, which sees reduced pesticide and synthetic fertiliser use - to improve the soil health and mineral density of the food we eat.

The whole purpose of what we are trying to achieve is to look after and improve the soil, to provide good quality produce and sustainable yields. From an environmental perspective, if we can improve soil quality we can achieve better water holding capacity, better water infiltration and better soil structure which allows plant roots to explore the soil profile better. We are always looking to try and improve the soil profile through adjustments to the physical and chemical composition of the soil, and also the cultural practices we employ, such as:

- Use of minimum tillage where possible
- We strip till cultivate the majority of our squash and row crops to minimise the loss of soil moisture and potential wind erosion
- We closely monitor soil and plant nutrient levels to ensure only the necessary minerals are being applied.

- We incorporate a lot of green manure crops - through the winter, any fallow ground is sown in green manure or catch crops to ensure nutrients are not lost from the soil profile and to feed soil biology. We aim to not leave any land fallow for an extended period of time.

Crop rotation

We don't tend to grow one crop on the same ground continuously, we will rotate through salad greens, into process crops or export squash or other crops. A sound rotation minimises pest, disease and weed pressure. The crop make-up and locations are determined by soil type and availability of water for irrigation.

Water

Water is a critical component of vegetable growing – if we don't have water, we don't have a reliable crop, and that means our business is at greater risk.

We place considerable focus on using water efficiently, including the regular monitoring of soil moisture by neutron probes and mobile telemetry. These tools allow me to apply the correct amount of water at the right time for optimal growth and yield.

We have invested heavily in technology to ensure that we are irrigating as efficiently as possible. Our irrigation infrastructure includes centre pivot irrigators, travelling booms and guns, and fixed line sprinklers.

For example - we have invested in the latest nozzle technology which provides a more uniform application, less wastage and more control. At the same time, we have transitioned the majority of crops to boom irrigation to gain efficiencies in irrigation water required, fuel use and uniformity of application.

This has seen further improvements to sediment and soil run-off, increased water use efficiency and reduced nutrient leaching.

All properties we farm have resource consents for irrigation and we will maintain those consents while we lease the property on the landowners behalf.

Pressure on land availability

Hawkes Bay vegetable growers are under continual pressure to retain suitable land from factors such as increasing land and lease values, and the economic viability of some crops, extensive fruit tree development and urban/lifestyle encroachment onto productive soils. The outcome of such pressures is the movement of farming operations onto land classes and soil types that are less productive and more sensitive to intensive farming.

Name: Lesley Wilson (DN & LR Wilson Limited)

Location: Dartmoor Valley (Tūtaekurī catchment)

Background

DN & LR Wilson Limited have been growing in the Dartmoor Valley for 32 years. The Wilson family have been in the valley since 1984.

We grow on 43 hectares of versatile soil on the boundary of the Tūtaekurī River. Initially we grew stone fruit, before diversifying into apples (25 hectares) and more recently, wine grapes. We employ two full-time employees and up to 55 seasonal workers.

We grow Pacific Beauty, Royal Gala, Pacific Queen, Braeburn and Pacific Rose apple varieties, with harvesting occurring from early February through to early May.

We are shareholders in Mount Erin Fruit Services (Packhouse) and Mount Erin Group (marketing).

Lesley is a director on the Board of New Zealand Apples and Pears and the Government appointee for Horticulture New Zealand on the Horticulture Export Authority Board, as well as being former President of the Hawke's Bay Fruitgrowers' Association and a past Chair of the Hawke's Bay Fruitgrowers' Charitable Trust.

Desmond is a director of Mount Erin Packhouse and recently retired director of Mount Erin Group.

I made a submission on the TANK Plan Change, in summary the key points of these submissions were that:

- Generally supported the overall framework, to the degree that it reflects a staged approach to improving the management of freshwater resources in the TANK catchments.
- Horticulture is important to the future sustainability of the TANK catchments and some changes are required to ensure that sufficient water of able to provide for this. There is a need to recognise the value of food supply and food security.
    - Food security should be a priority – there is not mention of food and fibre production in Obj TANK 2
    - We sought that Obj TANK 8 be amended to include "*maintain water quality and quantity for food and fibre production*"
- Real change comes from practice – we support all growers operating at good management practice.
- Support the ability for collective approaches to water and nutrient management and seek that this is enabled.
- Support the acknowledgement of Maori perspectives in the plan change and acknowledgement of the GAP system.
- A need to include more economic impact reporting – the TANK Economic Assessment Group spent a great deal of time working with the parties who collaborated to write the "Economy Wide Impacts of Proposed Policy Options

for TANK catchments, 20 August 2018".

- A directive that new houses be equipped with water meters to inform us with the knowledge we need (irrigators monitor and measure water use).
- Further analysis is needed to inform the change to minimum flows and allocation on the Tūtaekurī.
- It is important that provisions relating to 'actual and reasonable' use do not disadvantage those who are the most efficient with water – it also needs to account for variability in water use over the different phases of production.

DN & LR Wilson Limited is GlobalGAP and GRASP certified, and part of the Sustainable Winegrowing New Zealand programme. We are always looking for ways to improve production with regard to sustainability and quality, aligned with our philosophy of kaitiakitanga. We are proud of our continual efforts towards improvement.

I have been involved with TANK since its inception and like all participants have put much time and effort into this Plan Change.

Water security is one of the biggest issues we see threatening the sustainability of not only the horticultural sector in the TANK catchments but the communities in the catchment. Maintaining or improving the quality and quantity of water that in available to all facets of the community is a primary concern of mine. My own industry has been at the forefront of innovation in improving water use and I am proud of the outcomes our industry has achieved.

As you will be aware the pipfruit industry is undergoing a period of rapid change and development. All new blocks will have installed in them the latest irrigation systems with efficiencies not seen in the past. Monitoring of soil moisture, targeted irrigation both in space and time, and ongoing research in this field show the industry to be world leaders. We irrigate with a conscience both to the environment and to the community.

Name: Scott Lawson (Chair of Hawkes Bay Vegetable Growers Association)

Location: Roys Hill (Ngaruroro Catchment)

Background:

I was raised on a Pipfruit and vegetable property in Twyford, I have spent most of my working life in Horticulture.

Currently we grow blueberries on a 12 hectare title at Roys Hill on the unconfined aquifer.

I am currently the chair of the Hawkes Bay Vegetable Growers Association.

I have been involved with the TANK engagement process since its inception.

I made a submission on the TANK Plan Change, as did the Hawkes Bay Vegetable Growers Association, in summary the key points of these submissions were that:

- The Association generally supported the overall framework, to the degree that it reflects a staged approach to improving the management of freshwater resources in the TANK catchments.
- Horticulture is important to the future sustainability of the TANK catchments and some changes are required to ensure that sufficient water of able to provide for this. There is a need to recognise the value of food supply and food security.
- Real change comes from practice – we support all growers operating at good management practice.
- We support the ability for collective approaches to water and nutrient management and seek that this is enabled.

FOCUS TOPIC – Hawkes Bay Vegetable Growers Association

I have been asked by HortNZ to describe the Hawkes Bay Vegetable Growers Association and the role of Growers Associations within the Horticulture Sector.

The Hawkes Bay Vegetable Growers Association was established in 1990. The Association represents the commercial vegetable growers of the Tūtaekurī, Ahuriri, Ngaruroro and Karamū catchments and the wider region. Our aim is '*To represent the interests of Commercial Vegetable Growers and their businesses at a local and national level*'.

Our Association is affiliated to HortNZ and is levy funded via the commodity Levies Act, which means that by law a levy is to be paid at the first point of sale, this automatically includes all vegetable growers paying a levy as members of our Assoc. Many growers produce other product groups such as Pipfruit/Wine and Arable crops. So, there is a lot of common ground shared by our members.

As an Association we have always played an active part in positive discussions with local interest groups and various TLA.

The HBVGA is active in spending its money supporting Research projects such as *'What's Coming Out Tile Drains SFFF 2021'*.

Our members are very aware of environmental impacts, we aim to minimise our water use through wise use of existing irrigation equipment, adopt new technologies and remedial actions such as soil conservation. Investment and job opportunities are based on security of water supply. No water, no guarantee of food production. Very few hectares of vegetables are produced in HB on dryland, all growers rely in most part on the availability of irrigation water.

We see this as a necessity to produce quality, nutritious food.

Our members see the availability of this irrigation water as a privilege, not a right, as we are part of a community who needs to use this limited resource wisely.

We are seeing changing times where consumer, community and Central Government expectations are placing pressure on Growers. We wish to be part of the solution to managing our water resources here in HB.

Thank you for your time today.

