BEFORE THE INDEPENDENT COMMISSIONERS

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of the Proposed Waikato Regional Plan Change 1 - Waikato and Waipa River Catchments, and Variation 1 to proposed Plan Change 1

AND

IN THE MATTER of submissions under clause 6 First Schedule

ON BEHALF OF **BEEF + LAMB NEW ZEALAND LIMITED**
Submitter

BRIEF OF EVIDENCE OF RICHARD PARKES
15 FEBRUARY 2019

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BACKGROUND

1. My name is Richard Parkes

2. My area of expertise is in Sustainable Agriculture, Farm Systems, Extension and Education. I have over 20 years' experience specialising in agriculture systems, soil conservation, and nutrient management.

3. I am employed by Beef + Lamb New Zealand (B+LNZ) as its Environment Capability Manager. In this role my responsibilities are building the environmental capability of the sector and our farmers. This involves developing insights into how farmers learn, interact, and adopt change. A core part of my role is to empower farmers to make the knowledge connections around understanding their farms underlying natural resources, and their long term sustainable management, within a vibrant productive landscape. I work across the B+LNZ organisation and with farmers to design extension programmes that will drive tangible impact for farmers and their communities.

4. I have been in my current role for 12 months. Prior to this I spent five years as the Senior Sustainable Agriculture Advisor for the Greater Wellington Regional Council, eight years as the Discipline Leader /Programme Leader for Agriculture and Horticulture also at the Greater Wellington Regional Council and eight years as a lecturer in Agriculture and Agribusiness for The Open Polytechnic of New Zealand.

5. I hold a Bachelor of Applied Science in Systems Agriculture, along with a Graduate Diploma in Education. I have kept professionally current by completing a number of graduate short course at Massey University, Palmerston North:

   - Advanced Certificate in Sustainable Nutrient Management
   - Certificate in Sustainable Nutrient Management
   - Certificate in Farm Dairy Effluent System Design and Management
   - Introduction to New Zealand's Agriculture Green House Gas Emissions and Management
   - Advanced Soil Conservation – Module 1

- Land Use Capability Mapping on Farm and Classification System - Although no formal qualification currently exists in New Zealand I have:

  - o Received one-on-one training and mentoring from Dr Doug Hicks who is expert in soil conservation and who delivers in-house LUC training for Greater Wellington Regional Council;

  - o Undertaken LUC mapping training with expert soil conservationist consultant Garth Eyles (See the Proof) and Norm Ngapo (Wairoa Soil Conservation), who provide the majority of LUC training in NZ in the absence of formal qualification;

  - o As a Senior Sustainable Agriculture Advisor provided training and mentoring in LUC mapping to junior staff; and

  - o Completed approximately 30 LUC maps as part of the development of Farm Environment Plans for Greater Wellington Regional Council.

6. I am a member of the New Zealand Association of Resource Management and the New Zealand Institute of Primary Industry Management (NZIPIM).

7. In preparing this evidence I have reviewed:

   (a) The reports and statements of evidence of other experts giving evidence relevant to my area of expertise, including:

      (i) Mr Andrew Burtt;

      (ii) Dr Jane Chrystal;

      (iii) Mr Richmond Beetham;

   (b) The Council Officers s42A report;

   (c) Plan Change 1 and Variation 1; and

   (d) The section 32 Report.

8. I have read the Code of Conduct for Expert Witnesses in the Environment Court's 2014 Practice Note and agree to comply with it. I confirm that the opinions I have expressed represent my true and complete professional opinions. The matters addressed by my evidence are within my field of professional expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

SCOPE OF EVIDENCE

9. I have been asked by Beef + Lamb New Zealand (B+LNZ) to prepare evidence in relation to the sheep and beef sector generally and the implications of Plan Change 1 and Variation 1 (PC1) to the sector in Waikato. This includes:

   (a) An introduction to the sheep and beef sector;

   (b) Externalities of concern from the sheep and beef sector; and

   (c) Methods and approaches available to the sector to sustainably manage land and water resources.

10. This evidence relates primarily to hearing stream 1 (HS 1) and provides context that will be elaborated on through HS 2 and HS 3 relevant to the key issues which those hearing streams seek to address.

11. I am aware of the directions of the Hearing Panel to allocate blocks of time for particular topics. My evidence addresses matters relating to the overall direction of the Plan, particularly the tools that are available to farmers in the region to potentially reduce discharges of nutrient, sediment, or/and pathogens from their farms. For the purpose of HS 1, I have outlined the methods I consider are the most appropriate for the management of those discharges by the sheep and beef sector. These methods have the following matters in common:

   (a) They are tailored to the farm and its natural resources;

   (b) Enable flexibility, adaptation and innovation by the farmer and the sector;

   (c) They seek to engage farmers and provide a sense of ownership of the solutions including understanding the issues and linking practice change to outcomes; and

(d) Are spatially appropriate to allow for local solutions (on-farm and sub-catchment) to regional problems.

EXECUTIVE SUMMARY

12. An outstanding feature of the sheep and beef sector, in comparison with other agricultural land uses, is the high degree of spatial and temporal variation in both landscape characteristics and in farm systems and processes.

13. For the sector to remain resilient moving forward, the retention of the ability for farm businesses to be flexible, adapt, innovate, and respond to both climate and market changes as well as personal circumstances, is essential.

14. Policy interventions based on a ‘one-size-fits-all’ approach, as proposed in PC1, do not support holistic and integrated environmental outcomes for the sheep and beef sector nor will they deliver on the water quality improvements sought by PC1.

15. Key potential water contaminants for the sheep and beef sector are sediment, phosphorus (P) and faecal microorganisms. The risk of losses from sheep and beef farms of these contaminants is not comparatively higher than other pastoral land uses.

16. Overland flow is the primary contaminant transport pathway associated with sheep and beef farming, although the nature and scale of this loss are highly variable throughout the region.

