11 March 2024

Attention: Alister Hartstone

ref. 16782.blh

Email: alister@setconsulting.co.nz

Dear Alister

RE: MERIDIAN ENERGY LIMITED – SUPPLEMENTARY INFORMATION UNDER s92 RMA

Please see below and attached supplementary information provided in response to the s92 request for additional information dated 3 October 2023. It covers the following matters:

- Functional and operational need in the context of Regulation 45 of the NESFM.
- Further ecological and hydrological information relating to wetland extent.
- Boffa Miskell memo summarising recent bat, bird, and lizard surveys.

Functional and operational need

<u>Relevance and legal context</u>

In addition to resource consents required under the Whangarei District Plan and the Proposed Regional Plan, consent is also required under Regulation 45 of the NESFW.

Regulation 45(6) requires *inter alia* that the consent authority be satisfied that there is a functional need for the specified infrastructure in the chosen location. Functional need is defined in the NPSFW as:

functional need *means the need for a proposal or activity to traverse, locate or operate in a particular environment because the activity can only occur in that environment.*

The definition of functional need has been traversed in the High Court[1] and the Court of Appeal.[2] Both of these cases were provided in RFI Response No. 1.

Poutama Kaitiaki Charitable Trust and D & T Pascoe v Taranaki Regional Council (commonly referred to as “Mt Messenger”) concerned a new 6km section of State Highway north of New Plymouth. One of the key issues was whether Waka Kotahi could prove there was a ‘functional need’ for a state highway (bypass) to be built through an area containing multiple wetlands.

[1] *Poutama Kaitiaki Charitable Trust and D & T Pascoe v Taranaki Regional Council* [2022] NZHC 629 [30 March 2022].

[2] *Te Rūnanga o Ngāti Awa v Bay of Plenty Regional Council* [2022] NZCA 598.

The High Court acknowledged that the strict language of "can only occur" within the "functional need" definition employs a high threshold.[3] With that in mind, the Court then sought to broaden the application of "functional need" in this particular factual situation. The Court held that:

- The presence of alternative routes for a proposal is not in itself a sufficient argument to indicate a lack of "functional need", because with linear infrastructure, alternatives will always exist and their existence could not have been intended to make the specified infrastructure exception otiose.[4]

- The "location" in which the activity occurs does not mean the specific wetland in question, but the broader environment (as defined in s 2 of the Resource Management Act 1991) that is subject to the activity (in this case, a valley environment).[5]

The Court concluded that the Environment Court was correct in its finding that there was a functional need for the state highway to go through the valley due to the nature of the linear infrastructure, the distance of the project, the particular environment, and the fact that the alternatives were constrained by cost, distance, terrain and constructability issues.[6] This wider interpretation of 'functional need' was pragmatic and allowed the functional need exception in the regulations to operate effectively.

Te Rūnanga o Ngāti Awa v Bay of Plenty Regional Council concerned consents to take and bottle groundwater from an aquifer near Otakiri. In paragraph 152 of the decision the Court stated:

[152] The activity in this case relies both on the productive capacity of the land and has a functional need for a rural location because that is where the water is found. The Environment Court had found, on the evidence before it, that the requirement of "functional need" was established. This was essentially a determination of fact. We do not see the District Plan as requiring that the particular rural location be the only place where the resource is found, and there is no need in our view for that to be addressed or established for the purposes of Creswell's application.

While not specifically in relation to the NPSFM/NESFM, this was another example of the Courts (the CoA in this case) determining that "functional need" can be established, notwithstanding there may be other locations that can also accommodate the proposed activity.

<u>Functional need</u>

The functional need for the solar farm to be constructed in this location is broadly set out in Section 1.2.3 of the AEE. More detailed information is provided in the attached MEL memo **attached.**

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[3] At [48]
[4] At [57]
[5] At [52-55]
[6] At [57-58]

It should be noted that a consideration of functional need is not a consideration of whether the effects of an activity can be avoided. That is more appropriately a matter to be considered under the effects management hierarchy,[7] including specific consideration of practicability.

Wetland extent

Boffa Miskell has provided additional information confirming that the wetland extent identified in their report included in the AEE were determined in accordance with the wetland delineation protocol (see memo **attached**). This is supported by hydrological information received from Beca (also **attached**).

Supplementary Bat, bird, and lizard surveys

The Boffa Miskell memo (**attached**) includes a discussion on the results of recent bat, bird, and lizard surveys, with the associated reports included as appendices. Key takeaways from each of the reports are as follows:

<u>Bat survey</u>

(1) No bat passes were detected. As no bats were recorded, if bats are using the Sites, it is likely to be in very low numbers.

(2) Notwithstanding that no bat passes were detected, a precautionary approach of implementing the bat roost protocols prior to felling is recommended in order to minimise the risk of bat injury or death during tree felling.

<u>Bird survey</u>

(1) One male Australasian bittern was seen and heard booming on the northern stormwater pond between Sites 2 and 3 (which is outside of the proposed development footprint).
(2) No bittern booming or other evidence of breeding activity was detected or observed within the sites.

<u>Lizard survey</u>

(1) Prior surveys in 2022/23 did not detect any indigenous lizards.
(2) An additional night of spotlighting was undertaken on the edge of the kanuka in Site 1A in February 2024. One elegant gecko (*Naultinus elegans*), which has a threat status of At Risk – Declining, was found on a kanuka tree surrounded by gorse on the coastal side of the kanuka

[7] NPSFM, 2020 Section 3.21(a)

shrubland. This observation was outside of the site boundary and is a substantial distance from the proposed development footprint (the kanuka shrubland is being avoided).

(3) Notwithstanding that no indigenous lizards have been detected on the site, a lizard Management Plan has been lodged with Department of Conservation with the application for a Wildlife Permit Authorisation on a precautionary basis.

Yours faithfully

Brett Hood
Director

Encl. MEL memo (functional need), Boffa Miskell memo (wetland extent, and bat, bird, and lizard surveys), Beca memo (hydrology)

Memo on Ruakākā Solar - Functional Need

11/03/2024

The purpose of this memo is to provide the Northland Regional Council (NRC) with supplementary information related to the functional need of locating the Ruakakā Energy Park at Site 1.

Background:

A description of the functional need was provided in the AEE. By way of background this included that the location of the Ruakaka Solar Farm was selected because:

(1) It provided a high quality solar resource;
(2) The existing proximity to Battery Energy Storage System currently being built;
(3) The location to the National Grid and the Bream Bay Substation;
(4) The ability to achieve a low impact/low disturbance design;
(5) It supported the New Zealand government's strategy of:
- 100% renewable electricity generation by 2030; and
- A net zero carbon future by 2050.

Further Information on Functional Need:

Meridian understands that NRC has requested further clarification of why it is seeking to construct a solar farm in Ruakākā, and in particular on Site 1, and why it has proposed to create an offset wetland on Site 3 (rather than retaining additional wetland on Site 1 and expanding the solar farm on Site 3).

(a) Generation assets positioned close to a substation reduce transmission losses and improve the reliability and resilience of the grid. Northland experiences higher than average wholesale electricity prices which is largely due to a lack of generation in the area. Accordingly, there is a need for generation assets in Northland in locations where there is infrastructure to support them.

(b) Site 1 was chosen as the location for the Ruakākā Energy Park (which includes the currently under construction BESS and proposed solar farm) due to the immediate proximity of the Bream Bay substation and the presence of a 33kV bus which enables reduced grid connection costs, decreased connection timeframes, and improves the economic viability of the project.

(c) Site 1 is zoned Heavy Industrial under the District Plan. Solar farms are a permitted activity in this zone.

(d) Elements of infrastructure are shared between the BESS and proposed solar farm (i.e. grid connection, operation and maintenance building, and switching station board). Accordingly, the presence of the BESS makes this a one off in New Zealand in terms of suitability and compatibility with the BESS infrastructure.

(e) If Meridian were to build a solar farm and connect to the grid in a different location in Northland, it is likely that a high voltage transmission line, substation upgrade, and/or new substation would be required. Any of these additions would likely render the project unviable. The proposed site and solar proposal are unique in not requiring this.

(f) The proposed solar project is designed to support the BESS. To that end, it cannot be built anywhere else. That is, this project is reliant on adjacent infrastructure and is co-dependent. Therefore, there is a clear functional need for the project to be in this location.

(g) In general, there are a range of constraints that make finding suitable solar sites in New Zealand challenging, these include: geotechnical, access to the grid, available capacity in the grid, suitable terrain/topography, as well as other constraints such as highly productive land, visual impact, land use and zoning restrictions. Thus, the heavy industrial zoning of Site 1, the supporting policy framework, and the existing supporting infrastructure makes it an optimal site from operational and functional perspectives.

Site 3 Wetland

Site 3 was chosen for a wetland offset for the following reasons:

(a) The Southern part of Site 3 was historically a wetland and Patuharakeke strongly supports locating a wetland offset at this location as it will provide co-benefits by way of filtration functions for both the K drain and the drains coming from the Ruakākā town centre before flowing into the Ruakākā river and the Moana and otherwise satisfies s6, 7 and 8 matters of the RMA.

(b) The Southern part of Site 3 experiences regular flooding and would require the lowest elements of solar panels to be raised to heights over 2m (see Figure 1). This would result in additional visual impacts for the community. It would also increase wind loading thus requiring longer and more extensive piling.

(c) The presence of a thick layer of peat at this location means that longer and a higher density of piles would be required thus rendering solar in this area practically, and commercially, infeasible.

(d) The re-instatement of wetlands on Site 3 means overall there will be no loss of wetland extent or values due to the project as required by the National Policy Statement for Freshwater Management, and in particular the proposed use of site 3 would deliver net benefit in ecological structure and function relative to the status quo.

(e) The consolidation of Site 3 with wetlands will remove stock from the site thereby improving ecological values.

(f) The 33kV transmission line that Meridian is proposing to build between Site 3 and Site 1 has been designed to match the proposed site capacity. Thus, if additional solar was to be located on site 3, Meridian would not be able to get this electricity back to the substation without upgrading the current transmission design. Upgrading the additional transmission line would result in additional impacts and may not be technically feasible.

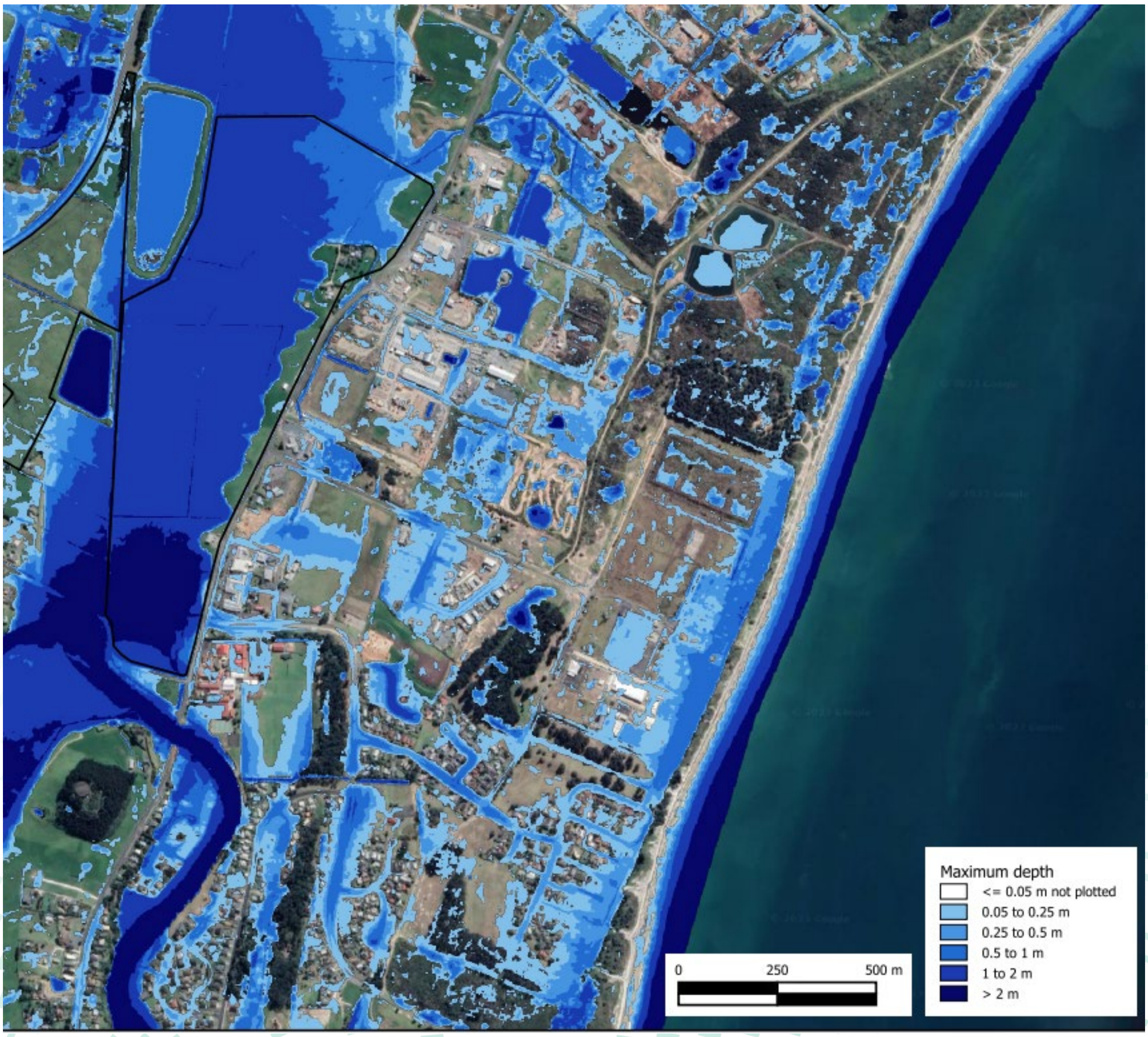

Figure 1: Flood maps for Site 3. 1:250 year flood event at RPC4.5.