Name: Richard Pentreath (President of Hawkes Bay Fruitgrowers' Association)

Location: The land that I manage is in the fernhill puketapu area (in both the Ngaruroro and Tūtaekurī catchments), and my family orchard is in the Tūtaekurī catchment.

Background:

I have had a variety of roles in the horticulture industry – from technical positions, through to management and more recently governance.

Currently I am the owner of a family business growing kiwifruit and a small amount of summerfruit, as well as responsible for the running of approximately 60 hectares of gold kiwifruit for a Māori trust (this is the largest kiwifruit operation in the Hawkes Bay).

I am currently the President of the Hawkes Bay Fruitgrowers' Association, a role I was appointed to 9 months ago. Prior to this I was the Vice President for around 18 months. I originally joined the executive committee as the kiwifruit sector chair for the Association, a role which I held for about 5 years.

In my role as President of the Hawkes Bay Fruitgrowers' Association I participate in the Hawkes Bay Regional Council horticulture sector meetings held three times a year.

I made a submission on the TANK Plan Change, in summary the key points of these submissions were that:

- Generally supported the overall framework, to the degree that it reflects a staged approach to improving the management of freshwater resources in the TANK catchments.
- Horticulture is important to the future sustainability of the TANK catchments and some changes are required to ensure that sufficient water of able to provide for this. There is a need to recognise the value of food supply and food security.
- Real change comes from practice – we support all growers operating at good management practice.
- Support the ability for collective approaches to water and nutrient management and seek that this is enabled.
- Horticulture producers need the ability to change crops in response changing market demand, regulations and environmental conditions. Regulations should allow farmer and growers the flexibility to make changes to not only meet financial needs but also changing environmental needs; otherwise the sustainability of horticulture on the Heretaunga plains will be severely impacted.

FOCUS TOPIC – Hawkes Bay Fruitgrowers' Growers Association

I have been asked by HortNZ to describe the Hawkes Bay Fruitgrowers' Association(HBFA) and the role of Growers Associations within the Horticulture Sector.

The HBFA is a not-for-profit organisation, working on behalf of it's members to ensure that the region's horticulture industry remains a dynamic, progressive and accessible sector for years to come.

The Association has three pillars (each supported by sub-committees):

- **Protect**, the longevity of Hawkes Bay as a fruit-growing region
- **Foster**, to support and drive awareness of career opportunities in horticulture
- **Promote**, the fruit-growing industry through effective marketing

Since 1899, when HBFA was established, the Association has been a platform for growers to exchange, implement and action matters that are important to fruit growing in this region. HBFA is the collective voice for Hawke's Bay Fruitgrowers, an industry that is a major economic provider for the region.

The HBFA represents over 200 members – the majority of which are located in the TANK catchments.

Horticulture New Zealand is the umbrella organisation representing growers on pan-sector issues, such as environmental policy. We also work with product group organisations including New Zealand Apples and Pears, SummerfruitNZ and New Zealand Kiwifruit Growers Incorporated.

HBFA were represented and quite active in the TANK collaborative stake group right up until it was disbanded. Growers (and the Association on their behalf) put a lot of time and effort into this process, so we are very motivated to see outputs from that work and continued with active engagement.

HBFA are here to respond to growers needs in any given season, the work that we have undertaken includes:

- Actively engaging with Council (district and regional) on resource management issues of relevance to growers – including on issues such as outdoor burning, roading and transport, reverse sensitivity and spray drift issues. We have also been involved in the past on urban development policy changes and have submitted quite regularly on issues relating to this and urban spread.
- One of our main activities is promotion and education - including running the Hawkes Bay Young Fruitgrower of the Year competition, support of industry around grower education, health and safety (for example we ran a workshop last year with Transpower communicating how to work safety around power lines)
- Depending on the need we can also be quite involved in pastoral care following hail events, and have been involved with pan-sector groups providing mental health support as pastoral support after droughts etc.
- Supporting the work of HortNZ and product groups in biosecurity – particularly readiness to respond in an incursion event.

HBFA 100% support good sensible management of natural resource for all users of the environment and we encourage best practice amongst fruit growing sector (and actively discourage poor practice).

The Hawkes Bay is a fruit bowl region with a diverse range of fruit crops; we also have a dynamic region which involved land use change for example, this could be from pasture to fruit, vineyards to fruit, or changing fruit varieties e.g. apples to kiwifruit. This is a huge part of sustainability for our industry – we need to be able to adapt and respond, not only to environmental cues but also market cues. We are very concerned that potential changes in TANK might make it difficult for land use change to occur (to fruit or between fruit varieties).

BEFORE THE HEARING COMMISSIONERS APPOINTED BY THE HAWKE'S BAY REGIONAL COUNCIL

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

AND

IN THE MATTER of Proposed Plan Change 9 - Tūtaekurī, Ahuriri, Ngaruroro and Karamū **(PC9)**

STATEMENT OF EVIDENCE OF STUART JOHN FORD (ECONOMICS AND OVERSEER) FOR HORTICULTURE NEW ZEALAND

7 MAY 2021

ATKINS | HOLM | MAJUREY

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CONTENTS

SUMMARY

1. It is my opinion that there are costs associated with the development of freshwater plans that are designed to manage environmental effects first and then allow for abstractive uses and that I am generally able to support the policy direction of PC 9.

2. The area that represents the irrigated horticultural area within the TANK catchment area represents a large and significant proportion of the output of the Hawke's Bay region. It supports a considerable amount of flow on contribution both in economic output and in employment.

3. The economic performance of the irrigated horticultural industry in Hawke's Bay is incredibly sensitive to changes in the supply reliability of their irrigation water. Any change which is enacted in the supply reliability of irrigation water below the current supply reliability, within the area covered as being hydraulically connected to the PC 9 area, will have a major negative effect on the economic output of the catchment and of the region.

4. Much of the planning regime that is currently proposed is designed to protect the current takes of irrigation water, but at the same time heralds the very significant possibility of those takes diminishing over time through a range of possible causes. This protection of the current takes relies on the possibility of establishing augmentation in the future to maintain or increase the current level of economic output. As it is proposed, it does not appropriately address how that augmentation is at least going to be investigated, let alone becoming a reality.

5. Based on my analysis presented here, there is a very sound economic case for the provision of root stock survival water in PC9 from the perspective of the potential negative impacts both on the individual grower, but also from the perspective of the potential negative impact on the Hawke's Bay economy.

6. When nitrogen loss is estimated from crop rotations, the analysis should be for the full crop rotation.

7. Both Kiwifruit and Pipfruit are very efficient users of N and the amount of leaching from both of these land uses is low compared to other land uses. While there are some vegetable rotations which are high in their modelled average N loss results

the average N leaching across a range of vegetable rotations is much lower.

8. In my opinion the notified version of schedule 29 is preferable, as an effective means of achieving a limit on the impact of land use change on nitrogen loss. It uses a load threshold of nitrogen loss for all land use change which is an appropriate effects based method.

9. I consider that using annual and sub annual crop budgets is a more effective method of driving towards GMP or the nitrogen loss target.

10. There still remains a high degree of uncertainty as to the results produced by Overseer in the CVP sector. I therefore support the recommendation that it is not appropriate for its use in PC9 in the vegetable production sector. I am of the opinion that in most instances the calculation of a simple N budget or balance is a satisfactory means of achieving the reporting requirements of PC9 and that demonstrating actions is much more effective than having to conform to an inaccurate model.

INTRODUCTION

Qualifications and experience

1. My full name is Stuart John Ford. I am a Director of The AgriBusiness Group (TAG) and work as an agricultural and resource economist based in Christchurch. I have a Diploma in Agriculture and Bachelor of Agricultural Commerce from Lincoln University and have undertaken post graduate studies in Agricultural and Resource Economics at Massey University.

2. I am a member of the New Zealand Agriculture and Resource Economics Society and the Australian Agriculture and Resource Economics Society. I am also a member of the New Zealand Institute of Primary Industry Management.

3. I have spent 39 years as a consultant in the agricultural industry, with the last 20 years specialising in agricultural and resource economics and business analysis.

4. I have undertaken a wide range of economic impact and cost benefit assessments of proposed statutory planning proposals particularly in relation to proposals to change minimum flow triggers on rivers and the impact on irrigators and the wider economy along with the requirement to limit or reduce the amount of resource loss from the primary industries into the environment.

5. I have prepared evidence and presented it to District and Regional Council Hearings Panels as well as the Environment Court and Special Hearing Panels on Conservation Orders.

