BEFORE THE HEARING COMMISSIONERS APPOINTED BY THE MANAWATU WANGANUI REGIONAL COUNCIL (HORIZONS)

IN THE MATTER	of the Resource Management Act 1991 (**RMA** or **the Act**)
AND	
IN THE MATTER	of Proposed Plan Change 2 to the Horizons One Plan

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STATEMENT OF EVIDENCE OF ANDREW BARBER (FEP AND SEDIMENT MANAGEMENT) ON BEHALF OF HORTICULTURE NEW ZEALAND

25 September 2020

ATKINS | HOLM | MAJUREY

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INTRODUCTION

Qualifications and experience

1. My name is Andrew John Barber. I am a Director of Agrilink NZ and work as an Agricultural Engineering Consultant based in Auckland. I have a Bachelor of Horticulture (Tech) with first class honours from Massey University.

2. I have spent 25 years as a consultant in the agricultural industry, specialising in resource use optimisation. This includes resource use benchmarking in the form of national and individualised reporting to growers comparing their performance to regional and national benchmarks.

3. In my years as a consultant I have helped develop vegetable industry soil and erosion management guidelines, and individual cultivated property erosion and sediment control plans.

4. I was Project Manager on the Franklin Sustainability Project and provided technical advice on managing soil erosion on cultivated land. This was a multi-stakeholder project that ran between 1996 and 2004 which, while having a broad goal of improving the overall sustainability of outdoor vegetable production in the Franklin region, had a clear focus on keeping soil on the paddock and mitigating any effects of off-site discharges. The project directly involved the growers, Horticulture New Zealand, the Ministry for the Environment, the Ministry for Primary Industries (**MPI**), Auckland Council, Waikato Regional Council, and the Franklin District Council.

5. I managed and conducted research for the MPI Sustainable Farming Fund (**SFF**) project Don't Muddy the Water (**DMTW**). This project has quantified the efficiency of Sediment Retention Ponds (**SRP**) and vegetated buffers on vegetable properties. It has also developed an erosion and sediment control app, Erosion & Sediment Control Plans, and is currently linking this through to NZ Good Agricultural Practice (**NZGAP**) Farm Environment Plans (**FEP**) audits (https://www.newzealandgap.co.nz/).

6. I have also worked on stormwater projects for the Franklin District Council where I designed the stormwater system for Pukekohe Hill and the Bombay Hills that ensured an integrated system between the council and grower drains that were sized to cope with high intensity storm events.

7. In 2014 I updated the Erosion and Sediment Control Guidelines for Vegetable Production. The DMTW Project was based largely on quantifying the efficiency of the SRP design in these guidelines.

Expert Witness Code of Conduct

8. I have been provided with a copy of the Code of Conduct for Expert Witnesses contained in the Environment Court's Practice Note dated 1 December 2014. I have read and agree to comply with that Code. This evidence is within my area of expertise, except where I state that I am relying upon the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Farm Environment Plan Implementation

9. Starting in 2019 I was part of the team that took the Levin growers through the NZGAP Environmental Management System (**EMS**) FEP process, from completing their FEPs through to completed 3rd party audits.

10. Alongside this process we developed a set of metrics for establishing baseline benchmarks and tracking future progress.

Purpose and scope of evidence

11. My evidence provides a description of the NZGAP EMS FEP implementation across the Horizon's region, with a focus on the Hokio 1a catchment.

12. It describes how FEPs fit within a whole system approach that is focused on implementing on the ground changes. The industry's framework – Joining the Dots, is a structured approach for vegetable growers to progressing from problem recognition through to meaningful sustainability reporting and consents.

13. My evidence describes how this process has been implemented at both an individual organisation and catchment level. It uses the two main contaminants in vegetable production, sediment (including phosphate) and nitrogen leaching, as worked examples where on the ground action has led to environmental improvements.

14. Having had a whole catchment of vegetable growers work their way through the NZGAP EMS, 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.

Summary of conclusions

15. The industry has developed an extremely robust process that takes growers from problem recognition through to third party audited FEPs.

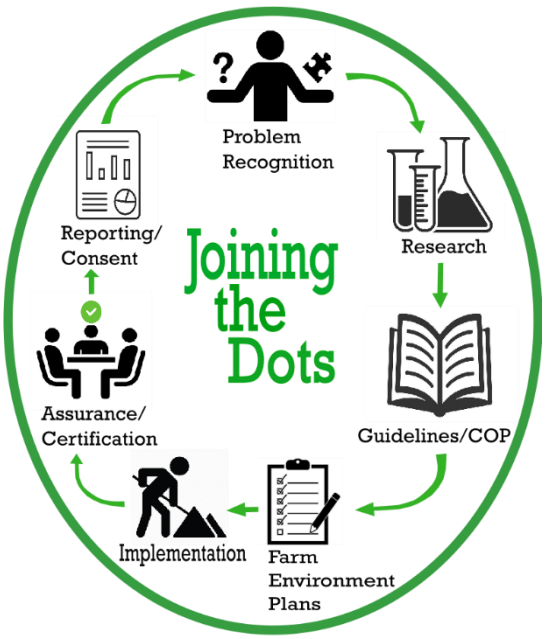
16. The industry approach allows for national, regional, catchment, and individualised benchmarking reports.

