Before Independent Hearings Commissioners
appointed by the Northland Regional Council

under: the Resource Management Act 1991

in the matter of: an application by Meridian Energy Limited for resource consents for earthworks, associated stormwater diversion and discharges and vegetation clearance for the construction of a solar farm at Ruakākā, Northland (APP.045356.01.01)

between: **Meridian Energy Limited**
Applicant

and: **Northland Regional Council**
Consent Authority

Statement of Evidence of Tanya Cook (Ecology - methodology)

Dated: 19 July 2024

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STATEMENT OF EVIDENCE OF TANYA COOK

INTRODUCTION

1 My full name is Tanya Louise Cook.

2 I am a Senior Ecologist and Associate Principal at Boffa Miskell Limited (*Boffa Miskell*), a national firm of consulting planners, ecologists and landscape architects.

3 I hold the qualifications of BSc in Zoology and Ecology (2000) and BSc (1st class Hons) in Ecology (2002) from Massey University and Grad Dip Teaching (Secondary) (2012) from Auckland University. My particular areas of expertise are in freshwater and terrestrial ecology. I have worked as a freshwater ecologist since 2001, in roles in local and central government, teritary education and consulting, the majority of which has been in Northland.

4 Since starting with Boffa Miskell in January 2022, I have undertaken stream and wetland assessments and other ecological surveys in Northland, Auckland, Waikato and Wellington, including applying the national protocols for wetland delineation and undertaking vegetation surveys. Over the last two and half years, I have undertaken several comprehensive wetland assessments on behalf of the Northland Regional Council and the Environmental Protection Authority to investigate unauthorised activties in natural inland wetlands.

5 I am a Certified Environmental Practitioner – Ecology Specialist and a member of the New Zealand Freshwater Sciences Society and the New Zealand Ecological Society.

6 I have been engaged by Meridian Energy Limited (*MEL*) since 2022. I undertook wetland delineations and assisted with the preparation of the assessment of ecological effects to support the resource consent application for the proposed solar farm development (*Proposal*).

CODE OF CONDUCT

7 Whilst this is a Council hearing, I acknowledge that I have read and agree to comply with the Environment Court's Code of Conduct for Expert Witnesses, contained in the Environment Court Practice Note 2023. My qualifications as an expert are set out above. Other than where I state that I am relying on the advice of another person, I confirm that the issues addressed in this statement 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 that I express.

SCOPE OF EVIDENCE

8 My evidence focuses on the wetland delineation that has been undertaken in relation to the Proposal.

9 The Proposal involves activities to construct and operate a solar farm across three sites in Ruakākā. Boffa Miskell undertook delineations and assessment of the wetlands across all three sites using the same methodology. The majority of the mapped wetlands are within Site 1, therefore, my evidence focuses on the delineation methodology, extent and values of the wetlands in Site 1 (referred to as the Site from here on). The wetland extents and values for Sites 2 and 3 are described in the evidence of **Dr Sarah Flynn**.

10 My evidence will address:

10.1 Background information on the assessment framework and the Site;

10.2 The methodology used to delineate the wetlands on the Site;

10.3 The field work undertaken to delineate the wetlands;

10.4 Extent and value of the wetlands on the Site;

10.5 Changes in wetland extents over time;

10.6 Additional fieldwork undertaken to determine the effects of the abnormally wet year and clarify the wetland extents on the Site; and

10.7 Freshwater information for the Site.

11 In preparing this evidence, I have considered and present an explanation of relevant information from the following:

11.1 Data collected by myself and other Boffa Miskell ecologists as part of the assessements undertaken to support the consent application

11.2 The data collected during additional site visits by Boffa Miskell ecologists and Mr Wardent;

11.3 The evidence relating to hydrology prepared by **Ms Mandy McDavitt**;

11.4 The Council ecologist's reviews and the Ecological Review prepared by Mr Jack Warden attached as Appendix A to the Council's section 42A report; and

11.5 The submissions.

12 Other ecological matters will be covered by other Boffa Miskell experts, including **Dr Flynn**, **Mr Stephen Fuller** and **Dr Lee Shapiro**.

SUMMARY OF EVIDENCE

13 The National Policy Statement for Freshwater Management 2020 (*NPS-FM*) provides the policy framework for the National Environmental Standard for Freshwater (*NES-F*), including a definition for natural inland wetlands, which are subject to regulatory controls under NES-F provisions.

14 To establish the extent of natural inland wetlands on the Site, Boffa Miskell applied the national protocols prescribed in the NPSFM across the entire Site in 8 visits between October 2021 and March 2023.

15 A total of 18.78 ha of natural inland wetlands were mapped on Site 1, of which 13.32 ha (70%) are intermittent wetlands dominated by exotic vegetation and shallow water or saturated soil, 0.75 ha are intermittent wetlands dominated by indigenous vegetation, and 4.71 ha are open pond habitats. The smaller open pond habitats are also intermittent wetlands dominated by exotic vegetation. The largest of the open pond habitats is the only permanent wetland on the site.

16 The exotic wetlands are highly degraded in their current state, due to the dominance of invasive exotic plant species, grazing by stock, and the influence of the existing drainage on the Site, which must be maintained due to the Whangarei District Council discharge of treated wastewater on adjacent land.

17 Mr Warden disagrees with Boffa Miskell's mapped wetland extents and questions the accuracy and validity of Boffa Miskell's process based on concerns with the timeframe of the assessment, location and number of plots conducted, misidentification of plant species and (assumed) dependency on outdated aerial imagery.

18 In my evidence I respond to the general themes of Mr Warden's review and present the findings of additional fieldwork undertaken in 2024 to clarify the difference in wetland extent on the Site.

19 Between October 2021 and July 2024 Boffa Miskell have undertaken over a hundred rapid visual assessments, 118 vegetation plots, hydrology and soil assessments and walked the edge of all natural inland wetland features identified on Site in line with the national protocols.

20 Overall, I consider Boffa Miskell's process was thorough and robust and followed the NPSFM requirements, resulting in an outcome that can and should be relied upon for the purposes of assessment of the Proposal.

BACKGROUND INFORMATION

Relevant policies

21 The National Policy Statement for Freshwater Management 2020 (*NPS-FM*) provides the policy framework for the National Environmental Standard for Freshwater (*NES-F*), including a definition for natural inland wetlands, which are subject to regulatory controls under NES-F provisions.

22 The RMA definition of a wetland is *"permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions*".

23 The NPS-FM (December 2022) defines a "natural inland wetland" as a wetland (defined in the RMA) that is not:

(a) in the coastal marine area; or

(b) a deliberately constructed wetland, other than a wetland constructed to offset impacts on, or to restore, an existing or former natural inland wetland; or

(c) a wetland that has developed in or around a deliberately constructed water body, since the construction of the water body; or

(d) a geothermal wetland; or

(e) a wetland that:

(i) is within an area of pasture used for grazing; and

(ii) has vegetation cover comprising more than 50% exotic pasture species (as identified in the National List of Exotic Pasture Species using the Pasture Exclusion Assessment Methodology (see clause 1.8)); unless

(iii) the wetland is a location of a habitat of a threatened species identified under clause 3.8 of this National Policy Statement, in which case the exclusion in (e) does not apply.

24 Clause (e) is the only exclusion that pertains to any of the wetlands identified on the proposed sites.

The Site

25 The topography of the Site 1has formed from consolidated dunes and is gently undulating, with remnant dune crests and slacks aligned parallel to the coast. Prior to human colonisation and modification of the land, it is likely about a third of the Site would have been an indigenous bog/fen mosaic (Singers & Lawrence 2018). I refer to **Dr Flynn's** evidence for more detail on the ecological context and features of the Site.

26 The majority of the Site had been cleared and drained for pastoral farming by at least 1942 (**Appendix 1**). At this time there appeared

to be very little indigenous shrubland remaining on the Site (<20%). A portion of the Site closest to the coast (~25%) appeared to be a relatively unmodified dune system with sparse vegetation cover in 1942. By 1950 this area was covered in shrubland vegetation. The extensive network of drains on the Site have been maintained since pre-1942, to allow for productive ongoing pastoral farming of the land.

27 As identified in **Dr Flynn's** evidence, Site 1 contains remnant landforms, soils, and plant communities derived from coastal and wetland ecosystem types that have been identified as naturally uncommon in New Zealand, e.g. stable dunes and dune swales (Williams et al. 2007). These remaining features are all highly modified, to the extent that most features are no longer representative of the original indigenous system, and the biological and/or hydrological components and functions of these systems are now largely lost or degraded.

28 Treated wastewater from the Ruakākā Wastewater Treatment Plant is irrigated on the land between the Site and the coast. The resource consent for the wastewater discharge requires the Whangarei District Council to maintain the drainage on Site 1. However, this drainage has not been well maintained in recent years. The only clearing of Bercich Drain undertaken in the last 5 years includes Site 1A in August – September 2022, a portion of Site 1B in ~ mid 2022 and the Council cleared the entire length in January 2024. Further, the southern portion of the drain that runs along the edge of Allis Bloy Place was filled in some years ago and has not been maintained for many years, so is no longer fully functional. The maintenance of Bercich Drain and other drains will influence the persistence of rainwater and wetland hydrology on the Site, particularly for the shallower wetlands on the land either side of Bercich Drain. I refer to **Ms McDavitt's** evidence for more details on the effects of drainage on the Site's hydrology.