Expert Witness Code of Conduct

6. Although this is a hearing before Hearings Commissioners I confirm that I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2014. I have complied with the Code of Conduct in preparing this evidence and agree to comply with it while giving oral evidence. 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 these proceedings

7. I was engaged by Horticulture New Zealand (**HortNZ**) in relation to these proceedings in February 2021.

8. I have an in depth understanding of the development and content of Proposed Plan Change 9 - Tūtaekurī, Ahuriri, Ngaruroro and Karamū (**PC9**) through my involvement in the Water Conservation Order on the Ngaruroro River (**WCO**). The development of the then named TANK process, proceeded in conjunction with the WCO and in many instances informed the WCO.

9. I prepared and gave evidence on the WCO to the hearing panel and subsequently have prepared and submitted evidence in chief for the Environment Court hearing on the WCO.

10. In relation to the Water Conservation Order matter, in September 2017 I went on a jet boat trip up the Ngaruroro River as far as it was possible to travel in a jet boat. I then took part in a meeting with the Hawke's Bay Regional Council (**HBRC**) where we discussed the possibility of running specific horticultural models through the HBRC's Source model.

11. In May 2016 I prepared a report titled "Hawke's Bay Horticultural Nutrient and Financial Benchmarking Results[1]" which was based on a survey of 28 growers and was commissioned by HortNZ and the HBRC. HortNZ wished to understand the absolute values and the ranges of values amongst growers in the Hawke's Bay as to N leaching and the financial performance which was being achieved by growers in the region. HBRC wished to gain values which they could use in their region wide modelling of the losses of N and P and the results of my survey were used in the HBRC's Source modelling which informed PC 9.

12. I created all of the Overseer files for the report on the nutrient and financial performance of the horticulture sector in Hawke's Bay. In the subsequent use of them for these hearings the modelling has been carried out by Charlotte Irving who also works for TAG as an Agricultural and Resource Economist. Ms Irving has a Bachelor of Environmental Management and Planning and a Bachelor of Commerce (First Class Honours) from Lincoln University and has completed both the Certified Nutrient Management Advisor and the Advanced Sustainable Nutrient Management courses at Massey University. She is a Certified Farm Environment Plan Auditor (Environment

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[1] The AgriBusiness Group (2016): Hawke's Bay Horticultural Nutrient and Financial Benchmarking Results

Canterbury) and a Certified Farm Nutrient Advisor (Waikato Regional Council). I have supervised her work for this hearing.

13. I have worked as a consultant for HortNZ for approximately the last 18 years dealing in matters related to economics and resource use. During that time I have been able to develop a detailed understanding of the extent and the nature of horticultural operations across the Hawke's Bay region. I have particularly developed an understanding of such operations and their relationship with irrigation and resource use including through my involvement in the report "Economic Impact of Proposed Minimum Flows on Horticultural Irrigators on the Tukituki River"[2].

14. In addition I have given evidence to the Board of Inquiry into HBRC's Plan Change 6 which dealt with the management of the Tukituki River.

Purpose and scope of evidence

15. HortNZ has asked me to provide this evidence on the potential economic impacts on the horticultural sector of PC9.

16. In my evidence I consider the following:

    (a) the economic contribution of horticulture on the Heretaunga Plains;

    (b) the vulnerability of the horticultural sector to irrigation restrictions;

    (c) the economic impact of the range of policy options that HBRC have used in PC 9;

    (d) the economic analysis to support understanding of the effect of the reduced reliability associated with minimum flows and the economic benefit of the root stock protection policy;

    (e) modelled Nitrogen leaching from typical growing systems and the effectiveness of mitigations to inform land-use change and farm management policy; and

    (f) my conclusions and recommendations.

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[2] The AgriBusiness Group: Economic Impact of Proposed Minimum Flows on Horticultural Irrigators on the Tukituki River

17. In preparing this evidence I have read the following:

    (a) HBRC (2020): Proposed Plan Change 9. Tūtaekurī, Ahuriri, Ngaruroro and Karamū Catchments

    (b) Mitchel Daysh (2020): Section 32 Evaluation Report - TANK Catchments Plan Change 9 to RRMP.

    (c) HBRC (2021): Section 42A Hearing Report on Proposed Plan Change 9.

    (d) HortNZ (2020): Submission on Hawke's Bay Regional Council TANK Plan Change (PC9).

    (e) HortNZ (2020): Further submission on Hawke's Bay Regional Council TANK Plan Change (PC9).

    (f) Williamson Water Advisory (2018): TANK Catchment SOURCE Model Build Report; and

    (g) The evidence of HortNZ.

18. In addition, for the initial Special Tribunal hearing on the Water Conservation Order I noted the following documents that I had read and these are still relevant for this hearing:

    (a) Steve Green (Plant &Food): Modelling the impact of water restrictions;

    (b) Market Economics 2018: Economy wide Impacts of Proposed policy options TANK catchments;

    (c) AgFirst 2018: Modelling Water Restrictions and Nutrient Losses for Horticulture;

    (d) AgFirst 2017: Part 2 of the TANK Economic Social and Ecological Assessment;

    (e) NimmoBell 2018: TANK Direct Economic Impacts FINAL;

    (f) Market Economics 2018: TANK Wider Economic Impacts Powerpoint presentation; and

    (g) Ngaruroro Values to Attributes Report Oct 2016.

CONTEXT TO PC9

19. Below I provide both general context, and context which is more specific to the economics and the nutrient losses as modelled through Overseer of PC9.

The economic contribution of horticulture on the Heretaunga Plains

20. In my evidence I refer to the Heretaunga Plains area which incorporates all of the area identified in the AgFirst[3] report (which is a report that has informed the TANK Plan Change) as being hydraulically connected to the Ngaruroro River. This area is a substantial proportion of the total area in horticulture in Hawke's Bay.

21. The Hawke's Bay area is unique in New Zealand with its combination of soil types and its climate which make it ideal for horticultural production. The climate encourages the growth of crops which require some degree of low winter temperatures with the hot and dry summer temperatures allowing good summer growth and maturity of crops and ideal harvest conditions. This has encouraged the development of the wide range of horticultural crops grown in the area. These range from the permanent crops like grapes, kiwifruit, Pipfruit and Summerfruit to the relatively short term process crops like squash, beetroot, and onions which I refer to as vegetable production.

22. One thing which is essential to economically growing these crops in Hawke's Bay is the ability to irrigate them at times in their growth when soil moisture is limiting their growth potential. This period is generally from December through until April when the Hawke's Bay can experience long periods when the amount of natural rainfall falls well short of the crops' requirements and so they require irrigation to maintain both their yield potential and their quality requirements.

23. The economics of growing these crops is variable in that it waxes and wanes according to local or international prices. The demand for irrigation waxes and wanes according to the variable rainfall of the region. It is essential that the reliability of irrigation capability is maintained to enable and encourage growers to continue to grow the crops.

24. In association with the ability to grow the crops, the off-farm processing industry in Hawke's Bay has also been developed to be able to receive, process, and pack the horticultural produce and to then market it throughout the world. This off-

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[3] AgFirst (2018): Modelling Water Restrictions and Nutrient Losses for Horticulture in the TANK Catchment – An Economic Analysis.

farm industry is a significant contributor and a significant employer to and in the Hawke's Bay economy.

25. Many of the industry players beyond the farm gate are now made up of multinational companies (such as Kraft Heinz) who operate in Hawke's Bay because of the relatively unique nature of productivity in the region. However, they are not tied to Hawke's Bay and if a crop can be grown cheaper in another part of the world and they can process it economically there then they will move their production to that site.

26. This means that although the horticultural industry and its downstream processing is well founded in Hawke's Bay it is constantly operating on a knife edge of pressure on the profitable production of the crops it is able to produce. This pressure comes from other locations in the world where the same crops can be grown often for less cost.

27. The one thing that the Hawke's Bay horticultural sector has been able to do is constantly improve the quality of the crops that it produces. This is often done with the use of advanced technology in the growing of the crop which enables it to achieve high yields of high-quality produce by international standards. The use of irrigation is a prime example of the use of technology in growing the crops in order to achieve both acceptable yields but also of a constantly high quality. This has enabled Hawke's Bay to maintain its position as a preferred grower of many of these crops in an international market place.

28. In the AgFirst report the authors developed a model which represented horticultural production within the area that they considered was hydraulically connected to the TANK catchment. In that model they estimated that there was a total of 16,851ha of land that was devoted to horticultural production. The crop mix which was adopted in the AgFirst report is shown in Table 1.

Table 1: Irrigated horticultural land area in each crop within the TANK area.

Crop	Area (ha)
Pipfruit	6,006
Grapes	4,347
Summerfruit	500
Kiwifruit	180
Process Vegetables	
Onions	873
Peas and Beans	873
Squash	1,745
Sweetcorn	873
Other Vegetables*	1,454
Total	**16,851**

* Other vegetables include tomatoes, beetroot, melons etc.