17. FEPs are underpinned by research, solution development, COPs, and dissemination. Crucially they provide a structured process to plan, document, and implement good and best practice which is verified via independent audits.

18. NZGAP EMS FEPs are practice and action focused. The implementation of identified new or improved practices are time bound and the focus of subsequent audits.

JOINING THE DOTS – WHOLE SYSTEM APPROACH

19. FEPs do not occur in isolation. They are a crucial element of a whole system approach. FEPs are underpinned by research, solution development, Codes of Practice (**COPs**), and dissemination. Crucially they provide a structured process to plan, document, and implement good and best practice which is verified via independent audits.



20. The first step towards improved practice is problem recognition. Without recognition and consequently motivation to change, there is confrontation and reduced effectiveness of what becomes begrudgingly applied measures.

21. NZGAPs EMS takes their good and best management practices from industry developed guidelines and codes of practice. These have been built upon years of Crown Research Institute and grower research and practice.

EROSION & SEDIMENT CONTROL RESEARCH AND DISSEMINATION

22. 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*.

23. 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.

24. 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.

25. Don't Muddy the Water built upon previous research on erosion control, including the use of cover crops and wheel track ripping.

26. On-going research includes MPI and FARs effectiveness of vegetated buffer strip trials.

27. 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.

28. The Erosion & Sediment Control Guidelines for Vegetable Production, like all focus areas within an FEP, starts with a risk assessment. The guideline details a suite of E&S control measures suitable for cultivated horticultural land. Measures in the guideline include vegetated buffers, SRPs, cultivation practices, interception drains, and wheel track ripping amongst many others. Within the NZGAP FEP Template each practice is categorised as a Good or Best Management Practice (**GMP / BMP**).

29. 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.

30. 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 (https://www.vri.org.nz/esc/). This research and app has been used to aggregate paddock losses to estimate catchment sediment loads.

31. The app allows growers to do a paddock risk assessment and subsequently prioritise their actions as part of their Farm Environment Plan.

32. This also 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 minimise sediment entering New Zealand waterways.

33. 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 can then be added to assess the impact of these practices.

NUTRIENT MANAGEMENT RESEARCH AND DISSEMINATION

34. 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.

35. The recently announced 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. It builds upon recent MPI SFF research projects including Rootzone Reality, Measure it and Manage it, and Future Proofing Vegetable Production.

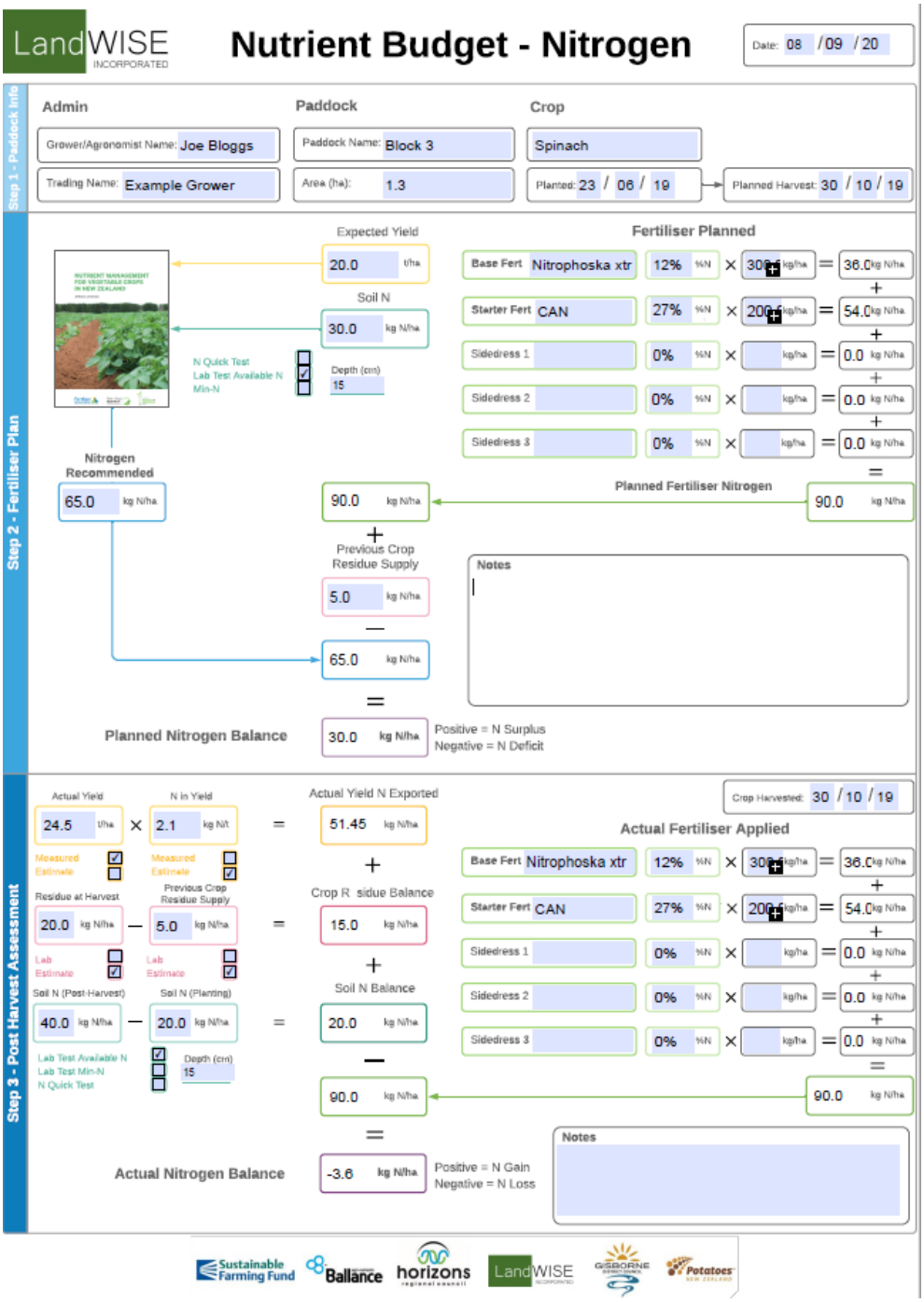
36. Just like Don't Muddy the Water did for sediment, SVS is focused on collecting robust data that in turn will be used in crop nutrient and nitrogen leaching models.

