Wellington Registry **ENV-WLG-2024-001**
Te Whanganui-a-Tara Rohe

In the Environment Court
I Mua I Te Kōti Taiao O Aotearoa

Under the Resource Management Act 1991 (**RMA**)

and in the matter of the direct referral of an application for resource consents by Meridian Energy Limited in respect of the proposed Mt Munro wind farm under section 87G of the Resource Management Act 1991

Meridian Energy Limited
Applicant

and

Tararua District Council, Masterton District Council, Manawatū-Whanganui Regional Council and Greater Wellington Regional Council (**Councils**)
Consent Authorities

and

s 274 Parties

Statement of Evidence of Vaughan Francis Keesing on behalf of Meridian Energy Limited

24 May 2024

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QUALIFICATIONS AND EXPERIENCE

1. My full name is Vaughan Francis Keesing.

2. I hold a PhD in Ecology from Massey University and a Bachelor of Science with First Class Honours in Zoology, also from Massey University.

3. I am a Member of the Ecological Society of New Zealand.

4. I am currently a Director of BlueGreen Ecology and have been in that position for one year. Before that I was a partner in the consulting firm Boffa Miskell and had been a practising ecologist in Boffa Miskell for a little over 25 years.

5. My areas of expertise include both terrestrial and aquatic ecology. I have researched and prepared ecological assessments with respect to resource consent applications, notices of requirement and for plan changes/ policy statements. I have also presented ecological evidence at Council, Boards of Inquiry and Environment Court hearings.

6. Wind-energy projects on which I have under taken ecological assessment and /or provided evidence include the Contact Energy Hauāuru Mā Raki (HMR) wind farm, for which I was the Regional and District Council technical expert, providing review and evidence on terrestrial and aquatic ecology, the Waitahora (Puketoi) wind farm (Contact Energy) for which I provided terrestrial and aquatic ecological evidence, and Mill Creek and West Wind farms (both Meridian Energy) for which I provided aquatic ecological evidence.

7. I have been involved in the development of a number of other wind farms (White Hill, Hurunui, Kaiwera, Harakapki, Central Wind, and Tararua 3) as well as a number of large roading projects. Some of the larger roading projects I have worked on include the Albany to Puhoi State Highway 1 (*SH1*) extension, SH16–18 extension and the SH20 west extension (all in Auckland), the MacKays to Peka Peka Expressway (2005, 2011) and the Transmission Gully Motorway (2010–ongoing). Each has involved field data gathering (fish, invertebrates, plants, water quality, habitat quality), analysis of the data,

a values assessment, and an effects assessment. My role has also involved making recommendations as to management of discharges, fish passage, fish salvage, mitigation options and conditions of consent relating primarily to the monitoring and management of aquatic ecosystems.

8. I have been engaged by Meridian to provide evidence in relation to its application for consents to construct, operate and maintain the proposed Mt Munro windfarm near Eketahuna (**Mt Munro** or the **Project**).

9. I confirm that Dr Bull and I reviewed the 'Ecological Assessment' Report (**Ecology Report**) for the Mt Munro application which is attached as Appendix C to the Assessment of Effects on the Environment, and I agree with the assessment methodology and conclusions that are relevant to my areas of expertise. The Ecology Report focusses on potential effects on terrestrial vegetation, wetlands, freshwater systems, herpetofauna, and avifauna.

10. I have also had input into the further information responses to the Councils that are relevant to my areas of expertise, in particular:

    (a) the Aquatic Ecology memorandum attached as Appendix 12 to the section 92 response dated 7 September 2023. This is attached as **Appendix A** to my evidence; and

    (b) the Memorandum attached as Appendix 1 to the section 92 response dated 31 January 2024. This is attached as **Appendix B** to my evidence.

11. I was responsible for developing the freshwater, stream and wetland survey strategy and methods when the Project was re-initiated in 2021. The evidence I am presenting draws upon, and summarises the results of the field investigations and analyses undertaken by the following people:

    (a) Jeremy Garrett-Walker, and Bryn Hickson-Rowden, Boffa Miskell Aquatic ecologists; and

    (b) Melanie Brown, Boffa Miskell Botanist / wetland ecologist.

12. I was directly involved in the wetland surveys and have spent 5 days on site investigating every possible feature on the Project site. I have spent a further two days on site traversing all of the waterways and considering the potential wetland offset areas.

13. Since the time of preparing the Ecological Report and further information responses, I have been engaged by Meridian to undertake some additional work to survey the areas along the current formed area of Old Coach Road. This survey work was to understand whether wetlands would be affected by the proposed widening of Old Coach Road, which has been recommended by the Councils' traffic expert,[1] as explained further in the evidence of Mr Shields. The results of my survey are set out in my evidence below from paragraph 195 onwards. I note that 477m^2 of **low value** 'natural inland wetland' was surveyed in areas which might be impacted by the widening of Old Coach Road along its whole length, and that this can be readily accommodated in the offset areas identified on the Site, using an ECR of 1:1. This updated position is explained in more detail in the body of my evidence, but is highlighted in this section for clarity,

CODE OF CONDUCT

14. I have read the Code of Conduct for Expert Witnesses as contained in the Environment Court Consolidated Practice Note 2023, and I agree to comply with it. My qualifications as an expert are set out above. I confirm that the issues addressed in this brief of evidence are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

SCOPE OF EVIDENCE

15. I will provide evidence on aquatic ecology (streams and wetlands) and terrestrial vegetation. Dr Leigh Bull shall address terrestrial ecology, including avifauna, bats and herpetofauna (lizards) in her statement.

[1] Appendix 4. Harriet Fraser - S87F Report Traffic & Transportation 15 March 2024

Mr Graeme Ridley is addressing sediment and erosion control in his evidence. I confirm that I have seen a draft of these statements.

16. In my evidence I will:

(a) describe the aquatic and terrestrial vegetation ecological context;

(b) describe the data collection and assessment methodologies used;

(c) describe the existing terrestrial vegetation and aquatic ecological values /quality of the Mt Munro site;

(d) describe the potential effects of the proposed wind farm on those ecological values;

(e) discuss the methods that have been or will be considered to avoid, remedy or mitigate those adverse effects;

(f) discuss monitoring requirements and consent conditions;

(g) discuss the concerns of submitters; and

(h) respond to issues in the officers' report that relate to aquatic ecology and terrestrial invertebrate ecology.

(i) Provide a conclusion.

SUMMARY OF EVIDENCE

17. A combination of desktop research and site investigations (undertaken between 2021 and 2024) has informed the ecological assessment for the Mt Munro windfarm project.

18. The project footprint is contained almost entirely on improved pasture and the land use would continue relatively unchanged by the construction of wind turbines, transmission line and substation.

19. The overall existing ecological values associated with the Mt Munro project site (terrestrial vegetation, wetlands, and freshwater) have been assessed as **Low**.

20. The Project will result in **very low** potential effects on terrestrial vegetation and wetlands, with opportunities to mitigate or offset the loss of natural inland wetland area.

21. Freshwater systems are expected to experience **low level effects** related in the main to enabling road access, again with offsets available to address the loss of a small area of aquatic habitat from culverting required.

22. Measures are recommended to address the loss of small areas of habitat and to manage potential sediment and contaminant release during the construction phase. The specific mitigations and management practices include:

    (a) Installation and management of best practice sediment controls for all earthworks;

    (b) Monitoring and reporting of sediment release events to freshwater systems;

    (c) Development of an ecological response protocol to monitor sediment/contaminant discharges to any perennial or intermittent waterway;

    (d) Fish salvage protocol for all instream and any dewatering effects to any intermittent or perennial stream,

    (e) Culvert installation following the National Environmental Standards for Freshwater (**NES FM 2020**) and New Zealand fish passage guidelines, including input from a freshwater ecologist prior to and during installation; and

    (f) Contaminant release prevention by ensuring concrete work areas are protected against leachate or spills.

23. In addition to the mitigations above, I recommend the continued refinement of the Project through the detailed design phase to avoid natural inland wetlands and streams where practicable. For areas which might still be affected following this design refinement, **offsetting** is recommended for the loss of natural inland wetland and stream habitat.

24. The final extent of the offsets required will be determined following detailed design, once the extent of the expected loss is better understood. However, the level of offset required based on the concept design and the Ecological Compensation Ratios (**ECR's**) I have calculated are set out in my evidence.

25. The following offsets are recommended:

    (a) Offsets for infilled stream loss at an ECR of 3.4:1. Protection and enhancement of a nearby perennial tributary, including through revegetation and addressing any existing fish barrier issues.

    (b) Offsets for impacted natural inland wetland at an ECR of 1:1. Creation or restoration of indigenous wetland on the Project site.

26. My recommendations have been brought through into the updated proposed conditions, which are attached to the evidence of Mr Anderson. This condition set retains conditions proposed in Appendix 23 of the Councils' s 87F Report, where I have considered these conditions appropriate. The Councils' conditions on freshwater ecology and wetlands have otherwise been deleted or revised according to my recommendations.

27. The overall potential effects of the project on terrestrial and freshwater ecological values will be **less than minor** and with Meridian's proposed updated conditions, the likely outcome is a net gain with respect to natural inland wetland and streams on the Project site.

Outstanding Points of Disagreement with the Councils' Experts

28. While there remains some disagreement between myself and Dr Forbes with regard to methods employed relating to fish survey and delineation of stream flow class and value in the Mangaroa tributary etc, I do not consider these are material to understanding the level of effect or in determining the appropriate responses to achieve a net gain in ecological values. I consider that the proposed consent conditions more than sufficiently cover off the areas of uncertainty that Dr Forbes has signalled he has concerns about and ensure appropriate protections and actions will be in place.

Stream Ecology

29. While no wind turbine will interact with any river, the internal roading access route crosses some waterways and large-scale earthworks always carry a risk of sediment discharge to waterways. Erosion control measures to be implemented via a Construction Water Management Plan (now referred to as an **Overarching ESCP**) are described in the evidence of Mr Ridley, and will appropriately address this risk.

30. The Project as proposed has the potential to impact around 18 headwater tributaries, 10 of the Mākākahi River, 6 of the Kōpuaranga River and 2 of the Mangaroa. It requires bridging across one perennially flowing tributary of the Mākākahi River and the installation or upgrade of three culverts (two new) of a different perennial tributary of the Mākākahi River (the Mangaroa). Other road-associated culverts are in the headwaters and interact with ephemeral flow paths which are not streams and do not have aquatic values.

31. Based on the field investigations, I have assessed the ecological values of the freshwater systems on the wind farm and transmission line site as **Low** (Mākākahi tributaries, Mangaroa tributary, Kōpuaranga tributaries).

32. The Project's overall potential effects on freshwater values relate to small scale (low and moderate magnitude) loss of aquatic habitat caused by culvert installations (3) and minor road widening.

33. There is also the potential for sediment release during construction, which is assessed as a **Low** to **Very Low** level of effect depending on how this risk is managed.

34. There should be no release of contaminants, but under unusual circumstances there remains a possibility of contaminant release and if such occurred it is assessed as likely to result in a **Moderate** level of effect to the Bruce Stream and **Low** level of effect to the minor tributaries.

35. It is possible that there could be an impediment to fish passage through the installation of culverts (two tributaries at two locations) which will not occur if design and installation occurs correctly. If culverts were designed or installed incorrectly, then the assessed level of effect would be **low** due to the stream's position in the catchment and the species present.

36. The loss of approximately 210 linear metres (~120 m^2) of aquatic habitat (from culvert installation) in the Mangaroa tributary requires offsetting. I recommend this would be in the form of an enhancement to an area (Ca. 700m) of the Mangaroa tributary on the Project site by way of fencing from stock, planting with indigenous riparian vegetation, instream habitat additions, and pest management. This recommendation has been brought through into the updated proposed conditions, which are attached to the evidence of Mr Anderson.

Wetland Ecology

37. Site investigation following the National Policy Statement Freshwater Management (NPS FM) wetland delineation protocol (NPS 2020, amended 2024) was used to locate, determine and map natural inland wetlands across the Project site and within 100m of an envelope generated to reflect any project earthwork area on the site.

38. 89 features were mapped and 44 features[2] identified within and within 100 m of the Turbine Exclusion Zone and the Turbine Envelope Zone (where the turbines are to be sited). These features meet the NPS FM definition of a 'natural inland wetland'. Of these, six features have the potential to be directly affected by the proposed internal roading alignment. Under the current Horizons One Plan, the identified features do not trigger Schedule F1 wetland criteria.

39. I have assessed each of the 'natural inland wetland' features as having **Negligible** ecological value because they are of low diversity, uniformly exotic dominated, are a result of land modification, and exist on artificially induced wet sediment trapped in old stream channels or

[2] The "count" of those mapped depends on how each feature is viewed given some are part of a continuous gully system.

pasture-seepages. In my opinion none of the identified features are in fact genuine natural wetlands given they are not indigenous representative features which were present on these slopes and gullies prior to Europeans modifying the land for pastoral use. Post-offsetting there will be one or several much better quality natural inland wetlands on the property.

40. Two wetland species were found during site investigations which are classed as At Risk – Naturally Uncommon – *Luzula leptophylla* and *Sphagnum perchaetiale*. The Luzula was in a wetland area located more than 100m away from the project envelopes and will not in any way be affected by the Project. No Sphagnum was found in the features that are likely to be cleared.

41. There were no fauna surveys undertaken in any wetland as most of the headwater gully wetland features were not wet enough to support aquatic fauna and are unlikely to have aquatic invertebrate, fish or wetland bird fauna present. Under the RMA definition of wetland this does then raise an issue as to whether these features, initially identified here under the Clarkson (2013, MfE 2020) method, are indeed actually natural inland wetlands. Outside of the Envelopes some of the lower catchment wetland features did have aquatic wetlands and will have aquatic fauna. However, surveys were not conducted in these areas, as the features are some distance from any works, and will not be impacted (unless significant levels of sediment are released during earthworks, which I do not expect to occur if the proposed conditions are met).

42. In consultation with terrestrial ecologists, the internal roading has been designed at a concept level to avoid as far as practicable the six features that qualify as natural inland wetlands under the NPS FM. Some avoidance has been achieved, and I note that further consideration will be given to avoiding these areas as far as practicable as part of detailed design.

43. However, it is anticipated that some natural inland wetland area will be lost when the internal roading is constructed. Should this occur, given the exotic species dominance and the limited ecological value of these

features, offsets will be an effective and appropriate response. It will be a simple matter to offset such a loss with a much better (higher value) wetland outcome elsewhere on the property.

44. In addition to the Project site, the potential widening of Old Coach Road to accommodate construction traffic may remove 477m^2 of natural inland wetland. This is mostly *Carex geminata* sward located between the current formed road and the pasture fence, but also several areas of wet paddock on the other side of the fence which technically qualify as natural inland wetland.

45. With the current road alignment there will possibly be on site 3200 m^2 (0.32ha) and offsite 477m^2 (0.05ha) of natural inland wetland adversely affected (removed). The Council reviewer Mr Lambie has agreed an appropriate offset ratio for the wetland types on site is 1:1 in this case. I agree and recommend a condition relating to the need to offset any natural inland wetland removed at a 1:1 offset and that the offset be focused on the property. There are many on-site opportunities to restore an appropriate amount of indigenous natural inland wetland, and these areas are identified in the Ecological Report. My recommended condition is included in the updated proposed condition set attached to Mr Anderson's evidence.

ECOLOGICAL CONTEXT OF THE PROJECT SITE

46. Dr Bull, in her statement (para 46–48), describes the existing environment of the site (pasture) and points to the general absence of indigenous vegetation on site other than old gully fragments that are well outside of the proposed development envelope.

47. In regard to waterways, the site is on a north-south axis of hills 1km east of SH 1 between Mt Bruce and Eketāhuna. The site is over 100 km inland (from either the Manawatū or Ruamahanga River mouth entrances). To the south of the hilltop axis is one headwater tributary that curls around the slope to drain north to the Mākākahi River at about Falkner and Opaki Kaiparoro Roads. To the south-east the hill country offers six primary headwater tributaries to the Kopuarunga River system that drains to the Ruamahanga. To the

north-west the hill country provides around nine headwater tributaries to the Mākākahi River system which drains north to the Mangatainoka River and eventually Manawatū River. To the north is a two headwater tributary that forms the Mangaroa that drains north to join with the Mangaoranga before joining with the Mākākahi near Eketāhuna. The Bruce stream, a large tributary of the Mākākahi system, is associated with the western transmission line. There are 18 first order headwater tributaries associated with the hill country of the project area and potentially one main stem (the Bruce).

48. The Kopuarunga River is listed in GWRC's Natural Resources Plan (NRP) as an important trout fishery river and spawning water.

49. The Mākākahi River is listed in Schedule B of the Horizons One Plan as having significant aquatic values (SOS-A), trout fishery and trout spawning habitat.

50. There are no mapped wetland features identified in any Council, Department of Conservation map or published material (FENZ, NZ wetland inventory etc). The project area is hill country with steep gullies and prior to 1840 was entirely forested (rimu/tawa forest on slopes with areas of podocarp forest (Rimu-matai-miro-totara/kamahi) on the hilltop plateaus including where the turbines are proposed. Large wetlands existed southeast in the Kopuarunga River valley floor and west and south of Mount Bruce.

51. The Mākākahi River flows at around 2.5–3 m^3/sec according to the NIWA and Horizons monitoring station south of Eketāhuna and has a common low flow of around 500L/s. The Kopuarunga River (at Palmers Bridge (GWRC data)) has a typical flow of 2.5–3.2 m^3/sec with a minimum flow typically 300–400 L/s.

52. Tributaries of the Kopuarunga in the project area at the time of survey had flows of 0 to 40 L/s. The Mangaroa tributary at the northern end of the project site contained around 10 L/s and the flows in the Mākākahi tributaries ranged from 20 to 60 L/s.

METHODOLOGIES FOR SITE INVESTIGATIONS AND DATA ANALYSIS

53. Freshwater data was first gathered on the Mount Munro site in 2010–2012, overseen and reported on by Dr Bull. For the freshwater systems this involved multiple pass Electric Fishing machine (EFM) fish surveys, standard replicated kick net macroinvertebrate surveys, and physical habitat descriptions. The vegetation surveys of the time included wetlands but that was prior to the NPS FM or the National Policy Statement for Indigenous Biodiversity (**NPS IB**) and wetlands were recognised at that time by the presence of **indigenous** wet-adapted assemblages of plants and animals with soils and hydrology reflecting wetland. A subtle but importance difference to the process today was the focus on indigenous representative naturally occurring assemblages, not induced exotic ones.

54. In 2021 Boffa Miskell was engaged to undertake an assessment of the current proposal. This required an analysis of the original data for accuracy, including by comparing it to more recent data, and collecting further data to address any information gaps identified.

55. As noted earlier, I was involved in developing the freshwater, stream and wetland survey strategy and methods. The evidence I am presenting draws upon and summarises the results of the field investigations and analyses undertaken by members of the ecology team at Boffa Miskell.

56. I was directly involved in the wetland surveys and have spent 4 days on site investigating all possible wetland features, and an additional day investigating adjacent wetlands along the proposed Old Coach Road upgrade area. I have spent another two days on site traversing all of the waterways and considering the potential offset areas.

SAMPLING METHODS

Freshwater

57. Visual stream inspections were undertaken in both 2011 and 2021 to categorise the condition of the tributaries and to choose sample sites to represent the tributaries. The entire waterways were walked so as to map the classification of the streams' flow patterns (i.e. ephemeral, intermittent or perennial). Given the boundaries of these classifications change seasonally and annually we used instream clues as directed by a number of methods (e.g. ARC:TP 310, 2006) to map, as best as we were able, where a stream was ephemeral or intermittent. The Greater Wellington Natural Resources Plan (NRP) definition of "active bed" was instrumental in this classification.

58. The sampling sites were determined in part based on the presence of sufficient surface flow to sample. The other prominent factor was project interaction. The proposal does not directly interact with the Kopuarunga tributaries nor the Bruce stream and tributaries. It only directly interacts with the Mangaroa system and the two northern most Mākākahi tributaries. This is reflected in the places sampled and numbers of places sampled.

59. In 2011 stream substrate composition focused on fine sediment utilising the method outlined in Wagenhoff et al. (2009). In 2021 stream habitat condition (including riparian condition) was surveyed following Clapcott et al. (2011, 2015).

60. Basic water quality parameters (pH, dissolved oxygen, NTU and TSS) were recorded during the 2011 survey using an Insite IG Model 3150 and TPS 90FL-T multi-meter. Water quality parameters were not reassessed in 2021.