17. Nitrogen (N) loss to water is proportionally much less of a concern for the drystock sector as that of other sectors, such as dairy, cropping, arable, or horticulture.

18. Management of Critical Source Areas (CSAs) is one of the best ways to mitigate environmental risk associated with sheep and beef farming, with up to 80 percent of sediment and phosphorus loss able to be mitigated in this way (McDowell et al., 2011; Monaghan et al., 2017).

19. Land Environment Planning provides the most efficient and effective way of identifying the opportunities and limitations of the natural capital assets (climate, soil, topography, biodiversity, and water) of the farm, including the identification of critical source areas (CSAs; small areas of the farm that

contribute a significant proportion of the whole farm losses), and ensuring that farming systems and practices sustainably manage these natural resources.

20. Land Environment Planning takes a wider approach to sustainability than purely acting as a compliance tool. Land Environment Planning should consider the economic, environmental and family wellbeing components of the farming enterprise. It acts to add real value to the farming business, guiding long-term strategic farm and business planning as well as day-to-day management decisions.

21. Land Environment Planning captures stewardship and sustainability as measures of success, offering a way to both provide proof points for programmes such as the Sustainable and Ethical New Zealand Farm Assurance Programme (SENZFAP) and support access to environmentally discerning markets.

22. Sub-catchment planning allows for the identification of risk at the catchment scale and translates it into targeted on-the-ground action, which is more efficient and effective than methods that approach risk at a larger, regional, scale. It also enables those implementing the change to understand why the changes need to be made and to have a say in designing solutions. This brings with it both individual and collective ownership of the issues and the solutions. This means that change is more enduring, and outcomes are more likely to be achieved (OECD, 2017).

INTRODUCTION

23. The New Zealand sheep and beef sector's total value of production was $10.4 billion in 2018, with exports worth $7.5 billion and domestic sales worth $2.9 billion. The sector has 80,000 employees, 59,000 of those are directly employed and an additional 21,000 are indirectly employed. The sector supports 5,877 direct jobs in Waikato and contributes $294 million to GDP (Statistics New Zealand, 2017).

24. The sector exports over 90 percent of its production. It is New Zealand's second largest goods exporter and New Zealand's largest manufacturing industry. The health and wellbeing of the sheep and beef sector within New Zealand is important to the economy of the Country, accounting for 3.2 percent of gross domestic product.

25. The New Zealand sheep and beef industry has evolved through many cycles of challenge and recovery over the last few decades as a result of changes in domestic policy, international markets, and environmental conditions including climate change. The sector's ability to adapt has been dependent on its flexibility. Flexibility allows innovation to occur and builds resilience within the sector.

26. The sector's ability to adapt has resulted in the sector doubling its contribution to national GDP, while sheep and beef numbers have fallen. Sheep and beef cattle numbers have fallen from 58 and 4.6 million, respectively, in 1990 to 27.4 and 3.6 million, respectively, in 2017 (Mackay et al, 2019), with corresponding reductions in greenhouse gas emissions (GHG) (30% less than 1990's), along with decreased nitrogen (N) and phosphorus (P) footprints. Against this background of down-sizing, the sheep and beef sector has made substantive productivity gains, including:

(a) increased average lambing percentage from 100 to 126 per cent nationally since 1990-91;

(b) increased lamb carcass weight per ewe from 13 to 17 kg; and

(c) increased wool per head from 5 to 6 kg (B+LNZ 2012).

27. These productivity gains have been made through:

(a) improved animal genetics;

(b) increased fecundity;

(c) improvements in animal welfare and management; and

(d) optimisation of farming systems so that they align with the natural capital of the land.

28. There has been an increased recognition that farming systems must fit with the 'natural capital' of the land. Where 'natural capital' is defined as the "*stocks of natural assets that yield a flow of ecosystem goods or services into the future*" (Dominati et al., 2010). At the farm scale they can be considered the farm's soil, geology, climate, slope, freshwater, and biodiversity values. I discuss this later under 'Natural Capital'.

29. This can be observed through, for example, the retirement of areas of the farm that are less suited to pastoral agriculture, and the selection of livestock age and class that recognises the underlying characteristics of the farm such as soil, slope, aspect, topography, and risk of erosion.

30. After conservation land, sheep and beef farmers are the largest custodians of indigenous habitats in New Zealand, with over 2.8 million hectares of sheep and beef land being retained in indigenous vegetation, of which 1.4 million hectares is native forest (Norton et al, 2018). It is estimated that the indigenous vegetation across sheep and beef farms has the potential to offset around 50 percent of the sector's GHG emissions (Herzig et al, 2019).

31. Today, a significant aspect of the sheep and beef sector, in comparison with other agricultural land uses, is the high degree of spatial and temporal variation in both landscape structure, farm systems, and processes.

32. The sector looks well-placed to meet the demands of current and changing markets, along with changing consumer attitudes toward the foods they consume. Some key indicators such as farm-gate price, improved export returns, and increased alignment between consumer preferences and the products the red meat sector is offering suggest the maturing of an industry that is positioned to meet future challenges.

33. In order for the sector to continue to meet environmental challenges, including water quality objectives, flexibility is needed to enable farm system adaption and continued land use optimisation.

34. Mr Burtt provides further evidence in relation to the economic importance of the red meat sector to New Zealand and the regional economy, along with summarising the red meat sector in the Waikato and changes that have occurred within this sector.