37. 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.

38. 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 the Nutrient Management for Vegetable Crops in NZ (Reid and Morton, 2019) are also being developed.

39. One of the recently developed grower focused nutrient management tools is the LandWISE single page nitrogen and phosphorus nutrient budgets. This integrates the nutrient management guide and soil testing – laboratory including hot water N, and Quick-N test.

40. An example budget is shown 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.



41. The nutrient budget has both a planning (Step 2) and review or assessment of performance (Step 3) components (see above example).

42. 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.

43. 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 cannot account for seasonal variability.

44. Seasonal variability is accounted for in the post-harvest review in Step 3. At this point the uncertainties of growing and the markets come in. The actual nitrogen gain or loss is the reality of growing in an unpredictable climate. From a continual learning perspective, it is important to review the season. There are aspects in this review step that are still being developed and are the focus of industry research. 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 higher than average rainfall or crop disease resulting in lower yields and consequently affecting the planned nitrogen balance. Clearly these scenarios are not envisaged when the fertiliser plan was prepared in Step 2.

45. 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. Uncertainties and previously mentioned research include how to determine residue levels and their associated nitrogen contribution and release timing.

46. It is also becoming abundantly clear that cover crops, a GMP, can have a large impact on the nitrogen balance. These cover crops, just like vegetable crop residues, are imperfectly modelled in Overseer.

47. Consequently, these uncertainties have become the focus of current research. This includes better understanding of cover crops and crop residues, including estimating the quantity, availability, and nutrient release timing. Likewise, new soil nitrogen testing such as Quick-N and hot water laboratory analysis are being incorporated into the research trials.

FARM ENVIRONMENT PLANS

48. The NZGAP EMS has developed a FEP Template. There are 5 management areas, with multiple sub sections:

    (a) Property Plan (map)

    (b) Soil

    (c) Nutrients

    (d) Water and Irrigation

    (e) Mahinga Kai and Biodiversity

49. The FEP process for each management area is the same:

    (a) Assess the environmental risks

    (b) Identify GMPs (and BMPs if applicable) currently completed

    (c) Identify GMPs (and BMPs if applicable) yet to be completed and set target date for completion

    (d) Make progress towards GMP (and BMP if applicable)

    (e) Actions and improvements are assessed during each EMS audit

50. 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. Metrics that establish the current level of BMPs and GMPs, as well as the planned actions over the next 5 years is included later in my evidence.

51. One of the questions in the Nutrients section of the FEP asks, does the grower plan fertiliser inputs for the crop? A 'Yes' response must be supported by evidence. In this case it could be the LandWISE nutrient budget described above.

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

52. In a situation where the response is a 'No', then this would require a timebound action to be added to the FEP Action Plan.

GROWER AND INDUSTRY REPORTING

53. With centralised and audited FEPs, there is a lot of data that can now be used to help drive practice-based change and tell the industry's story. An industry environmental dashboard is in the development phase, with the first metrics shown below (paragraph 60).

54. Practice change through benchmarking reports has been used for approximately 10 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, or 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.

