Boffa Miskell

# Tuumata Plan Change Area Rezoning – Private Plan Change

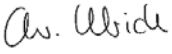
Ecological Impact Assessment

Prepared for TGH Ruakura Industrial Development Limited

8 November 2022

Boffa Miskell is proudly a
Toitū carbonzero® consultancy

## Document Quality Assurance

| | | |
|---|---|---|
| **Bibliographic reference for citation:**<br>Boffa Miskell Limited 2022. *Tuumata Plan Change Area Rezoning – Private Plan Change: Ecological Impact Assessment*. Report prepared by Boffa Miskell Limited for TGH Ruakura Industrial Development Limited. | | |
| Prepared by: | Kathryn Reeve<br>Ecologist / Freshwater<br>Boffa Miskell Limited |  |
| | Gavin Mathews<br>Ecologist/ Terrestrial<br>Boffa Miskell Limited |  |
| Reviewed by: | Andrew Blayney<br>Ecologist – Associate Principal<br>Boffa Miskell Limited |  |
| | Tine Ulrich<br>Ecologist – Freshwater review<br>Boffa Miskell Limited |  |
| Status: FINAL | Revision / version: 1.5 | Issue date: 8 November 2022 |

# CONTENTS

# Appendices

# 1.0 Introduction

Tainui Group Holdings Limited (TGH) proposes to develop the Ruakura South Tuumata Block (location and concept design depicted in Appendix 1 - Ruakura Land Development Plan Area B and D).

A private plan change is sought to rezone the Tuumata Block from Ruakura Industrial to predominantly residential, with a suburban centre and a network of open space (both for stormwater management and recreation purposes). A medium residential density will be enabled across the plan change area, providing for some 1050 dwellings in various typologies up to 3 stories high. Some 10,000 $m^2$ of suburban commercial centre will be provided. The plan change will be served by the staged provision of an extension of Fifth Avenue connecting to the East Coast Main Trunk (former Spine Road). Stormwater will be managed by a treatment train starting on site, large swales, and a large new wetland/stormwater treatment pond.

While this proposal is for a plan change, it occurs within the location and context of the wider Ruakura South Structure Plan Area (RSSPA) and as such, is part of the ecological compensation and mitigation context of this structure plan area. Therefore, to ensure alignment and consistency with the larger scale, cohesive mitigation proposed for this area, this Ecological Impact Assessment references the Ruakura Plan Change, and should be read in conjunction with the:

- Ruakura South Inland Port and Logistics Project Area Ecological Impact Assessment (2016 – submitted with Regional Council applications) (RIPLA EIA)
- Ruakura Structure Plan Area: Tree Removal Protocols for Ruakura South
- Ruakura South Native Lizard Management Plan (NLMP) and;
- Ruakura South Native Fish Management Plan (NFMP).

## 1.1 Scope

This Ecological Impact Assessment (EIA) brings together all the ecological requirements and assessments required for the Private Plan Change application. These specifically include:

- Managing effects on significant habitats of indigenous fauna. Under the provisions of the Waikato Regional Policy Statement, the use of habitat by a threatened or at-risk species confers ecological significance on the habitat regardless of its intrinsic ecological value. On that basis, this EIA focuses on the known habitats of at-risk and threatened species (longfin eels, black mudfish, long-tailed bats, and copper skinks), as well as the native management plan requirements.
- Alignment with the area-wide native lizard and native fish management plans;
- Evaluate the distribution of native fish populations, with an emphasis on black mudfish within the Tuumata Block areas and surrounding Structure Plan Area; and
- Assess the effects of the proposed development on indigenous fauna populations.

# 2.0 Land development context

The development of the Tuumata Plan Change Area sits within the wider context of the proposed development of the Ruakura Structure Plan Area (SPA). Development staging of the RSPA is governed by the Ruakura Structure Plan provisions of the Operative District Plan.

A wide range of assessments and investigations were undertaken for the Ruakura Plan Change Area including Tuumata Plan Change Area. Of relevance to this EIA are the following:

- Ruakura wide ecological assessment by Boffa Miskell (BML) (2010 & 2013).
- Ruakura wide surveys for indigenous fauna (fish, bats, lizards) by BML (2013 & 2014) which included the Tuumata Plan Change area.
- Draft Ruakura Integrated Catchment Management Plan prepared by Harrison Grierson (2013).
- Ruakura wide stormwater modelling and preliminary stormwater design by Harrison Grierson (2012).

This assessment should be read in conjunction with the documentation stated above.

## 2.1 Ruakura South development principles and design

Commercial and industrial land use is proposed for the southern portion of Ruakura based on the Ruakura Structure Plan. This development is occurring on the basis of a fully integrated stormwater design as confirmed by the Board of Inquiry in their approval of the Ruakura Plan Change in 2014.

Stormwater design was a primary driver of development design due to the largely flat and poorly drained characteristic of the Ruakura SPA. To facilitate land development, waterways have been and will be removed and replaced with a network of vegetated wetlands (swales) forming the main stormwater treatment and conveyance infrastructure. In the Tuumata Plan Change area, this includes removing two artificial farm drainage networks and replacing them with new stormwater swales which then feed directly into a piped network.

## 2.2 Tuumata Plan Change development area

The Tuumata Plan Change area is proposed for urban development to be established as a mixed-use precinct with medium density residential development throughout most of the site and a suburban centre to the northwest portion, as shown in the Preliminary Development Concept Masterplan (Drawing Number PDC-001, date issued 07/11/2022).

# 3.0 Methods

## 3.1 Desktop review

We reviewed existing information including available literature and aerial imagery of the area encompassing the proposed Tuumata Plan Change area. Key sources included:

- Aerial imagery of the area
- NZ Topo Map[1]
- RETROLENS Historical Image Resources
- Waikato Regional Council Biodiversity & Environment map[2]
- Waikato District Council Significant Natural Area map[3]
- Manaaki Whenua Landcare Research Biodiversity map[4]
- New Zealand River Environment Classification (REC)[5]
- Waikato Regional Council's water classification maps[6]
- New Zealand Freshwater Fish Database (NZFFDB)
- Department of Conservation Herpetofauna Bioweb database
- New Zealand Bird Atlas[7]
- Department of Conservation bat database[8]

A desktop review of previous information and assessments carried out for this Ruakura area was used to inform existing values and survey requirements. This included the following assessments and reports:

- Ruakura South Inland Port and Logistics Project Area Ecological Impact Assessment (RIPLA EIA, 2010 & 2013)
- Ruakura Native Lizard Management Plan (2016)
- Ruakura Native Fish Management Plan (2015)
- Ruakura Bat Survey and Roost Assessment (2018)

[1] NZ Topo Map: New Zealand Topographic Map (https://www.topomap.co.nz/accessed 15/02/2022)

[2] Waikato Regional Council: Biodiversity & Environment, (https://waikatomaps.waikatoregion.govt.nz accessed 15/02/2022)

[3] Waikato District Council: Significant Natural Area, (https://data.waikatodistrict.govt.nz/layer/95695-significant-natural-area-legal-effect/)

[4] Manaaki Whenua Landcare Research: Our Environment (https://ourenvironment.scinfo.org.nz/maps-and-tools/app/Land%20Suitability/lri_arable_suitability)

[5] Ministry for the Environment: River Environment Classification New Zealand (https://data.mfe.govt.nz/layer/51845-river-environment-classification-new-zealand-2010-deprecated/)

[6] Waikato Regional Council: Water Classification (https://waikatomaps.waikatoregion.govt.nz/Viewer/?map=11b87e5bebb14ca2a8b4a39ef8be87cb)

[7] New Zealand Bird Atlas, https://ebird.org/atlasnz/home, accessed on 29/03/2022.

[8] Department of Conservation bat database ranging from 1980 to 14 January 2021.

- Ruakura Native Fish Populations Assessment (2014)

## 3.2 Vegetation communities

### 3.2.1 Terrestrial vegetation

Vegetation communities were surveyed on 15 March 2022. A list of all native and exotic plant species observed was compiled, and a qualitative assessment of vegetation species and habitat diversity was also conducted.

Formal vegetation description, where used, followed the convention of Atkinson (1985) as outlined in Table 1. Where appropriate, generic descriptors such as “exotic grasses”, “rank grasses”, or “pasture grasses” are used in place of species names as this allows a better description and assessment of the value of the vegetation compared to long strings of non-native species epithets of low vegetation cover classes.

For mapping, similar vegetation types were aggregated (based on species composition and habitat type), as providing a detailed mapping of each vegetated habitat would be of limited value (when assessing ecological values).

*Table 1. Key to vegetation descriptions (from Atkinson, 1985). Typically, descriptions are restricted to species with a cover greater than 20% are included in the name but conspicuous, unique, or emergent species may also be included.*

| Notation device and format | Interpretation |
|---|---|
| *Species* | >50% of total vegetation cover of underlined species in a particular tier |
| *Species* | 20-49% of total vegetation cover of a species in a particular tier |
| *(species)* | 10-19% of total vegetation cover of a bracketed species in a particular tier |
| [species] | 1-10% of total vegetation cover of square bracketed species in a particular tier |
| *Species1*/*species* | Species 1 in a tier above species (e.g. species emergent above the canopy) |
| *Species-species* | Species occurring within the same tier |

### 3.2.2 Wetlands

During the desktop review of aerial imagery and the site visit on 15 March 2022, areas of putative wetlands were searched for. If putative wetlands were found, we followed the protocols outlined by the Ministry for the Environment (2020b) which is incorporated within the National Policy Statement for Freshwater Management (NPSFM) (Ministry for the Environment, 2020a) for determining the presence and extent of wetlands, the wetland delineation method. For ease of reference, Appendix  provides the wetland delineation flow chart from the Ministry for the Environment. This method relies on vegetation plot sampling and hydrophytic vegetation determination tool outlined within Clarkson (2013), as well as an assessment of the presence of hydric soils and wetland hydrology (Ministry for the Environment, 2020; Ministry for the

Environment, 2021). The wetland indicator rating status for each plant species follows Clarkson et al. (2013). The meaning of these classifications are as follows (reproduced from Clarkson (2013):

- OBL: Obligate. Almost always is a hydrophyte, rarely in uplands (estimated probability >99% occurrence in wetlands)
- FACW: Facultative Wetland. Usually is a hydrophyte but occasionally found in uplands (estimated probability 67–99%occurrence in wetlands)
- FAC: Facultative. Commonly occurs as either a hydrophyte or non-hydrophyte (estimated probability 34–66%occurrence in wetlands)
- FACU: Facultative Upland. Occasionally is a hydrophyte but usually occurs in uplands (estimated probability 1–33% occurrence in wetlands)
- UPL: Obligate Upland. Rarely is a hydrophyte, almost always in uplands (estimated probability <1% occurrence in wetlands)

To meet the standard for wetland hydrology, an area must meet the following (taken from Ministry for the Environment, 2021):

- Inundated for at least seven consecutive days during the growing season in most years (50 per cent probability of recurrence); or
- Saturated at or near the surface for at least 14 consecutive days during the growing season in most years (50 per cent probability of recurrence, for example, 5 years in 10). Soils may be considered saturated if the water table is within:

− 15 centimetres of the surface for sands

− 30 centimetres of the surface for all other soils

The final mapping of the wetland then used the plot information, contours, and vegetation types to delineate the wetland.

## 3.3 Bats

### 3.3.1 Acoustic bat survey

A bioacoustic bat survey was undertaken using automatic bat monitors (ABMs) manufactured by the Department of Conservation (DOC) which passively record both long-tailed bat (at 40 kHz) and short-tailed bat (at 28 kHz) echolocation calls on two concurrently operating frequency channels. The ABMs operate remotely by recording and storing each potential echolocation call (bat pass) along with the date and time of the occurrence of the potential bat pass.

This bat survey was conducted over three weeks from the 9th March to the 28th March 2021. During the survey, seven ABMs were deployed across the project extent targeting habitat features preferred by long-tailed bats for roosting, commuting, and foraging.

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

- Air temperature does not drop below 10°C from sunset until four hours after sunset;
- Rainfall of no more than 2.5 mm occurs in the first two hours after sunset;
- Mean overnight wind speed does not exceed 20 km/h;
- Overnight wind gusts do not exceed 60 km/h; and
- No monitoring occurs during full moon nights, including one night either side of the full moon.

Hourly weather data from the survey period was sourced from the nearest weather station available in New Zealand's National Climate database and included temperature, rainfall and wind speed (Hamilton station, ID: 26117)[9].

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

All ABMs were set to have the same date and time settings and programmed to monitor from one hour before sunset to one hour after sunrise[10]. All ABM recordings were downloaded and acoustic data from all nights was analysed using BatSearch 3.12, a programme designed by DOC for use with their ABMs. This software converts the potential bat echolocation calls (bat passes) into spectrograms that are visually analysed.

### 3.3.2 Bat roost assessment

A site walkover was undertaken on 9 and 10 November 2021, and trees with a diameter at breast height (DBH) of ≥15 cm were visually assessed from the ground. Where trees existed in groups or along shelterbelts, assessments were aggregated where roost potential was similar throughout the group and/or high value roost trees were found amongst other trees of lesser potential. In these circumstances, the areas were assessed in aggregate with the higher risk noted as tree felling operations are likely to be carried out over the same period and have the potential to impact on adjacent trees. It is important to note that there was no access to the quarantined area located in the south-eastern section of the site (Appendix 6b). Therefore, the few individual trees in this location were assessed from a vantage point.

Potential bat roost trees were recorded using GPS and photos were taken. In addition, potential bat roost features providing roosting opportunities to long-tailed bat(s) were described.

The trees were qualitatively categorised from low – high risk based on their potential to support roosting bats. Low risk trees are those with minimal roost features and are unlikely to support roosting bats. High risk trees are those that contain several and/or abundant roost features and have a high potential to support bat roosts. Features considered that indicate roost potential were:

- cavities,
- hollows,
- knot holes,
- cracks,
- flaking, peeling, and decorticating bark,
- epiphytes,

[9] The National Climate Database, Database Query Form (niwa.co.nz), accessed on 29/03/2022.

[10] Sunset and sunrise times were taken from the closest available location on the LINZ Sunrise/Sunset tables, see https://www.linz.govt.nz/sea/nautical-information/astronomical-information).

- broken or dead branches or trunk, and
- cavities/hollows/shelter formed by double leaders.

There is no formal guidance for categorising the roost value of trees for New Zealand bats based solely on habitat features. Therefore, the above categories are based on the experience of the bat specialist and studies that have been undertaken on roosting behaviour and roost selection by long-tailed bats (O'Donnell & Sedgeley, 1999; Sedgeley, 2001; Sedgeley & O'Donnell, 1999, 2004). Features of roost trees that were considered during the categorisation of bat roost value include:

- Type of roost features available – Studies undertaken in unmodified native forest have shown that long-tailed bats preferentially roost in knot-hole cavities with small entrance holes compared to cavities available throughout the forest. This has been linked to the more stable thermal characteristics within knot-hole cavities.
- The size (DBH) of the tree – New Zealand bats preferentially roost in the largest trees available as such trees generally have preferred thermal characteristics;
- Height of roost feature(s) – long-tailed bats generally roost high in trees, >15 m above the ground (O'Donnell & Sedgeley, 1999), potentially an adaptation to avoid predators;
- Canopy closure – Long-tailed bats are edge-specialists and are not adapted to flying in cluttered spaces. It has been demonstrated that they preferentially roost in trees with more open canopies.

It should be noted that the majority of long-tailed bat roost-selection studies are undertaken in pristine forest where roost trees are not a limiting resource compared to the highly modified landscape of peri-urban Hamilton. A comparison study undertaken with a long-tailed bat population in rural Canterbury has shown that bats utilise a wider range of roost types in response to the limited availability of preferential roost characteristics (Sedgeley & O'Donnell, 2004). Consequently, although trees have been categorised as 'low potential' in this assessment, they could still be used by long-tailed bats, particularly as solitary roosts and this does not change their required management.

## 3.4 Herpetofauna

No specific survey was conducted targeting herpetofauna on site. Instead, a desktop review was used to assist in identifying potential herpetofauna species that may be present, and to assess their ecological values. The following key source was reviewed:

- Department of Conservation Herpetofauna Bioweb database.

Any herpetofauna species that were incidentally encountered on site were noted.

A qualitative habitat assessment was conducted targeting coppers skink (*Oligosoma aeneum*), as these skinks are likely to be the only native lizard species on site. The qualitative habitat assessment is also based on experience of lizard salvage and relocation works undertaken in Ruakura South[11]. Habitats were qualitatively categorised from low – high risk based on their potential to support copper skink. Low risk habitats are those that were more exposed, containing minimal cover and sparse understorey growth. High risk habitats are those with

[11] Copper skink has been the only native species encountered during lizard salvage works in Ruakura South. Numbers of copper skinks salvaged in Ruakura South is generally low, but indicates this species is likely to be present within the Tuumata Plan Change area site.

dense cover (whether it be natural understorey growth including long rank grass and/or artificial debris) providing a cool damp environment ideal for copper skink.

## 3.5 Avifauna

No specific survey was conducted targeting avifauna on site. Instead, a desktop review was used to assist in identifying potential avifauna species that may be present, and to assess their ecological values. Key sources that were reviewed included:

- New Zealand Bird Atlas database[12], and
- Hamilton City biennial bird counts (Fitzgerald & Innes, 2013).

Any avifauna species that were incidentally encountered on site were noted.

## 3.6 Freshwater

### 3.6.1 Habitat survey methods

An initial reconnaissance of the waterways within the proposed development area was undertaken on 3rd March 2022 to establish which waterways had sufficient water depth over a sufficient length to deploy nets and undertake freshwater fauna surveys. The Tramway Road drain was completely dry within the lower reaches and had stagnant pools of water only in the upper reaches. The Powell's Road drain[13] was found to have sufficient flow and water depth to deploy traps during the 3rd March site visit. The survey was to be undertaken at Fairview Downs / Powell's Road drain on 7th March 2022; however, at this time the drain was completely dry. Due to the lack of flowing water, water quality assessment, fish and macroinvertebrate surveys were unable to be undertaken. Therefore, previously conducted onsite assessments were relied on for these aspects of the ecological assessment as outlined in Section 2.0.

### 3.6.2 Water & sediment quality assessment methods

Water and sediment quality of the waterways within the SPA has been assessed previously in 2013[14]. That assessment provides a baseline against which to evaluate changes in water and sediment quality that may occur from land development within this area of the catchment and the associated stormwater discharge.

Water samples were collected from the main waterways contributing to the stormwater currently discharging from the SPA. Water and sediment grab samples were collected, chilled, and delivered to Hills Laboratories for analysis. Water samples were analyses for heavy metals (arsenic, cadmium, chromium, copper, nickel, lead and zinc), aluminium, iron, turbidity, total suspended solids, carbonaceous biochemical oxygen demand and nutrients.

[13] Powell's Road section of drain within the TPC area, is stated in previous assessments as Reeves Close drain

[14] Boffa Miskell Ltd (2013). Ruakura Structure Plan Area – Assessment if Ecological Values to inform an Integrated Catchment Management Plan. Prepared for Tainui Group Holdings & Chedworth Park Ltd.

Results from the waterways relevant for the Tuumata Plan Change area, specifically from Tramway Road drain, Reeves Close drain and surrounding drains, Percival Road drain, and Ryburn Road drain are provided for context.

Water and sediment quality samples were unable to be obtained during the March 2022 assessment due to limited, or complete absence of, flowing water within the drain networks on site at the time of the surveys.

Comprehensive water and sediment quality sampling and analysis was undertaken on 5 July 2022 when water levels within the drains on site were suitable for sampling. Water quality spot measurements including dissolved oxygen, temperature, pH and specific conductivity were collected using a YSI ProPlus handheld parameter meter. In addition, water grab samples were collected, chilled, and delivered to Hill Laboratories for analysis. Water samples were analysed for heavy metals (arsenic, cadmium, chromium, copper, nickel, lead and zinc), aluminium, iron, turbidity, total suspended solids, petroleum hydrocarbons, polycyclic aromatic hydrocarbons, faecal coliforms, and nutrients. This sampling provides a more recent water and sediment quality baseline specific to the TPC area.

The results were compared against the Australian and New Zealand Guidelines for Freshwater and Marine Water Quality (ANZECC, 2000). ANZECC guidelines provide standards for chronic exposure of aquatic organisms to contaminants.

### 3.6.3 Fish & macroinvertebrate community assessment methods

Fish and macroinvertebrate communities of the waterways relevant to the TPC Area were previously investigated as part of the wider Assessment of Ecological Effects for the Ruakura Structure Plan Area[15].

Fish were previously surveyed on two occasions, in 2010 using electric fishing (EFM 300 backpack electric fishing machine) and Kilwell box traps, and in 2013 using baited Gee minnow traps and spotlighting. All fish captured were identified, measured, and released.

Aquatic macroinvertebrates were collected using a 500 micron net following Protocol C2 (Stark et al., 2001), preserved in ethanol and analysed according to Protocol P1: coded abundance. Soft bottom macroinvertebrate community index ($MCI_{sb}$) and semi-quantitative MCI (SQMCI) was calculated for each sample (Stark & Maxted, 2007). Species richness and number of EPT[16] taxa were also calculated.

## 3.7 Assessing the level of ecological effect

The assessment of the level of ecological value associated with the site follows the Environmental Institute of Australia and New Zealand (EIANZ) Impact Assessment Guidelines (Roper-Lindsay et al., 2018). This method involves the evaluation of the ecosystem/habitat values (Table 2), and species ecological values (Table 3) in combination with an assessment of the magnitude of effects (Table 5), which allows the assignment of an overall level of effect using the decision matrix in Table 6.

[15] Boffa Miskell Limited 2013. RUAKURA STRUCTURE PLAN AREA: Assessment of Ecological Values to inform an Integrated Catchment Management Plan. Report prepared by Boffa Miskell Limited for Tainui Group Holdings Ltd & Chedworth Park Ltd.

[16] EPT: Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies), the most sensitive aquatic macroinvertebrate species indication of good water quality.

### 3.7.1 Assigning ecological value to vegetation, habitats, and species

For terrestrial and aquatic habitats, we have assigned ecological value based on the assessment criteria outlined in Table 2 - Table 4 (from (Roper-Lindsay *et al.,* 2018)).

*Table 2: Guidelines for assessing ecological value to ecosystem/habitats (adapted from Roper-Lindsay et al. (2018)).*

| Matter | Assessment considerations |
|---|---|
| Representativeness | Extent to which area is typical or characteristic<br>Size |
| Rarity/distinctiveness | Amount of habitat or vegetation remaining<br>Supporting nationally or locally threatened, at risk or uncommon species<br>Regional or national distribution limits<br>Endemism<br>Distinctive ecological features<br>Natural rarity |
| Diversity and pattern | Level of natural diversity<br>Biodiversity reflecting underlying diversity |
| Ecological context | Contribution to network, buffer, linkage, pathways<br>Role in ecosystem functioning<br>Important fauna habitat<br>Contribution to ecosystem services |

*Table 3: Criteria for assigning ecological value to terrestrial habitats and species (modified from EIANZ (2018)).*

| ECOLOGICAL VALUE | SPECIES | HABITATS |
|---|---|---|
| **Very High** | *Threatened - (Nationally Critical, Nationally Endangered, Nationally Vulnerable)* | Area rates High for 3 or all of the four assessment matters listed in Table 2.<br>Likely to be nationally important and recognised as such. |
| **High** | *At-risk - (Declining)* | Area rates High for 2 of the assessment matters, Moderate and Low for the remainder, or Area rates High for 1 of the assessment maters, Moderate for the remainder.<br>Likely to be regionally important and recognised as such. |
| **Moderate** | *At-risk - (Recovering, Relict, Naturally Uncommon)*<br>Locally (Ecological District) uncommon or distinctive species | Area rates High for one matter, Moderate and Low for the remainder, or Area rates Moderate for 2 or more assessment matters Low or Very Low for the remainder.<br>Likely to be important at the level of the Ecological District. |
| **Low** | Native - *Not Threatened*. Nationally and locally common indigenous species. | Area rates Low or Very Low for majority of assessment matters and Moderate for one.<br>Limited ecological value other than as local habitat for tolerant native species. |
| **Negligible** | Exotic species, including pests, species having recreational value. | Area rates Very Low for 3 matters and Moderate, Low or Very Low for remainder. |

*Table 4: Criteria for assessment of freshwater stream ecological values*

| Value | Explanation | Characteristics |
|---|---|---|
| Very High | A reference quality watercourse in condition close to its pre-human condition with the expected assemblages of flora and fauna and no contributions of contaminants from human induced activities including agriculture. Negligible degradation e.g., stream within a native forest catchment. | • Benthic invertebrate community typically has high diversity, species richness and abundance.<br>• Benthic invertebrate community contains many taxa that are sensitive to organic enrichment and settled sediments.<br>• Benthic community typically with no single dominant species or group of species.<br>• MCI scores typically 120 or greater.<br>• EPT richness and proportion of overall benthic invertebrate community typically high.<br>• SEV scores high, typically >0.8.<br>• Fish communities typically diverse and abundant.<br>• Riparian vegetation typically with a well-established closed canopy.<br>• Stream channel and morphology natural.<br>• Stream banks natural typically with limited erosion.<br>• Habitat natural and unmodified. |
| High | A watercourse with high ecological or conservation value but which has been modified through loss of riparian vegetation, fish barriers, and stock access or similar, to the extent it is no longer reference quality. Slight to moderate degradation e.g., exotic forest or mixed forest/agriculture catchment. | • Benthic invertebrate community typically has high diversity, species richness and abundance.<br>• Benthic invertebrate community contains many taxa that are sensitive to organic enrichment and settled sediments.<br>• Benthic community typically with no single dominant species or group of species.<br>• MCI scores typically 80-100 or greater.<br>• EPT richness and proportion of overall benthic invertebrate community typically moderate to high.<br>• SEV scores moderate to high, typically 0.6-0.8.<br>• Fish communities typically diverse and abundant.<br>• Riparian vegetation typically with a well-established closed canopy.<br>• No pest or invasive fish (excluding trout and salmon) species present.<br>• Stream channel and morphology natural.<br>• Stream banks natural typically with limited erosion.<br>• Habitat largely unmodified. |
| Medium | A watercourse which contains fragments of its former values but has a high proportion of tolerant fauna, obvious water quality issues and/or sedimentation issues. Moderate to high degradation e.g., high-intensity agriculture catchment. | • Benthic invertebrate community typically has low diversity, species richness and abundance.<br>• Benthic invertebrate community dominated by taxa that are not sensitive to organic enrichment and settled sediments.<br>• Benthic community typically with dominant species or group of species.<br>• MCI scores typically 40-80.<br>• EPT richness and proportion of overall benthic invertebrate community typically low.<br>• SEV scores moderate, typically 0.4-0.6.<br>• Fish communities typically moderate diversity of only 3-4 species.<br>• Pest or invasive fish species (excluding trout and salmon) may be present.<br>• Stream channel and morphology typically modified (e.g., channelised)<br>• Stream banks may be modified or managed and may be highly engineered and/or evidence of significant erosion.<br>• Riparian vegetation may have a well-established closed canopy.<br>• Habitat modified. |
| Low | A highly modified watercourse with poor | • Benthic invertebrate community typically has low diversity, species richness and abundance. |

| Value | Explanation | Characteristics |
|---|---|---|
| | diversity and abundance of aquatic fauna and significant water quality issues. Very high degradation e.g., modified urban stream. | • Benthic invertebrate community dominated by taxa that are not sensitive to organic enrichment and settled sediments.<br>• Benthic community typically with dominant species or group of species.<br>• MCI scores typically 60 or lower.<br>• EPT richness and proportion of overall benthic invertebrate community typically low or zero.<br>• SEV scores moderate to high, typically less than 0.4.<br>• Fish communities typically low diversity of only 1-2 species.<br>• Pest or invasive fish (excluding trout and salmon) species present.<br>• Stream channel and morphology typically modified (e.g., channelised).<br>• Stream banks often highly modified or managed and maybe highly engineered and/or evidence of significant erosion.<br>• Riparian vegetation typically without a well-established closed canopy.<br>• Habitat highly modified. |

### 3.7.2 Assessing magnitude of effect

The magnitude of the effect on existing ecological values was assessed once ecological values were determined. The magnitude of the effect is a measure of the extent, or scale, of the effect, its duration, and the degree of change that it will cause. The magnitude ranges from very high to negligible, as shown in Table 5

*Table 5: Criteria for describing magnitude of effect (from EIANZ (2018)).*

| Magnitude | Description |
|---|---|
| **Very High** | Total loss of, or very major alteration to, key elements/features/ of the existing baseline conditions, such that the post-development character, composition and/or attributes will be fundamentally changed and may be lost from the site altogether; AND/OR<br>Loss of a very high proportion of the known population or range of the element/feature |
| **High** | Major loss or major alteration to key elements/features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR<br>Loss of a high proportion of the known population or range of the element/feature |
| **Moderate** | Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; AND/OR<br>Loss of a moderate proportion of the known population or range of the element/feature |
| **Low** | Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns; AND/OR<br>Having a minor effect on the known population or range of the element/feature |
| **Negligible** | Very slight change from the existing baseline condition. Change barely distinguishable, approximating to the 'no change' situation; AND/OR<br>Having negligible effect on the known population or range of the element/feature |

### 3.7.1 Assessing level of ecological effect

The overall level of the effect was determined by applying the following matrix (Table 6), which combined the ecological value of the site or species (Table 2 - Table 4) and the magnitude of effect (Table 5).

*Table 6: Criteria for describing overall level of effect (From EIANZ (2018)).*

| | | ECOLOGICAL VALUE | | | | |
|---|---|---|---|---|---|---|
| | | **Very High** | **High** | **Moderate** | **Low** | **Negligible** |
| **MAGNITUDE** | **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 |

The EIANZ (2018) guidelines note that the level of effect can be used as a guide to the extent and nature of ecological response (e.g., mitigation) required.

For example from EIANZ (2018):

- "Project effects in the 'Very High adverse' category are unlikely to be acceptable on ecological grounds alone (even with compensation proposals). Activities having very high adverse effects should be avoided. It is not the ecologist's role to make determinations with regard to project viability. The ecologist should present an objective and scientifically robust assessment of the effects of the project to assist the applicant in coming to an informed decision about project viability. Where very high adverse effects cannot be avoided, a net biodiversity gain would be appropriate.
- Options in the 'High and Moderate adverse' category represent a level of effect that requires careful assessment and analysis of the individual case. Such an effect could be managed through avoidance, design, or extensive offset or compensation actions. Wherever adverse effects cannot be avoided, no net loss of biodiversity values would be appropriate.
- Low and Very Low categories should not normally be of concern, although normal design, construction and operational care should be exercised to minimise adverse effects. If effects are assessed taking impact management developed during project shaping into consideration, then it is essential that prescribed impact management is carried out to ensure Low or Very Low-level effects".

# 4.0 Results and ecological values

The Ruakura SPA including the TPC area comprises approximately 822 hectares situated to the east of Hamilton City, approximately 2.7 kilometres from the central business district. Ruakura is

located within the Waikato Ecological Region and the Hamilton Ecological District, from which almost all of the original alluvial floodplain vegetation and swamps of the Waikato lowlands have been cleared and draining for farming (B. D. Clarkson et al., 2002). Waterways within the Structure Plan Area, particularly those that dry up periodically, have the potential to provide habitat for black mudfish and other native fish species as a surrogate for those historic wetland habitats.

Most of this land is intersected by a drainage network that discharges to the northwest (Kirirkiriroa Stream catchment), south (Mangaonua Stream catchment) an east (Komokorau Stream Catchment at the Brinkworth Drain). Some drains also discharge west into the Hamilton City Council (HCC) reticulated stormwater network.

The existing land use is predominantly agricultural comprising dairy farms, farms recently converted to cropping, and the AgResearch/Innovation Park campus. Intermittent vegetation is scattered within the project footprint, most of which is exotic in composition. Prior to human arrival and vegetation clearance, the site and surrounding land would have been dominated by a mix of kahikatea-pukatea-tawa forest and wetlands[17].