EXTERNALITIES OF CONCERN FROM SHEEP AND BEEF SECTOR

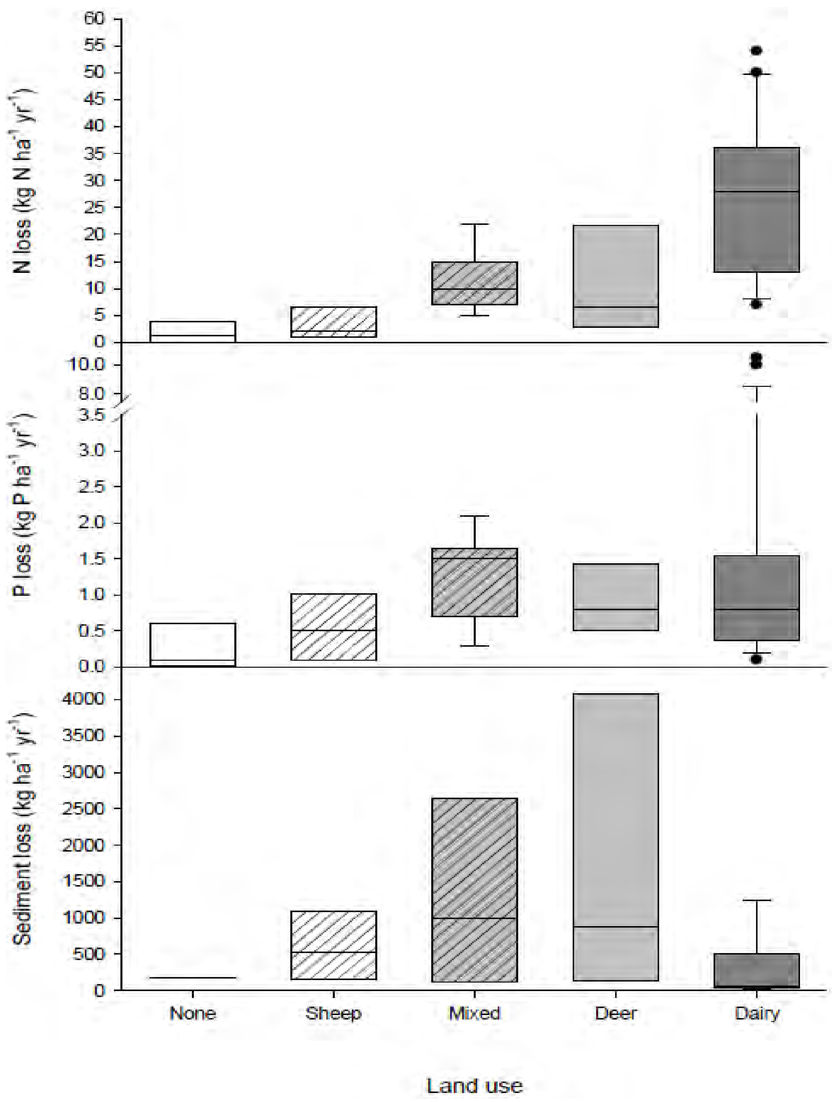
35. The main contaminants of concern, in relation to impacts on water quality, from sheep and beef farming systems include P, sediment and faecal pathogens (represented by *E. coli*). In comparison, N losses from sheep and beef farm systems are generally lower than that of other agricultural sectors (except forestry;

36. Figure *1*).

Table 1: Nitrogen and Phosphorus losses from various farming systems (Shepherd et al, 2016)

	kg N/ha/yr	range	kg P/ha/yr	range
Dairy	44	36-61	1.1	0.5-2.3
Sheep & Beef	16	11-31	1.0	0.2-5.3
Cropping	32	14-240	0.4	0.1-2.5
Forestry	4	0.5-6	0.2	-

Figure 1: Box plots showing the median concentration, bounded by the 25th and 75th percentiles, the 10th and 90th percentiles as whiskers, and outliers as • for N, P and sediment annual loads for each stock class of land (Wilcock, 2012)



37. Nutrient losses from a farm are governed by a number of factors, which fall broadly into two categories:

a. the farm's biophysical resources (e.g. soils, topography, climate (particularly rainfall)); and

b. the farm type (e.g. sheep, cattle, dairy, cropping).

38. Within and between farm types, N losses vary depending on the intensity of the farming operation. Losses are generally greater the more intensive the system, where higher production (e.g. stocking rates, crop yields) is supported by higher fertiliser inputs and/or fodder crops and/or irrigation. The leaching of nitrate occurs when there is an accumulation of nitrate in the soil profile that coincides with or is followed by a period of drainage.

39. Phosphorus losses, however, are generally more closely related to topography and climate. P contamination of surface water from sheep and beef farms is typically a result of eroded sediment and/or fertiliser use. Soil erosion and sediment export is highly site-specific and influenced by a range of factors including geology, rainfall and topography.

40. Faecal loadings from land to waterways is also a risk for the drystock sector, and fall into three broad classes according to Wilcock (2012):

- "The highest loadings occur where stocking rates are highest, e.g. wintering pads, block-grazed pasture, and standoff and feedpads for dairy cattle;
- The second group comprises average grazed pasture for dairy and sheep, and land disposal for dairy shed effluent by irrigation; and
- A third, smaller group comprises deer and beef cattle farms, based on what is regarded as 'typical' stocking rates, and runoff from dairy farm laneways."

41. Loss pathways for pathogens and the potential impacts on human health of waterborne zoonotic diseases are addressed in the evidence of Dr Dada. The primary routes for pathogens to enter surface waterbodies from agricultural land uses are via overland flow pathways, as with sediment and P, or via direct deposition from animals standing in the waterbody. Collins et al. (2007) notes that sheep are less attracted to water bodies than cattle and less prone to deposition of faeces directly into waterways.

42. Management approaches should be focused on identifying overland flow pathways and CSAs, with mitigation tailored to reduce or avoid the overland flow of contaminants. The risks associated with sheep and beef farming on rolling and/or hill country, and extensive farming systems is predominantly via overland flow pathways. As a result, fencing does little to address environmental risks, but rather is an appropriate mitigation approach for more intensive operations (>18 stock units per ha) and where direct deposition poses a greater risk.