DATA COLLECTION AND RESPONSES

55. Maps are the first Template (5A) and foundation for the FEP. Like all NZGAP EMS 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 explanation or 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) Y	P	N	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
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

56. 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.

57. 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 Plan.

58. The first GMP in the Nutrients Template (7C) is that all fertiliser inputs are planned. In the example 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 (discussed previously), OverseerFM, or their nutrient application records against crops and nutrient requirement lookup tables.

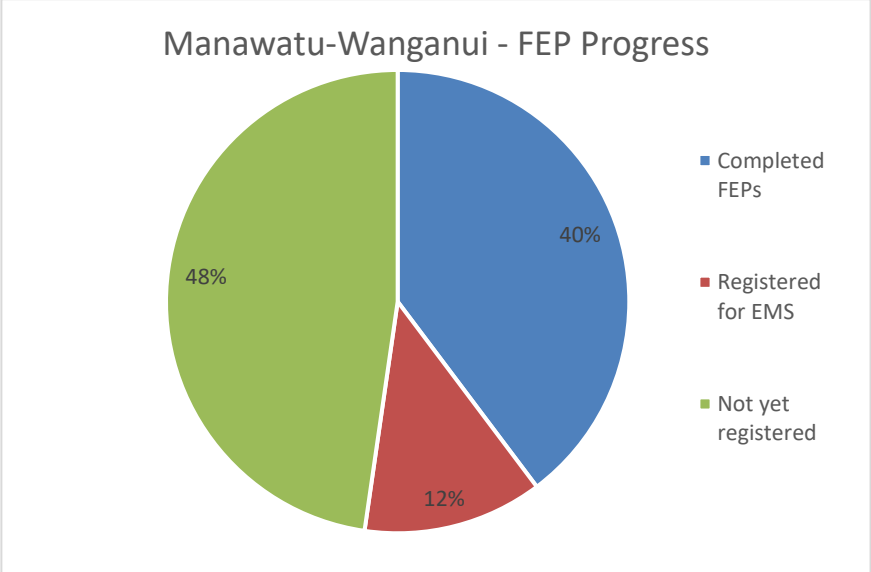
7C. NUTRIENTS: ***Implement measures to improve nutrient uptake and minimise nutrient loss***

Ref	Good/Best Management Practices	Currently Implemented? (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 provided (e.g. record, photo, observation)	Level
	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

59. In this example question 2 was an n/a, with the explanation that they did not use organic manure.

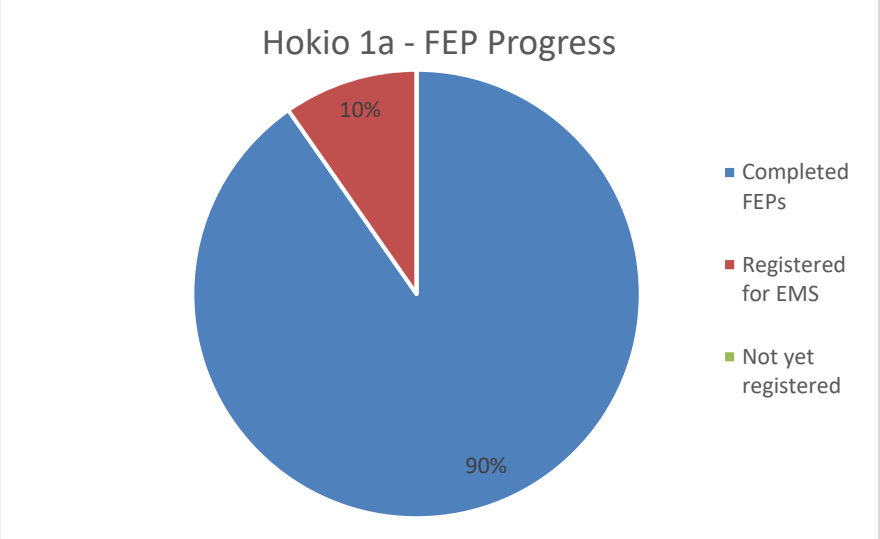
FEP PROGRESS

60. Since September 2019 9 growers, representing 40% of the vegetable production area in the Manawatu-Wanganui region, have completed and had their FEPs audited. A further 23 growers, representing 13% of the area, are EMS registered and working through their FEPs.



61. In the Hokio 1a (Lake Horowhenua) catchment 7 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.



Progress	Manawatu-Wanganui		Hokio 1A (Lake Horowhenua)	
	No.	Area	No.	Area
Completed FEPs	9	1,449	7	426
Registered for EMS	23	458	6	46
Not yet registered	-	1,740	0	0
TOTAL		**3,647**	**13**	**472**

CURRENT AND PROJECTED GMP & BMP

62. Across the NZGAP FEP there are 106 questions and mitigations, comprising of 65 GMPs and 41 BMPs. A summary of the responses to each practice question from the 7 completed FEPs in the Hokio 1a catchment is shown in the Table below.

