# Kaimai Wind Farm: Supplementary Ecology Report

Report Number: 1708069-02

Prepared for: Ventus Energy (NZ) Limited

14 June 2018

ECOLOGY NEW ZEALAND

# CONTENTS

# 1.0 INTRODUCTION

This report[1], prepared by Ecology New Zealand Limited (ENZL) for Ventus Energy (NZ) Limited ('the client'), presents the results of supplementary ecological investigations undertaken as part of the proposed Kaimai Wind Farm Project. It is intended that this report be read in conjunction with the main Ecological Effects Assessment (Kessels EEA) report prepared for the Project by Kessels Ecology (Kessels)[2]. A full introduction and context to this Project is detailed within Section 1 of the Kessels report.

## 1.1 Overview of Ecological Investigations

The EEA prepared by Kessels provides a robust assessment of actual and potential ecological effects associated with the construction and operation of the proposed Kaimai Wind Farm. The ecological investigations undertaken by Kessels were conducted from 2009 to 2017 and provide robust multi-year ecological datasets that informed the ecological effects assessment. Key ecological matters covered in the Kessels report include vegetation communities, bats, avifauna, herpetofauna, invertebrates and freshwater ecology. The findings of those investigations are described in detail in Section 6 of the Kessels report with recommendations for management provided in Section 7.

A gap analysis of the Kessels EEA carried out by ENZL identified additional ecological investigations that would be required to ensure a comprehensive ecological assessment package would be provided with the consent application(s). This supplementary ecological report is aimed at broadening the conclusions summarised within these overarching ecological works and providing further details where knowledge gaps were identified. Specifically, this report is aimed at providing:

- A targeted ecological assessment of the proposed clearance of an area of mature native treeland for the construction of a wind turbine;
- An investigation into bat distribution and activity patterns across the wider Project area; and
- An ecological assessment of proposed culvert upgrades,

[1] This report is subject to the Report Limitations provided in Attachment A.

[2] Kessels Ecology, March 2018. Kaimai Wind Farm, Ecological Effects Assessment March 2018

# 2.0 TURBINE 13 BUSH ASSESSMENT

## 2.1 Proposed Works

The Turbine 13 site has been identified as being suitably positioned along a ridge for the establishment of a turbine (Figure 1). The client has requested an assessment of this bush fragment to assess the ecological effects of establishing a turbine in this location. Within the Kessels EEA it was noted that the complete removal of this bush fragment would not be required. Based on designs provided, works associated with Turbine 13 will require the removal of approximately 1,500m$^2$ (i.e. 15%) of an area of approximately 1ha of near contiguous native treeland. This cleared area would then be subjected to earthworks to facilitate turbine installation.

## 2.2 Methodologies

An assessment of the treeland fragment's botanical values was presented within the Kessels EEA report. Two ENZL ecologists carried out a walkover at the site on 16th March 2018 to further assess the ecological values of the fragment, and to verify and supplement the assessment of effects provided in the Kessels EEA.

Vegetation communities and potential terrestrial fauna habitats across the subject site were inspected during the walkover to assess ecological values. Inspections were focused on assessing potential habitats for indigenous fauna such as herpetofauna, bats, and avifauna. The habitat assessments were used in conjunction with searches of relevant fauna databases in order to determine the likely values of indigenous fauna communities across the site. Fauna databases accessed included the Department of Conservation (DOC) herpetofauna BioWeb databases and DOC's bat distribution database. Representative photographs of ecological communities and features were taken to support the results of the assessment.

During the site assessment, manual habitat searches were undertaken to determine whether any native herpetofauna species are present. Manual searches included visually scanning terrestrial habitats and, where present, arboreal habitat for active lizards. Targeted active searches included manually lifting suitable refugia for terrestrial herpetofauna (e.g., woody debris).

A list of all bird species seen or heard across the Turbine 13 site and immediate surrounds of the site was compiled during the site walkover. This followed an extended five-minute bird count methodology whereby all birds seen and/or heard were noted.

## 2.3 Assessment of Ecological Values

The subject bush fragment's vegetation is best described as secondary podocarp-broadleaf treeland characteristic of '*Tawa, kohekohe, rewarewa, hinau, podocarp forest*'. Due to current and historic stock access into this area, the bush fragment completely lacks an understorey and is considered no more than moderate in quality. Livestock were observed within this bush area at the time of assessment. The vegetation composition is predominantly comprised of totara (*Podocarpus totara*) with notable areas of tawa (*Beilschmiedia tawa*), puriri (*Vitex lucens*), and kohekohe (*Dysoxylum spectabile*); further interspersed with a number of other mature natives including pigeonwood (*Hedycarya arborea*), rewarewa (*Knightia excelsa*), kahikatea (*Dacrycarpus dacridioides*), rimu (*Dacrydium cupressinum*), karamu (*Coprosma robusta*), cabbage tree (*Cordyline australis*) and gully tree fern (*Dicksonia squarrosa*).

A small amount of epiphyte growth (*Pyrrosia elaegnifolia*. *Astelia* sp. and *Meterosideros* sp.) and abundant lichen (*Physcia* sp.) were likewise documented within the bush fragment.

There are no obligations or expectations for the land owner to protect this bush block with fencing or any other means. Consequently, it is expected that a lack of understorey regeneration due to ongoing stock assess will eventually result in this bush fragment ultimately collapsing as it will be unable to regenerate naturally.

The bush fragment provides moderate quality habitat for native fauna. The mature trees onsite offered suitable habitat for several native bird species; with the presence of two disused nests confirming this suitability. A single kereru (*Hemiphaga novaeseelandiae,* Not Threatened[3]) was observed flying through the bush fragment during the assessment. Due to the close proximity of the site to the Kaimai-Mamaku Conservation Park to the west, and Significant Natural Areas (SNAs) of native forest to the north and south, it is likely that further native bird species intermittently utilise this site. These are likely to include species such as grey warbler (*Gerygone igata*), bellbird (*Anthornis melanura melanura*), tui (*Prosthemadera novaeseelandiae novaeseelandiae*), silvereye (*Zosterops lateralis lateralis*), and morepork (*Ninox novaeseelandiae novaeseelandiae*).