## 4.1 Vegetation communities

Most of the site is dominated by exotic pasture grasses with non-pasture vegetation scattered throughout the project footprint. Terrestrial vegetation surveyed within the project footprint is predominately exotic in composition. Non pasture vegetated habitats are mostly restricted to exotic shelterbelts and individual trees.

### 4.1.1 Terrestrial

A summary of the vegetation types and detailed vegetation description can be viewed below. A map of the vegetation present is provided in Appendix 3 and a list of species found during the survey is provided in Appendix 4. No at-risk or threatened species were recorded in the survey.

**Shelterbelt** – *Robinia pseudoacacia – Taxodium distichum – Populus spp. – (Ligustrum sinense) – (Eucalyptus sp.)* / *Robinia pseudoacacia – Ligustrum sinense* / (*Lonicera japonica*) – (*Hedera helix*) – (*exotic grasses*)

Shelterbelts are a common component of the vegetation within the project footprint. These shelter belts are dominated by exotic trees. The most common exotic trees encountered within the shelterbelts are black locust (*Robinia pseudoacacia*), Chinese privet (*Ligustrum sinense*), gum trees (*Eucalyptus sp*.), bald cypress (*Taxodium distichum*), and poplars (*Populus spp*.). The understorey/ground cover is typically limited. Though shelterbelts associated with drains or watercourses contain some dense patches of mostly exotic species such as Japanese honeysuckle (*Lonicera japonica*), English ivy (*Hedera helix*), exotic grasses, and young privet and black locust trees. Native species such as cabbage tree (*Cordyline australis*), lemonwood (*Pittosporum eugenioides*), pohuehue (*Muehlenbeckia australis*), silver fern (*Cyathea dealbata*), wheki (*Dicksonia squarrosa*), and kiokio (*Parablechnum novae-zelandiae*) are occasionally present. The native basket grass (*Oplismenus hirtellus subsp. imbecillis*) was occasionally noted in dense patches within some of the shelterbelts.

**Individual trees**

[17] Manaaki Whenua Landcare Research: Our Environment: Layer: Habitats – Potential Natural Vegetation: Suitability for Arable Cropping » Maps » Our Environment (scinfo.org.nz), accessed 27/04/2022.

Individual trees are occasionally scattered throughout the project footprint. These trees are all exotic, majority of which are London plane (*Platanus x acerifolia*) and black poplar (*Populus nigra*). The smaller individual trees adjacent to the farm race are ash trees (*Fraxinus sp*.).

**Kahikatea tree stand** – *Dacrycarpus dacrydioides*

Small stand of kahikatea (*Dacrycarpus dacrydioides*) trees. The kahikatea trees are relatively young and around 5 m tall. The understorey is dominated by pasture grasses.

**Native and exotic trees stand** – *Pittosporum eugenioides* – [*Solanum mauritianum*] – [*Magnolia sp*.] / *exotic grasses*

The canopy is dominated by lemonwood, with other species such as woolly nightshade (*Solanum mauritianum*), magnolia (*Magnolia sp*.), grey willow (*Salix cinerea*), and cabbage tree also occasionally present. The understorey is limited, with pasture grasses being the dominant ground cover.

**Tree stand** – *Platanus x acerifolia*

A couple of small tree stand habitats are present on site. These trees stand habitats are dominated by exotic trees. London plane is the most common tree present in these habitats. Occasional, horse chestnut (*Aesculus hippocastanum*), blackwood (*Acacia melanoxylon*), and lemonwood, and are also present. The understorey of the tree stands is limited, often containing pasture or long rank grass.

### 4.1.2 Wetlands

No putative wetlands were identified either on aerial imagery or during the site walkovers. The vegetation on site is not representative of wetland habitats, and therefore, as per the definition of NPSFM, no natural inland wetlands were identified within the project footprint.

### 4.1.3 Ecological value

Given the fragmented nature of the vegetated habitats and the lack of native vegetation species or communities present, the ecological value of the vegetation on the site is **low.** A summary of the EIANZ criteria for assessing the ecological value of terrestrial vegetation is provided in Table 7. Despite the lack of indigenous vegetation values, the vegetation/habitat types identified on site may have considerable ecological value for threatened indigenous fauna such as copper skinks and long-tailed bats.

*Table 7: Representativeness, rarity/distinctiveness, diversity/pattern, and ecological context of terrestrial vegetation on Site.*

| Ecological Feature | Matter | Ecological Value |
|---|---|---|
| Vegetation | Representativeness<br><br>Exotic dominated species composition that reflects the site's long history of land use disturbance. Remaining vegetation on site is highly modified and not representative of the kahikatea-pukatea-tawa forest that | Negligible |

| Ecological Feature | Matter | Ecological Value |
|---|---|---|
| | once would have been present within the Hamilton Ecological District. | |
| | Rarity/distinctiveness<br>The available habitat types and vegetation present on site are all common within the surrounding landscape. In addition, no rare or threatened species were noted. | Negligible |
| | Diversity & Pattern<br>Overall, there is a low level of biodiversity on site. The level of biodiversity is generally reflective of a modified rural landscape. The available habitat features are primarily exotic dominated and typically degraded. | Low |
| | Ecological Context<br>May play a role in acting as a 'stepping-stone' to facilitate movement of indigenous fauna within the area. The vegetation present could also be an important habitat for threatened native species such as copper skinks and long-tailed bats. | Moderate |
| **Overall Ecological Value for Vegetation** | | **Low** |

## 4.2 Bats

Bats are the only native terrestrial mammals in New Zealand. There are two species of bats in New Zealand, the long-tailed bat (*Chalinolobus tuberculatus*) and the lesser short-tailed bat which is separated into three subspecies (*Mystacina tuberculata spp*.). The long-tailed bat is classified as threatened – nationally critical and the central lesser short-tailed bat is classified as at risk – declining (O'Donnell *et al.*, 2018) due to predation, habitat degradation and loss, and competition.

Long-tailed bats preferentially roost in small cavities of old, large trees, but have also been observed to utilise other features such as loose bark, hollow limbs or epiphyte growth for roosting. They are able to fly long distances at night when they are commuting between roosts and/or foraging, for which they use echolocation to hunt for flying insects. Long-tailed bats are known to use linear habitat features (for example shelterbelts or edges of vegetation margins) to commute and forage (Borkin & Parsons, 2009; O'Donnell, 2000).

Short-tailed bats typically live within areas of mature native forest where they use hollow trees for roosting and ground hunting for foraging. No suitable habitat for short-tailed bats was identified within the project site and this species is not further considered in this assessment.

Several long-tailed bat passes have previously been recorded in Ruakura, including just south of the Tuumata site as part of current/previous development stages of Ruakura South. The level of bat activity previously recorded in Ruakura South has been low (Aughton, 2022). Bat monitoring undertaken across Hamilton City, however, demonstrates that the rural-urban fringe to the south of Hamilton city is core habitat for the Hamilton long-tailed bat population (Aughton, 2022; Kessels & Associates Ltd, 2017; Le Roux & Le Roux, 2012; Opus International Consultants Ltd, 2016).

### 4.2.1 Acoustic bat survey

All ABMs recorded over the whole survey period (19 days). The overall survey effort comprised a total of 133 survey detector nights. Three nights were not suitable survey nights due to a full moon on 18 March 2022 (which impacted the night prior and after the full moon; Appendix 5). Of the 133 total survey detector nights, 112 were suitable survey detector nights.

In total, 15 long-tailed bat passes were detected during this survey, recorded at six of the seven monitoring locations (Table 8). The highest level of bat activity was recorded in location 6, which had a total of four bat passes. Location 6 is a stand of very large eucalyptus trees at the southern boundary of the site. The next highest activities were recorded at locations 2, 3, and 7, which recorded three bat passes each. Location 4 (an exotic shelterbelt on the western side of the site) was the only ABM to not record any bat passes. One feeding buzz was recorded within this survey at location 6. A map of detected bat activity is provided in Appendix 6a.

Due to the low level of bat activity observed during this survey, all acoustic data that comprised bat activity was included in this assessment[18].

*Table 8: Bat survey summary. Note, summary includes all survey detector nights.*

| ABM location | Total number of nights recording data | Total number of nights recording data | Total No. of bat passes | Total No. of Bat Passes (Fine weather nights) |
|---|---|---|---|---|
| ABM 1 | 19 | 16 | 1 | 1 |
| ABM 2 | 19 | 16 | 3 | 3 |
| ABM 3 | 19 | 16 | 3 | 3 |
| ABM 4 | 19 | 16 | 0 | 0 |
| ABM 5 | 19 | 16 | 1 | 1 |
| ABM 6 | 19 | 16 | 4 | 3 |
| ABM 7 | 19 | 16 | 3 | 1 |

### 4.2.2 Bat roost survey

Based on the visual observation, the majority of the vegetation on site has been identified as having low – medium bat roosting potential (Appendix 6b). This includes the trees within the

[18] When excluding non-suitable survey nights, observed bat activity is reduced to a total of 12 bat passes during the whole survey period (Table 7).

quarantined area which were observed from vantage points. These trees appeared to display similar roost features to other trees of similar stature within the project footprint.

Trees or groups of trees that were noted to be of high bat roosting potential included the taller shelterbelt habitats and a large individual London plane in the middle of the site (Appendix 6b). These high-risk trees had numerous cavities, hollows, knot holes, cracks, loose bark, and broken or dead branches. The shelterbelts with mature eucalyptus trees had significant peeling and loose bark. Along the shelterbelt dominated by bald cypress trees, broken branches were commonly observed.

The low and medium risk vegetation did contain bat roosting features. However, these features were generally limited to occasional broken branches or cavities. It is important to note that the bat roost features assessed, were those visible from the ground. Therefore, no assumption should be made on whether other features (certain features not observed in a particular tree) are not present.

It is important to note that the bat roost features assessed were those visible from the ground. Therefore, no assumption should be made on whether other features (i.e., certain features not observed in a particular tree) were actually not present.

### 4.2.3 Ecological value

The results of this survey show that long-tailed bats are occasionally using the habitat features within the site. However, the sparse occurrence of activity observed during this survey suggests that the site does not form part of a significant commuting corridor and thus does not provide significant habitat connectivity. While only one feeding buzz and very low levels of bat activity were observed, the site does contain potential roost habitats. Several very large trees were noted to have bat roosting potential such as loose bark, knothole cavities or epiphyte growth. Furthermore, long-tailed bat passes have been recorded previously in Ruakura (though generally at very low levels). Given the above findings, we assess the ecological value of the site for long-tailed bat habitat as **Moderate.**

The threatened – nationally critical threat status of long-tailed bats means this species has a **Very High** ecological value.

## 4.3 Herpetofauna

Based on the available habitats within the project footprint, land use history of the site, review of the New Zealand Herpetofauna Bioweb database, and previous lizard salvage works in Ruakura South (an ecologically similar habitat to the Tuumata Plan Change area footprint), the only native species likely to be present is the copper skink. Recently, the threat status of this species has been changed from ‘Not Threatened’ to ‘At Risk – Declining’ (Hitchmough et al., 2021). The invasive plague skink (*Lampropholis delicata*) is also likely to be present on site and is commonly found in open disturbed habitats (such as the project footprint). Ornate skinks (*Oligosoma ornatum*) which have a ‘Threatened – At Risk’ status (Hitchmough et al., 2021) were identified within Claudelands bush (c. 1 km west from site) in 2020. Based on the nearby recent record of this species, there is a possibility that ornate skink may be present within the site extent. Generally, ornate skinks prefer stable environments such as deep leaf litter or rock piles (Van Winkel et al., 2018); however, they can be found in modified environments in similar habitats to copper skinks. Based on available habitats and herpetofauna records, other native lizard species are unlikely to be found within the site.

The site was found to contain several potential low, medium, and medium – high quality copper skink habitats throughout the project footprint. These habitats include dense undergrowth vegetation, natural and artificial debris, and long rank grass. Although much of the undergrowth within vegetated areas contain only sparse vegetation, they may still provide habitat values for native skinks. The remaining habitat surveyed within the site is grazed pasture which provides negligible lizard habitat value. A map of the potential copper skink habitats is provided in Appendix 7, and a breakdown of suitable micro-habitats within the different habitats is provided in Table 9.

*Table 9: Skink habitat types identified within Tuumata Plan Change area. Habitat values and breakdown of the available suitable micro-habitats within the different habitat types is also provided.*

| Habitat type | Available native skink micro-habitat | Habitat quality |
|---|---|---|
| Exotic shelterbelt 1 | Leaf litter, dense undergrowth, rank grass, woody debris including fallen trees. | Medium - High |
| Exotic shelterbelt 2 | Minimal leaf litter and woody debris. | Low |
| Individual trees | Minimal leaf litter and woody debris. | Low |
| Kahikatea tree stand | Minimal leaf litter and woody debris. | Low |
| Native and exotic trees stand | Occasional leaf litter, with some natural and artificial debris such as fallen branches and pieces of plastic, e.g., buckets. | Medium |
| Tree stand | Minimal leaf litter and woody debris. | Low |

### 4.3.1 Ecological value

It is likely that copper skinks are the only native lizard to be present on site. Copper skinks are relatively widespread in low numbers throughout the wider Hamilton area. Any copper skinks present may be at very low density due to predation by mammalian predators and the site's long history of disturbance. However, given that lizard salvage works in Ruakura South have captured this species, it is likely copper skinks are present within the Tuumata Plan Change area. For these reasons the ecological value for native lizards on site has been assessed as **Moderate**.

Taking into consideration the 'At Risk – Declining' threat status of copper skinks, this species has a **High** ecological value.

## 4.4 Avifauna

The avifauna assemblage on site is dominated by introduced and naturalised species such as house sparrow (*Passer domesticus*) and starling (*Sturnus vulgaris*), which are common in the Waikato agricultural landscape. The larger exotic shelterbelts may provide suitable resources to attract native birds (e.g., nesting and food resources) and any native species present are likely to be disturbance tolerant species such as silvereye (*Zosterops lateralis*) and pukeko (*Porphyrio melanotus*).

A list of bird species that may inhabit or visit the site, including their likelihood of utilising the habitats within the project footprint is provided in Table 10. Due to the lack of available native habitats, the majority of the native species identified in Table 10are likely to only periodically visit, rather than take up residence. One 'At Risk' bird species, kākā (*Nestor meridionalis*) has been noted to potentially be present on the site. Kākā, which has an 'At Risk – Recovering'

threat status (Robertson et al., 2021), was recorded once in 2012 as part of the Hamilton City biennial bird counts (Fitzgerald & Innes, 2013). Kākā may potentially traverse or visit the site periodically, however, are more likely to utilise the larger fragments of bush within the surrounding landscape and it is unlikely the site has any specific importance for this species.

*Table 10: Likelihood of avifauna present on site is categorised qualitatively into three categories: regular, infrequent, and seldom. Regular refers to species being common on site, infrequent refers to species being uncommon, and seldom refers to species rarely, if at all present on site.*

| **Common name** | **Species name** | **Threat status** (Robertson et al., 2021) | **Likelihood of being present on site** |
|---|---|---|---|
| Kākā | *Nestor meridionalis* | At Risk - Recovering | Seldom |
| Shining cuckoo | *Chrysococcyx lucidus* | Not Threatened | Infrequent |
| Swamp harrier | *Circus approximans* | Not Threatened | Infrequent |
| White-faced heron | *Egretta novaehollandiae* | Not Threatened | Seldom |
| Grey warbler | *Gerygone igata* | Not Threatened | Infrequent |
| Kererū | *Hemiphaga novaeseelandiae* | Not Threatened | Infrequent |
| Welcome swallow | *Hirundo neoxena* | Not Threatened | Regular |
| Morepork | *Ninox novaeseelandiae* | Not Threatened | Seldom |
| Pūkeko | *Porphyrio melanotus* | Not Threatened | Regular |
| Tūī | *Prosthemadera novaeseelandiae* | Not Threatened | Infrequent |
| Fantail | *Rhipidura fuliginosa* | Not Threatened | Infrequent |
| Sacred kingfisher | *Todiramphus sanctus* | Not Threatened | Seldom |
| Spur-winged plover | *Vanellus miles* | Not Threatened | Regular |
| Silvereye | *Zosterops lateralis* | Not Threatened | Regular |
| Common myna | *Acridotheres tristis* | Introduced and Naturalised | Regular |
| Eurasian skylark | *Alauda arvensis* | Introduced and Naturalised | Infrequent |
| California quail | *Callipepla californica* | Introduced and Naturalised | Infrequent |
| European goldfinch | *Carduelis carduelis* | Introduced and Naturalised | Infrequent |
| European greenfinch | *Carduelis chloris* | Introduced and Naturalised | Infrequent |
| Common redpoll | *Carduelis flammea* | Introduced and Naturalised | Seldom |
| Rock pigeon | *Columba livia* | Introduced and Naturalised | Infrequent |
| Yellowhammer | *Emberiza citrinella* | Introduced and Naturalised | Infrequent |
| Australian magpie | *Gymnorhina tibicen* | Introduced and Naturalised | Regular |
| Chaffinch | *Fringilla coelebs* | Introduced and Naturalised | Infrequent |
| Dunnock | *Prunella modularis* | Introduced and Naturalised | Seldom |
| Eastern rosella | *Platycercus eximius* | Introduced and Naturalised | Regular |
| House sparrow | *Passer domesticus* | Introduced and Naturalised | Regular |
| Common pheasant | *Phasianus colchicus* | Introduced and Naturalised | Infrequent |
| Spotted dove | *Streptopelia chinensis* | Introduced and Naturalised | Infrequent |
| Barbary dove | *Streptopelia risoria* | Introduced and Naturalised | Infrequent |
| Common starling | *Sturnus vulgaris* | Introduced and Naturalised | Regular |
| Eurasian blackbird | *Turdus merula* | Introduced and Naturalised | Regular |
| Song thrush | *Turdus philomelos* | Introduced and Naturalised | Regular |

### 4.4.1 Ecological value

The habitats available are unlikely to provide permanent habitat, or habitats of specific importance for any 'At Risk' or 'Threatened' avifauna. The habitats may act as a 'stepping-stone', facilitating avifauna movement throughout the area and contributing to the seasonal food and/or structural resources exotic and native birds utilise within this modified landscape. Overall, based on the available habitats, and the low probability of 'At Risk' or 'Threatened' birds visiting the area, the avifauna species ecological value and the habitat ecological value of the site have both been assessed as **Low**.

## 4.5 Freshwater

### 4.5.1 Catchment

The Tuumata Plan Change area is located within the Kirikiriroa sub-catchment, the largest area within the Ruakura Structure Plan area. There are four existing outlets to the Kirikiriroa sub-catchment and one surface flow outlet to the Komakorau system with surface flows occurring during extreme weather events.

Two discrete drainage networks occur within the Tuumata Plan Change area, Fairview Downs (Powell's Road drain / Reeves Close drain) and Tramway Road (Tramway Road drain). Both watercourses flow to the existing HCC reticulated system prior to discharging into the Kirikiriroa Stream (Appendix 7). The length of the reticulated network is likely to preclude the passage of all fish.

The northwestern margin of Tuumata Plan Change area connects with the Komakorau Stream catchment through artificial intermittent drains between Powell's Road and the railway corridor, along Ryburn and Percival Roads and through AgResearch farmland. Flows in these drains are typically very slow, if flowing at all. Connectivity is highly variable and there is frequently no connection when groundwater levels are low, and drains are empty or contain only shallow pools. Harrison Grierson[19] 2D modelling indicates that the Ruakura catchment generally only contributes flow to the Komakorau in rainfall events greater than approximately a 10-year event.

### 4.5.2 Aquatic habitat

Within the Tuumata Plan Change area (LDPA B & D), there is approximately 750 m of existing waterway comprised of artificial farm drain networks.

#### 4.5.2.1 Tramway Road drain

The Tramway Road drain is located towards the western extent of the site and discharges into the HCC reticulated system underneath Wairere Drive near the Tramway Road intersection. The artificial drain originates from a culvert and has two additional culverts throughout the length of the reach, the culverts within the assessed reach pose no fish passage obstacles. The channel consists typically of a U-shaped channel transect, uniform morphology and being predominantly straight with no intersecting tributaries or farm drains from surrounding paddocks. The length of the watercourse is approximately 285 m.

[19] Ruakura-wide stormwater modelling and preliminary stormwater design by Harrison Grierson.

The Tramway Road drain is classified as intermittent, as it features a well-defined channel and surface water more than 48 hours after a previous rain event resulting in stream flow, while no rooted terrestrial vegetation was established across the channel. However, during the assessment the downstream ¾ of the reach was dry with only stagnant ponds of limited water depth observed within the upper end of the reach. Instream water assessment was only conducted within the wetted section at the upstream section of the reach.

The Tramway Road drain has a narrow vegetated riparian area of approximately 5 m width on both banks providing a moderate level of shading Figure 1.

Riparian vegetation is outlined within Section 4.1 and Appendix 3 and is predominantly comprised of established exotic canopy trees including Chinese privet, black locust, poplars, and understorey of woolly nightshade, Japanese honeysuckle, blackberry, and English ivy. Some native species are sparingly present including *Coprosma*, cabbage trees, lemonwood, pohuehue, silver fern, whekī and kiokio.

Stream banks were mostly stable with no recent signs of erosion or slumping. Organic instream features such as woody debris and leaf litter were present. An oily sheen on the water surface was observed within the stagnant pools of water remaining in the drain.

Stream substrates were dominated by silt and mud, often with an organic overlay of leaf litter and/or woody debris. Aquatic macrophytes were present within the upstream section of the reach still containing standing water and included water pepper (*Persicaria hydropiper*) and water purslane (Ludwigia palustris) (Figure 2), with coverage of the water surface ranging from 75 to 100%. No periphyton was observed.

*Figure 1: Upstream reach of Tramway Road drain, shaded canopy cover and oily sheen on surface of water.*

*Figure 2: Macrophytes across upstream transect of Tramway Road drain.*

#### 4.5.2.2 Powell's Road drain

The Powell's Road drain has hydrologic connectivity with the Komakorau drainage network upstream, which is known to have established black mudfish populations. As such, it is inappropriate, regarding loss of habitat and development impacts, to assess the section of Powell's Road drain within the site boundary in isolation. Therefore, we have, where appropriate, referenced the relevant assessment within the RIPLA EIA (Boffa Miskell Ltd, 2013) submitted as part of the Regional Council applications which provides a comprehensive assessment of the waterways relevant to this site.

Powell's Road drain enters the Tuumata Plan Change area from the eastern boundary of the site and flows along a straight drain channel, with two approximately 45 degrees bends before flowing into the HCC reticulated water system (Figure 3). The length of the drainage network within the site is approximately 470 m. The downstream most 100 m of this drain has recently been evaluated[20] and modified in conjunction with the Powell's Road subdivision works. This drain section will be piped at a later stage and therefore is excluded from this assessment. An additional approximate 230 m artificial, lined canal and water retention pond have been created to divert water away from the extensive bulk earthworks and ongoing development of the Powell's Road subdivision to the north of the site.

At the time of the survey work for this EIA, Powell's Road drain was dry for the upstream 230 m section of reach and could not be assessed. However, in previous reports the watercourse has been described as an artificial waterway with uniform channel morphology, perennial, or

[20] Freshwater solution (2021) Powell's Road Fish Relocation Plan – December 2021, prepared for Tainui Group Holdings. p.11

intermittent flow regimes, limited riparian vegetation dominated by rank grasses and exotic vegetation such as English ivy and tree privet in some places. The drain has been described to be subject to disturbance by excavation, spraying and regular inputs of various contaminants, and to provide low habitat quality for aquatic organisms (Figure 4).

Riparian vegetation along the Powell's Road drain is outlined in Section 4.2 and Appendix 3, and typically consists of rank grasses, with small areas of willow weed and weeds (e.g., blackberry) or exotic shelterbelt trees. Water pepper was observed within the dry bed of the channel at the upstream end of the reach.

*Figure 3: Powell's Road drain, artificial drain, uniform channel morphology & limited riparian vegetation, confluence with newly created canal for Powell's Road subdivision works.*

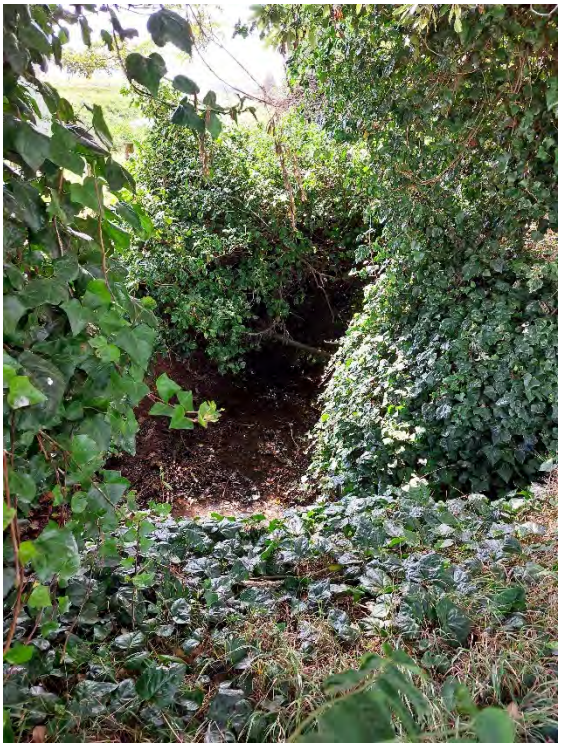


*Figure 4: Powell's Road drain, upstream section dry at time of assessment.*

#### 4.5.2.3 Water quality

Water quality of the waterways within the Ruakura Structure Plan area has been assessed previously in 2012.

A summary of these results is provided in Table 11 below and sample locations are provided in Appendix 7. Water quality parameters not meeting the guideline values are shaded and highlighted in bold. Results in bold only are those values that are elevated, but for which there are no guideline values.

*Table 11: Water Quality Sample Analysis from 2012 – Waterways within the Tuumata Plan Change area are highlighted by a red border.*

| | Units | Ruakura Road/ Ryburn drain | Tramway Road drain | Reeves Close drain | Percival Road drain | Guideline values |
|---|---|---|---|---|---|---|
| | | Sept 2012 | Oct 2012 | Oct 2012 | Sept 2012 | |
| Turbidity | NTU | 6.7 | **24** | **70** | 3.1 | - |
| pH | pH Units | 6.6 | **5.8** | 6.1 | **5.4** | 6-9[21] |
| Total Suspended Solids | $g/m^3$ | 6 | 15 | 53 | <3 | - |
| Total Copper | $g/m^3$ | 0.00126 | 0.00161 | 0.00163 | **0.0044** | 0.0018 |
| Total Iron | $g/m^3$ | 0.25 | 5.7 | 16.4 | 0.47 | - |
| Total Lead | $g/m^3$ | 0.00073 | 0.00033 | 0.00037 | 0.00039 | 0.0056 |
| Total Zinc | $g/m^3$ | **0.021** | **0.03** | **0.021** | **0.0163** | 0.015 |
| Total Nitrogen | $g/m^3$ | **1.73** | **0.99** | **1.74** | **1.26** | 0.04-0.1 |
| Nitrate-N + Nitrite-N | $g/m^3$ | **1.38** | **0.22** | **0.25** | 0.022 | 0.04-0.1 |
| Total Kjeldahl Nitrogen | $g/m^3$ | **0.34** | **0.77** | **1.48** | **1.24** | 0.04-0.1 |
| Dissolved Reactive Phosphorus | $g/m^3$ | 0.006 | 0.011 | 0.022 | 0.005 | 0.015-0.03 |
| Total Phosphorus | $g/m^3$ | **0.02** | **0.058** | **0.148** | **0.02** | 0.015-0.03 |
| Carbonaceous Biochemical Oxygen Demand ($CBOD_5$) | $G O^2/m^3$ | <2 | <2 | <2 | <2 | - |
| Escherichia coli | cfu/100mL | **410** | **700** | **3,200** | **140** | 100 |
| Total Petroleum Hydrocarbons C7-C36 | $g/m^3$ | <0.7 | <0.7 | <0.7 | <0.7 | - |

The water quality of all sampled drains reflects the natural characteristics of the local peat soils (such as pH values below 6.0), but also the shallow groundwater infiltration and groundwater quality, as well as the existing agricultural land uses. The sampled waterways receive ongoing inputs of sediment (reflected in increased turbidity), bacterial pathogens, and inorganic nutrients. The concentration of zinc in all the waterways except the Kirikiriroa Stream tributary at Wairere Drive exceeded the ANZECC guideline value for 90% protection of aquatic species; however, zinc concentrations obtained in 2012 are below Hamilton urban and rural average levels which have been shown to be generally above ANZECC guideline values. In the Percival Road drain, copper also exceeded the guideline value for 90% aquatic species protection. The concentration of iron in most of the waterways is likely to reduce dissolved oxygen concentrations.

A summary of the 2022 water quality data including water quality spot measurements, nutrient, metal screens, petroleum hydrocarbons and polycyclic aromatic hydrocarbons with comparative guideline values in Table 12. Water quality parameters not meeting the guideline values are shaded and highlighted in bold.

Water quality screening indicated unsatisfactory results for dissolved oxygen, pH, specific conductivity, total nitrogen, and total aluminium when compared to the Waikato Regional

[21] Australian and New Zealand Environment and Conservation Council (2000). Australian and New Zealand Guidelines for Fresh and Marine Waters Quality. Trigger values for aquatic ecosystems protection at 90% protection of species.

Council water quality guidelines[22], with dissolved oxygen and pH below guideline values, while specific conductivity, total nitrogen and total aluminium exceeded guideline values.

Similarly, total ammoniacal nitrogen, nitrate N + nitrite N and dissolved reactive phosphorus (Tramway Road drain only) were elevated when compared to current ANZECC guidelines[23]. Total kjeldahl nitrogen was also elevated compared to the Ministry for the Environment water quality guidelines[24].

Total petroleum hydrocarbons and polycyclic aromatic hydrocarbons where not detected within the water quality grab samples. Heavy metal analysis showed that arsenic, cadmium, chromium, copper, and lead levels were complaint with ANZECC guideline values, while aluminium (total and dissolved), nickel (total and dissolved, Powell's Road drain only), aluminium (total and dissolved) and zinc (total and dissolved) levels exceeded the ANZECC guideline values. Due to the lack of urban stormwater discharge within the catchment of these drains, the heavy metals are likely to be from an agricultural or groundwater source.

Faecal coliforms levels were unsatisfactory within Tramway Road drain when compared to Waikato Regional Council water quality guidelines. The guideline values for faecal coliforms is stated in the context of human health, therefore the relevance and level of concern to freshwater biota and its ability to reside within this waters are likely to be decreased.

*Table 12: Water quality analysis for waterways with the Tuumata Plan Change area.*

| Analytes | Unit | Tramway Road Drain (Site 1) | Powell's Road Drain (Site 2) | Guideline Source | |
|---|---|---|---|---|---|
| **Water quality** | | | | | |
| Temperature | °C | 12 | 11.5 | < 10°C: Excellent; 10-12°C: Satisfactory | (Waikato Regional Council, n.d.) |
| Dissolved oxygen | mg/L | 4.96 | 6.22 | | |
| | % | **46.1** | **57.1** | > 90: Excellent; < 80: Unsatisfactory | (Waikato Regional Council, n.d.) |
| Specific conductivity | µS/cm | **133.3** | **164.8** | 115 | (ANZECC, 2000) |
| pH | pH units | **6.06** | **5.81** | 6.5-7.0: Satisfactory; < 6.5: Unsatisfactory | (Waikato Regional Council, n.d.) |
| Turbidity | NTU | **9.8** | 4.4 | 2-5: Satisfactory; > 5: Unsatisfactory | (Waikato Regional Council, n.d.) |
| Total suspended solids | $g/m^3$ | 8 | 4 | 8.8 | (ANZECC, 2000) |
| | | | | | |
| Dissolved Aluminium | $g/m^3$ | **0.120** | **0.177** | 0.08 | (ANZECC, 2000) |
| Total Aluminium | $g/m^3$ | **0.181** | **0.33** | 0.08 | (ANZECC, 2000) |
| Dissolved Iron | $g/m^3$ | 0.51 | 0.51 | | |
| Total Iron | $g/m^3$ | 1.36 | 0.98 | | |
| Total Nitrogen | $g/m^3$ | **2.1** | **1.56** | >0.5: Unsatisfactory | (Waikato Regional Council, n.d.) |
| Total Kjeldahl Nitrogen | $g/m^3$ | **0.52** | **0.76** | 0.04 – 0.1 | (ANZECC, 2000) |

[22] Waikato Regional Council Water Quality Guidelines (https://www.waikatoregion.govt.nz/environment/naturalresources/water/rivers/healthyrivers/how-we-measure-quality/)

[23] Australian and New Zealand Environment and Conservation Council (ANZECC) 2019. Australian and New Zealand Guidelines for Fresh and Marine Waters Quality. Default guideline values for physical and chemical stressors, 80th percentile.