43. Studies have shown that the effectiveness of riparian buffer strips in attenuating faecal pathogens washed in by surface runoff is also influenced by slope angle, soil type, buffer width, the type of faecal material, the degree

of attachment of microbes to soil, and the rate of surface runoff (Aarons and Gourley, In Press; Collins et al., 2009; Monaghan et al., 2009). Effective CSA management and Land Environment Planning provides effective and tailored methods for addressing these variables. I will be providing further evidence on this through HS 2 in relation to the management approaches proposed by PC1 including fencing of all permanently flowing waterbodies up to a land slope of 25°.

44. Key points in relation to effective CSA management:

- Key potential water contaminants for the sheep and beef sector are sediment, P and faecal pathogens, although the risk of losses from sheep and beef farms of these contaminants are not higher than other pastoral land uses;
- Overland flow is the primary contaminant transport pathway associated with sheep and beef farming, although the nature and scale of this loss are highly variable throughout the region;
- Nitrogen loss to water is proportionally much less of a concern for the drystock sector; and
- The majority of contaminant losses for sheep and beef farms occur over short time scales and/or from small areas of the farm where areas of high contaminant sources and rapid transport processes coincide (CSAs).

HOW TO MOST EFFECTIVELY REDUCE CONTAMINANT LOSS FROM SHEEP AND BEEF FARMS

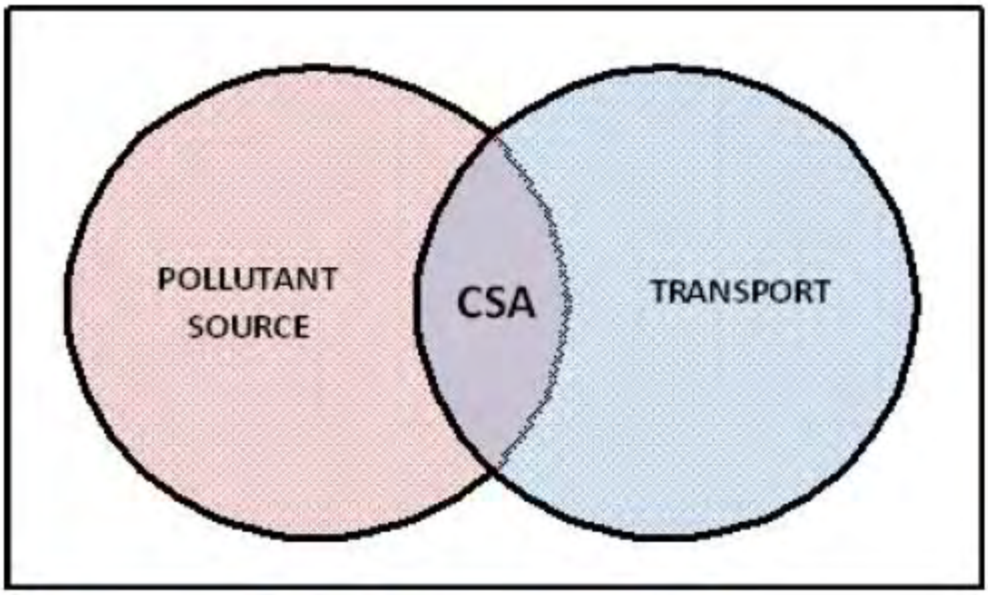
CRITICAL SOURCE AREAS

45. Researchers have widely observed that a relatively small fraction of a watershed can generate a disproportionate amount of pollutant load, particularly P and sediment (Pionke et al. 2000, Gburek et al. 2000, Yang and Weersink 2004). Simply put, the majority of a nonpoint source pollutant load can come from a minority of the watershed land. By identifying CSAs in a watershed, we can prioritise conservation practices to better protect water quality and reduce costs. The CSA concept may not apply equally to all nonpoint source pollutants. Nitrogen issues, for example, can be spatially

extensive where leaching coincides with excess nitrate in the soil profile over broad areas (Heathwaite et al. 2000).

46. Far from being characterised by 'diffuse source' pollution, contaminant losses on sheep and beef farms often occur over short time scales and/or from small areas of the farm where high contaminant concentration and rapid transport processes coincide (Monaghan et al 2007).

Figure 2: The Concept of Critical Source Areas (CSA) (Meals et al 2012)



The concept of critical source areas (CSA).

47. Examples of CSAs include landscape features such as swales, gullies or depressions that accumulate runoff and deliver it to surface waterways including rivers and lakes, artificial waterways and field tiles. Two factors help us identify a CSA: pollutant source and transport mechanism.

48. Transport potential also helps us to identify a CSA. Phosphorus is not a water pollutant until it is actually moved from a source to a water body. Sediment and P transport in a watershed occurs mainly through surface runoff and erosion. However, N is primarily transported through the soil into shallow subsurface flow or subsurface drainage.

49. CSAs account for the majority of P losses. For P, the general rule of thumb is that the majority (e.g., 80%) of surface runoff losses occur from areas that occupy a minority (e.g., 20%) of the catchment (Gburek et al 1998).

50. Pollutant sources in the watershed are usually, although not always, a function of land use and management. For example, conventional tillage or construction activities often increase a soil's susceptibility to erosion. Likewise, elevated soil test P and P fertiliser applications can increase P loss to streams, rivers, reservoirs, and lakes. Soil test P can build up when fertiliser applications exceed crop needs.

51. Discharges from CSAs lend themselves well to being managed through tailored farm-specific management plans. Such plans help farmers to identify, record and implement actions to manage these areas in a way that will significantly reduce the loss from those areas. For example, Dodd et al. (2016) state that maximum efficiency from mitigations in the long-term is best achieved by:

"Reducing contaminant discharges from drystock operations in the long-term when they are:

(a) Chosen on the basis of suitability to the farm;

(b) Implemented on the basis of cost-effectiveness; and

(c) Implemented in critical source areas.

With the result that 25-50% of some contaminant losses can be mitigated without impairing farm earnings."