Several trees with sizes greater than 60cm DBH (Diameter at Breast Height) could provide suitable roosting cavities for long-tailed bats (*Chalinolobus turberculatus*, Nationally critical[4]). The presence of this species has been confirmed approximately from the site during the targeted bat surveys described within Section 3 of this report. The highly mobile and transient roosting behaviour of this species, and confirmed presence within close proximity to this site, means that there is a possibility that bats could be roosting within the remnant bush fragment within at any given time.

Based on the visual habitat inspections, the bush fragment appeared to provide marginal quality habitat for terrestrial herpetofauna due to a heavily grazed and trampled understorey with no lower tier vegetation. Despite this, four copper skinks (*Oligosoma aeneum*, Not Threatened[5]), including juveniles, representing a local population were detected dwelling under woody debris items on the edge of the bush fragment within grassland habitat (Figure 1). An additional population of copper skink was detected in an open paddock under a cluster of woody debris items approximately 600m north of the site. Both adults and neonates were detected at this second site. Given the proximity of the site to the Kaimai-Mamaku Conservation Park in addition to historical records of up to 18 herpetofauna species within the wider local area[3], there is a likelihood that further species may be on site within the arboreal habitats provided by contiguous mature tree land. In particular, species potentially on site could include forest gecko (*Mokopirirakau granulatus,* At Risk) and striped skink (*Oligosoma striatum,* At Risk). Due to the site's position on a ridgeline, the site did not contain any significant freshwater values. As such, native aquatic fauna and semi-aquatic fauna values are absent within the subject site.

Scattered kauri (*Agathis asustralis,* At Risk) were noted across the wider Project area, however none were documented within the subject bush fragment.

[3] Robertson, H.A.; Baird, K.; Dowding, J.E.; Elliott, G.P.; Hitchmough, R.A.; Miskelly, C.M.; McArthur, N.; O'Donnell, C.F.J.; Sagar, P.M.; Scofield, R.P.; Taylor, G.A. 2017: Conservation status of New Zealand birds, 2016. New Zealand Threat Classification Series 19. Department of Conservation, Wellington. 23 p.

[4] O'Donnell, C.F.J.; Borkin, K.M.; Christie, J.E.; Lloyd, B.; Parsons, S.; Hitchmough, R.A. 2018: Conservation status of New Zealand bats, 2017. New Zealand Threat Classification Series 21. Department of Conservation, Wellington. 4 p

[5] Hitchmough, R.; Barr, B.; Lettink,M.; Monks, J.; Reardon, J.; Tocher, M.; van Winkel, D.; Rolfe, J. 2016: Conservation status of New Zealand reptiles, 2015. New Zealand Threat Classification Series 17. Department of Conservation, Wellington. 14 p

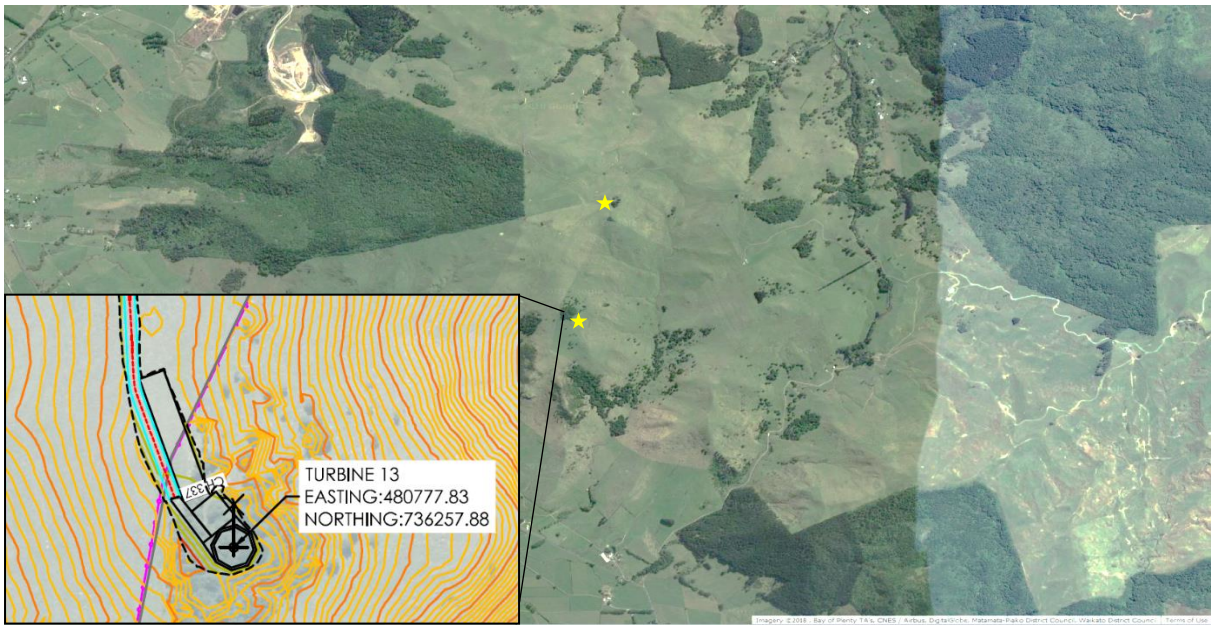



Figure 1: Locations of the treeland fragment at the Turbine 13 site and two copper skink popuations (*Yellow stars*).

## 2.4 Assessment of Ecological Effects

The Project will require the removal of approximately 1,700m2 of a 1.15ha fragment of contiguous podocarp-broadleaf treeland[6]. As described in Section 2.1 above, the clearance will impact canopy, subcanopy and epiphyte/vine species. Lower tier vegetation (e.g., groundcover and shrub species) will not be impacted due to the current absence of understorey vegetation. The relevant Hauraki District Plan map (Map 29) shows that the treeland fragment has not been identified as a Significant Natural Area; thus, significant and protected regional biodiversity values will not be affected. No kauri were identified within the Turbine 13 site during the assessment.