[24] Ministry for the Environment, 1992. Water Quality Guidelines No. 1: Guidelines for the Control of Undesirable Biological Growths in Water.

| Analytes | Unit | Tramway Road Drain (Site 1) | Powell's Road Drain (Site 2) | Guideline Source | |
|---|---|---|---|---|---|
| Total Phosphorus | g/m$^3$ | 0.035 | 0.038 | 0.01-0.04: Satisfactory; >0.04 Unsatisfactory | |
| Faecal Coliforms | cfu/100mL | **900** | 260 | 55-500 Satisfactory; >550 Unsatisfactory | (Waikato Regional Council, n.d.) |
| **Heavy Metals (dissolved)** | | | | | |
| Dissolved Arsenic | g/m$^3$ | <0.0010 | <0.0010 | 0.36 | (ANZECC, 2000) |
| Dissolved Cadmium | g/m$^3$ | 0.00007 | 0.00012 | 0.0008 | (ANZECC, 2000) |
| Dissolved Chromium | g/m$^3$ | <0.0005 | 0.0006 | 0.04 | (ANZECC, 2000) |
| Dissolved Copper | g/m$^3$ | 0.0012 | 0.0019 | 0.0025 | (ANZECC, 2000) |
| Dissolved Lead | g/m$^3$ | 0.00011 | <0.00010 | 0.0094 | (ANZECC, 2000) |
| Dissolved Nickel | g/m$^3$ | 0.0013 | **0.0027** | 0.0017 | (ANZECC, 2000) |
| Dissolved Zinc | g/m$^3$ | **0.031** | **0.038** | 0.0031 | (ANZECC, 2000) |
| **Heavy Metals (total)** | | | | | |
| Total Arsenic | g/m$^3$ | <0.0011 | <0.0011 | 0.36 | (ANZECC, 2000) |
| Total Cadmium | g/m$^3$ | 0.000085 | 0.000115 | 0.0008 | (ANZECC, 2000) |
| Total Chromium | g/m$^3$ | <0.00053 | 0.00091 | 0.04 | (ANZECC, 2000) |
| Total Copper | g/m$^3$ | 0.00155 | 0.0021 | 0.0025 | (ANZECC, 2000) |
| Total Lead | g/m$^3$ | 0.00038 | <0.00011 | 0.0094 | (ANZECC, 2000) |
| Total Nickel | g/m$^3$ | 0.00174 | **0.0028** | 0.0017 | (ANZECC, 2000) |
| Total Zinc | g/m$^3$ | **0.033** | **0.038** | 0.0031 | (ANZECC, 2000) |
| **Nutrient Profile** | | | | | |
| Total Ammoniacal-N | g/m$^3$ | **0.124** | **0.088** | 0.013 | (ANZECC, 2000) |
| Nitrite-N | g/m$^3$ | 0.015 | 0.035 | | |
| Nitrate-N | | **1.56** | **0.76** | 0.122 | (ANZECC, 2000) |
| Nitrate-N + Nitrite-N | | **1.58** | 0.80 | 0.04 – 0.1 | (ANZECC, 2000) |
| Dissolved Reactive Phosphorus | | **0.008** | 0.007 | 0.016 | (ANZECC, 2000) |
| **Total Petroleum Hydrocarbons in Water** | | | | | |
| C7 – C9 | | <0.10 | <0.10 | | |
| C10 – C14 | | <0.2 | <0.2 | | |
| C15 – C36 | | <0.4 | <0.4 | | |
| Total Hydrocarbons (C7 – C36) | | <0.7 | <0.7 | | |
| **Polycyclic Aromatic Hydrocarbons Screening in Water** | | | | | |
| Acenaphthene | g/m$^3$ | <0.00010 | <0.00010 | | |
| Acenaphthylene | g/m$^3$ | <0.00010 | <0.00010 | | |
| Anthracene | g/m$^3$ | <0.00010 | <0.00010 | | |
| Benzo[a]anthracene | g/m$^3$ | <0.00010 | <0.00010 | | |
| Benzo[a]pyrene (BAP) | g/m$^3$ | <0.00010 | <0.00010 | | |
| Benzo[b]fluoanthene + Benzo[j] fluoranthene | g/m$^3$ | <0.00010 | <0.00010 | | |
| Benzo[g, h, i]perylene | g/m$^3$ | <0.00010 | <0.00010 | | |
| Benzo[k]fluoranthene | g/m$^3$ | <0.00010 | <0.00010 | | |

| Analytes | Unit | Tramway Road Drain (Site 1) | Powell's Road Drain (Site 2) | Guideline Source | |
|---|---|---|---|---|---|
| Chrysene | g/m$^3$ | <0.00010 | <0.00010 | | |
| Dibenzo[a,h]anthracene | g/m$^3$ | <0.00010 | <0.00010 | | |
| Fluoranthene | g/m$^3$ | <0.00010 | <0.00010 | | |
| Fluorene | g/m$^3$ | <0.0002 | <0.0002 | | |
| Indeno(1,2,3-c,d)pyrene | g/m$^3$ | <0.00010 | <0.00010 | | |
| Naphthalene | g/m$^3$ | <0.0005 | <0.0005 | | |
| Phenathrene | g/m$^3$ | <0.0004 | <0.0004 | | |
| Pyrene | g/m$^3$ | <0.0002 | <0.0002 | | |

Stream temperatures is within the 'satisfactory' range for the WRC fish spawning temperature guidelines (May-September). These water quality parameters are taken at an individual point in time and as such the spot measurements will fluctuate throughout the day and within seasons. Stream temperatures are likely to exceed satisfactory levels during the summer months.

As expected in waterways draining peat soils, pH tends to be acidic at both sites.

Dissolved oxygen is a major indicator of water quality, the survival of aquatic life depends on a sufficient level of oxygen dissolved in water. Low dissolved oxygen in a water body can result from nutrient or organic matter enrichment due to anthropogenic activities. However, low dissolved oxygen conditions can also be caused by natural environmental variables, such as water stagnation and high temperatures.

A reduction of total suspended soils and turbidity has been observed since the 2012 water monitoring samples, this may be due to the exceeded period of dry watercourses due to the reduction on the groundwater levels from surrounding earthworks projects and/or due to time of the year sampling was undertaken in comparison to previous sampling events.

For Powell's Road and Tramway Road drains, when combined with naturally low pH from peat soils and high concentrations of metals (zinc, nickel, and aluminium) and elevated total ammoniacal nitrogen, nitrate N + nitrite N and dissolved reactive phosphorus levels, this water quality is very poor and provides harsh conditions suitable for only the most tolerant aquatic organisms.

### 4.5.3 Sediment quality

A results summary is presented below in Table 13 and the full laboratory results are provided in

(Boffa Miskell Ltd, 2013). Sediment quality parameters not meeting the guideline values are shaded and highlighted in bold. Results in bold only are those values that are elevated, but for which there are no guideline values.

*Table 13: Sediment Sample Analysis Waterways within the Tuumata Plan Change area are highlighted by a red border.*

| | Units | Ruakura Road/ Ryburn drain | Tramway Road drain | Reeves Close drain | Percival Road drain | Guideline values[25] |
|---|---|---|---|---|---|---|
| | | Sept 2012 | Oct 2012 | Oct 2012 | Sept 2012 | |
| Total Recoverable Iron | mg/kg | 16,400 | 7,600 | 46,00 | 7,100 | - |
| Total Recoverable Arsenic | mg/kg | 5 | 4 | 4 | 8 | 20 |
| Total Recoverable Cadmium | mg/kg | 0.24 | <0.10 | <0.10 | 0.4 | 1.5 |
| Total Recoverable Chromium | mg/kg | 17 | 4 | 14 | 9 | 80 |
| Total Recoverable Copper | mg/kg | **86** | 8 | 4 | 28 | 65 |
| Total Recoverable Lead | mg/kg | **142** | 90.4 | 5.9 | 18.3 | 50 |
| Total Recoverable Nickel | mg/kg | 8 | < 2 | < 2 | 4 | 21 |
| Total Recoverable Zinc | mg/kg | 630 | 43 | 91 | 98 | 200 |

Except for the Ruakura Road drain, contaminants detected in sediment samples from waterways within the site are below threshold for adverse effects to aquatic life, indicating a low risk of these contaminants causing biological disturbance to benthic fauna.

The 2022 sediment quality data shows that all metal concentrations were below appropriate guideline values indicating minimal potential for biological harm to freshwater biota as shown in Table 14.

*Table 14: Sediment quality analysis for waterways with Tuumata Plan Change area*

| Analytes | Unit | Tramway Road Drain (Site 1) | Powell's Road Drain (Site 2) | Applicable guideline values |
|---|---|---|---|---|
| | | | | |
| Total Organic Carbon | g/100g dry weight | 3.1 | 8.3 | |
| Total recoverable iron | mg/kg dry weight | 5,600 | 6,100 | |
| **Metals** | | | | |
| Total recoverable arsenic | mg/kg dry weight | 3.0 | 3.4 | 20 |
| Total recoverable cadmium | mg/kg dry weight | 0.089 | 0.38 | 1.5 |
| Total recoverable chromium | mg/kg dry weight | 4.0 | 6.9 | 80 |
| Total recoverable copper | mg/kg dry weight | 5.9 | 10.7 | 65 |
| Total recoverable lead | mg/kg dry weight | 8.5 | 9.1 | 50 |
| Total recoverable nickel | mg/kg dry weight | 1.9 | 4.7 | 21 |
| Total recoverable zinc | mg/kg dry weight | 33 | 85 | 200 |
| **Polycyclic Aromatic Hydrocarbons Trace in Soil** | | | | |
| Total of Reported PAHs in Soil | mg/kg dry weight | 0.88 | <0.11 | |

[25] Australian and New Zealand Environment and Conservation Council; Agriculture and Resource Management Council of Australia and New Zealand. 2000. Australian and New Zealand Guidelines for Fresh and Marine Waters Quality.

| Analytes | Unit | Tramway Road Drain (Site 1) | Powell's Road Drain (Site 2) | Applicable guideline values |
|---|---|---|---|---|
| 1-Methylnaphthalene | mg/kg dry weight | <0.003 | <0.005 | |
| 2-Methylnaphthalene | mg/kg dry weight | <0.003 | <0.005 | |
| Acenaphthene | mg/kg dry weight | <0.003 | <0.005 | |
| Acenaphthylene | mg/kg dry weight | 0.004 | <0.005 | |
| Anthracene | mg/kg dry weight | 0.008 | <0.005 | |
| Benzo[a]anthracene | mg/kg dry weight | 0.052 | 0.009 | |
| Benzo[a]pyrene (BAP) | mg/kg dry weight | 0.085 | 0.007 | |
| Benzo[b]fluoranthene + Benzi[j] fluoranthene | mg/kg dry weight | 0.123 | 0.011 | |
| Benzo[e]pyrene | mg/kg dry weight | 0.059 | 0.006 | |
| Benzo[g,h,i]perylene | mg/kg dry weight | 0.082 | 0.007 | |
| Benzo[k]fluoranthene | mg/kg dry weight | 0.043 | <0.005 | |
| Chrysene | mg/kg dry weight | 0.053 | 0.007 | |
| Dibenzo[a,h]anthracene | mg/kg dry weight | 0.014 | <0.005 | |
| Fluoranthene | mg/kg dry weight | 0.105 | 0.011 | |
| Fluorene | mg/kg dry weight | <0.003 | <0.005 | |
| Indeno91,2,3-c,d)pyrene | mg/kg dry weight | 0.079 | 0.006 | |
| Naphthalene | mg/kg dry weight | <0.012 | <0.03 | |
| Perylene | mg/kg dry weight | 0.031 | 0.014 | |
| Phenanthrene | mg/kg dry weight | 0.024 | 0.007 | |
| Pyrene | mg/kg dry weight | 0.112 | 0.012 | |
| Benzo[a]pyrene Potency Equivalency Factor (PEF) NES | mg/kg dry weight | 0.131 | <0.011 | |
| Benzo[a]pyrene Toxic Equivalence (TEF) | mg/kg dry weight | 0.130 | <0.011 | |

### 4.5.4 Fish

Fish communities of the Tuumata Plan Change area waterways were investigated previously as part of the wider Assessment of Ecological Effects for the Ruakura Structure Plan Area and results are provided in Table 15 below. Two waterways, Tramway Road drain and Powell's Road drain (otherwise stated as Reeves Close drain) were identified within the Tuumata Plan Change area as potentially supporting fish populations, out of a total of nine waterways within or immediately adjacent to the Ruakura SPA. Results from the adjacent Powell's drain reach and other drains with hydrological connectivity to the Powell' Road drain via the Brinkworth drain network (Appendix 7) are also provided for context.

Fish diversity was low across all surveyed sites. Within the Tuumata Plan Change area, no fish were captured or observed within the Tramway Road drain on either sampling occasion. This is unlikely to have changed since 2013 and the extensive piped network this drain is connected to poses a significant fish passage barrier. Shortfin eels (*Anguilla australis*) were captured and observed in the Powell's Road drain reach within the TPC area (Reeves Close drain) during the 2013 survey.

Outside the TPC Area, black mudfish (*Neochanna diversus*) were captured from Percival Road drain during both monitoring occasions. Shortfin eels, black mudfish and banded kokopu (*Galaxias fasciatus)* were captured within the Ryburn Road drain during the 2013 survey. Banded kokopu are itinerant individuals, rather than representatives of a resident population within the waterway. Black mudfish are classified as an 'At Risk - Declining' species (Dunn et al., 2018).

*Table 15: Fish capture & observations of waterways within or surrounding Tuumata Plan Change area - Waterways within the Tuumata Plan Change area are highlighted by a red border.*

| | Shortfin eel | | Black mudfish | | Banded kokopu | |
|---|---|---|---|---|---|---|
| | 2010 | 2013 | 2010 | 2013 | 2010 | 2013 |
| Tramway Road drain | | | | | | |
| Reeves Close drain | | 1 | | | | |
| Percival Road drain | | | 1 | 10 | | |
| Railway drain at Ryburn Road | | 4 | | 1 | | 1 |

Fish species captured and relocated from two separate reaches of the Powell's Road drain into drain reaches within the TPC Area in September and December 2021[26] are outlined in Table 16 below.

*Table 16: Relocation works along Powell's Road drain & species identified (X identifies presence of fish species, count unable to be identified through eDNA records)*

| | September 2021 | December 2021 | Threat Classification Status |
|---|---|---|---|
| | Capture | Capture | |
| Shortfin eel | 2 | | Not Threatened |
| Longfin eel | | 3 | At Risk - Declining |
| Elver | | 1 | |

The species relocated into the TPC Area waterways included longfin eel (*Anguilla dieffenbachii*), which are classified as '*At Risk – Declining'*. Section 2.6.2 of the Ruakura South NFMP states that existing mudfish habitat is thought to comprise some 9,930m of waterways within Ruakura South, principally through the central area between Powell's Road and Ruakura Road, on drains connected within the Ruakura Road drains and Brinkworth Drain on the Komakorau Stream catchment (Appendix 9). This includes the Powell's Road reach within the TPC area.

### 4.5.5 Macroinvertebrate community assessment

Macroinvertebrate communities of the TPC area waterways were investigated previously as part of the wider Assessment of Ecological Effects for the Ruakura Structure Plan Area and results

[26] Freshwater Solutions (2021) Powells Road Fish Relocation Plan – December 2021, prepared for Tainui Group Holdings, p. 11 and Freshwater Solutions (2022) Powells Road Fish Relocation Results – February 2022, prepared for Tainui Group Holdings, p.4

are provided in below. Results from the adjacent Powell's drain reach and other drains with hydrological connectivity to the Powell' Road drain via the Brinkworth drain network (Appendix 8) are also provided for context.

| | Ryburn Road drain | Percival Road drain | Reeves Close drain | Tramway Road drain |
|---|---|---|---|---|
| Taxonomic richness | 8 | 7 | 10 | 7 |
| No. of EPT taxa | 1 | 0 | 1 | 0 |
| $MCI_{sb}$ | 96.44 | 99.14 | 99.14 | 67.71 |
| $SQMCI_{sb}$ | 3.11 | 3.50 | 3.80 | 3.66 |

Macroinvertebrate diversity was low at all sites. MCI scores ranged from 67.71 to 99.14, which are low scores indicating poor to fair water and/or habitat quality.

### 4.5.6 Ecological values

In summary, the waterways within the TPC area are highly modified artificial farm drainage channels and uniform in comparison to natural stream conditions due to:

- Limited aquatic habitat diversity
- Habitat supports threatened, at risk or uncommon fauna species
- Stream channel morphology and habitat highly modified (i.e., channelised)
- Stream banks modified or managed
- Uniform hydrologic conditions
- Prevalence of exotic macrophytes
- Limited instream habitat available
- Poor/highly degraded water quality parameters with riparian cover primarily consisting of exotic canopy species and rank grasses
- Limited riparian cover, far removed from natural stream conditions
- resident aquatic macroinvertebrate communities were characterised by species highly tolerant to disturbance and/or pollution.

Table 17 below outlines the current, observed ecological values for TPC area waterways based on methods provided.

*Table 17: Representativeness, rarity/distinctiveness, diversity/pattern and ecological context of TPC area waterways.*

| Representativeness | Rarity / distinctiveness | Diversity and pattern | Ecological context |
|---|---|---|---|
| **Negligible:**<br>• **Impacted by anthropogenic modification and degraded water quality.** | High<br>• Habitat type is not uncommon in the Ecological District or on a national level.<br>• Habitat currently supports threatened, at risk or | Negligible:<br>• Aquatic habitat present, however, native aquatic biodiversity is affected by: | Low:<br>• Provides freshwater ecosystem services such as water treatment, flow attenuation |

| | | | |
|---|---|---|---|
| • **Limited riparian buffer vegetation.**<br>• **No hydrological heterogeneity.**<br>• **Limited aquatic habitat quality.**<br>• **Presence of exotic vegetation.**<br>• **Artificial farm drain, with intermittent flow type, limited habitat availability** | uncommon freshwater fauna species – black mudfish & longfin eels<br>• No distinctive ecological features were observed. | - anthropogenic modifications,<br>- degraded water quality,<br>- limited habitat for macroinvertebrates and fish species. | and aquatic habitat.<br>• However:<br>- limited habitat quality, and<br>- no connectivity to upstream reaches of tributary |
| **Overall ecological value** | | **Low** | |

Following the EIANZ guidelines and criteria outlined in Section 3.7.1, the overall ecological value of aquatic habitats within the TPC Area have been assessed as **Low**.

Surveys indicated that several native fish species are present on site including shortfin eels, longfin eels and black mudfish. Longfin eels and black mudfish are both classified as 'At Risk – Declining'. Following the EIANZ guidelines and criteria outlined in Section 3.7.1, these species have been assessed to be of a **High** ecological value.

# 5.0 Assessment of potential ecological effects pre management

The proposed development of the residential area will include the following key components relevant to ecological effects:

- Bulk earthworks to:
    - Remove most vegetation and existing waterways within the site boundary.
    - Form stormwater swales and roads and install major infrastructure.
    - Fill and compact building platforms for residential buildings.
- Temporary discharges of stormwater and temporary groundwater takes associated with dewatering during construction.
- Permanent discharge of stormwater from service facilities and roads post-development.
- Injury or death of native fauna.
- Habitat removal (including aquatic habitat for native fish species as well as potential foraging, commuting, and roosting habitat for bats), disturbance and avoidance of the area by native fauna, and loss of a small amount of native vegetation where it exists.
- Reduced base flows due to increased impermeable cover.
- Changes in water quality from stormwater discharges, and
- Changes in erosion dynamics from increased stormwater volumes

There are two key activities associated with the urbanisation that will affect waterways within and surrounding the Tuumata Plan Change area, namely earthworks for land development and the generation of stormwater because of urbanisation.

All waterways within the area are proposed to be removed and replaced with a network of swales and storage basins that will form the major stormwater treatment and conveyance infrastructure in addition to piped stormwater infrastructure.

## 5.1 Vegetation communities

The potential effects on terrestrial vegetation from the proposed development are:

- Loss of predominately exotic species dominated vegetation cover.
- Fragmentation of exotic species dominated vegetation cover.

The removal of vegetation on site will result in a minor - moderate shift away from the baseline condition and impact low value vegetation common throughout the landscape. The vegetation removal does not impact any vegetation that has ecological integrity or any remnant vegetation. As a result, the magnitude of effect on terrestrial vegetation is **Low.**

## 5.2 Bats

The potential effects on bats from the proposed development are:

- Mortality and injury of bats during vegetation clearance and earthworks.
- Permanent loss of bat habitat.
- Modification of remaining bat habitat that may lead to a degradation of habitat value or total functional loss of habitat, such as:
    - Increased levels of noise and disturbance (including light disturbance) during and after both construction and operation.

The loss of potential bat habitat on site represents a relatively minor shift from baseline conditions when considering the usage of the site and habitats present which are restricted primarily to agricultural land which has low connectivity to other habitats. The key effect is likely to be the loss of potential high value bat roosting habitats that are not common within the site (and potentially within the surrounding landscape). As such, we have assessed the potential magnitude of effect due to loss of bat habitat as **Moderate**.

Tree felling has the potential to injure/kill bats if they are present at the time of felling (especially of the high value bat roosting trees). Therefore, taking into consideration long-tailed bats 'Threatened – Nationally Critical' threat status, the magnitude of effect if a bat injury/mortality during tree felling where to occur is assessed as **High.**

## 5.3 Herpetofauna

The potential effects on herpetofauna from the proposed development are:

- Mortality and injury of lizards during vegetation clearance and earthworks.
- Permanent loss of lizard habitat.

- Modification of remaining lizard habitat that may lead to a degradation of habitat value or total functional loss of habitat, such as:
    - Habitat fragmentation and isolation (including potential, deaths from attempting to cross new roads/pathways).
    - Increased levels of noise and disturbance during both construction and operation.

The species most likely to be impacted is the copper skink. The loss of highly modified and fragmented habitats that exists within the agricultural environment that copper skinks persist within represents a minor shift away from baseline conditions. However, these habitats, while less than ideal for copper skink, are what this species is frequently restricted to within the modified landscape of the wider area, and better, more suitable habitats are mostly already lost. With this consideration, we assess the magnitude of effect from the loss of herpetofauna habitat as **Moderate**.

Without appropriate measures, vegetation clearance and associated works can have the potential to injure or kill any herpetofauna on site. Copper skink are likely present on site, and they are not very mobile/ not able to move away from impacts. However, the habitats onsite are unlikely to hold a meaningful proportion of the local population of copper skink and as such we assess the magnitude of effect as a result of herpetofauna injury/mortality as **Low.**

## 5.4 Avifauna

The potential effects on avifauna from the proposed development are:

- Mortality and injury of nesting birds during vegetation clearance and earthworks.
- Permanent loss of bird habitat.
- Modification of remaining habitat that may lead to a degradation of habitat value or total functional loss of habitat, such as:
    - Increased levels of noise and disturbance during both construction and operation.

The loss of potential avifauna habitat within the site represents a minor shift away from the baseline condition as the vegetation communities to be impacted are common throughout the landscape. The magnitude of effect from the loss of avifauna habitat is assessed as **Low**.

The bird species likely to be present at the site are all common and mobile. The noise and movement associated with vegetation removal and construction works is likely to act as a deterrent, preventing birds from getting harmed. Injury/mortality of native birds could occur (to adult birds, chicks or eggs) if nesting vegetation is cleared during the breeding season, but it is unlikely in this environment. Therefore, the magnitude of effect from avifauna injury/mortality is assessed as **Low.**

## 5.5 Freshwater

### 5.5.1 Aquatic habitat

The potential effects on the aquatic environment from the proposed development are:

- Removal of aquatic and riparian habitat
- Injury/mortality of native fish
- Temporary increase of sediment-related discharge due to earthworks
- Reduced base flows due to increased impermeable cover.
- Changes in water quality from stormwater discharges, and
- Changes in erosion dynamics from increased stormwater volumes

The proposal will result in the complete loss of aquatic and riparian habitat and there is potential for injury and/or death of fish during construction. The magnitude of effect from watercourse loss will be **Moderate** due to the complete loss of the current aquatic habitat.

Without management the earthworks and removal/replacement of the waterways also has the potential to injure and kill At-risk declining longfin eels and black mudfish, however this is likely to have an impact on relatively few individuals and as such, we assessed this to have a **Low** magnitude of effect.

### 5.5.2 Temporary bed disturbance & sediment discharges

The main potential for adverse water quality effects on the receiving environment of Kirikiriroa Stream related to elevated suspended sediment and reduced clarity downstream of the site extent during the earthwork and construction phases of the proposed works. Bed disturbance works and the effects of water quality are the potential impacts on freshwater faun (for example reduce water quality for visual feeders, sedimentation to the ned of the stream and associated habitat effects to benthic habitats. However, due to the distance downstream and the flow pathway through the HCC reticulated network and the temporary nature of the proposed works it is not anticipated that effects on water clarity and sedimentation will be localised and temporary with no lasting effects on freshwater fish habitat or benthic habitat quality. The magnitude of effect on the receiving environment from bed disturbance and sediment discharges is Low.

## 5.6 Summary of ecological effects pre management

The level of ecological effects on the site are summarised in Table 18.

*Table 18: Overview of the level of ecological effect from the proposed works in the project footprint.*

| Activity/Effect | Ecological value | Magnitude of effect | Level of potential ecological effect pre management |
|---|---|---|---|
| Vegetation loss | Low | Low | Very Low |
| Bat habitat loss | Moderate | Moderate | Moderate |
| Bat mortality/injury | Very High | High | Very High |
| Herpetofauna habitat loss | Moderate | Moderate | Moderate |
| Herpetofauna mortality/injury | High | Low | Low |
| Avifauna habitat loss | Low | Low | Very Low |
| Avifauna mortality/injury | Low | Low | Very Low |

| Activity/Effect | Ecological value | Magnitude of effect | Level of potential ecological effect pre management |
|---|---|---|---|
| Aquatic habitat loss | Low | Moderate | Low |
| Fish mortality | High | Low | Low |
| Sediment discharge & bed disturbance | Low | Low | Very Low |

# 6.0 Effects management recommendations

The following impact management measures are recommended to avoid, minimise, or mitigate any adverse effects of the proposed development within the Tuumata Plan Change area.

## 6.1 Proposed vegetation management

Effects on terrestrial vegetation values are limited, as the development is mainly impacting non-native species common in the surrounding landscape. Mitigation measures can be implemented to compensate against loss of any native vegetation through planting. The proposed new stormwater swales (estimated 6 ha) can be planted with native vegetation. Planting the swales will represent an improvement in the ecological value of the vegetation in Ruakura South compared to the existing baseline. The specifications of the swale plantings can be specified in a Planting Plan.

The enhanced biodiversity of indigenous species associated with the planted swales will result in a **Positive** magnitude of effect. Therefore, the level of ecological effect, post management, on vegetation value on site is a **Net Gain**.

## 6.2 Proposed bat management

Existing mature trees, particularly those that have been identified as high risk bat roosting trees ideally would be retained. However, it is unlikely that long-tailed bats would utilise these trees if retained. Given the context of the proposed development of the surrounding landscape (Appendix 1), these trees on site will be effectively isolated from other suitable habitats due to industrial and residential development of the Tuumata Plan Change and Ruakura South. Therefore, we recommendation not to attempt to retain the trees. There is already low, sporadic, bat activity levels within the agricultural environment and this is not likely to increase with the proposed development occurring in the area. Additionally, the likely proximity of roads, buildings and associated artificial lighting means there is low probability of retaining the trees habitat value and therefore the efficacy of retention as a strategy for mitigation is low.

However, we consider the key risk and effect from this proposal to be the loss of potential roost habitat. Therefore, we recommend as a focus for managing the impact on bat habitat to be the installation of artificial bat roost boxes. There is no standardised method to determine the ideal number of artificial bat roost boxes to utilise. Given that long-tailed bats have been recorded on site, their 'Threatened – Nationally Critical' threat status, the loss of roosting features, and

variability in bat occupancy rates in artificial bat roost boxes, a 4:1 artificial bat roost installation ratio for high risk roost trees is recommended (4 artificial roost installed for every high risk roost tree/habitat cleared). A 2:1 artificial bat roost installation ratio is also recommended for the loss of medium bat risk roost trees. Medium level roost trees also displayed several roost characteristics that could be utilised by bats, and therefore it is also important to mitigate against the loss of these habitats. No artificial roost boxes are recommended for the loss of low value roost trees. In total, 20 high value and 40 medium value roosts were identified on site. If all these trees are proposed to be cleared, we recommend 160 artificial roost boxes be established to compensate for bat habitat loss. These bat boxes should be installed in, or near to, Manganoa gully to the south of the site where higher bat activity levels are known to occur, and as this area potentially is the source of bat activity within the Tuumata Plan Change area.

We recommend that a Bat Management Plan (BMP) is developed to outline how these recommendations are to be implemented to ensure that the potential effects of the proposed development on long-tailed bats are appropriately managed. This management plan should also show integration with other mitigation actions and management plans developed for other Land Development Plan Areas and seek to integrate the management approach.

Taking into consideration the low levels of bat activity on site, and the recommended management approach, and requirement to integrate with other mitigation actions in the structure plan area, the ecological effects on long-tailed bats from habitat loss will be reduced to a **Low** magnitude of effect. Therefore, the level of ecological effect, post management, from long-tailed bat habitat loss is **Low**.

To manage for the potential injury/mortality of long-tailed bats during tree felling, it is recommended that a roost tree fell protocol is implemented. A tree fell protocol is required for any tree felling of a potential roost, as long-tailed bats are confirmed to be present in the area. Ruakura South has an established tree fell protocol (Appendix 10) which should be implemented to avoid the death or injury of bats potentially present during felling. Note, this tree fell protocol was produced before the most recent guidance provided by DOC on tree fell protocols (Bat Recovery Group - Department of Conservation, 2021), however, it is still consistent with the requirements and is more conservative than the updated protocols. Following this protocol is required under the Ruakura South Wildlife Act Authority to conduct tree felling on site (Authorisation Number: 70693-FAU). By following these recommendations, we consider that the potential magnitude of ecological effect on long-tailed bats due to injury/mortality will be reduced to **Negligible**. Therefore, the level of ecological effect from bat injury/mortality on site, post management, is **Low**.

## 6.3 Proposed lizard management

Under the provisions of the Waikato Regional Policy Statement, the use of a habitat by a threatened species confers ecological significance on the habitat regardless of its intrinsic ecological value. Copper skinks have a ‘Threatened – At Risk’ threat status and therefore fall under this provision. In addition, all native lizards are protected under the Wildlife Act.

As required by the Ruakura Plan Change provisions, a NLMP has been prepared for Ruakura South (Appendix 11). The Tuumata Plan Change Area native lizard management must be carried out in accordance with the NLMP which requires an implementation report be submitted at least 3 months before construction begin, demonstrating how native lizard management will meet NLMP requirements. A NLMP implementation report is therefore required to be developed for the proposed Tuumata Plan Change Area development.