Boffa Miskell

Memorandum

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Attention:	Andrew Guerin, Micah Sherman
Company:	Meridian Energy Limited
Date:	8 March 2024
From:	Tanya Cook, Dr Sarah Flynn
Message Ref:	Ruakākā Solar Park ecology update
Project No:	BM210988A

Meridian Energy Limited (MEL) are proposing to construct and operate a 170 ha solar energy park across three sites between Ruakākā township and Marsden Point and lodged a Resource Consent application for the proposed development in September 2023. Boffa Miskell Limited (BML) prepared the Assessment of Ecological Effects (AEcE) to support the resource consent application (Boffa Miskell Limited 2023). Based on the findings and recommendations in the AEcE, further ecological surveys have been undertaken since September 2023, including a spring cryptic wetland bird survey, bat survey and lizard survey.

This memo summarises the key findings of these ecological surveys and provides an update on further ecological work underway.

Bats

An acoustic bat activity survey and roost tree and habitat assessments were undertaken in January 2024. 22 recorders were deployed across the Sites for 20 nights, targeting features preferred by long-tailed bats for roosting, foraging and commuting. All recordings for all survey nights were analysed and no bat passes were detected. As no bats were recorded, if bats are using the Sites, it is likely to be in very low numbers.

High quality bat roosting, foraging and commuting habitat was found across the three Sites, especially in Sites 1 and 2. Given the habitat suitability on the Sites and that further suitable habitat is within commuting distance, a precautionary approach of implementing the bat roost protocols prior to felling is recommended in order to minimise the risk of bat injury or death during tree felling. A copy of the bat survey findings is provided in Appendix A.

Birds

Avifauna surveys were undertaken in Spring 2023, focusing on cryptic wetland species, including the use of acoustic recording devices, dawn and dusk playbacks surveys, five minute bird counts and 20 minute point counts. These spring surveys confirm that the three Sites provide suitable habitat and are used by a range of Threatened and At Risk bird species. A further 11 native bird species were detected within the Sites that had not been recorded previously, 8 of which are Threatened and At Risk species. While one male Australasian bittern was seen and heard booming on the northern stormwater pond between Sites 2 and 3 (which is outside of the proposed development footprint), no bittern booming or other evidence of breeding activity was detected or observed within the Sites. A copy of this report is provided in Appendix B.

The findings of the spring surveys do not change our assessment of the ecological avifauna value of the Sites, as they were already assessed as High to Very High, due to the habitat availability and presence/ use by Threatened and At Risk bird species. The findings also do not change the proposed effects management, which includes the development and implementation of a Native Bird Management and Monitoring Plan to avoid and minimise adverse effects on native birds, and habitat replacement and restoration.

We have recommended that the spring cryptic wetland bird surveys be repeated in 2024, to ensure robust baseline data is collected to compare future survey data to, during construction of the proposed solar farm and post construction. In addition, further bird monitoring is underway to assess variations in the distribution, habitat use and relative abundance of native birds across the three sites over successive seasons. This monitoring will also inform the effects management measures, and provide baseline data.

Lizards

Lizard surveys undertaken in the 2022-2023 field season to inform the Assessment of Ecological Effects did not detect any indigenous lizards. However, lizard survey methods currently available can have poor detection rates, particularly where population densities are low. Furthermore, significant and on-going rain throughout the 2022/23 field season caused widespread flooding within the sites in areas that would typically be dry over summer. Many of the survey devices were flooded, or became heavily infested with ant colonies which may have been a deterrent to lizards taking up residence within ACOs or inspecting tracking tunnels.

Consequently, a precautionary interpretation of the 2022/23 survey results was taken that assumes indigenous lizards are present within the Project Site. A Lizard Management Plan has been developed, with lizard salvage as the primary tool for managing effects on native lizards, as well as staged vegetation clearance, habitat replacement and predator control. The Lizard Management Plan has been lodged with Department of Conservation with the application for a Wildlife Permit Authorisation.

Given the survey limitations during the 2022/23 season, additional lizard surveys are underway within the higher quality lizard habitat in Site 1A to maximise detection likelihood. This includes a tracking tunnel survey for ground-dwelling skinks in the gorse and riparian vegetation along Bercich Drain in Site 1A, which was initiated in February 2024 and will continue through March.

An additional night of spotlighting was undertaken on the edge of the kanuka in Site 1A in February 2024. One elegant gecko (*Naultinus elegans*), which has a threat status of At Risk – Declining, was found on a kanuka tree surrounded by gorse on the coastal side of the kanuka shrubland. This observation was outside of the Site boundary and is a substantial distance from the proposed development footprint, as the kanuka shrubland is being avoided. Nevertheless, the presence of a gecko in an individual kanuka amongst gorse suggests that these lizards may move through the gorse scrub in order to access favourable habitat patches. This finding does not change our assessment of the ecological herpetofauna value of Site 1A, as it was already assessed as High. Therefore, the management outlined in the Lizard Management Plan is still appropriate.

Wetlands

Significance of wetlands

It was identified through the Section 92 RFI process that an At Risk – Declining plant; *Carex fascicularis*; was misidentified as *C. lessoniana* during earlier site visits. A site visit was undertaken in October 2023 to confirm the presence and map the extent of *C. fascicularis*, which is present in several locations in Site 1A (Figure 1). The majority are individual plants or small clumps of 3 to 4 plants within wetlands dominated by exotic vegetation, adjacent to historical drainage channels and the Bercich drain. As these areas are dominated by exotic vegetation, they do not meet the definition of a significant wetland under the Proposed Regional Plan for Northland. However, two patches of *C. fascicularis* (~100m^2 and 400m^2) are present, one in each of the two indigenous dominated wetlands in the south-eastern corner of Site 1A. As these two wetlands are an area of indigenous vegetation, and meet criteria 2b of Appendix 5 of the Regional Policy Statement, they meet the definition of a significant wetland under the Proposed Regional Plan for Northland.

The presence of the At Risk – Declining C. *fascicularis* does not change our assessment of the ecological value of these wetlands based on the EIANZ criteria, as they have already been assessed as High to Very High for the rarity/distinctiveness matter, and High overall ecological value.

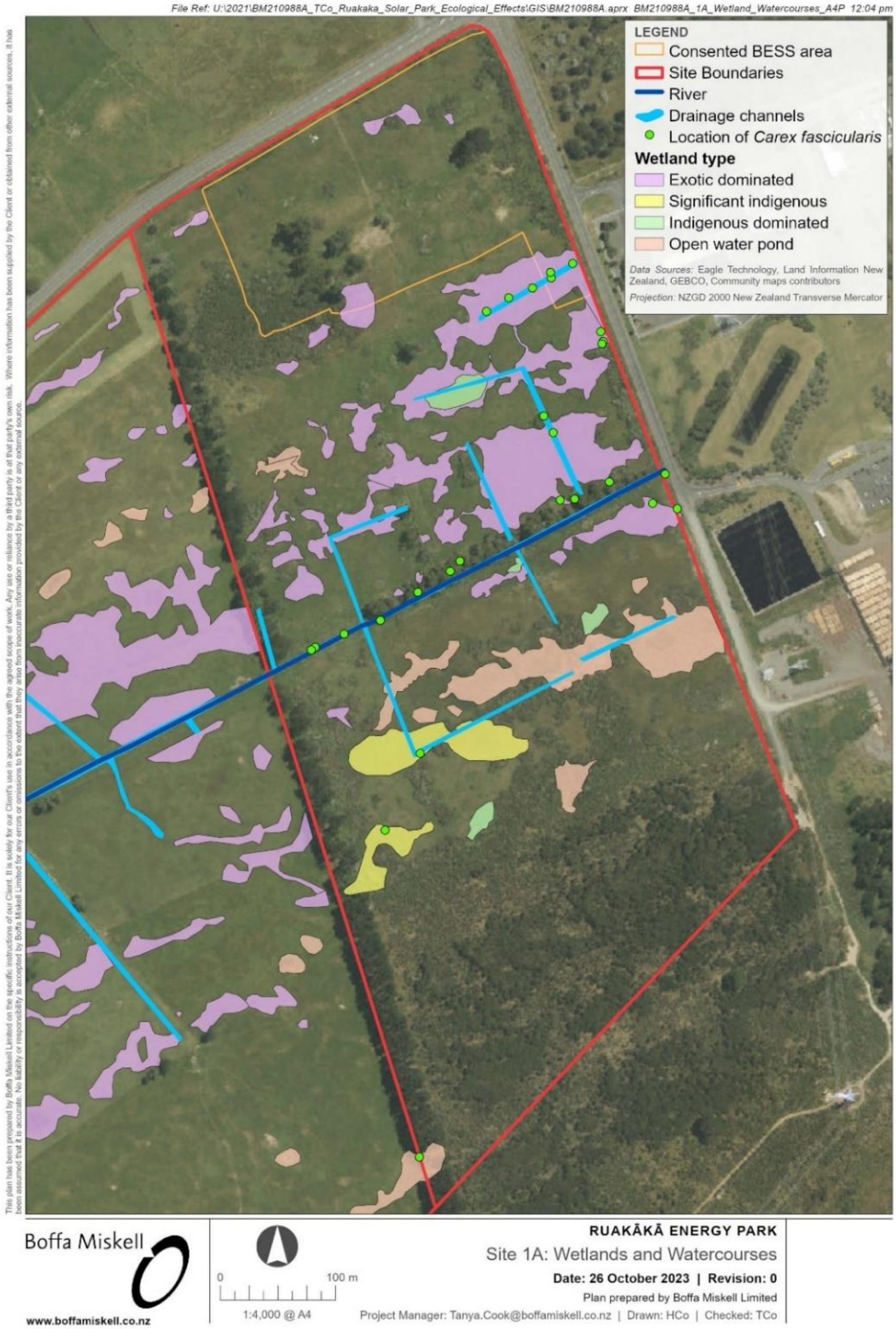

Figure 1: Location of Carex fascicularis and 'significant wetlands' in Site 1A

Wetland extent

Through the section 92 process it has been identified that there is disagreement between the Council's ecologist and Boffa Miskell's ecologists as to the extent of the wetlands on Site 1. There is agreement that Boffa Miskell appropriately applied the Ministry for the Environment's wetland delineation protocols, which state that the methods should be applied under normal climatic and hydrological conditions, or otherwise take into account additional information, such as contours and historical imagery. The key point of disagreement is that the Council's ecologist considers that the wetland delineation should encompass the maximum extent of surface pooling observed under unusually wet conditions.