NITROGEN MANAGEMENT

52. Farmers of extensive sheep and beef farms (those below around 16-18 SU/ha) have very few choices when examining mitigation options to further reduce nitrogen discharges. This is because as a rule, the sector already:

- has limited inputs, such as nitrogen fertiliser, on pasture;
- farms to their grass curve, (i.e. stock the land according to pasture growth);
- are typically net exporters of feed;
- winter stock on-farm, including non-capital stock; and
- do not generally use off-paddock structures, such as stand-off pads and wintering barns.

53. Furthermore, sheep and beef farming systems are complex. The nutrient budgeting model, Overseer, is often utilised, but this model cannot always accurately represent the farming system. This is discussed further in the evidence of Dr Chrystal.

54. Research undertaken in Southland as part of The Southland Economic Project (Moran et al. 2017), and in Waikato (as presented by Dr Chrystal and Mr Beetham) shows that seeking further nitrogen reductions from already low-leaching land uses such as sheep and beef farming can significantly impact on the viability of the farming business. Furthermore, it also reduces the ability for the farm to be optimised to address other environmental concerns such as biodiversity, climate change, erosion, and phosphorus and pathogen losses. I will elaborate on these issues during HS 2. Farms grandparented to N losses of 20 kg N/ha/yr or lower, or below the natural capital of their land, become significantly compromised in relation to their economic and environmental resilience.

TAILORED LAND ENVIRONMENT PLANNING

55. B+LNZ's Economic Service data shows huge diversity between sheep and beef farms in Waikato. There are hard hill country farms (Farm Class 3) – a quarter of which are greater than 900 ha – with very low stocking rates (the Farm Class 3 farms that Dr Chrystal modelled using Overseer v6.3.0 averaged 7.1 SU/ha). At the other end of the spectrum, there are lowland intensive finishing farms (Farm Class 5) between 50 and 450 ha (with nearly 45% between 150 and 200 ha) with a much higher stocking rate of around 13 SU/ha.

56. This diversity across Waikato's sheep and beef farms means that a tailored and farm-specific approach is the most effective and efficient way to manage the potential effects associated with pastoral farming. As such, I support the PC1 approach of adopting tailored farm environment planning as a key tool within its management framework, though have some concern around the structure and contents of the plan, which I will address in HS 3.

57. Land Environment or Farm Environment Plans (I use this term interchangeably) offer a tailored approach to understanding and categorising a farm's natural capital assets (geology, topography, soils, climate, biodiversity, and water resources), and identifying and managing

environmental risks. Such plans are also critical in ensuring that decisions are prioritised in line with business, family, social and cultural goals. In my experience, if developed by the farmer, with support where required, these plans can result in “issue and solution” ownership and ultimately optimal use of natural resources on that property.

58. Farm Environment Plans provide guidance and flexibility to facilitate the uptake and adoption of Good Management Practices (GMP) on-farm while recognising that each GMP and the range and degree to which they are required will vary from farm-to-farm depending on a farm’s:

(a) landforms,

(b) farming systems,

(c) climate,

(d) stock classes, and

(e) catchment characteristics.

59. I support the officers’ aspirations (section 42A, para 134, page 26) in relation to the applications of GMP, referred to in the Report as Good Farming Practices (GFP), in that GFP at a philosophical level supports “*setting outcomes with continuous improvement, in term of national research and consistency, and in terms of ongoing flexibility*”.

60. Farm Environment Plans are also an important tool to be utilised as a proof point of compliance with market assurance programmes such as the New Zealand Farm Assurance Program (NZFAP), providing access to environmentally discerning markets.

61. Through B+LNZ’s existing Land Environment Planning (LEP) system, farmers follow a seven step process:

(i) Create a farm map identifying the farm’s natural resources (waterbodies, lakes, wetlands, biodiversity) and any significant values (cultural, historic, recreational);

(ii) Define and describe areas of similar land (called ‘Land Management Units’ or LMUs), where paddock or farm scale Land Use Capability (LUC) mapping provides the gold standard;

(iii) Identify the strengths and weaknesses of each LMU (soils, erosion, wetness, dryness, aspect, connection to receiving waterbodies);

(iv) Review nutrient budget information in relation to LMUs;

(v) List environmental objectives and outline current on-farm good management practices;

(vi) Identify new actions based on identified risks; and

(vii) Implement, monitor and review.

62. This process is focused on categorising the farm's natural capital assets and undertaking an assessment of their health, production opportunities, and vulnerabilities. It takes the farmer through an assessment of the farm's natural capital and enables the farmer to adopt farm systems and management approaches that manage environmental risk, while providing production opportunities. Such an approach can help to link stock classes and stocking rate to the capability of the land. It can even identify issues with the capability of the LMU, leading to areas of the farm being retired. Areas may be identified where lighter or younger stock should be carried, or where other productive opportunities exists (e.g. horticulture on high-value and robust soils). While the approach incorporates GMP or GFP, the first element is to consider matching farming systems to the capability of the land, and once this is undertaken to then consider what practices should be applied and how they should be undertaken.

63. Therefore, in my opinion the approach in PC1 requiring the adoption of tailored FEP, is an appropriate way to respond to the variability in land characteristics for sheep and beef farms, empowering tailored approaches for managing their farming systems and management practices based on the natural capital of their land. Robust FEP, recognises that flexibility is desirable, and that mitigations achieve the greatest environmental outcomes when they work with both the farming business and its environmental characteristics. My evidence on later hearing streams will address the specifics of this approach.

NATURAL CAPITAL

64. B+LNZ has sought, through its submission, the recognition of the natural capital of land, and amendments to the Plan to empower the sustainable

management of land and water resources. I support the recognition of natural capital and amendments to the Plan that empower farmers to farm to the natural capital of their land. I understand that the main mechanisms proposed in PC1 are in relation to nitrogen allocation and farm environment planning. I will specifically address these provisions further through HS 2.