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

63. Just over half of the assessed practices (55%) were either at or above GMP. The 16% of n/a's are practices that do not apply to a particular property, such as in the example above (paragraph 59) 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".

64. Excluding n/a's and blanks, 82% of practices are currently implemented at the level of GMPs. This increased to 88% when analysed on an area basis. By company 48% of BMPs are currently being implemented, which increases to 63% when weighted by area.

65. For the 7 completed FEPs in the Hokio 1a catchment there were 38 Partial's, 136 No's, and 117 n/a's. All Partial, No, and n/a responses to GMPs requires an explanation, and where appropriate a time bound action recorded in the Action Plan. In catchments like Hokio 1a with water quality below bottom lines, all BMPs also require a response and possible action.

66. The FEP lists a suite of measures, not all of which require or make sense to be implemented. This aligns with the Joint Witness Statement of Experts "…*a set of GMP and BMP that are available is paramount. The ability to choose from these is important, they should be a 'toolbox' of options and not mandatory requirements to implement all.*" (21 and 22 July 2020 – page 12).

67. One of the lessons from taking the growers through the FEP process was the need to have clearer documentation around appropriate responses. Many of the No responses would have probably been more correctly recorded as n/a. For example, Sediment Retention Ponds are not appropriate on most paddocks in the Hokio 1a catchment. The response to this question in the FEP was an even split between 43% recording n/a and 43% recording No. These no's did not have an action recorded, but often have a response saying that they use vegetated buffer strips instead.

68. Of the 7 completed FEPs, 33 Actions were identified. The explanation above goes some way to explaining why not all of the 174 Partial's and No's had associated actions. This is also an area for further work to understand how the link between responses and action can be better communicated and assessed.

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
Total number of actions	33

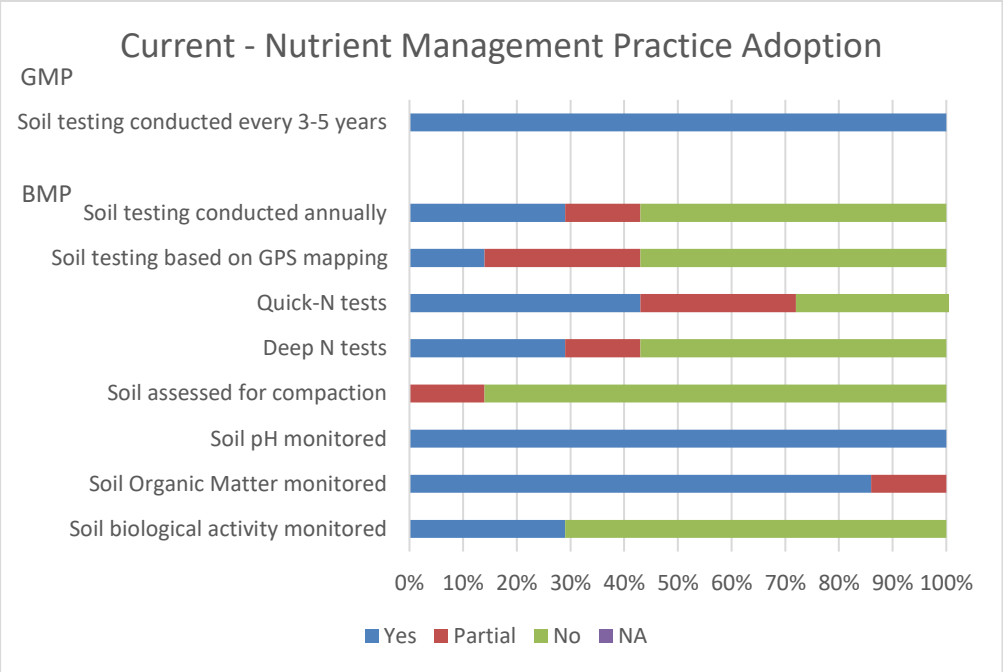
69. Being time bound the table below shows the implementation plan by 2025, with 69% of the actions to be implemented before the end of 2021.