Meridian has sought advice from a hydrologist to determine whether normal hydrological conditions were present on Site 1 during the dates of site visits and imagery capture (drone and satellite). The hydrologist has determined groundwater levels were above normal on the dates of all sites visits/ imagery capture but particularly from September 2022 to August 2023 (refer to the Beca letter dated 7 March).

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. Therefore, the effects of a very wet growing season can persist well into the next growing season or beyond.

In summary, the advice from the hydrologist is that groundwater levels were above normal on the dates of all sites visits/imagery capture but particularly from September 2022 to August 2023. Boffa Miskell's approach to wetland delineation is consistent with the national wetland delineation protocols. We disagree with the Council ecologist's approach of using the most conservative extent (i.e., maximum surface pooling) under abnormally wet conditions, and we do not consider that this is consistent with the wetland delineation protocols.

APPENDIX A: RUAKAKA BAT SURVEY

Boffa Miskell

Memorandum

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Attention:	Andrew Guerin, Micah Sherman
Company:	Meridian Energy Ltd
Date:	5th March 2024
From:	Hazel Burridge
Message Ref:	Ruakākā Solar Park Bat Survey
Project No:	BM210988D

Introduction

Meridian Energy Ltd has engaged Boffa Miskell Ltd to undertake a site visit and acoustic survey for bats at the Ruakākā Solar Park site. Meridian Energy Ltd are proposing to construct and operate a 170 ha solar energy park across three sites between Ruakākā township and Marsden Point. The proposed solar park will necessitate tree removal, and the scope of this work is to establish whether bats are likely to be using the areas of land to be cleared.

Bats are the only native terrestrial mammals in New Zealand. There are two species of bats in New Zealand, the long-tailed bat (*Chalinolobus tuberculatus*) and the lesser short-tailed bat which is separated into three subspecies (*Mystacina tuberculata spp*.). The long-tailed bat is classified as Threatened – Nationally Critical and the Northern lesser short-tailed bat is classified as Threatened – Nationally Vulnerable, due to predation, habitat degradation and loss, and competition[1].

Long-tailed bats preferentially roost in small cavities of old, large trees, but have also been observed to utilise other features such as loose bark, hollow limbs or epiphyte growth for roosting. They are able to fly long distances at night when they are commuting between roosts and / or foraging, for which they use echolocation to hunt for flying insects. Long-tailed bats are known to preferentially use linear habitat features such as shelterbelts or edges of vegetation margins to commute and forage but utilise a wide range of habitat types. This species is known to frequently switch roosts and rely on a large network of roosts used periodically.

Short-tailed bats typically live within areas of mature native forest where they use hollow trees for roosting. Short-tailed bats are ground foragers and crawl on the ground eating a variety of

[1] O'Donnell et al, 2023, Conservation status of bats in Aotearoa New Zealand, 2022, Department of Conservation

invertebrates, nectar, fruit, and pollen. There are currently no records of short-tailed bats being present within 50 km of the site, and no suitable habitat for short-tailed bats was identified within the project site. This species is therefore not further considered in this assessment.

Long-tailed bats are protected under the Wildlife Act 1953 and are included in the list of “specified highly mobile fauna” in the Draft National Policy Statement – Indigenous Biodiversity (NPS-IB).

Site description

The three sites are mostly exotic grassland, with some areas of shrubland, scattered mature native and exotic trees, exotic hedgerows and shelterbelts, and wetlands. The ~ 5 ha of kānuka forest and shrubland, on the southern edge of Site 1A is ecologically significant indigenous vegetation of high ecological value. The proposed development avoids this kānuka forest and shrubland. There is standing water and vegetated waterways within the sites.

Methods

Desktop review

The Department of Conservation (DoC) bat database was reviewed for previous records of bats within a 25 km radius of the site.

Acoustic bat activity surveys

An acoustic bat survey was undertaken using Song Meter Mini Bat (Wildlife Acoustics) full spectrum recorders which passively record both long-tailed bat (at 40 kHz) and short-tailed bat (at 28 kHz) echolocation calls.

The surveys were conducted over 20 nights during January 2024. 22 ABMs were deployed across the three sites, targeting habitat features preferred by long-tailed bats for roosting, commuting, and foraging (Figure 1).

Long-tailed bat activity can be influenced by overnight weather conditions such as temperature, rainfall and wind speed, Weather data from the survey period was analysed to ensure conditions were suitable for bats to be active and hence detectable via acoustic monitoring. Suitable conditions are defined for the purpose of this survey report as follows:

- Air temperature does not drop below 10°C from sunset until four hours after sunset;
- Rainfall of no more than 2.5 mm occurs in the first two hours after sunset;
- Mean overnight wind speed does not exceed 20 km/h;
- Overnight wind gusts do not exceed 60 km/h;

The number of suitable monitoring nights within a survey are used as a measure of survey effort. However, all data, including recordings during non-suitable survey nights were analysed.

All detectors were programmed to monitor from one hour before sunset to one hour after sunrise. All recordings were downloaded and acoustic data from all nights were analysed using Kaleidoscope Pro (Wildlife Acoustics).

The detectors were set to record in full spectrum format and the default sample rate of 256kHz was used. The minimum trigger frequency was 16kHz. Any signal below the minimum trigger frequency would not be recorded, preventing unwanted recordings of low frequency sounds.

The maximum recording length was set to 12 seconds.

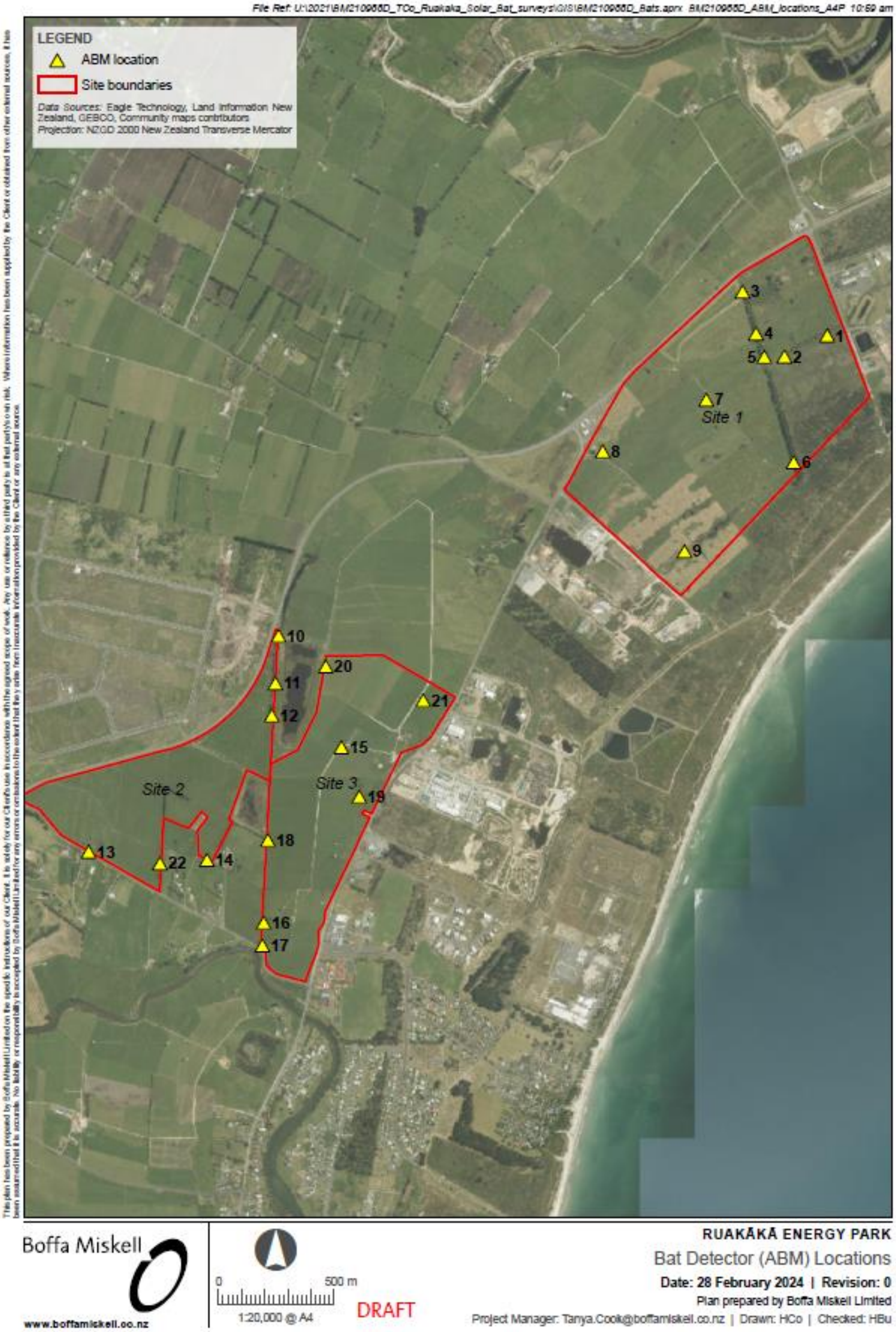

Figure 1 - Bat detector locations

The trigger window was set to 3 seconds. This is the amount of time the Song Meter Mini Bat continues to record after the last signal that satisfies the minimum trigger frequency unless the recording reaches the maximum recording length first. This avoids recordings ending after each single echolocation pulse.

Each spectrogram showing calls is recorded as a separate bat pass. The average number passes per night can then be calculated to compare activity levels across the site and with comparable sites. There is no standardised definition of high, medium and low activity levels for long tailed bats.

Roost tree assessment

A visual bat roost survey of the trees on site was carried out on 11th January 2024. Trees more than approximately 4 m in height with a diameter at breast height (dbh) of ≥15 cm were visually assessed from the ground (as per DoC guidance on bat roosting potential of trees), including using binoculars (Vortex Diamondback 10x42 mm) where needed. Areas of habitat containing potential bat roost trees were noted.

The trees were assessed based on their potential to support roosting bats. Features that indicate roost potential include:

- Cavities
- Hollows
- Knot holes
- Cracks
- Flaking and peeling of bark
- Epiphytes
- Broken or dead branches or trunk

There is no formal guidance for categorising the roost potential of trees for New Zealand bats therefore the categories below (Table 1) are based on the experience of the bat specialist and studies that have been undertaken on roosting behaviour and roost selection by long-tailed bats.

Habitat assessment

Both species of New Zealand bat are found in native forest from sea level to the treeline. Their natural habitat is mature forest with numerous hollows in large trees. Long-tailed bats also roost in caves at times, and some have become established in mature pine (*Pinus radiata*) forests.

Long-tailed bats have also been found to utilise highly modified landscapes and have been recorded within agricultural land and exotic vegetation. They have been shown to use waterways, gullies, shelterbelts and hedgerows to cross the landscape and reach foraging sites up to 19km from their roost, although the usual distance travelled is less.

Features on site that could provide connectivity and foraging opportunities were recorded. These were assessed in the context of the wider landscape, noting habitats and features outside of the site boundary that could support roosts or provide extended connectivity to suitable habitat. The presence of potential roost features and the suitability of foraging and commuting habitats were considered together to assess the overall suitability of the site to support bats.

Table 1 Potential suitability of a site to support roosting bats

Suitability	Roosting habitats	Commuting and foraging habitats
Negligible	Negligible habitat features on site likely to be used by bats	Negligible features on site likely to be used by commuting or foraging bats. No bats have been recorded within 25km if surveys have been undertaken.
Low	A tree of sufficient size and age to contain potential roost features (PRFs) but with none seen from the ground, or features seen with only very limited roosting potential, such as a small void with space for only a single bat.	Habitat that could be used by small numbers of commuting bats such as a fragmented hedgerow or unvegetated stream, but isolated, i.e. Not very well connected to the surrounding landscape by other habitat. Suitable, but isolated habitat that could be used by small numbers of foraging bats such as a lone tree or patch of scrub.
Moderate	A tree with one or more potential roost sites that could be used by bats due to their size, conditions, and surrounding habitat, but unlikely to provide optimal conditions for a large or maternity roosts.	Continuous habitat connected to the wider landscape that could be used by bats for commuting such as lines of trees and scrub. Habitat that is connected to the wider landscape that could be used by bats for foraging such as trees, scrub, grassland or water. Bats have previously been recorded within 25km if surveys within this area have been undertaken.
High	A tree with one or more potential roost features that are suitable for use by larger numbers of bats due to their size, conditions and surrounding habitat, such as a large, thermally stable cavity, high in a mature tree.	Continuous high-quality habitat that is well connected to the wider landscape that is likely to be used regularly by commuting and foraging bats such as rivers, vegetated gulleys, shelterbelts, forests and edge features. Site is close to and connected to known roosts.

