



Terrestrial Ecology Effects Assessment

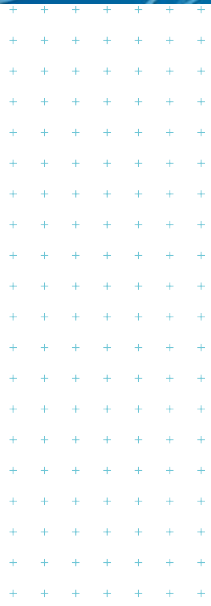
Beachlands South

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Beachlands South Limited Partnership

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Executive Summary

Beachlands South Limited Partnership (BSLP) is seeking a Private Plan Change (PPC) across multiple contiguous properties in Beachlands, Auckland (approximately 307 ha) to expand the existing Beachlands Maraetai coastal town.

The properties included in this PPC process and associated Beachlands South Structure Plan (herein 'Structure Plan') include the Formosa Golf Resort (approximately 170 ha), a farm at 620 Whitford-Maraetai Road (approximately 80 ha) and various smaller land parcels totalling 57 ha.

The PPC area is currently zoned Rural – Countryside Living under the Auckland Unitary Plan – Operative in Part (AUP-OP). Through the Structure Plan, the BSLP are seeking to rezone the land to a combination of Business (Mixed Use, Local Centre and Neighbourhood Centre), Open Spaces, various residential zones and Future Urban zone.

A key focus of the Structure Plan is to enable the urbanisation of the land whilst protecting and enhancing ecologically significant values. To this end, the proposed PPC area includes an Ecological Protected Area Network (EPAN) covering 88.7 hectares. This EPAN includes the most significant existing and potential ecological values, which will be protected from development and enhanced.

Initially it is proposed to 'Live Zone' the northern portion of the PPC area (the 170 ha Formosa Golf Course) via a plan change. It is also proposed to rezone the southern portion of the PPC area as Future Urban Zone. This Future Urban Zone will then be the subject of a further plan change application in due course.

The BSLP has requested that Tonkin & Taylor Ltd (T+T) prepare a terrestrial ecology effects assessment (this document) to inform the development of the Structure Plan and the section 32 analysis that will support the PPC application¹.

This assessment included a desktop investigation as well as field surveys from October 2020 to February 2021. An assessment of ecological effects was then undertaken in accordance with the Environment Institute of Australia and New Zealand ('EIANZ') Ecological Impact Assessment Guidelines ('EciAG') (Roper-Lindsay et al., 2018). Biodiversity modelling (Baber et al. 2021 *a,b,c*) was used to assist in determining the type and magnitude of habitat restoration and enhancement measures that would likely be required to address those residual adverse effects associated with the Live Zone (and more broadly the proposed PPC) that could not be avoided, remedied or mitigated.

Eleven terrestrial vegetation/habitat types and three terrestrial Significant Ecological Areas (SEAs) are present within the proposed PPC area (Table 1). Importantly, no terrestrial SEA vegetation is located within the proposed development area of the Live Zone or Future Urban Zone and almost all of the higher value vegetation is located within the EPAN.

These terrestrial habitat types include or are expected to include a range of native species, including several species listed as nationally 'Threatened' or 'At Risk' as set out in Table 2.

Table 1: Habitat descriptions with the 307 ha PPC area.

Vegetation type	Habitat extent (ha)	IUCN Threat Status/ SEA status
Terrestrial habitat types (areal extent in ha)		
Tawa, kohekohe, rewarewa, hīnau, podocarp forest	4.5	Vulnerable/SEA_T_1141

¹ This work has been undertaken in accordance with our letter of engagement dated 11 December 2020

Taraire, tawa, podocarp forest (WF9).	2.21	Endangered/SEA_T_1140 in part
Pōhutukawa, pūriri, broadleaved forest	0.5	Endangered/SEA_T_4556
Pōhutukawa treeland/flaxland/rockland	0.9	Vulnerable/SEA_T_4556
Kānuka forest (VS2)	4.5	Least Concern
Mānuka, kānuka scrub (VS3)	9.7	Least Concern/buffers SEA_T_1140
Broadleaved species scrub/forest (VS5)	0.03	Least Concern/SEA_T_4556
Native terrestrial plantings (PL)	1.7	Not Threatened
Exotic forest (EF)	14.8	Not Threatened
Exotic-dominated scrub (ES)	16.6	Not Threatened
Managed or rank grassland	ca 240	Not Threatened

Table 2: Nationally ‘Threatened’ or ‘At Risk’ species that are likely or known* to be present within the PPC area.

Nationally ‘Threatened’ or ‘At Risk’ Species	Threat status
Plant species	
Pōhutukawa (<i>Metrosideros excelsa</i>)*	Threatened – Nationally Vulnerable
Kānuka (<i>Kunzea robusta</i>)*	Threatened – Nationally Vulnerable
Akatea (<i>Metrosideros excelsa</i>)*	Threatened – Nationally Vulnerable
Mānuka*	At Risk - Declining
<i>Olearia angulata</i> (planted)*	At Risk – Naturally Uncommon
Bat species	
Long-tailed bat (<i>Chalinolobus tuberculatus</i>)*	Threatened – Nationally Critical
Forest or grassland bird species	
New Zealand pipit (<i>Anthus novaeseelandiae</i>)*	At Risk – Declining
Kākā (<i>Nestor meridionalis</i>)	At Risk – Recovering
Long-tailed cuckoo (<i>Eudynamys taitensis</i>)	Threatened – Nationally Vulnerable
Lizard species	
Ornate skink (<i>Oligosoma ornatum</i>)	At Risk – Declining
Elegant gecko (<i>Naultinus elegans</i>)	At Risk - Declining
Forest gecko (<i>Mokopirirakau granulatus</i>)	At Risk - Declining
Copper skink (<i>Oligosoma aenea</i>)	At Risk - Declining

* = confirmed as present within the PPC area.

The Live Zone comprises the 170 ha Formosa Golf Resort. The Formosa Golf Resort currently consists of open grass fields maintained for golfing purposes, interspersed with rank grass and areas of exotic vegetation. Small patches of regenerating native bush also occur, as does a Significant Ecological Area (SEA) of mature native vegetation on the coastal (western) edge of the golf course. A developed area of approximately 5 ha is present at the centre of the golf course area consisting of buildings and carparks.

The proposed change in land use within the Live Zone has the potential to result in a range of adverse effects on terrestrial ecology values and may include:

- Terrestrial, habitat loss, fragmentation and degradation through earthworks and vegetation clearance.
- Direct mortality or injury to species that may be harmed during vegetation clearance or earthworks activities.
- Construction and operations related noise, vibrations, dust, or lighting effects.
- Ongoing disturbance effects, particularly on habitat margins/edges, through noise, dust and lighting associated with infrastructure and housing and the increased presence of people and introduced species in previously less accessible areas.

Measures to avoid, remedy or mitigate the loss of freshwater wetlands associated with the change in land use activities in the Live Zone (and more broadly the PPC area) were developed through the optioneering and concept design phases of the project and have included:

- Site optimisation during the master-planning phase to avoid or minimise habitat loss of existing and potential high value habitat types and wetlands through the creation of the 88.7 ha EPAN.
- Inclusion of a minimum 10 m native vegetation buffer within or around all native terrestrial habitats within the EPAN. This vegetation buffer lies within the EPAN boundary and is intended to protect all native terrestrial habitats from potential effects associated with the proposed land use change within the Live Zone footprint).
- Seasonal constraints on earthworks or vegetation clearance activities to avoid or minimise effects on eggs or chicks during peak bird breeding season (in compliance with the Wildlife Act 1953).
- Salvage and relocation of lizards and habitat features (e.g. downed logs) from the Live Zone and (Future Urban Zone) into suitable habitats within the EPAN.

After measures to avoid, remedy or mitigate effects on terrestrial ecology values, the proposed land use change within the Live Zone is expected to result in the loss of approximately 1.35 ha of exotic forest, 5.08 ha of exotic scrubland and approximately 100 ha of rank or management exotic grassland. The 'Level of effects' associated with this habitat Loss is assessed as:

- 'High' for the At Risk (declining) copper skink.
- 'Low' or 'Very low' for all other terrestrial ecology values.

Biodiversity Compensation Models have been used to assist with determining the type and magnitude of proposed compensation to address residual effects on terrestrial ecology values within the Live Zone (and Future Urban Zones within the PPC area). Based on these models it is predicted that Net Gain outcomes will be achieved within 20 years of commencement for all terrestrial biodiversity values. As required by proposed precinct provisions, these anticipated Net Gain outcomes will be verified through biodiversity outcome monitoring, which will also guide adaptive management/contingency measures as required.

Compensation is proposed to address residual effects on terrestrial biodiversity values and is centred on habitat restoration and enhancement measures within the 88.7 ha EPAN including:

- 30.8 ha of terrestrial revegetation into all available areas within the network, which will generate habitat for terrestrial biodiversity; and
- Mammalian and invasive weed pest control within the entire network for 35 years, which will further protect and enhance terrestrial and wetland biodiversity values.

Additionally, freshwater wetland and stream habitat restoration and enhancement measures within the EPAN will also provide benefits for terrestrial biodiversity. These measures include, in particular wetland buffer plantings around the margins (10 m width) of wetlands and 8.8 ha of stream riparian planting.

We conclude that if the above terrestrial habitat restoration and enhancement measures are enacted through a combination of plan change provisions and management measures, then Net Gain overall outcomes are expected within 20 years of commencement of these measures. We therefore consider the potential adverse effects associated with land use changes within the Live Zone (and more broadly across the proposed PPC area) can be adequately addressed and that the proposed PPC provisions are appropriate.

1 Introduction

1.1 Overview

Beachlands South Limited Partnership (BSLP) is seeking a Private Plan Change (PPC) across multiple contiguous properties in Beachlands, Auckland (approximately 307 ha) to expand the existing Beachlands Maraetai coastal town.

The PPC area is bound by Jack Lachlan Drive to the north, the Pine Harbour Marina and ferry terminal directly to the northwest, a coastal edge and the coastal marine area along the west, Whitford-Maraetai Road to the east and rural-residential properties to the south. The properties included in this PPC process and associated Beachlands South Structure Plan (herein 'Structure Plan') include the Formosa Golf Resort (approximately 170 ha), a farm at 620 Whitford-Maraetai Road (approximately 80 ha) and various smaller land parcels.

The PPC area is currently zoned Rural – Countryside Living under the AUP-OP. Through the Structure Plan, the BSLP are seeking to rezone the land to a combination of Business (Mixed Use, Local Centre and Neighbourhood Centre), Open Spaces, various residential zonings and Future Urban zone.

A key focus of the PPC and Structure Plan is to enable the urbanisation of the land whilst protecting and enhancing the significant ecological values. To this end, the proposed PPC area includes an Ecological Protected Area Network (EPAN) covering 88.7 hectares and including the most significant existing and potential ecological values, which will be protected from development and enhanced.

Initially it is proposed to 'Live Zone' the northern portion of the PPC area (the 170 ha Formosa Golf Course at 110 Jack Lachlan Drive, Beachlands) via a plan change. It is proposed to rezone the remaining development footprint within the southern portion of the PPC area as Future Urban Zone. This includes the proposed development footprint within the farm at 620 Whitford-Maraetai Road and various smaller land parcels. These Future Urban Zone areas will be the subject of a further plan change application in due course.