65. Natural capital is defined as the "*stocks of natural assets that yield a flow of ecosystem goods or services into the future*"(Dominati et al., 2010). The notion of natural capital comes from trying to frame the contribution of natural resources alongside manufactured capital (factories, buildings, tools), human capital (labour, skills) and social capital (education, culture, knowledge) to the economy (McKay, 2019).

66. An associated but expanded notion is one of ecosystem services, which are defined as "*the benefits people obtain from ecosystems*" (Dominati et al., 2010). Ecosystem services are the many and varied services including market and non-market services that are provided by the natural environment and benefit humans. The sheep and beef sector within productive landscapes not only provides significant services in relation to economic and social wellbeing, valued through market instruments, but also provides a range of significant services that benefit society and are currently outside of traditional market valuation approaches. These services include wild foods, timber, biomass fuel, provision of freshwater, climate regulation, water regulation, pollination, natural hazard regulation, recreation, tourism, sense of belonging, soil formation and maintenance, and provision of natural habitat.

67. The recognition of these services should be incorporated into farm business planning, as they contribute significantly to the sustainability of the sector, the unique value proposition of the farming business, ability of the farm and the sector to operate into the future, and the achievement of environmental outcomes (including freshwater objectives). The 'ecosystems approach' has its origins in ecological economics, recognising that the economy is a subsystem of the ecological system, and that sustainable economic activity needs to be performed within the biophysical limits of the natural environment.

68. Natural capital and ecosystem services concepts provide a multidisciplinary approach to assessing the multi-functionality of natural resources,

recognising that the scarcity of natural resources is today the limiting factor to economic development.

69. New Zealand Land Use Capability system (LUC), as described below, provides an established method for assessing characteristics of the natural capital of the landscape, as it recognises that not all land is the same and provides a system for assessing the opportunities and limitations provided by a parcel of land.

70. Use of LUC in policy and practice includes a long history in underpinning land evaluation and planning processes to achieve sustainable land development and management on individual farms, in whole catchments, and at the district and regional levels. LUC continues to be used in a variety of situations:

(a) by regional councils in land management;

(b) as an integral part of industry planning and reporting tools;

(c) as the basis for the National Environmental Standard for Plantation Forestry;

(d) as a tool in the Bay of Plenty Regional Policy Statement (RPS) to achieve integrated management;

(e) to guide land use planning to ensure land is used efficiently and sustainably;

(f) in research such as the development of the Land Use Suitability Model under the National Science Challenge; and

(g) in the development of position papers for industry and policy.

LAND USE CAPABILITY

71. Land Use Capability Classification (LUC) was developed for assessing the capacity of land for long term sustainable production. Its current form is an eight class system.

72. The LUC Classification System is defined as "*[a] systematic arrangement of different kinds of land according to those properties that determine its capacity for long-term sustained production"* (Cairns et al 2001). Capability

is used to refer to the sustainability of productive use or uses after taking into account the physical limitations of the land.

73. The productive capacity of the land is dependent to a large extent on the physical properties of:

- Geology;
- Soil;
- Slope;
- Aspect;
- Water; and
- Climate.

74. An assessment is made of these physical properties. This is then compared to the ideal state, with the resulting difference indicating the limitations on productive potential. According to the LUC Handbook, (AgResearch, 2009), productivity is often limited by the number and complexity of corrective practices needed and the intensity and nature of land use. The greater the difference the greater the limitation.

75. Limitations include:

- Erosion susceptibility;
- Steepness of slope;
- Susceptibility to flooding;
- Liability to wetness or drought;
- Salinity;
- Soil depth;
- Soil texture;
- Soil structure;
- Nutrient supply; and
- Climate.

76. Land is assessed for long term sustained production based on an interpretation of the physical information in a Land Resource Inventory (LRI). This is compiled from a field assessment of rock types, soils, landform and slopes, erosion types and severities and vegetation cover. This LRI is supplemented with information on climate, flood risk, erosion history and the effects of past practices. See Appendix 1 for a more detailed description of the New Zealand Land Use Capability (LUC) Classification (Cairns et al 2001).

77. Land Use Capability remains the backbone of advanced land environment, or farm environment, planning. It provides a system that categorises the natural capital of a farm's land resources. The system can be further strengthened through the identification or critical source areas and the identification of sensitive receiving environments.

78. Horizons Regional Council's SLUI (Sustainable Land Use Initiative) program is the most advanced land environment program in the country, adopting B+LNZ's Land Environment Plan level III (LEP III) system which includes paddock-scale LUC mapping. The effectiveness of adopting advanced land environment planning supported by LUC mapping has been demonstrated in a study of the use of SLUI in the Horizons region (Snelder, T. 2018).

79. The main points of the paper can be summarised as follows:

    (a) A major storm event in 2004.

    (b) 683 farm plans developed for highly erodible land.

    (c) 80–85% of farmers implemented mitigations.

    (d) SLUI plans cover 493,650 ha (22% of the region).

    (e) Modelling predicted reduction of regional sediment loads by 47% and average catchment reductions of 27%.

    (f) Farmer cost of mitigation through SLUI - $22 million.

    (g) Actual water quality improvements align with predictions for *E. coli* and sediment parameters.

80. The effectiveness of the adoption of LEP and LUC mapping can be seen through reductions in erosion and optimising the productive capacity of the land.

81. I consider LUC is an appropriate way for PC1 to underpin tailored and robust approaches to farm environment planning. This will be discussed further in HS 2.

SUB-CATCHMENT MANAGEMENT

82. Frameworks that support and empower collective community ownership of the issues and the solutions provide a more enduring and outcomes-based approach than reliance on prescriptive regulatory frameworks (OECD, 2017).

83. The integrated catchment management (ICM) approach most likely to achieve positive outcomes as presented by Memon et al, (2010) contains the following:

   a. Inclusiveness
   b. Rules that promote: fairness, equality, continuous improvement and mutual gains.
   c. Mutual accountability
   d. Participant norms
   e. Collaborative capacity building leadership
   f. Commitment to collaboration (i.e. participants willingly direct their resources to cooperate in good faith), and
   g. Integrating and applying a broad knowledge base.