Results

Desktop Review

Monitoring has been undertaken for long-tailed bats at various locations within 25 km of the proposed sites. The nearest locations where long tailed bats have been recorded are Brynderwyn Hills Forest, Otaika Valley Bush and Pukenui Forest, with the nearest records for each of these being approximately 20, 18 and 20 km respectively from the Proposed Sites. These records were all from monitoring undertaken in the last 5 years. The land use between these known long-tailed bat populations and the proposed sites is predominately farmland. Negative results (surveys which did not detect bats) are recorded on Te Whara (Bream Head) on the other side of Whangarei Harbour. The nearest mature native forests to the sites are Takahiwai and Ruakākā, which are 1.5 and 4 km away respectively. Both provide high quality habitat for bats in close proximity to the sites. It is unknown whether bats are present in these forests, as no records were available for these locations.

On site habitat assessment

The mosaic of open spaces, shelterbelts and areas of forest provides a network of flightlines and edge habitats. Small watercourses and drains are present which increase the availability of potential prey insects. Vegetation on site includes mature trees with potential to support roosting bats and there is also standing deadwood.

The vegetated waterways and shelterbelts provide connectivity for foraging and commuting bats and the presence of standing water increases the likely insect abundance, and therefore foraging opportunities for bats. Much of the grassland was long with a high proportion of weeds, particularly in site 2, and herbaceous plants at the time of the site visit, increasing the likely insect abundance and therefore potential prey for bats. This is likely to change throughout the year as areas are grazed.

Numerous potentially high value roost features are present on site, including cavities, splits and lifted bark. These are predominantly in the mature willow and pine shelterbelts in sites 1 and 2 and are also present in smaller groups of trees scattered across the three sites.

The shelterbelt running north to south within site 1 had a high density of potential roost features (Figure 2) as well as open water with surrounding vegetation at the southern end and has high suitability as bat habitat (Figure 3). Also within site 1, small patches of mature willow and isolated trees with potential roost features are present.

Within site 2, the pine shelterbelt at the northern tip contains multiple potential roost features and provides connectivity to the adjacent landscape (Figure 3).

The vegetated boundary and waterway between sites 2 and 3 provides connectivity and foraging opportunities and occasional potential roost features are present within small patches of trees within the interior of site 3.

Acoustic Survey

Out of the 20 survey nights, there were no evenings with a temperature below 10°C at any time or with high winds. There were four evenings with rain or intermittent showers. Recordings from all survey nights were analysed and none of the detectors recorded any bat passes.

Figure 2 – Examples of potential bat roost features on site

Figure 3 – Examples of potential bat foraging habitats

Conclusion

The shelterbelts provide high quality roosting and foraging habitat within sites 1 and 2 for long-tailed bats, however no bats were recorded on site during the January survey. Within site 3 the potential roosting opportunities are confined to isolated groups of trees and the overall habitat is low /moderate. Within the long-tailed bat life cycle, January can include the late stages of pregnancy, non-volant young being present in roosts, and young beginning to fly. The lack of any recorded calls within the three sites at this time suggests that if bats are using the sites, it is likely to be in very low numbers.

From the survey undertaken it is not anticipated that the presence of long-tailed bats will be a constraint to the proposed development. However, given the suitability of habitat on site and further suitable habitat within commuting distance to the site, a precautionary approach of implementing the bat roost protocols prior to felling is recommended[2].

[2] Bat Recovery Group – Department of Conservation, 2021, Protocols for minimising the risk of felling bat roosts (V2)

APPENDIX B: RUAKAKA SPRING BIRD SURVEY

Spring Avifauna Surveys

Cryptic Wetland Avifauna Surveys, Ruakākā
Prepared for Meridian Energy Limited

5 March 2024

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Document Quality Assurance

Bibliographic reference for citation: Boffa Miskell Limited 2024. *Spring Avifauna Surveys: Cryptic Wetland Avifauna Surveys, Ruakākā*. Report prepared by Boffa Miskell Limited for Meridian Energy Limited.		
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Status: DRAFT	Revision / version: [1]	Issue date: 5 March 2024

Template revision: 20230505 0000

File ref: BM210988C_Spring_bird_surveys_DRAFT.docx

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1.0 Introduction

Meridian Energy Limited (MEL) are proposing to construct and operate a 170 ha solar energy park at three Sites in Ruakākā, Northland and lodged a Resource Consent application for the proposed solar energy park development in September 2023. Boffa Miskell Limited (BML) prepared the Assessment of Ecological Effects (AEcE) to support the resource consent application (Boffa Miskell Limited 2023).

Surveys undertaken earlier in 2023 to inform the AEcE identified several Threatened and At Risk bird species within and in the vicinity of the proposed solar farm sites (Sites), including Australasian bittern, New Zealand dabchick, banded rail, spotless crake and New Zealand pipit. Based on those findings, the Sites were assessed as having High to Very High avifauna values. As most avifauna habitat will be removed during construction the magnitude of effect on avifauna values was assessed as High. The effects on avifauna will be managed through mitigation and habitat replacement. Further monitoring was recommended by BML to inform the effects management measures, in order to minimise adverse effects on native birds.

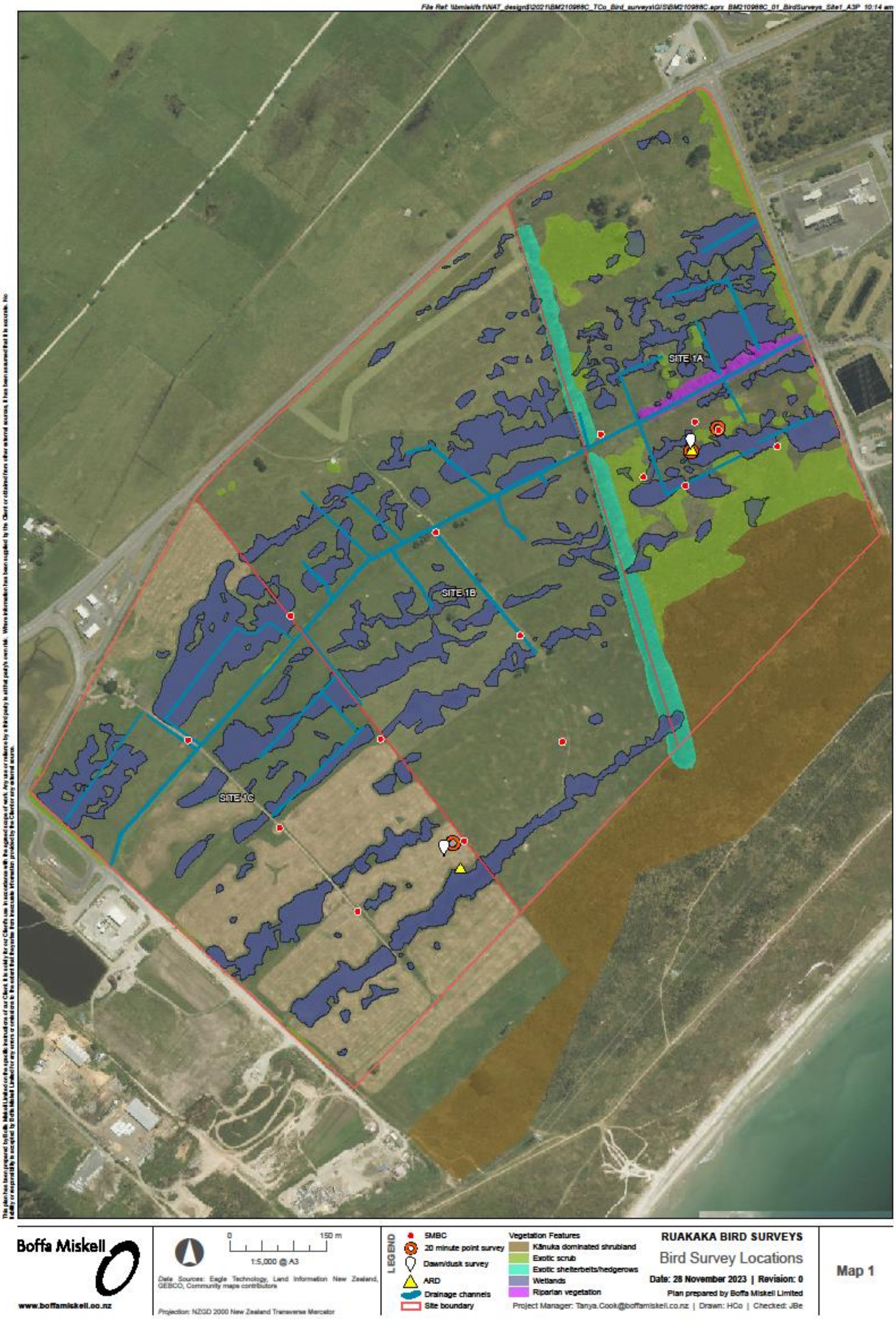
Surveys were undertaken in Spring 2023, focusing on identifying the presence and habitat usage of cryptic wetland birds across the three sites, as well as other native waterfowl and bird species. This report outlines the findings of these surveys.

1.1 Project Sites and surrounding landscape

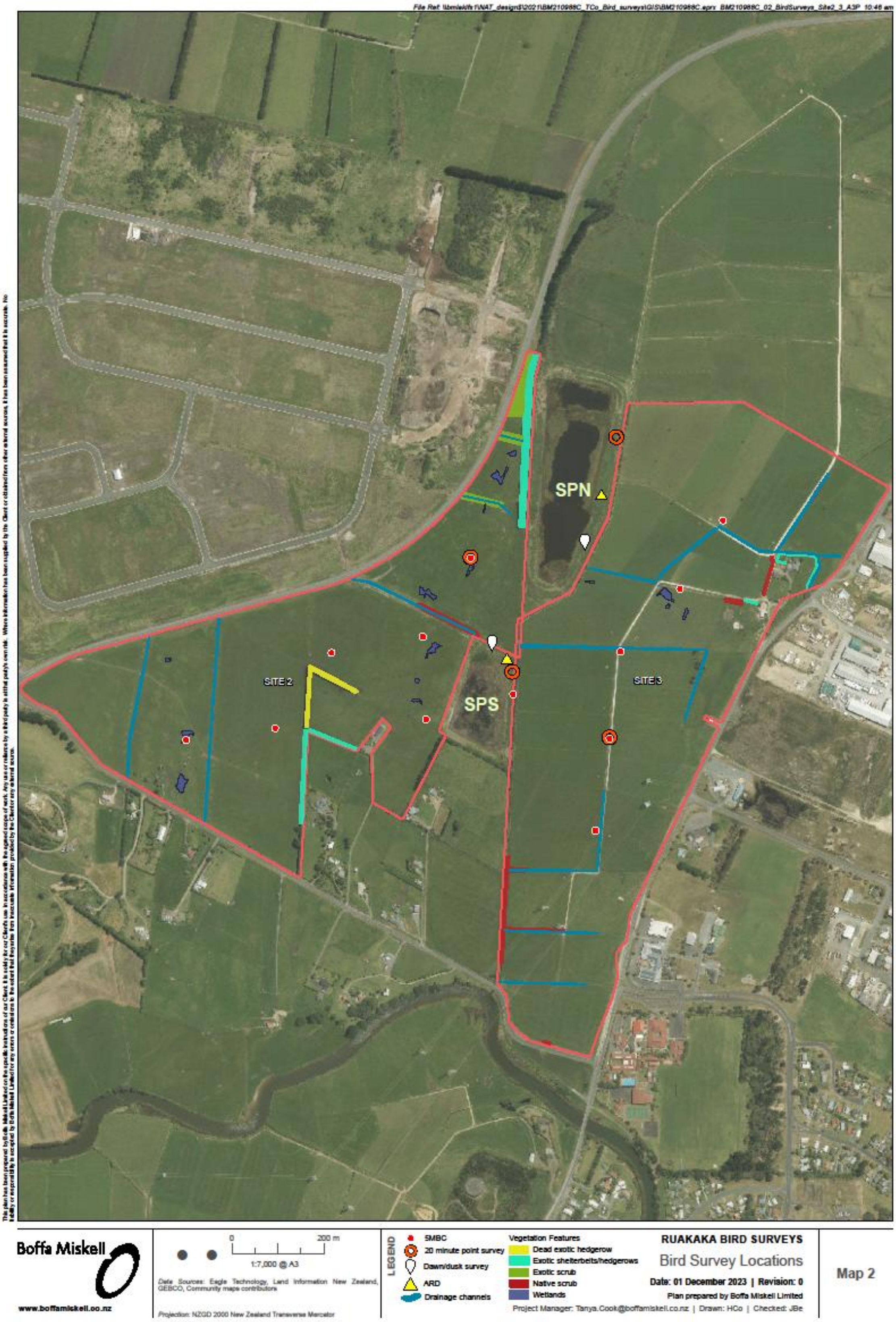
The three proposed solar energy park Sites and two adjacent stormwater retention ponds are between Ruakākā and Marsden Point (See Maps 1 and 2). The flat to undulating Sites are in a low-lying coastal area, surrounded by land predominately used for agricultural and industrial activities.