61. Visual estimation of percent cover of fine sediment (grain size <2 mm) on the stream bed was carried out at each 2021 survey site. Assessment methodology followed the standard visual assessment methodology (Sediment Assessment Method 2; SAM2) from Clapcott et al. (2011).

62. Macroinvertebrate communities were sampled using the Protocol C1 (Hard-bottomed, semi-quantitative; Stark, Boothroyd, Harding, Maxted, & Scarsbrook, 2001).

63. In 2011, a total of 1.0 m^2 of streambed was disturbed at each site. In 2021, five pooled kick samples were collected at each site ensuring a total of 0.6 m^2 of streambed. Macroinvertebrate sampling in 2021 took place at the same sites as in 2011, plus two new sites.

64. All samples were processed in accordance with Protocol P3 (Full Count; Stark et al., 2001) in 2011 and Protocol P1 (Coded Abundance; Stark et al., 2001) in 2021. The resulting data was analysed to determine standard macroinvertebrate indices.

65. In 2011, sites were surveyed for fish utilising backpack electrofishing methodology. A 50 m reach of each stream was electric fished (double passed) to determine what species were present. The particular area of 50 m reach chosen in each stream was deemed to be representative of the habitat types present within that stream.

66. In 2021 spotlighting methodology was employed to survey the freshwater fish present. Approximately 250 m of watercourse was spotlighted by two operators following the methodology outlined by Joy et al. (2013).

67. Table 1 below summarises the survey effort by waterway (coded label). The sample sites are presented in maps in **Appendix C** to my evidence.

Table 1: Survey type and effort in the sampled tributaries (see map for site codes)

SITE	2011 SURVEY		2021 SURVEY	
	Macroinvertebrate	Electrofishing	Macroinvertebrate	Spotlighting
BRU1	Y	Y	Y	
BRU2	Y	Y	Y	
BRU3				Y
KOP1	Y	Y	Y	
KOP2	Y	Y	Y	Y
MAG2			Y	Y
MAK1	Y	Y	Y	Y
MAK2	Y		Y	
MAK3	Y	Y	Y	
MAK4	Y	Y	Y	Y
MAK5			Y	

Wetlands

68. Aerial imagery was used to identify the potential natural inland wetlands on the site and specifically within 100 of the Turbine Envelope Zone and the Turbine Exclusion Zone (that area identified as being the outer limit of any works).

69. Over four days (November 2021, February 2022) the site was walked from the southernmost point following the hill slopes of the southern range, around the northern edge and south down the western edge and then centrally. I saw and assessed every gully and all of the central depressions.

70. Ms Brown, some weeks later (16th December 2022), walked the proposed transmission line and inspected and assessed every potential wetland feature within that 100m envelope.

71. I inspected the proposed substation in late 2022 and did not see by way of the rapid protocol any natural inland wetlands on that site across the main road.

72. Natural inland wetland determination is dictated by the legislation in the National Policy Statement for Freshwater (NPS-FM) (Ministry for the Environment, 2020a, amended 2024), the Resource Management Act 1991 (RMA – the Act). In addition there is guidance in Schedule F of

the Horizons One Plan (Horizons Regional Council, 2014) and the Greater Wellington Regional Natural Resources Plan NRP (Greater Wellington Regional Council, 2020).

73. I adhered to the methods outlined in Clarkson (2013) and Clarkson et al. (2021) as produced in MfE (2022**).**

74. In brief the process requires site feature identification, visual determination of the pattern of communities in the feature, plant cover plots, if required, determination of indices, a soil core for hydric soil testing and observations related to the hydrology tool to ascertain likely site hydrology.

RESULTS OF INVESTIGATIONS

Freshwater Streams

75. The freshwater systems on the Project site are dynamic, with sections of waterways on site moving between perennial, intermittent and ephemeral states seasonally (refer to Figure 1). For clarity, this freshwater assessment has focused on intermittent and perennial streams within the site (i.e. rivers[3]). This meant that the stream (to not be ephemeral) had to have a defined channel with flowing water (or evidence of recent prolonged flowing water) and an active bed (NRP definition) at survey. Consideration was given to where remnant stable pools were discovered and the gaps between such pools.

[3] As defined in section 2 of the Resource Management Act 1991 and adopted as the definition by the Horizons One Plan (2014).

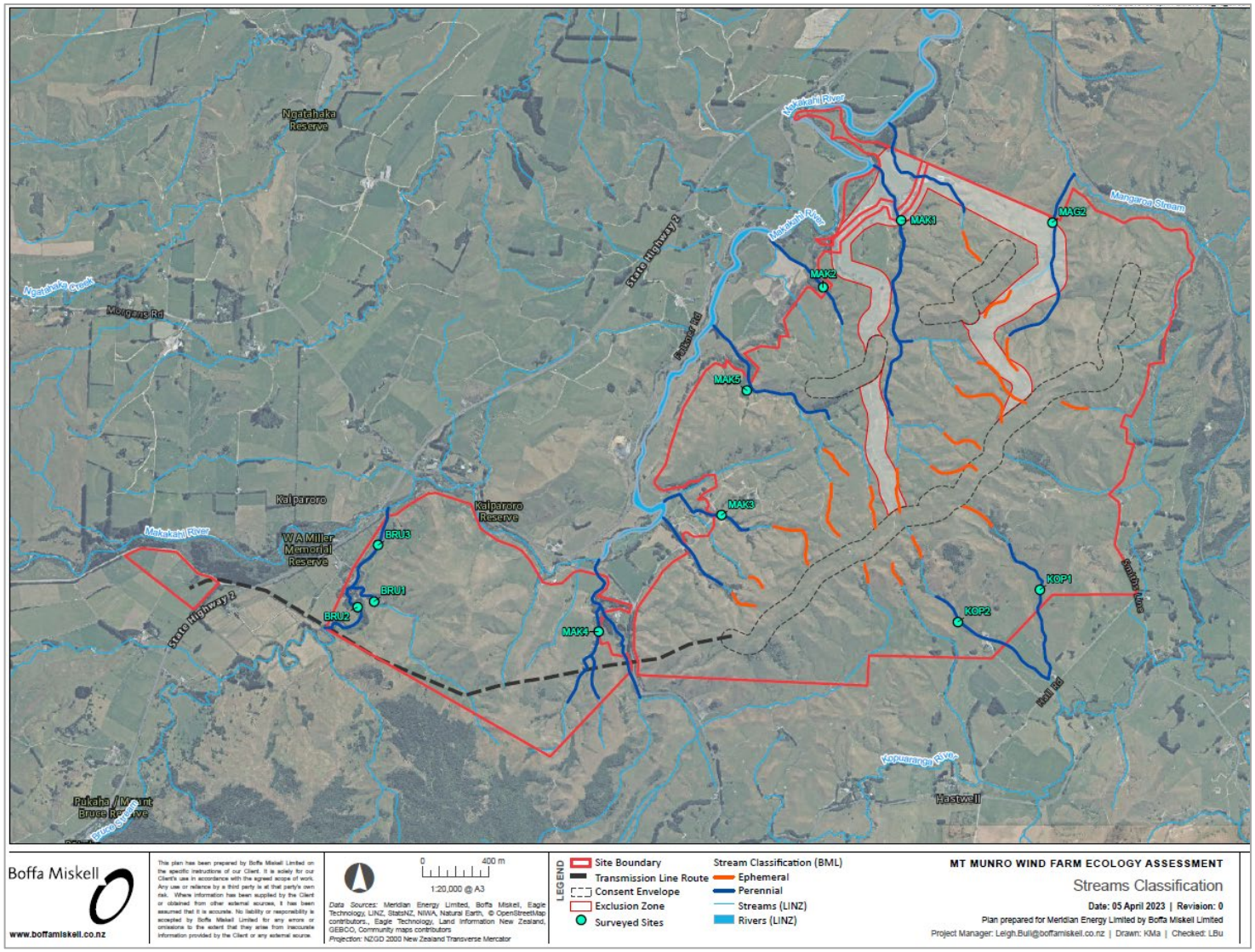

Figure 1: Stream classification (ephemeral, intermittent and perennial reaches). Aquatic sample sites are also shown (green dots). The red outline is the outer project boundary, the pale shapes the proposed roading corridors and the dashed enclosed shapes the turbine envelope.

76. There are no large freshwater ponds or lakes within the Turbine Envelope or Turbine Exclusion Zones.

Kopuarunga Tributaries

77. There are around 15 gullies draining the southern hill slopes but only seven features are identified as tributaries on the LINZ map and only two had open water surface flow at survey. The spring feeds for many of these tributaries are in the sparse canopy terrestrial native vegetation common to the southern hill gullies. All the springs are at least 100m down slope of the top plateau and most start in wetlands rather than open channel streams.

78. The beds are active and largely cobble and gravel with around 40–50% fine sediment cover. Riffles and runs predominate with few pools, although at vertical drops there is usually a pool. The typical channel is half a meter wide and has between 10 and 30 cm depth of water over half the bed flowing at around 0.3 m/s. Stock generally have access to the bank and stream and the banks are typically grassed with scattered Juncus rushes.

Figure 2: Site – Kop 2

Bruce Stream System

79. The Bruce Stream main stem forms a wide channel with mixed riparian and stream habitat, some trees but mostly varieties of pasture weeds and long grasses. The wetted width fluctuates from 5–10 m wide. The stream bed was composed with a mix of substrates (boulders, cobbles, gravels, sand) and is largely riffle habitat with some slow runs, and pools. Of the hard bottomed substrate, most of it was covered in a diverse assemblage of periphyton. Depths vary but across the wetted width the typical depth is 400–500mm with a velocity of 0.2–0.3 m/s.

Figure 3: Site – BRU 3

80. The side tributary surveys (BRU 1), has a 1m wide channel in pasture that meanders to the main stem. The riparian condition is a mix of native regeneration and planting with exotic invasives. The substrate is large cobble and gravel with 50% cover of fine sediments. The wetted width ranges from 0.7–1m with a 0.2–0.6m depth and velocities typically 0.2m/s.

Mākākahi Tributaries

81. There are seven tributaries arising on the property, but only two are likely to be affected by the Project. I focus here on sample sites MAK 1, MAK 2 and MAK 5 as the only reasonable possibly affected tributaries and the unsampled northern most tributary. MAK 3 and 4 (which have been sampled) are some distance from any works and are very unlikely to affected in any way.

MAK 1

82. Spring fed the springs originate in grazed pasture along the northern western hill slopes from 5 first order streams. All of the ephemeral headwaters are within the proposed road corridor or proposed turbine plateau. The stream varies in width between 0.2 m in the upper pastoral areas (intermittent) and 1.2 m in the lower sections of the tributary. The majority of the stream runs through pasture and scattered rushlands, however there are sections of the tributary where scattered native riparian vegetation (of good quality) such as below the existing farm road and pine trees are present. Stock has access to much of the stream.

83. The substrate is largely gravel and sediment (25%) with only small amounts of cobble even while being 60% riffle habitat. The riffle habitat was typically 1m wide and 10cm deep, runs 1.2m wide and 25–30cm deep and where a pool this was up to 60cm deep.

Figure 4: Site – MAK 1

MAK 2

84. This is a short first order tributary with one branch arising near the smaller turbine plateau as an intermittent flow. The spring originates in a fenced section of mature native and exotic trees (some stock access). The canopy in the fenced area provides stream shading and organic input. The native canopy consisted of naturally regenerating vegetation though had a limited understorey. The stream averages 0.3 m in width and contained within a shallow channel and continuous flow. The streambed is characterised by hardbottom substrate overlain by fine sediments. Fine sediments can in some parts reach 0.1m thick. Generally, the stream substrate was made up fine sediments (80%) with small amounts of cobble and gravel items. The wetted width of the reach ranged from 0.5–0.6 m, with depth ranging from 0.05–0.15 m. Stream habitat comprises runs, riffles and pools.

Figure 5: Site – MAK 2

MAK 5

85. The spring originates in grazed pasture and passes through mahoe dominated low forest and scattered rushland before entering a section of regenerating native scrub and exotic trees (some stock access). The canopy provides stream shading and organic input. At MAK5 the stream had a defined channel with a hardbottom substrate composition with limited deposited sediment.

86. Stream substrate is a mix of bedrock boulders, cobbles, pebbles and gravel but fine sediment is still dominant (39% cover). Stream habitat comprises runs, riffles and pools, with limited cascades. The wetted width ranged between 0.7–2 m and the depth ranged from 0.05–0.2 m in the riffles and runs. Pools ranged in depth from 0.3–0.4 m deep.

Figure 6: Site – Mak 5

Mangaroa Tributaries

87. The Mangaroa has two headwater branches, both upper ends are ephemeral leading down to a common main stem (perennial) in the property. This main stem has a cobble and gravel bed with little fine sediment. The bed is active[4] in this lower area and is largely a riffle and run system with few pools. The wetted width was 0.5m in a 5m bank to bank channel. The water depth is typically shallow at 10 to 15 cm deep and the velocity relatively slow at a common measure of 0.2 m/s. There is no woody or tall riparian vegetation, just pasture and some areas of rush or sedge and stock currently have free access to the stream banks.

Figure 7: Lower Mangaroa

[4] As per the NRP definition

Fish

88. EFM (2011) and spot lighting (2021) recorded four identified species of fish and freshwater crayfish (koura). The species were long fin eel, short fin eel, common bully and upland bully. Three of these species are diadromous (have a saltwater component to their life cycle).

89. Given the distance inland and the nature of these tributaries (their modified condition, depth of water) the presence of only eel and two bully species is not overly surprising.

90. All tributaries except MAK2 and 5 recorded at least one fish taxa. The Mangaroa tributary only had upland bully, MAK 1 only long fin eel.

91. It is probable that tuna (eel) are present in all of the tributaries but in low abundance. It is also likely that at least upland bully are also in all tributaries which are perennial and retain at least a modicum of cobble and gravel substrate but again in low densities.

92. Long fin eel has a conservation status of At Risk – Declining, although they remain one of the most commonly surveyed species in most river types.

Macroinvertebrates

93. The sampling undertaken in 2021 shows improvements in metrics when compared to sampling undertaken in 2011. I have therefore taken the more conservative position and have used the 2021 results when considering the effects of the Project.

94. Table 2 shows that densities (number of invertebrates per 0.6m^2) are on the low side for hard bottomed sites[5], indicating a level of pollution / poor quality habitat. However, taxa richness is as expected, and the number of EPT taxa making up that assemblage is also good at around 50% and 30–80% of individuals. The MCI indicates a good quality assemblage and only KOP 2 looks to have a predominance of poor quality habitat fauna. The QMCI scores are less positive which

[5] Hard bottomed reference (good quality) density 1418-6253 individuals (Maxted, Evans & Scarsbrook 2010)

indicates that the abundance of less sensitive taxa outweighs the abundance of the more sensitive taxa in the assemblages.

95. This is a common state for rural streams which retain a range of habitat conditions but are affected by long term sediment and lack of riparian cover.

Table 2: Summarised macroinvertebrate results from 2021 site investigation.

PARAMETER	BRU1	BRU2	KOP1	KOP2	MAG2	MAK1	MAK2	MAK3	MAK4	MAK5
Number of invertebrates	236	221	230	218	228	206	230	212	237	235
Number of taxa	21	23	29	33	33	27	30	27	33	29
Number of EPT taxa	9	9	12	12	13	12	8	12	12	11
% EPT invertebrates	38.1	22.2	13.9	14.2	36.4	78.6	31.3	85.	21.1	65.1
MCI score	104.8	101.7	103.4	100	95.8	105.9	102	117.8	100.6	106.2
QMCI score	5.6	3.3	4.2	3.6	4.3	6.8	4.6	7.4	4.3	6.7

Wetlands

96. Within the wind farm wetland survey area (i.e. a 100m envelope around all proposed infrastructure), more than 140 features were identified and assessed (labelled as ‘surveyed sites’ on Map 10 of the AEE), 97 of which were determined to be individual gully wetlands (as per the RMA definition of wetland). Of those 97 ‘RMA’ wetlands, 48 (and one ambiguous) were identified as ‘natural’ wetlands as determined from 106 vegetation plots. These 48 natural wetland features are narrowed to 44 (some being the same gully system) and are identified below (Figure 8).

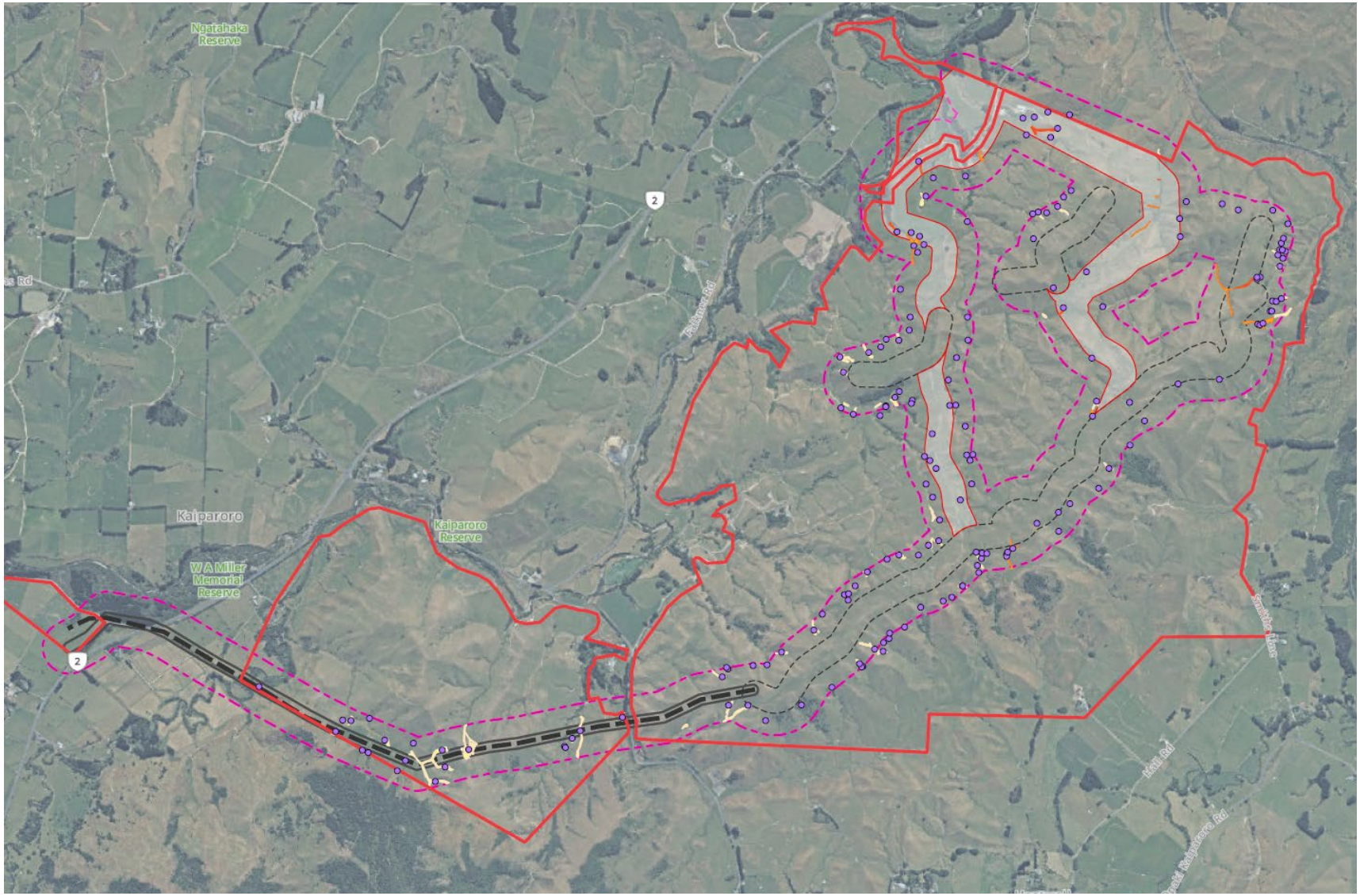

Figure 8. Wetland surveys and identified natural inland wetlands within 100m of the project.

97. The great majority of the features surveyed were wet spongy features of deposited sediments in narrow steep hill side gully systems. Most, under the NPS-FM identification system (vegetation, hydric soil and hydrology) qualify as natural inland wetland initially (dominated by wetland associated species), but a little over half are excluded because of the level of pasture species coverage. Despite 48 features identifying as “natural wetland” under the current definitions, there were no actual natural wetlands on site that are representative of natural indigenous wetland assemblages, or appropriate to the topography and place; all are a product of historic forest clearance, farming, slope erosion, gully sediment accumulation and stream retardation giving rise to wet muddy gullies (rather than streams under canopy). These conditions have allowed wet adapted species (mostly exotic) to colonise and persist under grazing pressure.