84. This in turn builds community resilience which has a positive impact on ecosystem resilience as shown in Figure 3.

Figure 3: Integrated catchment management develops community resilience to build ecosystem resilience (Fenemor et al., 2011).

85. Sub-catchment planning allows for the integration of catchment planning at landscape, whole catchment, sub-catchment and farm scale. Such planning enables individuals to see their actions within the context of the larger picture and to appreciate their contribution to the combined impacts at the catchment scale (OECD, 2017; Fenemor et al., 2011).

86. Actions from these plans sit at both the farm and catchment level. At the farm level, farm plans will contain prioritised actions. This approach supports peer review and accountability. Catchment actions may be a collective of farm-based actions or involve collective and coordinated investment in, for example, constructed wetlands, managing drainage networks to reduce contaminant loss, landscape scale species restoration or predator control. Catchment programmes can support the adoption of active farm plans and the delivery of community aspirations for the sustainable management of their natural resources, including freshwater objectives.

87. In my opinion participatory approaches such as sub-catchment management are essential to achieving long-term goals. They allow for the identification and implementation of innovative solutions. When individuals have little or no involvement in the change process then there is little ownership of the solutions and the regulatory bottom line becomes the focus (OECD, 2017).

88. I support the officers' preliminary view that focusing on sub-catchment could have real benefits in terms of implementing local solutions and community commitment (para 143, page 28). Sub-catchment approaches empower communities to understand local and broader spatial-scale issues that

relate to environmental health. It enables communities to find solutions that are spatially explicit, and efficient and effective at achieving freshwater objectives.

89. As discussed above, generally the majority (e.g. 80%) of P surface runoff losses occur from areas that occupy a minority (e.g. 20%) of the catchment (Gburek et al 1998). Sub-catchment planning enables the identification of these areas of risk and supports the efficient and effective targeting of resources. Targeting risk closer to source is far more cost-efficient and environmentally effective than targeting the bottom of catchments. The Section 42A report identifies that by "*pooling resources and choosing the best location a much more effective and less costly solution may result*" (para 138 page 27). Pooling resources and choosing the best location is an effective and less costly solution than a "broad brush" approach. These benefits go beyond constructed wetlands. As presented in this evidence and the evidence of Dr Chrystal, sub-catchment approaches, which may be supported by advanced land management tools such as Land Use Capability Indicator (LUCI) and MitAgator, provide the opportunity to target intervention at those areas within the catchment where the biggest environmental outcomes can be achieved. This includes all contaminants of concern such as *E. coli*, sediment, P, pathogens, and N.

90. Sub-catchment approaches support integrated and holistic approaches, such as ki uta ki tai (from the mountains to the sea). A sub-catchment approach provides for a whole-of-catchment approach, which connects communities with each other and environmental outcomes of their actions.

91. Sub-catchment planning provides a platform for councils and communities, including tangata whenua, to get together to discuss the values of the freshwater bodies in their rohe, impacts on those values, and empowers and supports tailored intervention. It provides the opportunity to both consider and recognise Te Mana o te Wai, as well as climate change, protection and restoration of biodiversity, enhancing community wellbeing, and cultural connection, recreational, and economic values.

92. I will elaborate on these sections through HS 3 which specifically addresses sub-catchment approaches.

CONCLUSIONS

93. An outstanding feature of the sheep and beef sector, in comparison with other agricultural land uses, is the high degree of spatial and temporal variation in both landscape characteristics and in farm systems and processes.

94. For the sector to remain resilient moving forward, the retention of the ability for farm businesses to be flexible, adapt, innovate, and respond to both climate and market changes as well as personal circumstances, is essential.

95. Key potential water contaminants for the sheep and beef sector are sediment, phosphorus (P) and faecal microorganisms. The risk of losses from sheep and beef farms of these contaminants is not comparatively higher than other pastoral land uses.

96. Overland flow is the primary contaminant transport pathway associated with sheep and beef farming, although the nature and scale of this loss are highly variable throughout the region.

97. Nitrogen (N) loss to water is proportionally much less of a concern for the drystock sector as that of other sectors, such as dairy, cropping, arable, or horticulture.

98. Management of Critical Source Areas (CSAs) is one of the best ways to mitigate environmental risk associated with sheep and beef farming, with up to 80 percent of sediment and phosphorus loss able to be mitigated in this way (McDowell et al., 2011; Monaghan et al., 2017).

99. Land Environment Planning provides the most efficient and effective way of identifying the opportunities and limitations of the natural capital assets (climate, soil, topography, biodiversity, and water) of the farm, including the identification of critical source areas (CSAs; small areas of the farm that contribute a significant proportion of the whole farm losses), and ensuring that farming systems and practices sustainably manage these natural resources.

100. Land Environment Planning takes a wider approach to sustainability than purely acting as a compliance tool. Land Environment Planning should consider the economic, environmental and family wellbeing components of the farming enterprise. It acts to add real value to the farming business,

guiding long-term strategic farm and business planning as well as day-to-day management decisions.

101. Land Use Capability remains the backbone of advanced land environment, or farm environment, planning. It provides a system that categorises the natural capital of a farm's land resources. The system can be further strengthened through the identification or critical source areas and the identification of sensitive receiving environments

102. Therefore, in my opinion the approach in PC1 requiring the adoption of tailored FEP, is an appropriate way to respond to the variability in land characteristics for sheep and beef farms, empowering tailored approaches for managing their farming systems and management practices based on the natural capital of their land. Robust FEP, recognises that flexibility is desirable, and that mitigations achieve the greatest environmental outcomes when they work with both the farming business and its environmental characteristics.

103. One of the key methods missing from PC1 is a framework which supports, incentivises, and empowers an integrated and holistic sub catchment approach to sustainable management of natural resources and achievement of freshwater objectives. While a policy pathway is created, this does not flow through to the rules, which are largely prescription and activity based.