1.1.1 Site 1

Site 1 (Map 1) is a mix of exotic grassland, shrubland and wetland with isolated shelter belts or trees. The western two-thirds of Site 1 is pastoral farmland used for cattle grazing (Sites 1B and 1C). The eastern third has been retired from grazing for some years, receiving minimal management or maintenance, and is a mosaic of open water wetlands, rank grassland and exotic and native scrub (Site 1A). The disposal field for the treated wastewater for Ruakākā township is in the shrubland to the southeast of Site 1B and 1C (Map 1). Construction of a Battery Energy Storage System (BESS) is underway on the north-eastern corner of Site 1A.



Map 1. Bird survey locations in Site 1 of the proposed MEL solar farm in Ruakakā.



Map 2. Bird survey locations in Sites 2 and 3 of the proposed MEL solar farm in Ruakakā and the stormwater ponds between the Sites.

1.2 Avifauna targeted in 2023 spring surveys

As part of the ecological assessment to inform the Resource Consent application, avifauna surveys were conducted in March 2023 to confirm the presence of native cryptic avifauna at the Sites and stormwater retention ponds. While no formal bird counts were undertaken during site visits in 2021 and 2022, incidental observations were recorded. The key species targeted for the 2023 spring surveys were native cryptic wetland avifauna previously recorded within or near the Sites (Table 1).

Table 1. Native cryptic wetland bird species recorded within the Sites and the two stormwater ponds (SPN and SPS) during site visits in 2021, 2022, and 2023, and the 2023 summer bird surveys.

Species	Scientific name	Threat classification (Robertson et al 2021)
Matuku-hūrepo/Australasian bittern	*Botaurus poiciloptilus*	Threatened - Nationally Critical
Weweia/dabchick	*Poliocephalus rufopectus*	Threatened - Nationally Increasing
Mohu-pererū/banded rail	*Gallirallus philippensis assimilis*	At Risk - Declining
Pūweto/spotless crake	*Porzana t. tabuensis*	At Risk - Declining

1.2.1 Matuku-hūrepo / Australasian bittern

Matuku-hūrepo are classified as Threatened – Nationally Critical (Robertson et al., 2021), the highest threat class for native birds in New Zealand. Matuku-hūrepo have a population in New Zealand estimated at less than 1,000 individuals, and their main threats are habitat loss (following the destruction of 90% of their wetland habitat), mammalian predators and disturbance (Robertson et al., 2021).

Previous surveys conducted by BML have identified matuku-hūrepo at various points in the Sites and stormwater retention ponds (Boffa Miskell Limited 2023).

2.0 Survey Locations and Methods

Surveys were conducted by BML ecologists in September and October 2023 to determine the presence, distribution and relative abundance of native cryptic wetland avifauna species, waterfowl and other avifauna species within the three project Sites and adjacent stormwater retention ponds.

2.1 Five-minute bird counts (5MBC)

Five-minute bird counts were conducted at 27 locations across the three Sites (Maps 1 & 2). Survey locations that provided good coverage of the Sites and encompassed different vegetation types and habitat features present (e.g., pasture, shelterbelts, wetlands, ponds, and other vegetation) were selected. The surveys were conducted during daylight hours on September 20 and 21, then repeated on October 16 and 17, 2023, and followed the standard 5MBC methodology (Dawson & Bull, 1975). The purpose of the 5MBCs was to identify exotic and indigenous species present within the Sites and their relative abundances. During the October surveys, three 5MBC could not be conducted on Site 2 due to stock being present.

2.2 Twenty-minute point counts

Twenty-minute point counts were conducted at seven locations across the three Sites and the two stormwater retention ponds (Maps 1 & 2). Each survey recorded native avifauna species, the number observed, direction from the observer, the direction of movement, behaviour, and habitat use (e.g., pasture, pond, wetland, shelterbelt, etc.). Weather conditions were also recorded. The surveys were conducted during daylight hours on September 20 and 21 and then repeated on October 16 and 17, 2023. The purpose of the point counts was to collect data on how avifauna species were using the Sites (e.g., habitats, behaviourally).

2.3 Dawn and dusk playback surveys

Dawn and dusk playback surveys were undertaken at four wetland locations, Site 1A, 1C, and stormwater retention ponds (SPN and SPS; Maps 1, 2). Surveys were over two intervals from 20 to 22 September and 16 to 18 October 2023. Each of the four survey locations was surveyed once at dawn and dusk in each interval, with surveys starting one hour before sunrise/set and lasting two hours. Each survey involved recording the species and numbers of all avifauna observed, direction of movement, behaviour, location (e.g., pasture, pond, wetland, shelterbelt, etc) and any other observations of note. Weather conditions were also recorded. During each survey, calls of the target species (Table 1) were played through a speaker approximately every 15 minutes to elicit a response call from cryptic wetland bird species that may be difficult to detect. The purpose of the dawn/dusk surveys was to determine the presence or absence of target cryptic wetland avifauna species and, where possible, how they were using the Sites.

2.4 Acoustic recording devices

Acoustic recording devices (ARDs) were stationed on the margins or slightly within wetlands at Sites 1A and 1C and at each stormwater retention pond (Maps 1 & 2). The use of ARDs was primarily aimed at matuku-hūrepo as they are not known to respond to playback recordings. The devices were attached to posts about 1.5 m above ground level, as specified by O'Donnell and Williams (2015). The ARDs were deployed on 20 and 21 September 2023 and retrieved on 18 October 2023. The survey time was chosen to coincide with the full moon during the key months of the bittern breeding season (September to November), when male bitterns are known to call (boom) and be at their most conspicuous during the year. Survey locations were selected around wetlands that provided potential habitat for native cryptic wetland avifauna species. Each ARD was set to “Low”, the frequency setting required to record Australasian bittern. Recordings started before sunrise and sunset each day of the survey, recording 15-minute sound files continually for two hours.

2.4.1 Acoustic recording device data analysis

ARD data was analysed by BML ecologists using RavenLite Software (Version 2.0.5), following Department of Conservation’s recommended acoustic settings for detecting Australasian bittern (O’Donnell & Williams, 2015). Data was also analysed for marsh crake, spotless crake and fernbird. Setting for RavenLite enables users to visualise sounds as spectrograms and identify the distinct spectrograms for different species, including bittern, which have a distinctive call

(Figure 1). For each survey day, the first 15-minute sound files from the first hour and second hours from both dawn and dusk recordings were analysed in RavenLite to determine if the target species were present in each wetland.

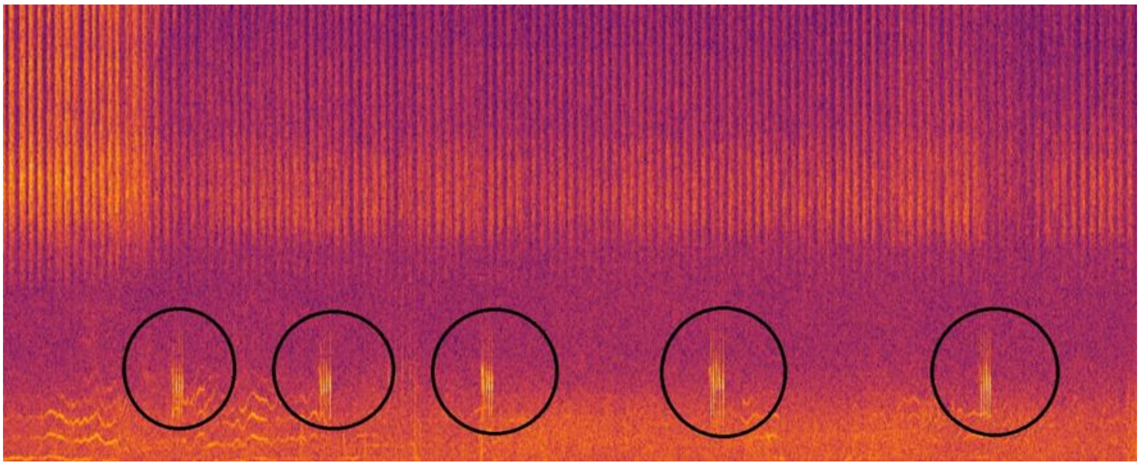


Figure 1. The spectrogram from RavenLite shows a male bittern's repeated booming (circled in black).

2.4.2 Data limitations of ARDs

ARDs are useful tools for determining the presence of a range of avifauna, particularly some cryptic species. These tools help build an understanding of species presence, habitat use and potentially an idea of relative abundance. However, due to avifauna calling across a wide spectrum of frequencies, the pre-set frequency of ARDs (Low or High) means that these tools are used to target specific species and cannot record all native cryptic wetland bird species potentially present during surveys.

2.5 Incidental observations

BML ecologists were equipped with 10 × 42 magnification binoculars and recorded all native bird species observed or heard when undertaking the dawn and dusk surveys, installing/retrieving ARDs and moving between survey locations.

3.0 Survey Results

Over the spring 2023 surveys undertaken during September and October and observations made during site visits between 2021 - 2023, 32 native species have been seen or heard within the Sites or the stormwater retention ponds between Sites 2 and 3 (Table 3, Appendix 1), all in low numbers (e.g., often individual birds). Of these, 16 species use freshwater bodies/wetlands as their primary habitat. Two of these 32 native species (Table 3) were only recorded on the stormwater retention ponds (SPN and SPS).

There were 14 species recorded in the spring 2023 surveys that had not been recorded in earlier surveys and site visits. Of these, 10 were native, including six shorebird species, and one was only recorded on SPS (ie, not within the Sites).

Of the 30 native species recorded within the Sites, five are Threatened; matuku-hūrepo, pārera, taranui, tūturiwhatu and weweia and a further eight have a threat status of At Risk; mohu-pererū, pīhoihoi tōrea, tarāpunga, karorokāruhiruhi, tōrea pango, and kawau (Table 2).

All avifauna, including native and exotic species, recorded within the Sites and the two stormwater retention ponds (SPN & SPS) between Sites 2 and 3, during site visits (2021, 2022, and 2023) and the 2023 spring 2023 surveys is provided in Table 3 (in Appendix 1).

3.1 Matuku-hūrepo

Matuku-hūrepo were recorded on eight occasions between 2021 and April 2023 within or in the vicinity of the sites, as stated in the earlier AEcE report (BML 2023). During the 2023 spring surveys, an individual matuku-hūrepo was observed flying over Site 1C on three separate occasions, an individual was seen in a drain on Site 1B, and an individual was seen at SPS. At least one male was seen and heard booming repeatedly on SPN during September and October surveys. The booming is the call of males during the breeding season (O'Donnell & Williams, 2015).