98. The following describes the various types of “natural” wetland features recorded on site during the field investigations (Photograph examples are presented in **Appendix D**). Four broad wetland types were recorded across the site:

(a) Gully mud sponges;

(b) Gully heads and hollows on the upper ridge line;

(c) Stream terraces; and

(d) Steep hill seepage slumps.

99. Despite having different labels, the four wetland types generally have the same species in them but in different proportions, reflecting the hydrological and sediment differences of the features.

100. All of these features are induced, opportunistically colonised features with a small diversity of exotic and indigenous wet tolerant species. No feature present could meet Schedule F wetland types or pass Policy 13-5 (Horizon One Plan), or Policy 23 (GWRC RPS) criteria.

101. Forty-nine (49) taxa were recognised in the various wet features. 11 where wetland obligate (OBL), 13 were facultative wetland (FACW), 6 were Facultative (FAC), and 18 were upland species. The

characterising species (those in more than 40% of the 100 vegetation plots) are listed in Table 3:

Table 3: Common and abundant wetland plant species

NATIVE	EXOTIC
Broom rush (Juncus sarophorus)	• Blue sweet grass (*Gylceria declinata*) • Dwarf montia (*Montia fontana subsp. Chondrosperma*) • Little mouse ear chickweed (*Cerastium semidecandrum*) • Creeping buttercup (*Ranunculus repens*) • Yorkshire fog (*Holcus lanatus*) • Sweet vernal (*Anthoxanthum odoratum*) • Clover (*Trifolium sp.*) • Duckweed (*Lemna disperma*) • Water forget-me-not (*Myosotis laxa subsp. caespitosa*)

102. These ten taxa are the most frequent and abundant cover of most of the wet features. The most cover dominant taxa were blue sweet grass, exotic dwarf montia, and sweet vernal, each typically around 30% of the total vegetative cover in any one plot.

103. There were 11 indigenous taxa in total across the site, but any one wetland feature only ever contained one or two indigenous taxa and in very low abundance. Across the 100 plots the frequency of occurrence of a native species was < 10%. One At Risk, naturally uncommon taxa was found in one of the gullies outside of the 100m activity envelope.

ASSESSING POTENTIAL EFFECTS

104. The level of the Project's potential adverse effects on ecological values was determined following the Environment Institute of Australia and New Zealand (EIANZ) impact assessment guidelines[6], which uses an assessment matrix (refer to Dr Bull's evidence – Table 10 in Appendix 1) that incorporates **ecological value** (Table 11 in Appendix 1) and **effect magnitude** (Table 12 in Appendix 1)). I describe the ecological values and effect magnitudes in the following sections.

AQUATIC ECOLOGICAL VALUES

105. While the AEE assessed the Bruce Stream and tributary this waterway will not be directly affected, and I have not discussed it in this evidence.

106. The ecological values of the freshwater systems on site were assessed for all sampled tributaries and their respective catchments in the AEE. Here I focus on the only two tributary systems that have any real risk of project related impact, the Mākākahi catchment focusing on the northern tributaries, sample sites MAK 1, 2 and 5 and the Mangaroa Tributary. These are the only tributaries which might potentially be directly impacted by the Project (along with the northern unsampled Mākākahi tributary near MAK 1).

107. The AEE discusses the values associated with the Bruce and the Kopuarunga systems (Appendix 6 of the AEE). I note here that the Kopuarunga tributaries ranked as being of **Low** value and the Bruce system as of **Moderate** value.

108. The following is my analysis following EIANZ (2018). The Metrics (upon which much of my assessments is based) suggest the following condition outcomes.

[6] Roper-Lindsay et al. (2018). *Ecological impact assessment (EcIA). EIANZ guidelines for use in New Zealand: Terrestrial and freshwater ecosystems* (2nd ed.). Environment Institute of Australia and New Zealand.

Table 4: Suggested condition outcomes

SITES	MACROINVERTEBRATE	FISH	PHAB / WQ
Mangaroa	Fair	Poor	Fair
MAK 1	Good–Excellent	Poor	Fair
MAK 2	Fair–Good	Poor	Fair
MAK 5	Good–Excellent	Poor	Fair

Mākākahi Catchment (MAK 1, 2, 5 and Unsampled Northern Tributary)

109. These northern tributaries on the property are very similar in form, water habitat, riparian condition, modification level and type. With respect to representativeness, the macroinvertebrate assemblages appear to have improved since 2011 and can be said to be relatively representative of a post-forest assemblage with good proportional representation of the more sensitive EPT taxa. However, the fish fauna is reduced from that expected, perhaps as a consequence of passage barriers, but also because the small tributaries are mostly shallow riffle habitats and lack stable deeper habitat that retains a variety of fish taxa year-round. The riparian condition is not representative of a natural hill country first and secondary order stream system, even while a common condition in rural land use today. The substrates are overly represented by fine sediments and in-stream debris and woody matter is much reduced from the expected natural state. I rate the representativeness as moderate. None of these tributaries present any important distinctive ecological species or features and there is no rarity on the understanding that long fin eel are not rare, even while being categorised as At Risk – declining. Rarity, I rate as Low (low rather than none, acknowledging long fin eel). Similarly due to the levels of modification of bank, channel, substrate, flow pattern and riparian cover I find diversity and pattern to be low.

110. Given the above and in reference to the retained reasonable macroinvertebrate community I consider the integrity of the tributaries (nativeness, pristineness, diversity, resilience) to be low but not Negligible.

111. With regard to the ecological context, in my opinion the tributary does not offer refuge or good stable aquatic habitat for fish populations or as spawning sites for recreation fishes, or functions related to water quality (temperature regulation by shading riparian vegetation, buffering through filtration of land run off etc), and continues to facilitate land use contaminants to be delivered downstream and so the contextual value of these tributaries is considered **Low**.

Mangaroa Tributary

112. The Mangaroa valley perennial system is a broader more expansive channel (bank to bank) than the Mākākahi tributaries although it too only has a narrow wetted width. While this system had less evident fine sediments in the substrate it had also less riparian cover (it is very exposed) and, because of the reduced incised nature of the wetted channel, greater stock access. The macroinvertebrate fauna were less representative than the Mākākahi tributaries, but not poor, and with only one fish taxa recorded, the combination of slightly poorer physical conditions and species assemblages, I rank the Mangaroa as having **Low** representativeness.

113. Similarly, there are no rarity or distinctiveness values present and no patterns of note or high diversity of habitat types, features or species assemblages. These two factors I also rank as **low**, although **very low** may also apply.

114. The integrity of this tributary system is lower than the Mākākahi systems. With less riparian cover and no indigenous cover, poor fish assemblage, a poor macroinvertebrate assemblage and reduced instream habitat conditions, I rank it as **very low**. As discussed above for context, while the Mangaroa tributary drains the hill slopes of the upper catchment, the tributary does not buffer the lower system from run off (sediment), does not offer good upper headwater stable fish habitat or recreation fish spawning sites, and while it continues to deliver water to the lower reaches has little ecological role to play in the catchments' sustainment of biological systems (it is a much reduced source of food and species). I rank its contextual value as low.

Table 5: Summary of the ecology value of each assessed catchment/sub-catchment system

CRITERIA	MAKAKAHI TRIBUTARIES	MANGAROA STREAM
Representativeness	Moderate	Moderate
Rarity & distinctiveness	Low	Low
Diversity and pattern	Low	Low
Ecological context	Very Low	Low
Ecological integrity	Low	Low
OVERALL ECOLOGICAL VALUE	**Low**	**Low**

Wetlands

115. I have not valued every natural wetland feature; rather, I group the four broad wetland types that were identified on the site. This is because in general, most of the gully "mud sponges" (for example) are the same species assemblages in slightly different situations and slightly different proportions. Thus, I assess the generic "mud sponge", seepage slumps, stream terraces, and gully head and hollows as follows (Table 6).

Table 6. Mt Munro wetland ecological value assessment

CRITERIA	GULLY MUD SPONGE	GULLY HEAD / HOLLOW	STREAM TERRACE	SEEPAGE SLUMPS
Representative-ness	Low. Poor species richness, largely exotic, does not resemble any natural native wetland assemblage. Induced situation.	Negligible. Poor species richness, largely exotic, does not resemble any natural native wetland assemblage.	Low. Limited species richness, largely exotic, often grazed, does not resemble any natural native wetland assemblage	Negligible. Very limited species assemblage. Does not resemble a natural fen, marsh, or other native natural assemblage. Induced by farming.
Rarity and distinctiveness	Negligible. Common, not rare or threatened taxa. These hill slope features are very common in the ED.	Negligible. Common, not rare or threatened taxa. These hill slope features are very common in the ED.	Negligible. Common, not rare or threatened taxa. These hill slope features are very common in the ED.	Negligible. Common, not rare or threatened taxa. These hill slope features are very common in the ED.

CRITERIA	GULLY MUD SPONGE	GULLY HEAD / HOLLOW	STREAM TERRACE	SEEPAGE SLUMPS
Diversity and pattern	Negligible. Very uniform.	Negligible. Simple limited gradients or plant responses.	Low. Reflecting sediment accrual, stream flow and flood patterns, but very limited mosaic.	Negligible. Simple uniform state and pattern.
Ecological context	Low. Some filtration and sediment entrapment.	Negligible. Small, often isolated or disjunct, no wetland functions of note.	Low. Some filtration in floods, supports retention of stream flow in a minor way.	Negligible. Too small and diffuse to have any wetland functions.
OVERALL VALUE	**Negligible**	**Negligible**	**Negligible**	**Negligible**

116. There are no natural inland wetland values on site greater than of Negligible ecological value.

117. All of the features are simple, uniform, exotic dominated and exist on artificial induced wet sediment trapped in old stream channels or pasture-seepages. None of the features bear any resemblance to a comparable indigenous fen, marsh or seepage assemblage.

118. The only wetland “functions” (most do not contain wetland fauna) are the retention and filtration of hill country rain derived sediment runoff, but this function is limited by the size and current fullness of the gullies. Also, there is minimal stream habitat protected by these gullies from such runoff.

EFFECTS ON AQUATIC ECOLOGY

119. In this part of my evidence, I will discuss the potential effects of the proposed wind farm on stream and natural wetland ecological values. The effects discussed in this section are relevant to the construction and operational stages of the proposed wind farm.

120. Where mitigation or offset is recommended, I will also discuss this in relation to each of the potential effects.

Streams

Potential Construction Effects

121. The following potential construction and operational phase effects (both direct and indirect) were considered for my assessment:

(a) Loss of stream habitat due to culvert installation,

(b) Sediment release during construction,

(c) Contaminant release during construction,

(d) Harm to fish during construction,

(e) Impediment to fish passage.

Culverting of Streams Resulting in Aquatic Habitat Loss

122. The current roading access design recommends a route that requires one bridge, two new culverts in perennial systems, one replacement of an existing culvert in a perennial system and 8 culverts in headwaters in ephemeral systems under the road.

123. Tonkin & Taylor has supplied the locations of these culverts as a concept design in Meridian's Section 92 response to Council and I have placed the proposed culvert locations over my stream classification map (Figure 9).

124. I am confident that the only culverts that intersect with an intermittent or perennial stream are culverts labelled C1, C2, C3 and C7 (Figure 9). Culverts C8 and C9, while in the lower catchment, facilitate overland flow paths and the rest of the culverts are in the headwaters in ephemeral flow paths.

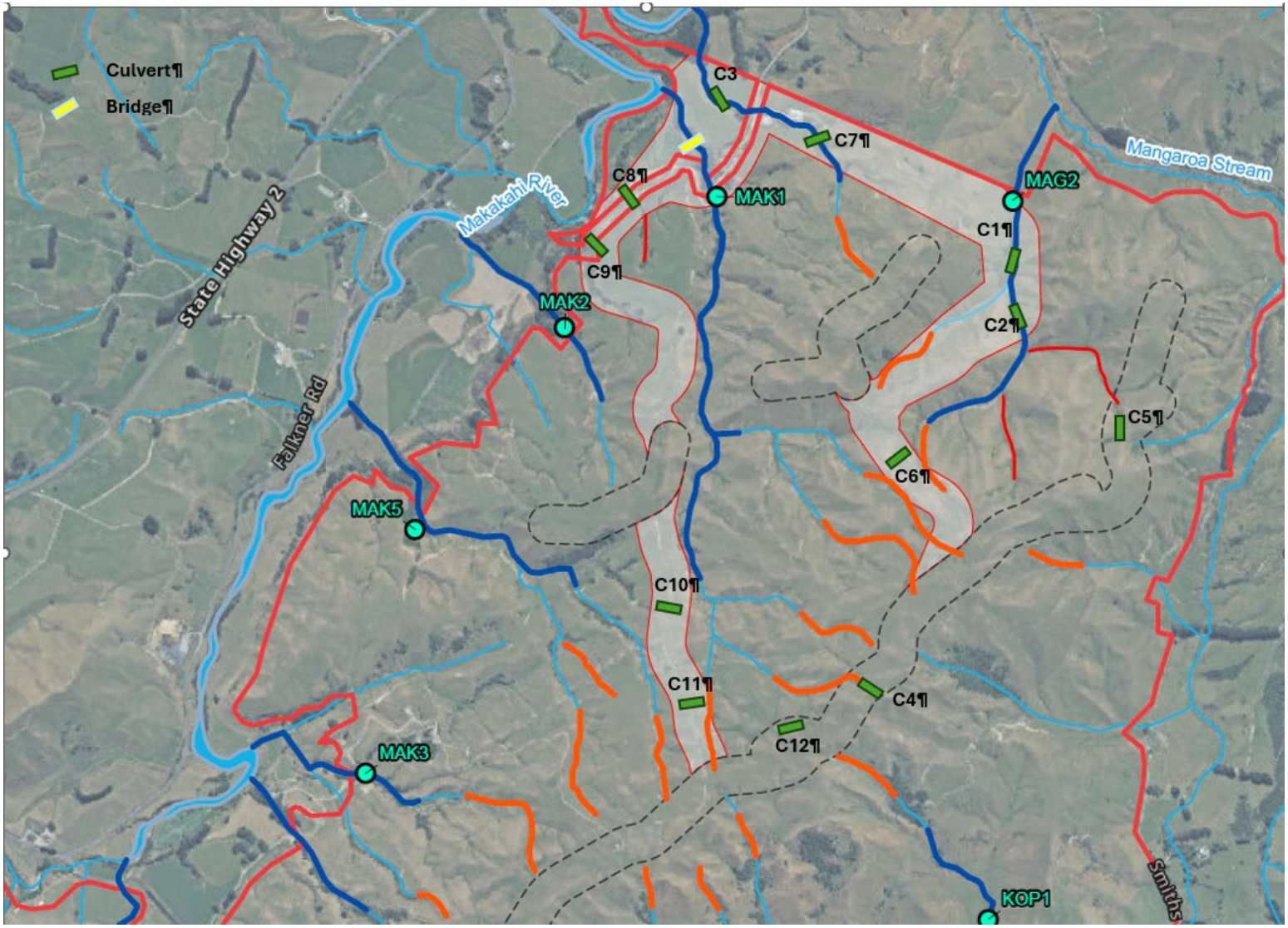

Figure 9. Stream classification (ephemeral to perennial) and the proposed culvert locations.

125. All four perennial intersection culverts are associated with the northern part of the site access road, two in the unnamed northern Mākākahi tributary that runs alongside the stock yards and two in the Mangaroa tributary. MAK 2 tributary (one of the better condition tributaries) is to be a bridge with no impact on the streambed.

126. The northern Makahi tributary did not receive a sample site in the assessment, but I have since visited and walked that reach affected. In terms of its substrate, banks and riparian condition (pasture and pasture weeds), instream habitat (macrophyte), and flow, the northern tributary is perhaps the least representative, poorest example of the sampled Mākākahi tributaries.

127. A new culvert is proposed (Ca. 30m long) below the existing farm road and a replacement culvert just upstream of the stock yards (a current farm road culvert) (See Figure 10).

128. The culverts are 300m apart (there is already a perched road culvert) and the uppermost services a further 200m of stream.

Figure 10: Location (orange lines) & extent of Mākākahi northern tributary culverts, and MAK 2 bridge (blue box).

129. While the new culvert and to a much lesser degree the replacement will result in changes of aquatic habitat quality, they do not represent a loss of extent of stream as per the NPS FM (2020). This is because as

much water habitat will be present after installation as before, it is just of a different type (lower value) than existed before. That is, there is not a loss of extent of aquatic habitat but instead of that habitat being open air, soft sediment and macrophyte, it will be low light, hard bottomed habitat that is periodically a mix of gravels and sediment.

130. Culvert 3 is estimated to be 30m long, while the current culvert is 15m. Culvert 7 I understand to also be 30m long. Both can very simply be installed to facilitate fish passage. However, I note that I do not consider that fish are common in this headwater tributary, and the current culverts are partial barriers already.

131. The change of 45m from soft bed macrophyte to concrete bed (in the absence of a properly fitted culvert without gravel installed in bed), is a change in quality of 4% of the tributary's habitat opportunity (the tributary is around 1100m in length). Such a change is a low magnitude of effect to a low or very low value aquatic habitat and under the EIANZ (20128) matrix results in a **very low or less than minor effect.**

132. In the Mangaroa tributary there are two proposed culverts.

133. Culvert 1 is estimated to be 110m long and culvert 2, 100m long.

134. In total some 210 linear meters of stream will be subject to culverting in this catchment. This will result in a change in habitat from open air to low light, but the stream will retain a reasonable proxy of its current substrate, assuming installation follows current culvert installation guidance. The following guidance paraphrases the NES for Freshwater (2020), and the New Zealand fish passage guidelines (NIWA 2018) which I recommend be followed.

The principles of good ecological culvert installation are:

(a) make the culvert as short as possible,

(b) retain the same gradient as the stream being replaced,

(c) use a bottomless arch where possible, or else oversize the barrel and ensure the invert is below the natural stream bottom such that 1/4 to 1/3 of the barrel is full of substrate,

(d) promote substrate into the bed of the installed structure,

(e) ensure the width does not pinch the natural wetted width and so does not change the velocity in the barrel.

135. If the design reflects these matters, then fish passage will be unaffected, and importantly, a range of macroinvertebrates will colonise the substrate even if the culvert is long and dark.

136. The proposed culverts in the Mangaroa are long and straight, while the stream currently meanders. The culvert length will therefore be shorter than the stream, and there will be some actual loss in extent of stream habitat. From aerial imagery measurement I estimate that the loss will be around 50m for 1 culvert (the 110m lower tributary culvert). I therefore assess that 210m of culverts will result in about 100m of actual habitat loss.

137. This loss of extent (rather than reduction in function) of a stream cannot be mitigated or remedied other than by shortening the culvert length or bridging the stream. I do not consider the values and size of the tributary warrant avoidance by bridging, but the aspects of good installation recorded above can mitigate the loss of function to a degree by making the culvert length count as habitat, albeit of lower value.

138. Therefore, I assess the effect in the Mangaroa is a loss of 100m of small tributary habitat and a change in around 210m of habitat from open air periphyton and detritus communities to dark detritus communities.

139. If the culverts in the Mangaroa tributary cause a 100 m loss this represents around 7% of the total amount of perennial tributary habitat in the Mangaroa tributary (I measure it at 1100m). This (at less than 10% of the habitat lost) is a **low but permanent effect**. A low value suffering a low magnitude is a **very low (less than minor)** level of effect.

Management of the Effect

140. Regardless of the level of effect, it is a loss and so I recommend an offset in order to adhere to the NPS FM requirement of avoidance of loss of extent of rivers where practicable.

141. However, there is little Meridian can do to recreate a stream. What it can do however, is replace the loss of extent with improvement of the retained stream's quality.

142. Under offset principals (NPS FM appendix 6), an offset is required to adhere to 11 principles, the primary principle being to work through the effects hierarchy and then to demonstrate through transparent calculation the value of the offset against the loss.

143. The offset also has to be additional to actions that would have occurred in any case, such as ensure no net loss or account for lag time.

144. It is common in parts of New Zealand to use the SEV (Storey et al., 2011) ecological compensation ratios (ECR) generated model to account for stream functional loss and offset gains. This allows a quantum loss to be offset by a quality gain.