29. An analysis of Table 1 indicates that the area is approximately one third of each in pipfruit, grapes and process cropping (which represents a wide range of vegetable crops).

30. The AgFirst modelling identified that under the modelling that was carried out, which represented 2017 values and production parameters, the average result expressed as Earnings Before Interest and Tax[4] (**EBIT**) as an average of the 18 years between 1998 and 2013 totalled $183 million for the area.

31. If we were to use the relationships shown in the AgFirst report, which represent the difference between the figure shown for EBIT and the total farm/orchard gate income on the $183 million, this would represent a total of approximately $761 million in output or Gross Domestic Product (**GDP**) which can be attributed to the area of irrigated horticultural land within the TANK catchments area.

32. In 2017 Statistics New Zealand reported that the total GDP of the Hawke's Bay Region was $7.4 billion. This would mean that the output of irrigated horticulture within the area defined by the TANK catchment area as measured by GDP is 10.3 % of the total output of the Hawke's Bay Region.

[4] EBIT = Total Income minus Working Expenditure minus depreciation and lease payments.

33. If we were to estimate the total direct output (farm/orchard gate) and the flow on impact of this level of output it would represent a significant proportion of the GDP, value added, employment, as expressed as Full Time Equivalents (**FTE**) and household income of the Hawke's Bay Region.

34. The area that represents the irrigated horticultural area within the TANK catchment area represents a large and significant proportion of the output of the Hawke's Bay region. It supports a considerable amount of flow on contribution both in economic output and in employment.

The vulnerability of the horticultural sector to irrigation restrictions.

35. At paragraph 22 of this evidence I refer to the reliability of irrigation capability being essential. Irrigation reliability is a critical factor in the grower's choice of crops because it is an absolutely essential element in both the crop quantity, as expressed in yield, and quality, as expressed in grading of the crop.

36. In the AgFirst report they were able to model the output, which is expressed in both yield and grade of the crops grown over the 18 year period which they modelled across a range of scenarios which represented different combinations of consented irrigation take conditions. The irrigation take conditions effectively represent a range of supply reliability for irrigation.

37. The results of this modelling are shown in Table 2.

Table 2: Modelled EBIT earnings for horticultural operations within the TANK at varying supply reliability.

Scenario	Description of take conditions.	Average EBIT ($ m)	EBIT in 2013* ($ m)
Base Case	Ngaruroro 2,400 l / sec	183	136
Future A	Ngaruroro 4,000 l / sec Restricted to "4 in 5" year allocation	144	-$100
Future B	Ngaruroro 3,600 l / sec Restricted to "4 in 5" year allocation	148	-99
Future C 2	Zone 2 -4 restricted to "9 in 10" year allocation.	124	-77

*2013 was the worst year in terms of drought conditions from within the 18 years that were modelled.

38. We can see from Table 2 that there is change between the Base Case results and the results from each of the Future scenarios which represent a:

    (a) 21% drop in EBIT between the base case and future A;

    (b) 19% drop in EBIT between the base case and future B; and

    (c) 32% drop in EBIT between the base case and future C 2.

39. We can also see from Table 2 that the result in the worst year, expressed as EBIT in 2013, is of a very significant negative change in the EBIT of 29% for the base case, 169% for the future A scenario, 167% for the future B scenario and 162% for the future C 2 scenario.

40. What these results indicate is that the economic performance of the irrigated horticultural industry in Hawke's Bay is incredibly sensitive to changes in the supply reliability of their irrigation water. A change in the minimum flow regime of 50% which represents the change from the base case to future B results in a drop of 19% in the average EBIT.

41. The changes which occur in the worst year in the future scenarios are so extreme that it is difficult to imagine the horticultural industry's ability to recover from such a heavy loss. In my opinion the horticultural industry is not economically

resilient enough to be able to manage such a massive loss in one year.

42. My interpretation of these results is that any change which is enacted in the supply reliability of irrigation water below the current supply reliability, within the area covered as being hydraulically connected to the PC 9 area, will have a major negative effect on the economic output of the catchment and of the region. This factor must be considered when having regard to the the needs of primary and secondary industry and of the community.

43. It is therefore my opinion that the consideration of the economic and social needs of the primary and secondary industry and the community is of fundamental importance in understanding the effects of PC9.

DETAILED REVIEW OF THE PLAN CHANGE PROVISIONS

44. It is my opinion that the TANK process has been a comprehensive one and that all parties have had access to the extensive available data and have had the opportunity to put their case during the collaborative process on the issues which affect them. It is my opinion that there are costs associated with the development of freshwater plans that are designed to manage environmental effects first and then allow for abstractive uses and that I am generally able to support the policy direction of PC 9. However, the detail around the design of the policy is essential to be effective and economically efficient and to manage the transition until storage, augmentation etc. is in place, and greater reliability can be achieved. The following topics are my opinion on where PC 9 can be strengthened in order to achieve the maximum amount of efficiency and effectiveness of its rules.

Provisions to allow for water harvesting and storage.

45. From an economic perspective the issue of water harvesting goes to the importance of reliability of irrigation water. In that context it is important to allow for the variability of climatic conditions. As I have stated previously in my evidence the Horticultural sector is highly sensitive to any deterioration in water reliability. Therefore the suggestion made in the S42A report that the actual and reasonable use test should be on the average amount of irrigation use instead of the maximum is unnecessarily harsh on the Horticultural sector as it requires a very high reliability of irrigation water and as proposed the plan

assigns a relatively low reliability of irrigation water. There will be a significant diminution in the overall economic output if the requirement is to only consent the average water use.

46. I am of the opinion that the concept of establishing a rating collective approach to water harvesting and storage as suggested in the S42A report is an excellent concept because it means that there is at least the option for the potential beneficiaries, including users and non users, to contribute to the cost. This option means that the high cost of getting agreement from all of those parties is somewhat diminished and the chances of a water storage option reaching fruition are much greater. At the same time there is the possibility of people advancing their own private scheme.

47. There is a need to advance the planning around water harvesting because of the threats of climate change, the possibility of lowering of the minimum flow on the Ngaruroro River and the requirement for growers to renew their consents possibly on a much lower take than is current. These instances all rely on water storage to at least maintain the current level of economic activity.

48. I note that in her evidence Ms Holmes provides evidence that the current High Flow limits are based on projected demand and do not reflect the true environmental limits that the Ngaruroro River could sustain. In her evidence if the limit is based on the environmental limits may be able to be lifted from 8,000 in future. it is my opinion that being able to set the limit at what is a sustainable environmental limit now will allow for the possibility of whatever demands are made on the river in the future, be they use takes or environmental augmentation, and being able to potentially at least maintain if not expand the volume of economic output.

49. It is my analysis that much of the planning regime that is currently proposed is designed to protect the current takes of irrigation water, but at the same time heralds the very significant possibility of those takes diminishing over time through a range of possible causes. This protection of the current takes relies on the possibility of establishing augmentation in the future to maintain or increase the current level of economic output. As it is proposed it does not appropriately address how that augmentation is at least going to be investigated, let alone becoming reality.

50. It is my experience that one of the advantages with water storage schemes is that when there are multiple beneficiaries of them, being urban and rural users, that those beneficiaries all pay according to the level of benefit that they receive. Examples of these multi beneficiary, multi contributor schemes are the Waimea Dam and the current project in Kaikohe which are paid for by multiple beneficiaries with their contributions according to the level of benefit.

Transfers

51. I note that in the S42A report in Policy 48 it restricts transfers away from versatile land. While I am firmly of the opinion that water transfers are a highly effective and efficient means of achieving economic outcomes, I am also of the opinion that the importance of water to versatile land and the national significance of the combination of water/soil/climate in supporting the horticulture industry in Hawke's Bay in this case outweigh the gains that could be made by transfers away from this versatile land. The ability to have transfers within versatile land will drive an economically efficient market.

The provision of root stock survival water.

52. I note that in the S42A report at Policy 51 there is the recognition of and an allowance for the provision of rootstock survival water and I agree with these provisions.

53. What HortNZ were proposing was that allowance should be made for the provision of sufficient water to maintain root stock during prolonged periods of drought. I refer you to Ms Sands evidence. HortNZ have successfully advocated for provision of root stock survival water in other constituencies throughout the country and the local authorities have recognised the potential for significant economic harm to their economy from not providing for root stock survival.

54. HortNZ is not proposing that sufficient water is made available to maintain the productive capacity of the plants, just that sufficient water is made available to keep the plants alive.

55. In this respect it is exactly the same as the provision of livestock drinking water which is designed to keep the animals alive. What HortNZ is proposing is that the same facility is provided for the horticultural producers in that they can retain the core of their businesses, their rootstock.

56. This is primarily because the loss of the plants would mean that the growers and the wider economy would have to survive for a prolonged period of time before the land can come back into full production and be able to provide a positive financial return.