Table 1.1: Complete Structure Plan area (properties owned by BSLP shaded)

Address	Lot and DP number	Area (Hectares)
110 Jack Lachlan Drive Beachlands	LOT 2 DP 501271	170.475
620 Whitford-Maraetai Road	LOT 100 DP 504488	79.9444
770 Whitford-Maraetai Road	LOT 10 DP 54105	6.8665
758 Whitford-Maraetai Road	LOT 9 DP 54105	6.1403
746 Whitford-Maraetai Road	LOT 8 DP 54105	5.7996
740 Whitford-Maraetai Road	LOT 7 DP 54105	5.1448
732 Whitford-Maraetai Road	LOT 6 DP 54105	5.0939
722 Whitford-Maraetai Road	LOT 5 DP 54105	4.9227
712 Whitford-Maraetai Road	LOT 4 DP 54105	4.7518
702 Whitford-Maraetai Road	LOT 1 DP 208997	2.1341
692 Whitford-Maraetai Road	LOT 1 DP 197719	1.7747

682 Whitford-Maraetai Road	LOT 1 DP 187934	1.2583
680 Whitford-Maraetai Road	LOT 26 DP 504488	12.8125
Total		307.1186

1.2 Report scope

The BSLP has requested that Tonkin & Taylor Ltd (T+T) prepare a terrestrial ecology effects assessment (this document) to inform the development of the Structure Plan and the section 32 analysis that will support the PPC application². The ecological effects assessment includes:

- A description of terrestrial biodiversity values of the PPC area and immediate surrounds, based on desktop review and field surveys.
- An assessment of effects on those terrestrial ecological values affected by the proposed land use change within the Live Zone.
- Recommendations for addressing potential adverse effects on terrestrial ecology that are associated with land use change within the Live Zone and more broadly within the Future Urban Zone within the PPC area.
- An assessment of the appropriateness and adequacy of the proposed precinct provisions for addressing potential effects on terrestrial ecology that are associated with land use change within the Live Zone and more broadly within the PPC area.

This Terrestrial Ecological Effects Assessment Report sits within a suite of ecological assessment reports and associated information as set out below:

- Volume 1: Ecology Technical Reports
 - Ecological Assessment of Effects Report: Executive Overview
 - Terrestrial Ecology Effects Assessment (this report)
 - Wetland Ecology Effects Assessment
 - Stream Ecology Effects Assessment
 - Marine Ecology Effects Assessment
 - Biodiversity Compensation Modelling Report
- Volume 2: Appendices
 - Appendix A: Combined Ecology Tables and Figures
 - Appendix B: Terrestrial Ecology Tables and Figures
 - Appendix C: Wetland Ecology Tables and Figures
 - Appendix D: Stream Ecology Table and Figures
 - Appendix E: Marine Ecology Tables and Figures
 - Appendix F: Biodiversity Compensation Modelling Tables

1.3 Statutory context

The statutory and planning documents that provide the framework for this terrestrial ecology effects assessment are detailed in the Assessment of Environmental Effects which forms part of the Section 32 Evaluation for the PPC proposal. In brief, these include:

- Part 2 of the Resource Management Act 1991.

² This work has been undertaken in accordance with our letter of engagement dated 11 December 2020

- The AUP-OP, which has identified Significant Ecological Areas (SEA) within the terrestrial environment of the area including SEA_T_1140, SEA_T_1141, SEA_T_1142 and SEA_T_4556. These SEAs are described in Schedule 3 (Significant Ecological Areas - Terrestrial Schedule) of the AUP-OP.
- The Wildlife Act 1953. Under this Act, the majority of native New Zealand indigenous vertebrate species are protected by law.

The following non-statutory documents are also relevant:

- Roper-Lindsay, J., Fuller S.A., Hooson, S., Sanders, M.D., Ussher, G.T. (2018). Ecological impact assessment Guidelines (EclAG). EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition.
- The draft National Policy Statement for Indigenous Biodiversity (NPS-IB) issued in November 2019. The NPS-IB is currently being developed by the Ministry for the Environment and will supersede the proposed National Policy Statement on Indigenous Biodiversity notified in 2011.
- Maseyk, F., G.T. Ussher, G. Kessels, M. Christensen and M. Brown (2018). Biodiversity Offsetting under the Resource Management Act: A guidance document September 2018. Prepared for the Biodiversity Working Group on behalf of the BioManagers' Group.

2 Methods

A desktop investigation and field surveys were used to identify the ecological characteristics and values onsite and in the immediate surrounds, using the methods described in Sections 2.1 to 2.3 below. An assessment of ecological effects was then undertaken in accordance with the Environment Institute of Australia and New Zealand ('EIANZ') Ecological Impact Assessment Guidelines ('EciAG') (Roper-Lindsay et al., 2018).

Biodiversity Compensation Modelling (refer to the Biodiversity Compensation Modelling Report) was used to assist in determining the type and magnitude of habitat restoration and enhancement measures that would likely be required to address those residual adverse effects associated with the proposed land use change within the Live Zone and Future Urban Zones that could not be avoided, remedied or mitigated.

2.1 Desktop Review

Relevant information and databases were reviewed to inform the methodology and approach to the ecological assessment and to determine the wider ecological context of the PPC site. This included a review of the following available information:

- Indigenous terrestrial and wetland ecosystems of Auckland (Singers et al. 2017);
- AUP geographic information system (GIS) layers:
 - Significant ecological areas (SEAs);
 - Ecosystem type layers; and
 - Aerial imagery assessment of the SEAs and wider landscape to assess habitat suitability for terrestrial fauna.
- Auckland Council Herpetofauna Database and NZ Herpetofauna Atlas Webmap;
- Historical records of bat presence from the New Zealand bat distribution database (DOC);
- New Zealand Plant Conservation Network Database (NZPCND);
- eBird database (<https://ebird.org>);
- Department of Conservation Bioweb database; and
- Inaturalist nz database.

2.2 Field assessment

Field investigations were undertaken on 7 October 2020, 17 December 2020, and on 12 and 26 February 2021 to evaluate terrestrial ecology values across the PPC area.

The field investigations involved a full site walkover, mapping habitats, developing a vascular plant species list and noting incidental observations of fauna. Terrestrial habitats were mapped according to Singers et al. (2017).

2.2.1 Bats

A desktop assessment and a site walkover were undertaken to determine potential bat habitat. An acoustic bat survey was also undertaken to determine if the PPC area is being used by critically endangered long-tailed bats (*Chalinolobus tuberculatus*) (O'Donnell et al., 2018).

2.2.1.1 Habitat assessment

Potential bat foraging, commuting and roosting habitat was identified across the proposed PPC area during the desktop assessment and site walkover.

Waterways, wetlands, and vegetated areas provide suitable foraging habitat as they typically have relatively high numbers of flying insect prey. Linear features such as shelterbelts, forest edges and riparian vegetation provide suitable commuting pathways and were identified during the site walkover and using aerial imagery. Trees >15 cm diameter at breast height (dbh) with cracks, crevices, cavities, epiphytes, rot and/or flaking or peeling bark offer potential roosting habitat. Such trees were also identified during the site walkover and subsequent acoustic bat survey.

2.2.1.2 Acoustic bat survey

ABM deployment

An acoustic survey was undertaken across the proposed PPC area over 12 nights (12th to 24th February 2021) to detect the presence of long-tailed bats. Ten automated bat monitors (ABMs; ARM v1.31 DSP v1) manufactured by the Department of Conservation (DOC) were deployed to record bat activity across the PPC area (Volume 2, Appendix B, Figure 1).

ABMs operate remotely by recording and storing echolocation calls (bat passes) as image files, along with the date and time of the event. The acoustic survey followed best practice directed by DOC's bat inventory and monitoring toolbox (Sedgeley, 2012). ABMs were deployed across the PPC area in locations where bat activity was considered most likely (e.g. mature trees, near watercourses and wetlands, or on the edge of natural corridors). Each ABM was set to record from one hour before sunset until one hour after sunrise.

ABM analysis

The ABM recordings were processed using an automated AI-based tool developed by T+T which identifies long-tailed bat recordings³. All results were then manually checked for quality assurance purposes and updated as necessary using the DOC BatSearch 3.11 programme. Analysis of bat data was undertaken in accordance with best-practice methodologies (Lloyd, 2017). The analysis of ABM data provides the following information:

- Presence or absence of bats within the proposed PPC area during the survey period;
- Distribution of bat activity within the proposed PPC area during the survey period;
- The number of bat echolocation calls within the detection area of each ABM (c. 50 m radius);
- Foraging echolocation calls (commonly called a 'feeding buzz') within the detection area of each ABM; and
- Activity that may be indicative of roosting within or nearby the proposed PPC area.

It should be noted that ABM data provides an index of bat activity rather than bat abundance, as the number of bat calls does not necessarily correlate with the number of individual bats encountered.

Bat activity is influenced by certain weather conditions (O'Donnell, 2000; Le Roux *et al.*, 2014). As such, weather data from the survey period was reviewed to ensure conditions were optimal for long-tailed bats to be active. Optimal weather conditions for bat activity include:

- Minimum temperature of 10 °C or higher in the first two hours following sunset;
- ≤ 2.5 mm rainfall over the first two hours after sunset; and
- Minimum overnight relative humidity of 70 %.

Weather data during the survey period was collected from the NIWA CliFlo website from the Mangere weather station (Agent No. 43711) as this was the nearest station.

³ Comprehensive testing of the AI-based tool and its accuracy is currently being undertaken. Preliminary results where the tool has been used to independently re-count datasets that have previously been manually processed indicate that accuracy of the tool is in the order of 95 %.

2.2.2 Terrestrial avifauna

Incidental observations of terrestrial avifauna were recorded during field investigations. Areas of suitable habitat for terrestrial avifauna were also recorded.

Additionally, Automatic Recording Devices (ARDs) were used to determine the presence of cryptic wetland bird species and any other avifauna species recorded incidentally). The locations of the ARDs are shown in Volume 2, Appendix C, Figure 1.

Wetland and coastal avifauna, including field survey methods, are addressed in the Freshwater Wetland and Coastal Marine Ecological Effects Assessment Reports respectively.

2.2.3 Herpetofauna

To determine potential presence of herpetofauna, habitat was described and mapped during field investigations. Mapped herpetofauna habitat included:

- Mature indigenous forest;
- Secondary broadleaf forest;
- Epiphytes;
- Dense leaf litter;
- Rank grass; and
- Other objects such as logs, rocks or refuse may serve as lizard refugia.

2.2.4 Invertebrates

No specific invertebrate surveys were undertaken on the basis that no 'Threatened' or 'At Risk' terrestrial invertebrate species were expected to be present.

2.3 Assessment of ecological effects

The assessment of ecological effects was undertaken in general accordance with the EciAG (Roper-Lindsay et al., 2018)⁴. These guidelines provide a systematic, consistent and transparent framework for undertaking assessments of effects, while also providing for professional judgement and flexibility where appropriate.

As outlined in the following sections, the EciAG have been used to determine:

- **Step 1:** 'Ecological value' (refer to Tables 4-6, EciAG, 2018) of the PPC area.
- **Step 2:** The 'Magnitude of Effect' on the environment (refer to Tables 8-9, EciAG, 2018).
- **Step 3:** The overall 'Level of Effect' after recommended measures have been taken to further avoid, remedy or mitigate for effects (refer to Table 10, EciAG, 2018).

2.3.1 Step one: Assigning ecological value

'Ecological values' were assigned on a scale of 'Negligible' to 'Very High' based on species and habitat values, using criteria in the EciAG (Roper-Lindsay et al., 2018) (refer to Tables 4-6, EciAG, 2018). The ecological value assigned to habitat types is based on an assessment against four sub-criteria including 'representativeness', 'rarity and distinctiveness', 'diversity and pattern' and 'ecological context'. The ecological values assigned to species that are known or likely to be present

⁴ Environment Institute of Australia and New Zealand Inc. (2018). Ecological Impact Assessment (EciAG). EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd Edition.

is based on the New Zealand Threat Classification Status (NZTCS; Townsend et al 2007) and corresponding threat classifications for each taxon (e.g., wetland birds, invertebrates and plants).

2.3.2 Step two: Assessing the magnitude of effects

The 'Magnitude of Effect' is a measure of the extent or scale of the effect of an activity and the degree of change that it will cause after measures to avoid, remedy or mitigate for effects have been applied.

The 'Magnitude of Effect' after measures to avoid, remedy or mitigate for effects, was scored on a scale of 'Negligible' to 'Very High' (refer to Tables 8-9, EclAG, 2018) and was generally assessed in terms of:

- Spatial scale of the effect.
- The relative permanence of the effect.
- The intensity of the effect within the impact footprint.
- Timing of the effect in respect of key ecological factors.
- Level of confidence in understanding the expected effect.