145. In essence the process measures a functional score of the affected waterway (the SEV score), reflects on the amount of that value in area or linear meters lost by the activity and seeks to balance that loss by predicted gains in SEV to an existing waterway or the likely SEV value of a new waterway. It commonly adds a lag time coefficient, a multiplier of 0.5.

146. I have not undertaken an on the ground SEV assessment of the Mangaroa tributary. I consider that I am able to predict with sufficient certainty the current SEV value without doing so, based on my extensive experience. I have undertaken hundreds of such assessments over the last 10 years and consider that in these highly modified rural settings my estimate will be sufficiently close as to make a site SEV survey unnecessary.

147. Based on my experience and the values of the stream, I assess the SEV outcome for the Mangaroa tributary will be around 0.45.[7] If, as I recommend, the offset is the riparian enhancement of the remaining Mangaroa tributary (inclusive of all perennial and intermittent reaches) by way of planted native riparian vegetation at a 10m width either side of the channel, that this area is fenced from stock and that substantive woody debris is also added to the reaches then this will raise the current SEV to Ca. 0.65 (a 0.2 SEV gain which is a conservative gain for such riparian actions).

148. I note that the recommended fencing is not additional but is required to protect the revegetation.

149. The use of the model is described in the following in two ways, to calculate the offset of the lost stream and to calculate the offset for the reduced value in the proposed piping.

150. For stream loss (100m) the model is:

(SEVP-SEVI / SEVmP-SEVmC) X 1.5

= (0.45-0) / (0.65-0.45) x1.5)

= 0.45/0.2 x 0.5 = ***3.375***

151. That is, the ECR for stream loss is a 3.4 to 1 ratio. 100m of stream extent is lost in the Mangaroa and therefore the model suggests that a 340m reach of perennial stream should receive enhancements (revegetation, etc) such that its current state is raised by 0.2 SEV points.

152. For the stream change to culvert, the model is:

(0.45-0.2) / (0.2) x 1.5 = 1.9

153. That is, the ECR for stream change to culvert is a 1.9 to 1 ratio. 210m is lost to culverting (this does not include the 30m of the northern

[7] SEV scores for typical rural and urban streams average 0.43-0.54 (Neale, Story & Quinn 2016).

Mākākahi tributary as this is not a loss of extent and only a very minor change in the quality of the aquatic habitat) meaning 399m is required to offset the habitat quality reduction.

154. Depending on final design, Meridian will likely need to investigate the undertaking of the **enhancement of around 739 m** of the Mangaroa tributary. In the Ecological Report, I was less detailed in the calculation of the reduced culvert effect and suggested 720m of enhancement, but this revised assessment is more precise.

155. I note that any riparian enhancement on the Mt Munro site would need to be of species that do not unduly attract birds (thereby putting them at risk of collision with turbines), although the Mangaroa is low in the valley and distant from most of the turbine plateaux.

Sediment Release Potentially Damaging Downstream Aquatic Habitat

156. Two aspects of the construction phase have the potential to release sediment into the various aquatic systems: constructing the access roads and the turbine platforms.

157. I have assumed good practice erosion and sediment control measures will be implemented during the construction phase of the wind farm, as outlined in Ridley Dunphy (2022) and Mr Ridley's evidence.

158. This includes an assumption that excavated material will not be side-cast into any ephemeral, intermittent, or perennial watercourse. Ridley Dunphy (2022) conclude that with proper site management sediment loss affecting receiving environments will be minor and unlikely.

159. This seems very reasonable to me for the turbine platforms because they are quite distant from any intermittent or perennial flow paths and generally on flatter lands. This is true for some of the roading but in lower-middle hill climbs where cuts may be larger and closer to flowing waterways there will be greater risk.

160. The primary risk of controls being compromised and extraneous material entering the aquatic system(s) will be during adverse weather

events. That said, all of the stream systems on the property have a certain tolerance to sedimentation as currently all the waterways have a level of fine sediments as part of the stream substrate as a result of decades of farming practices and this has had an effect to exclude any taxa particularly sensitive to benthic sediment loading. That said the macroinvertebrate fauna of most of the perennial systems as measured in 2021 is reasonable with relatively good EPT representation.

161. I consider that it is unlikely any spatially constrained earthwork defence related failure of fine sediment discharge would cause a lasting measurable change to the physical benthic condition. However, special care and monitoring should be afforded the Mangaroa and Mākākahi tributaries down stream of earthworks.

162. Sediment discharge over the years has been perceived as a major earthwork related risk that damages aquatic systems. I have monitored earthwork related discharge event effects in streams at many discharge scales over the last 20 years. The prediction of an effect is not intuitive, and it does not follow that a discharge of sediment to a waterway causes a measurable adverse effect to the benthic biota of a stream.

163. The effect is dependent on the timing, duration and flow in stream and the level of deposition. Then it is dependent on the assemblage of the receiving habitat. Deleatidium or Zepheblia for example are most often clustered on the larger cobble (grazing periphyton growths) and are often raised above the average bed and low points such that unless the sediment deposition is extensive, they are not greatly affected by an ordinary “discharge”. Where the sediment in suspension passes within hours their feeding and gill apparatus are typically unaffected. It tends to be the detritivores, those feeding on the bottom and in organic matter which sits in the main depositional zones that get covered. It is these fauna that are best adapted to such situations hence it is unusual to see an adverse response in macroinvertebrate community assemblages when monitored unless the deposition is deep and prolonged.

164. NIWA, in a report on a number of Bay of Plenty systems, measured event turbidities and found that they ranged from five to a little over

1500 (mg/l) and typically several 100 (Hicks et al., 2019). A raised level of several 100 NTU[8] is not "unnatural" and not often adverse to rural stream benthic assemblages in a rain event. Fish and invertebrates have a range of adaptive techniques to reduce dirty water impacts and do not suffer physically until nearer 10,000 NTU for fish (Rowe, 2002) and 20,000 NTU for most invertebrates (Suren et al., 2005). The pattern of reduced communities is related more to the streams' total loading of sediment over a long period, as opposed to any one event, with a greater loading of sediment correlated with fewer species of fish (Richardson & Jowett, 2002).

165. Therefore, my evidence is that while New Zealand streams should, and in native forests still do, contain low NTU / sediment in suspension in rain events (from 1–50 NTU), these streams are now rare and generally in conservation land. Rural land streams "naturally" experience suspended sediment rises with rain of several 100 to 2000 NTU commonly and have adapted to survive these events. That is the level of background sediment rise in rain events that is relevant to this project and as a result effects are likely to be less than minor (short term and small in spatial extent).

166. The only Threatened or At-Risk fish species recorded within the potentially affected waterways is the longfin eel (At Risk – Declining); this species can well tolerate heavily sedimented streambeds and is often found in greatest abundance in soft substrate beds dominated by macrophyte.

167. Any sediment release into the streams during construction is expected to have a Low magnitude of effect (being managed to minimise and spatially and temporally limited in scale) on the Low or Moderate (Bruce) freshwater values that are present; thus resulting in a Low (Bruce Stream) to Very Low overall level of effect (Table 7).

[8] Nephelometric Turbidity Unit

Table 7: Summary of potential overall level of adverse effects on the assessed streams from a substantive sediment discharge event

CATCHMENT OR SUB-CATCHMENT	ECOLOGICAL VALUE	MAGNITUDE OF EFFECT	LEVEL OF EFFECT
Mākākahi	Low	Low	Very Low
Mangaroa	Low	Low	Very Low
Bruce Stream tributary	Moderate	Low	Low
Bruce Stream main stem	Low	Low	Very Low
Kōpuaranga	Low	Low	Very Low

Ecological Effects Management

168. Avoidance of any discharge (to the greatest extent practicable) should be the primary aim of effects management.

169. I assume that well run sediment and erosion control management will minimise any substantive discharge, if not all discharges, to any intermittent or perennial waterways.

170. If and where a prolonged and substantive discharge occurs to an intermittent or perennial system on or downstream of the property it is my opinion, based on the data instream collected, that while there may be a disruption (for a time) of the benthic fauna, these systems are robust and will recolonise and reset as they have done since forest clearance. That is, I do not consider it likely that there will be any long-lasting adverse effect because of unmanaged sediment release.

171. In my opinion there is no mitigation requirement other than best practice erosion and sediment control, installed and managed well.

172. With regard to stream monitoring for sediment discharge and effects, I think that there is little merit in repeatedly measuring the benthic fauna pre works (baseline) as proposed in the Councils' condition EC18 (we have reasonable data already and the 24 month pre works collection of data is unnecessary to characterise the fauna from which to test an adverse effect) and there is no merit in trying to attain a baseline and measure fish presence in any of the tributaries present. I consider that

the focus of a monitoring program should be on the defences against discharges and that the erosion and sediment control staff should:

(a) in the first instance be responsible for monitoring the extent and location and management of open earth surfaces, and

(b) must monitor rain event discharges from those surfaces into the control devices; and

(c) check that those devices are working, such that any discharges to any waterway are only under extreme rain events when NTU levels are rising substantially across all of the property regardless of earthworks.

173. Where there is a measured discharge from the controls to an intermittent or perennial waterway then the aquatic ecologist is triggered to measure deposition in the receiving bed (SAM 2 and 6 Clapcott et al 2011) with a follow up if deposition is deep (2 cm) and extensive (over 80% of the bed for 70% of 100m reach).

174. Where that is the case, then this is followed by benthic macroinvertebrate surveys immediately and then at 3 month and 6 month intervals until it can be shown that the benthic macroinvertebrate fauna has returned to an equivalent pre-earthwork assemblage condition (testable through statistical ordinations against the currently held data set which is a series of samples across the tributaries at two times already).

175. I see that in the Councils' proposed consent condition EC18, the consent holder would be required to undertake 4 replicate measures, one in each of summer, autumn, winter and spring to form (i.e. add to) a baseline data set of macroinvertebrates, and I assume fish. As I have noted above, I think that this is unnecessary given the data already collected.

176. The condition would then require routine macroinvertebrate (and deposited sediment) monitoring (quarterly) in each catchment when construction activities are being undertaken. Again, I advise that such an approach is not useful and does not actually assist the process as all it generally measures is the natural variability in the system.

Nevertheless, if this condition is imposed, then where it states “routine” I suggest that that be biannually, an increase in frequency beyond that runs the risk of the monitoring program being the effect.

177. Further, I think in condition EC18, sub clause b(v) should be removed. While it says "where practicable” it will generally not be feasible to create an upstream control as this will need to migrate up stream with the work and as it does will become too unlike the effects area downstream to be a control.

178. The condition also has a process for monitoring of deposited sediment during trout spawning periods (May–September), which I assume is related to the potential for sediment to disrupt reeds or reed location. However, that monitoring would need to be in the main stem of the Mākākahi as no trout were recorded in the middle and upper tributaries and spawning is highly unlikely on the project property. If it is undertaken in the main stem of the stream then the reeds are exposed to any manner of wider catchment influences, not just from the Project. I consider that the on-site sediment monitoring process and measures are sufficient to identify any substantive sediment discharge issues and part of the biotic follow up monitoring (EC17) which involves deposited sediment measures could include checking of the confluences of the project tributaries with the main stem.

Construction – Contaminant Release

179. A 30,000-litre diesel tank is proposed within the Turbine Envelope or Turbine Exclusion Zones. I note that the Councils’ proposed conditions CM6 (a) and (b) include a minimum distance between waterways and diesel tank locations or machinery refuelling (or require that these are contained in a bunded facility). My recommendation is to increase this buffer from 20 m to 50 m. I note that this amendment has been brought through into Meridian’s updated proffered conditions as attached to the evidence of Mr Anderson. With this amendment, I consider fuel spills into waterways to be highly unlikely.

180. Contaminant runoff in the form of concrete (powder or slurry), though rare in occurrence, is the most likely contaminant that could be released during construction of the Project. If such products entered waterways, they could lower the pH of the water and could cause death of fish, eel in particular. However, there are few fish present and so the risk and the resultant impact is low. I have reviewed Condition CB4(c) regarding what a Concrete Batching Plan Management Plan must include as a minimum and consider that the measures required will isolate downstream/downslope aquatic systems from any area where concrete is being used, stored, or made. I agree with this condition and note that it is retained in the updated proposed condition set attached to Mr Anderson's evidence. I think it most likely the potential effect will be avoided.

Fish Harm During Culvert Installation

181. It is possible that despite low abundance of few species, during instream works including dewatering for the installation of the culverts, some fish may be harmed, either through machinery impact or dewatering. However, that effect is simply avoided through what is now a standard practice of fish recue and translocation. Proposed condition EC14 covers the required process to safeguard fish life and I support that condition.

Fish Passage

182. I recommend that any culverts that are required to pass fish (i.e. the two Mangaroa tributary culverts) are designed following the guidance of the New Zealand fish passage guidelines for structures up to 4 metres (NIWA (Franklin et al.), 2018) and in line with NES-FW (2020). Prior to installation the proposed designs should be checked by the project aquatic ecologist and then validated in the field at the time of installation. If this occurs, fish passage issues and associated effects can be avoided.

183. In that regard proposed condition EC15 will achieve the required passage validation.

Freshwater Recommendations

184. My recommendations in relation to freshwater are to:

(a) Offset the culvert-related impacts in the Mangaroa tributary using a 3.4:1 ratio for stream extent loss and 1.9 ratio for stream habitat reduction. The stream offset recommended is new native riparian revegetation 10m either side of the stream and introduction of large woody debris resource to the restored stream. Fencing to exclude stock, and pest management must also occur. Based on the current design, I have calculated the offset requirement to be 740 linear meters of offset. This offset program will need a plan and a measure against which success can be monitored.

(b) Prepare and implement a monitoring regime associated with the erosion and sediment controls which triggers ecological monitoring (as described in proposed condition EC18 after reflecting my comments in paragraphs 168 - 178 above) should large scale discharge of sediment be recorded by the sediment and erosion monitoring.

(c) Ensure concrete work and fuel use and storage areas are isolated and protected against leachate or spills.

(d) Install the Mangaroa tributary culverts as per the NES FM (2020) and as further guidance New Zealand fish passage guidelines (Franklin et al., 2018).

(e) Undertake fish salvage wherever instream works are to occur or a reach is to be temporarily dewatered.

185. I see that these recommendations are generally covered by the Councils‘ proposed conditions but in a more conservative way than I consider necessary (EC14–EC24 and CU14). I prefer the amended versions of these conditions attached to Mr Anderson’s evidence, which I note do not include CU14.

Wetlands

186. With respect to natural inland wetlands, the potential adverse effects from construction (on site and from Old Coach Road widening) are primarily:

(a) The infill of 3687 m^2 natural inland wetland for the internal access roading (3200 m^2 on site and 477 m^2 from road widening):

(b) the potential for surface discharges of construction phase stormwater containing sediments to wetlands; and

(c) a reduction in hydrology because of diversions or land shape changes that cause redirection of surface water or depletion of ground water.

187. Once the roading network is established, and given where the turbines are to be located, there will be no operational effects to natural inland wetlands.

188. I have identified (in both the windfarm site and transmission line) Ca. 44 natural inland wetlands. Of those 44, 6 (red features Figure 8 lie with some certainty under proposed infrastructure and 8 (orange features on Figure 8) lie within 50m of the likely infrastructure. The rest (24 labelled yellow) are within 100m of a Turbine Exclusion Zone or a Turbine Envelope Zone.

189. The gullies, which in part or in whole contain natural inland wetlands that are within 100 m of the Turbine Envelope and Turbine Exclusion Zones, could potentially receive earthworks generated sediments or incur a hydrological change in the wetland although that effect is unlikely given the features are “down gradient”.

Physical Loss of Wetlands

190. There are six natural wetland features (identified in Figure 11 as red features) that are within the Turbine Envelope Zone or the Turbine Exclusion Zone (on the likely road alignment or across the turbine plateaux) that are likely in the way of infrastructure. It is my understanding, having walked the alignment with the roading

designers, that at detailed design of the form and location of the road several of the possibly impacted wetlands could be avoided and in my view there is only one (1) red wetland area that is unlikely to be avoided (Figure 11).

Figure 11: The natural wetland that seems most unlikely to be avoided, at least in part.

191. Nevertheless, for my assessment to be as conservative as possible I have assumed that all six (reds) and 4 of the Old Coach Road side wetlands will be directly impacted through filling and loss. This area of wetland directly impacted sums to approximately 0.37 ha of low quality (Negligible value) exotic dominant natural inland wetland.

192. There are eight natural inland wetland features that are within 50m of the current road alignment, but which clearly are unlikely to lie underneath the road, but may be within a berm or construction affected area. These sum to 0.84 ha of natural inland wetland.

193. The total area of natural wetland within the 100 m zone of the Turbine Envelope and Turbine Exclusion Zones is 3.26 ha; at the scale of the wetland survey area, the worst case scenario is that 9.8% of the natural wetlands identified will be removed. I only have this close proximity total area because my assessment does not cover the entire gully wetlands, the length of the hills or the entire farm or landscape or Ecological District. At any of these wider and more appropriate scales, the magnitude of effect of this loss of the small natural wetland areas would be much less than 1%. This level of loss I assess as being of a

Negligible magnitude, which combined with Negligible value of the features (even while being permanent) results in a **Very Low** level of effect overall.

194. Such a Very Low level of effect does not usually require management (EIANZ 2018) and can be accepted without any loss of indigenous biological diversity or meaningful loss of wetland function on site. While the NPS FM (2020) seeks Councils to avoid loss of extent of natural inland wetlands I do not understand the NPS FM's direction to Councils to avoid the loss of extent of natural inland wetland to refer to these types of exotic induced "wetland" which have an induced hydrology.

195. Since the AEE was finalised the need to widen Old Coach Road has been considered. I went out on site (14th April 2024) to examine the widening areas and located 8 wetland features adjacent to the current road (Figure 12).

Figure 12: Old Coach Road wetlands.

196. There are three gully systems that cross the road and there are two damp terraces that abut the road which have wetland features. Two features are technical natural inland wetland (a Carex geminata sedge road edge, #1 and 3, Figure 12). Area #2 is a Juncus wet pastures and is likely in part natural inland wetland, Area 4 is a very diffuse Juncus wet pasture and if delineated using the MfE protocol it is unlikely to resolve to a natural inland wetland (nevertheless I treat it as such for the current assessment).

197. Two gully systems east of the road are natural inland wetlands (# 5, 6) but currently one (#5) has a 15m buffer space between the wetland and the road, the other (#6) is hard up against the road but will not be affected.

198. The southern most gullies (#7, 8, 9) are a product of the deliberate creation of water bodies, i.e. dammed ponds and so are excluded from being natural inland wetlands through the exceptions listed in the NPS FM (2020).

199. In total I assess there could be 477 m^2 of low quality, low ecological value induced natural inland wetland removed to widen the road (both from temporary and permanent works).

Wetland Loss Effects Management

200. Following the management Hierarchy in the NPS FM (2020) section 3.21, my recommendation is to:

(a) Pursue a roading design that avoids as much and as many natural wetlands as possible;

(b) Ensure cuts and fills leave surfaces directing surface flows in similar in direction and quantum as precut surfaces; and

(c) Ensure any intersected ground water flows are managed so that those flows remain to the natural wetlands currently.

201. Given the nature and extent of the natural inland wetland features involved I remain of the opinion that they are not of ecological value or condition and are not those envisaged by the NPS FM process to need

protection or that will assist in the recovery of indigenous natural wetlands which are the features greatly reduced in our landscape.

202. Having noted that, the requirement to provide mitigation and / or offset for the loss of natural wetlands is dependent on which statutory document, or combination documents, is in force (i.e. Horizons One Plan, GWRC PNRP and / or NPS-FM (2020)).

203. Under the Horizons One Plan, the identified natural wetlands do not trigger Schedule F1 wetland criteria and therefore (based on an absence of ecological significance) no mitigation or offset would normally be required. The exotic dominance, history, condition, and future potential under the current land use ecologically supports that conclusion.

204. Under the NPS-FM (2020) (and ostensibly the GWRC NRP), avoidance of 'loss of extent of natural wetland' is a directive to Councils granting consents. However, I understand that the wind farm is recognised as specified infrastructure, and so a consent pathway exists under Section 3.22(b)[9]. Under that section, Meridian is required to follow the effects management hierarchy.

205. There is a strong argument that the loss of 0.3677ha (all six features on the site and 4 road widening features) is a very low adverse effect and therefore after avoidance and remedy the residual effect is less than minor. Under the NPS FM (2020) effects management hierarchy only where more than minor residual adverse effects cannot be avoided, minimised, or remedied, must aquatic offsetting be provided where possible. I consider that that is the situation here.