29 The historical presence of wetlands throughout the dune swales in Site 1 has led to the development of peat soils, which persist in the Site today, as it does in most drained, peat-derived agricultural land throughout much of Ruakākā (and New Zealand). The depth and composition of the peat varies within Site 1, to some extent following the undulating site topography.

30 Parts of the Site at a higher RL typically have surface peat layer of 10 – 15 cm deep that is highly decomposed, dry and crumbly organic material, underlain by free-draining, dry sand with the occasional area having a ~2 cm layer of mineral loamy soil between the peat and sand. As I explain later in my evidence, these areas are only periodically wet for short periods of time and/or in an extremely wet years, presumably due to lowering of the water table due to drainage and cultivation practices.

31 The peat in the lowest-lying areas is about 25 – 30 cm deep and is moderately decomposed, sticky mesic peat. This peat overlays well-draining sand.

METHODOLOGY

32 To delineate (or establish the extent of) natural inland wetlands on the Site, Boffa Miskell applied the national protocols prescribed in the NPSFM, which involves:

32.1 Wetland delineation protocols (Ministry for the Environment (*MfE*) 2022a[1]), which primarily rely on a previously developed vegetation tool (Clarkson et al. 2014[2]);

32.2 Hydric soils tool – field identification guide (Fraser et al. 2018[3]);

32.3 Wetland delineation hydrology tool for Aotearoa New Zealand (MfE 2021[4]); and

32.4 Rapid pasture test from the Pasture exclusion methodology (MfE 2022b[5]).

33 The vegetation, soil and hydrology tools set out above are applied following a hierarchical sequence of tests, each requiring an increasing level of detail shown by the wetland delineation flow chart (**Figure 1**).

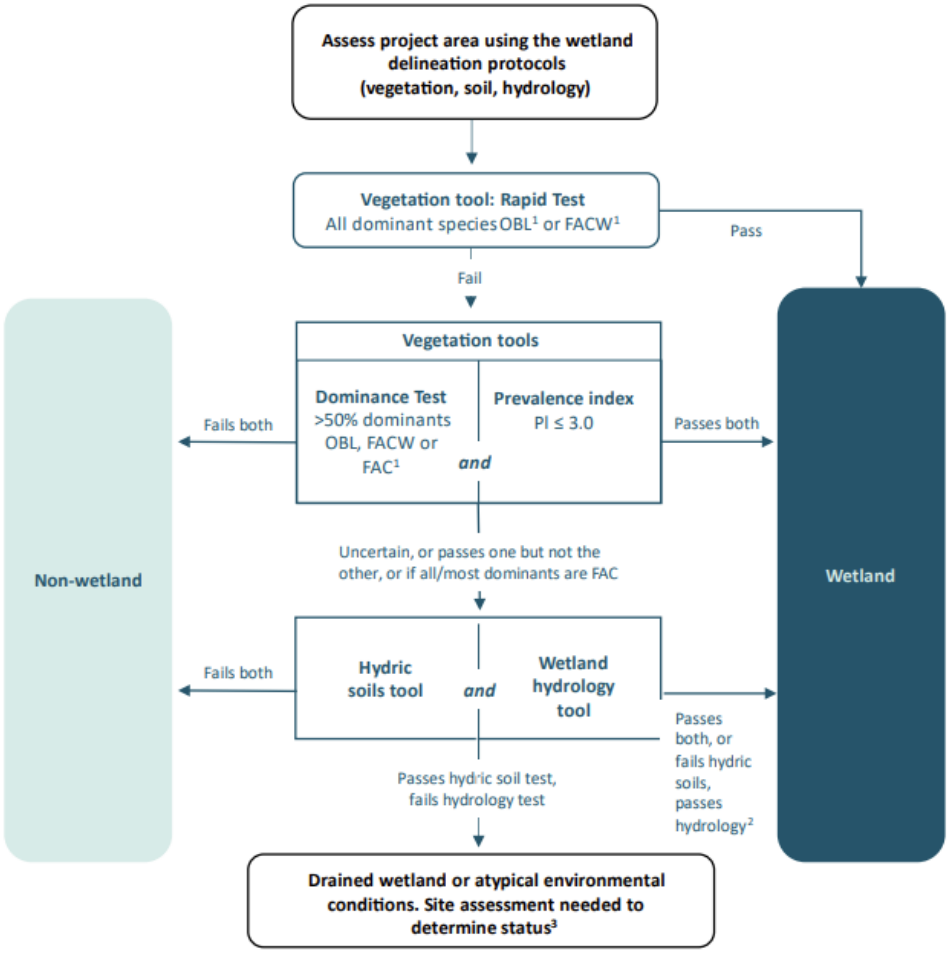
[1] Ministry for the Environment. (2022a). *Wetland delineation protocols*. Wellington: Ministry for the Environment.

[2] Clarkson, B.R. (2014). *A Vegetation tool for wetland delineation in New Zealand.* Landcare Research Contract Report LC 1793

[3] Fraser, S., Singleton, P., & Clarkson, B. (2018). *Hydric soils – field identification guide* (Landcare Research Contract Report LC 3233). Prepared by Manaaki Whenua - Landcare Research for Tasman District Council.

[4] Ministry for the Environment. (2021). *Wetland delineation hydrology tool for Aotearoa New Zealand* (ME 1575). Wellington: Ministry for the Environment.

[5] Ministry for the Environment. (2022b). *Pasture exclusion assessment methodology*. Wellington: Ministry for the Environment.



Footnotes:
[1] Wetland indicator status abbreviations: FAC = facultative, FACW = facultative wetland, OBL = obligate wetland.
[2] For example, recent wetland.
[3] The US procedures for atypical or problematic situations are recommended.

Figure 1: Key steps in hydrophytic vegetation determination (from NPS-FM Wetland Delineation protocols (MFE 2022a)).

34 For the purposes of wetland delineation, the three national protocols recommend that consideration should be given to whether normal circumstances are present. This means that climatic and hydrologic conditions are 'typical', i.e., no abnormal conditions are present (MfE 2021, MfE 2022a, Clarkson et al. 2014). The wetland delineation hydrology tool states: "*Wetland delineation using the hydrology tool should be undertaken during periods of 'normal rainfall'. Normal rainfall is monthly rainfall two-to-three months before the field assessment time, which is sufficiently similar to historical monthly rainfall." Page 16*

35 Weather conditions over the period in which the majority of the field sampling was undertaken for wetland delineation on Site 1 were not normal, with heavy rainfall in the month prior to the November 2021 and March 2023 visits and an unusually wet year from July

2022 to June 2023 (**Appendix 2**) leading to the highest groundwater level on record for the Ruakaka area from August 2022 to July 2023 (records began in September 2003) and a prolonged high groundwater table. I refer to **Ms McDavitt's** evidence for more detail.

36 The wetland delineation hydrology tool does not provide an alternative method for when rainfall is not 'normal'. The wetland delineation protocols (MfE 2022a) recommend that a comprehensive assessment be undertaken based on the US Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987[6]) if one or more of the three aspects (vegetation, hydrology and soils) is/are absent.

37 In the case of the Site, none of these criteria were absent during field assessments, although it was difficult to assess hydrology and hydric soils on several of the site visits due to the level and extent of water pooling on the Site, and the wetland delineation protocols do not make any recommendations for this situation. Therefore, the four national protocols identified above were applied across the Site, where possible.

Vegetation

38 The wetland delineation protocols (MfE 2022a) determine whether an area constitutes a natural inland wetland based on the percentage cover of plant species present and their wetland indicator status ratings from Clarkson et al. (2021[7]), which are provided in **Appendix 3**.

39 The Rapid (vegetation) Test in the wetland delineation protocols (MfE 2022a, MFE 2022b) is specified as an appropriate method to identify and delineate wetlands when the characteristics of the feature are obvious. For example, where the vegetation is dominated by OBL or FACW species, the area passes the rapid test and is accepted as a natural inland wetland. Where the vegetation cover is predominantly pasture species on dryland, the area is classified as non-wetland (**Appendix 4**).

40 On the Site, if the Rapid Tests failed to identify the area as a wetland or non-wetland (i.e., there was uncertainty) than the percentage cover of plants present in a representative 2 x 2 m plot was assessed and the Dominance Test (*DT*) and Prevalence Index

[6] Environmental Laboratory. (1987). *Corps of Engineers Wetlands Delineation Manual Technical Report Y-87-1*. US Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

[7] Clarkson, B. R., Fitzgerald, N. B., Champion, P. D., Forester, L., & Rance, B. D. (2021). *New Zealand wetland plant indicator status ratings 2021.* Data associated with Manaaki Whenua - Landcare Research contract report LC3975 for Hawke's Bay Regional Council. Manaaki Whenua - Landcare Research

(*PI*) were applied. If the area passed both the DT and PI, the feature was a natural inland wetland (refer to **Appendix 3** for more detail).