2.3.3 Step three: Assessing the level of effects

An overall 'Level of Effect' on each value (after measures to avoid, remedy or mitigate for effects) was identified for each activity or habitat/fauna type using a matrix approach. This approach combines the ecological values (described in Section 2.3.1 above) with the magnitude of effects (Section 2.3.2 above) resulting from the activity (refer to Table 10, EclAG, 2018, which is also set out below at Table 2.1).

The matrix describes an overall 'Level of Effect', after measures to avoid, remedy or mitigate effects, on a scale from 'Very Low' to 'Very High'. The 'Level of Effect' is then used to guide the extent and nature of measures to demonstrably offset and/or compensate for these residual effects.

It is considered necessary to address any 'Level of effect' assessed as being 'Moderate' or higher through offsetting or compensation measures. However, any 'Level of effect' deemed to be 'Very High' (if applicable) may not comply with the 'Limits to offsetting' principle and therefore cannot be offset.

Table 2.1: Criteria for describing overall levels of ecological effects (Step 3) Table 10, EclAG. If the overall level of effect is assessed as being 'Moderate' or greater (blue shade), this warrants measures to avoid, remedy and/or mitigate these effects.

Magnitude of effect	Ecological Value				
	Very high	High	Moderate	Low	Negligible
Very high	Very high	Very high	High	Moderate	Low
High	Very high	Very high	Moderate	Low	Very Low
Moderate	High	High	Moderate	Low	Very Low
Low	Moderate	Low	Low	Very low	Very Low
Negligible	Low	Very low	Very low	Very low	Very Low
Positive	Net gain	Net gain	Net gain	Net gain	Net gain

2.3.4 Determining residual effects management requirements

Determining the type and magnitude of terrestrial habitat and enhancement measures to address residual effects associated with the proposed PPC that cannot be avoided, remedied or mitigated will be guided by the application of a Biodiversity Compensation Model (BCM) (Baber et al. 2021a,b,c). These models provide additional objective transparency, process and justification for the overall compensation package (Baber et al. 2021). In summary, BCMs:

- Provide guidance on addressing all residual adverse effects associated with a project for which impacts or gains cannot feasibly be measured or quantified with adequate precision and for which residual effects management is deemed appropriate when assessed against the 'limits to offsetting' principle.
- Serve as a decision support tool that provides additional transparency and rigour to the process of addressing residual adverse effects on biodiversity through compensation measures at proposed habitat restoration/enhancement site(s).
- Provide guidance on whether Net Gain (NG) outcomes are expected to be achieved for specified biodiversity values. Expected NG outcomes are sought, rather than No Net Loss (NNL) outcomes, to provide more confidence that NNL will actually be achieved.
- Operate at the 'as close to offset as possible' end of the compensation continuum. This is termed 'biodiversity compensation' in the Draft NPS-IB.
- Operate across the full spectrum and scale of project optioneering and plan change or consent applications.
- Can be later used to verify offsetting based on real data that is collected after the commencement of habitat restoration and enhancement activities at proposed offset/compensation sites.

3 Site Context

3.1 Ecological context

The site is located within the Hunua Ecological District (ED). The Hunua ED is one of 11 Ecological Districts in the Auckland Region with each ED including a characteristic landscape and range of biological communities that are shaped by topographical, geological, climatic, soil and biological features (Park et al., 1983).

Pre-human vegetation composition consisted of pōhutukawa, pūriri, broadleaved forest (WF4) on the coastal fringes with kauri, podocarp, broadleaved, beech forest (WF12) occurring across inland areas⁵.

Large swathes of vegetation of the Hunua ED have been lost to agriculture, forestry and housing developments; however, relatively high indigenous forest cover remains, due in part to the protected Hunua Ranges, which comprise 250 km² of mature native forest, approximately 22 km south-east of the PPC site.

Vegetation types in the Hunua ED consist of fire-induced mānuka scrublands, kauri and kauri-hard beech forest and tawa-podocarp forest, with canopy species taraire, pūriri and rewarewa common at lower altitudes. The Hunua Ranges are a stronghold for key native species, including 'Threatened' long-tailed bat (*Chalinolobus tuberculatis*), 'Threatened' kōkako (*Callaeas wilsoni*), 'At Risk' kākā (*Nestor meridionalis*), and 'At Risk' Hochstetter's frog (*Leiopelma hochstetteri*).

Ōmana Regional Park and Duder Regional Park are located along the Beachlands-Maraetai-Clevedon coastal areas and host fragments of mature native forest. Furthermore, an unnamed area of 700 ha contiguous native forest occurs approximately 3 km east of the PPC site and connects from Clevedon north to Maraetai. This forest area has been classified as kauri, podocarp, broadleaved forest (WF12), taraire, tawa, podocarp forest (WF9), and kānuka scrub/forest (VS2) ecosystem types.

The immediate surrounds are dominated by farmland with native forest remnants along riparian margins and in gullies. A large housing block of approximately 300 ha occurs 100 m north of the PPC site and forms the main residential area of Beachlands.

3.2 Site description

The landscape immediately to the east and south of the PPC site is dominated by farmland with native forest remnants along riparian margins and in gullies. A large housing block of approximately 300 ha occurs 100 m north of the PPC site and forms the main residential area of Beachlands. Catchments on both properties drain to Waikopua Creek and Coastal Marine receiving environment, which is an important wading bird area with areas identified as marine SEAs (refer to the Marine Ecological Assessment report).

3.3 Terrestrial Ecology Site Overview

The area investigated comprised the entire 307 ha that made up the proposed PPC area (Volume 2, Appendix A, Figure 1)

Originally this area encompassed pōhutukawa, pūriri, broadleaved forest (WF4) across Formosa Golf Course and kauri, podocarp, broadleaved, beech forest (WF12) across 620 Whitford-Maraetai Road along with associated streams. Few, if any, natural wetlands would have been present onsite as

⁵ Auckland Council GeoMaps. Ecosystems Potential Extent. Accessed on 24 May 2021 from <https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html>

existing wetlands have either been constructed or have been induced⁶ through landscape modification (largely through the sedimentation of gullies).

Land use change and modification has transformed the PPC site into a golf course resort, farmland and lifestyle blocks that are dominated by managed rank or grassed pasture grasslands. Exotic pines have been planted between the golf course and 620 Whitford-Maraetai Road, as well as on the coastal margin of 620 Whitford-Maraetai Road. However, remnant mature indigenous forest is present in gullies and along the coastal fringe and includes SEA as identified in the AUP-OP (as described below).

3.3.1 Formosa Golf Resort site

Formosa Golf Resort (approximately 170 ha) consists of open grass fields maintained for golfing purposes, interspersed with rank grass and exotic forest and scrub. Areas of exotic vegetation are common across the Formosa Golf Resort site, comprising mature pine forest and areas dominated by lower stature pest plants, including blackberry (*Rubus fruticosus agg.*), gorse (*Ulex europaeus*), pampas (*Cortaderia selloana*), chinese privet (*Ligustrum sinense*) and woolly nightshade (*Solanum mauritianum*).

Patches of regenerating native bush occur, and mature native vegetation is present only on the coastal (western) edge of the course where small areas of remnant pōhutukawa, pūriri, broadleaved forest (WF4) and pōhutukawa treeland/flaxland /rockland (CL1) remain on steep cliffs. This coastal cliff forest is identified as an SEA (SEA_T_1142).

A developed area of approximately 5 ha is present at the centre of the Formosa site consisting of buildings and carparks.

3.3.2 620 Maraetai-Whitford Road

620 Maraetai-Whitford Road (approximately 80 ha) is to the immediate south of the golf course and is dominated by pasture grass and currently used for farming. Exotic pine forestry occurs on the western coastal edge, with rank grass and native vegetation also present.

Fenced SEAs (see below) are located in forested gully systems across this part of the PPC area which consist of regenerating native forest (mānuka, kānuka forest, (VS3)) and mature native forest (taraire, tawa podocarp forest (WF9) and tawa, kohekohe, rewarewa, hīnau, podocarp forest, (WF13)). Native plantings have been undertaken along riparian margins at the headwaters of these catchments. Weed invasions and pest mammals have impacted some of the native-dominated forest fragments.

3.3.3 Other land parcels

Various other land parcels along Whitford-Maraetai Road comprise around 57 ha and consist mostly of managed or rank grasslands, lifestyle housing with exotic and native forest fragments, and exotic dominated wetlands both constructed and natural.

⁶ under the National Policy Statement for Freshwater Management (Ministry for the Environment, September 2020) an induced wetland is defined as 'natural wetland' and a constructed wetland is a wetland that has been constructed for a specific purpose.

3.4 Terrestrial ecology characteristics and values

3.4.1 Vegetation/habitat types

Thirteen terrestrial vegetation/habitat types are present within the proposed PPC area, totalling approximately 290 ha⁷ (Volume 2, Appendix B, Figure 1). In broad terms these include 8.61 ha of mature native forest, 14.23 ha of regenerating native forest, 1.7 ha of native plantings and 234 ha of exotic-dominated vegetation, as described in Table 3.4.1 below.

Vegetation across the PPC site was observed to be impacted by possum and rabbit browse, stock browse and potentially drought as heavy dieback was occurring on mature canopy species on the edges of forest blocks.

Of the species observed during the site investigations, kānuka, pōhutukawa and akatea are classified as ‘Threatened – Nationally Vulnerable’⁸, and mānuka as ‘At Risk’ (Declining), due to the threat myrtle rust (*Austropuccinia psidii*) poses to these species. Moreover, *Olearia angulata*, classified as ‘At Risk – Naturally Uncommon’ was observed as plantings within stream riparian plantings connected to SEA-T-1140. All other vegetation observed during site visits is classified as ‘Not Threatened’ or ‘Introduced’. A full list of the plant species observed during the site visits is presented in Volume 2, Appendix B, Table 1).

Table 3.4.1: Habitat descriptions of broad terrestrial habitat types present across the PPC site.

Vegetation type	Areal extent (ha)	IUCN Threat Status / SEA status	Description
Mature native forest			
Tawa, kohekohe, rewarewa, hīnau, podocarp forest (WF13). None of this habitat is present within the proposed Live Zone or wider PPC development area	4.5	IUCN status of Vulnerable / SEA_T_1141	Main ecosystem type within SEA_T_1141 (see Section 3.5 below). Kānuka and gorse abundant on the periphery of this habitat. Mature native broadleaf and podocarp species dominate in canopy.
Taraire, tawa, podocarp forest (WF9). None of this habitat is present within the proposed Live Zone or wider PPC development area	1.4	IUCN status of Endangered/ SEA_T_1140	Taraire, tawa, podocarp forest in the central gully of 620 Whitford-Maraetai Road and forming part of SEA_T_1140 (See Section 3.5 below). Canopy is approximately 15 m consisting of indigenous species pūriri, taraire, kohekohe and tawa with kānuka dominating upper slopes. The subcanopy consisted of māhoe, red matipo, hangehange, kawakawa, nikau, silver fern, lancewood, pigeonwood and karaka. Ground cover species included rasp fern, <i>Carex</i> spp., <i>Gahnia lacera</i> and kiokio, and epiphytes included

⁷ The remaining areas predominately comprise wetland, streams, roads, houses, buildings and carparks (approx. 17 ha in total)

⁸ De Lange, P. J., Rolfe, J. R., Barkla, J. W., Courtney, S. P., Champion, P. D., Perrie, L. R., Beadel, S. M., Ford, K. A., Breitwieser, I., Schönberger, I., Hindmarsh-Walls, R., Heenan, P. B. & Ladley, K. (2017). Conservation status of New Zealand indigenous vascular plants. New Zealand Threat Classification Series 22. 82 p.