206. Meridian does not wish to pursue this and is willing to undertake an "offset" for the likely infilling / loss of 0.37 ha (rounded up) of "natural inland wetland".

207. Given the condition and absence of indigenous values, ecosystem health values, or functional values and based on other offset examples

[9] i.e., avoidance of loss of extent is not mandatory

(M2PP, TG), the Council reviewer (Mr Lambie) agrees that a 1:1 ratio of offset is appropriate in this case.

208. This ratio allows some flexibility in the consent offset target where the level of effect ends up being less than 0.37 ha.

209. The offset then would be in the order of 3,700 m^2 of creation or restoration of indigenous wetland. Ordinarily an enhancement rather than creation of a new feature would demand a higher ratio but the current mud sponges (both affected and the offset areas) have no value as representative indigenous wetlands and I consider the restoration of the features I have identified are in effect creations of new natural features not enhancements of existing value.

210. Figure 13 below identifies some features on the property that I consider the best targets for wetland offset actions. I have identified around 1 hectare of opportunity and favour the feature adjacent to the stock yards in the north as the best most cohesive larger option.

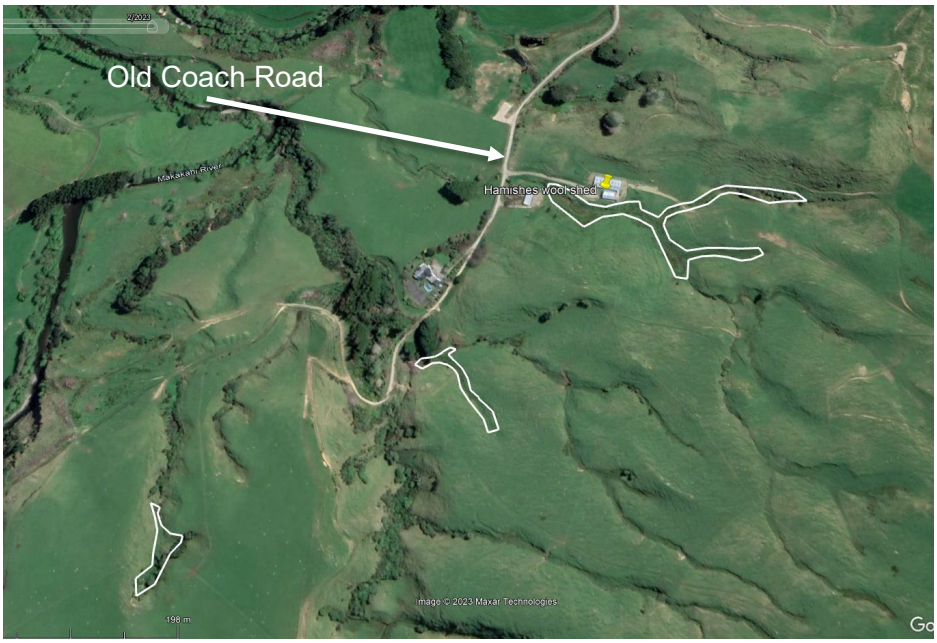

Figure 13: Areas of potential offset wetland creation using existing linear wet areas.

Potential Effects of Sediment Discharges

211. Hill country sheep farming in New Zealand normally releases a level of sediment into its gullies and streams every year, and in noticeable amounts under heavy rains; research suggests that between 900 and

3200 Kg/ha/yr can be expected (Quinn & Stroud, 2002). This has meant that most waterways and waterbodies over the last 200 years in farmed landscapes have experienced considerable sedimentation, and the current flora and fauna have adapted to that benthic change and persistent frequent suspended sediment loading.

212. At Mt Munro all of the gully wetland features are a product of land-based sediments being channelled to and caught up in those gullies (mud sponges), allowing water to be retained and wet grasses and herbs to grow (holding the sediments). The seepage slumps and hollows are likewise sediment developed. There are no peat or mineral substrates in the wetlands on the property, only recent sediment and organic material related wetlands on site. This means that where the various earthwork defences fail, if they do, and depending on the degree of failure, a worst-case scenario would see a level of sediment discharged to lower slope gully mud sponges and wetlands, but likely only one or two over the 60 or so present on site.

213. As I have recorded there are at least 44 natural wetlands within a 100 m range of potential earthworks. A really large discharge that evaded the controls could theoretically cover over an entire area of a mud sponge (for example) smothering the existing vegetation for perhaps tens of meters. This, for a period of months, would remove that portion of the wetland. After several months the sweet blue grass and dwarf montia, as well as the Yorkshire fog, creeping buttercup and chickweed will re-establish on the wet muds as they have done before, and the wetland will recover to its existing state.

214. Because of the type, nature, location and history of the wetlands present, sediment discharge is both the reason why they are present but also why there need be no ecological concern over such a process involving repeat sedimentation and recolonisation of the largely exotic wetland species present.

215. In any case the sediment management process (Ridley Dunphy, 2022) puts in place a range of sediment defences and predicts that the loss of sediment will be infrequent and minor.

216. Based on the above, I consider the magnitude of such an effect, with all the controls and the likely point source discharges to a very limited number of these gullies, that the magnitude of the effect of such a discharge is best described as of a **Negligible magnitude of effect**.

217. This, given the values present, is a resultant **Very Low level of effect**, one that does not need further mitigation consideration (other than the good sediment and erosion control methods and processes).

Construction – Potential Effects of Hydrological Change

218. Given all of the wetlands identified on site are down gradient of most earthworks, the potential for there to be drainage caused by those earthworks is very low (a highly unlikely effect).

219. The only potential of the proposed works to change any wetland feature would be the installation of a diversion of clean water away from the earthworks locations which might then divert water away from any wetland; and any earthworks that changes the ground surface such that rain fall direction is changed away from any wetland feature. Both are unlikely effects which can be managed by ensuring that worked surfaces will continue to discharge surface flows to the same sub-catchments and that diversion drains also still deliver clean water to the same sub-catchment after passing the open works area.

220. Thus, on the assumption of clean water discharge location management during and post-earthworks, we consider the potential overall effect of hydrological changes to be Very Low based on the Negligible value of the wetlands and a **Negligible** magnitude of effect.

221. A summary of the potential effects on freshwater values, as assessed in the proceeding sections, is provided in Table 8 below.

Table 8: Summary of the potential overall effects on natural wetlands.

POTENTIAL EFFECT	WETLAND VALUES	MAGNITUDE OF EFFECT	OVERALL LEVEL OF EFFECT
Physical loss of wetlands	Negligible	Negligible	Very Low
Sediment discharges	Negligible	Low	Very Low
Hydrological change	Negligible	Negligible	Very Low
Operational	Negligible	-	-

Wetland Recommendations

222. In relation to the effects of the Project on wetlands, I recommend to:

(a) Ensure the management of earthworks and water discharge is well maintained and monitored;

(b) Continue to refine the width and placement of access roads and road widening to minimise or avoid any wetland;

(c) Survey and transplant any threatened or at-risk plant taxa located in any wetland to be removed. (Proposed condition EC2)

(d) Where the planning regime requires it, offset the area of natural inland wetland lost through the restoration of some of the natural inland wetlands on site at a ratio of 1:1 (i.e. for every 1m^2 lost, restore 1m^2). We do not recommend that the area of effect or the offset be fixed as yet because we understand that the placement of infrastructure is not fully developed. A consent condition using this offset ratio related to actual effect could be used to enable the flexibility required.

223. The Councils' proposed conditions EC1 and EC2 cover the offset process and set the upper range of effects. I do not think an upper range is required as the effects are to low value wetlands and the offsets proposed will produce much better quality wetlands. An upper range in effect potentially stifles betterment. In any case there is a natural limit to natural wetland extent that can be affected by the Project which is not much more than the figure noted in the proposed consent. In all other respects I consider the conditions to ensure correct offset are suitable.

Terrestrial Vegetation – Construction – Physical Loss of Vegetation

224. The potential effects of the Mt Munro project on terrestrial vegetation relate to the permanent loss under the footprint during construction. The amount and composition of terrestrial vegetation located within the Turbine Envelope and Turbine Exclusion Zones, and therefore potentially lost, is outlined in Table 11 and Map 9 from the Ecological Report, which is **Appendix E** to my evidence; approximately 97% of the terrestrial vegetation within the project footprint is pasture. One area of non-pasture vegetation which is affected will be the riparian vegetation of one of the lower Makākahi tributaries which will have small areas removed on either side for the installation of the bridge abutments.

225. The pasture on site is extremely common, not just on site and in the region, but throughout the entire country, and ecologically provides little function or habitat, and is a highly modified, exotic-based community not representative of previous forest communities. When assessed at the catchment scale, this loss of pasture does not appear significant or impactful upon the wider communities. The single trees and shrubs within the footprint, when taken with the context of the nearby significant areas of vegetation show that there is preferable nearby habitat and seed source. Those native vegetation species present are locally common, and not representative.

226. With respect to the Mākākahi tributary, around 200 square meters of upper riparian vegetation may be required to be removed (100m^2 either side). This vegetation is a mix of exotic weeds (wattle, blackberry, gorse, broom) and native serial species: mahoe, karamu, tree fern and bush lawyer). This level of clearance does not even sum to 1% of the local mixed exotic native riparian vegetation (within 500m). There is an appreciable extent of riparian vegetation down the slope to the stream which is not affected. We deem the magnitude of effect to this riparian area to be negligible, without functional issue, and while the value is greater than the pasture (ecologically) it is no more than moderate. This effect then equates to a Very Low level.

227. The overall effects upon terrestrial vegetation associated with the Mt Munro project are considered **Very Low,** based on **Negligible value** and a **Low magnitude** of effect.

SUMMARY OF POTENTIAL AQUATIC ECOLOGICAL EFFECTS OUTCOMES

228. The effects on freshwater, actual and potential, are small scale on low value systems. The effects are a minor loss of stream habitat (around 110m of stream in the Mangaroa tributary) and a change in 40m of poor-quality soft bottom stream into 40m of low light hard bottomed culvert. At the scale of the various catchments this loss is of little ecological concern, less than minor or a very low level of adverse effect.

229. The only other potential effect of any note is the potential for the discharge of sediment during the construction of the internal roading network, or during turbine installation. However, much of that work will take place in the higher headwaters in ephemeral flow path areas. Further, where best practice erosion and sediment controls are in place and are managed well, and if there are no unusually heavy rain events, there should be no sediment discharge.

230. Any discharge which might escape controls during an unusually heavy rain event is unlikely to be deposited in the local tributaries, but carried far down stream to be diluted and deposited along kilometres of the main rivers.

231. Failed controls under moderate rain events could lead to discharges of sediment to the perennial tributaries on and off site. These systems currently have a high benthic sediment loading, and the communities are adapted to that regular sediment loading. Accidental discharges are unlikely to change the instream assemblages or current values and at worst might cause temporary reductions in EPT taxa proportions at deposition sites.

232. There are no indigenous representative natural wetlands on site, and the small area of natural inland wetland features which may be affected

by the internal access roading are of low ecological value. The size of the area affected (0.37 ha (0.32 ha on property and 0.048 ha on Old Coach Road)) may still be avoided or reduced as part of detailed design, and where this is not possible, I consider that the offset proposed is a good ecological outcome. It is highly unlikely any natural wetland could be adversely affected by a sediment discharge.

SECTION 92 RESPONSES

233. Following application lodgement, the Council issued a section 92 request and a follow up set of questions. My responses to these requests are included as Appendices A and B to this evidence, and I provide a summary of my responses below. Much of the subject matter covered in these responses forms the basis of the Council reviewer's section 87F report as well.

234. The Council reviewer (Dr Forbes) remains concerned with the identification of the stream classifications (ephemeral, intermittent and perennial) and the mapping of those general areas on site. I am confident of my team's mapping and that it is accurate to that year and season. The identification of those zones in a stream is primarily important where effects are to occur, which in this case is in the lower catchments of the tributaries (where all are considered perennial), or in the upper headwaters (where all are considered ephemeral). These two zones are the simplest to ascertain and map. It is the zone of intermittency which is the most dynamic and is hardest to map accurately. However, in this case the zone of intermittency is of least importance to the assessment because no activities occur in that zone.

235. The reviewer remains concerned about the integrity and sufficiency of the field work and methods to also identify fish presence. Given the small size, shallowness, velocity and clarity of the streams I am confident that the multi-pass 50m reaches surveyed by EFM in 2011 and then the additional spot lighting in 2021 was sufficient in a very homogeneous habitat to accurately represent the species present. The raising of possible species because of records in the wider area (including a possible variant of the upland bully) is not a substitute for

the actual data from survey work. I am confident in the species records I have based my assessment on.

236. The reviewer had questions regarding the value outcome of the Mākākahi tributaries, noting the value of long fin eel and the macroinvertebrate assemblage as that pertained to diversity which they considered showed a greater than ‘low’ diversity.

237. I have responded with statistics of other rural stream macroinvertebrate taxa and by calculating Shannon diversity indices, a statistic developed specifically to test diversity.

238. This is a matter of gradient. While the streams on site show a typical rural small stream condition with respect to diversity of species, being a typical rural modified stream does not make the stream of moderate diversity.

239. At paragraph 47 of his report, Dr Forbes cites *Scarsbrook et al* 1999 (which is actually a 2000 reference), a study of 66 rivers in New Zealand. That data illustrates a range of diversities from around 0.16 to 2.56 with a median of 1.52. There are any number of publications reporting macroinvertebrate species richness and / or diversity. To a degree the number is dependent on the age of the research and its purpose. I have tried to be relevant in my comparison by focusing on a nearby example, but ultimately the level of diversity (whether low or moderate) does not change the values outcome or, more to the point, the level of effect and how effects are appropriately managed.

240. As I have stated in my assessment the 2021 benthic macroinvertebrate fauna survey (the better assemblage data) shows an average species richness of 28 taxa (21–33). As a comparison I have collected data on the upper Whakamoekau Stream, a stream not far south of the site, near Masterton, which is similar in form and condition, and in the same land use. This stream had a species richness ranging 28–44 and averaged 35 taxa. By comparison, the Mt Munro tributaries in general are a little below average in diversity in terms of benthic macroinvertebrates and so I classified them as “low”.

241. To further assist I undertook a Shannon Weiner diversity indices score. The scores for the data collected are all between 1.35 and 1.7 (typical rural) except MAK4 which had a diversity index of 2.8. The Whakamoekau Stream examples averages 2.4.

242. In my opinion it is fair to say the majority of the tributaries on site have a low, not moderate diversity, noting the MAK4 site has a moderate diversity, although the physical conditions are still limited.

243. The one moderate diversity score for a MAK tributary site does not change the averaged condition. Further, I note that the MAK4 site is not likely to be affected by the Project. No disturbance of this stream will be required, given the only interaction with the Project is that the transmission line passes over it.

244. The reviewer questioned whether the magnitude of effect from the culverting of the Mangaroa should be higher, given that this is a permanent effect. In his opinion, this should result in a moderate magnitude effect. I do not agree and, as explained in my evidence, the extent of that permanent impact remains very low as a proportion of the resource impacted. In any case, nothing of moment rests on that difference as the requirement to culvert remains and the offset approach is the same regardless of either the value (low or moderate) or the magnitude (low or moderate).

245. With respect to the culvert installation offset, the reviewer was concerned that there was no explicit SEV data and modelling for the Mangaroa tributaries at either the impact or mitigation areas. As I explain in my evidence, I have undertaken hundreds of these assessments and I consider the SEV current score I have provided is sufficiently accurate at the impact and mitigate stream areas. I am of the firm opinion that this assessment does not require an on-site measurement and I note rural streams of this nature typically fall around 0.4.[10] The 3.4m offset for 1m lost outcome is commensurate

[10] SEV scores for typical rural and urban streams average 0.43-0.54 (Neale, Story & Quinn 2016).

with the values affected and is a fair offset ratio (ECR) for loss of typical rural stream habitat.

RESPONSES TO ISSUES RAISED BY SUBMITTERS

246. I have reviewed the submissions on the application which raise issues within my area of expertise.

247. In their summary of submissions, Councils identified 22 submissions which raised concerns relating to aquatic ecology. Most of these submissions referred to generic discharge quality aspects. The most frequently expressed concern was associated with the risk of pollution from oil and fire residue, trucks (refuelling) and machinery, oils from gear boxes in turbines, dust, toxic sludge and sediment, and the effects of these contaminants on waterways, trout habitat, eels, crawleys, mussels, and plants. I agree that the discharge of many of these substances, depending on the amount / concentration, are potentially harmful to aquatic life. I am, however, confident that there is sufficient spatial distancing proposed and procedures in place through the conditions that the risk and magnitude of such an accidental discharge is relegated to highly unlikely and very low.

248. The submission from Wellington Fish and Game notes that The Kopuarunga and Mākākahi Rivers provide important trout adult, spawning, and juvenile habitat, and good angling opportunity. I do not dispute that. The submission also states that impacts to these rivers and the tributaries supplying them have the potential to harm a protected fishery and life stage habitat. And again, I do not dispute that, noting that the tributaries on the project site, when flowing, distribute organic matter, sediments and macroinvertebrates to the lower larger trout rivers as food and resource.

249. However, as my assessment shows, this function will not be adversely affected through losses of that valued habitat as a resource or because of contaminant releases to the tributaries.

250. I have addressed the values present, the species located in the various surveyed tributaries, and there are few fish species, and generally low

abundances of most things. However, some tributaries do retain reasonable macroinvertebrate assemblages, all of which I assess as unlikely to be adversely affected because of:

(a) the general absence of direct impacts, except for three culvert installations; and

(b) the likelihood of good earthworks sediment controls and management.

251. No trout or freshwater mussel were detected during any field investigations.

RESPONSES TO THE S87F REPORT

Freshwater Ecology

252. Dr A Forbes has prepared the freshwater water ecology component of the officer's report and has provided a written report following the section 92 process which is included as Appendix 6 to the s 87F report.

253. Dr Forbes concludes that there are significant inadequacies in the methods followed for freshwater fish surveys and stream classifications, resulting in uncertainty over the accuracy of the statutory significance assessment, freshwater values assessment, and the corresponding effects assessment.

254. In part I addressed these under the Section 92 responses above (paragraph 234 onwards). In short, I am confident in the data collected and its ability to accurately depict the values on site and that it does so at a level of detail that is suitable given the potential impact of the project.

255. Dr Forbes also appears to be unclear as to how the effects management hierarchy has been applied, and he identifies inadequacies in the information provided which leave him unable to determine the level of effect or whether the proposed offset package is appropriate.

256. I am surprised at Dr Forbes's observations. Standard methods have been employed and in effect two assessments undertaken (2021 and 2011) with two sets of data collection involving industry best-practice methods and efforts. There is no deficiency in the data collection or in the data either spatially or temporally.

257. Standard application of the EIANZ (2018) assessment processes has been undertaken and effects management has been considered via the NPS FM (2020) hierarchy of avoid, minimise, remedy and then offset and compensation has been followed. An offset for wetland area and stream loss has been applied to residual effects. Throughout the effects assessment, ways to avoid effects are discussed and then a proposal to manage unavoidable effects has been set out. For example, with regard to aquatic habitat loss, section 9.3 of the Ecological Report explains how discussions were held with the Meridian project team as to how areas of wetland needed to be avoided where possible in planning the internal access route, how the loss of aquatic habitat could generally be minimised and, where residual effects remained, that these will be offset.

258. Perhaps it is not clear in the AEE that the principal management of sediment and contaminant discharge was to avoid such discharges, with monitoring to back that up and remedial actions undertaken where monitoring finds effects related to unmanaged discharges the extent of these actions to be determined at a later date if and where those effects are generated.

259. Regardless of Dr Forbes's opinion as to the adequacy of survey effort and methods, I need to make it clear that the areas of potential effect are spatially small and are limited in value. There are a couple of direct interaction points and some possible sediment discharges to a set of headwater systems which have by default small amounts of water and small habitat areas in modified conditions and in a clearly highly modified landscape.

260. I am aware that part of Dr Forbes's issue lies in the mapped extent of ephemeral waterway. However, as explained earlier at paragraph 235, I am confident my team has done as appropriate and accurate a job as

is possible given the nature of the site. Further, I consider that the classifications are as accurate as is required for consideration of effects and are appropriately conservative.