The NLMP requires lizard salvage to be undertaken prior to earthworks, and any native lizard found is to be transferred to Chelmsford Park. Chelmsford Park is ecologically suitable for copper skinks, and the habitat has been enhanced (planting and pest plant control undertaken to provide enhanced carrying capacity for lizards requiring translocation) to assist in lizard transfer. It is important to note that the report should also include an incidental detection protocol for other 'At Risk' or 'Threatened' species (e.g. Ornate skink) detected during the works.

Opportunities for creating or enhancing lizard habitat on site should be explored/implemented (e.g., planting of the swales). For example, copper skink habitat in the Waikato is best created by the dense planting of native vegetation that creates cool, damp, deep leaf litter. This habitat enhancement is proposed to be undertaken in BS1 located south of the site, but local enhancement could be considered as well.

Provided that a lizard management implementation plan is prepared to demonstrate how management aligns with the requirements of the NLMP for this area, the magnitude of effect on copper skink habitat loss and copper skink injury/mortality, post management, is likely to be **Low**[27]. Therefore, the level of ecological effect from both, herpetofauna habitat loss and lizard injury/mortality on site, post management, is **Low**.

## 6.4 Proposed avifauna management

The level of effect from the loss of avifauna habitat is low, and as such, management effects should focus on avoiding and remedying effects on individuals present within the site during the construction phase by putting in place management protocols to prevent the injury or mortality of any native birds present within areas of impact.

Any incidental encounter of bird nests identified on trees or shrubs during earth works season should be reported to an ecologist who shall inspect the nests. Vegetation found to contain indigenous bird nests should only be removed once the chicks have fledged. Following this incidental protocol will result in a **Negligible** magnitude of effect. Therefore, the level of ecological effect on avifauna from injury/mortality on site, post management, is **Very Low**.

## 6.5 Proposed freshwater management

As previously described in the Assessment of Effects of Development on Native Fish Populations (Boffa Miskell Ltd, 2014) within the Tuumata Plan Change Area there are 750 m of artificial waterways comprised of the Powell's Road/Fairview Downs Road drains and Tramway Road drain, providing low quality habitat for shortfin eel, longfin eel and black mudfish. On that basis, the Powell's Road drain is considered a *"significant habitat of indigenous fauna*" for black mudfish and longfin eel.

As required by the Ruakura Plan Change provisions, a Native Fish Management Plan (NFMP) has been prepared for the Ruakura South portion of the Ruakura Structure Plan Area (SPA). The NFMP has been accepted by HCC. It requires that an implementation report is prepared for every LDPA consent application demonstrating how native fish management will be undertaken to meet the NFMP requirements. We propose to continue this framework for the management of effects on freshwater fish within the Tuumata Plan Change area.

[27] A residual low magnitude of effect remains as salvage practices are not perfect and some individuals will be missed.

The Ruakura South Native Fish Management Plan will be used to adequately mitigate the transitional effects of habitat conversion from drains to swales and ensure that populations of eels and mudfish are maintained on site. A Tuumata Plan Change area NFMP Implementation report is therefore required and should provide the specific detail required to ensure that native fish habitat is being provided for and resident native fish are adequately managed throughout the land development process. The methods contained in the report should be consist with the requirements of Ruakura Plan Change Section 25H1.2(I) and NFMP. Prior to the removal of the Tuumata Plan Change area drains, native fish salvage and relocation will be required to prevent injury or death of resident native fish.

Native fish replacement habitat cannot be provided within the site extent as the proposed stormwater swales will discharge directly into the HCC reticulated networks. Therefore, any vegetated swale habitat created during the site development will be disconnected from the existing mudfish habitat and is unlikely to provide suitable habitat for mudfish.

We consider the best approach is to continue with the cohesive, catchment wide approach for habitat replacement in a location that is connected to existing black mudfish populations. Based on proposed post-development connectivity, existing black mudfish habitat in current farm drains will be replaced with a purpose-designed wetland basin (BE1) east of the Ruakura SPA which has good connectivity to the Komakorau Stream catchment, see NFMP for additional information.

The creation of a completely new habitat of mudfish provides its own constraints, as mudfish inhabit a very specific environment in terms of water quality, hydrology, pH and isolation from other (competitive and/ or predatory) fish species and the creation of bespoke wetland as mudfish habitat, in other projects, has proven difficult. The lag phase between impact and the construction and establishment of these environments needs to be considered in management considerations as there is, through the planned staging of works, an anticipated lag between the loss of habitat and replacement. We have outlined the approach and method for assessing the proposed mitigation for mudfish habitat in Section 6.5.1 below. This analysis shows that the proposed creation of BE1, within the limits for time lags outlined in Section 6.5.1 below would result in a **Net Gain** in biodiversity value.

Eel (*Anguilla australis, A. dieffenbachii*) habitat is already in the process of being constructed as part of the 23,000 m of swale network south of the railway and east of Silverdale Road in low flow channels of stormwater swales, known as Silverdale swale (2,000m of habitat) and within the BS1 wetland (1,000 m of habitat). These habitats, and their lengths are proposed for the replacement of all eel habitat removed across the Ruakura South Structure Plan Area and in many cases, including the habitat in question, will be built a considerable time prior to eel habitat loss.

The eel habitat provided within the Silverdale swale and BS1 wetland will provide higher quality habitat than that lost and in advance of impact, and we assess this will result in a **Positive** magnitude of effect contributing to level of ecological effect of a **Net Gain**.

Native fish salvage and relocation will be outlined within the required Tuumata Plan Change area NFMP Implementation report and should occur prior to works to prevent injury of death of native fish populations as outlined within the NFMP. Implementing fish salvage lowers the magnitude of effect related to fish mortality to **Negligible**. This results, post management, in a **Very Low** level of ecological effect.

### 6.5.1 Proposal for Mudfish Habitat Effects Management Approach (Compensation modelling scenario)

A biodiversity compensation model (Baber, Christensen, et al., 2021; Baber, Dickson, et al., 2021a), was used to assess the proposed management approach and was developed to provide certainty that the specific mitigation requirements for the creation of BE1 which are outlined in the Ruakura NFMP, will adequately compensate for the loss of black mudfish habitat (approximately 9,930 m of waterways) across the Ruakura Structure Plan area. Including the consideration of scale and timeframe, a No Net Loss/Net Gain in biodiversity values can be achieved for the proposed management approach. Calculations were done using the Biodiversity Compensation Model for New Zealand– Excel Calculator Tool (Version 1) (Baber, Dickson, et al., 2021b). The inputs and explanation to the inputs and the outputs of the model are provided Section 6.5.1.2 below. The output number of predicted net gain means the overall percentage increase in biodiversity value expected once the mitigation activities have reached the chosen finite end point.

#### 6.5.1.1 Assumptions and scenarios

An ecological outcome of No Net Loss is required to be confirmed specifically for the loss of black mudfish habitat within the TPC Area. However, as the proposed effects management takes a whole of catchment effects assessment and effects management approach, it is not appropriate to separate the black mudfish habitat loss and a commensurate proportion of the proposed habitat creation for the Tuumata Plan Change area alone. As such, we have calculated the impact and habitat creation for the wider Ruakura South Structure Plan area aligned with the whole of catchment, cohesive, approach proposed in the NFMP.

This approach, while more appropriate for the proposal, does introduce a considerable issue in that it requires an assumption of a total loss of all mudfish habitat at a specified time point or multiple specified time points. As the loss of mudfish habitat in the Ruakura Structure Plan area will be staged over what is likely to be several decades, the lag phase duration between impact and compensation (finite-end-point in model) is unknown.

In reality, some of the mudfish habitat is not likely to be lost in the near future, while other waterways have already been lost, such as sections of the Ruakura Road drain, waterways within the Port platform site extent and a section of the Percival Road drain (as part of Road 3 Tie In works). Therefore, the only known aspect for timing is a trigger outlined within the NFMP for the construction of BE1, which is:

> *"Basin BE1 will not be required until development of the area east of the future Spine Road and north of Percival Road is proposed, and therefore most mudfish habitat within Ruakura South will remain in rural land use for several decades."*

This trigger, if implemented, requires BE1 to be constructed once development is proposed within the area encompassing the majority of the mudfish habitat, east of the proposed Spine Road, within the Ruakura South area.

Consequently, we have elected to model two scenarios, one to represent the worst-case scenario assuming a single timeframe between impact and compensation, i.e., all mudfish habitat is lost all at once (Scenario one - Section 6.5.1.1), and another scenario where impacts are split in half with half occurring before the trigger of BE1 needing to be constructed and the other half impacted after BE1 construction is triggered (Scenario two – Section 6.5.1.3). We have used these scenarios and modelling to determine the acceptable timeframe between

impact and compensation efficacy, Note: Scenario two still assumes two distinct impact times which is still conservative compared to the more likely staged impact of habitat pre and post the trigger of BE1 construction.

Assumptions have been made regarding black mudfish habitat preferences and behaviours in selecting areas to inhabit and establish populations. As black mudfish are cryptic in nature and knowledge regarding their specific behaviours is limited, there is uncertainty around why they select to inhabit specific areas. Our assumption is that if the habitat we create aligns with all preferences previously outlined throughout current literature, the black mudfish population will choose to colonise the newly created BE1 wetland.

#### 6.5.1.2 Analysis – Scenario one

Outlined below is the justification for each scoring within the biodiversity compensation model and the overall score confirms that a **Net Gain** outcome of 10.1% can be achieved with the current mitigation requirements under the assumption of BE1 being completed and fully established in a period equal to 17 years between impact (under the assumption of all mudfish habitat lost at once) and habitat recreation (Table 19). The predicted net gain outcome of 10% has been selected to establish a limit to the lag phase from which to evaluate the model inputs (between impact and compensation) and in turn create a finite trigger point.

*Table 19: Biodiversity compensation Model inputs and explanations for Ruakura Structure Plan black mudfish habitats*

| **Model inputs** | **Explanation** |
|---|---|
| **Project/reference name** | Ruakura Structure Plan Area. Black mudfish habitat assessment. |
| **Biodiversity type** | Black Mudfish Habitat |
| **Technical expert input(s)** | Kathryn Reeve, Tine Ulrich, Andrew Blayney |
| **Benchmark** | A benchmark of 5 equates to a large mature contiguous lowland wetland ecosystem type, well connected to other similar habitats, with a peat substrate that is intermittently wet (dries for short periods in summer) with good water quality, complex habitats, and has either a habitat, connectivity, or hydrologic barrier to limit access from other species (i.e., eels and/or pest fish do not regularly gain access and mudfish are not subject to regular predation). Black mudfish population is at or near carrying capacity. |
| **How many habitat types OR sites are impacted** | 1<br>**Explanation:** Existing mudfish habitat comprises approximately 9,930 m of waterways within the Ruakura Structure Plan area, principally through the central area between Powell's Road and Ruakura Road, on drains connected with the Ruakura Road drains and Brinkworth Drain on the Komakorau Stream catchment. |
| **Number of proposed compensation measures** | 1<br><br>**Explanation:** The compensation measure proposed is the creation of one large wetland (BE1) designed to create mudfish habitat. |

| Model inputs | Explanation |
|---|---|
| **Net Gain target** | 10% (i.e., the compensation score needs to be at least 10% higher than the impact score) |
| **Impact model inputs and descriptions** | |
| **Habitat/site impacted** | **Ruakura Mudfish Habitat,** |
| **Impact risk contingency** | **Data input**: 3 - High risk (calculated biodiversity impact score is multiplied by 1.1 (+10%))<br><br>**Explanation**: The impact risk was assessed as 'High' as the mudfish habitats and the species are considered high value (see "value score prior to impact" below for further explanation). |
| **Impact uncertainty contingency** | **Data input**: 2 - Moderate uncertainty (calculated biodiversity impact score is multiplied by 1.1 (+10%))<br><br>**Explanation**: The impact is well defined loss of habitat within a clearly defined area. This loss of habitat also includes a change in catchment connection compared to predevelopment. The physical loss and changes are well understood. There remains a level of uncertainty around the black mudfish population effects and the resilience of the unimpacted areas outside the development footprint and how they respond to the loss of these habitats and sub-populations found within them. |
| **Areal extent of impact (ha)** | **Data input**: 1.986 ha<br><br>**Explanation:** Existing mudfish habitat is thought to comprise some 9,930m of waterways within Ruakura South, principally through the central area between Powells Road and Ruakura Road, on drains connected with the Ruakura Road drains and Brinkworth Drain on the Komakorau Stream catchment. Assuming that drains are a maximum of 2m wide throughout Ruakura which we consider would be a conservative estimation (most drains would be much narrower than 2m). The total area of mudfish habitat is therefore 19,860m$^2$ which, due to the conservative width estimate would include a considerable riparian margin and associated adjacent, habitat features. |
| **Value score <u>prior to</u> impact** | **Data input**: 3.5<br><br>**Explanation**: A value of 3.5 relative to the benchmark of 5. We acknowledge that the habitats remaining within the Ruakura Structure Plan Area are degraded, and not optimal for mudfish habitat. However, mudfish are retained in this environment because the historic, high-quality habitats, have been almost entirely lost in the landscape. As such, we |

| Model inputs | Explanation |
|---|---|
| | have scored a high ecological value to take into consideration the threat status of black mudfish as well as the importance of the remaining habitat to the species despite the habitat's poor quality. |
| **Value score after impact** | **Data input**: 0.001<br><br>**Explanation**: A value of 0.001 as there will be a permanent and complete loss of habitat (noting that the formula cannot work with 0). There is no assumption or allowance for continued habitat for mudfish within the Ruakura South area post development. |
| **Compensation model inputs** | |
| **Mudfish habit BE1** | |
| **Compensation action** | **Data input**: Compensation actions as described above under approach and outcome for this wetland. |
| **Discount rate** | **Data input**: 3%<br><br>**Explanation**: Default and aligned with best practise. |
| **Finite end-point** | **Data input**: 17<br><br>**Explanation**: We have calculated the compensation proposed under multiple timeline scenarios to assess the maximum time-lag between impact and creation and establishment of the proposed habitat. Under a scenario of all habitat loss occurs at the same time – 17 years was the determined maximum lag. |
| **Compensation confidence contingency** | **Data input**: 3 - Moderate confidence (50-75%)<br><br>**Explanation**: While wetland creation is a well-established and common way of mitigating for wetland habitat loss, the experience with creating mudfish habitat in the region has been met with variable success. For example, black mudfish populations have been shown to have limited success in recolonising areas, this may be due to poor detection levels of populations or unknown habitat variables that deter mudfish from these areas. Black mudfish habitat selection preference is still largely unknown. As such, we have used a moderate confidence (50-75%) for success of compensation. |
| **Areal extent (ha) of compensation type** | **Data input**: 7 ha<br><br>**Explanation**: This is the areal extent of the proposed BE1 wetland and it would include some non-wetland areas such as planted slopes, but this is consistent with the method used to calculate the affected area as this too |

| Model inputs | Explanation |
|---|---|
| | would include riparian zones of the drain network. |
| **Value score prior to compensation measure** | **Data input**: 0.001<br><br>**Explanation**: Area of proposed BE1 is currently a paddock with no habitat value to mudfish. |
| **Value score after compensation measure** | **Data input:** 3.5<br><br>**Explanation**: A score of 3.5 equates to a well-established (but not fully mature) lowland ecosystem wetland type with complex habitats, layers of organic detritus and leaf litter, overhanging vegetation and plant cover that meets exceeds 80% of the wetland area (outside of ponded areas), with a peat derived substrate. BE1 will have good water quality & limited sediment inputs from surrounding catchments, and a natural water area that will dry out periodically during summer, allowing mudfish to aestivate in leaves, mud, and damp soils and limiting access of other species (such as eels & pest fish, limiting predation on mudfish). Hydrological connectivity to mudfish habitat within the Komakorau Stream catchment, however, will be established as the sole wetland existing within the network (as no other wetlands and similar habitats remain within the surrounding catchment). Black mudfish populations will have colonised BE1 and are expected to be at low densities. |

The biodiversity compensation model outputs for this analysis are provided below in Table 18:

*Table 20: Biodiversity Compensation Model calculation outputs – Tuumata Mudfish*

| Impact model outputs | Totals |
|---|---|
| Impact score | **-1.68166** |
| **Compensation model outputs** | **Total compensation score** |
| Compensation score | **1.85233** |
| **Predicted Net Gain outcome** | **10.1%** |

#### 6.5.1.3 Analysis – Scenario two

As the key unknown variable in the compensation calculation is the lag time between habitat loss and establishment of replacement habitat (the "finite-end-point" in the model). We have tested the results under an alternative assumption, whereby the calculation is split into two equal halves for both effect size and areal extent of compensation. In one half we've assumed a 25-year time lag (impact occurs 15 years prior to BE1 trigger), and in the other half a 10-year[28] time lag (impacts occur at the time of the BE1 trigger). This assumption can be considered to be an approximation of a scenario of half of all mudfish habitats having been impacted prior to the

[28] An assumed 3-year period of construction, and planting, and an additional 7 years of establishment to reach habitat criteria suitable for mudfish.

trigger point for BE1 construction and half of all habitats being impacted post the BE1 construction trigger.

Under this scenario, an assumption of 10 years between the trigger and full establishment to the end state outlined in Table 17 has been used. This is still considered conservative as greater than 50% of mudfish habitat is located inside the area of Ruakura South where development would trigger the need to construct BE1. Also, the model still assumes a worst-case scenario of the impacts all occurring at once under each timeframe rather than staged over a period of time.

Metrics used in the model are the same as those outlined in Table 19 except the calculation has been split into two habitat impacts and two compensation actions as outlined in Table 21 below, a simplified table of data inputs with the corresponding model outputs provided in Table 22. Under this scenario, the model outputs conclude a 11.2% net biodiversity gain. This suggests that while much longer lag phases between impact and compensation for some habitats reduce the expected biodiversity net-gain, the approach proposed in the NFMP is reasonably robust, within limits, to variations of staging times.

The assumed scenario here therefore reflects a potential limit of lag phase between impacts on habitats which occur prior to the defined BE1 construction trigger point and the establishment of the compensation habitat (BE1) as lag phases that are longer than assumed here, would reduce expected net gains below 10%.

*Table 21: Biodiversity Compensation Model inputs and explanations for Ruakura Structure Plan black mudfish habitats – Scenario two.*

| Habitat/Site Impact(s) | 50% of Mudfish habitats impacted prior to BE1 trigger | 50% of Mudfish habitats impacted post BE1 trigger |
|---|---|---|
| Impact risk contingency: | 3 | 3 |
| Impact uncertainty contingency: | 2 | 2 |
| Areal extent of impact (ha): | 0.993 | 0.993 |
| Value score prior to impact: | 3.5 | 3.5 |
| Value score after impact: | 0.001 | 0.001 |
| **Compensation Action(s)** | **50% of Mudfish habitats impacted prior to BE1 trigger – 50% of BE1 area** | **50% of Mudfish habitats impacted post BE1 trigger – 50% of BE1 area** |
| Discount rate: | 3.0% | 3.0% |
| Finite end point (years): | 25 | 10 |
| Compensation confidence contingency: | 3 | 3 |
| Areal extent (ha) of compensation type: | 3.5 | 3.5 |
| Value score prior to compensation: | 0.001 | 0.001 |
| Value score after compensation: | 3.5 | 3.5 |

*Table 22: Biodiversity Compensation Model calculation outputs – Tuumata Mudfish – Scenario two.*

| Impact model outputs | Totals | 50% of Mudfish habitats impacted prior to BE1 trigger | 50% of Mudfish habitats impacted post BE1 trigger |
|---|---|---|---|
| Impact score | **-1.68166** | -0.84083 | -0.84083 |
| **Compensation model outputs** | **Total compensation score** | **50% of Mudfish habitats impacted prior to BE1 trigger – 50% of BE1 area** | **50% of Mudfish habitats impacted post BE1 trigger – 50% of BE1 area** |
| Compensation score | **1.87016** | 0.73112 | 1.13907 |
| **Predicted Net Gain outcome** | **11.2%** | | |

# 7.0 Conclusion

While this Ecological Impact Assessment is for a plan change rezoning within the Tuumata Plan Change area, the site occurs within the location and context of the Ruakura South Structure Plan area and as such, is part of the ecological compensation and mitigation context of this structure plan area. Therefore, our recommendation is to align the Tuumata mitigation approach to ensure alignment and consistency within the wider Ruakura structure plan, in turn providing cohesive mitigation for this area.

The report identified that the land at Tuumata Plan Change area has the following characteristics:

- Existing vegetation consists mainly of pasture and shade trees, with limited habitat values for indigenous fauna.
- The waterways consist of artificial drains with poor water and habitat quality, with ongoing anthropogenic inputs that provide poor conditions for fish and aquatic macroinvertebrates. It is likely that some water quality parameters approach or exceed the tolerance of all but the hardiest aquatic species for a large part of the year.
- Sediment quality in waterways is generally suitable for aquatic organism although some locations have elevated concentrations of contaminants.
- The waterways provide habitat for shortfin and longfin eels and black mudfish although the size of the populations supported are yet to be established. It is unlikely that the site provides habitat of value to bats, native birds, or lizards.

The ecological values within the Tuumata Plan Change area are limited by the extensive modification of vegetation and waterways that has occurred to facilitate agricultural use and the regular clearing of the artificial drain networks. The ecological value of terrestrial and riparian vegetation is **Low,** which contributes to a low likelihood that significant populations of native bird, lizards and bats inhabitant the area. No key ecological sites or significant ecological areas are located within the plan change area.

Longfin eel and black mudfish are both identified within the onsite watercourses and are classified as 'At Risk – Declining', scoring **Moderate** ecological value for rarity. However, all other aspects of the waterways ecological value are low and therefore the habitat is of **Low** overall ecological value for freshwater fish.

The ecological effect of the removal of the waterways is **Low**. The extensive Silverdale swale systems and BS1 wetland being developed for eels, and the dedicated BE1 wetland proposed for black mudfish, are considered to adequately mitigate for these proposed works.

We have used the Biodiversity Compensation Model for New Zealand to model the impacts and compensatory actions proposed within the Ruakura South NFMP for the loss of black mudfish habitat across the wider Ruakura Structure Plan area and to calculate the adequacy of the proposed mitigation requirements with the creation of BE1 in achieving a net gain in biodiversity.

However, as the proposed effects management takes a whole of catchment effects assessment and effects management approach, it is not appropriate to separate the black mudfish habitat loss and a commensurate proportion of the proposed habitat creation for the Tuumata Plan Change area alone. As such, we have calculated the impact and habitat creation for the wider Ruakura Structure Plan area aligned with the whole of catchment, cohesive, approach proposed in the NFMP.

The black mudfish habitat provided within the BE1 wetland will provide higher quality habitat than that lost or impacted, and we have confirmed through the biodiversity compensation modelling that a **Net Gain** outcome can be achieved within the current mitigation requirements under the assumption of BE1 being completed within some time frames limits.

The proposed construction of the Tuumata Plan Change area is assessed to have minimal impact on vegetation and avifauna ecological values within the project footprint. However, given that the site is likely utilised by long-tailed bats ('Threatened – Nationally Critical') and copper skinks ('At risk – Declining'), the development may have greater impact on bat and herpetofauna ecological values. This report identifies the potential ecological impacts and provides management measures to manage against these disturbances. By following these

recommendations, the impact on the terrestrial ecological values on site can be managed to have a no more than Low level of ecological effect.

# 8.0 References


ANZECC. (2000). *Australian and New Zealand guidelines for fresh and marine water quality*. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

Atkinson, I. A. E. (1985). Derivation of vegetation mapping units for an ecological survey of Tongariro National Park North Island, New Zealand. *New Zealand Journal of Botany*, *23*(3), 361–378.

Aughton, H. (2022). *Project Echo 2021 Hamilton City Wide Bat Survey*. Go Eco. https://www.waikatoregion.govt.nz/assets/WRC/WRC-2019/Project-Echo-Hamilton-city-survey-2021-report.pdf

Baber, M., Christensen, M., Quinn, J., Markham, J., Kessels, G., Ussher, G., & Signal Ross, R. (2021). The use of modelling for terrestrial biodiversity offsets and compensation: A suggested way forward. *Resource Management Journal*, *April 2021*, 28–33.

Baber, M., Dickson, J., Quinn, J., Markham, J., Ussher, G., Heggie-Gracie, S., & Jackson, S. (2021a). *A Biodiversity Compensation Model for New Zealand: A user guide (Version 1)* (Project Number 1017287.0000P.v1). Tonkin & Taylor Ltd.

Baber, M., Dickson, J., Quinn, J., Markham, J., Ussher, G., Heggie-Gracie, S., & Jackson, S. (2021b). *Biodiversity Compensation Model for New Zealand– Excel calculator tool (Version 1)* (Project Number 1017287.0000P.v1). Tonkin & Taylor Ltd.

Bat Recovery Group - Department of Conservation. (2021). *Protocols for minimising the risk of felling bat roosts* (No. V2). Bat Recovery Group - Department of Conservation.

Boffa Miskell Ltd. (2013). *Ruakura Structure Plan Area: Assessment of ecological values to inform an Integrated Catchment Management Plan* (Report No. A08274). Prepared By Boffa Miskel Ltd for Tainui Group Holdings Ltd & Chedworth Park Ltd.

Boffa Miskell Ltd. (2014). *Ruakura Structure Plan area: Assessment of effects of development on native fish populations* (Report No. A08274I). Prepared by Boffa Miskell Ltd for Tainui Group Holdings Ltd & Chedworth Park Ltd.

Borkin, K. M., & Parsons, S. (2009). Long-tailed bats' use of a *Pinus radiata* stand in Kinleith Forest: Recommendations for monitoring. *New Zealand Journal of Forestry*, *53*(4), 38–43.

Clarkson, B. D., Merrett, M., & Downs, T. (2002). *Botany of the Waikato*. Waikato Botanical Society Inc.

Clarkson, B. R. (2013). *A vegetation tool for wetland delineation in New Zealand*. Landcare Research for Meridian Energy Ltd.

Clarkson, B. R., Champion, P. D., Rance, B. D., Johnson, P. N., Bodmin, K. A., Forester, L., & Reeves, P. N. (2013). *New Zealand wetland indicator status ratings*. Landcare Research.

Dunn, N. R., Allibone, R. M., Closs, G. P., Crow, S. K., David, B. O., Goodman, J. M., Griffiths, M., Jack, D. C., Ling, N., Waters, J. M., & Rolfe, J. R. (2018). *Conservation status of New Zealand freshwater fishes, 2017* (New Zealand Threat Classification Series No. 24). Department of Conservation.

EIANZ. (2018). *Ecological impact assessment (EcIA): EIANZ guidelines for use in New Zealand: Terrestrial and freshwater ecosystems. 2nd EDITION.* Environment Institute of Australia and New Zealand.

Fitzgerald, N., & Innes, J. (2013). *Hamilton City biennial bird counts: 2004 – 2012* (LC 1484). Landcare Research. http://www.streamcare.org.nz/Hamilton_Bird_Counts_2004_12.pdf

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 No. 35). Department of Conservation.

Kessels & Associates Ltd. (2017). *Hamilton City Long-tailed Bat Survey 2016—2017*. Prepared by Kessels & Associates Ltd.

Le Roux, D., S., & Le Roux, N. N. (2012). *Hamilton City bat survey 2011—2012*. Prepared by Project Echo and Kessels & Associates Ltd.

Ministry for the Environment. (2020a). *National policy statement freshwater management 2020*. Ministry for the Environment.

Ministry for the Environment. (2020b). *Wetland delineation protocols*. Ministry for the Environment.

Ministry for the Environment. (2021). *Wetland delineation hydrology tool for Aotearoa New Zealand* (ME 1575). Ministry for the Environment.

O'Donnell, C. F. J. (2000). Influence of season, habitat, temperature, and invertebrate availability on nocturnal activity of the New Zealand long-tailed bat (*Chalinolobus tuberculatus*). *New Zealand Journal of Zoology*, *27*(3), 207–221.

O'Donnell, C. F. J., Borkin, K. M., Christie, J. E., Lloyd, B., Parsons, S., & Hitchmough, R. A. (2018). *The conservation status of New Zealand bats, 2017* (New Zealand Threat Classification Series No. 21). Department of Conservation.

O'Donnell, C. F. J., & Sedgeley, J. (1999). Use of roosts by the long-tailed bat, *Chalinolobus tuberculatus*, in temperate rainforest in New Zealand. *Journal of Mammalogy*, *80*(3), 913–923.

Opus International Consultants Ltd. (2016). *Hamilton Section Long-tailed Bat Surveys 2016: Pre-construction Baseline Surveys 3 & 4*. Prepared by Opus International Consultants Ltd.

Robertson, H. A., Baird, K. A., Elliott, G. P., Hitchmough, R. A., McArthur, N., Makan, T. D., Miskelly, C. M., Sagar, P. M., Scofield, R. P., Taylor, G. A., & Michel, P. (2021). *Conservation status of New Zealand birds, 2021* (New Zealand Threat Classification Series No. 36). Department of Conservation.

Roper-Lindsay, J., Fuller, S. A., Hooson, S., Sanders, M. D., & Ussher, G. T. (2018). *Ecological impact assessment (EcIA). EIANZ guidelines for use in New Zealand: Terrestrial and freshwater ecosystems* (2nd ed.). Environment Institute of Australia and New Zealand.

Sedgeley, J. (2001). Quality of cavity microclimate as a factor influencing selection of maternity roosts by a tree-dwelling bat, *Chalinolobus tuberculatus*, in New Zealand. *Journal of Applied Ecology*, *38*, 424–438.

Sedgeley, J., & O'Donnell, C. F. J. (1999). Roost selection by the long-tailed bat, *Chalinolobus tuberculatus*, in temperate New Zealand rainforest and its implications for the conservation of bats in managed forests. *Biological Conservation*, *88*(2), 261–276.

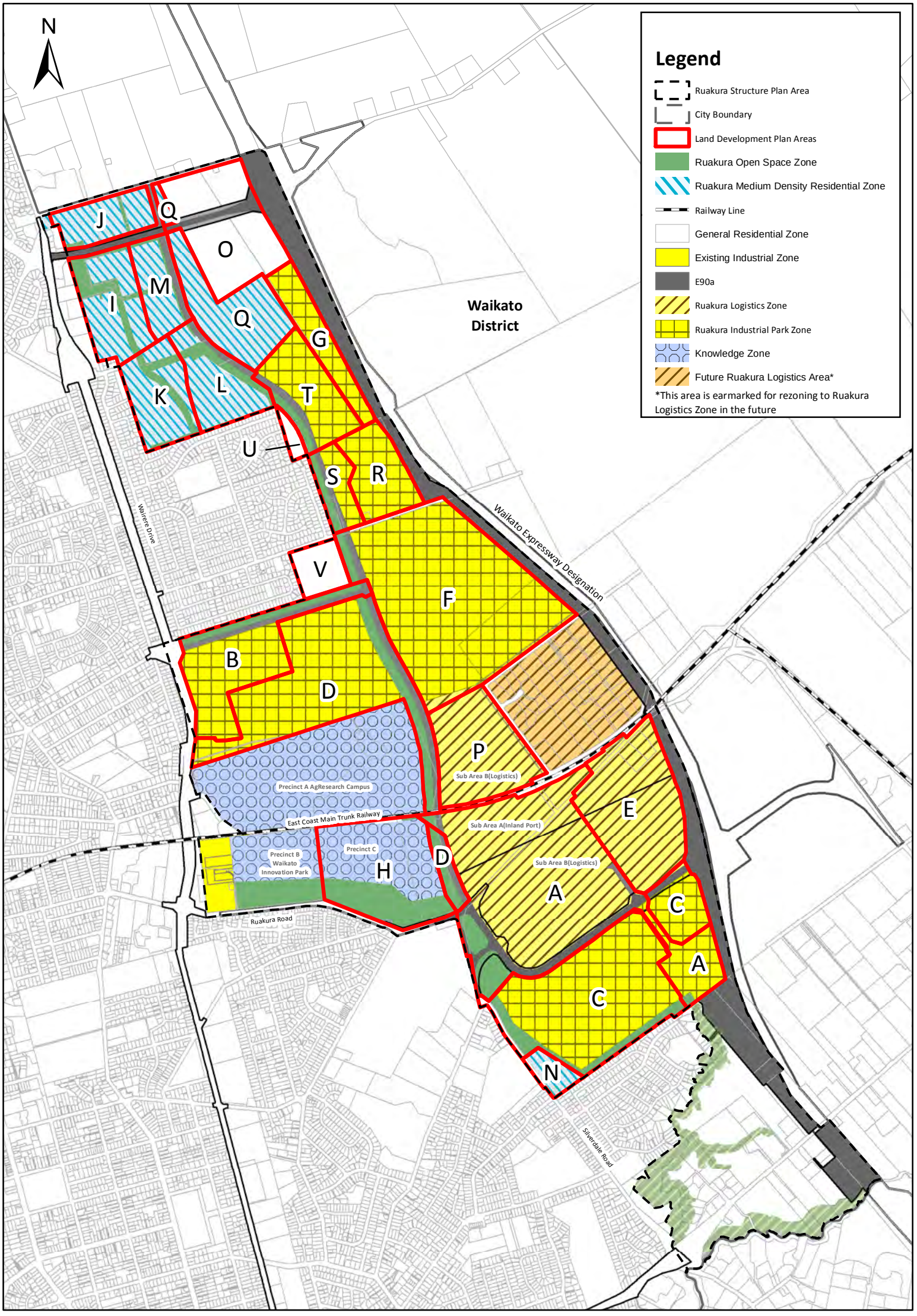
Sedgeley, J., & O'Donnell, C. F. J. (2004). Roost use by long-tailed bats in South Canterbury: Examining predictions of roost-site selection in a highly fragmented landscape. *New Zealand Journal of Ecology*, *28*(1), 1–18.