57. It is my opinion that livestock can either have sufficient drinking water shipped into them at their present location or the stock can be moved out to a reliable source of drinking water. In the case of the crops that rely on their rootstock to maintain their ability to produce, neither of these alternatives is open to them.

58. All of the crops which would take advantage of this root stock protection water have a higher economic output than the vast majority of livestock land uses.

59. I believe that there is a sound economic argument to allow for the provision of root stock survival water as a priority.

60. In a report that I wrote for HortNZ and the Tasman District Council[5] I detailed the costs to the District Council's economy of not providing for rootstock survival water. I identified that :

    (a) The impacts that occur on the Pipfruit Model is for the drought effect occurring before the picking of the fruit and therefore there is complete loss of income in the first year, with only the harvesting expenditure being saved. The orchard is then replanted with nil production in the first year, 50% production in the second year and full production occurring in the third year.

    (b) The impacts that occur on the Kiwifruit Model is for the drought effect occurring before the picking of the fruit and therefore there is complete loss of income in the first year with only the harvesting expenditure being saved. There is a two year gap before replanting can begin while the replacement plants are regrown. Once replanted there is no production in year one, 40% of optimum productivity in year two, 75% in year three and full productivity in year 4 after replanting (note that this is six years since the drought event).

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[5] The AgriBusiness Group (2015): Assessment of the requirement for, and the impact of, not providing sufficient irrigation capability to allow for root stock survival on the Waimea Plains.

(c) The impacts that occur on the Vineyard Model is for the drought effect occurring before the picking of the fruit and therefore there is complete loss of income in the first year with only the harvesting expenditure being saved. For the first two years after the drought event there is no productivity from the vines. In the third year productivity is at 20% of the optimum, 40% in year four, 70% in year five, 90% in year six and then full productivity in year seven.

61. When the impact of such an event was calculated to occur every 18 years and is expressed as the average of those 18 years the impact on Total Revenue, Net Present Value and Employment expressed as Full Time Equivalents (**FTE**) on a per Hectare (Ha) figure is as shown in **Table 3**, **Table 4** and **Table 5**.

Table 3: Gross Revenue With and Without Root Stock Water ($/ha)

	With Root Stock Water	Without Root Stock Water	Difference
Pipfruit	50,525	43,508	7,017
Kiwifruit	43,160	33,929	9,231
Vineyard	11,200	8,276	2,924

62. The impact of not having stock survival water for a ha of Pipfruit is the loss of 14% of the gross income, for Kiwifruit it is a loss of 21% and for the Vineyard it is 26% when it is averaged out over the full period.

Table 4: Net Present Value With and Without Root Stock Water ($/ha)

	With Root Stock Water	Without Root Stock Water	Difference
Pipfruit	132,950	37,530	95,420
Kiwifruit	181,402	48,566	132,836
Vineyard	43,298	-11,143	54,441

63. The impact of not having stock survival water on the Net Present Value of a ha of Pipfruit is a drop of 72% , on Kiwifruit it is a drop of 73% and for the vineyard it makes the net present value negative. The net present value is a form of valuing the income stream so it can be considered as an indication of the value of the enterprise. The figures presented in **Table 4** indicate

that there is considerable loss in value from not having access to root stock survival water.

Table 5: Employment With and Without Root Stock Water (FTE/ha)

	With Root Stock Water	Without Root Stock Water	Difference
Pipfruit	3.12	2.80	0.32
Kiwifruit	1.97	1.68	0.29
Vineyard	0.35	0.28	0.07

64. The impact of not having root stock survival water on a ha of employment expressed as FTE's is a loss in the Pipfruit sector of 10%, in the Kiwifruit sector it is 15% and in the Vineyard it is 20%.

65. I understand from Ms Holmes' evidence that the modelling for the Tutaekuri River indicated that there would be no restrictions in this river with the proposed minimum flow, the Ahuriri catchment has no flow gauge so there is no minimum flow calculated for this catchment and the allocation limit is set at the existing consented volume and that the Karamu catchment only has a small allocation limit (30 L/s) as the majority of takes are groundwater; so any root stock survival allocation limit would be minimal (around 3 L/s) so it is unlikely that it would be used.

66. It is most likely therefore that the only catchment that would require root stock survival water would be the Ngaruroro. It is unclear exactly what proportion of the area of horticultural production is within the Ngaruroro River catchment or the proportion of land that would require it but for the sake of demonstrating the impact of not having root stock survival water available but experiencing a dry period of 52 days as indicated by Ms Holmes in her evidence, which would result in the death of the root stock. I have modelled the impact as affecting 10% of the area in Pipfruit, Kiwifruit and Grapes.

Table 6: Gross Revenue With and Without Root Stock Water ($m)

	With Root Stock Water	Loss Without Root Stock Water	Percentage Loss
Pipfruit	30.35	4.21	14%
Kiwifruit	0.78	0.17	21%
Vineyard	4.87	1.27	26%
Total	36.0	5.7	16%

67. What we can see from **Table 6** is that the negative impact on the Hawke's Bay economy of not having access to root stock protection water would be a drop of approximately $5.7m annually in gross revenue (and GDP), the majority of which would be within the Pipfruit sector.

Table 7: Net Present Value With and Without Root Stock Water ($m)

	With Root Stock Water	Loss Without Root Stock Water	Percentage Loss
Pipfruit	79.85	57.31	72%
Kiwifruit	3.27	1.46	44%
Vineyard	18.82	23.67	126%
Total	101.9	82.4	81%

68. The impact on net present value as is shown in **Table 7** is very severe with a $82.4m loss, or 81% of that with root stock survival water.

Table 8: Employment With and Without Root Stock Water (FTE)

	With Root Stock Water	Loss Without Root Stock Water	Percentage Loss
Pipfruit	1,873	193	10%
Kiwifruit	35	5	15%
Vineyard	152	29	19%
Total	2,061	228	11%

69. The employment impacts are equally severe with the loss of 228 FTE positions permanently or 5% of the on-orchard work force as is shown in **Table 8**.

70. The negative flow on impacts from the inability to access root stock survival water will be in addition to those reported here.

71. It is my opinion, based on my analysis presented here, that there is a very sound economic case for the provision of root stock survival water in PC9 from the perspective of the potentially negative impacts both on the individual grower but also from the perspective of the potential negative impact on the Hawke's Bay economy.

NITROGEN LEACHING FROM TYPICAL GROWING SYTEMS

72. The nature of vegetable production is that the crops that are grown are part of a rotation. This is a practice which is carried out for a number of reasons including:

    (a) to spread the financial risk of growing just the one crop;

    (b) to spread the risk of pests and diseases building up from the growing of the one crop; and

    (c) providing for restorative crops that are designed to bring the growing environment back into the desired state after a number of years of the growing of depletive crops.

73. This adoption of a rotation enables the growers to ensure that their systems are sustainable in the long term.

74. Within the crops included in the vegetable rotations there is a very high degree of substitutability between the range of crops available. The decision as to which crop to grow is made on the market signals as to which is the best mix of crops for the grower to plant within that year and even within the season. Subsequently, there is considerable range in the crop mix grown in any one season and therefore, potentially, the amount of N leached from the farm in that one year. Other factors such as the severity of rainfall will be bigger determinants of the amount of N leached in any one single year.

75. The actual crop mix which a vegetable grower will plant in the ground is driven by a complicated mix of drivers. This is partly the reason for the relatively large area of leased land used in the vegetable sector because the opportunity for a grower to grow on "new" ground opens up the opportunity for them to grow a much wider range of crops and so react to the market signals as to the best crop mix to grow.

76. The diversity of the crop rotations used in the vegetable production sector is almost infinite. It ranges from a very tight rotations of process crops with the rotation repeated on owned land through the use of either owned or leased land which may be on a long term rotation and incorporates elements of arable cropping and livestock farming; or on a short term lease which means that the N leaching from the vegetable production is only a subset of the total long term average leaching from that rotation as the predominant use of the land be it arable or pastoral.

Updating of Nitrogen leaching numbers for Horticulture

77. In their submission HortNZ offered to update the results of modelling for Kiwifruit, Pipfruit and vegetable production as to the N leaching numbers.

78. Modelling of leaching is possible in the horticulture sector through the use of:

    (a) SPASMO which is owned by Plant and Food Research and is used for research purposes and is not available for public use;

    (b) APSIM which is available for public use but the operation of it is difficult and its use is mainly for research purposes; and

    (c) Overseer which is available for public use, for an annual fee, but it requires significant farm and grower systems knowledge by the user as to its use and the parameters that it is modelling.