41 If there was uncertainty with the area or if the area passed one but not both the DT and PI, or if all or most dominant species (i.e., > 50%) were FAC, then the hydric soil and wetland hydrology tools were applied.

Hydric soils and hydrology

42 Based on the hydric soils tool (Fraser et al. 2018), if there is peaty material (peat soils) within the top 30 cm of a soil profile, then it is a hydric soil.

43 However, peat soils can be relict wetland soils of historical wetlands, i.e., the presence of peat alone is insufficient. Wetland hydrology must also be present.

44 Based on the wetland hydrology tool "*to meet the standard for wetland hydrology, an area must be:*

- *inundated for at least seven consecutive days during the growing season in most years (50 per cent probability of recurrence); or*
- *saturated at or near the surface for at least 14 consecutive days during the growing season in most years (50 per cent probability of recurrence, for example, 5 years in 10). Soils may be considered saturated if the water table is within:*
    - *15 centimetres of the surface for sands*
    - *30 centimetres of the surface for all other soils".*

45 A difficulty with the hydrology tool is the need for long term data, at least several seasons, to establish the primary water source(s) to wetland hydrology and groundwater movement on Site.

46 As covered in paragraph 35, due to the surface flooding on the Site during most site visits the hydrology tool was difficult to assess and in the absence of more long-term hydrology data for the site a conservative approach was used. That is, where water inundation was observed in an area this was assessed as meeting the primary indicator 1A: surface water, and therefore passed the hydrology tool. It is probable that the inundation observed in some areas during the site visits is unlikely to be present in most years (a 50% or greater probability of reoccurring) and therefore some areas are likely to have been assessed as passing the hydrology test, when they in fact did not meet the standard (i.e., were a false positive).

FIELD WORK

47 As outlined in step 1 of the wetland delineation protocols (MfE 2022a), desktop mapping was undertaken to identify the putative (potential) wetland areas prior to the first site visit, using satellite and aerial imagery and contours.

48 Multiple site visits were undertaken over a 16-month period to determine the typical range of wetland extent (8 days in total for the Site). Site visits were not undertaken in summer or at times following periods of lower than normal rainfall. Mr Hagen in his Review of Assessment of likely groundwater levels report8 concludes that "*most of the BML site visits occurred during classically drier periods*", however, I note that there is an error in Table 1. No site visit was undertaken in January 2021 (this should be November 2021). All Boffa Miskell site visits were undertaken at times when groundwater levels were above average and rainfall in the 2-3 months prior to the visit was average or above the monthly average (**Appendix 2**).

49 During site visits the entire Site was walked, focusing on areas identified as potential wetlands during the desktop mapping.

50 Natural inland wetlands were identified either using the Rapid Test, or the DT and PI from the vegetation tool (72 vegetation plots were undertaken on Site 1), and the hydrology and soil tools.

51 The edge of all identified wetland features were walked and marked using a GPS. At least one side and/or multiple sections of larger wetland features and the entire edge of smaller wetland features were delineated in the field. Species composition, surface water, soils and other relevant observations, e.g., pugging, drainage channels, dead vegetation, were noted.

52 Based on field observations during multiple site visits I observed that the extent and composition of wetland features changed, especially the extents in November 2021 and June 2022 compared to March 2023 - July 2024. The wetland features identified on the Site are dynamic features, with their extent and species composition changing with season, climatic conditions, maintenance of drainage channels and stock grazing pressure/farming practices.

53 This is not unusual for intermittently wet features, which is the majority of the wetlands on the Site. Intermittent wetlands include areas on a gradient from almost permanently wet to seasonally wet but does not include areas that are mostly dry (i.e., only occasionally wet) and therefore would not normally support communities adapted to wet conditions.

8 Appendix C of Section 42A report

54 The data collected during site visits was used in conjunction with vegetation patterns discerned from high-resolution drone imagery, satellite imagery and topography data (1 m contour lines) to map the wetland features on the Site.

NATURAL INLAND WETLANDS

55 A total of 18.78 ha of natural inland wetlands were mapped on Site 1, of which 13.32 ha (70%) are highly degraded exotic wetlands with shallow water, 0.75 ha are indigenous wetlands, and 4.71 ha are open pond habitats (**Appendix 5**).

56 The exotic wetlands are dominated by invasive exotic plant species, grazed by stock and highly influenced by the existing drainage on the Site (**Appendix 6**). As **Dr Flynn** explains in her evidence, the exotic-dominated wetlands are assessed as having moderate ecological value.

57 As **Dr Flynn** explains in her evidence, the indigenous wetlands and open pond habitats are assessed as having high ecological value. The larger open pond habitats (**Appendix 7**) and two of the indigenous wetlands in Site 1A meet the definition of a significant wetland under the Proposed Regional Plan for Northland.

58 **Dr Flynn's** evidence, together with the evidence of **Dr Shapiro** and **Mr Fuller**, describes the proposed measures to avoid, mitigate and offset the wetland features and values on the Site. The remainder of my evidence provides a response to Mr Warden's Ecological Review as it relates to wetland delineation.

RESPONSE TO SECTION 42A REPORT

59 Mr Warden (section 3.1) disagrees with Boffa Miskell's mapped wetland extents and questions the accuracy and validity of Boffa Miskell's process based on concerns with the timeframe of the assessment, location and number of plots conducted, misidentification of plant species and (assumed) dependency on outdated aerial imagery.

60 I respond to the general themes of his review below. Overall, I consider Boffa Miskell's process was thorough and robust and followed the NPSFM requirements, resulting in an outcome that can and should be relied upon for the purposes of assessment of the Proposal.

Timeframe

61 Mr Warden states on P6 para 3 *"While the MfE guidelines do not explicitly bind specific timeframes on the duration of wetland delineation in the field, splitting in-situ delineation over multiple years in my opinion is highly unusual".*

62 As I have explained at paragraph 48 above, Boffa Miskell undertook multiple site visits over a 16-month period in order to determine the typical range of wetland extent on the Site. In my view, this process resulted in a more certain delineation outcome, taking into account the dynamism of the environment and changing conditions, than would otherwise have occurred with fewer site visits.

63 In addition, as I have explained in my evidence (paragraph 35), the assessments were complicated by extreme rainfall events and a period of extremely elevated groundwater levels, the effects of which coincided with the time of Mr Warden's review of our delineation. Multiple site visits were therefore necessary in these circumstances.

64 Boffa Miskell's assessments were also undertaken in the context of a changing policy environment and evolving practice with respect to implementation of delineation methods. The NPSFM (with wetland delineation protocols incorporated by reference) and NES-F were gazetted in August 2020. MfE received feedback on a number of technical issues and provisions that required clarification with respect to both the definition of "natural wetlands", which in turn changed to "natural inland wetland", delineation protocols and the "pasture exclusion rule". Consultation occurred on successive "exposure drafts" of proposed amendments to the NPS-FM and NES-F over the subsequent year, closing on 10 July 2022. Final amendments to the NPSFM came into effect in January 2024. MfE also released iterative guidance documents and updates to the delineation tools during this time, including the wetland hydrology tool and pasture exclusion methodology. In my view, our overall process was appropriate and in accordance with the NPSFM delineation requirements.

Wetland delineation methodology

65 Mr Warden's opinion (P6 para 4 & P7 para 2) is that Boffa Miskell's assessment "*is not robust and diverges from best practice"* and that "*accurate delineation requires detailed field investigations (to examine the vegetation, soil and hydrological conditions) while analysis of geospatial data should only be used as supplementary tools."* Further on in his review (P8 para 1), Mr Warden states that Boffa Miskell did not ground-truth large areas of the site (~36 ha).

66 As I explained in my methodology section, we applied the four national wetland delineation protocols to identify and delineate wetlands, our visits covered the entirety of Site 1 (i.e., all of the site was covered by on-site assessment) and the edge of all delineated wetland features were walked and visually assessed.

67 The majority of wetland features were clearly wetland and were assessed using the Rapid Test as outlined in the wetland delineation protocols (MFE2022a, MFE2022b), i.e., vegetation plots were not needed. As recommended in step 7ii of the wetland delineation protocols (MFE 2022a), representative plots were undertaken along

transects in several locations and further plots were undertaken in areas of uncertainty both in and outside of wetland features. A total of 72 vegetation plots were assessed over a 16-month period.

68 In my opinion, our assessment followed the national protocols (i.e., "best practice") and incorporated sufficient field assessment to accurately delineate the wetland features.

Aerial imagery

69 Mr Warden appears to query (P7 paras 3-5) Boffa Miskell's lack of reference to drone imagery from September 2022 and Google aerial imagery from 24th March 2023, despite reference to it in Appendix 2 of the Ecological Effects Assessment accompanying the application. Instead, he states, that Boffa Miskell relied on the most recent site visits to confirm wetland extents, which on Site 1A were undertaken on the 7th and 8th of March 2023 and on Site 1B was undertaken on 22nd March 2023, noting that Mr Warden has transposed these dates in his report.

70 Specifically, Mr Warden has raised concerns that our mapped wetland extent in Site 1A and 1B does not match the "*more extensive wetland area*" in the September 2022 drone image or March 2023 Google Earth Image. I note to some extent this contradicts his previous section where he states "*accurate delineation requires field investigations*".