Stark, J. D., Boothroyd, I. K. G., Harding, J. S., Maxted, J. R., & Scarsbrook, M. R. (2001). *Protocols for sampling macroinvertebrates in wadeable streams* (p. 65). Prepared for the Ministry for the Environment.

Stark, J. D., & Maxted, J. R. (2007). A biotic index for New Zealand's soft-bottomed streams. *New Zealand Journal of Marine and Freshwater Research*, *41*(1), 43–61.

Van Winkel, D., Baling, M., & Hitchmough, R. A. (2018). *Reptiles and amphibians of New Zealand: A field guide*. Auckland University Press.

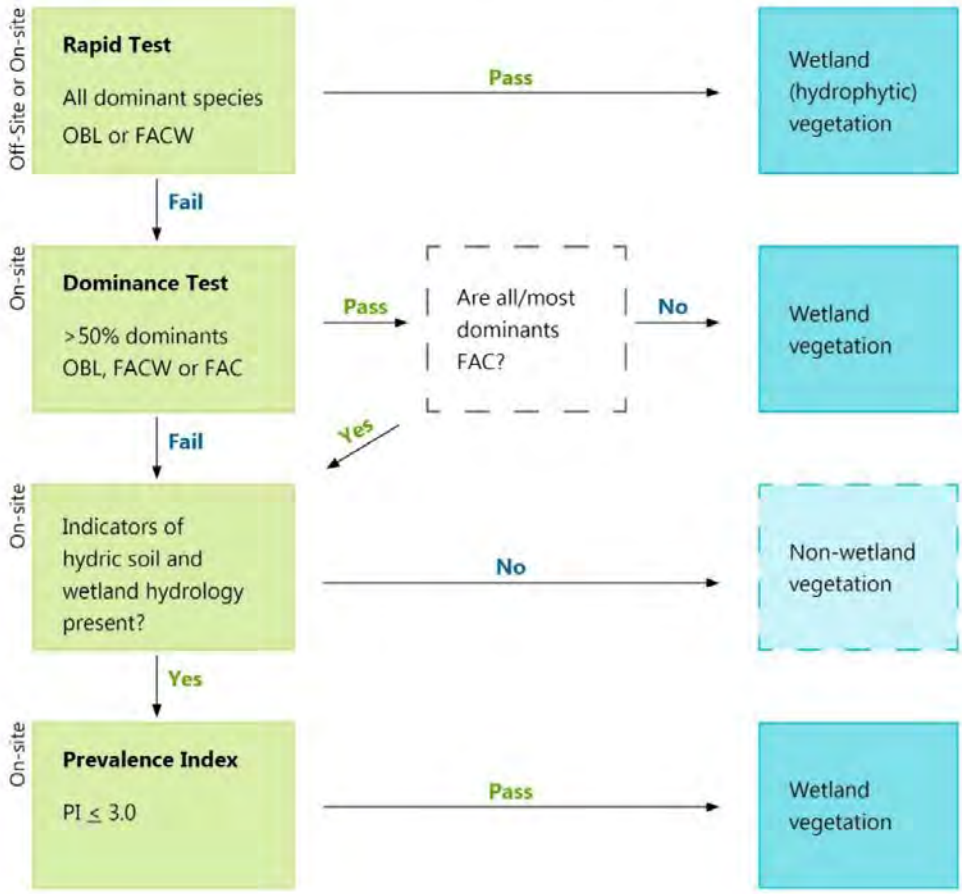
# Appendix 1: Ruakura land development plan




Document Path: L:\GIS\1 Working\City Planning\Ruakura Variation\Figure 2-16 Ruakura Land Development Plan Area -fixed.mxd

# Appendix 2: Wetland delineation flow chart

**Figure 1:** **Flow chart of steps for hydrophytic (wetland) vegetation determination. Wetland indicator status abbreviations: FAC= facultative; FACW = facultative wetland; OBL = obligate wetland.**



# Appendix 3: Vegetation map

File Ref: BM211065.mxd


Boffa Miskell

www.boffamiskell.co.nz



0 100 m

1:4,000 @ A3

*Note:* Based on 2019 aerial imagery

*Data Sources:* BML, 2019 Imagery: Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors., Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

*Projection:* NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Site Boundary
- Vegetation Type
  - Exotic shelterbelt
  - Individual tree
  - Kahikatea tree stand
  - Native/exotic tree stand
  - Tree stand

**RUAKURA TUUMATA REZONING PRIVATE PLAN CHANGE**

# Vegetation Map

**Date: 04 November 2022 | Revision: 0**

Plan prepared by Boffa Miskell Limited

Project Manager: Dave.Moule@boffamiskell.co.nz | Drawn: HHu | Checked: GMa

# Appendix 4: Vegetation species list

| Common | Species | Status |
|---|---|---|
| Cabbage tree | *Cordyline australis* | Native - Not threatened |
| Silver fern | *Cyathea dealbata* | Native - Not threatened |
| Kahikatea | *Dacrycarpus dacrydioides* | Native - Not threatened |
| Wheki | *Dicksonia squarrosa* | Native - Not threatened |
| Water fern | *Histiopteris incisa* | Native - Not threatened |
| Pohuehue | *Muehlenbeckia australis* | Native - Not threatened |
| Red mapou | *Myrsine australis* | Native - Not threatened |
| Basket grass | *Oplismenus hirtellus subsp. imbecillis* | Native - Not threatened |
| Kiokio | *Parablechnum novae-zelandiae* | Native - Not threatened |
| Lemonwood | *Pittosporum eugenioides* | Native - Not threatened |
| Totara | *Podocarpus totara* | Native - Not threatened |
| Blackwood | *Acacia melanoxylon* | Exotic |
| Maple | *Acer* sp. | Exotic |
| Horse chestnut | *Aesculus hippocastanum* | Exotic |
| Agapanthus | *Agapanthus sp.* | Exotic |
| Common alder | *Alnus glutinosa* | Exotic |
| Bindweed | *Calystegia* sp. | Exotic |
| Pampas | *Cortaderia selloana* | Exotic |
| Hawthorn | *Crataegus monogyna* | Exotic |
| Japanese cedar | *Cryptomeria japonica* | Exotic |
| Cypress | *Cupressus sp*. | Exotic |
| Cocksfoot | *Dactylis glomerata* | Exotic |
| Mexican tea | *Dysphania ambrosioides* | Exotic |
| Eucalyptus | *Eucalyptus sp*. | Exotic |
| Ash tree | *Fraxinus sp*. | Exotic |
| English ivy | *Hedera helix* | Exotic |
| Tree Privet | *Ligustrum lucidum* | Exotic |
| Chinese privet | *Ligustrum sinense* | Exotic |
| Japanese honeysuckle | *Lonicera japonica* | Exotic |
| Lotus | *Lotus pedunculatus* | Exotic |
| Water purslane | *Ludwigia palustris* | Exotic |
| Magnolia | *Magnolia sp.* | Exotic |
| *Paspalum* | *Paspalum dilatatum* | Exotic |
| Water pepper | *Persicaria hydropiper* | Exotic |
| Inkweed | *Phytolacca octandra* | Exotic |
| Narrow-leaved plantain | *Plantago lanceolata* | Exotic |
| London plane | *Platanus x acerifolia* | Exotic |
| Lombardy/black poplar | *Populus nigra* | Exotic |
| Poplar | *Populus sp.* | Exotic |
| Cherry tree | *Prunus sp.* | Exotic |
| Mountain fivefinger | *Pseudopanax colensoi* | Exotic |
| Creeping buttercup | *Ranunculus repens* | Exotic |
| Black locust | *Robinia pseudoacacia* | Exotic |

| Common | Species | Status |
|---|---|---|
| Blackberry | *Rubus fruticosus agg.* | Exotic |
| Dock | *Rumex sp.* | Exotic |
| Grey willow | *Salix cinerea* | Exotic |
| Woolly nightshade | *Solanum mauritianum* | Exotic |
| Black nightshade | *Solanum nigrum* | Exotic |
| Bald cypress | *Taxodium distichum* | Exotic |
| Gorse | *Ulex europaeus* | Exotic |

# Appendix 5: Bat survey weather data

| Survey night | Date | Time | Minimum Temperature (°C) | Precipitation (mm) | Surface wind speed (km/hr) | Maximum wind gust (km/hr) | Notes |
|---|---|---|---|---|---|---|---|
| Night 1 | 9/03/2022 | 18:00 | 23 | 0 | 13.3 | 25.6 | Valid survey night |
| | | 19:00 | 20.6 | 0 | 12.6 | 21.6 | |
| | | 20:00 | 18.6 | 0 | 8.6 | 18 | |
| | | 21:00 | 17.5 | 0 | 6.8 | 13.7 | |
| | | 22:00 | 17 | 0 | 1.1 | 5.8 | |
| | | 23:00 | 17.2 | 0 | 1.4 | 3.6 | |
| | | 0:00 | 18 | 0 | 2.9 | 5 | |
| | 10/03/2022 | 1:00 | 17.3 | 0 | 2.2 | 4.3 | |
| | | 2:00 | 15.4 | 0 | 2.2 | 3.6 | |
| | | 3:00 | 15 | 0 | 1.8 | 5.8 | |
| | | 4:00 | 14.7 | 0 | 3.6 | 7.9 | |
| | | 5:00 | 13.9 | 0 | 2.2 | 5.8 | |
| | | 6:00 | 15 | 0 | 3.6 | 9 | |
| | | 7:00 | 14.3 | 0 | 4.3 | 9.4 | |
| | | 8:00 | 15.1 | 0 | 4.7 | 12.2 | |
| | | 9:00 | 18.2 | 0 | 6.1 | 14 | |
| Night 2 | 10/03/2022 | 18:00 | 22 | 0 | 12.6 | 27 | Valid survey night |
| | | 19:00 | 19 | 0 | 9 | 19.4 | |
| | | 20:00 | 16.3 | 0 | 7.6 | 13.3 | |
| | | 21:00 | 15.9 | 0 | 6.5 | 14.8 | |
| | | 22:00 | 15.2 | 0 | 2.5 | 5.8 | |
| | | 23:00 | 14 | 0 | 2.2 | 6.1 | |
| | | 0:00 | 13.7 | 0 | 2.9 | 6.5 | |
| | 11/03/2022 | 1:00 | 13.2 | 0 | 3.2 | 9.4 | |
| | | 2:00 | 13.6 | 0 | 3.2 | 7.6 | |
| | | 3:00 | 14.4 | 0 | 2.9 | 5.8 | |
| | | 4:00 | 15.5 | 0 | 3.2 | 6.5 | |
| | | 5:00 | 16.1 | 0 | 2.9 | 8.6 | |
| | | 6:00 | 16.2 | 0 | 4.7 | 10.1 | |
| | | 7:00 | 15.5 | 0 | 2.5 | 10.1 | |
| | | 8:00 | 16 | 0 | 1.8 | 7.2 | |
| | | 9:00 | 17.2 | 0 | 4.3 | 10.1 | |
| Night 3 | 11/03/2022 | 18:00 | 20.9 | 0 | 9.7 | 20.2 | Valid survey night |
| | | 19:00 | 19.7 | 0 | 8.6 | 19.1 | |
| | | 20:00 | 18.7 | 0 | 8.3 | 17.3 | |
| | | 21:00 | 17.4 | 0 | 4.3 | 9.4 | |
| | | 22:00 | 16.7 | 0 | 5.8 | 11.5 | |
| | | 23:00 | 14.5 | 0 | 3.6 | 9.4 | |
| | | 0:00 | 13.8 | 0 | 2.5 | 7.2 | |
| | 12/03/2022 | 1:00 | 14.6 | 0 | 2.2 | 6.5 | |
| | | 2:00 | 15 | 0 | 5 | 8.6 | |
| | | 3:00 | 14 | 0 | 4 | 10.8 | |
| | | 4:00 | 15.1 | 0 | 2.9 | 6.8 | |
| | | 5:00 | 14.6 | 0 | 2.5 | 5 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6:00 | 13.2 | 0 | 1.1 | 3.6 | |
| | | 7:00 | 12.5 | 0 | 2.2 | 5.8 | |
| | | 8:00 | 14.2 | 0 | 2.2 | 5.4 | |
| | | 9:00 | 17.6 | 0 | 4.3 | 11.9 | |
| Night 4 | 12/03/2022 | 18:00 | 21.7 | 0 | 13.3 | 23.4 | Valid survey night |
| | | 19:00 | 20.9 | 0 | 8.6 | 17.3 | |
| | | 20:00 | 20.2 | 0 | 7.9 | 15.1 | |
| | | 21:00 | 19.6 | 0 | 5.4 | 10.1 | |
| | | 22:00 | 19.3 | 0 | 5 | 10.1 | |
| | | 23:00 | 18.8 | 0 | 5.4 | 10.4 | |
| | | 0:00 | 17.5 | 0 | 1.4 | 6.1 | |
| | 13/03/2022 | 1:00 | 16.2 | 0 | 1.8 | 5 | |
| | | 2:00 | 16.6 | 0 | 1.4 | 4 | |
| | | 3:00 | 17 | 0 | 1.4 | 4.7 | |
| | | 4:00 | 18.1 | 0 | 2.9 | 11.5 | |
| | | 5:00 | 18.6 | 0 | 3.6 | 10.8 | |
| | | 6:00 | 18.6 | 0 | 6.8 | 18.7 | |
| | | 7:00 | 19.2 | 0 | 9 | 23.4 | |
| | | 8:00 | 19.7 | 0 | 7.2 | 20.9 | |
| | | 9:00 | 20.1 | 0 | 6.8 | 21.6 | |
| Night 5 | 13/03/2022 | 18:00 | 21.4 | 0 | 7.6 | 20.5 | Valid survey night |
| | | 19:00 | 19.4 | 0 | 8.3 | 23.8 | |
| | | 20:00 | 18.2 | 0 | 8.3 | 23 | |
| | | 21:00 | 17.9 | 0 | 10.1 | 29.5 | |
| | | 22:00 | 17.1 | 0 | 9 | 31 | |
| | | 23:00 | 16.4 | 0 | 6.8 | 20.5 | |
| | | 0:00 | 14.7 | 0 | 4 | 13 | |
| | 14/03/2022 | 1:00 | 14.3 | 0 | 4.3 | 14.4 | |
| | | 2:00 | 13 | 0 | 3.2 | 13.7 | |
| | | 3:00 | 12 | 0 | 2.9 | 7.2 | |
| | | 4:00 | 11.5 | 0 | 2.5 | 5 | |
| | | 5:00 | 11.5 | 0 | 2.5 | 6.8 | |
| | | 6:00 | 10.3 | 0 | 1.4 | 4 | |
| | | 7:00 | 10.3 | 0 | 2.2 | 6.5 | |
| | | 8:00 | 11 | 0 | 2.9 | 9.4 | |
| | | 9:00 | 14.8 | 0 | 6.8 | 14.8 | |
| Night 6 | 14/03/2022 | 18:00 | 23.6 | 0 | 16.6 | 26.6 | Valid survey night |
| | | 19:00 | 21.2 | 0 | 14.4 | 26.6 | |
| | | 20:00 | 19.8 | 0 | 9 | 17.3 | |
| | | 21:00 | 18.3 | 0 | 5.8 | 15.1 | |
| | | 22:00 | 17.6 | 0 | 4.7 | 11.9 | |
| | | 23:00 | 16.8 | 0 | 5 | 11.2 | |
| | | 0:00 | 16 | 0 | 4.7 | 9.7 | |
| | 15/03/2022 | 1:00 | 15.5 | 0 | 5.8 | 10.1 | |
| | | 2:00 | 14.7 | 0 | 4 | 7.9 | |
| | | 3:00 | 13.8 | 0 | 5 | 7.9 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 4:00 | 13.6 | 0 | 5.8 | 9.4 | |
| | | 5:00 | 12.9 | 0 | 4.7 | 9.4 | |
| | | 6:00 | 12.4 | 0 | 4.7 | 8.6 | |
| | | 7:00 | 12.2 | 0 | 6.1 | 10.1 | |
| | | 8:00 | 12.9 | 0 | 6.8 | 11.5 | |
| | | 9:00 | 15.9 | 0 | 7.6 | 13 | |
| Night 7 | 15/03/2022 | 18:00 | 23.9 | 0 | 7.6 | 24.8 | Valid survey night |
| | | 19:00 | 21.8 | 0 | 9.4 | 23.8 | |
| | | 20:00 | 20.4 | 0 | 8.6 | 22.7 | |
| | | 21:00 | 19 | 0 | 9.7 | 27.7 | |
| | | 22:00 | 18 | 0 | 11.9 | 27.7 | |
| | | 23:00 | 16.8 | 0 | 12.2 | 34.6 | |
| | | 0:00 | 16.7 | 0 | 10.4 | 31 | |
| | 16/03/2022 | 1:00 | 16 | 0 | 8.3 | 22.3 | |
| | | 2:00 | 15.1 | 0 | 4.7 | 14.4 | |
| | | 3:00 | 15 | 0 | 6.8 | 20.5 | |
| | | 4:00 | 14.7 | 0 | 5.4 | 19.8 | |
| | | 5:00 | 14.4 | 0 | 5.8 | 18.7 | |
| | | 6:00 | 14.1 | 0 | 5 | 15.8 | |
| | | 7:00 | 13.2 | 0 | 2.9 | 10.1 | |
| | | 8:00 | 13.9 | 0 | 4.3 | 16.6 | |
| | | 9:00 | 16.7 | 0 | 8.6 | 23.8 | |
| Night 8 | 16/03/2022 | 18:00 | 20.7 | 0 | 11.2 | 28.8 | Valid survey night |
| | | 19:00 | 19.3 | 0 | 10.8 | 29.2 | |
| | | 20:00 | 17.7 | 0 | 7.6 | 22 | |
| | | 21:00 | 17 | 0 | 8.3 | 23 | |
| | | 22:00 | 16.3 | 0 | 7.9 | 23.4 | |
| | | 23:00 | 15.8 | 0 | 6.8 | 18.7 | |
| | | 0:00 | 14.6 | 0 | 4 | 11.5 | |
| | 17/03/2022 | 1:00 | 12.6 | 0 | 4.3 | 9.7 | |
| | | 2:00 | 12.4 | 0 | 3.6 | 10.8 | |
| | | 3:00 | 11.3 | 0 | 2.2 | 7.6 | |
| | | 4:00 | 10.7 | 0 | 3.2 | 8.3 | |
| | | 5:00 | 10.6 | 0 | 4 | 8.6 | |
| | | 6:00 | 9.9 | 0 | 2.5 | 8.3 | |
| | | 7:00 | 9.6 | 0 | 1.8 | 6.5 | |
| | | 8:00 | 10.7 | 0 | 4.7 | 10.8 | |
| | | 9:00 | 13.9 | 0 | 6.1 | 15.1 | |
| Night 9 | 17/03/2022 | 18:00 | 21.4 | 0 | 4 | 10.8 | Non-valid survey night: 1 night prior to full moon |
| | | 19:00 | 19.1 | 0 | 3.6 | 11.2 | |
| | | 20:00 | 15.8 | 0 | 4.3 | 13 | |
| | | 21:00 | 16.1 | 0 | 5 | 12.2 | |
| | | 22:00 | 15.8 | 0 | 4.3 | 10.1 | |
| | | 23:00 | 15.7 | 0 | 5.4 | 13 | |
| | | 0:00 | 14.9 | 0 | 6.1 | 17.6 | |
| | 18/03/2022 | 1:00 | 14.2 | 0 | 5.8 | 13.3 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2:00 | 13.7 | 0 | 5.4 | 12.2 | |
| | | 3:00 | 13.7 | 0 | 5.4 | 14.4 | |
| | | 4:00 | 13 | 0 | 3.6 | 10.8 | |
| | | 5:00 | 12.6 | 0 | 4.3 | 10.8 | |
| | | 6:00 | 12 | 0 | 3.6 | 7.9 | |
| | | 7:00 | 11.6 | 0 | 4 | 13 | |
| | | 8:00 | 11.9 | 0 | 4.3 | 13.7 | |
| | | 9:00 | 14.6 | 0 | 5.4 | 13 | |
| Night 10 | 18/03/2022 | 18:00 | 20.2 | 0 | 14.4 | 25.2 | Non-valid survey night: Full moon night |
| | | 19:00 | 18.7 | 0 | 10.4 | 19.4 | |
| | | 20:00 | 16.3 | 0 | 4.7 | 12.2 | |
| | | 21:00 | 15.3 | 0 | 2.9 | 5.4 | |
| | | 22:00 | 15.6 | 0 | 3.6 | 7.2 | |
| | | 23:00 | 15.6 | 0 | 6.5 | 13 | |
| | | 0:00 | 15.6 | 0 | 7.9 | 14.8 | |
| | 19/03/2022 | 1:00 | 14.4 | 0 | 4.7 | 13.3 | |
| | | 2:00 | 11.8 | 0 | 2.9 | 6.8 | |
| | | 3:00 | 11 | 0 | 2.5 | 5.8 | |
| | | 4:00 | 10.6 | 0 | 1.4 | 4.7 | |
| | | 5:00 | 9.4 | 0 | 2.9 | 7.6 | |
| | | 6:00 | 9.3 | 0 | 1.4 | 5 | |
| | | 7:00 | 10.3 | 0 | 2.5 | 6.1 | |
| | | 8:00 | 11.4 | 0 | 4.7 | 7.9 | |
| | | 9:00 | 13 | 0 | 3.2 | 8.6 | |
| Night 11 | 19/03/2022 | 18:00 | 19.9 | 0 | 14 | 28.1 | Non-valid survey night: 1 night post full moon |
| | | 19:00 | 18.1 | 0 | 9.4 | 22 | |
| | | 20:00 | 16.8 | 0 | 8.3 | 15.1 | |
| | | 21:00 | 16.2 | 0 | 7.9 | 15.8 | |
| | | 22:00 | 16 | 0 | 7.9 | 14.4 | |
| | | 23:00 | 15.7 | 0 | 6.5 | 15.1 | |
| | | 0:00 | 15 | 0 | 5 | 11.5 | |
| | 20/03/2022 | 1:00 | 13.7 | 0 | 2.9 | 8.6 | |
| | | 2:00 | 13.6 | 0 | 3.2 | 9 | |
| | | 3:00 | 14.4 | 0 | 5.4 | 18 | |
| | | 4:00 | 16.6 | 0 | 12.2 | 27.4 | |
| | | 5:00 | 15.8 | 0 | 6.1 | 14.4 | |
| | | 6:00 | 15.1 | 0 | 4.7 | 10.8 | |
| | | 7:00 | 14.8 | 0 | 4 | 11.2 | |
| | | 8:00 | 15.2 | 0 | 4 | 13 | |
| | | 9:00 | 17.5 | 0 | 9.4 | 25.2 | |
| Night 12 | 20/03/2022 | 18:00 | 19.3 | 0 | 14.8 | 29.2 | Valid survey night |
| | | 19:00 | 18.8 | 0 | 14.8 | 30.2 | |
| | | 20:00 | 18.4 | 0 | 16.9 | 33.8 | |
| | | 21:00 | 18.6 | 0 | 17.3 | 39.6 | |
| | | 22:00 | 18.8 | 0 | 18.7 | 37.4 | |
| | | 23:00 | 19 | 0 | 19.1 | 41 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 0:00 | 19.2 | 0 | 18.4 | 41 | |
| | 21/03/2022 | 1:00 | 19.3 | 0 | 19.1 | 39.2 | |
| | | 2:00 | 18.8 | 0 | 16.9 | 36 | |
| | | 3:00 | 18.5 | 0.1 | 19.4 | 46.1 | |
| | | 4:00 | 16.8 | 2.3 | 14.4 | 32 | |
| | | 5:00 | 16.3 | 2.1 | 10.8 | 34.2 | |
| | | 6:00 | 16.6 | 0.2 | 14 | 29.5 | |
| | | 7:00 | 16.8 | 0.5 | 14.8 | 31 | |
| | | 8:00 | 17.1 | 2.6 | 15.8 | 32.8 | |
| | | 9:00 | 17.4 | 6.2 | 10.4 | 27.4 | |
| Night 13 | 21/03/2022 | 18:00 | 21.9 | 0 | 5.8 | 11.5 | Valid survey night |
| | | 19:00 | 20.5 | 0 | 5 | 9.7 | |
| | | 20:00 | 20 | 0 | 4.3 | 11.5 | |
| | | 21:00 | 19.1 | 0 | 5 | 11.5 | |
| | | 22:00 | 19.1 | 0 | 5.8 | 13.3 | |
| | | 23:00 | 18.5 | 0 | 6.8 | 14.8 | |
| | | 0:00 | 17.5 | 0 | 2.5 | 7.9 | |
| | 22/03/2022 | 1:00 | 17.1 | 0 | 3.6 | 9.4 | |
| | | 2:00 | 17.3 | 0 | 5 | 9.7 | |
| | | 3:00 | 16.3 | 0 | 2.9 | 7.2 | |
| | | 4:00 | 15.8 | 0 | 3.2 | 8.3 | |
| | | 5:00 | 14.8 | 0 | 1.8 | 7.6 | |
| | | 6:00 | 14.3 | 0 | 1.4 | 3.6 | |
| | | 7:00 | 14.3 | 0 | 2.2 | 5 | |
| | | 8:00 | 15.5 | 0 | 1.8 | 5 | |
| | | 9:00 | 18.2 | 0 | 6.5 | 19.4 | |
| Night 14 | 22/03/2022 | 18:00 | 22.8 | 0 | 15.8 | 28.8 | Valid survey night |
| | | 19:00 | 20.8 | 0 | 7.6 | 19.4 | |
| | | 20:00 | 20.1 | 0 | 8.3 | 16.2 | |
| | | 21:00 | 19.2 | 0 | 5.4 | 12.2 | |
| | | 22:00 | 19.1 | 0 | 5.4 | 9.4 | |
| | | 23:00 | 19 | 0 | 6.5 | 13.7 | |
| | | 0:00 | 18.9 | 0 | 5.8 | 13.3 | |
| | 23/03/2022 | 1:00 | 18.2 | 0 | 4.7 | 10.8 | |
| | | 2:00 | 17.8 | 0 | 1.8 | 6.8 | |
| | | 3:00 | 17.9 | 0 | 4.7 | 10.1 | |
| | | 4:00 | 17.9 | 0 | 3.2 | 9 | |
| | | 5:00 | 17.1 | 0 | 3.2 | 7.2 | |
| | | 6:00 | 17.2 | 0 | 4.7 | 8.6 | |
| | | 7:00 | 17.8 | 0 | 4.7 | 9.4 | |
| | | 8:00 | 18.1 | 0 | 3.2 | 6.1 | |
| | | 9:00 | 18.5 | 0 | 4.7 | 10.1 | |
| Night 15 | 23/03/2022 | 18:00 | 19.6 | 0 | 5.4 | 12.2 | Valid survey night |
| | | 19:00 | 18.6 | 0 | 5 | 10.4 | |
| | | 20:00 | 18.3 | 0 | 4.3 | 9 | |
| | | 21:00 | 18 | 0 | 4 | 8.3 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 22:00 | 17.8 | 0 | 4.3 | 7.9 | |
| | | 23:00 | 16.8 | 0 | 4 | 7.6 | |
| | | 0:00 | 16.8 | 0 | 3.6 | 5.8 | |
| | 24/03/2022 | 1:00 | 16.9 | 0 | 5.4 | 11.5 | |
| | | 2:00 | 16.7 | 0 | 5.4 | 11.5 | |
| | | 3:00 | 16.6 | 0 | 6.1 | 16.6 | |
| | | 4:00 | 16.7 | 0 | 7.6 | 13 | |
| | | 5:00 | 17.1 | 0 | 8.3 | 17.3 | |
| | | 6:00 | 17.8 | 0 | 9.4 | 18 | |
| | | 7:00 | 17.9 | 0 | 9.7 | 20.2 | |
| | | 8:00 | 18 | 0.4 | 12.2 | 23 | |
| | | 9:00 | 18 | 1 | 14 | 29.2 | |
| Night 16 | 24/03/2022 | 18:00 | 20.7 | 0 | 24.8 | 42.5 | Valid survey night |
| | | 19:00 | 20.2 | 0 | 19.1 | 36 | |
| | | 20:00 | 19.7 | 0 | 14.8 | 34.6 | |
| | | 21:00 | 19.6 | 0 | 13.7 | 28.8 | |
| | | 22:00 | 19.6 | 0 | 16.6 | 29.2 | |
| | | 23:00 | 19.3 | 0 | 14.4 | 29.2 | |
| | | 0:00 | 19.3 | 0 | 15.5 | 29.2 | |
| | 25/03/2022 | 1:00 | 19.2 | 0 | 15.5 | 28.8 | |
| | | 2:00 | 19.2 | 0 | 15.8 | 29.2 | |
| | | 3:00 | 19.5 | 0 | 15.1 | 29.5 | |
| | | 4:00 | 19.2 | 0 | 17.3 | 33.1 | |
| | | 5:00 | 19.2 | 0 | 17.3 | 39.6 | |
| | | 6:00 | 19 | 0 | 15.1 | 28.4 | |
| | | 7:00 | 18.5 | 0 | 12.6 | 30.2 | |
| | | 8:00 | 18.4 | 0 | 12.6 | 23 | |
| | | 9:00 | 18.3 | 0 | 18.4 | 37.4 | |
| Night 17 | 25/03/2022 | 18:00 | 20.2 | 0 | 15.5 | 32.4 | Valid survey night |
| | | 19:00 | 18.2 | 0 | 11.5 | 24.5 | |
| | | 20:00 | 17 | 0 | 12.6 | 27 | |
| | | 21:00 | 16.2 | 0 | 14.8 | 33.5 | |
| | | 22:00 | 15.7 | 0 | 15.1 | 30.6 | |
| | | 23:00 | 15.3 | 0 | 13 | 27.4 | |
| | | 0:00 | 15.4 | 0 | 13.3 | 31 | |
| | 26/03/2022 | 1:00 | 15 | 0 | 11.2 | 27.7 | |
| | | 2:00 | 14.7 | 0 | 10.4 | 28.4 | |
| | | 3:00 | 14.6 | 0 | 12.2 | 23.8 | |
| | | 4:00 | 14.2 | 0 | 9 | 22 | |
| | | 5:00 | 14.3 | 0 | 10.1 | 25.9 | |
| | | 6:00 | 13.9 | 0 | 8.6 | 18 | |
| | | 7:00 | 13.5 | 0 | 8.3 | 24.5 | |
| | | 8:00 | 13.8 | 0 | 11.9 | 29.5 | |
| | | 9:00 | 15.2 | 0 | 16.9 | 33.8 | |
| Night 18 | 26/03/2022 | 18:00 | 20.8 | 0 | 10.8 | 23.4 | Valid survey night |
| | | 19:00 | 19 | 0 | 7.9 | 15.8 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 20:00 | 18.1 | 0 | 7.6 | 17.3 | |
| | | 21:00 | 17.2 | 0 | 8.6 | 19.8 | |
| | | 22:00 | 15.9 | 0 | 7.9 | 18 | |
| | | 23:00 | 14.6 | 0 | 5.4 | 14 | |
| | | 0:00 | 13.3 | 0 | 4.7 | 10.1 | |
| | 27/03/2022 | 1:00 | 12.4 | 0 | 3.2 | 7.6 | |
| | | 2:00 | 12 | 0 | 2.9 | 10.1 | |
| | | 3:00 | 13.5 | 0 | 5 | 11.5 | |
| | | 4:00 | 12.9 | 0 | 4.3 | 11.9 | |
| | | 5:00 | 10.9 | 0 | 2.9 | 7.2 | |
| | | 6:00 | 10.9 | 0 | 2.2 | 6.8 | |
| | | 7:00 | 10.5 | 0 | 1.4 | 4.7 | |
| | | 8:00 | 11.5 | 0 | 2.5 | 6.5 | |
| | | 9:00 | 13.2 | 0 | 2.9 | 14.4 | |
| Night 19 | 27/03/2022 | 18:00 | 21.4 | 0 | 7.9 | 18.4 | Valid survey night |
| | | 19:00 | 18.7 | 0 | 6.1 | 15.1 | |
| | | 20:00 | 17.3 | 0 | 5.8 | 20.2 | |
| | | 21:00 | 16.5 | 0 | 4.7 | 22 | |
| | | 22:00 | 15.1 | 0 | 3.6 | 15.1 | |
| | | 23:00 | 12.6 | 0 | 1.4 | 4.3 | |
| | | 0:00 | 10.1 | 0 | 1.1 | 7.6 | |
| | 28/03/2022 | 1:00 | 10 | 0 | 2.2 | 6.5 | |
| | | 2:00 | 9.1 | 0 | 1.8 | 4.7 | |
| | | 3:00 | 8.6 | 0 | 1.4 | 4.3 | |
| | | 4:00 | 8 | 0 | 2.2 | 8.6 | |
| | | 5:00 | 8 | 0 | 2.5 | 7.9 | |
| | | 6:00 | 8.3 | 0 | 2.2 | 7.9 | |
| | | 7:00 | 8.2 | 0 | 2.5 | 7.9 | |
| | | 8:00 | 8.6 | 0 | 2.9 | 9.4 | |
| | | 9:00 | 10.3 | 0 | 3.6 | 9.7 | |