79. The development of the science functions in all of these models has been slow, but the accuracy of the modelling is improving be it very slowly in the case of Overseer. However Overseer is the preferred version for general use because despite its well documented short comings as to its accuracy, it is the most available modelling tool.

Kiwifruit

80. In the work that I did in the Benchmarking Report I modelled two Kiwifruit orchards in Overseer and found that the average N leaching was 15 kg N/ha/annum with the range being very tight with one orchard measuring 15 kg N/ha*annum and one measuring 16 kg N/ha/annum. This figure was used in the HBRC's source modelling.

81. In the AgFirst[6] report the modelling was carried out using SPASMO and was for one orchard system that was trialled across a range of potential soil types. They found that the N leaching results varied greatly over the 14 soil types that Kiwifruit was modelled on ranging from 9 kg N/hs/annum to 23 kg N/ha/annum but the average was 13 kg N/ha/annum. These results were used to map the N leaching results from Kiwifruit across the TANK area but no weighted average N leaching result is available.

82. Attached in **Appendix A** is a brief report from Zespri[7] which reports the results of the recent modeling of Kiwifruit in the Hawke's Bay using SPASMO across five different soil types. In the Zespri report they say that the SPASMO modelling uses updated parameters within the SPASMO software and that other modelling changes were to use more recent production data. Therefore this data should be considered to be an update of the previous methodologies used. The results are shown in **Table 9**.

Table 9: Modelled long-term nitrogen loss rates in Kiwifruit in the Hawke's Bay region (kg N/ha/annum)

	Hayward	Gold3	Weighted by variety hectares*
Average	11.0	7.9	8.6
Maximum	17.4	10.6	11.8
Minimum	3.2	2.5	2.7

*Values weighted by the green (45) and gold (152) hectares in Hawke's Bay region as per 2018.

83. As the figure presented as the average is weighted according to the variety and the soil type, it should be considered as the most accurate depiction as to the rate of N leaching from Kiwifruit in the Hawke's Bay. Therefore if the Source or the AgFirst models were to be run again, this lower average figure and tighter ranges would be the most appropriate to use.

84. The main thing that we can take from these figures is that Kiwifruit is a relatively efficient user of N and the amount which is leached is a very low proportion of the total applied and the

[6] AgFirst 2018: Modelling Water Restrictions and Nutrient Losses for Horticulture

[7] Zespri (2020): Modelled nitrogen losses for kiwifruit in the Hawke's Bay

total N leached is very low when compared against other land uses.

Pipfruit

85. In my benchmarking report I surveyed 12 apple orchards and modelled them in Overseer Ver 6.2.2 and reported the results as shown in **Table 10**. The average results were used in the HBRC's Source modelling. When exactly the same files were run in the latest version of Overseer Ver 6.3.5 the results are as shown in **Table 10**.

Table 10: Modelled long-term nitrogen loss rates in Pipfruit in the Hawke's Bay region using Overseer. (kg N/ha/annum)

	Old Ver 6.2.2	Current Ver 6.3.5
Minimum	7	5
Average	13	8
Maximum	26	11

86. The figures in **Table 10** show a significant drop in the average figure which lowers from 13 to 8 kg N/ha/annum and a much narrower range with the maximum dropping from 26 to 11 kg N/ha/annum.

87. It is my opinion that the changes that are demonstrated in **Table 10** can be explained by the more accurate definition of the soils in OverseerFM and in the correction of errors in the way that the calculations were made in the old version of Overseer.

88. In the AgFirst report the modelling was carried out in SPASMO and they ran the same model, which applied 50 kg N/ha/annum to an orchard across a range of soil types. The average across the soil types was 15 kg N/ha/annum with the range being from 9 to 24 kg N/ha/annum. There is no way of knowing what the weighted average figure is for the TANK area.

89. The one thing that we can say about the N leaching of Pipfruit is that it is a very efficient user of N and the amount of leaching from Pipfruit is low compared to other land uses.

Vegetable Production

90. In the AgFirst report they modelled four individual crops, Squash, Onions, Sweetcorn and Peas and Beans through

SPASMO and reported both the range as expressed by running exactly the same crops through a range of soil types and the average of the results as is shown in **Table 11**.

Table 11: Modelled long-term nitrogen loss rates in four vegetable crops grown in the Hawke's Bay region.

	Minimum	Average	Maximum
Squash	8	31	57
Onions	8	33	61
Sweetcorn	8	29	54
Peas and Beans	7	28	55

91. It is important to note that the AgFirst report shows the results from four individual crops and doesn't report the results of the total rotation.

In

Table 12 I report the results of running 11 vegetable growing operations (rotations) through Overseer 6.2.2 from my original report and currently through OverseerFM. In order to run them through the current version of Overseer they have had to have some alterations to how they are modelled. We contacted two of the major growers to check that we have represented their growing operations correctly and apart from some increased yields and the inclusion of more sheep winter grazing have found that the models still reflect their rotations.

Table 12: Modelled long-term average nitrogen loss rates from 11 sample crop rotations in vegetable crops grown in the Hawke's Bay region. (kg N /ha/annum)

	Old Ver 6.2.2	Current Ver 6.3.5
Minimum	5	8
Average	15	21
Maximum	47	60

92. It is interesting to note that running these 11 farm rotations through the current version of Overseer results in the same range of results for the maximum and minimum as the AgFirst

results but the average of our whole rotation is significantly lower than the combined average of the AgFirst individual crop results.

93. It is my opinion that these results show that while there are some rotations which are high in their modelled average N loss results the average N leaching across a range of rotations is much lower and vegetable production is on a par with or lower than the pastoral irrigation systems results.

94. In my opinion, when nitrogen loss is estimated from crop rotations, the analysis should be for the full crop rotation.

Land Use Change

95. In schedule 29 as proposed there is a requirement that if the land use changes over more than 10ha on a property it will require a resource consent if the land use change is from a lower to a higher level of leaching as shown in Table 1.

96. In my opinion where nitrogen loss is being used in the plan for freshwater accounting or assessing land use change, the estimates of nitrogen loss must be average annual loss rates. I therefore support Ms Sands where she recommends that the definition of the annual nitrogen loss be expanded to represent the average annual nitrogen loss. This is necessary because there is considerable variation between seasons as to the annual nitrogen loss of a rotation because of annual variations in the crop mix, climatic variability and the impact of growing the rotation on a different range of soil types as is present in leasing different blocks. That is why it is important to record the average annual result. This is even more important if Overseer is the modelling tool utilised because it calculates all farms against an average climate over 30 years , so it is not possible to represent anything other than an average annual long term result in Overseer.

97. I also support Mr Dooney where he recommends that the description is expanded to include a better definition of vegetable cropping to include the full crop rotation. In my opinion this is necessary because as proposed it is unclear exactly what is in the definition of a farm enterprise with vegetable cropping because there is a large proportion of leased ground which is constantly changing and so the revised description as suggested by Mr Dooney gives a much better description for the vegetable production sector.

98. I am of the opinion that Table 1 does nothing to achieve the objective of Schedule 29 Land Use Change and could lead to some quite perverse results. This is mainly because it is impossible to rank land use types according to their N leaching risk categories with any degree of certainty or accuracy because of the massive variability in N leaching losses both within and between land use types. I have demonstrated the wide range of individual results in the horticulture sector and it is my experience that the range is equally as wide within the pastoral sector. This means that the ranges within land use types for N loss overlap when compared with other land use types.

99. It would be quite conceivable for a commercial vegetable grower to convert to dairying, as is proposed at present, without having to gain a consent and have a much higher N leaching average annual loss under the new land use of dairy farming than that being lost currently by the land as a vegetable production unit.

100. As I understand it the purpose of Schedule 29 is to limit land use change that has the potential to increase the amount of N leached from the land uses while HBRC are able to develop appropriate Nutrient limits for catchments. This is much more effectively managed by making a rule which deals with the issue of N leaching loss in a far more direct way than the current method which deals with it in a quasi and inappropriate manner.

101. I have experience in Canterbury, Horizons and the Waikato where they have direct mechanisms which deal with the issue of land use change through rules which directly manage the issue of N loss not through the mechanism of land use type. In my opinion the notified version of schedule 29 is preferable, as an effective means of achieving a limit on the impact of land use change on nitrogen loss. It uses a load threshold of nitrogen loss for all land use change which is an appropriate effects based method.

N Calculation and GMP

102. In my opinion changes are required in regards to N calculation and GMP in order to ensure the TANK plan is fit for purpose.

Descriptions and Definitions

103. In my opinion changes to the wording of Schedule 30 Catchment Collective, Industry Programme and Freshwater Farm Plan are required to achieve a better description of the requirements to describe the vegetable production systems as described in my paragraph 96 to 97 and a clearer differentiation between what is intended to be achieved in the requirement for a Nitrogen Loss Rate and in the requirement for a Nitrogen loss target and to define a Nitrogen Budget as a separate task to estimating nitrogen losses. I support the wording proposed in the evidence of Mr Dooney.