3.2 Weweia/dabchick

A pair of weweia were seen within the large open pond wetland on the south-east side of Sites 1B and 1C during three of four surveys in March 2023. Three weweia (two adults and one juvenile) were also observed on SPN, likely to be different individuals to the pair on Sites 1B and 1C. During the 2023 spring surveys, pairs were again seen in the same wetland locations of 1B/C and SPN, with the pair on Site 1C showing breeding behaviour. A pair of weweia were also seen feeding on SPS.

3.3 Other avifauna of note

A moho-pererū was heard in Site 1A in the wetlands in March 2023. However, during the 2023 spring surveys, no moho-pererū were recorded. Pīhoihoi were seen on several occasions within the grassland areas of Sites 1B and 1C during site visits in early 2023. They were observed again on Site 1C and on Sites 2 and 3, during the 2023 spring surveys. At least one pair of tūturiwhatu were observed on Site 3 in open pastoral land during the October 2023 survey. A single taranui was seen flying over Site 1B/C in October 2023.

A further 15 native Non-Threatened, one non-resident native (vagrant) and 13 introduced species were recorded during the Site visits and surveys (Appendix 1). Additionally, two native species that were not detected within the Sites, were seen on the stormwater ponds between Sites 2 and 3; pāteke and pūweto (Table 2).

Table 2. Threatened and At Risk avifauna recorded within the Sites and the two stormwater retention ponds (SPN & SPS) between Sites 2 and 3 during site visits (2021, 2022, and 2023) and the 2023 bird surveys. Species shown in bold use freshwater systems/wetlands as their primary habitat. Note that two species marked with an asterisk were only observed on the stormwater ponds, not within the Sites. SPN = Stormwater Pond North. SPS = Stormwater Pond South.

Species	Scientific name	Threat classification (Robertson et al., 2021)	Location			
			Surveys and observations 2021, 2022 and summer 2023	ARDs Spring 2023	September 2023	October 2023
Matuku-hūrepo/Australasian bittern	***Botaurus poiciloptilus***	**Threatened - Nationally Critical**	**1A, 1B, 1C, 3, SPS**	**SPN**	**1C, SPN**	**SPN, SPS**
Pārera/grey duck	***Anas superciliosa***	**Threatened - Nationally Vulnerable**	**SPN**		**1C, 3**	**1C, SPN**
Taranui/Caspian tern	*Hydroprogne caspia*	Threatened - Nationally Vulnerable				1C
Weweia/dabchick	***Poliocephalus rufopectus***	**Threatened - Nationally Increasing**	**1C, SPN**		**1C, SPN, SPS**	**1C, SPN**
Pāteke/brown teal *	***Anas chlorotis***	**Threatened - Nationally Increasing**			**SPS**	
Tūturiwhatu/Northern NZ dotterel	*Charadrius obscurus aquilonius*	Threatened - Nationally Increasing				3
Moho-pererū/banded rail	***Gallirallus philippensis assimilis***	**At Risk - Declining**	**1A, SPN**			
Pīhoihoi/New Zealand pipit	*Anthus novaeseelandiae*	At Risk – Declining	1B, 1C		1C, 2, 3	1C
Pūweto/spotless crake *	***Porzana t. tabuensis***	**At Risk - Declining**	**SPN**	**SPN**		
Tōrea/South Island pied oystercatcher	*Haematopus finschi*	At Risk - Declining			1A	2
Tarāpunga/Red-billed gull	*Larus novaehollandiae scopulinus*	At Risk - Declining			1C	1A, 1C, 2
Karoro/Black-backed gull	*Larus bulleri*	At Risk - Declining			1A, 1C, 2, SPS	1A, 1C, 3, SPN, SPS
Kāruhiruhi/pied shag	***Phalacrocorax v. varius***	**At Risk - Recovering**	**1A, 1C, SPN**		**1C, 2, 3, SPN**	**2, SPN, SPS**
Tōrea pango/Variable oystercatcher	*Haematopus unicolor*	At Risk - Recovering				2
Kawau/black shag	***Phalacrocorax carbo novaehollandiae***	**At Risk - Relict**	**3**		**3**	**1C, SPN, SPS**
Kawau tūī/little black shag	***Phalacrocorax sulcirostris***	**At risk - Naturally Uncommon**			**1C, SPN, SPS**	

4.0 Summary and Recommendations

The 2023 spring surveys have built on the previous surveys and observations from between 2021 and 2023, with a further 11 native species detected within the Sites that had not been recorded previously. Eight of these eleven have an elevated threat status of Threatened or At Risk. The results of the 2023 spring surveys confirm that the Sites, in particular the large open water wetland to the east of Site 1B/C, provide suitable habitats for and are inhabited by a range of At Risk and Threatened avifauna.

Most of the avifauna recorded in the surveys will move across the wider landscape, either regularly as part of their foraging or as part of seasonal patterns of breeding and dispersal. They will use habitats within the Sites as stepping stones or destinations for these movements. The repeated observations of matuku-hūrepo (Threatened - Nationally Critical), weweia (Threatened - Nationally increasing), and other Threatened and At Risk avifauna within the Sites and surroundings (eg, stormwater ponds), emphasise the importance of the habitats provided.

With a single year of data collection, the survey methods have provided an understanding of the cryptic wetland species in the Site's wetlands and the two stormwater retention ponds between Sites 2 and 3. Given the threat ranking of matuku-hūrepo and weweia, we recommend that the spring surveys, focusing on native cryptic wetland species, be repeated in 2024, to ensure robust baseline data is collected to compare future survey data to, during construction of the proposed solar farm and post construction.

We also recommend that MEL proceed with the additional 5MBC and 20-minute point surveys in 2024, that BML has been engaged to undertake, to better understand the avifauna present within the Sites in different seasons. This will help inform effects management measures in order to minimise adverse effects on avifauna using the Sites and provide baseline data.

5.0 References

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Appendix 1: All Avifauna Recorded in Surveys

Table 3. All avifauna recorded within the Sites and the two stormwater retention ponds (SPN & SPS) between Sites 2 and 3, during site visits (2021, 2022, and 2023) and the spring 2023 surveys. SPN = Stormwater Pond North. SPS = Stormwater Pond South.

Species	Scientific name	Threat classification	Location			
			Surveys and observations 2021 - 2023	**ARDs Spring 2023**	**September 2023**	**October 2023**
Matuku-hūrepo /Australasian bittern	*Botaurus poiciloptilus*	Threatened - Nationally Critical	1A, 1B, 1C, edge of Site 3, SPS	SPN	1C, SPN	SPN, SPS
Pārera/grey duck	*Anas superciliosa*	Threatened - Nationally Vulnerable	SPN		1C, 3	1C, SPN
Taranui/Caspian tern	*Hydroprogne caspia*	Threatened - Nationally Vulnerable				1C
Weweia/dabchick	*Poliocephalus rufopectus*	Threatened - Nationally Increasing	1C, SPN		1C, SPN, SPS	1C, SPN
Pāteke/brown teal	*Anas chlorotis*	Threatened - Nationally Increasing			SPS	
Tūturiwhatu/Northern NZ dotterel	*Charadrius obscurus aquilonius*	Threatened - Nationally Increasing				3
Moho-pererū/banded rail	*Gallirallus philippensis assimilis*	At Risk - Declining	1A, SPN			

Pīhoihoi/New Zealand pipit	*Anthus novaeseelandiae*	At Risk – Declining	1B, 1C		1C, 2, 3	1C
Pūweto/spotless crake	*Porzana t. tabuensis*	At Risk - Declining	SPN	SPN		
Tōrea/South Island pied oystercatcher	*Haematopus finschi*	At Risk - Declining			1A	2
Tarāpunga/Red-billed gull	*Larus novaehollandiae scopulinus*	At Risk - Declining			1C	1A, 1C, 2
Karoro/Black-backed gull	*Larus bulleri*	At Risk - Declining			1A, 1C, 2, SPS	1A, 1C, 3, SPN, SPS
Kāruhiruhi/pied shag	*Phalacrocorax v. varius*	At Risk - Recovering	1A, 1C, SPN		1C, 2, 3, SPN	2, SPN, SPS
Tōrea pango/Variable oystercatcher	*Haematopus unicolor*	At Risk - Recovering				2
Kawau/black shag	*Phalacrocorax carbo novaehollandiae*	At Risk - Relict	3		3	1C, SPN, SPS
Kawau tūī/little black shag	*Phalacrocorax sulcirostris*	At risk - Naturally Uncommon			1C, SPN, SPS	
Kāhu/swamp harrier	*Circus approximans*	Not threatened	1A, 1C, SPN		1A, 1C, 2, SPN, SPS	All, SPN, SPS
Kōtare/sacred kingfisher	*Todiramphus sanctus vagans*	Not threatened	1A		1A, 2, SPS	1A, 1C, 2
Pūkeko/swamp hen	*Porphyrio m. melanotus*	Not threatened	1A, 1B, 3, SPN		All, SPN, SPS	All, SPN, SPS
Spur-winged plover	*Vanellus miles novaehollandiae*	Not threatened	All, SPN		All, SPN, SPS	1B, 1C, 3, SPN, SPS

Matuku moana/white-faced heron	*Egretta novaehollandiae*	Not threatened	1A, 1B, 1C, 2, SPN		1B, 1C, 3	1A, 1C, 2
Pūtangitangi/paradise shelduck	*Tadorna variegata*	Not threatened	All, SPN		All, SPN, SPS	All, SPN, SPS
Warou/welcome swallow	*Hirundo n. neoxena*	Not threatened	1B, 1C, 2, 3		All, SPN, SPS	1A, 1C, 2, 3, SPN
Kakīānau/black Swan	*Cygnus atratus*	Not threatened	1C, SPN		1C, SPN, SPS	1C, SPN, SPS
Grey duck x mallard	*Anas superciliosa x platyrhychos*	Not threatened	SPN			1C
Tete/grey teal	*Anas gracilis*	Not threatened	1C, SPN			2
Poaka/pied stilt	*Himantopus h. leucocephalus*	Not threatened	1B		1A,1C, SPS	
Tauhou/silvereye	*Zestrops lateralis*	Not threatened	1A			
Tūī/Tui	*Prosthemadera n. novaeseelandiae*	Not Threatened			1C	1A
Pīwakawaka /fantail	*Rhipidura fuliginosa placabilis*	Not Threatened			1A	1A
Riroriro/Grey warbler	*Prosthemadera novaeseelandiae*	Not threatened	1A			1A, 1B
Kawaupaka/little pied shag	*Phalacrocorax melanocephalus melanocephalus*	Vagrant	1A, SPN		1C	
Rakiraki/mallard	*Anas platyrhynchos*	Introduced and Naturalised	1A, 1C, SPN		1A,1C, 3, SPN, SPS	1C, 3, SPN, SPS
Magpie	*Gymnorhina tibicen*	Introduced and Naturalised	1		1A, 1B, 3	1A

Yellowhammer	*Emberiza citrinella*	Introduced and Naturalised	1A			
Tārangi/European starling	*Sturnus vulgaris*	Introduced and Naturalised	All		1A, 1C, 2, 3	1A, 2, 3,
Tiu/house sparrow	*Passer domesticus*	Introduced and Naturalised	All		All, SPS	1A, 1B, 2, 3, SPS
Manu pango/blackbird	*Turdus merula*	Introduced and Naturalised	All		1A, 1B, 1C, 2, SPS	1A, 3, SPS
Myna	*Acridotheres tristis*	Introduced and Naturalised	3		All, SPS	1A, 2, 3, SPS
Kairaka/Eurasian skylark	*Alauda arvensis*	Introduced and Naturalised	2, 3		SPS	2, SPS
Manu kai-hua-rakau/song thrush	*Turdus philomelos*	Introduced and Naturalised	1B, 1C		All	
Mute swan	*Cygnus olor*	Introduced and Naturalised			1C	1C
Finch	*Chloris chloris*	Introduced and Naturalised			1C, 2, SPS	1A, 1B, 1C, 3, SPS
California quail	*Callipepla californica*	Introduced and Naturalised			3	
Chickens	*Gallus domesticus*				1C	

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Boffa Miskell is a leading New Zealand environmental consultancy with nine offices throughout Aotearoa. We work with a wide range of local, international private and public sector clients in the areas of planning, urban design, landscape architecture, landscape planning, ecology, biosecurity, Te Hīhiri (cultural advisory), engagement, transport advisory, climate change, graphics, and mapping. Over the past five decades we have built a reputation for creativity, professionalism, innovation, and excellence by understanding each project's interconnections with the wider environmental, social, cultural, and economic context.