104. Sub-catchment approaches support integrated and holistic approaches, such as ki uta ki tai (from the mountains to the sea). A sub-catchment approach provides for a whole-of-catchment approach, which connects communities with each other and environmental outcomes of their actions.

105. Sub-catchment planning provides a platform for councils and communities, including tangata whenua, to get together to discuss the values of the freshwater bodies in their rohe, impacts on those values, and empowers and supports tailored intervention. It provides the opportunity to both consider and recognise Te Mana o te Wai, as well as climate change, protection and restoration of biodiversity, enhancing community wellbeing, and cultural connection, recreational, and economic values.

DATED this 15th day of February 2019

Mr Richard Parkes

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APPENDIX 1: NEW ZEALAND LAND USE CAPABILITY CLASSIFICATION

New Zealand Land Use Capability Units(From Our Land Resources a bulletin to accompany New Zealand Land Resource Inventory Worksheets, 1979)

The Land Use Capability (LUC) is an ordered arrangement of the land according to those properties that determines its capacity to sustain production permanently. The LUC takes into account physical limitations, management requirements and soil conservation needs.

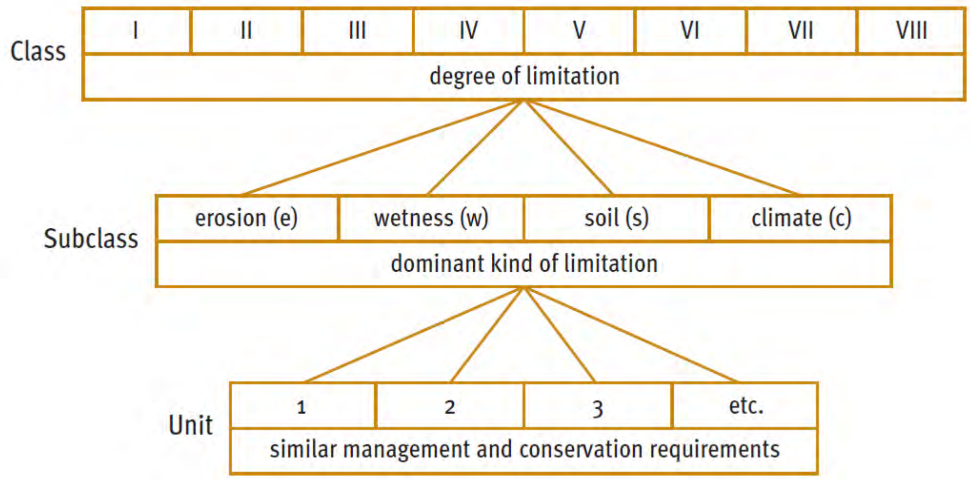
As a basis for the land use capability assessment, an inventory is made of the facts about the land. The facts recorded are: rock type, soil, slope, erosion degree and type, and vegetation. Additional information on climate is also factored in. This information is then displayed on the New Zealand Land Resource Inventory Worksheets as land inventory units.

These units are areas of land which, in terms of the five physical factors mapped, have uniform characteristics. They are therefore 'homogeneous' for every factor.

The classification has three components – a class, subclass and a unit. The diagram below illustrates the relationship between the various components of the land use capability classification:

New Zealand Land Use Capability

The classification has three components – a class, a subclass and a unit. The diagram below illustrates the relationship between the various components of the land use capability classification.



The capability class is the broadest grouping of the capability classification. It is an assessment of how versatile the land is for sustained production taking into account its physical limitations. It give the general degree of limitation to use.

There are eight classes represented by roman numerals. Classes I-IV are suitable for cropping, pasture or forestry while Classes V-VII are limited to pastoral or forestry use. The limitations reach a maximum with Class VIII land which is not suitable for grazing or production forestry; it best serves a protection function.

The capability subclass is identified by a lower case letter in the land use capability code. It divides the land within each class according to the major kind of limitation to use. There are four kinds identified but only the dominant one for each land unit is recorded.

The four subclasses are:

e	erodibility	where susceptibility to erosion is the dominant limitation to use
w	wetness	where a high water table, slow internal drainage, and/or flooding constitutes the major limitation to use
s	Soil limitation	Where the major restriction to use is a limitation within the rooting zone. This can be due to a shallow soil profile, stoniness, rock outcrops, low soil moisture holding capacity, low fertility (where this is difficult to correct), salinity or toxicity
c	climate	Where the climate is the major limitation to use

In the land use capability code, the capability unit is represented by an Arabic number. It groups together land inventory units which require the same kind of management and the same kind and intensity of conservation treatment. Units of land having the same land use capability unit number are capable of growing the same kind of crops, pasture or forest species and have about the same potential yield.

The capability units are arranged in order of decreasing versatility of use and increasing degree of limitation to use.

Capability Classification

increasing limitations to use

decreasing versatility

<table>
<tr><th>Class</th><th>Cropping Sustainability</th><th>* General Pastoral & Production Forestry Suitability</th><th>* General Suitability</th></tr>
<tr><td>I</td><td rowspan="2">High</td><td rowspan="5">High</td><td rowspan="4">Multiple land use</td></tr>
<tr><td>II</td></tr>
<tr><td>III</td><td>Medium</td></tr>
<tr><td>IV</td><td>Low</td></tr>
<tr><td>V</td><td rowspan="4">Unsuitable</td><td rowspan="3">Pastoral or Forestry land</td></tr>
<tr><td>VI</td><td>Medium</td></tr>
<tr><td>VII</td><td>Low</td></tr>
<tr><td>VIII</td><td>Unsuitable</td><td>Catchment protection land</td></tr>
</table>

* land use capability classes IV – VII which have wetness as the major limitation and those units in very low rainfall areas of those occurring on shallow soils are normally not suited to production forestry.