# Appendix 6: Bat ABM & habitat maps

Appendix 6a: Bat ABM survey map

Appendix 6b: Bat roost habitat map


Boffa Miskell

www.boffamiskell.co.nz



0 100 m

1:4,000 @ A3

*Note:* Based on 2019 aerial imagery

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

*Projection:* NZGD 2000 New Zealand Transverse Mercator

LEGEND

Stage 01 - Tuumata Block

**Survey Period 9 - 28 March 2022**

Mean number of bat passes per night

- 0
- 0.01 - 0.09
- 0.10 - 0.19
- 0.20 - 0.29

**RUAKURA TUUMATA REZONING PRIVATE PLAN CHANGE**

# Bat Results - Mean Passes

**Date: 04 November 2022 | Revision: 0**

Plan prepared by Boffa Miskell Limited

Project Manager: Dave.Moule@boffamiskell.co.nz | Drawn: JWa | Checked: TUI


Boffa Miskell

www.boffamiskell.co.nz



0 100 m

1:4,000 @ A3

*Note:* Based on 2019 aerial imagery

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

*Projection:* NZGD 2000 New Zealand Transverse Mercator

LEGEND

**Survey Period 9 - 28 March 2022**
Total number of bat passes

0
1
3
4

Stage 01 - Tuumata Block

**RUAKURA TUUMATA REZONING PRIVATE PLAN CHANGE**

# Bat Results - Total Passes

**Date: 04 November 2022 | Revision: 0**

Plan prepared by Boffa Miskell Limited

Project Manager: Dave.Moule@boffamiskell.co.nz | Drawn: JWa | Checked: TUI

File Ref: BM211065.mxd


Boffa Miskell

www.boffamiskell.co.nz



0 100 m

1:4,000 @ A3

*Note:* Based on 2019 aerial imagery

*Data Sources:* BML, 2019 Imagery: Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors., Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

*Projection:* NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Site Boundary

Bat Roost Habitat Potential

- Low
- Medium
- High
- Not Accessible

**RUAKURA TUUMATA REZONING PRIVATE PLAN CHANGE**

# Bat Roost Habitat

**Date: 04 November 2022 | Revision: 0**

Plan prepared by Boffa Miskell Limited

Project Manager: Dave.Moule@boffamiskell.co.nz | Drawn: HHu | Checked: GMa

# Appendix 7: Herpetofauna habitat map

File Ref: BM211065.mxd


Boffa Miskell

www.boffamiskell.co.nz



0 100 m

1:4,000 @ A3

*Note:* Based on 2019 aerial imagery

*Data Sources:* BML, 2019 Imagery: Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors., Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

*Projection:* NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Site Boundary

Lizard Habitat Value

- Low
- Medium
- Medium - High

**RUAKURA TUUMATA REZONING PRIVATE PLAN CHANGE**

# Lizard Habitat

**Date: 04 November 2022 | Revision: 0**

Plan prepared by Boffa Miskell Limited

Project Manager: Dave.Moule@boffamiskell.co.nz | Drawn: HHu | Checked: GMa

# Appendix 8: Watercourse & sample location map

| Site | Description |
|---|---|
| **BML Water and Sediment Quality Sampling Sites** | |
| 1A | Ruakura Rd drain (Sediment) |
| 1B | Ruakura Rd drain (Water) |
| 2 | Tramway Rd drain |
| 3 | Reeves Close drain |
| 4 | Kirikiriroa Stream tributary at Wairere Dr |
| 5 | Greenhill Rd drain downstream |
| 6 | Percival Rd drain upstream |
| 7 | Mangaonua Stream tributary at Silverdale Rd |
| 8 | Brinkworth Drain |
| **BML Fish and Macroinvertebrate Sampling Sites** | |
| 1A | Mangaonua Stream tributary West |
| 1B | Mangaonua Stream tributary West |
| 2 | Mangaonua Stream tributary East |
| 3 | Railway drain at Ryburn Rd |
| 4 | Mangaonua Stream tributary at Nevada Rd |
| 5 | Percival Rd drain downstream |
| 6 | Reeves Close drain |
| 7 | Greenhill Rd drain upstream |
| 8 | Kirikiriroa Stream tributary at Wairere Dr |
| 9 | Tramway Rd drain |
| **WRC Water Quality Sampling Sites** | |
| 1 | Mangaonua Stream at Hoeka Road |
| 2 | Kirikiriroa Stream at Tauhara Drive |

Boffa Miskell
www.boffamiskell.co.nz



0 1 km
1:35,000 @ A3

*Data Sources: Aerial photography sourced from LINZ. Freshwater Fish Database information sourced from NIWA.*
*Projection: NZGD 2000 New Zealand Transverse Mercator*

Legend
Sampling Sites
- Water & Sediment Quality (Boffa Miskell)
- Fish & Macroinvertebrate (Boffa Miskell)
- Water Quality (WRC)

**RUAKURA STRUCTURE PLAN AREA**

# Sampling Locations

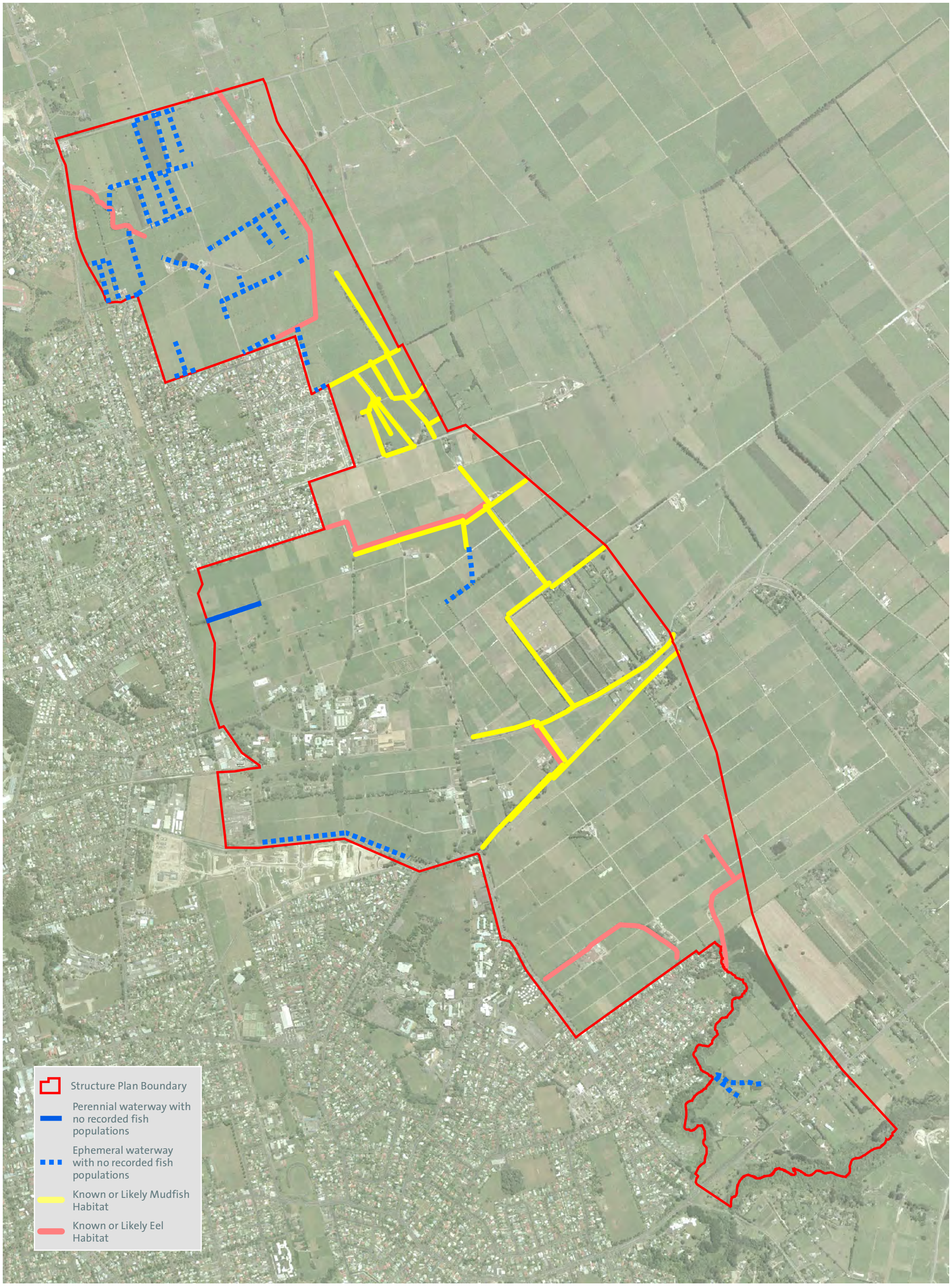
**Date: 4 June 2013 | Revision: A**

Plan Prepared by Boffa Miskell Limited
*Author:* john.watt@boffamiskell.co.nz | *Checked:* Louise Clark

**Figure 6**

# Appendix 9: Ruakura Mudfish & Eel Distribution Map

File Ref: A08274_FishSurveyData_Fig4_Eel&MudfishDistribution.mxd






Boffa Miskell
www.boffamiskell.co.nz

0 500 m
1:18,000 @ A3

*Data Sources: LINZ*

*Projection: NZGD 2000 New Zealand Transverse Mercator*

**Ruakura Plan Change Area**

# Likely Mudfish & Eel Distribution

**Date: 11 February 2014 | Revision: A**

Plan Prepared by Boffa Miskell Limited

*Author:* john.watt@boffamiskell.co.nz | *Checked:* LCl

**Figure 4**

# Appendix 10: Ruakura south tree fell protocol

# Ruakura Structure Plan Area

Tree Removal Protocols for Ruakura South
Prepared for Ruakura Limited

14 January 2020

## Document Quality Assurance

| | | |
|---|---|---|
| **Bibliographic reference for citation:**<br>Boffa Miskell Limited 2020. *Ruakura Structure Plan Area: Tree Removal Protocols for Ruakura South*. Report prepared by Boffa Miskell Limited for Ruakura Limited. | | |
| Original prepared in April 2018 by: | Georgia Cummings<br>Ecologist<br>Boffa Miskell Limited |  |
| Reviewed and updated on 14 January 2020 to align with DOC 2019 Bat Tree Protocols by: | Andrew Blayney<br>Ecologist – Associate Principal.<br>Boffa Miskell Limited |  |
| Status: DRAFT | Revision / version: 2.0 | Issue date: 14 January 2020 |



Template revision: 20170727 0000

File ref: H17030F_Tree_Removal_Protocol_Final_v2.docx

*Cover photograph: Stand of mature Eucalyptus trees containing potential bat roost features such as cavities, hollow branches and loose bark, © G. Cummings, 2018.*

# CONTENTS



# Appendices

# 1.0 Introduction

This protocol applies to all potential bat roost trees as identified in the Bat Roost Assessment (Boffa Miskell Ltd., 2018) to be felled as part of the Ruakura Structure Plan Area LDPAs A, C, and N and any bat roost trees further identified in further stages of the development of Tainui Group Holdings owned property in the Ruakura Structure Plan Area (henceforth referred to as 'the project area'; Map 1).

The protocol aims to:

1. Provide clear, concise procedures that are to be followed prior to removal of all potential bat roost trees, with the goal of avoiding mortality or injury to long-tailed bats during the tree removal process; and
2. To locate long-tailed bat colonial (and where possible, solitary) roost trees that exist within the project area prior to removal.

The identification of potential bat roost trees across the Ruakura Structure Plan Area LDPAs A, C, and N has been undertaken and can be referred to in Appendix 1.

## 1.1 Wildlife Act Authority

The long-tailed bat is 'absolutely protected' under the Wildlife Act (1953, s63 (1) (c)) Department of Conservation (DOC). As bats have been confirmed using the site and potential bat roosts have been identified across the project area, a Wildlife Act Authority (WAA) to potentially disturb long-tailed bats as part of construction works is required for this project. The WAA will need to be granted prior to these protocols being implemented, WAA permits can take a significant amount of time to process and should be applied for at the earliest opportunity to prevent delays.

## 1.2 Dawn and dusk definition

Dawn and dusk are defined as starting and ending 0.5 hours either side of the closest sunrise and sunset times provided by LINZ[1].

## 1.3 Bat Ecologist definition

Only personnel certified as competent Bat Ecologists at levels A, B, C2 and D (see Table 1) can operate under this Plan.

Competency can be certified by the Leader of the Department of Conservation Bat Recovery Group (Colin O'Donnell) or any other Class E Bat Ecologist.

[1] See https://www.linz.govt.nz/sea/nautical-information/astronomical-information

*Table 1: Bat Competency Classes supplied by DOC in July 2017.*

| Class | Key field activity | Competency | Individual Experience/Knowledge |
|---|---|---|---|
| **A** | ABMS | Setting up Automatic Bat Detector Monitoring Systems (ABMS). | Recent previous experience in installing ABMS in at least 2 comprehensive surveys. |
| **B** | Analysing ABMS | Setting up ABMS, and analysing and interpreting results. | Recent previous experience at analysing and interpreting ABMS results in at least 2 comprehensive surveys. |
| C1 | Identifying bat roosts (short-tailed bats) | Finding and identifying short-tailed bat roosts that are either occupied or unoccupied. This competency may also include arborists. | Recent extensive experience in searching for and finding active and inactive roosts (by radio tracking, exit observations, and/or visual inspections). |
| **C2** | C2 Identifying bat roosts (long-tailed bats) | Finding and identifying long-tailed bat roosts that are either occupied or unoccupied. This competency may also include arborists. | Recent extensive experience in searching for and finding active and inactive roosts (by radio tracking, exit observations, and/or visual inspections). |
| **D** | Handling bats | Handling bats (in one or more field methods), as outlined in Department of Conservation's (DOC) best practice manual (DOC, 2012). (Pages 58-108 of the Department of Conservation Best Practice Manual of Conservation Techniques for Bats Version 1.0 (Sedgeley et al. 2012 - http://www.doc.govt.nz/Documents/scienceand-technical/inventory-monitoring/imtoolbox-bats/im-toolbox-bats-doc-bestpractice-manual-of-conservationtechniques-for-bats.pdf). | Has undertaken field training from a competent trainer demonstrating the required technique to the trainer's satisfaction and meets DOC's best practice manual standards (DOC, 2012) to carry out one or more of the following specialised field methods:<br>Extracting bats from mist nets;<br>Use of harp traps at roost sites;<br>Handling bats;<br>Marking bats (e.g. forearm band, temporary marks);<br>Wing biopsies for genetic sampling;<br>Attaching transmitters;<br>Inserting transponder tags; and<br>Release techniques. |
| E | Trainer for Class X | Competent at the relevant class plus capable of training staff. | Has a high level of knowledge and experience regarding the competency they are training people in. |

Only personnel certified at the appropriate level may undertake tasks in the tree felling protocol. Thus, ecologists certified as competent in classes A and B can deploy ABMs and subsequently analyse the data, but a Bat Ecologist certified as competent in Class C2 is required to undertake tree roost inspections and make decisions about whether a potential roost is deemed occupied or unoccupied by bats. Further to this, the Bat Ecologist must be certified as Class D to supervise tree felling in the event that bats may need to be handled.

In the case of felling a bat roost accidently, whereby bats are injured or dislodged and capable of being caught, and if a Class D Bat Ecologist is not available to handle the bat, the attending

personnel must carefully place the bat or bats in cloth capture bags following guidance in the DOC Best Practice Manual (pages 154-155) and take them to the authorised veterinarian described in Protocol B.

# 2.0 Tree removal protocols

## 2.1 Are bats at risk?

All areas of the Ruakura Structure Plan area – South are to be considered within a 'bat zone' i.e. there is a risk of bat roosting in any suitable tree.

### 2.1.1 Identifying potential bat roost trees

| Assessment method | Who can make this assessment | Timing | Outcome |
|---|---|---|---|
| For the purposes of this protocol, trees offering potential bat roost habitat are defined as being ≥15 cm diameter at breast height (DBH), and have one or more of the following features:<br>• Cracks, crevices, knot holes, cavities and/or fractured limbs large enough to support roosting bat(s);<br>• Sections of loose flaking bark large enough to support roosting bat(s);<br>• A hollow trunk, stem or branches;<br>• Deadwood in canopy or stem of sufficient size to support roost cavities or hollows;<br>• Epiphytes that may provide roosting bats; or<br>• Bat droppings, grease marks and/or urine staining around cavities.<br>Refer to Appendix 1 for a description of all trees classified as potential roost trees within the survey boundary on Map 1.<br><br>Areas that have not been surveyed will require pre-felling surveys to identify potential bat roosts. Methods for these surveys should follow those outlined in Appendix 1. | Measuring DBH can be carried out by anyone capable of measuring a tree DBH. Roosting tree features must be assessed by an approved bat ecologist. | This assess-ment can be done at any time. | Trees which are not ≥15 cm DBH can be felled at any time.<br><br>Trees which are ≥15 cm DBH but do not have any of the features indicative of roost potential may be felled at any time under the supervision of an approved bat expert who can identify if a potential bat roost becomes apparent during the removal process that was not previously observed. In this case, felling must stop until the tree has been further assessed.<br><br>Trees which are ≥15 cm DBH and have features indicative of roost potential must be further assessed following either of the assessments outlined below (or a suitable combination of detailed methods) in sections 2.2.1 & 2.2.2. |

## 2.2 Do bats roost in the tree?

There are two ways in which a tree can be assessed for bat roosting activity:

Climbing the tree and inspecting features - this is usually most suitable when there are a small number of trees that are safe to climb and can be visually inspected – Detailed in section 2.2.1.

Using ABMs (Automatic Bat Monitoring devices) to check if bats are present close to the time of tree removal - Detailed in section 2.2.2.

### 2.2.1 Inspection of roost features by climbing

Note: Care must be taken while climbing trees to avoid disturbing, removing or destroying tree features with bat roost potential such as large sections of loose bark or cavities in dead wood.

| Assessment method | Who can make this assessment | Timing | Outcome |
|---|---|---|---|
| a) Do possible roost features observed from the ground still show potential on closer inspection when the tree is climbed? For example:<br>• Cracks, holes and splits may lead to cavities or may be superficial.<br>• A cavity may be wet indicating no potential.<br>• Cobwebs may be across a cavity indicating it is not used.<br>• Other incompatible animals may be occupying the cavity (e.g. rats). | An approved bat expert or an experienced tree- climber (e.g. an arborist) working with an approved bat expert. If the latter, the tree-climber provides information along with photographs or video footage, which the bat expert assesses. | Any time | **If no:** the tree can be removed.<br><br>**If yes:** further assessment must be done 2.2.1 b) or 2.2.2. |
| b) Are potential features being used by roosting bats?<br>• Can bats be seen?<br>• Can bats be heard - either audible squeaking or using a hand-held bat detector listening at 25 kHz (for social calls) and 40 kHz | | Between October 1st and April 30th only. | **If no:** the tree can be removed on the day of the tree inspection following the method in section 2.3.<br><br>**If yes:** the following communication procedures shall be implemented:<br><br>• if bats are sighted or sign detected, the approved bat expert, as soon as possible, shall:<br>i. Call the tree felling |

| | | | |
|---|---|---|---|
| (for echolocation calls)?<br>• Is guano present or urine staining? | | | supervisor to inform him/her which affected tree(s) cannot be felled due to detection of bat sign.<br>ii. Send an email to the site manager, and a bat expert representing the council and DOC detailing the results of the survey and outlining the measures for protection or relocating the roost tree. Measures for the immediate protection of the tree/s should follow that detailed in section 2.2.3.<br>• A record (including photos) of any vegetation containing bat roosts shall be kept detailing the size, location and type of tree. |

### 2.2.2 Survey of bat activity

Note: Prior to the commencement of surveys, ABMs must be checked for correct operation at a site where bat activity is known to be high. Faulty or suspect ABMs must not be deployed.

| Assessment method | Who can make this assessment | Timing | Outcome |
|---|---|---|---|
| Is bat activity recorded at any time during two consecutive, valid survey nights proceeding tree felling?<br>Bat activity can be recorded using ABMs or trained observers with handheld detectors. Location of ABMs or observers must provide sufficient coverage to be able to determine if bat roosts are present in one or more of the trees.<br>'Valid' survey nights must meet the following criteria:<br>• Begin one hour before official sunset and end one hour after official sunrise.<br>• Temperature between 10 and 17°C.<br>• Relative humidity > 70 %.<br>• Precipitation < 2.5mm in the first 2 hours after dusk.<br>• Not during a full moon, or 1 night either side of full moon.<br>• Mean overnight wind speed does not exceed 20 km/h.<br>• Maximum overnight wind gust does not exceed 60 km/h. | Only under supervision of an approved bat expert. | Between October 1st and April 30th only. | **If no:** the tree can be removed on the day of the tree inspection following the method in section 2.3.<br>**If yes:** roost features of each tree must be visually assessed via climbing as outlined in section 2.2.1, or, survey must continue until no bat activity is recorded for two consecutive nights prior to felling following the method in section 2.3. |

### 2.2.3 Protection and protocols for trees confirmed to have roosting bat/s present:

If bats are confirmed to be roosting within a tree, it will not be removed until further monitoring (to minimise further disturbance to roosting bats) confirms that the bat(s) have abandoned the roost. The following actions will be taken:

a) The immediate area will be cordoned off with safety fencing and signage erected in a 10 m radius around the roost, alerting any person approaching the area that a bat roost is present and to stay clear.

b) The existence of the roost will be widely publicised to all works staff and work instructions for the immediate area will be updated to reflect the presence of the roost and the measures to minimise disturbance.

c) No work will take place within 100 m of the roost from one hour before dusk to 1 hour after dawn.

Roost trees will be clearly marked and all relevant staff briefed to ensure the tree is not removed. The Grantor shall be informed by email with relevant information, such as photos, provided. Monitoring using thermal imaging will continue until the roost is no longer occupied by bats. The thermal imaging monitoring will be confirmed by visual inspection (as per section 2.2.1) immediately prior to felling.

## 2.3 Tree removal

### 2.3.1 Does the tree have to be removed?

| Assessment method | Who can make this assessment | Timing | Outcome |
|---|---|---|---|
| a) Is the tree known to provide a roost location for bats or has potential to do this? | Only under supervision of an approved bat expert. | Between October 1st and April 30th only. | **If no:** remove as in 2.3.1 b)<br><br>**If yes:** consider whether any changes can be made to maintain the tree, or consider carefully relocating the tree, or part of the tree, when bats are not present (not detected for two valid survey nights prior[2]), to continue to provide future roosting opportunities. This is particularly important where roosting opportunities are limited. Follow section 2.4 should bats appear during tree relocation. |
| b) Is the only option to remove the tree entirely? | | | **If no:** consider leaving or relocating the tree, revisit 2.3.1 a).<br><br>**If yes:** the tree can be removed under supervision of an approved bat expert when bats are not present (not detected for two valid survey nights prior[3]).<br>Trees must be inspected again for signs of bats once felled and before removing from the site.<br>Follow section 2.4 should bats be detected during tree removal. |

[2] See section 2.2.2 for valid survey night criteria.

[3] See section 2.2.2 for valid survey night criteria.

## 2.4 Bats encountered during tree relocation or removal

| Assessment method | Who can make this assessment | Timing | Outcome |
|---|---|---|---|
| a) Have bats been detected prior to the tree being completely felled? | Only under supervision of an approved bat expert. | Between October 1st and April 30th only. | **If no:** 6.b.<br><br>**If yes:** felling must stop, and DOC must be contacted. See 2.4 c) if bats do not fly away or are injured. |
| b) Bats have been detected once the tree has been felled. | | | All further work must stop, and DOC must be contacted.<br>Any live bats that are not immediately able to fly away must be collected and placed in cloth bat bags or cloth-lined bat boxes.<br>The felled tree must be thoroughly inspected for further bats.<br>See 2.4 c) if bats do not fly away or are injured, or 2.4 d) if they are dead. |
| c) Do any captured bats have injuries? | Approved bat expert in consultation with vet and DOC. | | **If no:** keep the bat in a secure bat bag in a safe, temperature-controlled environment and release only at a safe location close to the site of capture the following evening.<br><br>**If yes:** take the bat to a nearby vet to be examined.<br>Vets must euthanise bats whose injuries are causing suffering and are not likely to heal sufficiently to allow rehabilitation and return to the wild. The bat expert and vet must consult with DOC to consider appropriate rehabilitation options where suffering is minimal and chances of return to the wild are high.<br>Euthanised bats must be handed over to DOC. |
| d) Dead bats have been found. | Approved bat expert. | | Dead bats must be handed over to DOC. |

# 3.0 Reporting

1. A report will be completed and issued to the Grantor within two months of completion of the vegetation clearance works scheduled for LDPAs A, C, and N of the Ruakura Structure Plan Area.
2. The applicant must ensure that reporting includes:
   a) A record of any trees that contain bat roosts detailing the size, location and type of tree.
   b) Where no bats are detected within potential bat roost trees scheduled for removal then survey data will be attached in the annual monitoring report.

c) Details of any bats managed under section 2.4, the outcome of the vet's assessment and any adaptive management implemented to improve detection of bats occupying trees scheduled for removal.

# 4.0 References

Sedgeley, J., O'Donnell, C., Lyall, J., Edmonds, H., Simpson, W., Carpenter, J., … McInnes, K. (2012). *DOC best practice manual of conservation techniques for bats* (Inventory and Monitoring Toolbox: Bats No. DOCDM-131465). Wellington: Department of Conservation.

# MAP 1


Boffa Miskell
www.boffamiskell.co.nz



0 600 m
1:15,000 @ A3

*Data Sources:* Boffa Miskell, Tanui Group Holdings

*Projection:* NZGD 2000 New Zealand Transverse Mercator

Legend

- Potential Bat Roost Trees
  - Low
  - Low - Moderate
  - Moderate
  - Moderate - High
  - High
- Survey Boundary
- Ruakura Structure Plan Area - South

**RUAKURA STRUCTURE PLAN AREA**

# Bat Roost Assessment Surveyed Areas: LDPAs A, C, and N

**Date: 1 June 2018 | Revision: 0**

Plan prepared for Tanui Group Holdings by Boffa Miskell Limited

*Project Manager:* **Dave.Moule@boffamiskell.co.nz** | *Drawn:* GCu | *Checked:* ABl

# Appendix 1: Ruakura Structure Plan Area: Bat Roost Assessment Bat Roost Assessment LDPAs A, C, and N

# Ruakura Structure Plan Area

Bat Roost Assessment LDPAs A, C, and N
Prepared for Ruakura Limited
21 May 2018

## Document Quality Assurance

| | | |
|---|---|---|
| **Bibliographic reference for citation:**<br>Boffa Miskell Limited 2018. *Ruakura Structure Plan Area: Bat Roost Assessment LDPAs A, C, and N*. Report prepared by Boffa Miskell Limited for Ruakura Limited. | | |
| Prepared by: | Georgia Cummings<br>Ecologist<br>Boffa Miskell Limited |  |
| Reviewed by: | Andrew Blayney<br>Senior Ecologist<br>Boffa Miskell Limited |  |
| Status: Final | Revision / version: 1 | Issue date: 21 May 2018 |

**Use and Reliance**

This report has been prepared by Boffa Miskell Limited on the specific instructions of our Client. It is solely for our Client's use for the purpose for which it is intended in accordance with the agreed scope of work. Boffa Miskell does not accept any liability or responsibility in relation to the use of this report contrary to the above, or to any person other than the Client. Any use or reliance by a third party is at that party's own risk. Where information has been supplied by the Client or obtained from other external sources, it has been assumed that it is accurate, without independent verification, unless otherwise indicated. No liability or responsibility is accepted by Boffa Miskell Limited for any errors or omissions to the extent that they arise from inaccurate information provided by the Client or any external source.

Template revision: 20170727 0000

File ref: H17030F_Bat_Roost_Assessment_v1.docx

*Cover photograph: Stand of mature Eucalyptus trees containing potential bat roost features such as cavities, hollow branches and loose bark*, © G. Cummings, 2018.

# CONTENTS



# Appendices



# Figures

# 1.0 Introduction

There are two species of bat endemic to New Zealand, both species are 'Absolutely Protected' under the Wildlife Act (1953). A population of Long-tailed bats (Threatened – Nationally Critical, (O'Donnell et al., 2018)) occurs in the Hamilton South area, which the project site is located near.

Long-tailed bats roost in mature trees that contain cavities, hollow branches and loose bark that are large enough for them to roost in. The site contains many such trees. As bats are nocturnal and often roost deep in tree cavities, they are particularly vulnerable to injury or mortality if they are roosting in a tree during felling. To prevent injury or mortality of long-tailed bats, a bat survey and roost assessment was undertaken across the site to ascertain if bats are using the site identify potential roost habitat that will be monitored prior to vegetation clearance.

## 1.1 Report Scope

This report details the plan and results of a bat presence/absence survey undertaken across Land Development Plan Area (LDPA) A, N, and C of the Ruakura Structure Plan Area in line with conditions 20 and 21 of Land Use Resource Consent 010.2017.9210.001. This report also provides an assessment of the potential of the trees within this area to support roosting long-tailed bats. Further to the assessment, recommendations are provided to avoid injury and mortality to roosting bats during vegetation clearance.