The clearance of native vegetation will directly remove some habitat for native birds. Due to their highly mobile nature, it is likely that direct impacts on adult forest birds on-site will be largely avoided as they are expected to disperse to other habitat during vegetation clearance. Potential impacts on nesting adult native birds, and both their eggs and unfledged chicks should be avoided/minimised by only clearing vegetation outside of the peak of the breeding season for native forest bird species (October to February inclusive). If vegetation clearance during the peak of the bird breeding season is unavoidable, then those areas should be checked by a suitably qualified ecologist for nesting birds immediately prior to vegetation removal and, if any active nests (i.e. one or more viable eggs or live chicks are present) are detected, vegetation clearance in the immediate vicinity of the nest (e.g., within a 10m radius) should be delayed until a suitably qualified ecologist confirms that any nests present are no longer active.

Though bat habitat on within the subject bush pocket is limited to a few suitable trees and associated epiphytes, it is considered that there is a risk of injury and/or death of protected bats during tree felling. This is especially the case given that bats have been documented within 500m of the site (Figure 2). Vegetation removal protocols aimed at protecting bats are recommended for implementation prior to felling trees >15cm DBH within the treeland fragment in order to avoid/minimise these potential impacts. As described below in section 3, the clearance at the Turbine 13 site avoids the long-tailed bat feeding

[6] Kessels Ecology, March 2018. Kaimai Wind Farm, Ecological Effects Assessment March 2018

sites identified during surveys. Turbine 13 is located over one kilometre from the nearest confirmed long-tailed bat feeding area and the possible roosting area described in Section 3 of this report.

Actual and potential habitats for several native lizard species are present across the site as described above in section 2.3. Vegetation removal and earthworks therefore pose a direct risk of impacts on protected native lizards including the species confirmed to be present and those potentially on site but not detected to date. This is highlighted by the presence of lizards within vegetation proposed for clearance within the Turbine 13 bush fragment pocket and within the works footprint for the construction of vehicle access to Turbines 11, 12 and 13. Both areas containing relict populations of copper skink. Without mitigation, it is likely that the proposed vegetation clearance and earthworks will adversely affect native lizards (e.g., by causing injury, death or displacement). It is therefore recommended that prior to any vegetation clearance and earthworks, an appropriately qualified and DOC-approved herpetologist/ecologist should implement appropriate lizard management prior to and during vegetation removal and earthworks. A Project-specific Wildlife Act permit will be required by the Department of Conservation to salvage and relocate native lizards.

# 3.0 SUPPLEMENTARY BAT SURVEYS

## 3.1 Context

As part of the proposed Kaimai Wind Farm Project, Ecology New Zealand Limited (ENZL) was commissioned to carry out supplementary native bat monitoring across the proposed wind farm site and surrounding areas. Preliminary bat surveys were undertaken by Kessels during 4 – 17 January 2013 and 22 September – 27 October 2015. The preliminary surveys confirmed the presence of long-tailed bats (*Chalinolobus tuberculatus*) within the site. Supplementary bat monitoring by ENZL was undertaken to provide a robust assessment of bat distribution and activity across the wider Project area, including areas within the wind farm area as well as off-site areas/habitats. The findings of the supplementary bat investigations support and improve impact assessments for this protected native species.

ENZL's bat monitoring programme utilised historical sites where monitoring had been previously undertaken (by Kessels Ecology), as well as at additional lower altitude sites positioned further from the proposed Wind Farm. It is intended that the sites used in this supplementary monitoring work can be used to monitor bats during both the construction and operational phase of the Wind Farm.

## 3.2 Methodologies

Bat monitoring was undertaken by ENZL using nocturnal acoustic surveys using the latest generation of Department of Conservation (DOC) issue VR4 Automatic Bat Monitors (ABM). These ABMs work by capturing a spectrogram image of ultrasound bat echolocation calls which are then identified and interpreted with DOC's BatSearch v3.11 software. These ABMs were set to record data from one hour before sunset to one hour after sunrise. Due to erratic background noise caused by wind, rain, insects, rodents and faint readings, which can make recordings difficult to interpret, ABM data can only be interpreted by an experienced bat ecologist; i.e. an ecologist that is listed on DOC's bat competency register as being endorsed at the Class B competency level.

A total of four ABMs were set on 16 March 2018 within lower altitude areas away from the proposed ridgeline wind turbine footprints (Figure 2). These ABMs were positioned away from wind turbine areas to target bat activity within the wider Project area to provide context for the bat activity recorded within the wind farm area, and to provide a baseline dataset for future monitoring works. The inclusion of off-site locations provides for the investigation of bats shifting activity away from the wind farm area during construction and/or once the wind farm is operational.

A further 13 ABMs were installed over 4 and 5 April 2018 across sites previously surveyed by Kessels. These ABMs were also set to record bat activity data from one hour before sunset to one hour after sunrise. The positioning of these ABMs was guided by the survey location map within the Kessels EEA which showed the approximate locations of their bat monitoring sites. Where historical sites were closely clustered, a single representative ABM was set by ENZL. A single historic site (Attachment A, site B19), located south of the Wind Farm was not surveyed by ENZL due to equipment failure.

ABMs were retrieved from the field on the 26th and 27th of April 2018.

ABM data were initially processed for bat presence/absence in BatSearch 3.11 software by suitably experienced and competent bat ecologists. Bat activity is measured as bat passes which are defined as a recorded sound file with identifiable bat calls. Data were processed to exclude from subsequent analyses any bat activity data obtained on nights which did not meet the criteria for a valid survey night. A night was deemed 'valid' for all ABMs if bat activity was detected on any one or more of the ABMs during that night. The mean number of bat passes was calculated for each bat monitoring site

by dividing the total number of bat passes recorded there by the number of valid nights of recordings obtained. Bat activity levels were categorized as low (mean number of bat passes per night <1), medium (1-10 passes per night) or high (>10 passes per night). Bat feeding activity as indicated by the occurrence of 'feeding buzzes' was documented where present (see section 3.4 below). Data were summarised and graphed using a series of ENZL-developed Microsoft Excel pivot tables to analyse for the timing of bat activity. The timing of bat activity was investigated to assess whether the activity patterns recorded provided an indication of potential roosting activity in the vicinity of any ABMs.