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7 March 2024

Meridian Energy Ltd
PO Box 10840
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Attention: Micah Sherman

Dear Micah

Assessment of likely Groundwater levels at Site 1 for Proposed Ruakākā Solar Farms

1 Introduction

Meridian Energy Limited (MEL) are undertaking the development of a new solar farm near Ruakākā, Northland split across three sites (Figure 1). At Site 1, a wetland feature has been identified by the Project ecologists Boffa Miskell while undertaking on-site assessments to meet the requirements of the Wetland Delineation Protocols. We understand there is currently disagreement between Boffa Miskell and Northland Regional Council's (NRC) ecologists with respect to the wetland extent on Site 1.

Boffa Miskell has requested advice from Beca Limited (Beca) as to whether the climatic and hydrogeologic conditions prevailing in the Ruakākā area during the assessment dates (by both Boffa Maskell and NRC) were representative of 'normal' conditions or otherwise to assist in evaluating the typical extent of the wetland.

2 Site 1 Description

Site 1 predominately consists of undulating sand dunes running in the southwest to northeast direction, approximately parallel to the current coastline. The sand dune crests peak between 5 m RL to 7 m RL with the troughs, located between the sand dunes, sitting at approximately 3 m RL to 4 m RL (Preliminary Geotechnical Assessment Report – Beca, 2023).

Based on pore water pressure CPT data from WSP investigations in September 2022 (Beca, 2023), groundwater was typically encountered between 0.5 m and 3 m below ground level across the site. Due to the terrain, the groundwater level is likely deeper along dune crests (some 4 mRL) and shallower along dune troughs (some 2.5 mRL mRL). This is supported by long term groundwater level monitoring of the Ruakākā Racecourse bores, by Northland Regional Council (NRC), which indicate an average groundwater level of ~2.6 m above mean sea level (MSL) with a typical seasonal variation of ~1.2 m (Section 3).

Wetlands are common in the interdune troughs across the site with surficial soils consisting of amorphous sandy peats as observed by Beca during a site walkover on 10 February 2023. During this site walkover, ponding water was also observed within drainage channels on site and low-lying wetland areas (note the site visit followed a particularly wet January 2023, as described further in Section 3).

make everyday better.

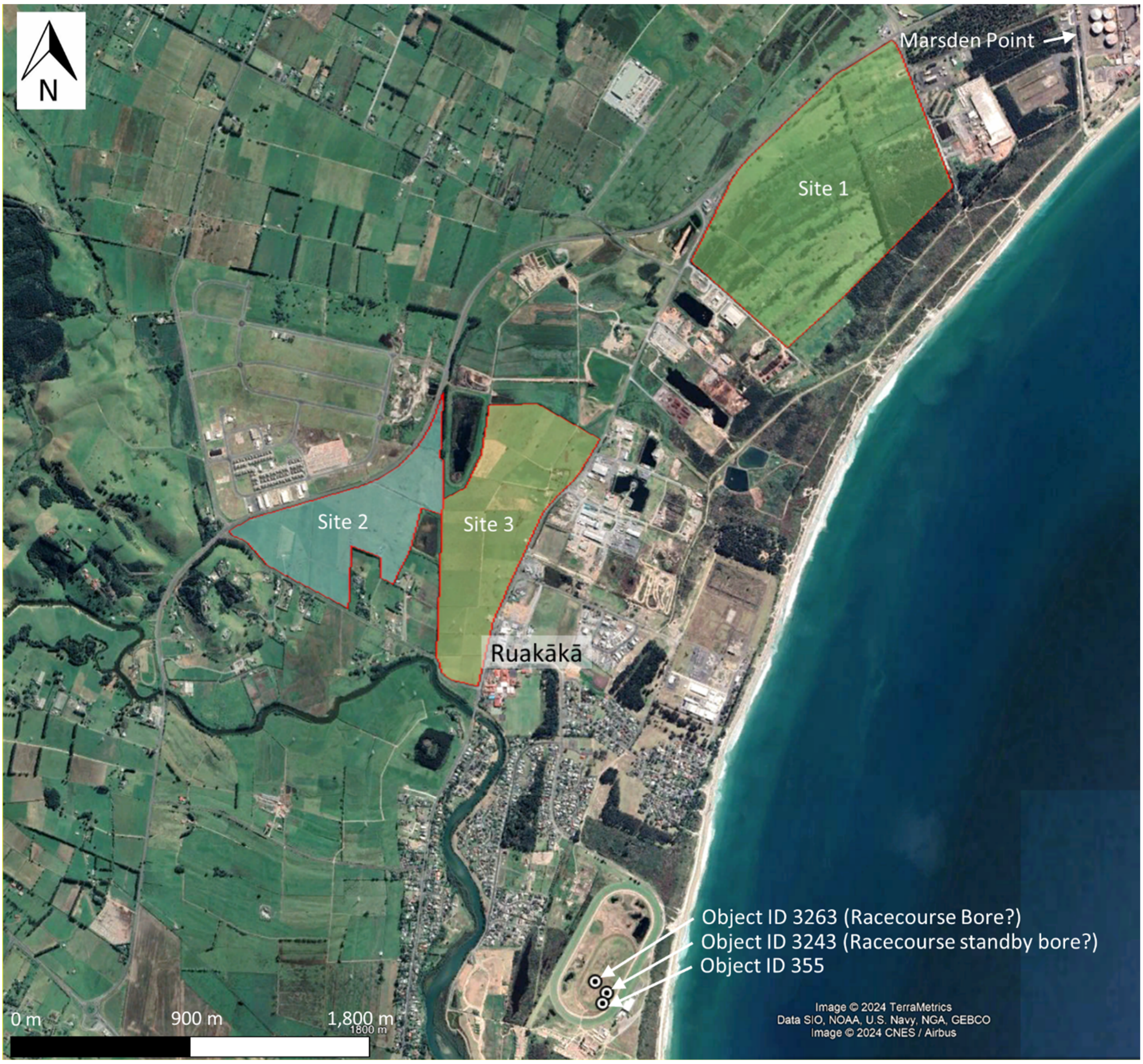

Figure 1: Site locations (image obtained from Google Earth, imagery date 24 March 2023). Location of three bore log records from NRC Bore Log database is shown at Ruakākā Racecourse where long term groundwater level monitoring of two bores by NRC is undertaken. Relative position of the Racecourse bore and the standby bore are inferred based on their spatial position shown in NRC Environmental Data hub.

3 Assessment of Hydrogeological Conditions during Ecological Site Visits

The following presents the likely groundwater level (based on monthly records) and antecedent rainfall at Site 1 during each of the site visits undertaken by Boffa Miskell and NRC to complete their respective ecological assessments. This includes groundwater levels and rainfall for when Google Earth and MEL Drone Imagery was used to support NRC's wetland extents.

Table 1 presents data supplied by Boffa Miskell (columns 1-5), including when they undertook their site visits, the area assessed, along with rainfall 7 days and 1 month prior to the visit. Beca has confirmed the rainfall data using the closest weather station - NRC's rainfall station on Whangārei Harbour at Marsden Point Oil Refinery. Rows 6-7 of Table 1 also set out the groundwater level for that month, as recorded at Ruakākā Racecourse bores by NRC, and the relevant Marsden-Ruakākā Aquifer groundwater level status for that month, as reported by NRC.

Table 1 also includes dates that NRC's ecologist undertook their site visits (highlighted in dark red) and as per above the rainfall, groundwater level and aquifer level status for that day/month. We understand that NRC also determined wetland extents at Site 1 based on Google Earth imagery from 24 March 2023, along with some utilisation of MEL drone imagery flown September 2022. Both are highlighted in orange and includes measured rainfall, groundwater level and aquifer groundwater level status around the time the imagery was used.

Table 1: Dates of site visits and aerial or drone imagery used to identify and delineate wetlands on the Proposed Sites.

Date	Who visited the site	Site area covered during site visit	Rainfall[1] (mm)		Groundwater level	
			7 days prior	1 month prior	Level (m MSL)[2]	Marsden-Ruakākā Aquifer groundwater level status[3]
27 Oct – 2 Nov 2021	Boffa Miskell	Site 1 (A+B+C)	152	255	3.26	Above normal (> 60^{th} percentile)
31 May 2022	Boffa Miskell	Site 1A	29.5	67.5	2.49	Above normal (> 60^{th} percentile)
20 Jun 2022	Boffa Miskell	Site 1 (A+B)	27	177	2.67	Above normal (> 60^{th} percentile)
Sep 2022[4]	No site visit	Drone survey	2-38	64-107	3.12	Above normal (> 60^{th} percentile)
7 & 8 March 2023	Boffa Miskell	Site 1A	0.5	344.5	3.75	Above normal (> 60^{th} percentile)
22-Mar 2023	Boffa Miskell	Site 1B	12	104		
24 Mar 2023[5]	No site visit	Google Earth	9	104		
28 Sept 2023[6]	NRC	Site 1	33	107	2.89	Above normal (> 60^{th} percentile)
5 Oct 2023	NRC	Site 1	22	85	2.85	

[1]: Rainfall data sourced from NRC Rainfall Station: Whangārei Harbour at Marsden Point Oil Refinery.
[2]: Groundwater level data sourced from NRC Groundwater Levels Manual: Ruakākā Race Course standby bore.

[3]: Aquifer level status as per NRC monthly hydrology climate report for month of relevant groundwater level measurement.
[4]: MEL Drone imagery utilised by NRC for their assessment – the exact date of drone survey is unknown hence the maximum range of antecedent rainfall is presented and the water level measured that month.
[5]: We understand Google Earth imagery is one of the main basis for the Council Ecologist's mapping.

As mentioned in Section 2, groundwater level data for this assessment has been sourced from the Ruakākā Racecourse bore and standby bore, both located 3-4 km south of Site 1 at a similar distance from the coastline (i.e., ~300-400 m) (Figure 1). This groundwater data is the closest publicly available data to the site with long term records. Records started in 2003 for the racecourse bore, where water levels were measured quarterly until 2010, then monthly thereafter. Records started in 2009 for the standby bore, which were collected quarterly and changed to monthly in 2010.

The monitoring data indicates an average groundwater level of ~2.6 m above mean sea level at both bores with a typical seasonal variation of ~1.2 m (Figure 2). Note there is limited data available regarding bore construction details. The NRC Bore Logs database[1] indicates three bores are located at the Ruakākā Racecourse with recorded bore depths of 40.5 m, 10 m and an undisclosed depth. The Bore Logs data base records do not indicate which borehole is the Racecourse bore and standby bore however a tentative label has been added to Figure 1 based on their spatial position shown on the NRC monitoring data hub.

The similarity in groundwater level data at each bore (Ruakākā Racecourse bore and standby bore) suggests that the bores may be screened at similar depths (and response zones). Alternatively, it could suggest that minimal hydraulic separation between the shallow and deeper bore exits due to the absence of a low permeability confining unit and both bores intercept an unconfined regional water level. The latter scenario is consistent with the Site 1 ground model presented in Beca's 2023 report, which infers that recent Kariotahi Group dune sands overlie older Kariotahi Group sands to a depth of at least 8 m. The depth to Waipapa Group rock, expected to underlie the Kariotahi Group sand at Site 1, is unproven.