			<p>akatea, kiekie, perching lily, tank lily, fragrant fern, and leather leaf fern. At the north-eastern corner of this gully a treeland consisting of tōtara, rimu, mataī, pigeonwood, tawa and kānuka with grazed understorey is present.</p> <p>Pest plants in this ecosystem type included woolly nightshade, elephant ear, and a rubbish dump that has resulted in the spread of ladder fern and yucca. Gorse is present on the edges of this ecosystem type.</p> <p>Many of the pūriri trees exhibited severe dieback. A possum was observed in this ecosystem site during a site visit.</p> <p>This ecosystem type is buffered by mānuka, kānuka scrub.</p>
Taraire, tawa, podocarp forest (WF9). None of this habitat is present within the proposed Live Zone or wider PPC development area	0.81	IUCN status of Endangered	<p>Taraire, tawa, podocarp bush fragment 220 m north of the central gully, buffering a small tributary and on the coastal edge. Taraire is the canopy dominant at up to 18 m tall, with rewarewa, tōtara, karaka, māhoe and kōwhai (<i>Sophora microphylla</i>) present as other canopy species. Kānuka trees dominate on the edges of this bush fragment. Understorey composition dominated by native hangehange, kawakawa, and tree ferns. This forest has not been identified as an SEA in the AUP-OP.</p>
Taraire, tawa, podocarp forest (WF9) None of this habitat is present within the proposed Live Zone or wider PPC development area	0.5	IUCN status of Endangered	<p>Taraire, tawa, podocarp bush fragment 300 m north of the central gully, buffering a small tributary and on the coastal edge. Taraire, tōtara, pūriri and kohekohe are the dominant canopy species. Kānuka trees and gorse dominate on the edges of this bush fragment. This forest has not been identified as an SEA in the AUP-OP.</p>
Pōhutukawa, pūriri, broadleaved forest (WF4) None of this habitat is present within the proposed Live Zone or wider PPC development area	0.5	IUCN status of Endangered/ SEA_T_4556	<p>Pōhutukawa, pūriri, broadleaved forest borders the coastal edge of Formosa Golf Resort site and is immediately adjacent to the ecosystem type pōhutukawa treeland (CL1) and secondary broadleaved forest/scrub (VS5). Forms part of SEA_T_4556 (See Section 3.5 below).</p>
Pōhutukawa treeland/flaxland/rockland (CL1) None of this habitat is present within the proposed Live Zone or wider PPC development area	0.9	IUCN status of Vulnerable/ SEA_T_4556	<p>0.9 ha of pōhutukawa treeland on the western coastal edge of Formosa Golf Resort site, comprising 10 m tall pōhutukawa trees with harakeke, kawakawa, rengarenga and karo in the understorey. Woolly nightshade and gorse were the primary pest plant species present in this ecosystem type. Forms part of SEA_T_4556 (See Section 3.5 below).</p>
Regenerating native forest			

Kānuka forest (VS2)	4.5	IUCN status of Least Concern	Kānuka forests are generally present on steep slopes across native-dominated gullies across the PPC site, including SEA_T_1140 and SEA_T_1141. Some individuals > 50 cm DBH. The canopy was dominated by kānuka trees, however secondary regeneration is occurring, with tanekaha, pūriri, rewarewa, tōtara, rimu and māhoe emerging through the existing canopy. Kōwhai and cabbage trees were also present on the edges of this ecosystem. Understorey species include ferns rasp fern and trembling brake and seedlings of the main canopy species.
Mānuka, kānuka scrub (VS3)	9.7	IUCN status of Least Concern/ buffers SEA_T_1140	Mānuka, kānuka scrub surrounds and buffers taraire, podocarp forest in the central gully. The canopy was dominated by kānuka trees, however secondary regeneration is occurring, with tanekaha, pūriri, rewarewa, tōtara, rimu and māhoe emerging through the existing canopy. Kōwhai and cabbage trees were also present on the edges of this ecosystem. Understorey species include ferns rasp fern and trembling brake and seedlings of the main canopy species. Tasmanian blackwoods are present on the edge of this ecosystem type.
Broadleaved species scrub/forest (VS5)	0.03	IUCN status of Least Concern/ SEA_T_4556	Located within SEA_T_4556. A small strip of native vegetation adjacent to CL1 and WF4 ecosystems. Consists of predominately mahoe but kanuka, cabbage-tree, hange hange, coprosma rhamnoides, silver fern and manuka are also common.
Native revegetation			
Native terrestrial plantings (PL)	1.7	Not Threatened	Planted terrestrial vegetation has been established at the upstream extents of SEA_T_1141 and SEA_T_1140. Plantings in SEA_T_1140 protect and buffer a tributary which extends to Whitford-Maraetai Road. Vegetation consisted of mānuka, kānuka, cabbage tree, pūriri, akeake, harakeke, <i>Carex secta</i> , lemonwood, <i>Olearia angulata</i> , gorse and woolly nightshade, up to 8 m high tall.
Exotic vegetation			
Exotic forest (EF)	14.8	Not Threatened	3.3 ha of exotic forest occurs (mapped on GeoMaps) in the gully immediately between Formosa Golf Course and 620 Whitford-Maraetai Road. Mature pine trees are the dominant canopy species. The understorey consists of a typical mix of native species such as hangehange and māhoe, and exotic species including gorse, pampas and woolly nightshade. A further 11.5 ha of exotic pine forest was mapped during field investigations across the PPC area.
Exotic-dominated scrub (ES)	16.6	Not Threatened	Exotic-dominated scrub was dominated by a variety of exotic species, including woolly nightshade, gorse, blackberry, Japanese honeysuckle, Chinese privet and pampas. Occasional early successional native species were present, including karamu, hangehange and māhoe.
Exotic rank or managed grassland (EG)	Approx 234 ha	Not Threatened	Exotic grasslands were dominated by exotic grass species including common bent, cocksfoot, narrow-leaved plantain, wild carrot, kikuyu, buffalo grass and Bermuda grass. Native vegetation was generally absent from these areas.

3.5 Significant Ecological Areas (SEAs)

Three terrestrial SEAs ranging in size from 0.8 ha to 11.1 ha are located across the PPC site (Table 3.5.1 below). SEA_T_1140 and SEA_T_1141 consist of mature and regenerating forest in gully systems, while SEA_T_4556 is located along cliffs on the western edge of Formosa Golf Resort site. All terrestrial SEA vegetation is located within the EPAN proposed by the PPC and so will be protected from development.

Table 3.5.1. Significant Ecological Areas within the PPC site boundaries.

SEA ID/size (ha)	Vegetation classification	Site location	Reason for classification
SEA_T_1140 (11.1 ha)	<ul style="list-style-type: none"> Taraire, tawa, podocarp forest (WF9) Mānuka, kānuka forest (VS3) 	Located within the EPAN and within the FUZ on property 620 Whitford-Maraetai Road, largest native-dominated gully in the PPC area.	<ul style="list-style-type: none"> Diversity
SEA_T_1141 (4.6 ha)	<ul style="list-style-type: none"> Tawa, kohekohe, rewarewa, hīnau, podocarp forest (WF13) 	Located within the EPAN and within the FUZ on property 620 Whitford-Maraetai Road, immediately south of SEA_T_1140 (11.1 ha)	<ul style="list-style-type: none"> Diversity
SEA_T_4556 (0.8 ha)	<ul style="list-style-type: none"> Pōhutukawa, pūriri, broadleaved forest WF4, Pōhutukawa treeland/flaxland/rockland CL1, Broadleaved species scrub/forest (VS5) 	Located within the EPAN and within the Live Zone and includes a strip of coastal vegetation on the western cliffs of Formosa Golf Course site.	<ul style="list-style-type: none"> Threat status and rarity Diversity Stepping-stones, migration pathways and buffers.

3.6 Notable species

Table 3.6.1 below presents notable flora and terrestrial fauna species potentially utilising terrestrial habitats across the site. These include nationally 'Threatened' or 'At Risk' species, keystone bird species as well as herpetofauna 'absolutely protected' under the Wildlife Act 1953. Areas of suitable habitat for these species are shown in Volume 2, Appendix B, Figure 1.

In total within the PPC site boundaries there are:

- Three 'Threatened' plant species (due to myrtle rust) and two 'At Risk' plant species;
- One 'Threatened' bat species that is potentially present (not identified during surveys);
- One 'Threatened', two 'At Risk' and two keystone avifauna species; and
- Four 'At Risk' lizard species.

Table 3.6.1. Nationally Threatened or At Risk species that are likely or known () to be present on the PPC site (also see Volume 2, Appendix B, Figure 1).**

Species	Threat status	Population characteristics and habitat values on site
Terrestrial vegetation		
Pōhutukawa (<i>Metrosideros excelsa</i>)**	Threatened – Nationally Vulnerable	Common on cliff edges on the western face of Formosa Golf Course site. Dominant canopy species.
Kānuka (<i>Kunzea robusta</i>)**	Threatened – Nationally Vulnerable	Dominant canopy species on steep slopes across native-dominated gullies across the PPC site, including SEA_T_1140 and SEA_T_1141. Some individuals > 50 cm DBH.
Akatea (<i>Metrosideros excelsa</i>)**	Threatened – Nationally Vulnerable	Common vine in native-dominated mature forest systems on the PPC site.
Mānuka**	At Risk - Declining	Common in native plantings across the PPC site.
<i>Olearia angulata</i> (planted)**	At Risk – Naturally Uncommon	Planted in the riparian margins at the top of SEA_T_1140.
Bats		
Long-tailed bat (<i>Chalinolobus tuberculatus</i>)	Threatened – Nationally Critical	Surveys detected no long-tailed bats. May intermittently use mature native forest edges and gullies for foraging.
Terrestrial avifauna		
New Zealand pipit (<i>Anthus novaeseelandiae</i>)**	At Risk – Declining	Utilises rough open-farmland and pasture habitats. Nests in dense scrub, rush and fern habitat. Observed on rough farmland at 620 Whitford-Maraetai Road.
Kākā (<i>Nestor meridionalis</i>)	At Risk – Recovering	Not observed during site visits. May intermittently forage in mature native and exotic forests.
Long-tailed cuckoo (<i>Eudynamys taitensis</i>)	Threatened – Nationally vulnerable	Heard during one night of ARD recording. Likely to be present intermittently, but unlikely to be breeding at the PPC site due to an expected absence of Whitehead (<i>Mohoua albicilla</i>), its parasitic host.
Kererū (<i>Hemiphaga novaeseelandiae</i>)**	Not Threatened (keystone seed disperser)	Present in mature and regenerating native vegetation across the PPC site.
Tūi (<i>Prosthemadera novaeseelandiae</i>)	Not Threatened (keystone pollinator and seed disperser)	Present in mature and regenerating native vegetation across the PPC site.
Herpetofauna		
Ornate skink (<i>Oligosoma ornatum</i>)	At Risk – Declining	Possibly present in native and exotic forests on the PPC site, or under

Species	Threat status	Population characteristics and habitat values on site
		suitable refuges including logs, stumps, refuse.
Elegant gecko (<i>Naultinus elegans</i>)	At Risk - Declining	Possibly present in mature native forest, CL1, WF4, VS2, VS3 and VS5 ecosystems.
Forest gecko (<i>Mokopirirakau granulatus</i>)	At Risk - Declining	Possibly present in mature native forest, CL1, WF4, VS2, VS3 and VS5 ecosystems
Copper skink	At Risk – Declining	Present or potentially present in all habitat types excluding managed grassland.

3.7 Bats

3.7.1 Desktop survey

The nearest record of long-tailed bat activity is approximately 8.5 km to the south of the PPC area in the southern end of Clevedon Scenic Reserve⁹. A matrix of indigenous and commercial pine forest stretches from this location to approximately 700 m south of the PPC area. If long-tailed bats are present across this matrix of forest habitats, they may also be present within the PPC area as 700 m is well within the expected home range of long-tailed bats.

Historical surveys have also been completed approximately 2 km and 3 km northeast of the PPC area in Ōmana Regional Park and Maraetai Bush, but no bats were detected.

3.7.2 Long-tailed bat habitat assessment

Long-tailed bats are an edge-adapted species and utilise a variety of ecosystems for foraging, roosting and commuting including exotic and native forest edges, wetlands, hedgerows and shelterbelts (O'Donnell 2010). Such features are common across the PPC area, particularly along streams. The indigenous and exotic forests (approx. 37.24 ha) described in Table 3.4.1 above all contain trees with features suitable for roosting e.g. crevices, flaking bark, and broken branches.