71 However, I agree with Mr Warden, that our mapped wetland extent does not reflect the wet/saturated areas or water pooling visible in the drone and google earth imagery. Instead, we mapped the wetland features present on site at the time of our site visits based on applying the national protocols in the field and walking features on site. This field data was used in conjunction with imagery to produce a final wetland map.

72 Mr Warden (P7 para 3) states that Boffa Miskell used the "*outdated*" national LINZ aerial imagery dataset (2014-2016) for the basemap for Figures 12 and 13 in the Ecological Effects Assessment. To clarify, this dataset is used as a basemap for the majority of the maps Boffa Miskell produces, as this national LINZ dataset contains the highest resolution imagery available for all areas of New Zealand in a seamless layer. However, the high-resolution drone imagery (September 2022) was used in the mapping of wetland features in Site 1, particularly in Site 1A and 1B, as field data could be used to validate whether "wet areas" shown on the imagery were wetland. In other words, this imagery was considered but was ground-truthed to determine the correct wetland extent.

73 I also note that the examples (Figures 3, 4 and 5) that Mr Warden has given in his report are all located in Site 1C, which is an area that was delineated based on earlier site visits (November 2021 and June 2022) under normal conditions.

Difference in extent

74 Mr Warden on P7 para 4 states that he is of the opinion that the natural inland wetland extent on site (presumably only Site 1) is 29 – 30 ha, approximately 10-11 ha more than what Boffa Miskell delineated. Mr Warden states that this was based on a *"combination of site visit observations, GPS data (applying the rapid test) and analysis of current and historic aerial imagery".*

75 Mr Warden (P9 para 1) appropriately notes that his role was to undertake a peer review of Boffa Miskell's assessment, not undertake his own wetland re-assessment. However, the limited assessment that Mr Warden has undertaken has been useful to highlight the changes in wetland extent that have resulted from the extreme climatic and hydrological conditions in 2022-2023.

76 Based on the data provided by Mr Warden on request, he has undertaken one vegetation plot and soil core in Site 1C on 5 October 2023 and as noted above his examples are all also in Site 1C.

77 Data from this one plot point highlights the complexity of delineating wetlands on this Site, due to the dynamic nature of the wetland features present, and the difficulty distinguishing between marginal wetland and non-wetland areas, as many wet-tolerant species present on the Site can also tolerate prolonged dry conditions.

78 Facultative wetland (FACW) species dominated the sample point at the time of Mr Warden's site visit (5 October 2023) and therefore passed the Rapid Test, DT and PI.

79 I note the location of the plot does not appear to be wet. In the photographs provided by Mr Warden from 5 October 2023 the soil looks dry and crumbly, with a substantial amount of sand (**Appendix 8**). In my experience of the wetland features on the Site, if this was a RMA wetland (i.e., a permanently or intermittently wet area*)* and an area *"saturated at or near the surface for at least 14 consecutive days during the growing season in most years (50% probability of recurrence)",* I would expect there to be surface water or water to the surface, given there was 54 mm of rain in the 14 days prior to their visit.

80 Boffa Miskell sampled the same location as Mr Warden's plot in Site 1C on 4 July 2024 in (**Appendix 8**). The vegetation plot was dominated by rye grass, a facultative upland pasture species. The plot failed the Rapid Test, DT and PI. There was dry, crumbly highly decomposed peat mixed with mineral soil to a depth of 18 cm, then dry sand and no wetland hydrology (no surface water was present and no groundwater was reached in a hole dug to a depth of 55 cm). Therefore, this area is not a wetland.

81 I suspect that the prevalence of a FACW species in the plot in October 2023 without the presence of wetland hydrology is an after-

effect from the extreme rainfall events and prolonged highly elevated groundwater table in 2022-2023.

82 Prolonged high groundwater levels can have long-lasting effects on vegetation composition. Most wet-tolerant species are also tolerant of normal (and dry) conditions, while non-wet tolerant species cannot withstand prolonged inundation and get drowned off. Wet-tolerant species proliferate and persist until non wet-tolerant species re-establish and spread, which can take a long time if the vegetation cover of wet-tolerant species is continuous, as is the case with fast-growing exotic wet tolerant species that dominate this Site. In addition, unusually wet conditions can limit farming practices in areas which would, during normal conditions, be cultivated, maintained and used for pastoral grazing, as is the case for a large portion of Site 1.

83 While Mr Warden states that he has used a combination of "*site visit observations, GPS data (applying the rapid test) and analysis of current and historic aerial imagery"* to review Boffa Miskell's wetland delineation, when his mapped wetland extent (October 2023) is compared to available imagery it aligns exactly with the wet/saturated areas in March 2023 Google Earth imagery.

84 The wetland and/or water pooling extent in the March 2023 satellite imagery is the greatest extent captured in the last 22 years of Google Earth imagery (since 2001). The farm race in the south of Site 1C is inundated with water in only two of the 20 Google Earth images available[9]. About 22 m of the farm race was inundated on 28 August 2020, compared to 55 m on 24 March 2023 (**Appendix 9**). About 27 metres of the farm race was inundated in the 6 September 2022 drone imagery. These three dates all coincide with extreme rainfall events in the preceding months prior to imagery capture.

85 The wetland hydrology tool (MfE 2021) provides a caution when using inundated areas on aerial imagery: "*Not all areas with flooding or ponding are wetlands but may have surface water after heavy rainfall events*". The US Army Corp of Engineers manual (2010)[10] and 650.1903 supplemental data for remote sensing (USDA 1997)[11], from which the New Zealand hydrology tool indicators were developed from, states when using aerial imagery:

[9] Dates of Google Earth imagery capture: 22/5/2001, 1/8/2002, 21/2/2010, 2/11/2010, 9/12/2012, 6/3/2013, 5/4/2013, 27/3/2014, 22/10/2016, 31/12/2015, 8/1/2018, 3/4/2018, 24/5/2018, 8/12/2018, 6/12/2019, 1/1/2020, 28/8/2020, 29/6/2021, 24/5/2022, 24/3/2023.

[10] U.S. Army Corps of Engineers. (2010). Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Version 2.0). Vicksburg: U.S. Army Corps of Engineers.

[11] USDA Natural Resources Conservation Service. 1997. Hydrology tools for wetland determination. Chapter 19 in *Engineering Field Handbook*. Fort Worth, TX: U.S.

85.1 five or more years of growing season photography should be used;

85.2 "*only photos taken in normal rainfall years, or an equal number of wetter-than-normal and drier-than-normal years are used*";

85.3 if wetness signatures are observed on photos in more than half of the years, then wetland hydrology is present;

85.4 saturation and/or inundation has to be observed for a specified duration and frequency to confirm wetland hydrology and an aerial photograph only represents conditions on the day of image capture; and

85.5 an aerial photograph alone does not provide sufficient information to establish wetland hydrology.

86 I note that the presence of wetland hydrology (i.e., surface flooding or saturated soil) alone is not sufficient to meet the RMA definition of a wetland. Boffa Miskell's assessment sampled 13 vegetation plots within the areas that Mr Warden mapped as wetland, which we had not mapped as wetland because these plots failed the DT and PI. These plots were typically dominated by kikuyu, rye grass and/or *paspalum dilatatum*, all facultative upland pasture species. I note that some of these plots were undertaken in March 2023 (within the period of elevated groundwater levels and after extreme rainfall events).

87 In summary, I consider that the observations that Mr Warden relies on to determine wetland extent are the result of a very wet growing season, as experienced in the 2023/2024 summer, which has persisted well into the next growing season.

Additional fieldwork

88 Based on the feedback from the Mr Warden as part of the Section 92 RFI process (which is repeated in the Ecological Review) Boffa Miskell has sought to clarify the difference in wetland extent on the Site.

89 I visited the site on 28 March 2024, together with Jonny Beech, to assess the hydrology at a drier time of year and visited the Site again with Regional Council ecologists and Mr Warden on 9 May 2024. There was no surface water present in the majority of the wetlands for both of these visits. Hydrophytic vegetation (e.g., *Myriophyllum propinquum*, an obligate wetland species) was noted in non-wetland areas, such as in the tyre tracks in the farm race in the northern side of Site 1B.

Department of Agriculture, NRCS.

90 I also revisited the Site to undertake further wetland assessments (using the same national protocols) on the 19th and 21st of June and Boffa Miskell ecologist Jonny Beech visited the site on 4th of July 2024, proceeding normal climatic and hydrological conditions, although there was 110 mm of rainfall in the week prior to the 19th of June. On these site visits, an additional 46 vegetation plots, hydric soil, hydrology assessments and 24 rapid visual assessments were undertaken.

91 In my opinion, based on all these additional site visits and assessments, the exotic dominated wetlands that are on slightly higher ground rely on rainfall for their wetland hydrology in a year of normal climatic conditions, while the bed of the open water pond habitats on the south-east of the Site is lower and is connected with the groundwater table throughout the year in a normal climatic year. This is supported by **Ms McDavitt's** evidence.

92 I believe that the groundwater levels were high enough in February and March 2023 that all wetland features within the site would have been connected with the groundwater and areas that normally would not be "wet" had surface pooling as a result of the high groundwater table, creating connections between what would be unconnected wetland features on the surface in normal conditions. This is supported by **Ms McDavitt's** evidence.