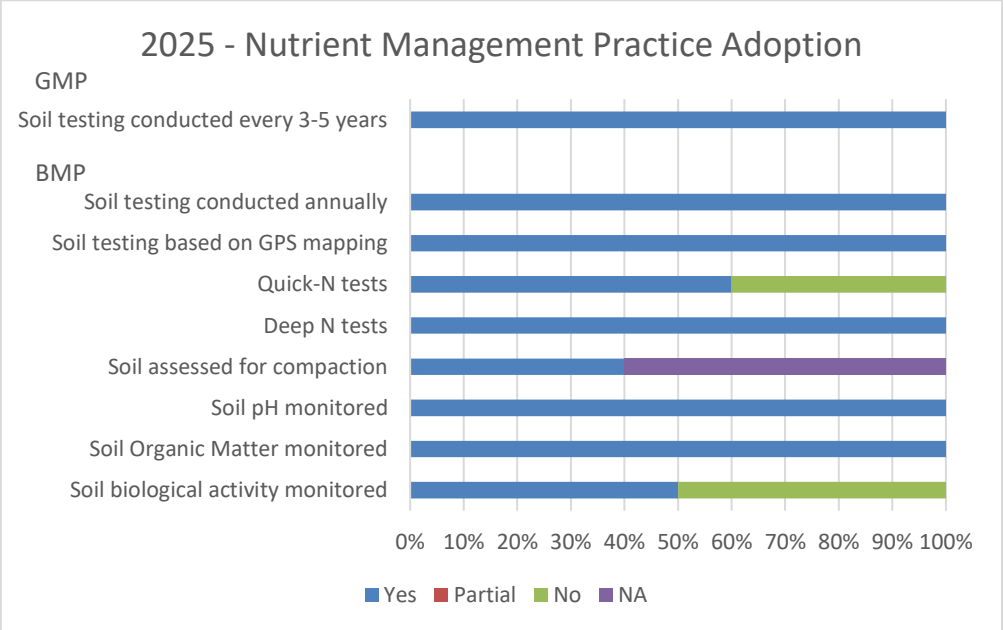
	Actions to be completed		
Ongoing	2	7%	7%
2020	7	24%	31%
2021	11	38%	69%
2022	2	7%	76%
2023	5	17%	93%
2024	1	3%	97%
2025	1	3%	100%

70. It is also possible to drill further into the FEP risk assessment and mitigation responses. An analysis of the grower completed paddock risk assessment for nutrient management showed that from a problem recognition perspective, growers considered the fertiliser 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 higher risk factors. This has already been reflected in current research through the Future Proofing Vegetable Systems project, the LandWISE nutrient budget, and the new Sustainable Vegetable System project.

71. A selection of current nutrient management practices is shown in the Figure below. Currently all growers conduct the GMP of soil testing at least every 3-5 years. Below this is a

selection of GMPs with a wide range of adoptions. With greater emphasis on nutrient budgeting - which incorporates soil nutrient testing, we expect to see annual soil testing increase across the industry. As it is a BMP it needs to be implemented in the Hokio 1a catchment. Likewise, with FEPs making mapping more integrated into an operation's practices and documentation, the proportion of growers linking soil testing to GPS mapping will increase generally and will need to move to 100% within priority catchments, such as the Hokio 1a.





72. 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 above shows the projections by 2025 in Hokio 1a.

73. As described previously this is a suite of practices, not all of which 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.

ESTIMATING SEDIMENT LOAD REDUCTIONS FROM GMP AND BMPS

74. The DMTW app was used to estimate the sediment catchment loads from vegetable production under a range of scenarios; 1. Unmitigated; 2. Current practice (high and low efficiency); and 3. Enhanced practice. 124 paddocks sediment losses were modelled, of which 94 paddocks were in the Hokio 1a catchment covering 375 ha.

75. Using the growers' paddock location, FEP maps, contour vectors, and mitigations, sediment loss was calculated through the DMTW app. This uses the Revised Universal Soil Loss Equation (**RUSLE**). The baseline assumptions are included in the paper Factors and Assumptions Used in the Don't Muddy the Water Erosion and Sediment Rate Calculator (http://agrilink.co.nz/wp-content/uploads/2020/02/Factors-and-Assumptions-for-DMTW-App.pdf).

76. The sediment load reduction factors for current practices is collected through the completed FEPs. This included the use of erosion control measures such as cover crops and wheel track ripping.

77. Current sediment control was based on a satellite imagery assessment of the existence of vegetated buffer strips. Where they were present their effectiveness was modelled at both 80% (high) and 20% (low) efficiency. The biggest impediment to their effectiveness is channelising.

78. The efficacy of vegetated buffer strips comes from a meta-analysis review of vegetated buffer mitigation efficacy by

Xuyang et. al., 2009[1]. However, many real-world horticultural applications modelled vegetated buffer strip effectiveness is overestimated. Hence, in the DMTW app we added a buffer strip integrity or channelising factor. Not all buffer strips are created equal, irrespective of how wide they are. Optimised implementation is part of an industry programme, which includes a new vegetated buffer strip guideline (in progress - final draft), and grower workshops.

79. As new vegetated buffer strips are installed and existing ones improved, modelling was done on the impact of this work once completed by 2025. The results of this modelling are shown in the table below and included in the evidence of Claire Conwell.

80. Sediment loss rates for current practice, and future practice ('potential enhanced rate'), have been calculated (see table below). High and low efficiency of current practice relates to the effectiveness of the vegetated buffer strip in removing transported sediment (see paragraph 77).