## 3.3 Bat Activity Levels

ABM locations and bat activity levels are presented in Figure 2 below. A total of 1,612 long-tailed bat passes were recorded during the ENZL bat survey. No short-tailed bats were detected at any monitoring site. Long-tailed bats were detected at all but one of the survey sites. Six of the 17 ABMs were found on the ground on retrieval; most likely due to the large storm that impacted New Zealand on 10 April 2018 (Table 1). ABM 09 which recorded no bat passes was found on the ground and appeared to have malfunctioned.

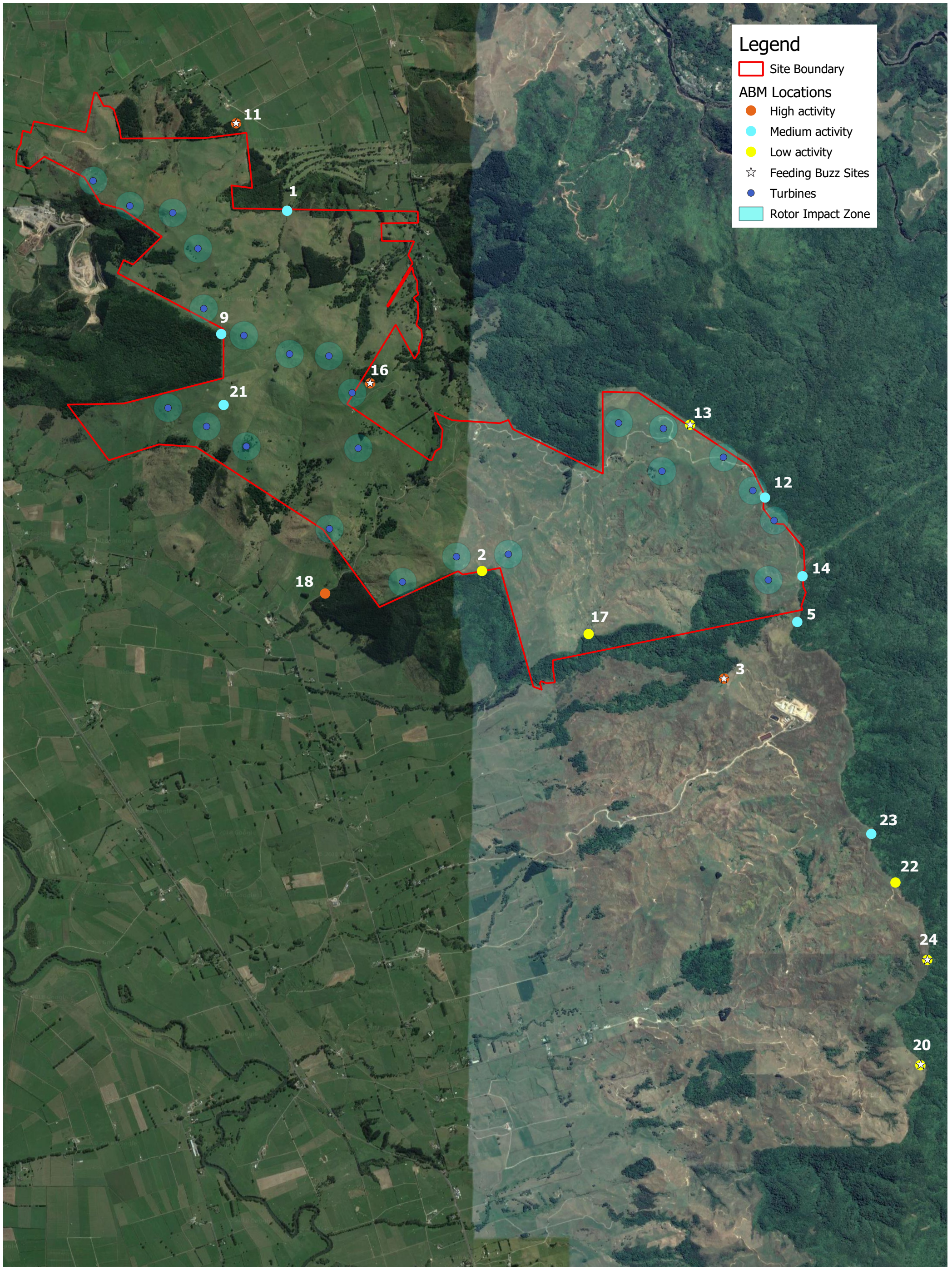
Long-tailed bat activity at all monitoring sites is summarised in Table 1 below. Relatively high levels of long-tailed bat activity were recorded at ABM sites 03, 11, 16 and 18. ABM 03 was positioned on the edge of mature native bush (Figure 3). This area was fenced from stock access and had a diverse native understorey. ABM 18 was positioned approximately five metres into a block of pine trees (Figure 4). Of note, this area contained limited understorey and had a permanent watercourse which flowed adjacent to the ABM. ABM 11 was positioned on the edge of a stand of pine which contained a small pond with areas of open water (Figure 5). Finally, ABM16 was located on the edge of an area of unfenced mature treeland (Figure 6). Due to stock access, the bush lacked understorey. The significance of ABM sites 3 and 16 are further highlighted in section 3.4 below. Moderate levels of bat activity were recorded at ABMs 02, 13, 20, 22 and 24. Low levels of bat activity were recorded at all other ABM monitoring sites.

Bat activity levels were found to be highest outside of the Project boundaries. Three of the four ABM sites with relatively high levels of activity areas (ABM 03, 11 and 18) are located outside of the Project boundary. These ABMs were located from approximately 500m to 1,200m away from the nearest turbine locations.