3.7.3 Acoustic survey results

No bat passes were recorded in the ten ABMs deployed across the PPC area during the survey period (refer Table 3.7.3.1 below) and see Volume 2, Appendix B, Figure 1 for ABM locations. A total of 72 monitoring nights were recorded by the 10 ABMs over this survey period (refer Table 3.7.3.1 below).

Table 3.7.3.1: Number of monitoring nights for the 10 deployed ABMs

ABM	No. of monitoring nights	No. of bat passes
ABM1	7	0
ABM2	5	0
ABM3	3	0
ABM4	11	0
ABM5	4	0

⁹ Record from the DOC national bat database.

ABM6	12	0
ABM7	1	0
ABM8	12	0
ABM9	9	0
ABM10	8	0

Weather conditions were 'optimal' for acoustic surveying of bats on 6 of the 12 survey nights due to relative humidity recorded below 70 % on remaining nights of the survey (Volume 2, Appendix B, Table 2).

3.7.4 Summary of bat habitat values

Suitable habitat for long-tailed bats was identified at the PPC site through the desktop investigation and onsite habitat assessments. However, the acoustic bat survey found no bat activity, which suggests that these habitats may not be frequently used by long-tailed bats. Nevertheless, long-tailed bats have a large home range and move around the landscape, using different areas at different times of year. Due to the transient nature of bat distribution across the landscape, a second acoustic bat survey will be undertaken in February 2022¹⁰. If bat activity is again not detected, we can conclude with more confidence that the habitats within the PPC area are not of importance to the critically endangered long-tailed bat. Until such time, it is assumed that bats occasionally use the site for foraging and commuting, and the potential presence of roost sites within more mature vegetation cannot be ruled out.

3.8 Terrestrial avifauna

A total of 30 terrestrial avifauna species, including 16 native species, were identified during the site visits and incidentally through ARD analysis, which was used to record wetland birds (refer Table 3.8.1 below). Wetland and coastal avifauna are addressed in the Wetland Ecology Assessment and Marine Ecology Effects Assessment respectively.

Most importantly, New Zealand pipit (At Risk – Declining) were observed in farmland habitats at 620 Whitford-Maraetai Road, and long-tailed cuckoo ((Threatened – Nationally vulnerable) were detected in forested habitat. Moreover, kākā (At Risk – recovering) may intermittently use mature forest habitats on the PPC site but were not observed during site investigations. All other species observed are classified as 'Not Threatened' or 'Introduced'. Additionally, tomtit may use habitats within the PPC area, but were not observed during site investigations.

Bird communities were typical of those in farmland and fragmented native forest habitat in the Auckland region, with common native and introduced birds frequently observed.

Table 3.8.1.: Terrestrial avifauna identified utilising the site, and other potential terrestrial avifauna which may utilise the site. ✓ = observed during field investigation, * = identified during ARD analysis.

Common name	Species name	Threat status ¹¹	Confirmed on site
Myna	<i>Acridotheres tristis</i>	Introduced	✓*

¹⁰ A second survey was scheduled for late Spring however this survey could not be completed due to COVID-19 related constraints. The results of this February 2022 survey will be provided in a supplementary report.

¹¹ Robertson, H.A.; Baird, K.A. Elliott, G.P. Hitchmough, R.A. McArthur, N.J. Makan, T.D. Miskelly, C.M. O'Donnell, C.F.J. Sagar, P.M. Scofield, R.P. Taylor, G.A. Michel, P. (2021): Conservation status of birds in Aotearoa New Zealand, 2021. New Zealand Threat Classification Series 36. Department of Conservation, Wellington. 43 p.

Common name	Species name	Threat status ¹¹	Confirmed on site
Skylark	<i>Alauda arvensis</i>	Introduced	✓*
NZ pipit	<i>Anthus novaeseelandiae</i>	At Risk - Declining	✓
Goldfinch	<i>Carduelis carduelis</i>	Introduced	✓*
Greenfinch	<i>Carduelis chloris</i>	Introduced	✓*
Shining cuckoo	<i>Chrysococcyx lucidus</i>	Not Threatened	✓*
Swamp harrier	<i>Circus approximans</i>	Not Threatened	✓*
White-faced heron	<i>Egretta novaehollandiae</i>	Not Threatened	✓*
Yellowhammer	<i>Emberiza citrinella</i>	Introduced	✓*
Long-tailed cuckoo	<i>Eudynamis taitensis</i>	Threatened – Nationally Vulnerable	*
Chaffinch	<i>Fringilla coelebs</i>	Introduced	✓*
Grey warbler	<i>Gerygone igata</i>	Not Threatened	✓*
Australian magpie	<i>Gymnorhina tibicen</i>	Introduced	✓*
Kererū	<i>Hemiphaga novaeseelandiae</i>	Not Threatened	✓
Welcome swallow	<i>Hirundo neoxena</i>	Not Threatened	✓*
Kākā	<i>Nestor meridionalis</i>	At Risk - Recovering	
Ruru/morepork	<i>Ninox novaeseelandiae</i>	Not Threatened	✓*
House sparrow	<i>Passer domesticus</i>	Introduced	✓*
Tomtit	<i>Petroica macrocephala</i>	Not Threatened	
Common pheasant	<i>Phasianus colchicus</i>	Introduced	✓*
Eastern rosella	<i>Platycercus eximius</i>	Introduced	✓*
Pūkeko	<i>Porphyrio melanotus</i>	Not Threatened	✓*
Tūī	<i>Prosthemadera novaeseelandiae</i>	Not Threatened	✓*
North Island fantail	<i>Rhipidura fuliginosa</i>	Not Threatened	✓*
Spotted dove	<i>Streptopelia chinensis</i>	Introduced	✓*
Starling	<i>Sturnus vulgaris</i>	Introduced	✓
Paradise shelduck	<i>Tadorna variegata</i>	Not Threatened	✓*
New Zealand kingfisher	<i>Todiramphus sanctus</i>	Not Threatened	✓*
Blackbird	<i>Turdus merula</i>	Introduced	✓*
Song thrush	<i>Turdus philomelos</i>	Introduced	✓*
Spur-winged plover	<i>Vanellus miles novaehollandiae</i>	Not Threatened	✓*
Silvereye	<i>Zosterops lateralis</i>	Not Threatened	✓*

3.9 Herpetofauna

Based on habitat suitability and as determined through desktop assessment of nearby lizard observations, a total of five native herpetofauna and one introduced herpetofauna species potentially occur on site (refer Table 3.9.1 below). No incidental observations of herpetofauna were made during field investigations.

Shore skink (*Oligosoma smithii*; At Risk – Naturally Uncommon) are present in Waharau (35 km from the site); however, the PPC site and coastal margin are not considered to provide effective habitat for this skink.

Table 3.9.1.:Herpetofauna recorded within 15 km (excluding offshore islands) and potentially present in the PPC area based on habitat assessments.

Species (** = confirmed present)	Threat classification ¹²	Habitat preference	No. of records within 15 km of the PPC area ¹³
Ornate skink (<i>Oligosoma ornatum</i>)	At Risk – Declining	Mature native forest, regenerating native forest, under leaf litter, logs, stones and refuse.	2
Elegant gecko (<i>Naultinus elegans</i>)	At Risk - Declining	Mānuka, kānuka forests and in native mature forest and regenerating native forest. Flaking bark of black wattle may provide habitat for this species.	1
Forest gecko (<i>Mokopirirakau granulatus</i>)	At Risk - Declining	Mānuka, kānuka forests and in native mature forest and regenerating native forest. Flaking bark of black wattle may provide habitat for this species.	3
Pacific gecko (<i>Dactylocnemis pacificus</i>)	Not Threatened	Mānuka, kānuka forests and in native mature forest and regenerating native forest. Flaking bark of black wattle may provide habitat for this species.	1
Copper skink (<i>Oligosoma aeneum</i>)	At Risk - Declining	Native mature forest, regenerating forest, under logs across farmland, beneath rocks and refuse.	10
Plague skink** (<i>Lampropholis delicata</i>)	Introduced	On the edges of native mature forest, regenerating forest, exotic forest and under logs across farmland. May be found in garden refuse or around buildings.	22

3.10 Terrestrial invertebrates

The presence of nationally ‘Threatened’ or ‘At Risk’ terrestrial invertebrates was considered unlikely based on a desktop review of available information and data but cannot be ruled out. If any such species are present they are more likely to be within the SEAs, which will not be impacted.

3.11 Summary of terrestrial ecology values

A summary of terrestrial habitat types across the PPC site is presented in Table 3.11.1 below and a summary of notable terrestrial flora and fauna is presented in Table 3.11.2; also see Volume 2, Appendix B, Figure 1.

¹² Hitchmough, R.A., Barr, B., Knox, C., Lettink, M., Monks, J.M., Patterson, G.B., Reardon, J.T., van Winkel, D., Rolfe, J., Michel, P. (2021): Conservation status of New Zealand reptiles 2021. New Zealand Threat Classification Series 35. Department of Conservation, Wellington. 15 p.

¹³ Auckland Council Herpetofauna, DOC herpetofauna atlas and iNaturalist records. Excludes island records.

Table 3.11.1: Summary of terrestrial habitat types and their areal extent within the PPC

Terrestrial habitat types	Areal extent of habitat	Regional threat status (Singers et al. 2017)
Tawa, kohekohe, rewarewa, hīnau, podocarp forest (WF13)	4.5 ha (SEA_T_1141) (all within the EPAN)	IUCN status of Vulnerable
Taraire, tawa, podocarp forest (WF9)	1.4 ha (SEA_T_1140) and 1.31 ha outside SEA areas (all within the EPAN)	IUCN status of Endangered
Pōhutukawa, pūriri, broadleaved forest (WF4)	0.5 ha (SEA_T_4556) (all within the EPAN)	IUCN status of Endangered
Pōhutukawa treeland/flaxland/rockland (CL1)	0.9 ha (SEA_T_4556) (all within the EPAN)	IUCN status of Vulnerable
Kānuka forest (VS2)	4.48 ha almost all within the EPAN))	IUCN status of Least Concern
Mānuka, kānuka scrub (VS3)	9.7 ha (almost all within the EPAN)	IUCN status of Least Concern
Broadleaved species scrub/forest (VS5)	0.03 ha (Almost all within the EPAN)	IUCN status of Least Concern
Native terrestrial plantings (PL)	1.655 ha (almost all within the EPAN)	Unclassified
Exotic forest (EF)	14.79 (1.35 ha within the Live Zone and outside the EPAN) development area)	Unclassified
Exotic-dominated scrub (ES)	16.6 ha (5.08 ha within the Live Zone but outside the EPAN)	Unclassified
Exotic managed or rank grassland (EG)	Approximately 130 ha within the Live Zone but outside the EPAN.	Unclassified

Notable species	Habitat use	Threat status
Nationally Threatened or 'At Risk' flora (excluding common species assigned a threat status due to myrtle rust) (** = confirmed present)		
Pōhutukawa**	Within mature forest on cliff face and potentially other locations	Nationally vulnerable
Kānuka**	Within all indigenous habitat types	Nationally vulnerable
Akatea**	Within most native habitat types	Nationally vulnerable
Mānuka**	Within most native habitat types	At Risk - Declining
<i>Olearia angulata</i> (planted)**	Within stream plantings above SEA_T_1141	At Risk – Naturally Uncommon
Nationally Threatened, 'At Risk' or ecologically important or fauna and/or fauna that are legally protected under the Wildlife Act (1953)(** = confirmed present)		
New Zealand pipit (<i>Anthus novaeseelandiae</i>)**	Expected to use scrub and rank grassland habitats predominately (estimated at 100 ha)	At Risk – Declining
Kākā (<i>Nestor meridionalis</i>)	41.48 ha which includes all native forest, exotic forest and native plantings.	At Risk – Recovering
Long-tailed cuckoo (<i>Eudynamys taitensis</i>)		Threatened – Nationally Vulnerable

Notable species	Habitat use	Threat status
Kererū**		Not Threatened but ecologically important as a seed disperser and plant pollinator
Tūī**		
Ornate skink (<i>Oligosoma ornatum</i>)	25.02 ha which includes all native habitat types except native plantings. However, the areal extent of habitat for copper skink is expected to be much larger and includes all habitat available in the PPC area excluding managed grassland.	At Risk – Declining
Elegant gecko (<i>Naultinus elegans</i>)		At Risk - Declining
Forest gecko (<i>Mokopirirakau granulatus</i>)		At Risk - Declining
Pacific gecko (<i>Dactylocnemis pacificus</i>)		Not Threatened
Copper skink (<i>Oligosoma aenea</i>)	The areal extent of habitat is expected to include all habitat available in the PPC area excluding managed grassland.	At Risk – Declining

4 Assessment of Ecological Effects

The previous section described the ecological characteristics present within the PPC area and immediate surrounds. This section focuses on assessing potential effects associated with land use change within the Live Zone and wider PPC area on terrestrial ecological values that are directly or indirectly affected. The assessment is based on the EciAG (Roper-Lindsay et al, 2018).