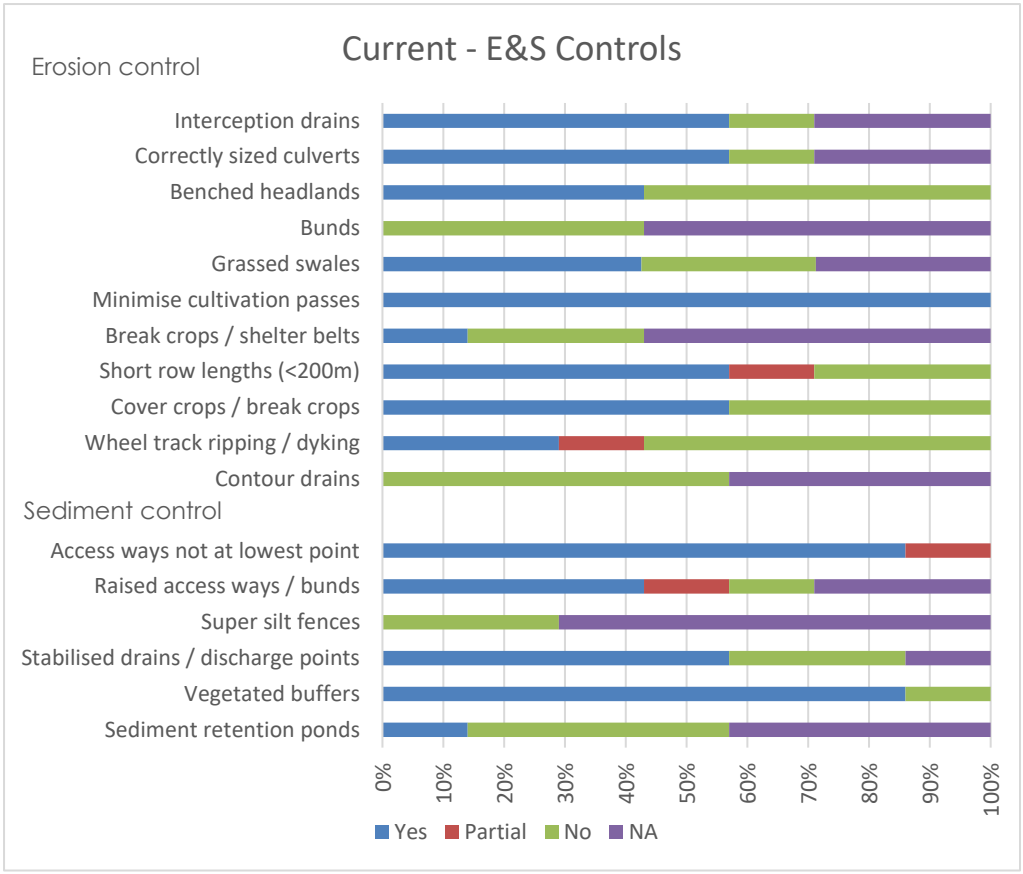
Loss rate metric	Unmitigated sediment loss rate (t/ha/yr)	Current sediment loss rate (t/ha/yr) – low efficiency	Current sediment loss rate (t/ha/yr) – high efficiency	Potential enhanced sediment loss rate (t/ha/yr)
Average	0.85	0.56	0.38	0.22
Maximum	15.3	9.8	6.1	3.9
Minimum	0.06	0.01	0.01	0.02

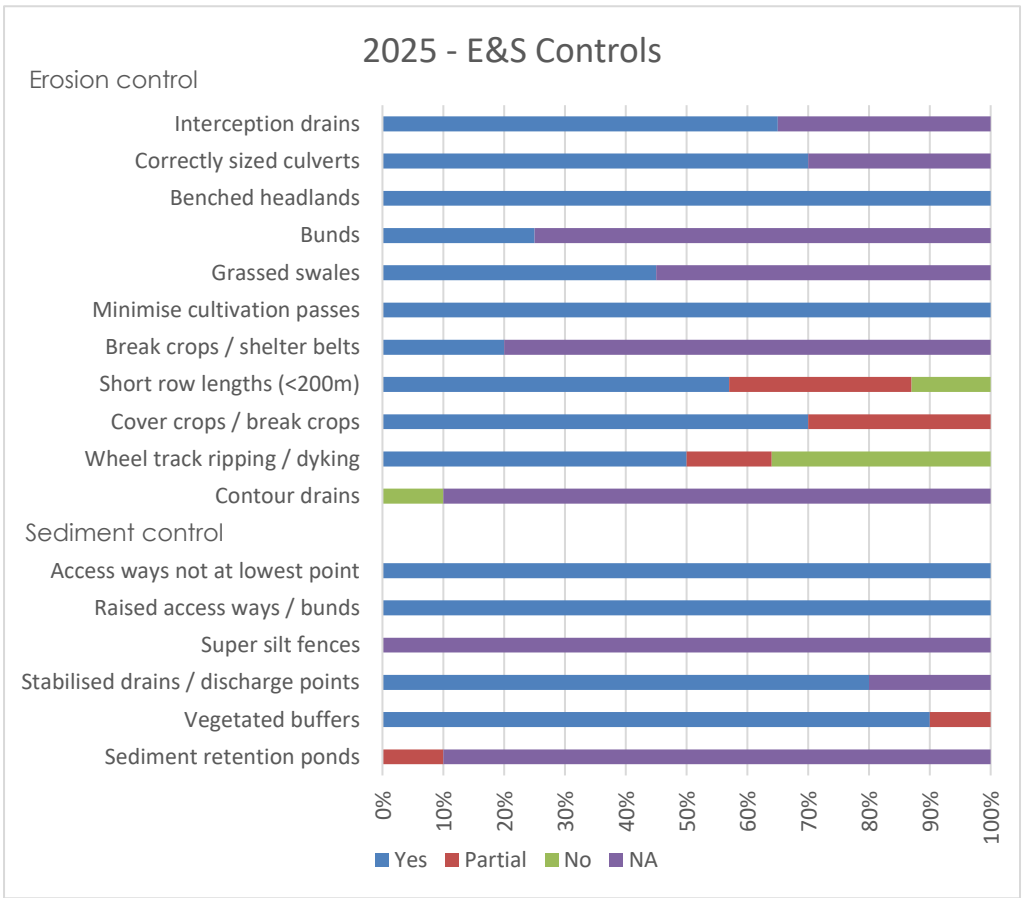
81. The table above shows that current erosion and sediment control practices reduce average sediment loss by between 34% (low efficiency) and 55% (high efficiency) compared to the unmitigated sediment loss rate. The potential enhanced practice achieves a 74% reduction in sediment. The improvements in erosion and sediment control represent that, over time, there is a combination of more mitigations being implemented and that both existing and new mitigations are delivered more effectively (primarily less channelising).