# 2.0 Methodology

## 2.1 Acoustic Bat Survey

Bat surveys were undertaken using acoustic recorders (ARs) which passively record both long-tailed bat (40 kHz) and lesser short-tailed bat (28 kHz) echolocation calls on two concurrently operating frequency channels. They operate remotely by recording and storing each echolocation call (bat pass), along with the date and time of occurrence.

Eighteen ARs were deployed across the site targeting habitat features preferred by long-tailed bats. Features surveyed included: gully habitat, shelterbelts, groups of tall stature trees, and individual trees with bat roost potential.

Acoustic recorders were deployed on 17 – 18 April 2018 for between 14 – 15 nights. Recorders were programmed to record from one hour before sunset[1] to one hour after sunrise during the survey period. The timing of bat activity relative to sunrise/sunset was also analysed to provide an indication of bats roosting in the site.

Long-tailed bat activity is influenced by overnight temperatures and rainfall (O'Donnell, 2000). Weather data from the survey period was analysed to ensure conditions were suitable for bats to be active and therefore detectable via acoustic recordings. Suitable conditions are henceforth

[1] Sunset and sunrise times were taken from the closest available location (Tauranga) on the LINZ Sunrise/Sunset tables, see https://www.linz.govt.nz/sea/nautical-information/astronomical-information).

referred to as ‘fine weather nights’ and are defined for the purpose of this report as nights where the minimum overnight temperature was above 5°C and there was less than 5 mm of rainfall during the night. Weather data was taken from the “Ruakura 2 Ews” located approximately 1.5 km from the project site (www.cliflo.niwa.nz).

Acoustic data from fine weather nights was analysed using BatSearch version 3.12, a programme designed by the Department of Conservation for use with their ARs. The software converts the bats echolocation calls (passes) into spectrograms that are visually analysed. Each spectrogram was recorded with the date and time which was then used to analyse the timing of activity across the site.

## 2.2 Bat Roost Assessment

During AR deployment, a site walkover was undertaken and any trees more than approximately 4 m in height with a diameter at breast height (DBH) of >15 cm were visually assessed from the ground using binoculars (Bushnell Bone Collector 10x42 mm). Potential bat roost trees were recorded using GPS and photos were taken. Potential bat roost features such as cavities, hollow limbs, loose bark and epiphytes suitable for supporting a long-tailed bat(s) were described and each tree was categorised from low – high based on its potential to support roosting bats. Evidence of use by bats such as staining, scratches and guano around cavities and at the base of the tree was also noted if present.

There is no formal guidance for categorising the roost potential of trees for New Zealand bats therefore the above categories are based on the experience of the bat specialist and studies that have been undertaken on roosting behaviour and roost selection by long-tailed bats (O’Donnell & Sedgeley, 1999; Sedgeley, 2001; Sedgeley & O’Donnell, 1999, 2004). Features of potential roost trees that were considered during the categorisation of bat roost potential include:

- Type of roost features available – Studies undertaken in unmodified native forest have shown that long-tailed bats preferentially roost in knot-hole cavities with small entrance holes compared to cavities available throughout the forest. This has been linked to the more stable thermal characteristics within knot-hole cavities.
- The size (DBH) of the tree – New Zealand bats preferentially roost in the largest trees available as such trees generally have preferred thermal characteristics;
- Height of roost feature(s) – long-tailed bats generally roost high in trees, >15 m above the ground (O’Donnell & Sedgeley, 1999), potentially an adaptation to avoid predators;
- Canopy closure – Long-tailed bats are edge-specialists and are not adapted to flying in cluttered spaces. It has been demonstrated that they preferentially roost in trees with more open canopies.

It should be noted that the majority of long-tailed bat roost-selection studies are undertaken in pristine forest where roost trees are not a limiting resource compared to the highly modified landscape of peri-urban Hamilton. A comparison study undertaken with a long-tailed bat population in rural Canterbury has shown that bats utilise a wider range of roost types in response to the limited availability of preferential roost characteristics (Sedgeley & O’Donnell, 2004). Consequently, although trees have been categorised as ‘low potential’ in this plan, they could still be used by long-tailed bats, particularly as solitary roosts.

We also analysed the timing of bat passes recorded during the acoustic surveys as this can give an indication of whether bats are roosting in close vicinity to the site. During summer, long-

tailed bats emerge from roosts approximately 30 minutes after sunset (Griffiths, 2007). Consequently, if no bat passes are recorded across the site up to an hour after sunset, it is unlikely that bats are roosting, at least communally, within the site.

*Figure 1: An acoustic recorder deployed in a crack willow with a large trunk cavity.*

*Figure 2: An acoustic recorder deployed along a shelterbelt.*

# 3.0 Results

## 3.1 Bat Activity

Automatic bat monitors were deployed on 17 – 18 April 2018 for between 14 and 15 nights (example of deployment shown in Figure 1 and Figure 2). During this period, three nights had a minimum overnight temperature of less than 5°C and it rained[2] on two nights. Consequently, 11 nights of data were analysed for all of the ARs (weather data supplied in Appendix 3). A summary of the results for each AR deployed is provided in Table 1, and the survey locations are shown in Map 1.

Bats were recorded at 16 of the 18 ARs. Overall the level of activity across the site was low with an average of one pass per night being the highest activity recorded and 11 of the 18 ARs recording no more than a single pass across the 11 fine weather nights analysed. It should be noted however that the survey was undertaken late in the season[3] when night-time temperatures are low and long-tailed bats are generally less active (O'Donnell, 2000).

[2] ≥ 5 mm cumulative throughout the night.

[3] Generally considered to be between October 1st and April 30th.

Notwithstanding the above, bats were recorded across the site and were present on 64% of fine weather nights.

Activity at specific locations was relatively variable on a nightly basis, for example AR 08, which recorded the highest level of activity across the site, only recorded bats on two consecutive nights; four passes between 5:08 – 5:09 am on 30 April and a further seven passes between 5:16 – 5:18 am on 1 May.

A single bat pass was recorded within an hour of sunset[4], this was recorded at AR 01 at 6:41 pm on 27 April, the only bat pass recorded across the site that night. A further seven passes were recorded within two hours of sunset across the survey period, these varied across recorders but six of the seven passes were recorded on April 24 and 30.

Again, only a single pass was within an hour of sunrise[5] during the survey period this was recorded at AR 17 at 5:47 am on 28 April. It should be noted that all 15 passes recorded in the am across the survey period were recorded after 4:00 am, 14 of which were within two hours of sunrise.

[4] Sunset time 17:46 as at 17 April 2018 in Tauranga (the closest available location on the LINZ Sunrise/Sunset tables, see https://www.linz.govt.nz/sea/nautical-information/astronomical-information)

[5] Sunrise time 06:46 as at 17 April 2018 in Tauranga (the closest available location on the LINZ Sunrise/Sunset tables, see https://www.linz.govt.nz/sea/nautical-information/astronomical-information)

File Ref: H17030F_Bat_Results_Map.mxd


Boffa Miskell
www.boffamiskell.co.nz



0 250 m
1:7,500 @ A3

*Data Sources:* Boffa Miskell, Tanui Group Holdings

*Projection:* NZGD 2000 New Zealand Transverse Mercator

Legend
Acoustic Recorders
Mean passes per night
0
0.01 - 0.09
0.1 - 0.19
0.2 - 0.49
0.5 - 1
Survey Boundary

**RUAKURA STRUCTURE PLAN AREA**

# Map 1: Location of Acoustic Bat Recorders

**Date: 22 May 2018 | Revision: 0**

Plan prepared for Tanui Group Holdings by Boffa Miskell Limited

*Project Manager:* **Dave.Moule@boffamiskell.co.nz** | *Drawn:* GCu | *Checked:* ABl

**Table 1: Summary information and results of the acoustic bat survey undertaken as part of the bat roost assessment for Ruakura Structure Plan Area LDPAs A, C, and N during April – May 2018.**

| Acoustic Recorder | Date Deployed | No. Nights Analysed | Total No. of Bat Passes | Average per Night | No. Nights with Passes | % Nights with Passes |
|---|---|---|---|---|---|---|
| AR 1 | 18-Apr-18 | 11 | 3 | 0.27 | 2 | 14% |
| AR 2 | 18-Apr-18 | 11 | 0 | 0.00 | 0 | 0% |
| AR 3 | 18-Apr-18 | 11 | 2 | 0.18 | 2 | 14% |
| AR 4 | 18-Apr-18 | 11 | 1 | 0.09 | 1 | 7% |
| AR 5 | 18-Apr-18 | 11 | 1 | 0.09 | 1 | 7% |
| AR 6 | 18-Apr-18 | 11 | 1 | 0.09 | 1 | 7% |
| AR 7 | 18-Apr-18 | 11 | 1 | 0.09 | 1 | 7% |
| AR 8 | 18-Apr-18 | 11 | 11 | 1.00 | 2 | 14% |
| AR 9 | 17-Apr-18 | 11 | 2 | 0.18 | 2 | 14% |
| AR 10 | 17-Apr-18 | 11 | 4 | 0.36 | 3 | 21% |
| AR 11 | 17-Apr-18 | 11 | 1 | 0.09 | 1 | 7% |
| AR 12 | 17-Apr-18 | 11 | 0 | 0.00 | 0 | 0% |
| AR 13 | 17-Apr-18 | 11 | 1 | 0.09 | 1 | 7% |
| AR 14 | 17-Apr-18 | 11 | 1 | 0.09 | 1 | 7% |
| AR 15 | 17-Apr-18 | 11 | 1 | 0.09 | 1 | 7% |
| AR 16 | 17-Apr-18 | 11 | 2 | 0.18 | 2 | 14% |
| AR 17 | 17-Apr-18 | 11 | 5 | 0.45 | 4 | 29% |
| AR 18 | 17-Apr-18 | 11 | 1 | 0.09 | 1 | 7% |

## 3.2 Bat Roost Assessment

Over 146[6] trees were assessed as having potential to contain bat roosts, of these 107 scored in the Low to Moderate range for roost potential and 39 in the Moderate - High to High range (Appendix 1). The majority of trees assessed were mature exotic trees that possessed deep cavities as well as hollow branches and loose bark. Crack willow, poplar, pin oak, Eucalyptus, and tree privet were the trees most commonly assessed as having a moderate – high roost potential.

The locations of the potential roost trees are mapped in Appendix 2.

[6] Groups of trees that had similar characteristics were assessed together and are displayed in Appendix 2 as a single point.

*Figure 3: A cavity with a clear entrance in a very old* Griselinia littoralis *tree.*

*Figure 4: Loose bark on an unhealthy* Cupressus *tree.*

*Figure 5: A cavity in a dead, hollow branch of a mature poplar tree.*

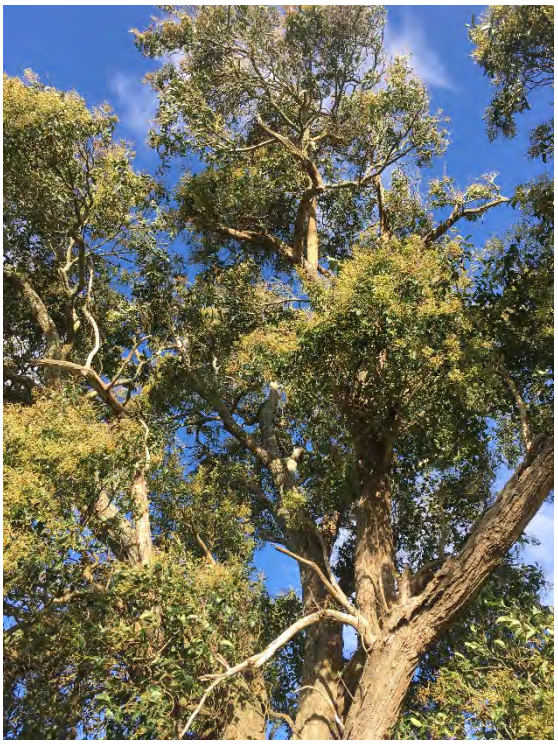


*Figure 6: A very old tree privet containing multiple potential roost features including hollow limbs and loose bark.*

# 4.0 Conclusion and Recommendations

A large number of trees on site possess features that could be used by roosting bats. The bat activity on site was not indicative of bats roosting communally however, the survey was undertaken in late autumn when bat activity is generally lower. Furthermore, the survey results do not preclude solitary bats roosting on the site.

Long-tailed bats are 'absolutely protected' under the Wildlife Act (1953). Bats are known to remain within trees during felling and therefore may be injured or killed when this occurs (Borkin & Parsons, 2010). Consequently, it is necessary that steps are taken to ensure that no bats are roosting in any of the identified trees prior to vegetation clearance. A tree removal protocol detailing these steps will need to be developed and adhered to for this area to minimise injury or mortality of bats during tree removal associated with project construction.

The recommendations below outline approaches to preventing injury or mortality to long-tailed bats during vegetation clearance. The below methodologies cannot preclude potential disturbance of roosting bats. As such it is advised that a Wildlife Act Authority is obtained prior to pre-felling surveys commencing.

## 4.1 Pre-felling Acoustic Surveys

Below is an example of commonly implemented tree felling protocols during warmer weather when long-tailed bats a generally exiting and entering roosts on a nightly basis and their echolocation calls can be readily detected using acoustic recorders.

1. Potential bat roost trees will only be removed between October 1st and April 30th to ensure bats are active and can be picked up effectively using acoustic recorders.
2. Immediately prior to the potential roost trees being removed, a pre-felling acoustic survey will be undertaken for three 'fine weather nights'[7], concluding on the morning that clearance is scheduled to commence.
3. The data will be analysed the morning of clearance, and clearance can commence after confirmation that no bats were recorded at each potential roost tree.
4. If bats are recorded, monitoring will continue as per Steps 3 - 5 until the bat specialist can confirm that bats are no longer using the tree(s).
5. As bats often move between roost trees on a nightly basis, if the trees cannot be removed the same day that bat monitoring concludes, the acoustic recorders will need to be redeployed and steps 3 - 5 repeated.

**Advice notes:**

Long-tailed bats enter torpor (a state of reduced activity) during colder weather where they often do not leave roosts for days at a time. Acoustic surveys as described above only detect bats when they are echolocating (generally during flight). Consequently, acoustic surveys must be undertaken during warmer weather when bats are more likely to be leaving roosts.

[7] Fine weather is defined as a 10°C minimum nightly temperature and there is no rainfall in the first two hours after sunset and before sunrise. The night is defined as one hour before sunset to one hour after sunrise, the same as the acoustic recorders' monitoring period.

Long-tailed bats generally move roosts on a nightly basis (O'Donnell & Sedgeley, 1999) hence it is important that the above steps are taken immediately prior to felling and that once a tree is confirmed to be vacant, felling occurs the same day.

## 4.2 Visual Assessments of Potential Roost Features

Below is an example of methods that can be implemented if vegetation clearance is required outside of October to April (inclusive), or when acoustic surveys are inconclusive. It should be noted that this alternative is labour intensive and requires a bat specialist to be onsite supervising arborists during clearance of all potential bat roost trees.

1. Immediately prior to felling potential roost trees will be climbed by an arborist, and potential roost features such as cavities, hollow limbs and loose bark will be inspected for roosting bats under the supervision of a bat specialist.
2. If no bats are located during the inspection, the tree(s) can be felled that day.
3. If bats are identified, the roost tree will not be felled until the bats have vacated the roost and a 50 m buffer will be set set-up around the roost within which no works will be undertaken until the tree is vacated.

**Advice notes:**

As stated above, long-tailed bats generally move roosts on a nightly basis (O'Donnell & Sedgeley, 1999) hence it is important that the above steps are taken immediately prior to felling and that once a tree is confirmed to be vacant, felling occurs the same day.

# 5.0 References


Borkin, K. M., O'Donnell, C., & Parsons, S. (2011). Bat colony size reduction coincides with clear-fell harvest operations and high rates of roost loss in plantation forest. *Biodiversity and Conservation*, *20*(14), 3537–3548. https://doi.org/10.1007/s10531-011-0144-7

Borkin, K. M., & Parsons, S. (2010). The importance of exotic plantation forest for the New Zealand long-tailed bat (*Chalinolobus tuberculatus*). *New Zealand Journal of Zoology*, *37*(1), 35–51.

Griffiths, R. W. (2007). Activity patterns of long-tailed bats (*Chalinolobus tuberculatus*) in a rural landscape, South Canterbury, New Zealand. *New Zealand Journal of Zoology*, *34*(3), 247–258. https://doi.org/10.1080/03014220709510083

O'Donnell, C. F. J. (2000). Influence of season, habitat, temperature, and invertebrate availability on nocturnal activity of the New Zealand long-tailed bat (*Chalinolobus tuberculatus*). *New Zealand Journal of Zoology*, *27*(3), 207–221.

O'Donnell, C. F. J., & Sedgeley, J. A. (1999). Use of roosts by the long-tailed bat, *Chalinolobus tuberculatus*, in temperate rainforest in New Zealand. *Journal of Mammalogy*, *80*(3), 913–923.

Sedgeley, J. A. (2001). Quality of cavity microclimate as a factor influencing selection of maternity roosts by a tree-dwelling bat, Chalinolobus tuberculatus, in New Zealand. *Journal of Applied Ecology*, *38*, 424–438.

Sedgeley, J. A., & O'Donnell, C. F. J. (1999). Roost selection by the long-tailed bat, *Chalinolobus tuberculatus*, in temperate New Zealand rainforest and its implications for the conservation of bats in managed forests. *Biological Conservation*, *88*(2), 261–276. https://doi.org/10.1016/S0006-3207(98)00069-X

Sedgeley, J. A., & O'Donnell, C. F. J. (2004). Roost use by long-tailed bats in South Canterbury: examining predictions of roost-site selection in a highly fragmented landscape. *New Zealand Journal of Ecology*, *28*(1), 1–18.

# Appendix 1: Bat Roost Assessment Results

**Table 2: Descriptions of all potential roost trees assessed across Ruakura Structure Plan Area LDPAs A, C, and N in April - May 2018.**

| GPS ID | Tree Spp. | Common name | DBH (cm) | Roost feature(s) description | General Assessment of Bat Roost Potential |
|---|---|---|---|---|---|
| R001 | *Populus nigra* | Lombardy poplar | | Dense foliage but opens up near top of tree. Mature but relatively healthy, no obvious cavities but potentially some small knot holes. Close to Manganoa Gully along a barberry hedge. | Moderate |
| R002 | *Quercus palustris* | Pin oak | 50<br>58<br>63.5<br>59<br>63<br>58<br>59.5<br>60 | A shelterbelt comprising 8 pin oak. All appear healthy with smooth bark and limited cavities. One with a large but shallow scar on the trunk. | Low |
| R003 | *Quercus palustris* | Pin oak | | Pin oak closest to gully in shelter belt described in R02. Has upwards facing knot hole that way be hollow. Near fork in main trunk approximately two-thirds up tree. | Moderate |
| R004 | *Quercus robur* | Oak | 57 | Semi-mature oak in 'Nevada branch' of Manganoa Gully. No obvious cavities but difficult to assess entire tree | Low - Moderate |

| | | | | | |
|---|---|---|---|---|---|
| R005 | *Populus spp.* | Poplar | 80 | Large, mature tree on Nevada Tributary stream edge. Multiple good quality potential roost features including cavities, dead branches and loose bark. | High |
| R006 | *Populus nigra* | Lombardy poplar | Multi-stem: 69, 65.5, 72 | Large, mature tree beside R05. Roost features available but less potential than R05. | Moderate |
| R007 | *Populus spp.* | Poplar | Multi-stem: 30 - 35 | Smaller multi-stemmed poplar also close to R05. Less habitat potential as it is shorter and more cluttered. | Low |
| R008 | *Populus spp.* | Poplar | 41 | Medium-sized poplar also close to R05. Bigger than R07. One small cavity identified. | Moderate |
| R009 | *Populus spp.* | Poplar | Multi-stem: 66.5, 62, 49 | Very large poplar with a good-looking knot hole. Knot hole is clear with bleaching / staining around the lower half of the entrance and a uncluttered entrance. Other smaller cavities and dead branches also present. | High |
| R010 | *Populus spp.* | Poplar | | Tall, skinny poplar compared to R09. Dead branches and loose bark present. | Moderate |
| R011 | *Cupressus macrocarpa* | Macrocarpa | 40 - 70 | A shelterbelt comprising multiple young macrocarpa interspersed with emergent poplars. Macrocarpas are young with smooth bark, limited cavities and dense foliage. | Low |

| | | | | | |
|---|---|---|---|---|---|
| R012 | *Populus spp.* | Poplar | | Mature but not as large as R09. Falling over with a couple of dead branches and one obvious cavity. | Moderate - High |
| R013 | *Populus spp.* | Poplar | 49<br>47 | Two emergent poplars. No obvious cavities but with some small dead branches and loose bark. | Moderate |
| R014 | *Populus spp.* | Poplar | | Large emergent poplar hanging over stream with a dead tree beside it. No obvious cavities but quite mature. Dead tree has loos bark and dead branches. | Moderate - High |
| R015 | *Populus nigra* | Lombardy poplar | 40 - 65 Plus single large tree on the end: 125.5 | Line of approximately 10 lombardy poplars. Smaller than the emergent poplars above (R09 - R14). The DBH of 125.5 cm is misleading as the trunks branch above breast height. Limited roost potential of small cavities (none identified) or loose bark. | Low |
| R016 | *Populus spp.* | Poplar | | Single large emergent poplar directly infront of lombardy poplars above (R15). Multiple small dead branches but no obvious cavities. | Moderate |
| R017 | *Robinia pseudoacacia (?)* | Black locust | - | Small group of trees without roost potential themselves but covered in dense ivy. Habitat potential limited as close to busy road and directly below high voltage powerlines. | Low |
| R018 | *Cupressus spp.* | | | Group of 4 exotic conifers. Relatively young without cavities but have a lot of loose bark. | Moderate |
| R019 | *Salix fragilis* | Crack willow | 157.5 | Old with a lot of large cavities and dead, hollow branches. | High |

| | | | | | |
|---|---|---|---|---|---|
| R020 | *Salix fragilis* | Crack willow | 142 | Old with multiple cavities and dead branches. | High |
| R021 | *Unidentified exotic tree* | | | Mature exotic broadleaf spp. No obvious cavities but a couple of smaller dead branches. | Moderate |
| R022 | *Acacia spp.* | | | Large mature Acacia spp. with a group of smaller trees around it. Smooth bark and limited dead branches. Some loose bark but low down in the interior. One potentially hollow knot hole (photo). | Moderate |
| R023 | *Acacia spp.* | | | Taller Acacia but not as mature. No roost features visible. | Low |
| R024 | *Cupressus spp.* | | | Shelter belt of Cupressus spp. All trees tall but relatively young and very similar so assessed as a single unit. No cavities visible but some have dense ivy growing some of on them. All have dense foliage - difficult to access. | Low |
| R025 | *Quercus palustris*<br>*Acer pseudoplatanus* | Pin oak<br>Sycamore | 60.5<br>52<br>73 | Group of 3 pin oaks and 3 sycamores. Relatively young with no obvious cavities, loose bark, or dead branches. Some dense ivy growing up the tree closest to the road. DBH subset 60.5, 52, 73 cm | Moderate |
| R026 | *Quercus palustris* | Pin oak | 65 | Still relatively young with smooth bark, no cavities or dead branches. | Low |
| R027 | *Quercus robur*<br>*Quercus palustris* | Oak<br>Pin oak | 87<br>83, 65, 57 | A older oak close to three pin oaks. No obvious cavities but difficult to assess entire trees. Pin oaks appear to be lower quality habitat except one (83 cm DBH) which has small spilt cavity on southern aspect. | Low - Moderate |
| R028 | *Quercus robur* | Oak | 94 | A couple of potentially hollow cavities. No loose bark or dead limbs. | Moderate |

| | | | | | |
|---|---|---|---|---|---|
| R029 | *Fraxinus spp.* | Ash | 96 | Large DBH but trunks branch after breast height. Appears old and unhealthy, potential hollow cavities but difficult to assess due to dense foliage. | Moderate |
| R030 | *Quercus palustris* | Pin oak | 62<br>62 | Two very tall pin oaks. Appear healthy, no obvious cavities and smooth bark. | Low - Moderate |
| R031 | *Quercus palustris* | Pin oak | 99<br>96 | Two very large pin oaks. Still appear very healthy but a couple of small cavities that may be hollow. Still very smooth bark and no dead branches. | Moderate |
| R032 | *Eucalyptus spp.* | Gum | | Stand of 5 very large (tallest one approx. 30 m high) Eucalyptus trees surrounded by some smaller ones (7x 20 - 40 cm DBH) and tree privet. The larger trees all have roost features primarily dead limbs but also a few knot hole cavities. Limited loose bark | High |
| R033 | *Platanus x acerifolia* | London plane | 103.5 | Limited roost features namely one dead hollow branch. Smooth bark, visible knot holes all appear to have healed over. | Moderate |
| R034 | *Juglans ailantifolia* | Japanese walnut | 55 | Short tree with a couple of small cavities. | Low - Moderate |
| R035 | *Pittosporum eugenioides* | Lemonwood | | A row of 3 mature lemonwood. Old but short trees with multiple cavities. Nothing visible higher than approx. 3 m. | Low |
| R036 | *Acer spp.* | Maple species | 104.5 | Multiple dead limbs near top of tree but they do not appear to be hollow however the trunk is. Potential roost entrances into hollow trunk approximately 3 m high. | High |

| | | | | | |
|---|---|---|---|---|---|
| R037 | *Salix fragilis* | Crack willow | 114.5 | Mature with multiple cavities on the larger branches. Also loose bark available and dead hollow limbs. | High |
| R038 | *Quercus palustris* | Pin oak | 55 | Single hollow cavity in the main trunk. Smooth entrance with potential scratch marks and wear in the small branch beneath the entrance. | High |
| R039 | *Quercus palustris* | Pin oak | 59 | Multiple potentially hollow cavities lower down on main trunk and dead branches and loose bark higher in tree. | Moderate - High |
| R040 | *Quercus palustris* | Pin oak | 77 | Unhealthy with multiple dead limbs (but don't appear hollow). Bark smooth no obvious cavities. | Moderate |
| R041 | *Quercus palustris* | Pin oak | 53 | Smooth bark no trunk cavities. Dead branches but small and don't appear hollow. | Low |
| R042 | *Quercus palustris* | Pin oak | 57.5 | Smooth bark no trunk cavities. Dead branches but small and don't appear hollow. | Low |
| R043 | *Quercus palustris* | Pin oak | 59 | Smooth bark no trunk cavities. Dead branches but small and don't appear hollow. | Low |
| R044 | *Quercus palustris* | Pin oak | 68.5 | Smooth bark no trunk cavities. Dead branches but small and don't appear hollow. | Low |
| R045 | *Quercus palustris* | Pin oak | 61 | Smooth bark no trunk cavities. Dead branches but small and don't appear hollow. | Low |
| R046 | *Quercus palustris* | Pin oak | 68.5 | Very healthy no visible roost features. Very few dead branches. | Low |

| | | | | | |
|---|---|---|---|---|---|
| R047 | *Quercus palustris* | Pin oak | 71.5 | Very healthy no visible roost features. Very few dead branches. | Low |
| R048 | *Quercus palustris* | Pin oak | 65.5 | Some small trunk cavities but don't appear deep enough to support a bat(s). | Low |
| R049 | *Quercus palustris* | Pin oak | 77.5 | Some small trunk cavities but don't appear deep enough to support a bat(s). One dead branch which looks like it forms a hollow cavity with the trunk but no protection from rain (see photo). | Low - Moderate |
| R050 | *Quercus palustris* | Pin oak | 63.5 | Smooth trunk with no visible cavities but a few dead branches that appear hollow. | Moderate |
| R051 | *Banksia spp.* | Banksia | Multi-stem: 50, 61 | Dead with a lot of loose bark and some split branches. | High |
| R052 | *Platanus x acerifolia* | London plane | 93 | Multiple knot holes but none appear to be deep enough to support a bat(s). Occasional small hollow branch. Relatively smooth bark. | Moderate |
| R053 | *Platanus x acerifolia* | London plane | 85 | Multiple knot holes but none appear to be deep enough to support a bat(s). Occasional small hollow branch. Relatively smooth bark. | Low - Moderate |
| R054 | *Platanus x acerifolia* | London plane | 81 | Multiple knot holes but none appear to be deep enough to support a bat(s). Occasional small hollow branch. Relatively smooth bark. | Low - Moderate |
| R055 | *Platanus x acerifolia* | London plane | 72 | Multiple knot holes but none appear to be deep enough to support a bat(s). Occasional small hollow branch. Relatively smooth bark. | Low - Moderate |

| | | | | | |
|---|---|---|---|---|---|
| R056 | *Platanus x acerifolia* | London plane | 78 | One knot hole that has potential to support a bat(s) but not protected from rain. | Low - Moderate |
| R057 | *Platanus x acerifolia* | London plane | 90 | A couple knot holes on the main trunk that has potential to support a bat(s). | Moderate |
| R058 | *Platanus x acerifolia* | London plane | 86 | Multiple knot holes but none appear to be deep enough to support a bat(s). Occasional small hollow branch. Relatively smooth bark. | Low - Moderate |
| R059 | *Salix fragilis* | Crack willow | Multi-stem: 68, 74 | Old with multiple cavities and dead branches / branch splits. One large cavity with clear entrance facing W. | High |
| R060 | *Platanus x acerifolia* | London plane | 77.5 | Multiple knot holes on trunk and main branches, difficult to tell how deep they are as most facing upwards. | Moderate |
| R061 | *Populus spp.* | Poplar | 110.5 | No visible cavities but very fissured bark and some dead small branches with loose bark around them. | Moderate |
| R062 | *Salix fragilis* | Crack willow | 117 | Old with multiple clear cavities, one with bird feathers at the base. Loose bark and dead branches also. | High |
| R063 | *Platanus x acerifolia* | London plane | 78.5 | Multiple knot holes but none appear to be deep enough to support a bat(s). Occasional small hollow branch. Relatively smooth bark. | Moderate |
| R064 | *Platanus x acerifolia* | London plane | 82 | A single knot hole looks like it may be deep enough to support a bat(s), a very tight entrance though. | Low - Moderate |
| R065 | *Quercus palustris* | Pin oak | 66.5 | Bark smooth. A single cavity visible low down on a small branch. | Low |

| | | | | | |
|---|---|---|---|---|---|
| R066 | *Quercus palustris* | Pin oak | 69 | Smooth bark and no cavities visible. A single dead, twisted branch that a solitary bat could potentially use. | Low |
| R067 | *Quercus palustris* | Pin oak | 64.5 | Smooth bark and no cavities visible. Some small dead branches but unlikely to support to a bat(s). | Low |
| R068 | *Quercus palustris* | Pin oak | 63 | Smooth bark and no cavities visible. Some small dead branches but unlikely to support to a bat(s). | Low |
| R069 | *Quercus palustris* | Pin oak | 67.5 | Smooth bark and no cavities visible. Some small dead branches but unlikely to support to a bat(s). | Low |
| R070 | *Araucaria heterophylla* | Norfolk pine | 81.5 | Young and healthy, no potential roost features. | Low |
| R071 | *Phoenix canariensis* | Phoenix palm | 114 | Structure of the palm provides a lot of potential bat roost habitat, particularly below the fronds. Palms often inhabited by mammalian predators. | Moderate - High |
| R072 | *Olea spp.* | Olive | | Shelterbelt of small, olive-like trees. Roost features limited except for ivy growing on trunks. Very dense foliage. | Low |
| R073 | *Ulmus spp.* | Elm | | Short but mature tree. No visible cavities and dead branches to small to support roosting bats. | Low |
| R074 | *Alnus glutinosa* | Alder | 20 - 35 | Alder shelterbelt. A single cavity but low on tree (< 2 m). Branches too small to support roosting bats. | Low |