4.1 Ecological values assessment (Step 1)

The ecological values associated with each habitat type, are assessed based on EIANZ guidelines in Table 4.1.1 below and the ecological value assigned to each species or taxa based on EIANZ guidelines is provided in Table 4.1.2.

Table 4.1.1: Ecological values assessment for habitat types based on EIANZ guidelines (Volume 2, Appendix A, Table 1)

Ecological characteristic	Assessment of ecological value attributes based on EIANZ guidelines (Volume 2, Appendix A, Table 1)	Assigned Ecological value
Terrestrial habitat types		
Tawa, kohekohe, rewarewa, hīnau, podocarp forest (WF13)	<p>Moderate value for representativeness: typical structure and composition is present, but pest animals and weed invasions have reduced the value of this habitat fragment.</p> <p>High value for rarity and distinctiveness because it is a Regionally Vulnerable ecosystem type. May provide habitat for At Risk lizard species.</p> <p>High value for diversity and pattern because the level of natural diversity is good and due to its relatively large size. Noted SEA due to factor 'Diversity'.</p> <p>High value for ecological context because this forest buffers watercourses from nutrient runoff and connects other mature forest ecosystems on the PPC site. Forms part of SEAs.</p> <p>Three high value and one moderate value equates to an overall value assessment of Very High.</p>	Very high
Taraire, tawa, podocarp forest (WF9)	<p>Moderate value for representativeness: typical vegetation structure and composition is present, but pest animals and weed invasions have reduced the value of this habitat fragment. Dieback of key canopy species was apparent.</p> <p>High value for rarity and distinctiveness, Regionally Endangered ecosystem type. May provide habitat for At Risk lizard species.</p> <p>High value for diversity and pattern, level of natural diversity is good and due to its relatively large size. Noted SEA due to factor 'Diversity'.</p> <p>High value for ecological context, this forest buffers watercourses from nutrient runoff, and connects other mature forest ecosystems on the PPC site. Forms part of SEAs.</p> <p>Three high value and one moderate value equates to an overall value assessment of Very High.</p>	Very high
Pōhutukawa, pūriri, broadleaved forest (WF4)	<p>Moderate value for representativeness: typical vegetation structure and composition is present, but pest animals and weed invasions have reduced the value of this habitat fragment.</p> <p>High value for rarity and distinctiveness, Regionally Endangered ecosystem type. Hosts Nationally Threatened pōhutukawa and may provide habitat for At Risk lizard species.</p>	Very high

Ecological characteristic	Assessment of ecological value attributes based on EIANZ guidelines (Volume 2, Appendix A, Table 1)	Assigned Ecological value
	<p>High value for diversity and pattern, level of natural diversity is high as noted by the SEA assessment.</p> <p>High value for ecological context, this habitat type is preventing cliff erosion and providing important habitat for native birds, such as moderate value tuī. Forms part of an SEA, classified for its capacity to provide stepping-stones, migration pathways and buffers.</p> <p>Three high value and one moderate value equates to an overall value assessment of Very High.</p>	
Pōhutukawa treeland/flaxland/rockland (CL1)	<p>Moderate value for representativeness because a typical structure and composition is present, but pest animals and weed invasions have reduced the value of this habitat fragment.</p> <p>High value for rarity and distinctiveness, Regionally Vulnerable ecosystem type. May provide habitat for At Risk lizard species. Main canopy species is a Threatened species (pōhutukawa).</p> <p>High value for diversity and pattern, level of natural diversity is high, and due to its relatively moderate size and surrounding modification.</p> <p>High value for ecological context because this forest buffers watercourses from nutrient runoff and connects other mature forest ecosystems on site. Forms part of a SEA, classified for its capacity to provide stepping-stones, migration pathways and buffers</p> <p>Three high value and one moderate value assessments equates to an overall value assessment of Very High.</p>	Very High
Kānuka forest (VS2)	<p>Moderate value for representativeness because a typical structure and composition is present, but pest animals and weed invasions have reduced the value of this habitat fragment. Kānuka trees in this ecosystem type are often large (> 50 cm DBH).</p> <p>Moderate value for rarity and distinctiveness, this ecosystem is classified as Least Concern. May provide habitat for 'At Risk' lizard species. Canopy consists of Threatened kānuka.</p> <p>Moderate value for diversity and pattern because level of natural diversity is moderate, and due to its relatively moderate area and surrounding modification.</p> <p>High value for ecological context because this forest buffers watercourses from nutrient runoff and connects other mature forest ecosystems on the PPC site.</p> <p>One high value and three moderate value assessments equates to an overall value assessment of High.</p>	High
Mānuka, kānuka scrub (VS3)	<p>Moderate value for representativeness because a typical structure and composition is present, but pest animals and weed invasions have reduced the value of this habitat fragment.</p> <p>Moderate value for rarity and distinctiveness, this ecosystem is classified as Least Concern. May provide habitat for 'At Risk' lizard species. Canopy consists of Threatened kānuka and 'At Risk' mānuka.</p> <p>Moderate value for diversity and pattern because level of natural diversity is moderate, and due to its relatively moderate area and surrounding modification.</p>	High

Ecological characteristic	Assessment of ecological value attributes based on EIANZ guidelines (Volume 2, Appendix A, Table 1)	Assigned Ecological value
	<p>High value for ecological context because this forest buffers watercourses from nutrient runoff and connects other mature forest ecosystems on the PPC site. Buffers WF9 ecosystems, and forms part of SEA_T_1140.</p> <p>One high value and three moderate value assessments equates to an overall value assessment of High.</p>	
Broadleaved species scrub/forest (VS5)	<p>Low value for representativeness; weed invasions have affected this habitat type and are outcompeting native species.</p> <p>Moderate value for rarity and distinctiveness, this ecosystem is classified as Least Concern; however, may provide habitat for 'At Risk' lizard species. Threatened kānuka and 'At Risk' mānuka present.</p> <p>Moderate value for diversity and pattern, level of natural diversity is moderate, moderately sized area and surrounding modification.</p> <p>High value for ecological context because this forest buffers watercourses from nutrient runoff and connects other mature forest ecosystems on the PPC site. Buffers WF9 ecosystems, and forms part of SEA_T_1140.</p> <p>One low value, two moderate value and one high value assessment equates to an overall value assessment of Moderate.</p>	Moderate
Native terrestrial plantings (PL)	<p>Low value for representativeness, plantings consist of common native species of relatively small stature, with some weed invasion.</p> <p>Moderate value for rarity and distinctiveness, may provide habitat for 'At Risk' lizard species. Threatened kānuka trees present. 'At Risk – Naturally Uncommon' <i>Olearia angulata</i> present.</p> <p>Low value for diversity and pattern, level of natural diversity is low, and due to its relatively small area and surrounding modification.</p> <p>Moderate value for ecological context because the plantings buffer watercourses from nutrient runoff and connect other mature forest ecosystems on the PPC site. Buffers SEA_T_1140.</p> <p>Two low value and two moderate value assessments equates to an overall value assessment of Moderate.</p>	Moderate
Exotic forest (EF)	<p>Low value for representativeness, overall diversity is very low, with few indigenous plants in this ecosystem type.</p> <p>Moderate value for rarity and distinctiveness, exotic forest is common in the wider environment but trees may provide roosting habitat for long-tailed bats (however, bats have not been identified during surveys).</p> <p>Low value for diversity and pattern because level of natural diversity is low.</p> <p>Low value for ecological context, marginal habitat for most native bat, bird, lizard and invertebrate species.</p> <p>Three low value and one moderate value assessments equates to an overall value assessment of Low.</p>	Low
Exotic-dominated scrub (ES)	<p>Very low value for representativeness, overall diversity is very low, with few indigenous plants in this ecosystem type and exotic pest plants dominating.</p> <p>Low value for rarity and distinctiveness, exotic-dominated scrub common in wider environment. Provides marginal habitat for native fauna.</p> <p>Low value for diversity and pattern, level of natural diversity is low, and modification levels are high, with adverse ecological impacts from pest mammals and pest plants.</p> <p>Low value for ecological context, exotic-dominated scrub provides marginal habitat for most native bat, bird, lizard, and invertebrate species.</p>	Low

Ecological characteristic	Assessment of ecological value attributes based on EIANZ guidelines (Volume 2, Appendix A, Table 1)	Assigned Ecological value
	Three low value and one very low assessment equates to an overall value assessment of Low.	
Exotic grassland (EG)	<p>Very low value for representativeness, overall diversity is very low, with few indigenous plants in this ecosystem type.</p> <p>Moderate value for rarity and distinctiveness, exotic grasslands common in the wider environment, however provides habitat for 'At Risk' New Zealand pipit, and potentially for native copper skink (where woody debris is present).</p> <p>Low value for diversity and pattern, level of natural diversity is low, and modification levels are high, with adverse ecological impacts from pest mammals and stock.</p> <p>Low value for ecological context, exotic grasslands provide marginal habitat for most native bat, bird, lizard and invertebrate species.</p> <p>One very low, two low value and one moderate value assessments equates to an overall value assessment of Low.</p>	Low

Table 4.2.2: Ecological values assessment for species based on EIANZ guidelines (Volume 2, Appendix A, Table 1) (= confirmed present)**

Ecological characteristic	Threat status	Assigned Ecological value based on national Threat status
Nationally 'Threatened' or 'At Risk' flora		
Pōhutukawa**	Nationally Threatened (Nationally Vulnerable)	Very high
Kānuka**	Nationally Threatened (Nationally Vulnerable)	Very high
Akatea**	Nationally Threatened (Nationally Vulnerable)	Very high
Mānuka**	At Risk (Declining)	High
<i>Olearia angulata</i> **	At Risk (Naturally Uncommon)	Moderate
Terrestrial fauna		
Long-tailed bat	Nationally Threatened (Nationally Critical)	Very high
New Zealand pipit**	At Risk (Declining)	High
Kākā	At Risk (Recovering)	Moderate
Long-tailed cuckoo	Threatened – Nationally Vulnerable	Very High
Kererū**	Not Threatened (keystone species)	Moderate
Tūi**	Not Threatened (keystone species)	Moderate
All other common native birds	Not Threatened	Low
Ornate skink	At Risk (Declining)	High
Elegant gecko	At Risk (Declining)	High
Forest gecko	At Risk (Declining)	High
Pacific gecko	Not Threatened	Low

Ecological characteristic	Threat status	Assigned Ecological value based on national Threat status
Copper skink	At Risk species (Declining)	High
Invertebrate assemblage	Not Threatened	Low

4.2 Magnitude of effects assessment (Step 2)

The 'Magnitude of Effects' on ecological values that is associated with the proposed land use change within the Live Zone is assessed based on the extent, intensity, duration and timing of effects associated with the project after measures have been undertaken to further avoid, remedy or mitigate effects.

An overview of the potential adverse effects associated with the Live Zone (refer Section 4.2.1 below) and corresponding measures to further avoid, remedy or mitigate effects is provided below (Section 4.2.2), followed by an assessment of the 'Magnitude of Effects' for each value (refer Section 4.2.3 below).