[1] Available: https://tinyurl.com/y5mf9zbo

82. The results from this analysis are included in the catchment scale water quality analysis discussed in the evidence of Claire Conwell.

83. Progress will be tracked through the growers' FEP updated mitigation measures and Action Plan. Supporting evidence for these changes include auditor field walks and photographs. The graphs below shows the current level of GMP erosion and sediment control mitigations (note all E&S Control measures are considered GMP, there are no listed BMPs). The second graph shows the predicted practice change as we approach 2025.


Current - E&S Controls
Erosion control
Interception drains
Correctly sized culverts
Benched headlands
Bunds
Grassed swales
Minimise cultivation passes
Break crops / shelter belts
Short row lengths (<200m)
Cover crops / break crops
Wheel track ripping / dyking
Contour drains
Sediment control
Access ways not at lowest point
Raised access ways / bunds
Super silt fences
Stabilised drains / discharge points
Vegetated buffers
Sediment retention ponds
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Yes
Partial
No
NA


2025 - E&S Controls
Erosion control
Interception drains
Correctly sized culverts
Benched headlands
Bunds
Grassed swales
Minimise cultivation passes
Break crops / shelter belts
Short row lengths (<200m)
Cover crops / break crops
Wheel track ripping / dyking
Contour drains
Sediment control
Access ways not at lowest point
Raised access ways / bunds
Super silt fences
Stabilised drains / discharge points
Vegetated buffers
Sediment retention ponds
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Yes
Partial
No
NA

84. The 2025 projections 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.

ESTIMATING NITROGEN LOAD REDUCTIONS FROM GMP AND BMPS

85. Paragraphs 71 and 72 describe the current and projected uptake for a range of nitrogen loss mitigating GMPs and BMPs.

86. The Overseer modelling undertaken by Page Bloomer estimates the percentage reduction in nitrogen load that can be predicted due to the implementation of the GMPs and BMPS identified within the NZGAP EMS. The modelling estimates reductions of between 7 – 46%. This work is discussed in the evidence of Stuart Ford.

RECOMMENDED AMENDMENTS

87. I believe that there is a need to recognise tools that help improve understanding and assist with implementing change. New tools are emerging all the time. The NZGAP EMS is structured such that it recognises these new industry driven tools and learning resources and becomes a conduit for their adoption. Tools like the LandWISE Nutrient Budget can make a material difference to grower understanding, practice, and future research priorities. This needs to be council recognised and supported.

88. While the LandWISE tool cannot be used to estimate average annual leaching to compare against Table 14.2, or achieve the alternative standards in Rule 14-1, in many situations it is a more useful industry supported tool for driving continual improvement than submitting to Council a long-term average Overseer model. These types of tools are linked into on-going industry research and dissemination programmes.

89. While the NZGAP EMS does not require a modelling approach that would generate an estimate of leaching comparable with Table 14.2, it does require a nutrient management plan linked to industry crop nutrient use guidelines and selected GMP and BMP practices. This budgeting approach and associated grower research and support will deliver lower nitrogen leaching.

90. I support the use of a risk-based approach to mitigation selection. As has been demonstrated in my evidence the NZGAP EMS provides a suite of GMPs and BMPs. Not every measure is appropriate in any given situation, however a grower needs to consider each measure and justify the approach they have taken.

Andrew Barber

25 September 2020