93 Many of the wetlands mapped on the Site are intermittently wet under normal climatic conditions, meaning they only have wetland hydrology present in wetter months of the year (typically mid-Autumn to spring). The only wetland that still had surface water on 28 March 2024 was the open pond habitat on sites 1B and 1C, that will be avoided and enhanced as part of the Proposal. The area of water in March 2024 was limited to a few small shallow pools, about 2 x 20 m in size (**Appendix 7**).

94 Further, areas of perched surface water (water pooling) observed in areas of shallow peat on the 19th of June, following heavy rainfall in the week prior, were dry when the site was revisited on the 4th of July.

95 The results show that the wetland extents have changed in some places compared to the 18.78 ha of wetlands mapped in the Assessment of Ecological Effects, including both expansions and contractions in extent. This is expected given the dynamic nature of the wetlands on the Site and the extremely wet conditions experienced over 2022 and 2023.

96 Of the 40 plots undertaken in areas that Mr Warden has mapped as wetland that Boffa Miskell had not (**Appendix 10**), 27 locations had no wetland hydrology during Boffa Miskell's June and July 2024 visits and a thin lens (~10-15 cm) of dry, crumbly highly decomposed peat. The groundwater table was at least 40 cm below the ground surface in all of these plots and greater than 60 cm for

the majority. These areas were typically dominated by facultative upland (FACU) pasture species. Photographs showing an example area is provided in (**Appendix 11**). These areas do not meet the RMA definition of a wetland and the NPSFM definition of a natural inland wetland.

97 There were 8 plots that also had no groundwater within 40 cm of the ground surface (most > 60 cm) and a thin lens of decomposed dry peat (< 15 cm) that were dominated by facultative wetland (FACW) species. The wet-tolerant species in these areas were either dead, dying off or unhealthy and non-wet tolerant pasture species (e.g., clover, rye grass, summer grass and kikuyu) were re-establishing (**Appendix 12**). If the dead vegetation is excluded from the calculations for these plots, they no longer pass the DT and/or PI and therefore do not meet the RMA definition of a wetland. As covered above, I suspect the persistence of hydrophytes in these areas is an aftereffect of the abnormal climatic and hydrologic conditions in 2022/2023. In my opinion these areas are likely only occasionally wet in an abnormally wet year(s) and the area will revert to upland pasture species over time under normal conditions.

98 Five plots had a peat lens of 18–23 cm depth and a groundwater level at 43 – 62 cm below the ground surface. Based on the vegetation present during the June and July 2024 visits these areas meet the RMA definition of a wetland. The vegetation in these areas was a mix of FACW, FAC and FACU species, including pasture grasses. Four of these five plots are adjacent to mapped wetland areas and/or the Bercich Drain, and therefore it is likely that they are a result of encroachment of hydrophytic vegetation into higher (normally drier) areas when groundwater levels were higher on site. The last of these five plots was a small area dominated by mercer grass (8 x 10 metres) in a shallow depression in Site 1B. It is uncertain whether this feature would be present in most years but I note it was not observed in March 2023 or earlier site visits while walking the site.

99 An additional 18 locations in areas that Mr Warden had mapped as wetland that Boffa Miskell had not, were assessed using a rapid assessment, as these locations were on elevated dry ground, had no evidence of pugging and were dominated by FACU exotic pasture species, including summer grass, carpet grass and/or kikuyu, therefore, they are not RMA wetlands (**Appendix 13**).

100 I observed that the wetland extent present in June and July 2024 had retracted in several areas on the Site compared to our mapped wetland extent. This was particularly the case for the eastern extent of the largest open water habitat (**Appendix 14**) because this area was mapped based on the delineated edge in March 2023 and the September 2022 drone imagery.

101 Overall, these additional assessments show that the original wetland extents Boffa Miskell mapped are an accurate delineation of the natural inland wetlands on the Site at the time of our site visits and that these extents are representative of the wetland extents under normal climatic and hydrologic conditions, noting that some areas mapped based on the March 2023 site visit have mapped slightly larger extents than would be expected under normal conditions.

Plant identification

102 On P8 Mr Warden questions the accuracy of Boffa Miskell's plant identification, by providing several examples of where he thinks we have mis-identified species. I respond to each of them below.

103 I agree with Mr Warden that *Carex fasicularis* was initially incorrectly identified and this has already been corrected based on Mr Warden's Section 92 RFI. A site visit was undertaken to determine the distribution of *C. fasicularis* across the Site on 16 October 2023. Its distribution is restricted to isolated plants or clumps in amongst exotic vegetation and two larger patches in Site 1A. These two larger wetland features dominated by this At Risk – declining species are significant indigenous wetlands under the Proposed Regional Plan for Northland. I refer to **Dr Flynn's** evidence for more detail.

104 I do not agree that *Persicaria* has been misidentified. The majority of the *Persicaria* present in the exotic wetlands is the exotic waterpepper (*P. hydropiper*) (**Appendix 6**), with the native willow weed (*P. decipiens*) typically only found in areas that are wetter for longer or permanently wet, e.g., drains within the wetland extents, Bercich Drain and the open water habitats. I also note that as both species are annual herbs that die off in winter, their distribution in the Site will change from year to year, particularly in 2023/2024 due to the elevated water levels during the 2023/2024 summer through to March, when both species were flowering.

105 *Myriophyllum propinquum* was observed in localised areas in some of the open water habitats in recent site visits. It was likely undetected in earlier visits due to the increased extent of surface pooling, therefore not visible. In my opinion its distribution within the Site has increased as a result of the 2022/2023 elevated water levels, which is consistent with it being observed in the shallow tyre tracks on the farm race in May 2024, an unusual location for an obligate wetland species.

106 While nahui (*Alternanthera nahui*) was not observed during Boffa Miskell's site visits, there are several areas of exotic alligator weed (*Alternanthera philoxeroides)* present in Site 1. I note that nahui has a national classification of Not Threatened (de Lange et al.

2018)[12] and is often found in urban settings, with plant conservationists referring to it as an "*urban weed*"[13].

107 I note that Mr Warden (P8 para 3) states that he found common wetland grass species, such as creeping bent, mercer grass and sweet grass (all exotic species), throughout the wetland extents on the Site during his visits, which is consistent with our findings.

108 Mercer grass was recorded in many plots and wetlands in Site 1B and 1C, being the dominant wetland grass species within these areas of the site. During earlier site visits creeping bent was mainly located in areas of Site 1C, although I note that we have detected this in more areas of Site 1B in the 2024 visits. *Glyceria declinata* was observed in several locations in Site 1B and 1C in the earlier site visits. I note that as this obligate species typically dominated areas it was found in, these areas passed the Rapid Test and therefore a vegetation plot was not needed. I note this species was recorded in low percentage covers in new areas in Site 1B in June and July 2024, where it was not present in March 2023.

109 Mr Warden criticises the use of Inaturalist by one of Boffa Miskell's staff members. It is common and sensible for ecologists to validate their identification using available technology, particularly a lone ecologist working under covid lockdown conditions. I note that Inaturalist is a tool widely used by ecologists, which is a useful way of increasing knowledge on species distribution. These inaturalist records confirm that the species identification done by this staff member was accurate.

Information on freshwater fauna

110 Mr Warden states on P23 para 4 that the fauna assessments "*are limited in some way*". I note that Boffa Miskell provided an assessment of freshwater fish values, which was based on the findings of a fish survey of the main waterbodies on Site 1 undertaken in August 2020, a review of fish records in the New Zealand freshwater fish database and an assessment of the quality and availability of habitat.

111 All aquatic features on Site 1 are seasonally wet, other than the features that are being retained and enhanced (Bercich Drain and the largest open water habitat). These features only provide aquatic habitat for short periods of time and therefore will be inhabited by invertebrate species adapted to fluxes in available aquatic habitat, i.e., species that will quickly recolonise new aquatic habitats. There

[12] de Lange, P. J., Rolfe, J. R., Barkla, J. W., Courtney, S. P., Champion, P. D., Perrie, L. R., Beadel, S. M., Ford, K. A., Breitwieser, I., Schönberger, I., Hindmarsh-Walls, P. B., Heenan, P. B., & Ladley, K. (2018). *Conservation status of New Zealand indigenous vascular plants, 2017* (New Zealand Threat Classification Series No. 22). Department of Conservation.

[13] https://www.nzpcn.org.nz/flora/species/alternanthera-nahui/

is no standard protocol for sampling invertebrate communities in still intermittent features and no clear baseline. I note that no 'permanent or intermittent streams' will be reclaimed as part of the proposed works.

112 As covered in section 8.3 of the Ecological Effects Assessment, effects associated with earthworks in wetlands, rivers and drains, will be managed through the development of a Native Fish Capture and Relocation Plan.

ISSUES RAISED BY SUBMITTERS

113 Most of the ecology-related matters raised by submitters have been addressed in my evidence above, in particular in my response to the Section 42A Report section. In the following paragraphs I address a specific matter raised by Mangawhai Ecology.

114 Mangawhai Ecology raised specific concerns with the fish survey undertaken by Wildlands Consultants in August 2020 and state that eDNA sampling has not been undertaken.