*Table 1: Long-tailed bat activity at ABM sites (in ascending order of bat activity level)*

| ABM | Valid Survey Nights | Survey Nights with bats | Total Bat Passes | Mean Bat Passes |
|---|---|---|---|---|
| **ABM 09*** | 0 | 0 | 0 | 0.00 |
| **ABM 12*** | 6 | 1 | 1 | 0.17 |
| **ABM 14*** | 11 | 2 | 2 | 0.18 |
| **ABM 01** | 5 | 1 | 1 | 0.20 |
| **ABM 23*** | 12 | 3 | 5 | 0.42 |
| **ABM 05** | 14 | 7 | 11 | 0.79 |
| **ABM 21** | 12 | 6 | 10 | 0.83 |
| **ABM 17** | 9 | 6 | 9 | 1.00 |
| **ABM 02*** | 10 | 5 | 23 | 2.30 |
| **ABM 24** | 27 | 18 | 92 | 3.41 |
| **ABM 20** | 12 | 6 | 54 | 4.50 |
| **ABM 13** | 14 | 10 | 69 | 4.93 |
| **ABM 22** | 7 | 6 | 40 | 5.71 |
| **ABM 11** | 37 | 37 | 569 | 15.38 |
| **ABM 18** | 5 | 5 | 98 | 19.60 |
| **ABM 16*** | 12 | 12 | 236 | 19.67 |
| **ABM 03** | 14 | 12 | 392 | 28.00 |

*ABMs found on the ground on retrieval

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**Kaimai Wind Farm Project**

Bat Acoustic Survey

**Date: 7 June 2018| Revision : 2**

Plan prepared for Ventus Energy by Ecology New Zealand Limited
Author: stephanie.angove-emery@ecologynz.nz |
Checked: SCh

Figure 3: Representative photo of ABM 03 site

Figure 4: Representative photo of ABM 18 site

Figure 5: Representative photo of ABM 11 site

Figure 6: Representative photo of ABM 16 site

## 3.4 Bat Foraging

A marked change in bat echolocation can be used to distinguish foraging activity. These changes are characterised by 'search phase' echolocation calls which transition to that of a more rapid 'approach phase' echolocation and ultimately a 'feeding buzz'. Feeding buzzes were recorded at six sites as summarised in Table 2.

*Table 2: Long-tailed bat foraging activity*

| ABM | Number of Feeding Buzzes | Number of Feeding Events | Days with Feeding Activity | Valid Survey Nights | Average # of days with Feeding Activity |
|---|---|---|---|---|---|
| **ABM 16** | 23 | 12 | 7 | 12 | 0.58 |
| **ABM 03** | 24 | 13 | 8 | 14 | 0.57 |
| **ABM 11** | 9 | 7 | 7 | 37 | 0.19 |
| **ABM 13** | 2 | 2 | 2 | 14 | 0.14 |
| **ABM 20** | 1 | 1 | 1 | 12 | 0.08 |
| **ABM 24** | 1 | 1 | 1 | 27 | 0.04 |

Long-tailed bat foraging was detected at a total of six ABM locations across the survey areas (Table 2 and Figure 2). These included areas both within and outside of the Projects boundaries. Where feeding activity was detected on an ABM, an 'average number of days with feeding' was determined by calculating the number of days with feeding against the number of valid survey nights (Table 2).

Two key foraging areas were detected during surveys, these being located at ABMs 03 and 16. Both of these ABMs recorded foraging activity on approximately 60% of valid survey nights during the survey period. ABM 03 was positioned immediately south of the Project boundary and approximately 900m from the nearest turbine location (Turbine 24) whilst ABM 16 was located within the Project boundary and approximately 70m from the closest turbine (Turbine 9). Both of these areas were dominated by mature native forest, however, one contained dense native understorey (ABM 03) and another consists of mature treeland (ABM 16). An exotic pine stand outside of the Project boundaries (ABM 11) also appears to provide suitable foraging habitat for bats, with feeding buzzes detected on approximately 20% of valid survey nights.

To further interpret feeding activity data, these recordings were categorised into feeding events whereby feeding buzzes which occurred in 30-minute window were documented as a single event. As summarised in Table 2, a total of 12 individual feeding events were recorded at ABM 16 and 24 feeding events were recorded at ABM 03.

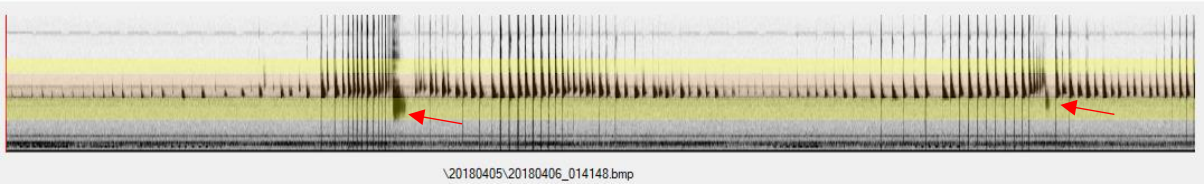


Figure 7: Feeding buzzes detected at ABM 03

## 3.5 Bat Roosting

Where suitable bat roosting habitat exits, it is sometimes possible to infer indicative roosting activity through the interpretation of the timing of bat activity. Bat roosting can be indicated by a peak in dusk activity as bats depart the roost, followed by a peak in dawn activity as bats return to the roost. No clear roosting activity was identified at any ABM monitoring site, which may indicate that bats are roosting elsewhere (i.e. off-site). This being due to multiple factors including the restricted recording distance of ABMs and the transient roosting nature of long-tailed bats.