104. Mr Dooney's recommended change to the definition of Nitrogen loss rate brings it into line with my recommended changes in the method of calculating nitrogen loss which clearly specifies that it describes the average annual nitrogen loss rate and that this figure is calculated over the full crop rotation.

105. Mr Dooney's recommended changes to the Nitrogen loss targets definition achieve the same as my recommended changes to the Nitrogen loss rate.

106. The addition of the definition of a Nutrient Budget is important in my opinion. The definition proposed by Mr Dooney broadens the scope of what is an appropriate calculation methodology for calculating the net result of supply and demand for a nutrient. The definition also allows for it to represent either a specific crop or a property. The results from annual or sub-annual nitrogen budgets cannot be directly compared to long-term average annual nitrogen loss rates and target loss rates, but by the plan allowing for nutrient budgets, this means that it will allow growers to continue to use their current methodology of calculating crop nutrient balances by individual crops and then it can be used to assist in their planning to achieve GMP and their N loss target over time.

GMP

107. It is my experience that for some growers crop specific nitrogen budgets are a much more practical method of planning for GMP than having to go through the full exercise of completing full farm modeling through Overseer with its variable and sometimes unreliable results.

108. I consider that using annual and sub annual crop budgets is a more effective method of driving towards GMP or the nitrogen loss target.

109. What the recommendations in Mr Dooney's evidence achieve is a differentiation between the nitrogen budget from the nitrogen loss. Nitrogen loss is the more macro assessment, and N budget is the activity that assists in achieving GMP and the N loss target over time.

Demonstrating N loss and the use of Overseer

110. In Schedule 30 A 2.3 the plan is specific about nutrients in and out and demonstrating an N loss rate and whether or not a property is above or below good management practice.

111. While it is relatively simple to demonstrate a reasonably accurate N loss for some Horticultural systems using Overseer ie: Pipfruit and Kiwifruit, for vegetable production there is a much greater level of inaccuracy in modeling them through Overseer.

112. In terms of Overseer as an analysis tool for vegetable production I consider:

(a) Overseer is a "black box" piece of software which means that its operation is not open sourced and therefore it is not able to be reviewed as to the accuracy of what it is modelling. At the same time, it has not been externally reviewed in any form, although I understand that it is currently undergoing some form of external review.

(b) The modelling of phosphate (**P**) is crude in the way that Overseer analyses and reports the transfer of P across the surface of the ground.

(c) The gross nature of the inputs used in entering data into Overseer (monthly data is the finest input timeframe) are unable to accurately reflect the complexities of relatively fine scale vegetable production systems.

(d) Overseer is not currently capable of modelling all possible crop types and therefore forces the modeller to choose proxy crops to represent the crop being analysed.

(e) Overseer is a long term averaging tool which has a fixed, and somewhat limited, array of long term climatic data which it uses to spread the climatic data entered over, which represents an average of thirty years' data.

113. In a paper written for ECan, Hume[8] identified 21 examples of complexities that were encountered during modelling in Overseer for the arable and CVP sector and detailed the work arounds that she had to adopt to make the modelling work.

114. I also note that the Parliamentary Commissioner for the Environment (**PCE**) released his report "Overseer and regulatory oversight: Models, uncertainty and cleaning up our waterways December 2018" where he concludes that "*a significant amount of information needed to confirm Overseer's use in a regulatory setting is lacking*". He then goes on to make a number of recommendations as to what needs to be done to make Overseer suitable for use in a regulatory setting[9].

115. It is HortNZ's policy to work with Overseer to try and improve the accuracy of the N leaching figures produced by the tool. However, when councils seek to use Overseer as a tool to aid their legislative intentions in the horticulture sector I have some serious doubts about Overseer's ability to accurately predict the performance of the sector in terms of both N and P leaching.

116. In the report[10] which I wrote for HortNZ I identified a number of challenges related to modelling vegetable crops in Overseer which had a potential negative effect on our ability to accurately model the N leaching performance of the vegetable growing sector.

117. In that report, TAG commented on a review of the use of Overseer in the arable and horticultural sector as follows:

> The Foundation for Arable Research carried out an independent review of the use of Overseer in the arable sector, which incorporated consideration of the

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8 Hume et al 2015. MGM Technical Report Arable and Horticultural crop modelling. Report written by Plant and Food for ECan.

9 https://www.pce.parliament.nz/media/196493/overseer-and-regulatory-oversight-final-report-web.pdf

10 The AgriBusiness Group (2015): Nutrient Performance and Financial Analysis of Lower Waikato Horticulture Growers

horticultural sector. It came up with the following conclusion:

> Overseer is the best tool currently available for estimating N leaching losses from the root zone across the diversity and complexity of farming systems in New Zealand. This review sets out a pathway for improving its fitness for this purpose in the arable sector (see recommendations). It also highlights that the new challenges facing OVERSEER® place demands on the development team and model owners that need to be acknowledged and resourced appropriately."

118. The Foundation for Arable Research (**FAR**) review came up with the following recommendations which are relevant to the horticultural sector. The first of which is:

> Overseer crop model estimates of N leaching should be evaluated against measurements of N leaching to identify whether there are any systematic errors in predictions.

119. We note that this has been the subject of new projects facilitated and led by HortNZ and FAR through the "Rootzone Reality" Programme establishing a national network of lysimeters. The work commenced in 2014 with the installation of sites. It will take at least 3-4 years to establish measurements that are useful. It will take additional time for the Overseer owners to incorporate the new information into modelling predictions.

120. The second recommendation was:

> Overseer crop model estimates of N leaching should be evaluated against predictions of long term leaching produced by established, detailed research models e.g. APSIM.

121. HortNZ, FAR and the Fertiliser Association of New Zealand contracted Plant and Food Research to test Overseer results in comparison with Agricultural Productions Systems Simulator (APSIM). The project was started in early 2015 and delivered its final report[11] in early 2017.

122. The analysis identified that there were key places in the calculations where differences are occurring in the output of N leaching data in both the arable and horticultural rotations which they ran through both models. It was the opinion of the authors that these differences were caused by inaccuracies in

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[11] Khaembah E, Brown H (2016): OVERSEER crop module testing – end of project report

the way that Overseer was modelling both the arable and horticultural rotations.

123. The Plant and Food Research team recommended that it would be worthwhile to carry out further investigation into:

(a) Creating outputs of all the components of the water and nitrogen balances in Overseer and SCRUM-APSIM and key predictor variables to enable full comparison of the models.

(b) Further investigation into the Overseer hydrology model in order to identify what is causing it to over- estimate leaching rates and the possible methods of improvement; and

(c) A detailed comparison of the components of the N balance is needed in order to determine where improvement is required.

124. The third recommendation from the FAR review into Overseer was to:

> The testing outlined in recommendations (1) and (2) is likely to identify and justify areas for further development of Overseer to improve N leaching predictions.

125. As far as I am aware none of the three recommendations made in that report have been completed. This is at least partially due to the development of Overseer being limited by the expenditure of capital and partially due to the low priority put on the development of vegetable production capability by Overseer.

126. There still remains a high degree of uncertainty as to the results produced by Overseer in the CVP sector. I therefore support the recommendation that it is not appropriate for its use in PC9 in the vegetable production sector.

127. I am of the opinion that in most instances the calculation of a simple N budget or balance is a satisfactory means of achieving the reporting requirements of PC9 and is much more cost effective in terms of the effort required to complete it.

GAP and Farm Environment Plans

128. Mr Farrelly has given you evidence on the use of GAP and Farm Environment Plans as a means of recording the progress being made in terms of environmental performance. It is my

experience from Canterbury that demonstrating the actions that are necessary to achieve the full range of environmental performance and having these actions audited by an independent body is able to achieve significant progress towards achievement of these environmental aims.

Conclusion

129. It is my opinion that demonstrating actions is much more effective than having to conform to an inaccurate model. I support the inclusion of the approval of alternatives to Overseer in Schedule 30. For the vegetable sector, appropriate alternatives would be crop nitrogen budgets or if average annual nitrogen loss estimates are required for freshwater accounting land use change assessment, then a set of representative proxy rotations, similar to N-check in Canterbury, are likely to be as useful as farm specific models.

THE USE OF FARM ENVIRONMENT PLANS

130. TAG have a long history in the development of FEP's. Four of our staff are certified as FEP auditors. This means that they have reached a high standard of performance in both compiling and auditing FEP's. Annually we carry out approximately 350 FEP audits, the majority of these are carried out for the large irrigation schemes across Canterbury. We have been carrying out this exercise ever since we wrote the first FEP's for the Morven Glenavy Irrigation Scheme over ten years ago.