115 I note that methods are well developed for monitoring mudfish (Ling et al., 2013[14]) and these were followed for the survey undertaken in August 2020. I consider 50 Gee minnow traps over three consecutive nights (i.e., a total of 150 traps nights) in documented locations within the drains and wetlands on Site 1 is sufficient sampling effort to detect mudfish. The effectiveness of eDNA sampling for detecting mudfish, especially in wetland habitats with no water flow is uncertain, and at this stage is still being trialled alongside standard trapping methods to determine its effectiveness.

116 Other than the habitats being retained, which were surveyed in 2020, it is highly unlikely that other aquatic features on the Site are providing suitable mudfish habitat due to their seasonal drying. While I agree that mudfish are adapted to survive in aquatic features that periodically lack surface water, this is restricted to habitats that have microclimates and/or deeper peat which is more likely to retain soil moisture and allows mudfish to burrow into moist areas (O'Brien & Dunn 2007)[15]. The peat in the aquatic habitats (other than those being retained) on site is shallow and underlain by free-draining sand and lacked soil moisture in March 2024.

19 July 2024

Tanya Louise Cook

[14] Ling, N.; O'Brien, L.K.; Miller, R. & Lake, M. (2013) A revised methodology to survey and monitor New Zealand mudfish. Department of Conservation, Wellington (unpublished).

[15] O'Brien, L. K. & Dunn, N. R. (2007) Mudfish (Neochanna Glaxaiidae) literature review. Science for Conservation 277. Published by Department of Conservation: Wellington.

APPENDIX 1: Aerial imagery of Marsden Point area, collected on 28 May 1942. Approximate Site 1 boundary shown in red. Source: Retrolens.nz.

APPENDIX 2: Rainfall information for Ruakaka area relevant to site visit dates.

Figure 2: Rainfall (mm) at Whangarei Airport in July 2023 – June 2024 and July 2022 – June 2023 compared to the historical average for data from 1991 to 2020. Source: https://www.metservice.com/towns-cities/locations/whangarei/past-weather.

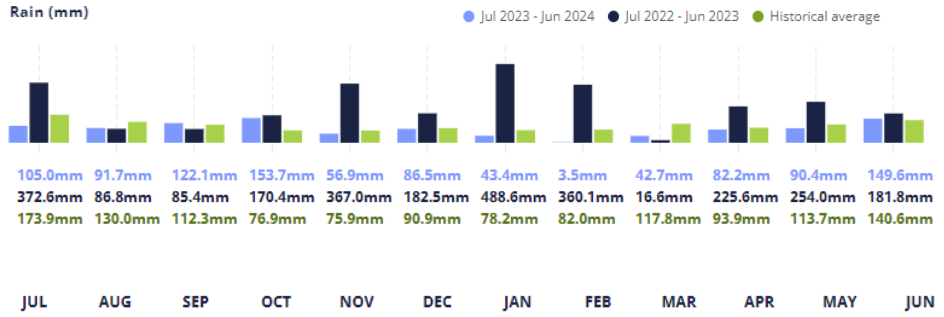
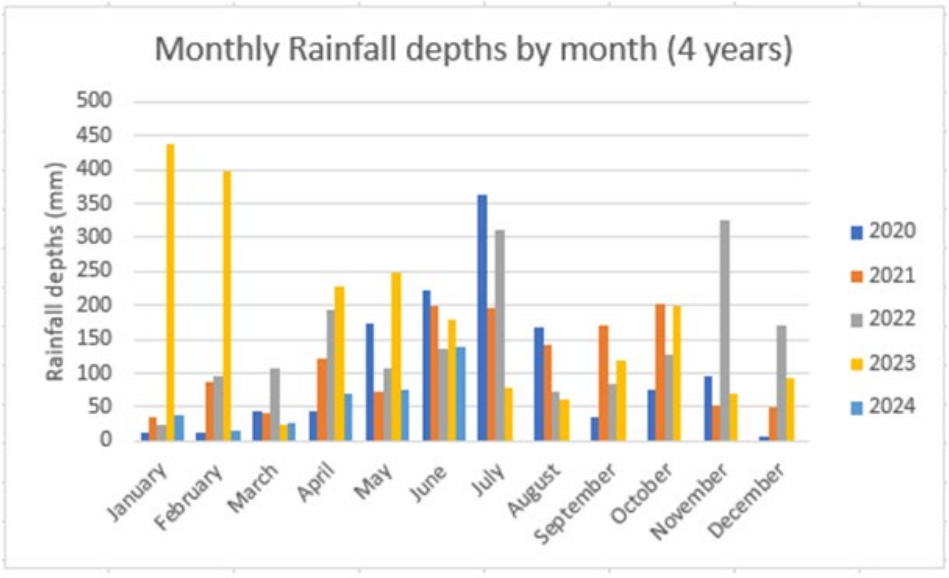


Table 1: Percentage of monthly average rainfall for the month based on records from December 2015 to June 2024 collected at NRC rainfall station at Marsden Point. Cells highlighted in yellow are 150% or above monthly average and cells highlighted in pink are 50% or below monthly average.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
2016	153	80	84	89	66	74	73	144	149	81	77	22	97
2017	19	84	335	220	63	116	71	149	88	37	76	12	112
2018	93	190	133	89	92	162	60	52	125	39	87	193	114
2019	1	20	20	57	24	53	65	76	103	124	38	79	59
2020	14	6	62	21	163	97	139	150	24	30	116	7	78
2021	27	76	38	83	78	97	112	100	136	258	72	98	105
2022	58	104	142	128	127	101	222	80	68	114	284	190	141
2023	494	317	37	161	195	103	58	48	107	118	50	200	160
2024	41	23	47	52	92	98							34
Annual average (mm)	99	113	81	128	103	169	163	106	117	101	95	70	1273

Figure 3: Monthly rainfall at Whangarei Airport for January 2020 to June 2024. Graph supplied by Justin Kirkman (Beca).



APPENDIX 3: Additional relevant information from the Wetland Delineation Protocols (MFE 2022a) used when applying the vegetation tool.

Clarkson et al. (2021) assigns species into one of five categories based on their likelihood of being present in a wetland. The five categories are:

- Obligate (OBL): occurs almost always in wetlands (estimated probability >99 per cent in wetlands)
- Facultative wetland (FACW): occurs usually in wetlands (67–99 per cent)
- Facultative (FAC): equally likely to occur in wetlands or non-wetlands (34–66 per cent)
- Facultative upland (FACU): occurs occasionally in wetlands (1–33 per cent)
- Upland (UPL): rarely occurs in wetlands (<1 per cent), almost always in 'uplands' (non-wetlands)

For the Dominance Test (DT): If >50% of the dominant species are OBL, FACW or FAC using the 50/20 rule, the area passes the Dominance Test

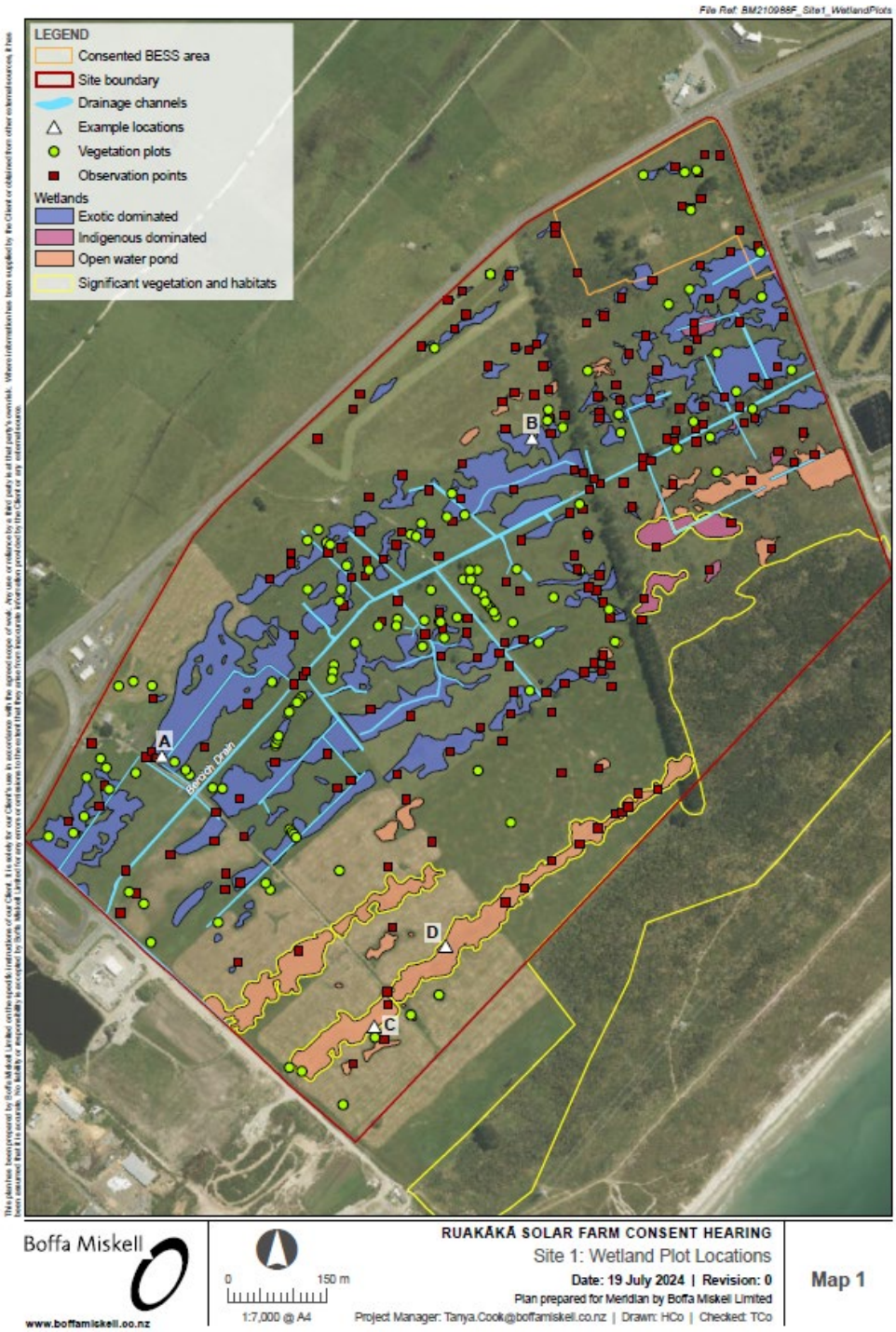
For the Prevalence Index (PI): a plot-based algorithm calculated from the species composition and cover abundance of plants. If the PI ≤ 3.0, the area passes the Prevalence index, but values around 3.0 should be used alongside hydrology and hydric soil indicators.