261. Where there will be some direct impact to a perennial stream system (i.e. culverting of Mangaroa tributary and the northern Mākākahi tributary) the effects and the management outcome will be the same. The offset proposed for the two long culverts in the Mangaroa is based on an SEV derived ECR, not on the ecological value.

262. The two other culverts in the Mākākahi northern tributary are of even less concern. One is an extension of an existing culvert, and the other is only 30m long, in a straight stream such that there is no loss of extent of river only a reduction in habitat quality (perhaps a 0.2 SEV reduction). This represents such a low level of adverse effect as to not require offsetting (in the absence of loss of extent).

263. However, I have, subsequent to his earlier review, revisited the offset package and in this evidence, I have attempted to make the offset calculation even more transparent by illustrating the offset for loss of extent of stream (3.4:1) and then for loss of condition by pipe (1.9:1). In doing so, I have shown a sum of 740m of Mangaroa tributary restoration and enhancement for the impact of two culverts. I trust this addresses his concerns in this regard.

264. Similarly, the data collected on all the other tributaries that might receive sediment during the construction of the windfarm is in my opinion more than sufficient to understand the sensitivity of those systems (and form a base measure) and what could be affected if sediment management on the site was to fail. While there can always be more data collected during longer periods and by different collection methods, I am very confident that the data for this Project is fit for purpose and the ecological assessments which rely on it are robust.

265. Dr Forbes recommends a range of things to be in the proposed conditions: a freshwater management plan that covers fish passage, management of temporary diversions, environmental monitoring).

266. I agree with the essence, if not all the detail, of these, i.e. the need for a freshwater management plan.

267. Similarly, I have no objection to the threatened fish species discovery protocol recommended by Dr Forbes, noting that a fish salvage protocol in any affected stream area is in the conditions and achieves the same outcome.

268. I also agree that there should be (and I note there is) a requirement for a comprehensive offset plan (wetland and stream).

269. However, I am unsure what the adoption of the One Plan water quality targets for trout (aligned with winter works periods) is supposed to achieve where sediment is the only realistic possible contaminant. It is important to understand that the trout spawning occurs in or very near the main stems of the Bruce and Mākākahi Rivers, and not on the Project site. These spawning locations are a considerable distance downstream of the location of the proposed Project works, and so will be subject to other influences of water quality such as other land uses and potential sediment and other contaminant sources. This means that monitoring water quality and substrate quality at spawning sites will not capture or accurately measure the impacts from the Project.

270. I suggest that the proposed erosion and sediment monitoring programme (Mr G Ridly evidence) is sufficient to record and understand the magnitude of any releases to any waterways on site, and that the triggered ecological instream monitoring is sufficient to observe any deposition and effect on site. However, monitoring off site will not be useful as it will not be a measure of the Project's contribution to any sediment received by a downstream waterway which is subject to various other inputs and land use impacts.

Terrestrial Ecology

271. Mr Lambie has prepared the technical report attached as Appendix 5 to the s 87F Report. In relation to wetlands, Mr Lambie agrees in general with the low value assessment of the features and with the effects management approach I have recommended (under which there is a net gain).

272. Mr Lambie agrees that with good sediment controls effects on downstream wetlands will also be less than minor. Mr Lambie does raise three vulnerable species which he considers might be present on site: a sphagnum moss, a sedge and a poroporo. In my section 92 response I reviewed my species lists and noted I found one *Luzula leptophylla* specimen in a gully wetland well outside the 100m distance to any work zone and no other record. I found *Sphagnum perchaetiale* in 15 plots but not in any affected wetland. Nevertheless, there is a proposed condition (EC2) that addresses Mr Lambie's concern and ensures that any affected wetland (those requiring to be cleared) are searched again and these taxa, if present, are rescued and transplanted to the offset areas. I agree that this condition is appropriate.

273. With regard to the poroporo, again it is unlikely present in any affected clearance zone (on the bend of an existing farm track beyond the proposed road). However, a condition of consent (EC3) is proposed to ensure that any at risk poroporo is either not removed if practicable, or is salvaged appropriately. To that end I agree with proposed condition EC3.

274. At paragraph 84 Mr Lambie raises aspects of the offset details which are not currently in the proposed condition set but which are covered by the need for an offset plan (EC4). Mr Lambie discusses the need for a canopy closure success measure (80%) within 5 years, the need for a planting plan, which must provide the extent of planting, number of plants, no less than 7 native hydric species, a review clause etc. I consider that the draft conditions under EC 1, EC4, EC6, EC7 cover the matters raised by Mr Lambie.

275. Mr Lambie raises (paragraph 43) a proposition that the 0.32ha natural inland wetland affected (as estimated based on the current design) should be an upper extent of effect in Horizons Region and zero in the Greater Wellington Region and that future detailed design should work down from this assessed extent, not up. I am in two minds. While the wetland loss is, as Mr Lambie says, a hydrological loss not a loss of indigenous representative biological loss, that hydrology and the vegetation and fauna on it, is not going to improve or change under the

current land use and so its potential value is unlikely to ever be realised. Therefore, it is arbitrary in my opinion to set a hard upper limit for the loss of such a low value feature where it will be replaced with an equivalent area of wetland with real biological wetland value. Whether the lost extent is 0.37 hectares, or (for instance) 0.39 hectares, does not in my opinion change the level of effect I have assessed, or the management approach applied.

276. These hydrological features on site are numerous and are not rare even while indigenous wetlands are rare. In my opinion any amount that is affected (and it is limited as it can only be that within the identified project zones relating to road access and turbine installation) that returns an indigenous representative natural wetland on site is more valuable to the protection and increase in indigenous wetland than limiting the effect to 0.37ha, or zero in the GWRC area. However, I understand that no wetlands will be removed by the Project in the GWRC area in any case.

277. Mr Lambie makes note that a fill site overlaps one of my suggested offset sites, my preferred northern site (Hamish's wool shed). However, even with that overlap, which I can confirm will likely be reduced in detailed design, there remains around 3 times the area that would be required for offsetting (assuming an affected area of 0.37 ha), and I note that there are two other viable areas available if required.

CONCLUSIONS

278. The onsite values of the streams potentially impacted are reflective of long-term rural activities. They are modified and have low value. The potential extent of impact is spatially limited and the risk of harm is low. These risks and the actual extent of impact can be managed and the result with the proposed offset (at a 3.4:1 ratio for stream loss or 1.9:1 ratio for change to pipe) will create a net aquatic habitat benefit on the Project site.

279. The case for natural inland wetlands is similar. There are no indigenous representative wetlands on the Project site. Nevertheless, most natural inland wetlands can and will be avoided. The few areas that may not be

avoided are of low value, and the loss of these features is proposed to be offset through creation of indigenous wetlands on site (at a 1:1 ratio) such that the likely outcome is a net benefit to local natural inland wetland.

280. My recommendations with respect to streams and natural inland wetlands are:

(a) Where any stream is being dewatered, filled, drained or otherwise made unsuitable to fish life, then prior to those activities barrier the area, salvage the fish and transfer them to a suitable habitat.

(b) Ensure best practice sediment controls are implemented for all earthworks and that these are managed effectively.

(c) Manage all potential contaminant discharges such that the risk of discharge is avoided or minimised to the maximum extent practicable.

(d) Develop an ecological response process to monitor sediment discharges to any perennial or intermittent waterway.

(e) Continue to design the roading to avoid wetlands and streams where practicable.

(f) Offset any impacted natural wetland at a ratio of 1 for 1 m^2 and place that offset in the appropriate hydrology areas identified on the property.

(g) Offset any infilled stream loss due to the proposed culverts at a ECR of 3.4:1 and at 1.9:1 for stream changed to culvert and place that offset in the Mangaroa Catchment and tributary using 10m either side riparian enhancement and instream habitat enhancement and ensure that the area is fenced and pest managed.

281. Having reviewed and had input to the proposed conditions I consider these elements are suitably provided for.

Dr Vaughan Francis Keesing
24 May 2024

APPENDIX A – FIRST FRESHWATER ECOLOGY SECTION 92 RESPONSE

Boffa Miskell

Memorandum

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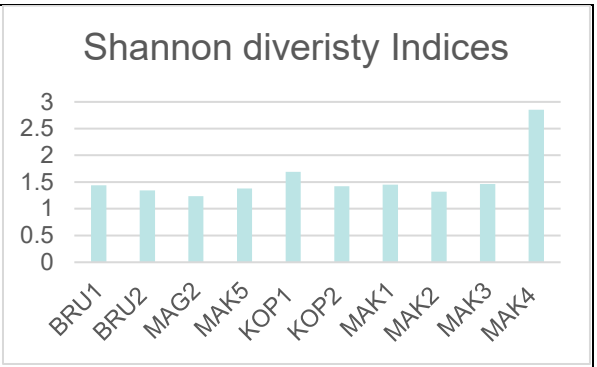
Attention:	Tom Anderson, Nick Bowmar, Lynley Fletcher
Company:	Incite, Meridian Energy
Date:	29.08.2023
From:	Dr Vaughan Keesing
Message Ref:	Mt Munro Windfarm section 92 responses

Dear all please find below the ecological responses to the various ecological Section 92 requests and several of the Erosion and Sediment control queries also.

Erosion and Sediment control	
63. Consent conditions offered contain no discharge monitoring requirements or standards. These should be considered in relation to the sensitivity of receiving catchments. Are you proposing a discharge standard to protect the values of the receiving environments?	We note from the ecological perspective the likely receiving environments are the small headwater tributaries which are currently all in unfenced farmlands and are well adapted to regular sediment and nutrient inputs and are not comprised of overly sensitive macroinvertebrates (see figure 5 AEE). The majority of benthic invertebrate abundances are diptera and Mollusca in the Kopuaranga and Bruce and all but the Makakahi 2 and 4 (least affected). The one affected Mangaroa tributary has low mayfly but some caddis but a low MCI and QMCI - not sensitive. Therefore we have suggested that these data be used as an effects baseline but that there is no need for a calendar monitoring regime but rather an event based system whereby the erosion and sediment monitoring system on site be a trigger such that potential effects (measured by monitoring discharge) are related directly to a project event and not the effect of the ongoing farming (natural) events.
65. Table 31 of the Ecological Assessment provides a summary of the overall level of adverse effects from a substantive sediment discharge event. This table indicates a low magnitude of effects and a low to very low level of effect from a substantive sediment discharge event. Please clarify how this is measured (both the substantive sediment discharge event and level of effect). It is unclear how the potential sediment discharge has been estimated and how this then impacts on the freshwater environment. Further	The assumption that an event even if discharging substantive sediment will be temporary, flushed and is within the experience of these systems. It comes from a long-gained understanding at construction sites such as West Wind, Mill Creek and Transmission Gully, where earthwork management failures did not collapse the benthic community but altered proportions of taxa for short periods. Indeed at the

understanding of this may assist in determining discharge monitoring standards and requirements.	Westwind wind farm the management regime resulted in better out comes than the original farming practices. So the expectation is a low magnitude of effect for what might be very occasional event discharges that overwhelm the defences. As to a measure, a substantial discharge would be one that causes deposition that is across the stream (say 70% of the wetted width), is over 10 cm deep, lasts more than a further rain event, and is over 20% of the receiving habitats downstream linear length. These are somewhat arbitrary measures, but ones we have found to be effective, measurable and telling. The SAM 2 (Clapcott et al. 2011) processes are sufficient protocol to measure these factors.
Aquatic Ecology	
66. In relation to the stream classification method, the hydroclasses of waterways have been classed as either permanent, intermittent, or ephemeral, however the method undertaken to define these hydroclasses is not stated and is unclear. For instance, page 41 of the Ecology Assessment states that perennial and intermittent reaches were determined based on having a defined channel and flowing water, however we note that by definition intermittent reaches might not always contain flowing water. Additionally, Map 14 appears not to display intermittent reaches. The boundary between intermittent and ephemeral is particularly important as this determines whether the waterbody is a 'river' in terms of the RMA. Existing methods are available, such as the Auckland Unitary Plan (AUP) Practice and Guidance Note River/Stream Classification. Please provide information to demonstrate the stream classifications in accordance with the Guidance Note River/Stream Classification method.	The following methodology outlines how waterways on site were classed as either perennial, intermittent or ephemeral: Each waterway was walked on site by two qualified freshwater ecologists. Site observations and notes were recorded of the stream system, including presence of surface water, the flow, signs of aquatic life and the presence of an active bed. Subsequently, using aerial imagery the site notes were crossed referenced with the aerial imagery and each waterway was marked with the boundary between perennial / intermittent / ephemeral, accepting that those zones are fluid and dependent on the time of year and amount of preceding rain. This is in reality an abridged version of the AUP method. I.e. evidence of natural pools, well defined channels, and a distinguishable bank and bed, surface water presence, rooted terrestrial vegetation, flood plain evidence of organic debris and evidence of substrate sorting processes (in an active bed) bed relative to the ground water table. However, considering no interactions are proposed of the project in the intermittent areas, the top end of perennial or lower ephemeral, the accurate depiction of the intermittent zone is not crucial to an effects decision. We supply a new map which illustrates this point (Appendix 2) and that the only interactions are with top of the gully ephemeral systems.

67. In relation to ecological values, the assessment of rarity contained in Appendix 6 incorrectly labels the status of longfin eel to be not threatened, when it does in fact have a threatened status. There is no science basis for this, and the position taken has been used to justify a low rarity value for all waterways assessed. A more appropriate valuation would be moderate rarity for all waterways where longfin eel occurs due to its threatened classification. Please provide justification on why this classification has been used. Diversity for all streams has been rated as low. However, in contrast the macroinvertebrate results (Figure 6) show good water quality being indicated at most sites monitored at least once, and four sites have returned >50% %EPT taxa richness. This data provides evidence that diversity is greater than low in a number of instances, and this is not reflected in the ecological valuation. Please provide justification as to why this classification has been used. Table 6 of EIANZ (2018) states that an area has Moderate value if it rates Moderate for two or more assessment matters and Low or Very Low for the remainder. A review consistent with the above would likely result in changes from low to moderate value, which has implications for the overall level of effect. Please review the ecological valuation considering these points or justify why the ecological valuation shows the area as having a low value.	The Appendix correctly labels long fin eel as At Risk - Declining (Appendix 6, page 1, rarity and distinctiveness"). However, it then goes on to explain why long fin eel, in this catchment and indeed in most catchments around New Zealand, are not considered "rare" for the purposes of value. This is because rarity is a function of numeric abundance and / or frequency of presence. Long fin eel is one of the most ubiquitous species in the fish records and one of the most abundant and therefore regardless of its threat classification it is not rare. Given ecological value is not a statutory assessment the assessor is entitled to provide evidence-based decisions as to the fit or not of a species to a value criteria - we have done that. The presence of long fin eel in any stream does not, in our opinion, render the stream habitat as of moderate habitat or as "moderate rarity" under rarity. In regard to Diversity. The assessment of diversity, we see, has been solely with regard to the physical habitat and its complexity. We agree that consideration of the faunal and flora diversities is also a component. We concur that the benthic macroinvertebrate fauna surveyed are now (they were much poorer in 20911), of an average species richness for pastural hard bottomed streams (an average of 28 taxa (21-33). As a comparison we have collected data on the upper Whakamoekau Stream, a stream south of the site, near Masterton, which is similar in form and condition in the same land use and had a species richness ranging 28-44 and averaged 35 taxa. So the Mt Munro streams in general are a little below average in diversity in terms of benthic macroinvertebrates. To assist in terms diversity we have undertaken a Shannon diversity indices score (a commonly used diversity indices for invertebrate assemblage samples). The scores for the data collected are all between 1.35 and 1.7 except MAK4 which had a diversity indices of 2.8. The Whakamoekau stream examples averages 2.4.

	 We suggest that an average SW diversity for similar hard bottomed rural streams is around 2. Thus it is perhaps fair to say the majority of the tributaries have a low, not moderate diversity while the MAK4 site has a moderate or better diversity, although the physical conditions are still limited. The one moderate MK tributary site does not change the averaged condition. We note that the MAK4 site is not likely to be affected its only interaction is that the transmission line passes over it and that will not require any disturbance. We note also that the MAK1 interaction is well above the stream, involving the upper riparian and not the bed. We note that the MAG2 sites macroinvertebrate fauna will influence the SEV outcome related to the culverting.
68. In relation to your proposal to culvert 210m of the Mangaroa tributary, we note that your evaluation of the magnitude of effect has not considered the duration of effect. The culvert installation would be permanent (i.e., c. 25 yrs + as per EIANZ 2018 Table 9). The character of the zone of influence would be partially changed, which is in line with a moderate magnitude of effect. Please review the proposed magnitude of effect in line with best practice guidance for ecological impact assessment as outlined here and detailed in EIANZ (2018), and also the corresponding overall level of effect for these proposed culverting works (following review of value and magnitude as above). As a result of the review, please provide any amendments or provide justification as to why the provided magnitude of effect and corresponding overall level of effect for the culverting works are appropriate.	We agree that the effect can be viewed as permeant. We also note that the effect is nevertheless reversable. While the culverts will change the aquatic habitat over 210 or so meters, two (culverts 1 & 2 in T&T response, Appendix A) are in a tributary of at least 3000m, we consider that the magnitude of effect in this instance is far more a spatial scale issues than a temporal one and that the view in the initial assessment was not that the aquatic habitat “lost” was only a temporary effect, it was always considered a “permanent” effect and the magnitude assessment undertaken with that accounted for. The third culvert (Culvert C7 is a replacement of an existing culvert), is a 30 m culvert in a 1500m tributary (2%), spatially and at a permanent temporal consideration, a low magnitude effect . The value of the MAG2 tributary and the tributary at large remains, from our assessment, low (of average to low macroinvertebrate assemblage and low habitat condition despite a generally hard substrate and the magnitude of effect 210 m of permeant loss of a 3000-meter tributary remains, in our opinion a low magnitude of

	effect – the resultant level of effect remains very low (less than minor).
69 In line with requirements of the National Policy Statement for Freshwater Management 2020 (NPS-FM), please provide an assessment of alternatives to avoid the proposed 210m of culverting of the Mangaroa tributary. Please also describe how the mitigation hierarchy has been applied in the decision making to culvert the Mangaroa tributary. These assessments should consider both alternative alignments and alternative methods of stream crossings (e.g., stream simulation culverts) as means of reducing freshwater habitat loss and loss of freshwater values.	It is not possible to divert or create a new stream section that does not involve some loss. Following the engineering requirements to place culverts (at those lengths) not arches or bridging, the instream structures that replace 210m of stream cannot be minimised, except to ensure that the culvert effects do not include armouring of the stream bed above and below the headwalls and that the installation is as per the NES permitted activity guidance in so far as the headwalls and culvert bed are set below the natural stream bed and the sizing is appropriate, such that fish passage is fully facilitated (which is expressed in the AEE). It is also likely under that regime that the bed of the culvert will accumulate gravels and that too will assist fish passage. The stream habitat lost to the culverts cannot be remedied. We assessed the level of effect of culverting 210m of the 3000m of tributary as very low, we consider that this equates to a minor or less than minor level of effect, not more than minor. The NPS FM (3.21. 1.(d)) states that more than minor residual adverse effects are offset and that lesser effects receive no further management. As a precautionary approach (and also we note that it covers the discussion above about the overall level of effect being low or moderate) we have recommended to Meridian that there be an offset nevertheless, and in part to ensure all less than minor potential effects are accounted for (ephemeral reaches, riparian effects and fish passage). We consider that this approach is a more than fair and responsible undertaking in a farmed small stream catchment.
70 Please describe specific treatments to ensure fish passage would be achievable through the 210m of culverting in the Mangaroa tributary.	The recommended approach is to ensure that the bed of the culvert and headwalls are sufficiently sunk into the bed such that there is no lip or barrier to a benthic traveling fish; that there be no armouring of the bed above or below the headwalls; ands that the culvert is sufficiently sized (be it a pipe or box) that the natural stream width (bank to bank) is accommodated such that there is no velocity change within the culvert. These three considerations will ensure the same fish passage ability as is currently available. We note that in terms of