## 3.6 Discussion and Summary of Findings

Long-tailed bat threat status was described in the Kessels EEA report as Nationally Vulnerable. Genetic research has recently led to the reclassification of long-tailed bats as a single species (previously broken into North and South Island taxa)[7]. The threat status of this species has also been updated and it is now classified as a Threatened - Nationally Critical species. The threat level was

[7] Dool, S.; O'Donnell C.F.J.; Monks, J.M.; Puechmaille, S.J.; Kerth, G. 2016: Phylogeographic-based conservation implications for the New Zealand long-tailed bat, (Chalinolobus tuberculatus): identification of a single ESU and a candidate population for genetic rescue. Conservation Genetics 17: 1067–1079.

increased due to concerns regarding impacts from vespulid wasps, significant habitat loss, and continuing declines being reported within populations without predator control[8].

It has been confirmed that long-tailed bats occur across the western extents of the Kaimai Mamaku Forest, both within and outside of the Project boundaries. These bats were detected commuting across the ridgeline edge of this forest and down through lower altitude areas to the west of the Project site. The landscape in the lower altitude western areas provide habitat comprised of a mosaic of farmland, plantation forest and pockets of remnant forest. These results indicate that long-tailed bats are utilising wide areas across the local landscape. With the exception of four sites where high bat activity levels were recorded, activity levels across the Project site and wider landscape were moderate or low.

The 2013 and 2015 bat surveys undertaken by Kessels Ecology indicated the presence of bats across 63% (8 ABMs) and 59%. (19ABMs) of survey sites respectively. In comparison, the results of the survey undertaken for this report indicate bats were detected at 95% of all surveyed sites (noting ABM 9 malfunctioned). With the exception to the ABM 9 site, these confirmed the presence of bats in all areas previously surveyed by Kessels. Of particular note, surveys undertaken at the ABM 16 site by Kessels (referred to as K1 within the Kessels EEA) did not show any bat presence. In contrast, ENZLs survey indicate that this site displayed overall moderate bat activity, and within context of the site, the second highest area for bat activity. The results of the 2018 bat survey data obtained from ABM 02 and ABM 12 now confirm the presence of long-tailed bats in these areas and updates previous absence within the Kessels report.

Foraging areas not previously noted were identified during ENZLs March/April 2018 surveys. The most notable of which occurred immediately south of the Project boundary (ABM 03) and the second within the northern extent of the Project site (ABM 16). These areas did not overlap with any identified rotor impact zones associated with the proposed turbine positions, however ABM 16 was found in relatively close proximity

No short-tailed bats were detected during ENZLs survey efforts. This supports prior findings undertaken by Kessels ecology. The closest records of this species lie approximately 70km north of the Projects boundary.

Though no indicative roosting habitat was identified during survey efforts, it is expected that the most abundant and higher quality roosting areas for long-tailed bat lie within the Kaimai Mamaku Forest area.

The above findings expand the knowledge of long-tailed bat distribution and activity patterns across the local landscape. The Kessels EEA concluded that the proposed wind farm poses a potential turbine strike risk for the local bat population (noting that turbine blades may not actually need to make contact with a bat to cause injury or mortality – bats may be killed by barotrauma). That finding is consistent with international studies that have shown that wind farms can cause substantial numbers of bat mortalities. However, a comprehensive multi-year bat strike monitoring programme at the Te Uku Wind Farm (a wind farm of similar scale and within a similar habitat matrix to this Project) provides a strong indication that the actual impact of wind farms on long-tailed bats is not significant[9]. Given that there is some uncertainty regarding the impact of the proposed wind farm on bats, the targeted pest control recommended as bat mitigation in the Kessels EEA is considered appropriate

[8] O'Donnell, C.F.J.; Borkin, K.M.; Christie, J.E.; Lloyd, B.; Parsons, S.; Hitchmough, R.A. 2018: Conservation status of New Zealand bats, 2017. New Zealand Threat Classification Series 21. Department of Conservation, Wellington. 4 p.

[9] Bull, L., Cummings, G. (2014). Project Te Uku Post-construction Avifauna & Bat Monitoring, Year 3 Annual Report Boffa Miskell Ltd

# 4.0 CULVERT UPGRADES

As part of the proposed Kaimai Wind Farm Project, the Project Civil Engineer (M. J. Preston of Civil Engineering Services) has recommended the upgrade of eight culverts on site to avoid/minimise the potential adverse effects of overflow during heavy rainfall events. ENZL has been commissioned to provide recommendations on the ecological management aspects of the proposed culvert upgrades.

The site is drained by several identified catchments (Waikato Regional Council GIS, River Layer) Owhakatina Stream, Raeotepapa Stream, Rotokohu Stream, and Romaru Stream. All of these streams form part of the wider Waihou River catchment. The four stream catchments within the site have not been surveyed extensively therefore their fish diversity is largely unknown. For this reason, all local fish species have not been excluded from assumptions, however, local conditions such as gradients have been factored in.

Three key ecological aspects are considered for the proposed culvert upgrades:

- Fish passage maintenance or improvement;
- Sediment and erosion control; and
- Consideration of potential injury or death of resident fish.

## 4.1 Fish Passage

The design and placement of a culvert can significantly affect or even eliminate the possibility of fish passage upstream. Given the steep gradients of the site's watercourses in general, it is expected that the aquatic habitat is largely utilised by climbing and anguilliform species (this could include koaro [*Galaxias brevipinnis*], short-fin [*Anguilla australis*] and long-fin eels [*Anguilla dieffenbachia*] and to some extent banded kokopu [*Galaxias fasciatus*] shortjaw]) as these species often migrate to higher reaches. Additional species may still make their way past partial barriers (the current culverts) in many cases, however the weaker climbing species will be essentially locked out of potential habitat (and in some instances important breeding sites) if a barrier is present and thus reducing the carrying capacity of the catchment.

It is recommended that culverts be placed well below the level of the current stream bed and material placed in the culvert to replicate the natural stream bed present on site and allow for natural substrate movement. Culverts should be placed at the same gradient and alignment as the stream and the diameter should be equal to or greater than the average stream width – narrower culverts cause a sudden increase in flow rate which can reduce the ability of fish to move through the culvert. Placement should be such that "perching" of the culvert is avoided – if a culvert is above the water level on the downstream side, then there is a gap between two effective stream beds which prevents fish from migrating past this point. If this situation is unavoidable the installation of a fish ladder or similar should be undertaken to maintain connectivity.