Dominant species are "*The most abundant plant species (when ranked in descending order of abundance, eg, in a plot, and cumulatively totalled) that immediately exceed 50 per cent of the total cover for the stratum, plus any additional species comprising 20 per cent or more of the total cover for the stratum. This is known as the 50/20 rule, and is calculated for each stratum (tree, sapling/shrub and herb).*"

APPENDIX 4: Key characteristics used when applying the Rapid Wetland Test and Rapid Pasture Test (from the Pasture exclusion assessment methodology, MFE 2022b)

Clearly wetland or clearly not pasture	Uncertain	Clearly dry pasture
• Dominated by OBL or FACW species. • Not grazing land– no or small amounts of palatable exotic pasture species. • Visible signs of high water table (wet in summer). • Topographic signs– low-lying / depression, but could be on a slope (seepage). **» Natural inland wetland**	• Some OBL or FACW species present. FAC species often dominant. • Signs of wetland hydrology– pugging, damp, but may be dry in summer. • Some palatable exotic pasture species present. **» POTENTIAL WETLAND in pasture**	• Grazing land. • No / minor amounts of OBL or FACW species. • No evidence of wetland hydrology– dry year-round, not pugged, typically on high ground. • Dominant species are exotic pasture species. **» Not a natural inland wetland**

APPENDIX 5: Natural Inland Wetlands mapped in Site 1 (from Assessment of Ecological effects report, Boffa Miskell 2023) and updated to include location of data collected during recent site visits (March, June and July 2024). Map shows locations of examples provided in Appendices 6 & 7.



APPENDIX 6: Photos showing examples of degraded exotic wetlands in Sites 1B and 1C.

Wetlands in Site 1C in June 2022; feature dominated by exotic soft rush, mercer grass and creeping buttercup, showing cattle grazing and drainage channel through the middle (top photo) and adjacent area showing heavy pugging from stock (bottom photo). Example A in Map 1 (Appendix 5).

Wetlands in Site 1B in March 2023; feature dominated by exotic water pepper (*Persicaria hydropiper*) (top photo) and nearby area of mercer grass showing saturated peat soil (bottom photo). Example B in Map 1 (Appendix 5).

APPENDIX 7: Open pond wetlands on Site 1B and 1C that will be avoided and enhanced as part of the Project.

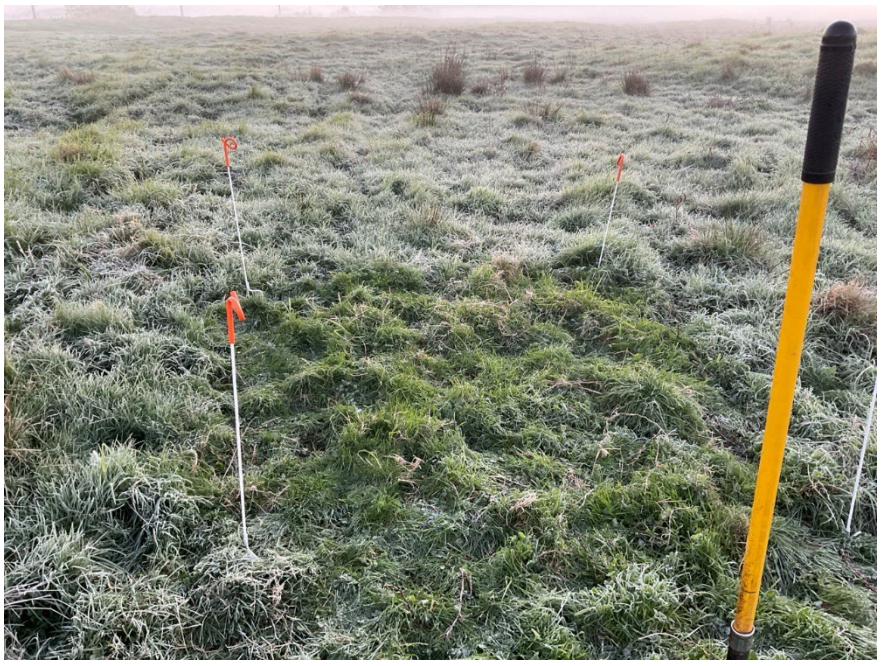
Open pond habitats in June 2022. Example C in Map 1 (Appendix 5).

Pair of weweia (NZ dabchick) showing signs of breeding behaviour during bird surveys in September 2023 on the open pond habitat that is being avoided and enhanced (Near Example location D in Map 1):

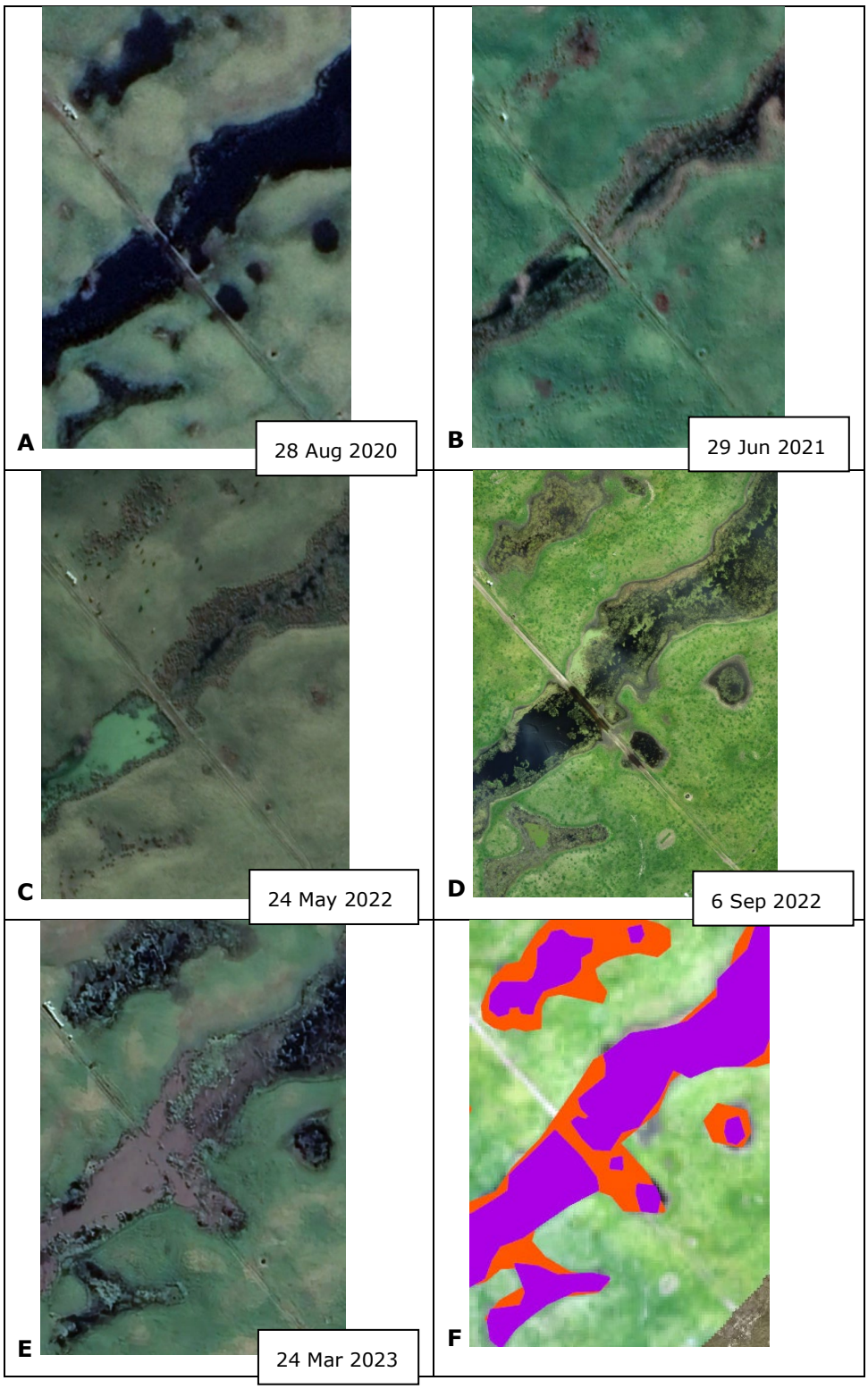
Example D in Map 1 (Appendix 5). Near location of above photo in March 2024 showing low water table:

APPENDIX 8: Soil test pit dug by Mr Warden on 5 October 2023 in the location of his one vegetation plot, showing no surface water and dry crumbly soil (top photo). Topsoil layer of soil core dug on 4 July by Jonny Beech showing mineral soil content and presence of earthworms (bottom photo). Example 1 on Map 2 (Appendix 10).