	length of culvert, it is Inanga that suffer most in terms of travel through darkened areas, but there are no Inanga this far up the catchment.
71 Please provide a full set of Stream Ecological Valuation data and offset calculations to demonstrate a no-net loss position for the affected waterways for each of the main activities/effects. The formula and steps to be followed can be found on page 56 of the document below: https://knowledgeauckland.org.nz/media/1397/tr2011-009-streamecological-valuation.pdf The offset calculation must include the standard multiplier for risk and time lag as the positive effects from the restoration treatment (riparian restoration) will lag behind the time of culverting by about 5-10 years (+) and planting native trees is uncertain regarding weather, pests and other factors beyond your control.	Arguably with a residual effect outcome that is less than minor there is no offset requirement for the culverting of the Mangaroa (2) tributary. However, and because we have encouraged a precautionary approach, an offset (such that there is net aquatic gain) has been offered that involves the fencing from stock and the revegetation of the riparian zone (as well as instream habitat enhancement). Currently the AEE recommends a 3:1 ratio (enhancement to effect area (Ca. 240m)) - this is a reasonable ratio not uncommon or even a little generous as compared to other projects given that the level of effect does not, in our opinion, direct Meridian to offset for this level of effect. The proposed offset ratio means around 720m (but that will depend on the final total length of culvert/s) of stream would receive enhancements (those enhancements would mean a 0.3 SEV gain/m if that model was to be used). There is around 1000m of stream available in the catchment beyond the culverts and we promote the use of all of this area, but 720m active revegetation (both sides to 10m)). If we used the SEV ECR system the ratio would hinge upon what the predicted SEV of the enhanced stream would be. If, for example we accept that the current SEV is 0.4 (and 0.5 for SEVI-P) and that the resultant new forested stream could be 0.7 (a conservative outcome), then the ECR would be 2.5. We suggest that there is little need (and nothing to gain) in actually undertaking an SEV analysis, but rather to agree on the likely current condition and the possible future condition with the safety net that regardless of the ECR the proposed 720m stream enhancement and protection of most of the upper tributary in this valley will produce a net gain that exceeds the likely SEV out come if we were to use the SEV model approach.
72 In tandem with the above point, please clarify what corresponding structures are required (such as concrete aprons, bed armouring, etc) in addition to the culverts. Please describe and quantify the effects if there are any additional structures and determine the quantity of restoration required to address these effects.	To our knowledge the installation method and the other structures associated with the culvert have not as yet been designed. We have recommended that there be no additional armouring and that the headwall and apron will be set in the stream bed along with the culvert such that there will not be an un-natural gradient change or

	surface (gravels and sediments will cover the bed), that the culvert be the same gradient as the current stream bed and no flow velocity change and so no additional effects related to ancillary culvert infrastructure or installation with regard to fish passage and flow.
73 Please provide a protocol in accordance with best practice for managing effects to instream values during instream works (e.g. culvert installation), including temporary diversions, so that works can be undertaken in the dry and provide for fish salvage. This may be included within the site specific erosion sediment control plan for the culverts.	Again the detail from the engineers is not as yet published. We have recommended that a standard fish / koura salvage and relocation process be in place, which BML have successfully carried out on numerous projects in the last 10 years. We have also recommended an offline installation to minimise sediment and time of stream disturbance. Salvage, given the small stream size, will involve reach isolation by way of a mesh fencing above and below the works and then repeated EFM fishing. Our MPI accepted protocol (we hold a range of national permits to salvage and translocate fish) is to fish a reach until our catch is 10% or less of the numeric averaged first two catch abundances, and that there are no threatened or at risk species in the catch. The sediment control plans and management is developed and co-ordinated by Mr Ridley.
74 Please provide a method for monitoring the effects of sediment released from the site. During the site visit, the ecologists discussed using existing instream survey sites as baseline sites that erosion and sediment events could be monitored at when triggered at the earthworks site. Please provide details of this monitoring including confirming sites, methods, duration, frequency, and any discharge standards.	We do not anticipate there being any measurable sediment discharges from earthworks for turbine installation and consider the road development has a low risk discharge profile that could reach any intermittent or perennial stream habitat. The primary risk relates to the three culvert installations and establishment of a bridge abutments. It is not possible to avoid all sediment discharge when installing culverts, but the process usually requires a brief period of turbidity. The existing benthic macroinvertebrate data at MAG 2 and MAK sites are baseline measures (including the 2011 samples) against which comparisons can be undertaken and SAM [1] methods employed. However, while some of the streams are stony bottomed all receive season rain event sediments yearly and the level of deposited sediments is highly variable. We do not consider a calendar monitoring regime is required. The first component of sediment management sits with those experts (see

[1] Joanne Clapcott et al., *Sediment Assessment Methods: Protocols and Guidelines for Assessing the Effects of Deposited Fine Sediment on in-Stream Values* (Nelson: Cawthron Institute, 2011).

	Mr G Ridley) and the indication of stream effects will rest first on the earthworks sediment management team alerting of discharge and location and amount and receiving environment. From that alert an ecological survey using SAM and then benthic macroinvertebrates can be undertaken in the identified receiving habitat to establish if a lasting adverse effect has occurred (or is likely).
75 In tandem with the above point, please describe possible remediation measures that can be adopted in the event of a sediment release to freshwater.	In these farmed stream environments sediment discharge is a frequent event, although rarely on a large scale. The benthic fauna usually recovers rapidly. While there have been exploratory uses of sediment vacuums (in urban sites) and one example we monitored through TG in the Ration catchment, it is unlikely a discharge event will be of such a scale as to affected 100's of meters of intermittent / perennial stream. We feel it is that magnitude of a discharge that, in these streams would warrant active cleaning. If such a magnitude of effect was to occur in the Mangaroa or Makakahi tributaries then a vacuum truck may be an option if truck access is available.
76 Regarding the proposed freshwater offseting, please provide the following information: b. The location, area (ha) and timing of the freshwater offset. c. The proposed planted species composition and spacing. d. A description and quantification of what is meant in the ecological assessment as "improvements to substrate and flow heterogeneity" at the offset site. What would these restoration treatments constitute? e. The proposed mechanism of legal protection (conservation covenant) of the freshwater offset site to ensure the positive effects are protected in perpetuity. f. The width of riparian planting. On site your ecologist stated that riparian planting would be 20m either side of the stream. Please confirm. g. Please describe and detail the proposed methodology of determining the proposed offset and if it's successful (such as using SEV monitoring).	Appendix 1 illustrates the area considered appropriate as the offset with (for stream effects (250m)) a near 900m linear reach of the main Mangaroa tributary, with a 10m either side revegetation programme, a range of woody weirs installed to cause flow heterogeneity and increase retention, and the deposition of a large amount of small woody debris in stream. The precise treatment we consider better put into an offset design report post consent rather than as notes to a section 92, but the essence will be a seral broadleaf revegetation focused on woody species (makomako, karamu, heketara, tarata, mahoe, kamahi, kanono and mapou) planted at a 1m spacing and planted as 1L plants, with guards and a weed mat and maintained until an 80% canopy cover and absence of serious ecological weeds. In terms of legal protection we envisage a covenant in favour of perhaps Regional Counsel, which is in force while the culverts remain in stream. We consider that 10m either side of this small stream is sufficient to provide all the instream functions and support required,

	and at those dimensions it will be self sustaining[2]. Success, we suggest can be monitored through site inspection to warrant successful riparian development and a post woody installation stream physical habitat assessment. To expect an improvement in macroinvertebrate or fish taxa in anything but a very long time is unrealistic since the source of any new EPT taxa, for example, is very distant and may not in reality ever be able to colonise this stream.
Terrestrial Ecology	
77 There is no general section or comment on terrestrial invertebrates. We note that indigenous vegetation that is likely to be habitat for threatened or at-risk invertebrate species is avoided. Therefore, there are unlikely to be any impacts. We also note the extensive survey undertaken for lizards and birds which could also have resulted in the discovery of invertebrates should they have been present and so we are comfortable that the risks to threatened or at-risk invertebrates is low. However, it would be useful if you could please confirm that the assumption of low risk is valid and provide an explanation as to why.	We confirm that the ecology team on the project also considered the risk to indigenous invertebrate assemblages or taxa was low to extremely low (so low as to be non-existent) because there is no habitat of these taxa in the wind farm envelope. The most likely habitats are in the southern lower-mid gully forest remnants which are untouched by the project.
78 We note and agree that the wetlands within Horizons' region that are likely to be lost are not those that the One Plan 2022 seeks to protect. We also note and agree that the NPS-FM identifies these sites as "wetlands" and therefore the effects management hierarchy is to be followed and, if these wetlands are lost, then some kind of offset or compensatory response is warranted. There is one of these such (non-indigenous dominated boggy ground) "wetlands" that is earmarked as "partially within" the effects envelope in the Greater Wellington Region. We note that the intent is to avoid the "partially within" wetlands. However, the application in general has taken an effects envelope approach to provide flexibility in design and that these approaches usually assume total loss of the values within. There is a condition for 1:1 wetland loss offset/compensation with no upper limit/maximum area for the loss, and no condition specifically specifying avoidance of wetlands in the first instance. Therefore, the loss of the partial extent of "partially within" wetlands remains in scope and avoidance is not the inherent	We have advised, and Meridian have acknowledged, that it is preferable to avoid all and any adverse effects to natural inland wetland regardless of their quality and we identified those habitats within the construction foot print and within 100m of earthworks for that purpose. To that end we can confirm that all of those wetland features identified in the GWRC region, because all of these features only just in or adjacent to the road / tower envelope will be actively avoided, i.e. the actual roading and works are shifted so as to not affect these wetland. Therefore, no wetland identified in the GWRC jurisdiction will be affected. However, the road cannot in all circumstances avoid several of the long narrow features in the Horizons jurisdiction. It remains uncertain how much will be affected until full design and the designs for the road, in particular, we understand will not be concluded until advanced site survey and hence an envelope approach.

[2] Stephanie Parkyn, W. B. Shaw, and Philip A. Eades, "Review of Information on Riparian Buffer Widths Necessary to Support Sustainable Vegetation and Meet Aquatic Functions," Auckland Regional Council Technical Publication (Hamilton: National Institute of Water & Atmospheric Research for Auckland Regional Council, 2000).

strategy. In this way, the application does not clearly show an intent to follow the effects hierarchy with regard to potential wetland loss. Please provide further details on how the hierarchy is followed. The proposal is to compensate for the loss of wetland extent by replacing the wetlands with 1:1 ratio of vastly improved wetland habitat value. This does not seek to limit the total loss of wetland extent, but does seek to adequately compensate for loss of ecological value. This is consistent with the pathway available for specified infrastructure, although this could put the proposal at odds with the Greater Wellington Regional Plan (GWRP) with respect to avoiding loss of extent. We note that the one wetland in the Greater Wellington Region is in the Pahiatua Ecological District, but the proposed wetland restoration sites are on the boundary of the Pahiatua/Woodville ecological District or just inside the Woodville Ecological District. This would also put the proposal at odds with the wetlands effects hierarchy within the GWRP. Please provide justification as to why this has been selected and detail as to why it's included. Please confirm whether it is possible to specifically identify and exclude the "partially within" (and possibly one of the "within") wetlands with a slight adjustment to the effects envelopes (see figures below). If it is possible, the issue with adhering to the GRWP goes away as there would be no potential loss of wetland extent in the Greater Wellington Region, and there would also be a more obvious intent to follow the effects hierarchy to avoid wetlands in the first instance. Has this been considered?	Thus we propose a tally of wetland area affected through construction. The quality (exotic grazed) and complexity of the features likely affected is low and simple and so loss of habitat minimal but more to the point the risk of offset failure low and the "lag" time to recovery low. Any improvement on the other similar features on the farm is a simple matter of revegetation (indigenous) and fencing and management. We have "pointed" to three areas for wetland restoration ass the offset which we consider contribute best to the wider landscape. Appendix 1 has a figure showing where and what these features are. The first is the stream-wetland complex that passes from several small catchment tributaries downstream past the stock yards and could form an offset of 0.78 ha. The second is a long small gully (0.13 ha) which feeds into the dammed wetland with fragmented riparian bush and the third is the upper section of a spring feed gully that while having reasonable lower riparian woody cover has an open expanded "wetland" area (0.12 ha). All three of these features require indigenous vegetation and fencing and management. The current "bank" of wetland offers just over 1 ha. The current identified possibly affected wetland sums to less than 0.3 ha. At the 1:1 offset ratio (see below)(this is sufficient offset for even the worse case.
79 With regard to the 1:1 wetland loss compensation approach and reference to previous examples (cited in Appendix C of the Consent Application, Section 9.2, paragraph 4), have the previous examples been backed by a model or other objective approach to establish that this is a fair ratio? If so, please provide that evidence which may include details of the models.	If adverse effects do occur and cannot be avoided, then we have recommend a 1:1 ratio of offset based on the size and condition of the affected wetland. In other examples we have been involved in such as M2PP, we used a 3:1 ratio because the wetlands being lost were largely indigenous and somewhat representative of dune slacks, a naturally rare system. That is those losses were of wetlands with much greater ecological value. Those examples where not offsets based on modelling. We use (in the Wellington office) a standard set of compensation / offset ratios which are 1:1 for early serial and highly degraded examples, 3:1 for young seral and good condition examples, 6:1 for middle to older seral and high integrity examples and 12:1 for old complex systems in good condition. We have found that these ratios are

	reasonable and when we have had to model an offset using for example the DoC model [3] that our ratios stand up well. We consider that taking a linear "drainage" wetland with perhaps 1 native species and causing an equal linear length (or area) of wetland to be revegetated in dense plantings of numerous indigenous species: several rush taxa, several sedge taxa, raupo, Eleocharis, and Machaerina (where appropriate) as well as edge protection from harakeke, Ti koura and pukatea, then that is more than sufficient and well in advance of anything these exotic small sediment wetlands could achieve without assistance even if farming patterns and effects substantially changed. The referenced successes have been most recently related to the Mackays to Pekapeka motorway where we caused through offset the creation of 4 ha of various types of wetland to offset 1.8 ha which was infilled or lost to the road.
80 Please confirm whether the wetland offsets/compensation sites involve any other third party other than the landowner/occupier of the land that the windfarm is on (i.e., does it require the permission of the neighbouring properties?).	They do not, all are on the property on which the windfarm is proposed and on the same landowner. However, there remains scope to reorganise which wetland features are the focus of an offset as there are a number of potential features in close proximity that for the requirements.
81 The effect on pipits is identified as "low" (Appendix C of the Consent Application, end of par 4, Section 8.5.2, pg. 83), whereas Table 36 identifies the effects as "very low". Mr James Lambie is of the view that "very low" is the correct assessment using the EIANZ framework and therefore it is understandable that you have not suggested a condition requiring pre-clearance surveys even though farmland tracks are prime real estate for this high value species. However, disturbance of nesting pipit may be avoidable in the first instance through a condition that requires the grass to be maintained (through grazing or mowing) at a low height and for pre-clearance checks if the grass is suitably tall. Have you considered this as a possible methodology?	We accept and concur that so long as the grassed landscape remains well managed and grazed including the tracks then the opportunity for pipit to be nesting is remote. The inclusion of a condition requiring appropriate pasture management within the proposed construction envelope to remove the potential for pipit nesting prior to construction is recommended.
82 The application states that the effect on lizards is likely to be very low (Appendix C of the Consent Application,	We accept that an accidental discovery protocol is at least advisable even while

[3] F. J. F Maseyk et al., "A Disaggregated Biodiversity Offset Accounting Model to Improve Estimation of Ecological Equivalency and No Net Loss," *Biological Conservation* 204 (2016): 322–32.

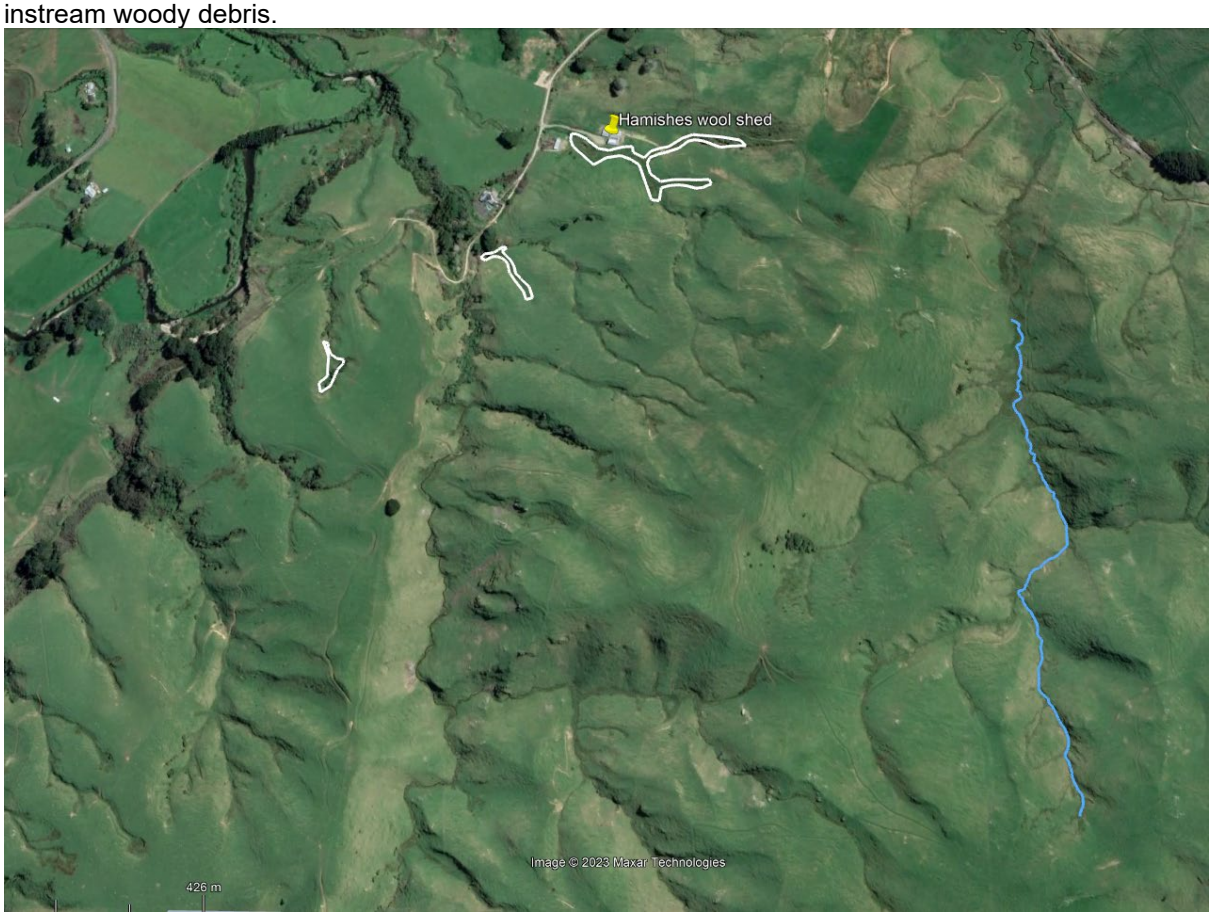
Section 8.4.1) and that mitigation is not warranted (Section 9.4). Nevertheless, a permit under the Wildlife Act is likely to be required, and that permit may have conditions (Section 9.4). Have you considered whether it may be appropriate for the Regional Councils to view this permit prior to commencing construction activity? Please also advise if you have considered whether an accidental discovery protocol should be included in order to reduce effects on lizards even further.	considering the risk of discovery and effect is remote. As to the need for the Regional Counsels to cite a Wildlife Act permit, we are unsure of the need for this, but cannot see an issue with such a curtesy, but we do not see that it needs to be a condition of consent. A permit will be required if, once detailed design is complete, areas identified as lizard habitat (as per the AEE) are affected, but that may not be the case.
83 With regard to the proposed Regional Council Ecological Condition 16 – it would be in keeping with the effects hierarchy that the total anticipated unavoidable effect of 0.32 hectares of wetland loss be specified here as the upper limit. The condition could also specify that a lesser amount of replacement is anticipated if there is a lesser loss of extent. Have you considered setting limits to manage the potential effects based on the envelope approach?	If through this process the engineering aspect cannot form a solid opinion as to which wetlands are to be avoided then we agree that an upper limit of 0.32 ha of natural inland wetland to be affected be set by way of condition and that the condition be written to enable a sum of affect to be made thro9ugh construction such that at the end the total that is actually affected be then the offset target. It is possible that through detailed design post consent more or all of the natural wetlands are avoided.
84 Please clarify what is meant by "…for 5 years…" in proposed Condition 19 in terms of the frequency of inspection and maintenance in any given year. We note that the site is likely going to require at least a spring and autumn inspection for weed clearance. It also would aid certainty if the wetland vegetation restoration condition specified a target (such as 80% indigenous canopy cover) as a logical, reasonable, and measurable extension of the "net gain" principle of offsetting to demonstrate fulfilment of a compensation outcome.	Condition 19 states that the management (required by condition 17) of the offsets wetlands must be for 5 years (in condition 17), not that 5 years is the frequency of inspection and maintenance. That is management will be for 5 years, but the condition should also say …or until the wetland revegetation succeeds in forming an 80% cover as viewed from above. Re the wetland offset and stream riparian revegetation, we agree and as noted above for the stream offset, a programme of planting and maintenance would be established by way of a management plan (required by the condition?) and that should contain measures of success, one of which would be a suitable cover target for revegetation. For a wetland rehabilitation however, this may not be of canopy cover, but rather of plant cover as the cover may be a low growing wetland species.
85 In terms of proposed Condition 21, have you considered the inclusion of a mechanism that would show that the plantings are not being counted twice given that the wetland planting is to be conjunction with stream planting (perhaps through reporting on areal extent of wetland loss and wetland planted)?	We concur with that requirement and had envisaged that the stream in Mangaroa tributary valley and the wetlands in the small catchments westward where distinct and shown as separated in the AEE. A condition clarification to that end is supported.