4.2.1 Overview of potential adverse effects

The proposed change in land use associated with the Live Zone has the potential to result in a range of adverse effects on ecological values. The precise effects of the proposal on these ecological values will be determined at the resource consents stage of the project when detailed design is available. Nevertheless, in broad terms, the potential adverse effects on terrestrial ecological values relating to the change in land use within the Live Zone (as shown on the Structure Plan) (and see Volume 2, Appendix A Figure 1) is expected to include:

- Exotic vegetation and habitat loss through vegetation clearance and earthworks (no native habitats will be lost);
- Direct mortality or injury to species, for example all plants and most of the smaller less mobile species (e.g. lizards and invertebrates) may be harmed during vegetation clearance or earthworks activities. Likewise, roosting bats could potentially be harmed during vegetation clearance activities, noting that no long-tailed bats have been detected in surveys thus far. Outside of bird breeding season, bird mortality would be low, however during breeding season vegetation removal has the potential to result in the destruction of nests, eggs and fledglings;
- The creation of habitat edge effects, altering the composition and health of adjacent vegetation (i.e. habitat degradation), which may affect habitat suitability for flora and fauna;
- Habitat fragmentation and isolation due to the loss and reduction of available habitat types and by reducing the ability for plants and animals to disperse across the landscape for food, shelter, and breeding purposes, i.e. severing or partially severing access to habitats that would otherwise be suitable; and
- Construction and operations related noise, vibrations, dust, or lighting effects.

Potential long-term ongoing adverse effects associated with the change in land use within the Live Zone may include:

- Ongoing habitat degradation associated with habitat loss, edge effects and fragmentation, which permanently affect movement of some species, with possible effects on meta-population dynamics and increased vulnerability to local extinction;
- Ongoing disturbance effects, particularly on habitat margins/edges, through noise, dust and lighting associated with infrastructure and housing;

- Mortality or injury on roads through strike or road kill for some species;
- The increased presence of people and introduced species in previously less accessible areas; and
- Lost opportunities for creating wildlife corridors.

4.2.2 Overview of recommended measures to avoid, remedy or mitigate effects

Measures to avoid potential for adverse ecological effects associated with the change within the Live Zone (and more broadly across the PPC area) were undertaken through the optioneering and concept design phases of the project and have included refining the configuration of the project (e.g. designing the footprint to avoid terrestrial SEAs and other areas with existing or potential high value habitats within the EPAN).

Potential adverse effects associated with the land use change in the Live Zone (and the wider PPC area) will be further mitigated through:

- Further refinement within the Live Zone development area through detailed design and construction methodology (where possible) to minimise the need to remove native forests and mature native trees, (e.g. through the select use of retaining walls, slope/batter refinements or minor alterations to the footprint);
- A minimum 10 m vegetation buffer around native vegetation types (all within the EPAN) to reduce edge effects and general disturbance effects relating primarily to light and noise associated with construction and existence of development;
- Seasonal constraints on vegetation clearance. The vegetation clearance programme will be affected by specific timing restrictions to avoid or minimise effects on fauna that are legally protected under the Wildlife Act 1953. This includes avoidance of vegetation clearance:
 - outside of earthworks season (i.e., should not be undertaken from 1 May – 1 October) due to the need for erosion and sediment controls to be in place;
 - during peak forest bird breeding season within native or exotic forest habitat to reduce harm to eggs or chicks; and
 - due also to seasonal constraints for salvaging and relocating lizards (lizards cannot be salvaged in colder months (e.g. from May to August)).
- Vegetation/habitat clearance protocols which will include:
 - Physical delineation of vegetation to be cleared to avoid inadvertent clearance and to minimise potential damage to branches and roots;
 - Directional felling to prevent damage to vegetation immediately adjacent to the development area within the Live Zone and wider PPC area;
 - Within native regenerating and mature forest habitat types, removal or pruning will be managed by experienced arborists to reduce tree damage and to accommodate construction;
 - Within native regenerating forest and native mature forest, vegetation clearance/habitat loss activities will be overseen by a suitably qualified ecologist; and
 - Minimising harm or injury to nationally 'At Risk' geckos through the delimiting (main trunk only) of felled trees and stockpiling of the remaining vegetative material adjacent to remaining mature or regenerating forest for a minimum of 1 month prior to mulching. This will enable geckos not detected during salvaging operations to disperse from felled vegetation into surrounding habitats.

- Vegetation clearance salvage and relocation operations for nationally ‘Threatened’, ‘At Risk’ or legally protected species present or potentially present onsite (including ornate skinks, elegant gecko, forest gecko, Pacific gecko and copper skink); and
- Controlling rank grass through continued stock grazing or mowing regime until construction commences, to restrict breeding habitat for New Zealand pipit to existing areas of rank grass and scrub.

All the above measures to avoid, remedy or mitigate potential adverse effects will be undertaken to reduce the severity of adverse ecological effects associated with the proposed land use changes within the Live Zone (and more broadly the wider PPC area). These measures will be enacted through consent conditions and associated management plans as part of future resource consent applications.

4.2.3 Magnitude of effects after measures to avoid, remedy or mitigate

The magnitude of effects on ecological values associated with the proposed land use change within the Live Zone is assessed based on the extent, intensity, duration and timing of effects associated with the project. Project effects on terrestrial values are set out below and in turn the magnitude of effects on each of these values are assessed after effort to avoid, remedy or mitigate effects.

The magnitude of effects categories in ascending order include ‘no effect’ ‘negligible’, ‘low’, ‘moderate’, ‘high’ or ‘very high’ (see Volume 2, Appendix A, Table 1). A magnitude of effects assessment was only undertaken for those habitat/vegetation types for which the proposed land use change within the Live Zone was expected to have ‘negligible’ or higher effects¹⁴.

As set out in Table 4.2.3.1 below, the magnitude of potential effects on all other indigenous terrestrial ecology values ranged from ‘Negligible to ‘Low’ for all terrestrial biodiversity values except for exotic scrub, exotic grassland and copper skink, for which the magnitude of effects was ‘Moderate’.

Table 4.3.3.1: ‘Magnitude of Effects’ assessment associated with the proposed Land use change in the Live Zone (See Volume 2, Appendix A, Table 1)

Ecological characteristic	Potential effects associated with the proposed land use change within the Live Zone	Measures to avoid, remedy or mitigate effects	Expected Magnitude of effect (EciAG, 2018)
Terrestrial habitat type			
Tawa, kohekohe, rewarewa, hīnau, podocarp forest (WF13)	Well outside the Live Zone Development Area	Not required	Negligible
Taraire, tawa, podocarp forest (WF9)	Well outside the Live Zone Development Area	Not required	Negligible
Pōhutukawa, pūriri, broadleaved forest (WF4)	Outside of the Live Zone development area. Temporary construction-related dust effects may affect vegetation growth on the edge of this habitat type.	Dust Management Minimum 10 m native revegetation buffer from construction activities and buildings.	Negligible

¹⁴ Several of the vegetation/habitat types present within or immediately surrounding the PPC area were located well outside the Live Zone development area and there was considered to no potential for effect on these habitat types.

Ecological characteristic	Potential effects associated with the proposed land use change within the Live Zone	Measures to avoid, remedy or mitigate effects	Expected Magnitude of effect (EciAG, 2018)
	There is approximately 0.26 ha of this habitat within the PPC area and 4.68 ha within 5 km of site.		
Pōhutukawa treeland/flaxland/rockland (CL1)	Outside of the Live Zone development area. Temporary construction-related dust effects may affect vegetation growth on the edge of this habitat type. There is approximately 1.14 ha of this habitat onsite and 5.61 ha within 5 km of site.	Dust Management. Minimum 10 m native revegetation buffer from construction activities and buildings.	Negligible
Kānuka forest (VS2)	Outside of the Live Zone development area. Temporary construction-related dust effects may affect vegetation growth on the edge of this habitat type. There is approximately 4.48 ha of this habitat onsite and approximately 45 ha within 5 km of the Live Zone.	Dust management. Minimum 10 m native revegetation buffer from construction activities and buildings.	Negligible
Mānuka, kānuka scrub (VS3)	Well outside the Live Zone development area	Not required	Negligible
Broadleaved species scrub/forest (VS5)	Outside of the Live Zone development area. Temporary construction-related dust effects may affect vegetation growth on the edge of this habitat type. There may also be indirect negative effects associated with the proposed land use change. There is approximately 1.76 ha of available habitat on site. and 4.9 ha within 5 km radius of Live Zone).	Dust and sediment management. Minimum 10 m native revegetation buffer from construction activities and buildings	Negligible
Native terrestrial plantings (PL)	Well outside the Live Zone development area	Not required	Negligible
Exotic forest (EF)	Permanent loss of 1.35 ha which equates to 9.1 % of the available habitat within the PPC area. The loss totals a negligible proportion of this habitat type in the surrounding landscape (approximately 747 ha occurs within 5 km of the site).	No effects management measures are proposed	Low
Exotic-dominated scrub (ES)	Permanent loss of 5.08 ha which equates to 30.6 % of the available 16.60 ha of this habitat within the PPC area. The loss	No effects management measures are proposed	Moderate

Ecological characteristic	Potential effects associated with the proposed land use change within the Live Zone	Measures to avoid, remedy or mitigate effects	Expected Magnitude of effect (EciAG, 2018)
	equates to a moderate proportion available in the surrounding landscape (within 5 km of the PPC area).		
Exotic grassland (EG)	Permanent loss of approx. 40 ha of habitat which equates to approximately 50 % of available habitat onsite. More than 1,565 ha occurs within 5 km of the site.	No effects management measures are proposed	Moderate
Threatened or 'At Risk' flora			
Pōhutukawa	Loss of trees within native habitats. The extent of tree loss for each species is expected to be range from No Effect to Negligible relative to what is available on the property and in the immediate surrounds.	Loss of individual trees will be minimised through vegetation clearance protocols	Negligible
Kānuka			Negligible
Akatea			No Effect
Mānuka			Negligible
<i>Olearia angulata</i>			No Effect
Terrestrial fauna			
Long-tailed bat	<p>Permanent loss of roosting trees in exotic forest, as well as standalone trees and foraging habitat (i.e. edges of mature forest). Habitat immediately adjacent to the development area is expected to be subject to edge effects such as noise, light and dust disturbance. Bats in the wider landscape may also be affected by severance or partial severance of flyways.</p> <p>The magnitude of this loss is considered low relative to what is available in the immediate surrounds (747 ha of exotic forest within 5 km of site, > 200 ha of native mature forest within 5 km of site).</p> <p>Magnitude of effect on the local population through mortality is considered to be low.</p>	<ul style="list-style-type: none"> Avoidance of vegetation removal during cooler months (May to September inclusive). Vegetation clearance protocols to avoid impacts to bats to be described in the Bat Management Plan. 	Negligible (assuming presence)
New Zealand pipit	Permanent loss of rank or managed exotic grassland (100 ha) and exotic scrub (5.08 ha) which is a Low proportion of that available in the surrounding landscape.	Continued stock browsing on pastoral land and continued mowing of golf courses until construction works to minimise habitat availability and restrict breeding habitat.	Low

Ecological characteristic	Potential effects associated with the proposed land use change within the Live Zone	Measures to avoid, remedy or mitigate effects	Expected Magnitude of effect (EciAG, 2018)
Kākā	Permanent loss of potential nesting and foraging habitat in 1.35 ha of exotic forest habitat, which is a Low proportion of what is available in the surrounding landscape. The magnitude of effect on local population through mortality expected to be low.	<ul style="list-style-type: none"> Avoidance of native forest habitat types within the EPAN. Avoidance of terrestrial vegetation clearance during peak forest bird breeding season (September to December inclusive). 	Negligible
Long-tailed cuckoo			Negligible
Kererū			Low
Tūi			Low
Ornate skink	Negligible effects are expected on geckos and Ornate skink as habitat is of only marginal quality at best so these species are not expected to be present within the proposed Live Zone development area.	<ul style="list-style-type: none"> Avoidance of terrestrial vegetation removal during months when copper skink are inactive and therefore difficult to capture (May to August inclusive). Lizard Management Plan to detail salvage and relocation prior to vegetation clearance.	Negligible
Elegant gecko			
Forest gecko			
Pacific gecko			
Copper skink	Permanent loss of up to approximately 46 ha of suitable habitat, including 40 ha of exotic grassland, 5.08 ha of exotic scrub and 1.35 ha of exotic forest. This equates to a Low proportion of available habitat within the surrounding landscape. Direct harm to any skinks that are not salvaged as part of the salvage and relocation measures	<ul style="list-style-type: none"> Avoidance of the highest value copper skink habitat. Avoidance of terrestrial vegetation removal during months when copper skink are inactive and therefore difficult to capture (May to August inclusive). Lizard Management Plan to detail salvage and relocation prior to vegetation clearance. 	Moderate (assuming presence)

4.3 Level of effects (Step 3)

Table 4.4.1 below sets out the potential 'Level of Effects' on terrestrial biodiversity values that are associated with land use change within the Live Zone after measures to avoid, remedy or mitigate for effects have been considered. Recommendations for addressing potential residual effects that are 'Moderate' or higher are provided in Section 5 of this report.