[1] Available at <https://data-nrcgis.opendata.arcgis.com/search?collection=dataset&q=bore>, accessed 5 March 2024

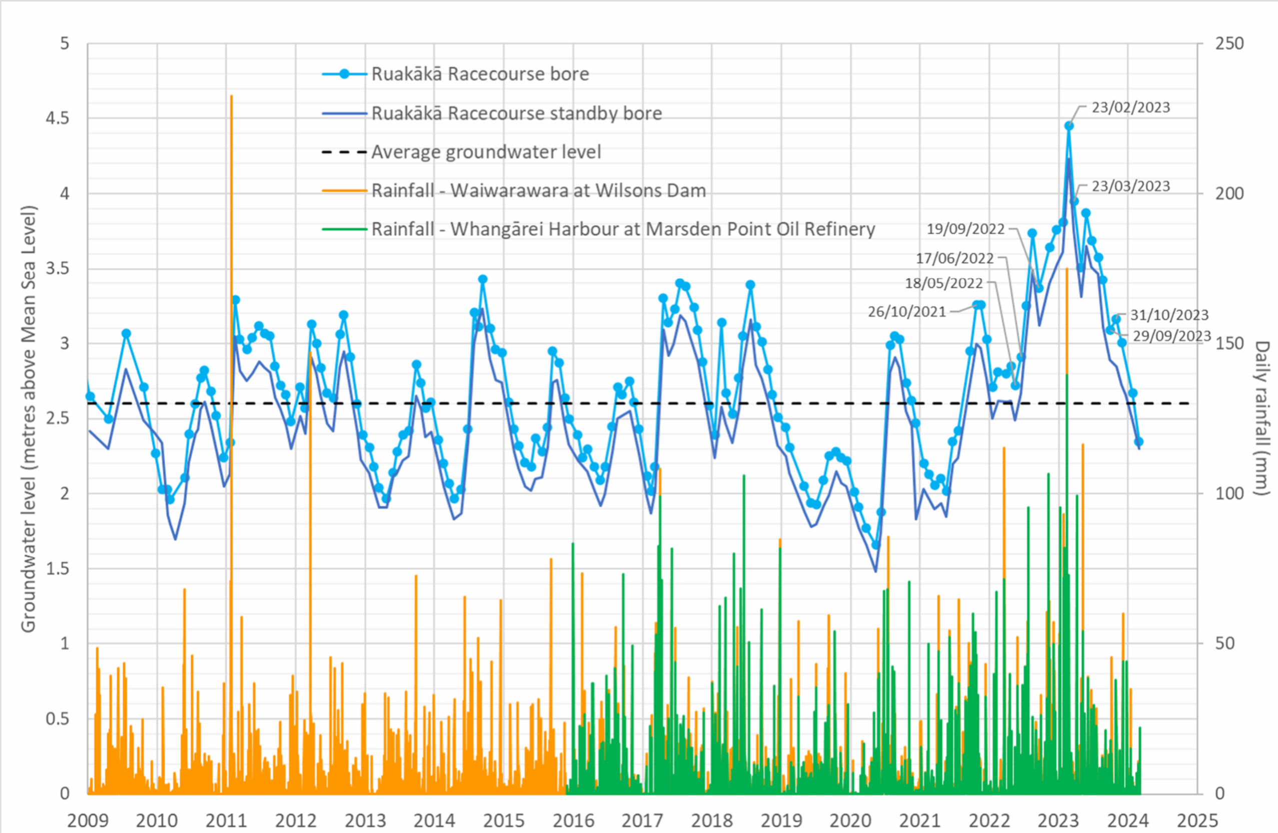

Figure 2: All available monthly groundwater level data from Ruakākā Racecourse bore and standby bore (2009-present), daily rainfall data from Waiwarawara at Wilsons Dam rain gauge (2009-present) and daily rainfall from Whangarei Harbour at Marsden Point Oil Refinery rain gauge (November 2015-present). Average groundwater level of 2.6 m MSL marked by black dashed line. The dates represent when the groundwater level was measured.

For this assessment we have adopted the NRC groundwater level data from Ruakākā Racecourse as being representative of the groundwater level beneath Site 1. It can be seen from Table 1 that the Marsden-Ruakākā Aquifer groundwater level status on the NRC website was ‘above normal’ at the time of all site visits and aerial or drone imagery collection dates. NRC clarifies in their monthly hydrology climate reporting that ‘above normal’ corresponds to greater than 60th percentile of the long-term groundwater level percentile for the month in question; groundwater levels between the 40th and 60th percentiles are considered typical for the month.

Above-normal groundwater levels have been consistently recorded by NRC in the racecourse bore since September 2022. However, Figure 2 best illustrates the magnitude of the groundwater level rise that occurred in March 2023, coinciding with the capture of Google Earth imagery used as the foundation for wetland mapping by NRC:

- In March 2023, a groundwater level of 3.75 m MSL was measured in Ruakākā Racecourse bore, some 1.45 m above the median March level of 2.3 m MSL.
- This followed a particularly wet February 2023, where a groundwater level of 4.45 m MSL was measured in Ruakākā Racecourse bore, some 2.23 m above the median March level of 2.22 m MSL.

These elevated groundwater levels are attributable to the exceptional rainfall in the Northland region in January and February 2023, as illustrated in NRC monthly hydrology climate reporting for those months[2] with some of the heaviest rainfall occurred in the southwest near Ruakākā (Figure 3a and Figure 3b).

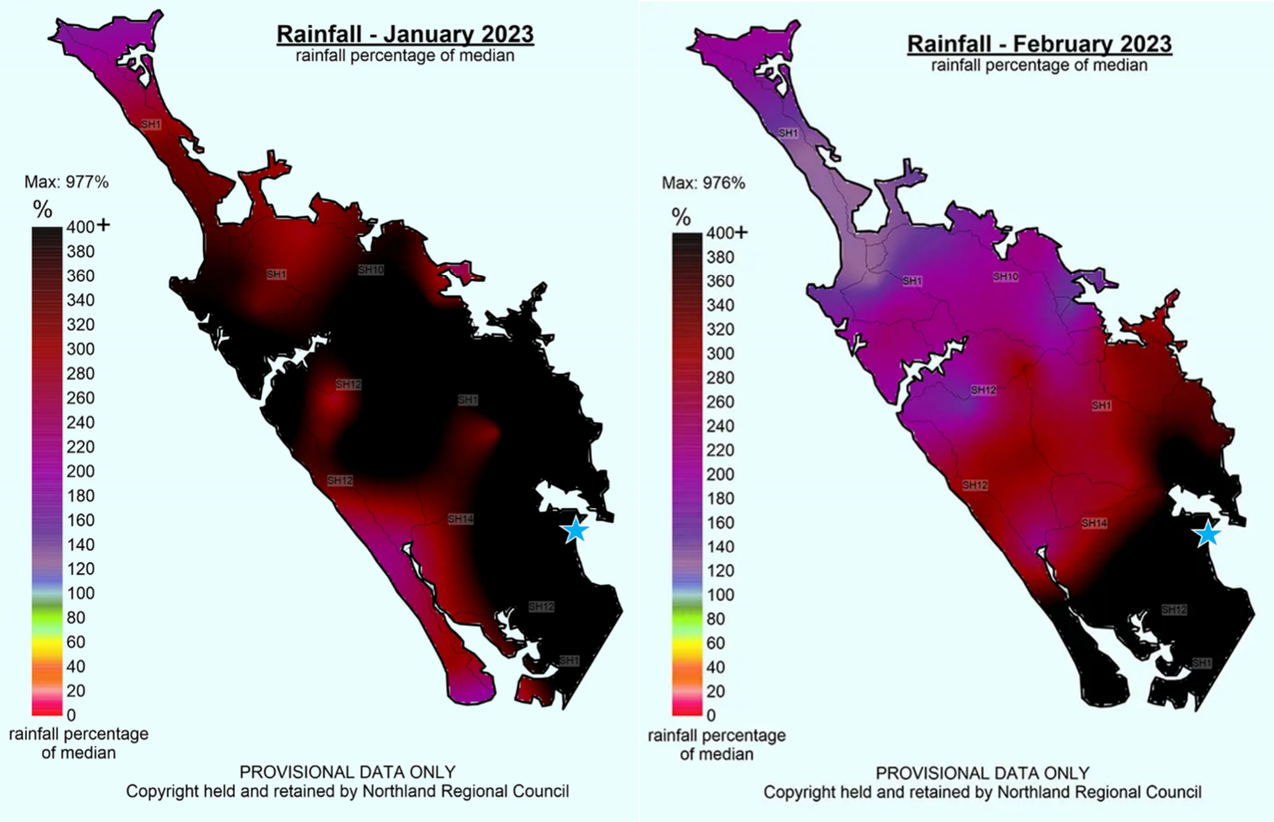

Figure 3a (left) and Figure 3b (right): Monthly rainfall percentage of median for January 2023 (left) and February (right). Sourced from NRC hydrology climate reports for January and February respectively. Ruakākā marked by blue star in both figures.

On the basis of historically high rainfall and groundwater levels, the wetland extents captured by Google Earth imagery on 24 March 2023 represent 'above normal' hydrological conditions with elevated rainfall and groundwater levels likely maintaining wetland water levels and extents beyond those typical.

We understand that NRC also utilised MEL drone imagery flown September 2022, which we note is when seasonally high groundwater level typically occurs, as seen over most years (Figure 2). While the groundwater level measured in September 2022 is similar to past seasonal maxima and therefore representative of normal hydrological conditions, it coincides with the time of year when wetland extents can reasonably be expected to be at their greatest.

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[2] January 2023 climate report available at [Hydrology climate report - Northland Regional Council - January 2023 climate report - Northland Regional Council (nrc.govt.nz)](), accessed 4 March 2023.

February 2023 climate report available at [Hydrology climate report - Northland Regional Council - February 2023 climate report - Northland Regional Council (nrc.govt.nz)](), accessed 4 March 2023.

4 Conclusions

Site 1 of the proposed MEL solar farm predominately consists of undulating sand dunes with wetlands common in the interdune troughs across the site. Based on geotechnical testing and a site walkover by Beca, the groundwater level at the site is expected to be shallow, particularly along dune troughs. This is supported by long term groundwater level monitoring by NRC of Ruakākā Racecourse bore which indicates an average groundwater level of ~2.6 m above mean sea level (MSL) with a typical seasonal variation of ~1.2 m.

Elevated groundwater levels have been recorded at Ruakākā from approximately September 2022 to August 2023, which coincides with the dates of all site visits and aerial or drone imagery used to identify and delineate wetlands on the Proposed Sites. The cause of the elevated groundwater levels over this period are likely attributable to seasonally high rainfall in September 2022 (normal) followed by exceptionally high rainfall in January and February 2023. It is likely that wetland mapping based on site visits undertaken and aerial or drone imagery captured during this time, particularly March 2023, may overestimate typical wetland extents.

5 Applicability

This letter has been prepared by Beca Limited (Beca) on the specific instructions of Meridian Energy Limited (Client). It is solely for our Client's use for the purpose for which it is intended in accordance with the agreed scope of work. Any use or reliance by any person contrary to the above, to which Beca has not given its prior written consent, is at that person's own risk.

Should you be in any doubt as to the applicability of this report and/or its recommendations for the proposed development as described herein, and/or encounter materials on site that differ from those described herein, it is essential that you discuss these issues with the authors before proceeding with any work based on this document.

In preparing this report Beca has relied on key information including the following:

- Email detailing dates of site visits by Boffa Miskall ecologist or Northland Regional Council ecologist and dates of aerial or drone imagery used by Boffa Miskall or Northland Regional Council to identify and delineate wetlands on the Proposed Sites (email) provided by Boffa Miskall to Beca on 4 March 2024.
- Rainfall data sourced from NRC Rainfall Station Whangārei Harbour at Marsden Point Oil Refinery and Waiwarawara at Wilsons Dam, and groundwater level data sourced from Ruakākā Racecourse bore and standby bore. Data available from <https://www.nrc.govt.nz/environment/environmental-data/environmental-data-hub>, accessed 5 March 2024
- Northland Regional Council monthly hydrology climate reports. Available from <https://www.nrc.govt.nz/environment/environmental-data/hydrology-climate-report>, accessed 4 March 2024
- Northland Regional Council Bore Logs data set. Available from <https://data-nrcgis.opendata.arcgis.com/search?collection=dataset&q=bore>, accessed 5 March 2024

Unless specifically stated otherwise in this report, Beca has relied on the accuracy, completeness, currency and sufficiency of all information provided to it by, or on behalf of, the Client, including the information listed above, and has not sought independently to verify the information provided.

This report should be read in full, having regard to all stated assumptions, limitations and disclaimers. No part of this report shall be taken out of context and, to the maximum extent permitted by law, no responsibility is accepted by Beca for the use of any part of this report in any context, or for any purpose, other than that stated herein.

6 References

Beca, 2023. *Preliminary Geotechnical Assessment Report - Ruakākā Energy Park Solar Farm*. Report prepared for Meridian Energy Ltd by Beca Limited, dated 31 May 2023.

Yours sincerely

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