86 Please provide clarification on the conclusion presented in Appendix C, Consent Application, Section 9.1. It appears that the assertion that there is "…unlikely to be any adverse effects…" only refers to the loss of indigenous terrestrial vegetation and not fauna or wetlands (which are listed later). Is this the correct interpretation?	That is correct – there will be no adverse effects to any terrestrial vegetation / habitat, all other aspects have effects or potential effects which are addressed.

Appendix 1. Stream and wetland offsetting locations

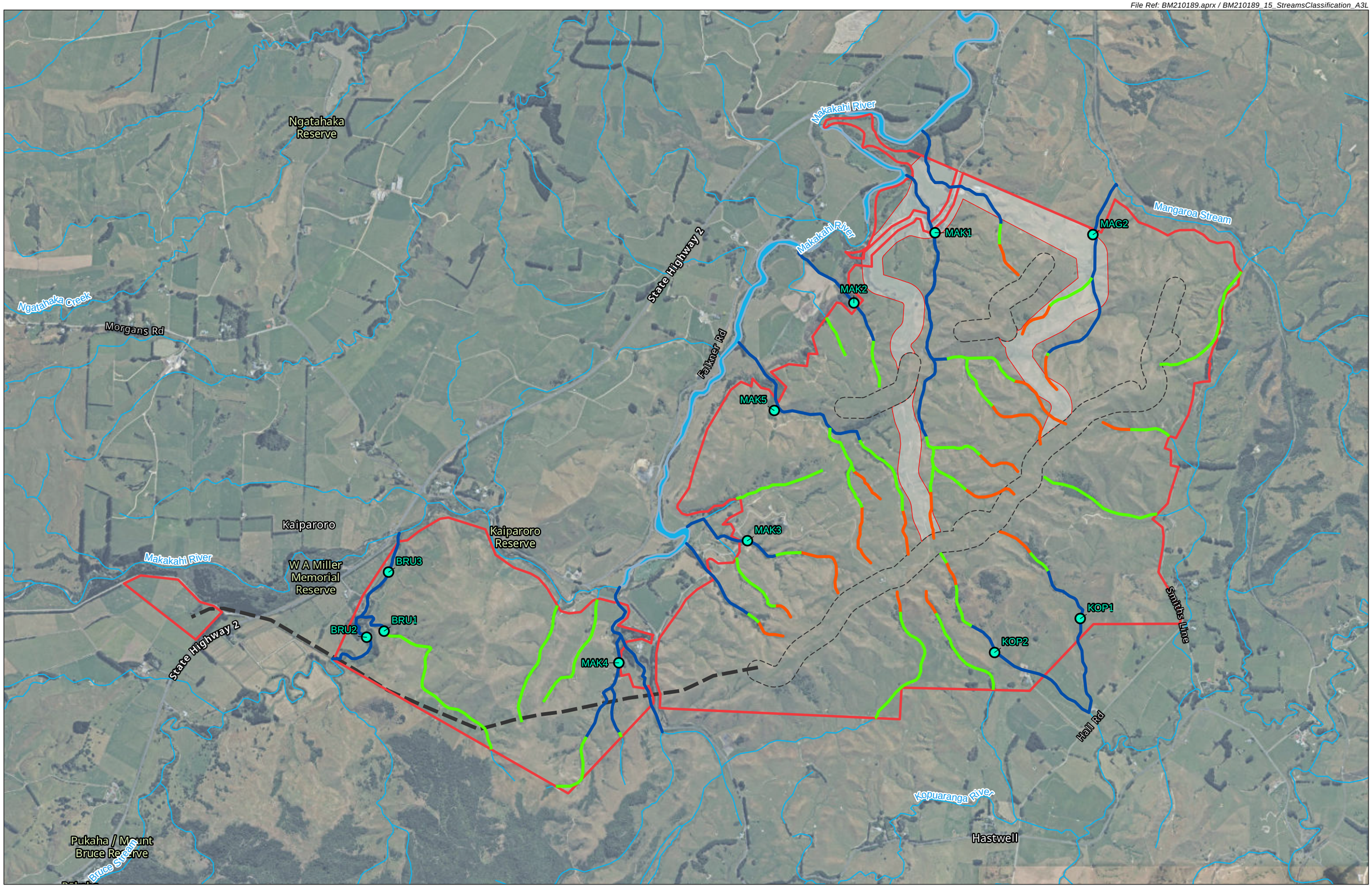
The basic Stream “offset” approach, 900m with 10m either side, fenced and revegetated in seral broadleaf woody species (makomako, karamu, heketara, tarata, mahoe, kamahi, kanono and mapou).

In addition a range of small wood weirs installed to create flow heterogeneity and supply a large biomass of instream woody debris.



The white areas are the set of wetland areas that would form the offset where and depending on how much of the natural wetlands identified are in fact affected by the final road alignment and installation works (we understand that many identified in the envelope will be avoided).

Appendix 2 Aquatic hydro-class map



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Data Sources: Meridian Energy Limited, Boffa Miskell, Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors., Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Site Boundary
- Transmission Line Route
- Turbine Envelope Zone
- Turbine Exclusion Zone
- Surveyed Sites

Stream Classifcaton (BML)

- Ephemeral
- Intermi t ent
- Perennial
- Streams (LINZ)
- Rivers (LINZ)

MT MUNRO WIND FARM ECOLOGY ASSESSMENT

Streams Classification

Date: 30 August 2023 | Revision: 2

Plan prepared for Meridian Energy Limited by Boffa Miskell Limited

Project Manager: Vaughan.Keesing@boffamiskell.co.nz | Drawn: KMa | Checked: BHi

Map 15

APPENDIX B – SECOND FRESHWATER ECOLOGY SECTION 92 RESPONSE

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Memo.

Ecological Responses to additional S92 questions for Mt Munro	**To:** Lynley Fletcher Meridian
	From: Vaughan Keesing
Date: 12 January 2024	**Project title:** Mt Munro

Introduction

I provide the following responses to the additional ecological questions Council has posed based on submitter queries.

Question. The importance of the watercourses, particularly the Makakahi River and the Kupoaranga River, for trout spawning and migration. Have you given consideration to any potential impacts of the proposal on this, and any potential monitoring that could be undertaken to assess any effects?

Response. We are aware that these systems contain trout and that the smaller gravel bottom reaches of tributaries are areas of trout spawning. No spawning habitat was recorded in the various small headwater tributaries on the property for either catchment, and no trout were revealed in surveys.

In the assessment we considered the only potential effect (to downstream systems and trout) was related to potential discharge of sediments from culvert installations and the creation of the access road. Given the headwaters of all of the tributaries of both catchments are fully farmed, stock have access to all features and the steep headwater catchment lands are prone to slips there is already a history of substantive periodic sediment release into the various waterways. This results in a current level of tolerance for sedimentation effects.

The roading and culvert installation must be managed to a high standard so as to not release typically, or under rain events, sediment into the waterways. That consideration overlaps the work of Mr Graeme Riddley. Where those works and controls are well managed the assessment concluded that the risk to such areas and features was very low (including given the distance of works to the majority of spawning areas).

My assessment is that any potential residual effects on these features during high rainfall events would not be materially different from the current natural release during storms. It is deposition of any released sediment that causes the impact to spawning sites and with good ESC measures in place the risk of lower tributary and main stem deposition of any measurable sediment would be very low. Monitoring (if required) could be by way of an event trigger, a magnitude of release measure by the sediment management team would trigger a SMA2 (Clappcott et al 2011) assessment in lower reaches. This will be confirmed through the proposed SEMP process.

Question. Please clarify if there is any and/or the nature of any discharge from turbines/nacelles and how the effects of these discharges would be expressed in the receiving environments, including the wetlands.

Response. With regard to the potential for oils to seep down a turbine and across the hard stand and pasture to a wetland, I note that the predominantly exotic sedge and herb wetlands are extremely tolerant of water quality and most wetland plants have systems that regulate their uptake of a range of possible contaminants, such as heavy metals and anions and cations and therefore are able to grow in relatively high concentrations of a range of "contaminants" without adverse effect.

For lower catchment streams we consider that oil leakage, if it occurs and if it somehow makes it past the turbine base to a headwater wetland, by the time it gets there the oil would be in very low concentration. Given the headwater wetlands are dense deep sediment grassed sedges, any oil is likely to buried into the wetland and not travel or at worst could travel very slowly downhill.

Where it passed south in to the Kupoaranga catchment it would need to pass through the fully vegetated gully wetlands for over 500m before it could reach an intermittent stream section and even further before it would threaten fish populations in perennial reaches. At that range with the level of filtration both of surface flow and wetland we can not see a valid basis for concern about a potential effect.

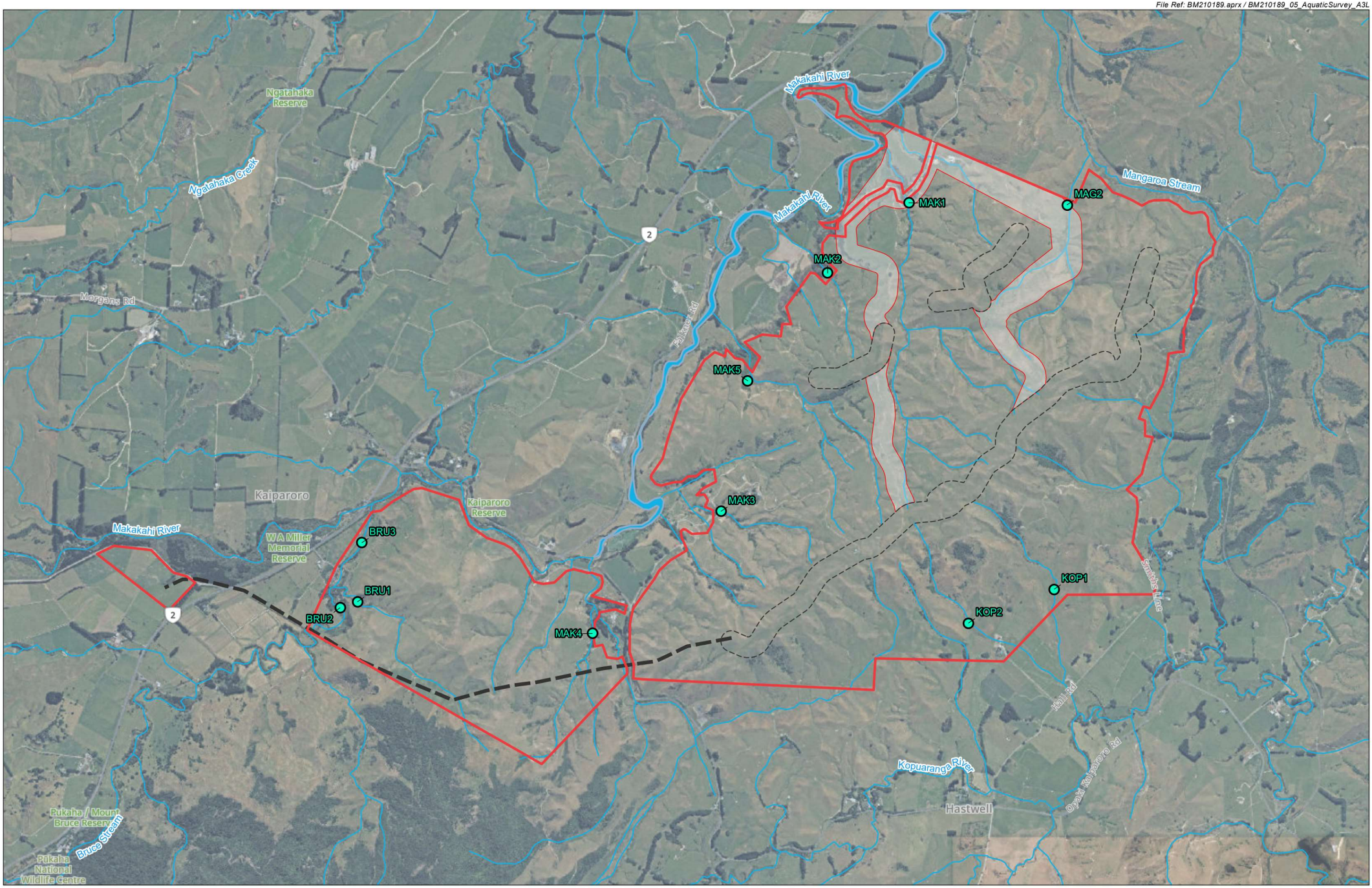
Question. Concerns have been raised in several submissions as to the classification of the waterways as intermittent. It has been raised that these waterways do not stop flowing even through the summer months and should not be classified as being intermittent. In light of this, please advise if this changes your assessment as to the classification of these waterways and amend if required.

Response. The assessments were undertaken from the headwaters of the catchments down to the property boundary and all of the systems progress from areas of ephemeral flow to intermittent flow to perennial flows as they progress down the catchment. As the extent of intermittent flow varies based on rainfall in any season and in any year, no one season of survey can conclude exactly the areas of intermittency, only the core or general area of intermittency. The mapping undertaken for this assessment shows, from several survey periods, where the ecologists, working from a range of ecological cues, consider the likely boundaries between ephemeral intermittent and perennial watercourses. I remain confident of the classifications made and the assessed extents of intermittent verse perennial. Minor variance in extent or indeed major variances will not change the assessment, because a lesser value or importance was not placed on an intermittent reach over a perennial one, the only difference being its tolerance to drying times. Given the assessment in intermittent reaches is not about water takes but of direct disturbance (culverts) and the potential discharges of sediment, the assessment remains valid for either intermittent or perennial reaches.

Ngā mihi/Yours sincerely

Dr Vaughan Keesing

APPENDIX C – AQUATIC SURVEY SITES



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Data Sources: Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors., Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors, BML

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Site Boundary
- Transmission Line Route
- Turbine Envelope Zone
- Turbine Exclusion Zone
- Surveyed Sites
- Streams (LINZ)
- Rivers (LINZ)

MT MUNRO WIND FARM ECOLOGY ASSESSMENT

Freshwater aquatic survey sites

Date: 17 May 2023 | Revision: 1

Plan prepared for Meridian Energy Limited by Boffa Miskell Limited

Project Manager: Leigh.Bull@boffamiskell.co.nz | Drawn: KMa | Checked: LBu

Map 5

APPENDIX D – WETLAND TYPE PHOTOGRAPHS

Gully Mud Sponges

Gully mud sponges

A wide lower gradient gully mud sponge

Example of a mud sponge vegetation cover

Gully Heads/Hollows

Gully heads

Gully heads and hollows

A upper ridge hollow

Stream Terraces

Stream edge rushland

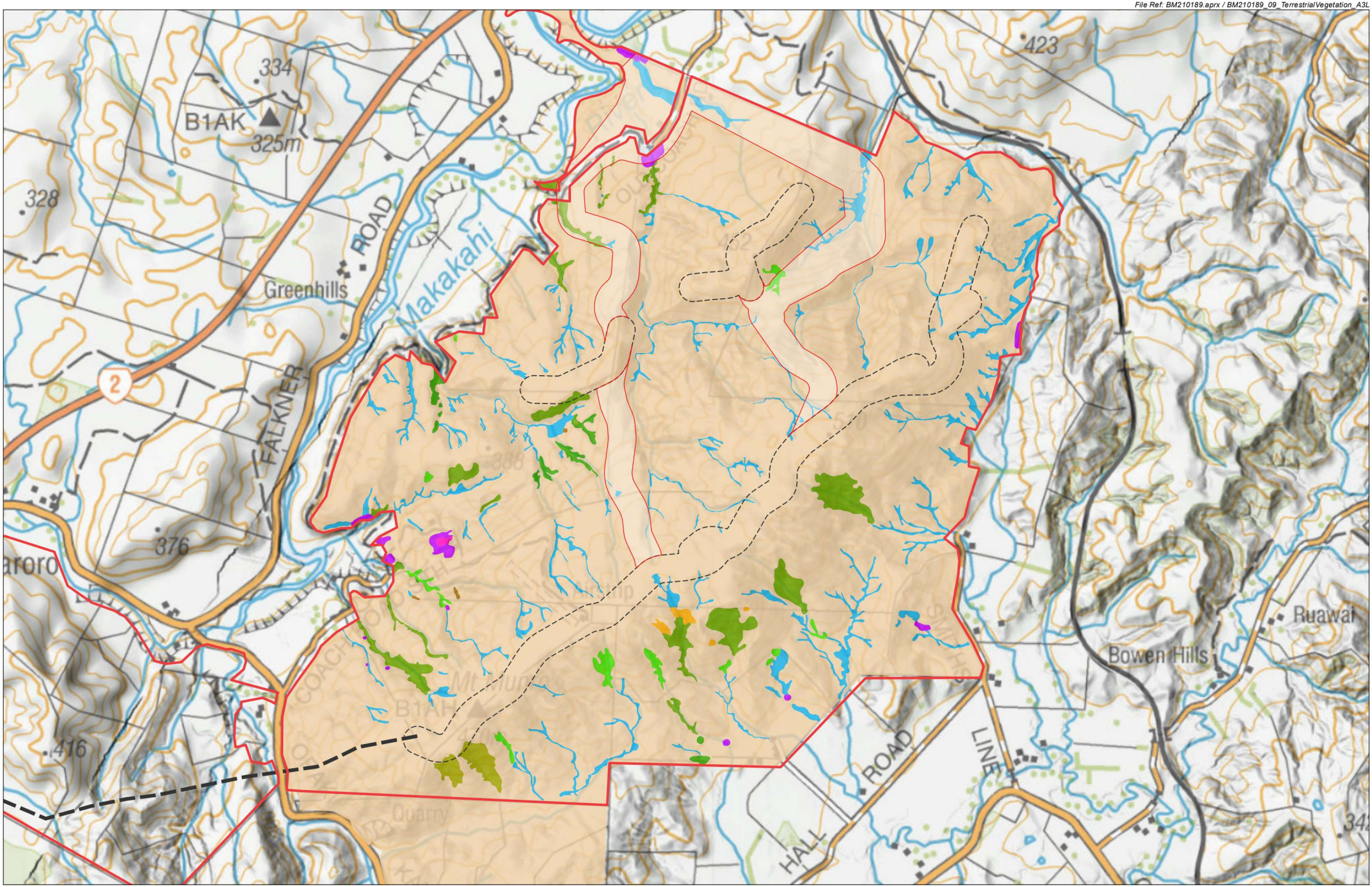
Stream terrace rushland

Steep Hill Seepage Slumps

Steep hill seepage slumps (1)

Steep hill seepage slumps (2)

APPENDIX E – TERRESTRIAL VEGETATION SURVEY MAP (MAP 9)



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Data Sources: Eagle Technology, Land Information New Zealand, BML

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Site Boundary
- Transmission Line Route
- Turbine Envelope Zone
- Turbine Exclusion Zone
- Improved pasture
- Rushland & wet pasture
- Divaricating shrublands
- Manuka/kanuka shrublands assoc. w/ regenerating shrublands
- Mahoe/broadleaf treeland assoc. w/ regenerating shrublands
- Mahoe/kamahi forest assoc. w/ regenerating shrublands
- Mahoe treeland
- Mahoe & low forest
- Exotic trees
- Garden ornamentals

MT MUNRO WIND FARM ECOLOGY ASSESSMENT

Terrestrial vegetation (2011)

Date: 17 May 2023 | Revision: 1

Plan prepared for Meridian Energy Limited by Boffa Miskell Limited

Project Manager: Leigh.Bull@boffamiskell.co.nz | Drawn: KMa | Checked: LBu

Map 9