Overall, the overall level of ecological effects on all terrestrial biodiversity values range from 'Very Low' to 'Low' with the notable exception of effects on copper skink which were assessed as 'High'. This was due to the extent of habitat loss and the expectation that most copper skink within the footprint will be lost even after salvage and relocation measures even with considerable effort.

Recommendations for addressing residual effects on copper skinks as a result of the proposed land use change in the Live Zone (and the broader PPC area) are provided in Section 5 below. These measures primarily include native habitat restoration and enhancement planting and mammalian pest control and will also provide benefits for terrestrial biodiversity values for which the level of effects is assessed as 'Very Low' or 'Low'.

Table 4.4.1: Level of effects associated with the proposed land use change after proposed measures to avoid, remedy or mitigate for effects have been undertaken (based on EciAG (see Volume 2, Appendix A, Table 1))

Ecological characteristic	Ecological value category	Magnitude of effects category	Level of effects category
Terrestrial habitat type			
Tawa, kohekohe, rewarewa, hīnau, podocarp forest (WF13)	Very high	No Effect	No Effect
Taraire, tawa, podocarp forest (WF9)	Very high	No Effect	No Effect
Pōhutukawa, pūriri, broadleaved forest (WF4)	Very high	Negligible	Low
Pōhutukawa treeland/flaxland/rockland (CL1)	Very high	Negligible	Low
Kānuka forest (VS2)	High	Negligible	Very Low
Mānuka, kānuka scrub (VS3)	High	Negligible	Very Low
Broadleaved species scrub/forest (VS5)	Moderate	Negligible	Very Low
Native terrestrial plantings (PL)	Moderate	Negligible	Very Low
Exotic forest (EF)	Low	Low	Very Low
Exotic-dominated scrub (ES)	Low	Moderate	Low
Exotic grassland (EG)	Low	Moderate	Low
Terrestrial vegetation			
Pōhutukawa	Very high	Negligible	Low
Kānuka	Very high	Negligible	Low
Akatea	Very high	Negligible	Low
Mānuka	High	Negligible	Very Low
<i>Olearia angulata</i>	Moderate	Negligible	Very Low
Terrestrial fauna			
Long-tailed bat	Very high	Negligible	Low
New Zealand pipit	High	Low	Low
Kākā	Moderate	Negligible	Very Low
Long-tailed cuckoo	Very High	Negligible	Low

Kererū	<i>Moderate</i>	<i>Low</i>	<i>Low</i>
Tūi	<i>Moderate</i>	<i>Low</i>	<i>Low</i>
Ornate skink	<i>High</i>	<i>Negligible</i>	<i>Very Low</i>
Elegant gecko	<i>High</i>	<i>Negligible</i>	<i>Very Low</i>
Forest gecko	<i>High</i>	<i>Negligible</i>	<i>Very Low</i>
Pacific gecko	<i>Low</i>	<i>Negligible</i>	<i>Very Low</i>
Copper skink	<i>High</i>	<i>Moderate</i>	<i>High</i>

5 Proposed Residual Effects Measures

This section sets out:

- An overview of the residual effects that will need to be addressed (Section 5.1);
- An overview of biodiversity offsetting and compensation definitions and principles (Section 5.2);
- The overall approach for addressing the residual effects (Section 5.3); and
- The proposed habitat restoration or enhancement measures that will be undertaken for the purpose of addressing residual effects on terrestrial ecological values (Section 5.4).

5.1 Potential residual effects that will need to be addressed

As assessed in Section 4 above, the proposed land use change associated with the Live Zone is expected to have 'High' residual adverse effects on copper skink. For all other terrestrial biodiversity values present within the PPC area, the proposed land use change within the Live Zone is expected to have either 'No Effect', Very Low' Effects or 'Low' effects after measures to avoid, remedy or mitigate for effects.

5.2 Biodiversity offsetting and compensation

Management of residual effects after measures to avoid, remedy or mitigate impacts fall to offsetting or compensation. As defined in Baber et al. (2021a) and Quinn et al. (2021):

“A biodiversity offset is a ‘measurable conservation outcome’ that meets certain principles and balances adverse residual effects, to a No Net Loss (NNL) or preferably Net Gain (NG) standard. While offsetting requires a measurable outcome that has been quantified through a robust and transparent process, biodiversity compensation does not necessarily need to be quantified and measurable. However, compensation measures under the principles of biodiversity compensation (as described below) are intended to achieve No Net Loss or preferably Net Gain outcomes where possible.”-

Key biodiversity offsetting principles as set out in Appendix 8 of the AUP-OP and Appendix 3 of the draft National Policy Statement for Indigenous Biodiversity (NPS-IB) (November 2019) (see Volume 2, Appendix A, Table 2) include the principles of:

- NNL or preferably NG outcomes.
- Adherence to the effects management hierarchy. Offset should only be contemplated after steps to avoid, remedy, or mitigate adverse effects have sequentially been exhausted, and thus applies only to residual biodiversity impacts. Compensation, as the least certain and most risky management of effects, should be considered as a last resort.
- Ecological equivalence, meaning the ecological values that benefit from the offsetting measures are the same or similar to those being impacted.
- Additionality, meaning the gains in biodiversity must be above and beyond gains that would have occurred anyway in the absence of the offset or compensation.
- Long-term outcomes (preferably in perpetuity).
- Landscape context, whereby the biodiversity offset or compensation considers the landscape context of both the impact site and the offset site.

- Science and mātauranga Māori, whereby the design and implementation of a biodiversity offset must be a documented process informed by science, including an appropriate consideration of mātauranga Māori¹⁵.

Similarly, key biodiversity compensation principles are outlined in Appendix 4 of the NPS-IB (See Volume 2, Appendix A, Table 2). These biodiversity compensation principles generally follow the above offsetting principles, with the most notable difference relating to the scale of biodiversity compensation. Instead of the NNL or preferably NG outcomes required by offsetting, compensation requires the indigenous biodiversity values lost through the activity to be addressed by positive effects to indigenous biodiversity that are proportionate to the adverse effects.

5.3 Overall approach for addressing residual effects

The proposed residual effects management approach seeks to achieve NG outcomes after 20 years for the residual adverse effects on indigenous terrestrial biodiversity values, in order to inform the Structure Plan. This outcome can be achieved through native terrestrial planting and a weed and mammalian pest control programme to enhance existing terrestrial biodiversity values.

These proposed habitat restoration and enhancement measures are all forms of compensation and do not strictly meet the definition of offsetting, largely because at this stage of the process, the expected future gains associated with the proposed habitat restoration and enhancement activities cannot be quantified with adequate precision to constitute an offset (Baber et al. 2021). However, although biodiversity compensation does not require the same numerical rigour as offsetting, it is generally recognised that ecological outcomes are improved where offset principles are applied as a guideline when designing compensation packages.

As described in Section 2.3.4, the type and magnitude of proposed compensation measures have been guided by the application of a BCM (Baber et al., 2021 a,b,c) as detailed in the Biodiversity Compensation Modelling report.

5.4 Proposed terrestrial biodiversity compensation requirements

The biodiversity modelling (see the Biodiversity Compensation Modelling Report) suggests that to address residual adverse effects on terrestrial ecology within the Live Zone (and more broadly the PPC area) to an expected Net Gain standard within 20 years, will require the following:

- 30.8 ha of terrestrial revegetation and habitat enhancement into all available terrestrial planting areas within the network to create additional habitat for terrestrial biodiversity.
- 88.7 ha of mammalian and invasive weed pest control for 35 years, which will further protect and enhance terrestrial and wetland biodiversity values.

Additionally, the wetland buffer plantings and the stream riparian plantings into terrestrial habitat around wetland and stream riparian margins (10 m width) will also provide benefits to terrestrial biodiversity values.

Importantly:

- These habitat and enhancement measures within the EPAN will address residual effects on copper skink which were as assessed as 'High' as well as providing Net Gain outcomes for a range of terrestrial ecology values that not adversely affected by the proposed land use change within the Live Zone or wider PPC area.

¹⁵ This principle will be addressed primarily in the Cultural Impact Assessment and integrated into the residual effects management approach. Similarly, other inter-related principles and disciplines, e.g., stormwater management and landscape design will be built into the overall residual effects management package for ecology.

- The habitat restoration and enhancement measures will generate enormous Net Gains with relative to adverse effects associated with the Live Zone

The location and type of compensation measures proposed are present in Volume 2, Appendix A, Figure 2. As required by proposed precinct provisions, Net Gain outcomes will be verified through biodiversity outcome monitoring, which will also guide adaptive management/contingency measures as required.

The proposed habitat restoration and enhancement measures will align with biodiversity offsetting and compensation principles and ecological best practice. Specifically:

- Revegetation will include the full suite of native trees affected by the project as well as native trees and shrubs that are commonly used for revegetation, and that are known to occur within the SEAs.
- Revegetation will include plants eco-sourced from the respective SEAs where this is possible and if not possible, from the Hunua ED.
- A 20-year weed maintenance and revegetation planting programme will be undertaken within all compensation and mitigation revegetation sites (noting that weed infestation is likely to be an issue given the prevalence of weeds in the area).
- All proposed revegetation sites will be contiguous with the existing SEAs.
- A proportion of already fallen (coarse woody debris) or felled exotic or native tree trunks and stumps shall be deployed within revegetation sites to provide for native biodiversity, e.g., lizards, invertebrates and fungi. Trunks or stumps equating to 50 m total length per ha shall be deployed. Logs shall be a minimum of 60cm (dbh) for tree trunks and cut up into 0.5 – 2 m lengths.
- Long-term protection of the EPAN is further assured via encumbrances or covenants.
- Mammalian pest control will follow best practice and be undertaken for 35 years with a focus on reducing densities of rats, possums, mustelids and feral cats.
- A biodiversity outcome monitoring programme will be developed and implemented across impact sites and compensation sites to:
 - Verify that expected NG outcomes have been achieved (i.e. that adverse effects on those values affected by the PPC project have been demonstrably offset).
 - Guide adaptive management response and contingency measures in the event that biodiversity gains are not tracking as expected. This programme will include baseline monitoring at the impact and compensation sites and will focus on vegetation characteristics and the relative abundance of birds.

6 Conclusion

In conclusion, we consider that all potential adverse effects on terrestrial ecology due to rezoning from the PPC and associated land use change within the Live Zone and wider PPC area can be addressed to an expected NG standard within 20 years.

The above outcomes for terrestrial ecology will be achieved firstly through existing Auckland-wide provisions under the AUP and proposed precinct provisions developed for the proposed Beachlands South Precinct (as set out in the Planning Report that accompanies the PPC application). Secondly through subsequent resource consent processes, in which effects management measures will be enacted through consent conditions and associated management plans.

Through the creation of the 88.7 ha EPAN, we consider that the proposed precinct provisions set out in the planning report will:

- Ensure the protection of the most significant terrestrial ecology values onsite, which are located within the EPAN; and
- Provide for adequate terrestrial ecology mitigation and habitat restoration and enhancement opportunities that will be required at the resource consent application stage to address adverse effects associated with development.

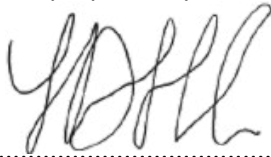
7 Applicability

This report has been prepared for the exclusive use of our client, Beachlands South Limited Partnership, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client, BSLP, will submit this report as part of an application for a private plan change and that Auckland Council as the consenting authority will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd

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