## 4.2 Sediment & Erosion Control

Given that some degree of earthworks/excavations are likely to be required to replace the current culverts, there is a risk of significant sediment entering the stream system. Increases in sediment can adversely affect both aquatic fauna and flora by reducing light penetration through the water column, smothering plants and invertebrates, altering flow regime, altering the temperature in the stream and in extreme cases, clogging of the gills of fish. Appropriate sediment and erosion control practices should be put in place before and during earthworks to prevent erosion of the stream banks and of disturbing soil in the riparian zone to prevent any sediment from entering the stream during the culvert upgrades.

## 4.3 Fish Salvage

Where culvert upgrades are likely to lead to the disturbance of the in-stream bed, then a fish salvage should be implemented to avoid impacts on native fish such as injuries or mortalities. Fish salvage would involve the temporary damming and diversion of the stream upstream and downstream of the culvert and then using a combination of electric-fishing and/or netting/trapping, in addition to the supervision of the dewatering process. Any fish salvaged would be relocated downstream so they are not harmed during the culvert upgrade works. A detailed site-specific fish management plan should be prepared before the work is undertaken to ensure that the correct methodologies are selected.

## 4.4 Freshwater Overview

Overall, the culvert upgrades have the potential to increase the ecological value of the site by improving fish passage throughout the site ensuring that previously restricted habitat become accessible. This improvement could be coupled with fencing and riparian restoration of stream headwaters to ensure that there will be a significant benefit to the freshwater environment within the site.

# 5.0 SUMMARY OF RECOMMENDED MITIGATION MEASURES

The key findings of the Kessels EEA report include recommendations to avoid, minimise, remediate and mitigate both actual and potential residual ecological impacts associated with the construction and operation of the Kaimai Wind Farm. These recommendations primarily seek to address key aspects which have the potential to generate adverse ecological effects without appropriate management. The prescribed measures aimed to mitigate these impacts are described in detail in sections 5.1 – 5.6[10]. Where appropriate, ENZL have provided further supporting mitigation recommendations to expand on these recommended mitigation measures. Section 5.1 below is intended to be used as recommended consent conditions for ecological management.

## 5.1 Ecological Management Plan

No less than three months prior to the commencement of any works for, or associated with, the proposed Kaimai Wind Farm Project, a draft Ecological Management Plan (EMP) shall be submitted to the District and Regional Council following consultation with DOC. The EMP shall be prepared by one or more suitably qualified and experienced ecologists and include details of the following minimum requirements:

- Ecological Enhancement Plan (EEP) - this plan shall aim to detail enhancement of the ecological quality of targeted natural features; ideally across the Project site and/or nearby areas. As an option, this may look to provide riparian plantings across the headwaters of several on-site stream reaches, provide on-site pest control and revegetation/restoration plantings to provide contiguity with on-site areas of ecological significance and the adjacent Kaimai Mamaku Forest. These ecological enhancement works would look to contribute to benefiting local biodiversity (including forest birds, invertebrates and fish) and form a part of the larger biodiversity offset mitigation package to address foreseeable ecological impacts.

- Lizard Management Plan (LMP) - This shall aim to mitigate impacts associated with vegetation removal and earthworks required to construct and operate the wind farm. This plan should detail methodologies to salvage and relocate native lizards out these areas prior to and during as well as providing a suitable relocation site of higher quality than where lizards were salvaged. Given that existing copper skink populations occur onsite, this relocation should be an area on-site specifically enhanced for the relocation of this species and any other species that are salvaged. The release site shall be fenced and must contain sufficient suitable habitat for the species and number of lizards relocated. The details of lizard habitat enhancement measures such as planting and predator control shall be provided as part of the LMP.

- Vegetation Removal Protocol (VRP) – A detailed vegetation removal protocol should be developed to mitigate the potential injury and/or mortality of potentially roosting long-tailed bats within the mature treeland proposed for clearance within the Turbine 13 footprint, and any other trees >15cm DBH that are removed as part of the Project. The VRP shall include all appropriate bat management measures detailed within the '*Bat Management Framework for Linear Transport Infrastructure Projects*'[11].

[10] Kessels Ecology, March 2018. Kaimai Wind Farm, Ecological Effects Assessment March 2018

[11] Smith, D., Borkin, K., Jones, C., Lindberg, A., Davies, F., & Eccles, G. (2017). Effects of land transport activities on New Zealand's endemic bat populations: reviews of ecological and regulatory literature (No. 623).

- Fish Management Plan (FMP) – A fish salvage and relocation plan to mitigate potential injury and/or mortality of native fish during the proposed upgrades of eight culverts. This plan shall detail appropriate fish trapping, electrofishing and dewatering supervision methodologies. Where appropriate, this plan will further detail fish passage enhancement to be undertaken across these culverts.

- Monitoring Programme (MP) – monitoring of key fauna species (specifically native long-tailed bats, native herpetofauna and birds) shall be implemented. Monitoring shall focus on relocated lizard populations and bat and bird carcass searches under the operational turbines, for a specified period, in order to monitor the actual effects associated with the operation of the wind farm. Monitoring shall include carcass retrieval and grid searches based on a statistically robust study design for a minimum period of three years post-operation, with associated reporting detailing any bird/bat fatalities, known or likely cause of death and any species, seasonal or spatial patterns. Additional monitoring and/or research may be included in the monitoring programme if appropriate. Examples include a Before-After-Control Impact (BACI) study to investigate changes in bat habitat use and patterns of bat activity, and the use of thermal imaging to investigate bat behaviour at turbine sites.