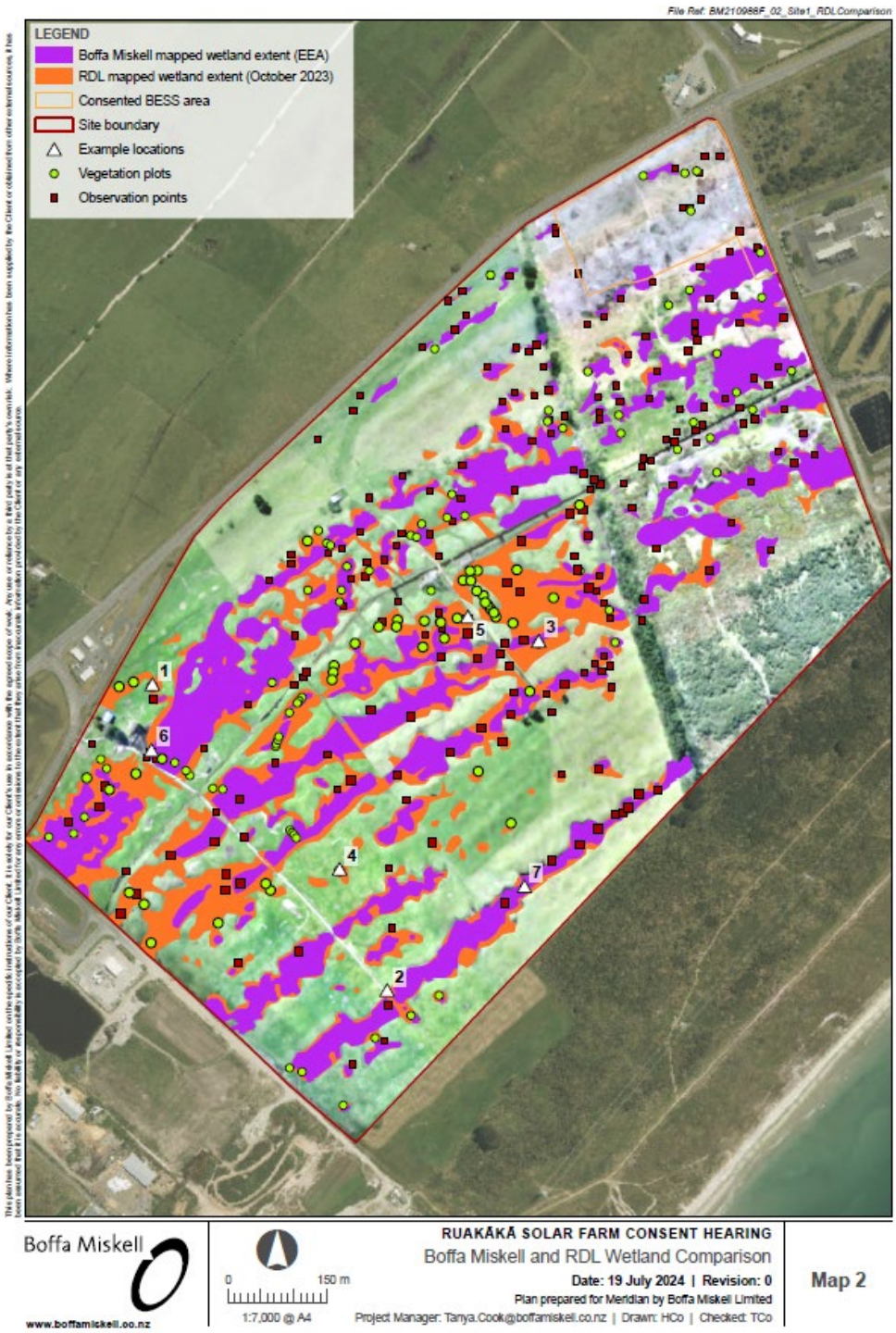
Soil core dug by Jonny beech on 4 July, showing dry crumbly peat mixed with mineral soil to a depth of 18 cm. (top photo). No groundwater waws reached to the depth that the hole was dug (55 cm). Vegetation plot dominated by rye grass, with kikuyu, creeping bent, clover, broadleaved dock and water pepper also present (bottom photo). Example 1 on Map 2 (Appendix 10).



APPENDIX 9: Wetlands in Site 1C showing variation in wetland extent and water-pooling between August 2020 and March 2023 (A-E). RDL mapped wetland extent in red, including farm race, and Boffa Miskell wetland extent in purple delineated by walking the edge of features in June 2022 (F). Heavy rainfall occurred or elevated groundwater levels were present for the capture date of images A, D and E. Example 2 on Map 2 (Appendix 10).



APPENDIX 10: Map showing location of rapid assessments, vegetation plots, soil and hydrology assessments undertaken by Boffa Miskell between November 2021 and July 2024 overlaid over the Boffa Miskell (purple) and RDL (red) mapped wetland extents. Map shows location of examples provided in Appendices 8, 9 and 11 – 14.



APPENDIX 11: Example of difference in wetland extent between Boffa Miskell and Mr Warden located in Site 1B. Purple line is the Boffa Miskell wetland extent mapped by walking the edge of the wetland in September 2021 on a photo taken at this time. The red line shows approximate edge of the wetland extent mapped by RDL, about 17 m away to the south at an elevation (RL) of 4 msl. Photographs for vegetation and soil plot are provided on the next page. Example 3 in Map 2 (Appendix 10).

The vegetation plot was sampled on the 4 July 2024. The plot was dominated by carpet grass, a FACU species and had a PI score of 4 (top photo). This plot failed the rapid test, DT and PI. There was a thin layer (14 cm) of dry crumbly peat, underlain by dry sand (bottom photo). Groundwater was reached at a depth of 59 cm. Example 3 in Map 2 (Appendix 10).

APPENDIX 12: Example of difference in wetland extent between Boffa Miskell and Mr Warden. All mercer grass in this plot was dead and pasture species were re-establishing (top photo). Waterpepper had died off (normal for an annual herb). If the mercer grass is excluded from the plot data this area fails the rapid test and DT and has a PI of 2.95. The soil was 13 cm of dry crumbly peat overlaying sand to > 70 cm depth (bottom photo). No groundwater was reached at 70 cm. In my opinion, while hydrophytic vegetation persisted in this area for about a year after the elevated groundwater levels, this location is no longer a wetland. This wetland mapped by RDL was at an elevation (RL) of ~4.5 - 5 msl. Example 4 in Map 2 (Appendix 10).

APPENDIX 13: Example of area of dry pasture mapped as wetland by RDL that was assessed as pasture (clearly non-wetland) using the rapid test by Boffa Miskell on 21 June 2024 and earlier site visits. Photo below shows pasture area in Site 1B in June 2024, dominated by kikuyu and carpet grass (both FACU species) in foreground and background of photo which was mapped as wetland by RDL. Dark red-brown areas in background are the dead stems of exotic waterpepper in wetland features mapped by Boffa Miskell. The entire area inside the red box was mapped as wetland by RDL. Example 5 in Map 2 (Appendix 10).

An area of elevated dry pasture dominated by kikuyu in June 2024 mapped as wetland by RDL (top photo). The red dashed line on bottom photo shows the approximate edge of the wetland area mapped by RDL, including half of the cattle holding area, and the purple line is the approximate edge of the wetland mapped by Boffa Miskell based on the June 2022 site visit. Bottom photo is September 2022 drone imagery. Example 6 in Map 2 (Appendix 10).

APPENDIX 14: Contraction of wetland extent in largest open pond in site 1B as a result of lower groundwater table. Top photo shows areas reverted to pasture in June 2024 compared to inundated with water in March 2023 (bottom photo). The extent for this feature was mapped by Boffa Miskell based on the site visit in March 2023 and September 2022 drone imagery, resulting in a larger than "normal" extent. Example 7 in Map 2 (Appendix 10).

Photo below is approximately the same area in November 2021. Example 7 in Map 2 (Appendix 10).