131. It is our experience that FEPs have been embraced by the majority of growers and farmers who are now almost competitively trying to improve their grading or maintain their grade at the highest A level.

132. From an ECan perspective, the audit system is constantly improving in its ability to assist the farmers to achieve the required water quality standards. The requirements of the auditing as set by ECan is constantly becoming more comprehensive and the audit standards are constantly expanding.

133. It is my opinion that the operation of FEP's alone will provide a very real improvement in water quality metrics across the horticulture sector in Hawke's Bay.

The importance of the domestic market

134. I am aware that currently the amount of horticultural production that is destined for the domestic market in Hawke's Bay is relatively small. I am also aware that in its original submission HortNZ proposed that allowance be made in PC9 for the growth of domestic food supply.

135. The majority of production for domestic food supply is carried out in Auckland, Canterbury and in the Horizons regions. In each of these regions there are threats to their ability to produce. These threats come from the encroachment of urban development, tight planning regimes and many other causes.

136. Hawke's Bay has already experienced growth in its vegetable production area to service this demand as it is seen as the next best option to expand production into.

137. I note that Ms Sands in her evidence is asking that the importance of food supply is inserted into the Objectives and Policies of PC9.

138. I support her in this because from a supply side there are pressures against the suitable land being available and from a demand side the demand is growing, so I see Hawke's Bay as being an important region in helping balance supply and demand in the future.

CONCLUSIONS AND RECOMMENDATIONS

139. The irrigated horticultural area within the TANK catchment represents a large and significant proportion of the horticultural output of the Hawke's Bay region. It supports a considerable amount of flow on contribution both in economic output and in employment.

140. The results of the work referred to in my evidence indicate that the irrigated horticultural industry in Hawke's Bay is incredibly sensitive to changes in the supply reliability of their irrigation water. A change in the minimum flow regime of 50% which represents the change from the base case to future B results in a drop of 19% in the average EBIT. My interpretation of these results is that any change which is enacted in the supply reliability of irrigation water below the current supply reliability within the area covered as being hydraulically connected to the Ngaruroro River will have a major negative effect on the economic factors which are considered when having regard

to the needs of primary and secondary industry and of the community.

141. It is my analysis that much of the planning regime that is currently proposed is designed to protect the current takes of irrigation water but at the same time heralds the very significant possibility of those takes diminishing over time through a range of possible causes and relies on the possibility of establishing augmentation in the future to maintain or increase the current level of economic output while not appropriately addressing how that augmentation is at least going to be investigated let alone becoming reality.

142. I note that in the S42A report in Policy 48 that it restricts transfers away from versatile land. While I am firmly of the opinion that water transfers are a highly effective and efficient means of achieving economic outcomes I am also of the opinion that the importance of water to versatile land and the national significance of the combination of water/soil/climate in supporting the horticultural industry in Hawke's Bay in this case outweighs the gains that could be made by transfers, away from this versatile land. The ability to have completely open transfer within versatile land will drive an economically efficient market.

143. I support the fact that in the S42A report at Policy 51 there is the recognition of and an allowance for the provision of rootstock survival water and I agree with these provisions. There is a very sound economic case for the provision of root stock survival water in PC9 from the perspective of the potential negative impacts both on the individual grower but also from the perspective of the potential negative impact on the Hawke's Bay economy.

144. The diversity of the crop rotations used in the vegetable production sector is almost infinite. It ranges from tight rotations of process crops use of either owned or leased land and incorporates elements of arable cropping and livestock farming which means that the N leaching from the vegetable production is only a subset of the total long term average leaching from that rotation as the predominant use of the land be it arable or pastoral.

145. The N leaching of both Kiwifruit and Pipfruit is a very efficient user of N and the amount of leaching from both of these land uses is low compared to other land uses.

146. While there are some vegetable rotations which are high in their modelled average N loss results the average N leaching across a range of vegetable rotations is much lower and vegetable production is on a par with or lower than the pastoral irrigation systems results.

147. Table 1 does nothing to achieve the objective of Schedule 29 Land Use Change and could lead to some quite perverse results. The Notified version of schedule 29 is preferable as an effective means of achieving a limit on the impact of land use change on nitrogen loss because it used a load threshold of Nitrogen for all land use change which is an effects based method.

148. I support Mr Dooney where he recommends changes to the wording of Schedule 30 Catchment Collective, Industry Program and Freshwater Farm Plan. What his wording achieves is a better description of the requirements to describe the vegetable production systems for a Nitrogen Loss Rate and in the requirement for a Nitrogen loss target and the suggested introduction of a definition of a Nitrogen Budget.

149. There still remains a high degree of uncertainty as to the results produced by Overseer in the CVP sector. I therefore support the recommendation that it is not appropriate for its use in PC9 in the vegetable production sector alone.

150. I am of the opinion that in most instances the calculation of a simple N budget or balance is a satisfactory means of achieving the reporting requirements of PC9 and is much more cost effective in terms of the effort required to complete it.

151. It is my opinion that the operation of FEP's alone will provide a very real improvement in water quality metrics across the horticulture sector in Hawke's Bay.

152. Ms Sands in her evidence is asking that the importance of food supply is inserted into the Objectives and Policies of PC9. I support her in this because from a supply side there are pressures against the suitable land being available and from a demand side the demand is growing so I see Hawke's Bay as being an important region in helping balance supply and demand in the future.

Stuart John Ford

7 May 2021

APPENDIX A: MODELLED NITROGEN LOSSES FOR KIWIFRUIT IN THE HAWKE'S BAY

Prepared by Zespri International Ltd and New Zealand Kiwifruit Growers Incorporated – July 2020

Regional Councils throughout New Zealand are responding to the National Policy Statement for Freshwater Management and as result there is a need to understand the impact of different land uses on water quality. In recent years, various nitrogen loss values for kiwifruit orchards have been used by Regional Councils for modelling and limit setting purposes. These values have generally been derived from modelling and have the caveat that they are based on very limited data on measured outputs. In 2016, Zespri recognised a need to measure nutrient losses and to improve the modelling of this. A study was therefore commissioned with Plant and Food Research (PFR) to measure and model nutrient losses which has just reached its fourth year of data collection and is ongoing. The study includes seven sites within the Bay of Plenty. Modelled nutrient loss values, tested against real measurements, are now emerging from the study. The modelling is SPASMO based.

In May 2018, AGFIRST presented a report to the Hawke's Bay Regional Council "Modelling Water Restrictions and Nutrient Losses for Horticulture in the TANK Catchment – An Economic Analysis". The report includes various tables with the predicted nitrogen loss from kiwifruit on various soil types in the catchment. The software used for this analysis was SPASMO which is proprietary from PFR. The Bay of Plenty nutrient loss study has provided new information for setting parameters within SPASMO.

Zespri and NZKGI have had PFR re-evaluate the TANK soils using updated parameters within the SPASMO software, other modelling changes were to use more recent production data.

Table 1. Modelled long-term nitrogen loss rates in the Hawke's Bay region. SPASMO model input parameters consider five predominant soil types in the region, average long-term rainfall of the region (741 mm) and addition of nitrogen fertiliser at rate of 120 Kg-N/Ha/Yr.

Hawke's Bay		**kg-N/Ha/Yr**		
Weather station	**Soil type**	**Hayward ***	**Gold3****	**Weighted by variety hectares*****
Whakatu	Average	11.0	7.9	**8.6**
Whakatu	Maximum	17.4	10.6	**11.8**
Whakatu	Minimum	3.2	2.5	**2.7**
Whakatu	Twyford_silt_loam	11.6	10.5	**10.8**
Whakatu	Twyford_sandy_loam	9.9	8.2	**8.6**
Whakatu	Farndon_silt_loam	10.2	5.4	**6.5**
Whakatu	Hastings_silt_loam	13.7	10.6	**11.3**
Whakatu	Hastings_silty_clay_loam	11.2	7.9	**8.7**
Whakatu	Pakipaki_silty_clay_loam _7	3.2	2.5	**2.7**
Whakatu	Esk_sandxx	17.4	10.2	**11.8**

* Considering a mean regional productivity of 7,600 TE/he, dry matter of 17.1 % and tray weight of 3.6 kg/TE
** Considering a mean regional productivity of 12,000 TE/he, dry matter of 18.3 % and tray weight of 3.3 kg/TE
*** Values weighted by the green (45) and gold (152) hectares in Hawke's Bay region as per 2018.

The Zespri-PFR project is ongoing and over time is expected to deliver new and more accurate data which will be used to refine the model. This may result in modelled values that differ to those presented here, which is the best currently available for Hawke's Bay.