## 5.2 Migratory Bird Strike Risk Offset/Compensation

Initial strike risk analysis at similar New Zealand sites indicates that turbine strike is possible for wader species and it will be in the range of less than 2-5 birds per annum for the proposed Kaimai Wind Farm. This level of strike risk is considered likely to have a minor adverse effect on the target migratory species[12]. However, given that several migratory species are threatened (e.g., wrybill), offset mitigation may be required to compensate for any residual adverse effects on wader bird species. Quantification of this offset can be addressed at the consenting stage but could involve a contribution to conservation activities by community groups at Miranda, which is a key site for international and national wader birds. Further proposed studies across the Project site which aim to further detail wader collision risks are expected to contribute to this quantification.

## 5.3 Bat Strike Risk Offset/Compensation

The most appropriate method for the mitigation of bats would be to undertake predator control within a nearby area of forest which is known long-tailed bat habitat. This predator control should be comprised of a sustained intensive ground-based pest control programme targeted towards rats, possums, mustelids and feral cats in indigenous forest habitats near the wind farm. The quantification of the area (size and location) where predator control is to be undertaken can be addressed at the consenting stage but could include pockets of significant bush across local landscape, areas within the adjacent Kaimai Mamaku Forest, or a combination of both.

Though the above described predator control is provided as a specific offset for potential impacts on native bats, it is expected that this will further provide multi-species benefits. The targeted removal of mammalian predators would relieve predatory pressures on supplementary biodiversity values which could look to include hochstetters frogs, forest birds and palatable flora species; all of which are found in the local environment.

[12] Kessels Ecology, March 2018. Kaimai Wind Farm, Ecological Effects Assessment March 2018

## 5.4 Sediment and Erosion Control Plan

A sediment and erosion control plan shall be prepared by a suitably qualified and experienced environmental professional. This plan would look to ensure appropriate avoidance and mitigation measures are employed during the construction phase of the Project to manage the risk of runoff entering the sites waterways.

## 5.5 Environmental Weeds

Along the length of the access roads fresh earth exposed during clearance and construction will provide ideal conditions for the further spread of weeds already existing within the area. Furthermore, machinery and aggregate brought in from other areas increases the risk of new weed species establishing within the existing natural areas. Therefore, it is critical that all machinery and aggregate is thoroughly cleaned, or otherwise guaranteed free of attached seed or plant matter before it is brought on site.

## 5.6 Disease Spread

Thus, procedures and measures to prevent the introduction and or spread of kauri dieback and myrtle rust into the area should be developed and implemented. For instance, it is recommended that all equipment brought to site, both during construction and operation, is washed to remove soil prior to entry into the area and all contractors clean their equipment with the appropriate chemicals to kill the spores before undertaking work on the site to avoid any spread of the spores. Advice shall be sought from the Ministry of Primary Industries in regards to Myrtle Rust due to on-going changes in this diseases management.

## 5.7 Residual Ecological Effects

The predicted significance of residual adverse ecological effects for each of the key ecological values following implementation of appropriate avoidance, mitigation and compensation measures are provided in Table 3. This summarised assessments have been drawn from the conclusions of the Kessels EEA and updated or built upon by ENZL where appropriate.

*Table 3: Summary of residual adverse ecological effects after recommended management has been implemented*

| Key Ecological Values | Risk Assessment | Predicted significance of residual adverse effects following implementation of avoidance, mitigation and compensation measures |
|---|---|---|
| **Vegetation** | Localised vegetation clearance to occur for the establishment of a single Turbine footprint | Non-significant effects expected |
| **Long-tailed bats** | Localised vegetation clearance and potential collision risks may impact bats but monitoring at operational wind farms indicates little or no impact on bats. | Non-significant effects expected but with uncertainty. Monitoring and adaptive management to be applied accordingly. |
| **Internal Migratory Avifauna (Waders)** | Flight paths may cross the site. South Island Pied oystercatcher have been detected flying over the site but in low numbers | Non-significant effects expected but with uncertainty. Monitoring and adaptive management to be applied accordingly. |
| **Northern Hemisphere Avifauna Migrants** | Migration pathway(s) may cross the site. Bioacoustic surveys will be carried out during migration periods to reduce uncertainty. | Non-significant effects expected but with some uncertainty. Monitoring and possibly adaptive management/compensation to be applied accordingly. |
| **Resident Avifauna** | Resident native birds (e.g., tui, harrier and kereru, are likely to be present in low numbers. Monitoring at operational wind farm sites indicate very low actual strike rates. | Non-significant effects expected |
| **Local Avifauna Migrants** | Collision may occur during dispersal or localised migration by NZ falcons and North Island kaka, but likely to be rare event | Non-significant effects expected but with uncertainty. Monitoring and adaptive management to be applied accordingly. |
| **Herpetofauna** | Localised in areas of vegetation rank grass clearance | Non-significant effects expected |
| **Terrestrial Invertebrates** | Low - Negligible localised impacts expected for individuals/local populations. | Non-significant effects expected |
| **Freshwater Quality (including aquatic invertebrates)** | Sediment and erosion from construction pose risks to entering the sites waterways. | Non-significant effects expected |
| **Native Fish** | Localised impacts at eight culvert sites across the site. | Non-significant effects expected |
| **Environmental Weeds** | Potential spread and introduction of weeds during the construction and operations phase. | Non-significant effects expected |
| **Disease Spread** | Potential spread and introduction of disease during the construction and operations phase. | Non-significant effects expected |

# 6.0 CONCLUSIONS

Supplementary ecological investigations were carried out by ENZL as an extension to the investigations described in detail within the Kessels EEA. Supplementary investigations included, additional acoustic bat surveys, the assessment of the loss of vegetation for Turbine 13, and the impacts associated with the upgrading of eight culverts. Key findings included the discovery of two populations of copper skink, the extended known distribution of long-tailed bats across the local landscape, and the identification of several long-tailed bat feeding areas. The findings of the Kessels EEA together with those of the supplementary investigations have been used to refine and build upon the recommendations made within the Kessels EEA which are aimed at appropriately managing the actual and potential ecological impacts associated with the construction and long-term operation of 24 wind turbines as part of the Kaimai Wind Farm Project.

# ATTACHMENT A

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