| | | | | | |
|---|---|---|---|---|---|
| R075 | *Bambusa spp. Unidentified exotic tree* | Bamboo | 15 - 30 | Bamboo with a row of unhealthy exotics trees, many of which have fallen over. Some cavity potential in unidentified exotics but small trees and unlikely to have high roost value. | Low |
| R076 | *Sophora tetraptera* | Kowhai | 38.5 | Old but short. No cavities. Small dead branches but too small to support roosting bat. | Low |
| R077 | *Ginkgo biloba* | Ginkgo | 37 | Mature but no cavities. Some dead branches but too small to support roosting bats. | Low |
| R078 | *Acer spp. (?)* | Maple | 87.5 | Some broken off branches low down but have not yet formed hollow cavities. | Low |
| R079 | *Ulmus spp.* | Elm | Multi-stem: 64, 31, 24.5 | Smooth bark but a couple of cavities with clear entrances. | High |
| R080 | *Ginkgo biloba* | Ginkgo | 56 | No cavities, smooth bark. | Low |
| R081 | *Liquidambar spp.* | Liquidambar | 86 | No visible cavities. A single dead branch low down. | Low |
| R082 | *Eucalyptus spp.* | Eucalyptus | 130 | Large mature eucalyptus-type tree. Roost features limited to a couple of dead branches and loose bark. | Moderate |
| R083 | *Ulmus spp.* | Elm | 89 | Large elm. Roost features limited: a couple of dead branches that do not appear to be hollow. | Low |

| | | | | | |
|---|---|---|---|---|---|
| R084 | *Ulmus spp.* | Elm | Multi-stem: 41.5, 56 | Elm tree. No visible cavities but one potentially hollow dead branch low on trunk. | Low - Moderate |
| R085 | *Ginkgo biloba* | Ginkgo | 66 | No visible roost features. | Low |
| R086 | *Liquidambar spp.* | Liquidambar | Multi-stem: 26, 26, 37 | A few knot holes but none appear deep enough to support a bat roost. | Moderate |
| R087 | *Liquidambar spp.* | Liquidambar | 47.5 | One hollow knot hole (pictured). | Moderate - High |
| R088 | *Ulmus spp.* | Elm | 86 | Large elm. No visible roost features but difficult to assess whole tree. | Low - Moderate |
| R089 | *Liquidambar spp.* | Liquidambar | 62.5 | A single hollow knot hole visible, entrance facing SW. | Moderate |
| R090 | *Quercus palustris* | Pin oak | 85 | Very large and difficult to assess whole tree but definite potential for roost features. | High |
| R091 | *Quercus palustris* | Pin oak | 75<br>75 | 2x pin oaks approx. 75 cm DBH. No visible roost features but difficult to assess both trees completely. | Moderate |
| R092 | *Banksia spp.* | Banksia | Multi-stem: 30 - 50 | Very large, old banksia multiple stems. No visible features but difficult to assess the tree completely. | Moderate |

| | | | | | |
|---|---|---|---|---|---|
| R093 | *Quercus palustris* | Pin oak | 75 | Some dead branches potentially large enough to support bat roosts. Also potential for cavities but none visible from ground. | Moderate - High |
| R094 | *Unidentified exotic tree* | | 45 | Unidentified exotic broadleaf. No roost features visible. | Low |
| R095 | *Quercus palustris* | Pin oak | 100 | Very large pin oak. No visible cavities but some dead branches. Don't appear hollow. | Moderate |
| R096 | *Unidentified exotic tree* | | 70 | Unidentified exotic broadleaf. No visible cavities but many dead, hollow branches that could support bat roosts. | High |
| R097 | *Quercus palustris* | Pin oak | 80 | Dead branches and cavities starting to form. | High |
| R098 | *Salix fragilis* | Crack willow | 85 | Hollow cavities with clear entrances (no spider webs etc.). | High |
| R099 | *Platanus x acerifolia* | London plane | 104 | Some dead branches but they don't appear hollow. No visible trunk cavities. | Moderate |
| R100 | *Ligustrum lucidum* | Tree privet | Multi-stem: 73, 35.5 | Very old tree privet. Multiple cavities with clear entrances and loose bark. | High |
| R101 | *Salix fragilis* | Crack willow | 53 | A couple of high potential cavities with clear entrances. Also loose bark and some dead, hollow branches. | High |
| R102 | *Quercus palustris* | Pin oak | 80 | No obvious cavities but small, dead branches some of which may be hollow. | Low - Moderate |

| | | | | | |
|---|---|---|---|---|---|
| R103 | *Quercus palustris* | Pin oak | 80 | One cavity below where two large branches have grown together, but it was open all the way through. Multiple small dead branches that may be hollow. | Moderate |
| R104 | *Quercus palustris* | Pin oak | 75 | No visible cavities but some dead branches which are potentially hollow. | Low - Moderate |
| R105 | *Quercus palustris* | Pin oak | 95 | Very large, mature pin oak. No visible cavities on trunk but larger dead branches with cavities and likely hollow. | Moderate - High |
| R106 | *Quercus palustris* | Pin oak | 95 | Large, mature pin oak. No visible cavities but dead branches and one branch split up high that could support bats. | Moderate - High |
| R107 | *Ligustrum lucidum* | Tree privet | Multi-stem: 51, 61 | Very old tree privet with multiple high-potential cavities and large hollow dead branches. | High |
| R108 | *Ligustrum lucidum* | Tree privet | Multi-stem: 43, 65, 47 | Very old tree privet with multiple large, dead, hollow branches and a couple of small cavities. | High |
| R109 | *Griselinia lucida* | Puka | 58 | Very old *Griselinia*. Completely Hollow trunk plus multiple dead branches with cavities. | High |
| R110 | *Griselinia lucida* | Puka | Multi-stem: 40, 45, 48 | Very old *Griselinia*. Hollow trunk and multiple large hollow branches with cavities. | High |

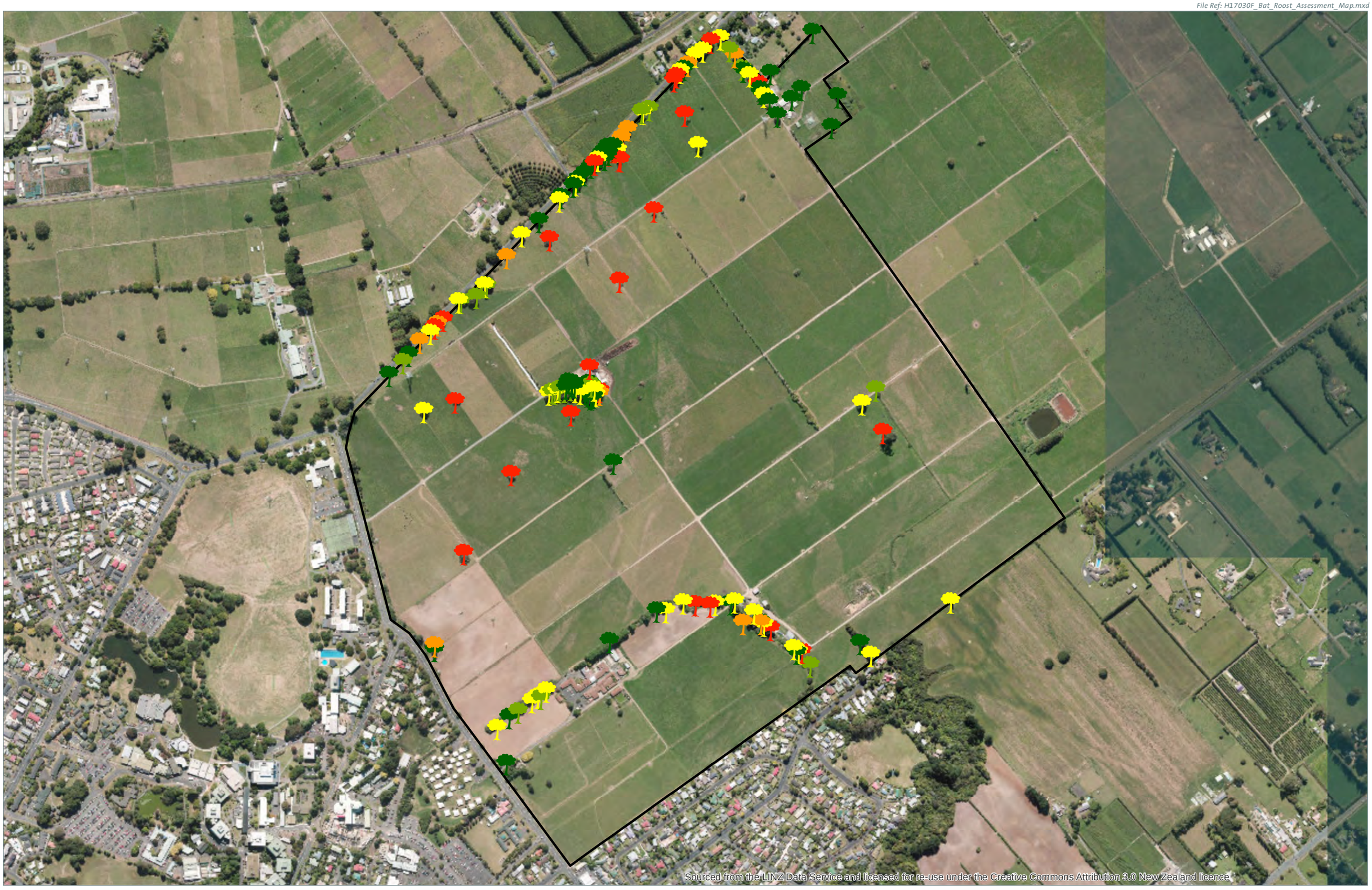
| | | | | | |
|---|---|---|---|---|---|
| R111 | *Ligustrum lucidum* | Tree privet | 34 | Old tree privet DBH 34. Some dead branches but cavities minimal. | Low |
| R112 | *Ligustrum lucidum* | Tree privet | 49.5 | Old tree privet DBH 49.5. 1 cavity visible but potential not hollow. some small dead branches. | Moderate |
| R113 | *Ligustrum lucidum* | Tree privet | Multi-stem: 65, 45, 38 | Very old tree privet. A couple of trunk cavities and large dead branches. | High |
| R114 | *Cupressus spp.* | | 58 | Unhealthy, appears half dead with loose bark. | High |
| R115 | *Quercus palustris* | Pin oak | 70 | No visible cavities and very few small dead branches unlikely to support bats. | Low |
| R116 | *Quercus palustris* | Pin oak | 70 | No visible cavities and very few small dead branches unlikely to support bats. | Low |
| R117 | *Banksia spp.* | Banksia | 55 | No visible cavities or dead branches. | Low |
| R118 | *Banksia spp.* | Banksia | 110 | Very large Banksia. No visible cavities and no dead branches. | Low |
| R119 | *Unidentified exotic tree* | | 30 | Very unhealthy Unidentified exotic tree. A lot of small dead branches but unlikely to support bats. | Low |
| R120 | *Acer spp.* | Maple species | 50 | No visible cavities and few dead branches which are all very small and unlikely to support bats. | Low |

| | | | | | |
|---|---|---|---|---|---|
| R121 | *Quercus palustris* | Pin oak | 95 | One knot hole cavity and few dead branches that could potentially support bats. | Moderate |
| R122 | *Acer spp.* | Maple species | 80 | Splits in limbs that could support bats and one hollow knot hole cavity. | High |
| R123 | *Quercus palustris* | Pin oak | 80 | No visible cavities and dead branches are small and unlikely to support bats. | Low |
| R124 | *Quercus palustris* | Pin oak | 80 | No visible cavities and dead branches are small and unlikely to support bats. | Low |
| R125 | *Quercus palustris* | Pin oak | 90 | No visible cavities and dead branches are small and unlikely to support bats. | Low |
| R126 | *Quercus robur* | Oak | 93 | No visible cavities but larger dead branches that could support bats. | Moderate |
| R127 | *Acer spp.* | Maple species | 70 | No visible cavities and dead branches unlikely to support bats. | Low |
| R128 | *Quercus palustris* | Pin oak | 90 | No visible cavities and dead branches unlikely to support bats. | Low |
| R129 | *Juglans ailantifolia* | Japanese walnut | Multi-stem: 52, 53, 48 | Multiple cavities with clear entrances. | High |
| R130 | *Banksia spp.* | Banksia | 90 | No visible cavities but a large dead branch that could support bats. | Moderate |

| | | | | | |
|---|---|---|---|---|---|
| R131 | *Quercus palustris* | Pin oak | 95 | No visible cavities and dead branches largely unlikely to support bats. | Low |
| R132 | *Cupressus spp.* | | | Half dead, loose bark at base of dead spar. | Moderate |
| R133 | *Betula pendula* | Silver birch | 40 - 50 | Group of 7 silver birches. Small cavities in most trees. | Moderate - High |
| R134 | *Pinus spp.* | Pine | 72 | Very tall. Some small dead branches with loose bark. | Low - Moderate |
| R135 | *Unidentified exotic tree* | | | Damaged with a single large cavity. | Moderate |
| R136 | *Pinus spp.* | Pine | 61 | Very tall. Some dead and split branches at top with potential to support bats. | Low - Moderate |
| R137 | *Betula pendula* | Silver birch | 45 | A couple of large but upwards facing cavities low down on tree. | Low - Moderate |
| R138 | *Unidentified exotic tree* | | 35 | Some visible cavities that appear to be hollow. | Moderate |
| R139 | *Unidentified exotic tree* | | 45 | One hollow knot hole cavity. High roost potential but upwards facing. | High |
| R140 | *Unidentified exotic tree* | | 35 | UNID exotic tree DBH approx. 35. Some small cavities and dead branches with loose bark. Moderate to high roost potential. | Moderate - High |
| R141 | *Acer palmatum* | Japanese maple | 50 | Multiple small but hollow cavities with open entrances. | High |

| | | | | | |
|---|---|---|---|---|---|
| R142 | *Betula pendula* | Silver birch | 30 | Old and unhealthy. Loose bark around galls. | Moderate |
| R143 | *Unidentified exotic tree* | | 40 | A couple of small cavities in a dying branch. | Moderate - High |
| R144 | *Cupressus spp.* | | | No visible cavities. Some somewhat loose bark but unlikely to support bats. | Low |
| R145 | *Betula pendula* | Silver birch | 28 | Not very tall but multiple cavities low down. | Low - Moderate |
| R146 | *Cupressus spp.* | | | No visible cavities, very dense foliage and bark 'flakes' not large enough to support bats. | Low |

# Appendix 2: Location of Potential Roost Trees, Ruakura Structure Plan Area LDPAs A, C, and N




Boffa Miskell
www.boffamiskell.co.nz



0 250 m
1:7,500 @ A3

*Data Sources:* Boffa Miskell, Tanui Group Holdings

*Projection:* NZGD 2000 New Zealand Transverse Mercator

Legend

Potential Bat Roost Trees
- Low
- Low - Moderate
- Moderate
- Moderate - High
- High

Survey Boundary

**RUAKURA STRUCTURE PLAN AREA**

# Bat Roost Assessment: LDPAs A, C, and N

**Date: 22 May 2018 | Revision: 0**

Plan prepared for Tanui Group Holdings by Boffa Miskell Limited

*Project Manager:* **Dave.Moule@boffamiskell.co.nz** | *Drawn:* GCu | *Checked:* ABl

# Appendix 3: Weather data During Acoustic Bat Activity Surveys

| Date | Minimum Temperature (°C) | Rain (mm) | Data Analysed | Minimum Temperature at Sunset (18:00) |
|---|---|---|---|---|
| 17/04/2018 | 11 | 6.1 | No | 19.1 |
| 18/04/2018 | 13 | 0.7 | Yes | 11.9 |
| 19/04/2018 | 4 | 0.5 | No | 14.1 |
| 20/04/2018 | 9 | 1.5 | Yes | 14.9 |
| 21/04/2018 | 9 | 0 | Yes | 16.2 |
| 22/04/2018 | 13 | 0 | Yes | 13.9 |
| 23/04/2018 | 3 | 0 | No | 14.5 |
| 24/04/2018 | 10 | 0 | Yes | 14.4 |
| 25/04/2018 | 7 | 0 | Yes | 14.3 |
| 26/04/2018 | 4 | 0 | No | 15.1 |
| 27/04/2018 | 8 | 0.5 | Yes | 15.9 |
| 28/04/2018 | 14 | 40.1 | No | 15.8 |
| 29/04/2018 | 15 | 2.6 | Yes | 16.5 |
| 30/04/2018 | 13 | 0 | Yes | 17 |
| 1/05/2018 | 13 | 0 | Yes | 17.7 |
| 2/05/2018 | 10 | 0 | Yes | 14 |

# Appendix 11: Ruakura south lizard management plan

# RUAKURA SOUTH NATIVE LIZARD MANAGEMENT PLAN

Capture, Management and Release
Prepared for Tainui Group Holdings

2 June 2016

Boffa Miskell

## Document Quality Assurance

| | | |
|---|---|---|
| **Bibliographic reference for citation:**<br>Boffa Miskell Limited 2016. *RUAKURA SOUTH NATIVE LIZARD MANAGEMENT PLAN: Capture, Management and Release*. Report prepared by Boffa Miskell Limited for Tainui Group Holdings. | | |
| Prepared by: | Katherine Muchna<br>Senior Ecologist<br>Boffa Miskell Limited |  |
| Reviewed by: | Ian Boothroyd<br>Senior Ecologist<br>Boffa Miskell Limited |  |
| Status: FINAL | Revision / version: 2 | Issue date: 2 June 2016 |



Template revision: 20150331 0000

File ref: Document1

*Cover photograph: Ruakura and Hamilton City, © Tainui Group Holdings Ltd*

# CONTENTS

# Appendices

# 1.0 Introduction

## 1.1 Background

This Native Lizard Management Plan (NLMP) was prepared for Tainui Group Holdings (TGH) and contains recommendations for the management of lizard fauna within the TGH development site. The project site includes the central and southern areas of the Ruakura R1 Structure Plan Area (SPA) between Powells Road in the north, and Sheridan Street/Nevada Road in the south, hereafter referred to as Ruakura South.

Ruakura South is located approximately 3 km east of Hamilton City, and is currently used for dairy grazing and agricultural research. Proposed land development within Ruakura South includes development of an inland port and logistics area, an industrial park and additional roading. The development also includes several large open space areas.

This NLMP fulfils part of the requirement of the Ruakura Plan Change for Land Development Plan consent applications to implement native lizard management within the Ruakura Schedule Area.

The NLMP provides guidance for individual Land Development Plan Areas (LDPAs) on ecological management of lizard fauna throughout site development. Implementation of this Ruakura South NLMP is triggered when development is proposed within a LDPA under the provisions of the Ruakura Plan Change.

## 1.2 Purpose

This plan seeks to integrate the management of lizard fauna within the context of the LDPA by identifying roles and co-ordinating management activities with construction timing.

Broadly, the purpose of the NLMP is to meet the requirements of Rules 25H.11.2.1 (k) and (n) insofar as they apply to indigenous lizards (see Section 1.3). To address this requirement, this plan will:

- Describe the statutory obligations and legislation relating to lizards.
- Describe the quality and availability of lizard habitats and species most likely to occur on the site.
- Describe the likely effects of the proposed site development on lizard fauna and habitats.
- Describe the methodology and timing of lizard surveys and the limitations associated with these methods.
- Provide a lizard relocation plan to ensure that any lizards captured within the development site are relocated elsewhere (site subject to approval) prior to the commencement of any earthworks or vegetation removal.
- Provide guidance towards lizard habitat enhancement and pest management actions that may be required at a relocation site.
- Analyse the risk related to timing of collection/survey, containment and translocation and other considerations.
- Specify any Department of Conservation permits and/or consents that are required.

## 1.3 Statutory Processes and Documents

In addition to regional and district statutory documents, urban development of the Ruakura Plan Change Area is subject to the specific provisions of the Ruakura Plan Change approved by the Board of Inquiry (BOI) on 9 September 2014.

The Plan Change provisions specify that a NLMP must be prepared for the entire Structure Plan Area that provides for all aspects of lizard management to ensure adverse effects on indigenous lizard fauna and habitats are mitigated and habitats are enhanced where possible. This NLMP addresses these requirements for Ruakura South only, and provides the standard against which LDPA consent applications must be assessed.

The Ruakura Plan Change information requirements for Land Development Plan consent are (BOI 2014):

**Rule 25H.11.2.1(k)**

*(k) A Landscape Concept and Ecological Enhancement Plan that includes the following:*

*x. Methods to ensure implementation of a Native Lizard Management Plan for the Land Development Plan Area consistent with the requirements of a Schedule Area-wide Native Lizard Management Plan.*

*xi. The Native Fish Management Plan and Native Lizard Management Plan prepared by suitably qualified and experienced ecologist and shall include:*

*a) containment and translocation methods for at risk species;*

*b) methods to ensure adequate separation between black mudfish and longfin eels; (not applicable)*

*c) adaptive management, monitoring and response process to determine the success or otherwise and to implement a contingency plan if necessary; and (see Section 7.4)*

*d) an analysis of risk relating to timing of collection, containment[1] and translocation.(see Section 8.0)*

## 1.4 Further Statutory Obligations and Legislation

In addition to the above, all indigenous lizard species are 'absolutely protected' under the Wildlife Act (1953, s63 (1) (c)), and lizard habitats are protected by the Resource Management Act (1991) and administered by the Department of Conservation (DOC) and local authorities (Waikato Regional Council (WRC)) respectively.

Indigenous lizard species often occupy habitats of otherwise low ecological value (i.e. weedy vegetation, vegetation margins), and guidelines have been developed to identify and address lizard habitat loss through land development (Anderson *et al.* 2012). These guidelines identify the procedures involved to meet the legislative requirements for lizard fauna in an Assessment of Environmental Effects (AEE). These procedures are addressed throughout this NLMP and include:

- Obtaining Wildlife Act permits from DOC to survey, capture and transfer lizards. Iwi consultation also forms a part of permit approval.
- Undertaking lizard or lizard habitat surveys.

[1] 'Containment' does not apply for lizards, with the exception of the transport period (from the capture site to the release site) (Section 5.0).

- Development of a lizard management plan.
- Description of actions to mitigate adverse effects on indigenous lizards.

# 2.0 Ruakura South Development

## 2.1 Site Location, Context and Character

The Ruakura South property is located east of Hamilton CBD in the Waikato Region. The site lies within the southern section of the Ruakura Structure Plan Area. Land cover within the wider area comprises flat to slightly undulating farmland to the north and east, and rural-residential areas to the west and south. The balance of land contained within the Ruakura R1 Schedule Area is north of the Ruakura South site.

Vegetation in the catchment comprises exotic pasture, shelterbelts and shade trees. The Ruakura South site is located predominantly within well-grazed pasture with scattered buildings. Ruakura South is bounded by Powells Road and Sheridan Street/Nevada Road and is shown in Figure 1 (Appendix A). Ruakura South is currently divided into five LDPAs (Areas A-H, and N) that will be developed successively over a period in excess of 20 years. Development of the Ruakura Inland Port and Logistics Area (Area A) is expected to begin in 2016. AgResearch and the Waikato Innovation Park are not included in the Ruakura South development footprint.

## 2.2 Development Principles and Design

The Ruakura Plan Change includes policies and objectives relating to the protection and enhancement of ecological values and the provision of ecological restoration through design. The proposed development involves the construction of building platforms, roads, and infrastructure, including a stormwater swale network. The earthworks required necessitate the removal of vegetation, temporary stockpiling of topsoil, and removal of waterways, mainly artificial farm drains. The drains will be replaced with a network of open planted swales and detention basins.

Although proposed swale vegetation and amenity landscaping may contribute to habitat connectivity in the long term, these areas are not expected to positively benefit indigenous lizards in the interim because of the staged nature of the development programme. However, development of open space areas and stormwater swales will provide indigenous lizard habitats and other native fauna in the medium to long term.

## 2.3 Potential Effects of Development on Lizard Fauna and Habitats

Potential development effects on indigenous lizards may occur during vegetation clearance, and include both direct impacts (injury or death, habitat loss, and displacement) and indirect impacts (loss of habitat connectivity and disturbance). These effects are only considered in relation to indigenous lizard species.

The sedentary behaviour of lizards increases the potential for direct adverse effects (i.e. injury or death) as a result of un-managed clearance of vegetation and other habitat features. The proposed development will effectively remove most of the existing vegetation and associated

habitat, potentially displacing lizards into unsuitable or occupied surrounding habitat. Displacement may expose lizards to increased competition for refuge habitats and predators. The magnitude of adverse effects on lizards depends on the size and composition of lizard populations within the site, which is related to the quality and quantity of vegetation and habitat present, and the extent of vegetation clearance.

Lack of comprehensive lizard survey to date precludes a fully informed assessment of effects. However, as described in Section 3.1, a lizard habitat assessment identified only small and discrete areas of potential lizard habitat within the project area (e.g., wood piles and debris piles amongst dense weed), within large areas of poor lizard habitat (e.g., intensively grazed pasture).

## 2.4 Mitigation for Potential Loss of Significant Habitat

The lizard habitat values of this highly modified site are considered low, and despite the removal of vegetation and scattered debris, the effects of the site development on indigenous lizard habitat values are not considered significant.

# 3.0 Ruakura South Lizard Fauna

## 3.1 Habitat Assessment

A lizard habitat assessment was carried out in July 2015. Habitats within the Ruakura South development footprint were assessed as predominantly poor quality for indigenous lizards. The majority of the site comprises grazed pasture lacking suitable refugia, although fragments of higher quality habitat were identified. Potential lizard habitat within the Ruakura South site is largely confined to wood/debris piles and rough grass around disused buildings and stockyards, pampas and tree rows bordering paddocks, riparian margins around waterways (principally farm drains) (Figure 2, Appendix A). Copper, ornate and plague skinks are typically associated with low, dense vegetation, including rough pasture and modified scrub environments (van Winkel 2009).

Potential lizard habitats within the Ruakura South site are described below and tabulated in Table 1.

**Rank grass, weedfield and pampas**
Small areas of tall, rank grass (>30 cm height) and weedfield were observed around disused buildings and stockyards. These weedy habitats were similar in structure to stands and rows of pampas that provide dense, and structurally complex habitat. Rank grass, weedfield and pampas comprised approximately 3.4 ha in total (1.09 % of the site area).

**Vegetation around waterways**
Rank grass and tree margins along waterways were typically less open than the weedfield and pampas described above. These habitats tend to be damper and shadier with a more open ground layer. Riparian margins were typically narrow and fenced and may provide long-standing habitat corridors. This habitat comprised approximately 2.4 ha in total (0.77 % of the site area).

### Isolated wood and debris piles

Large piles of wood and debris (e.g., rocks, rubbish and bricks) provided isolated lizard habitats within the Ruakura South property (Figure 2 and Figure 3) (Appendix A). Although wood piles typically have high value as habitat for lizards, these were isolated within large grazed areas. As a consequence, there is a low likelihood of lizard occupancy. Wood piles and debris piles comprised 0.1 ha in total (0.03 % of the site area).

### Lizard habitat around buildings

Scattered wood, corrugated iron and other debris around active and unused farm buildings and sheds may also provide stable habitat for lizards. This habitat type comprised 5.0 ha, or 1.60 % of the site area (including building footprint).

*Table 1: Summary of habitat types within the Ruakura South development footprint.*

| Description | Area (ha) | % of Total Designation |
|---|---|---|
| Rank grass, weedfield and pampas | 3.4 | 1.09 |
| Vegetation around waterways | 2.4 | 0.77 |
| Isolated wood and debris piles | 0.1 | 0.03 |
| Lizard habitat around buildings | 5.0 | 1.60 |
| Grazed pasture/unsuitable | 299.2 | 96.5 |
| **Total** | **310.1** | **100** |

The habitats described above are potentially suitable for grassland and open habitat skink species. However, given the long history of modification and lack of predator control within the site, there is a low likelihood of sizeable residual lizard populations within the site. If present, lizard fauna are likely to be restricted to a small number of common and widespread species.

## 3.2 Herpetofauna Database Search

The DOC Herpetofauna database contains records for one species of native lizard (copper skink) within 10 km of the Ruakura South site (DOC 2012). Lizards recorded within the Waikato Conservancy, and in habitats similar to those within the Ruakura South site are listed in Table 2. The three lizard species most likely to be seen are plague and copper skink, and ornate skink. We note that ornate skinks have not been recorded within the Ruakura South site (see Section3.3 3.3).

*Table 2: Herpetofauna database records for lizards within the Waikato Conservancy that could potentially occupy the Ruakura South site based on the available habitats. Conservation status and nomenclature follows Hitchmough et al. (2013).*

| Common name | Scientific name | Threat class | Habitat preferences (Landcare 2012) |
|---|---|---|---|
| Copper skink | *Oligosoma aeneum* | Not Threatened | Open and shaded areas where sufficient cover is available (e.g., rock piles, logs, dense vegetation). |
| Ornate skink | *Oligosoma ornatum* | Declining (Conservation Dependent) | Occupies moist habitats (e.g., under rocks and logs) and is very secretive. |
| Plague skink | *Lampropholis delicata* | Exotic (Unwanted Organism) | Occupy open habitats including rough pasture and clearings under vegetation. |

## 3.3 Baseline Surveys

### 3.3.1 Survey methods

A preliminary qualitative survey of the site was carried out in 11 December 2013, and ecologists noted the presence of small localised populations of copper skink (1-3 individuals) under natural and artificial debris and in vegetation along drain margins within the Ruakura South area. An additional 2 copper skinks were observed in similar habitats in Ruakura North. Further survey work is required to confirm the presence and extent of lizard communities within the site, and will be undertaken as part of the LDPA implementation process.

A robust survey of lizard populations within specific habitat types on the site should be carried out in summer 2015-6, or before vegetation clearance begins[2]. The survey objectives will be to determine what species are present and how they are distributed across the site (i.e., inventory survey), to inform site specific Lizard Management Plan - Implementation Plans for each LDPA. Sample sites are identified in Figure 3 (Appendix A).

The survey methodology should comprise variety of techniques including systematic searches, artificial retreats and funnel traps (i.e., Gee's minnow traps). These methods are detailed in the Department of Conservation Inventory and Monitoring Toolbox: Herpetofauna (DoC 2012b).

Plague skinks (also known as rainbow skinks) are an exotic species and are classified as Unwanted Organism (UO). The presence of plague skinks should be noted, but should not trigger any further management action. Additionally, care should be taken to avoid transporting plague skinks around the site.

Vegetation within the site is unsuitable for arboreal geckos, and lizard survey methods will not include methods appropriate for geckos.

### 3.3.2 Limitations of survey methods

Lizard survey methods currently available have poor detection rates as a consequence of typically low population densities, species' cryptic colouration, difficulty in surveying preferred habitats, and behaviour/activity patterns. As such, even an intensive lizard survey will not detect all individuals in the population or, possibly all species present, but will indicate whether the site is occupied by lizards and whether further action is required.

Lizard survey methods are strongly weather dependent, and surveys should be carried out in fine weather, ideally in the days following rain when lizards are most likely to be active. A description of specific limitations associated with survey methods is provided in Department of Conservation Inventory and Monitoring Toolbox: Herpetofauna (DoC 2012b).

## 3.4 Summary of lizard values within the Ruakura South site

The Ruakura South site has low habitat values for indigenous lizards, based on the small, generally poor quality and isolated habitats available. Most of the site comprises cropland and pasture subject to regular disturbance, and thus unsuitable as long term habitat. Three copper skinks and several plague skinks were previously observed within Ruakura South.

[2] If required, this survey will also act as a salvage operation for lizard immediately affected by site development in the first Ruakura South LDPA proposed for development, Area A.

# 4.0 Lizard Capture Methods

Indigenous lizards are required to be captured and removed from each Ruakura South LDPA before development commences. The following sections set out the most appropriate methods for lizard capture.

- Lizard capture should be undertaken between September to May (preferably September – December, March-May) outside of extreme heat, but when higher temperatures facilitate high lizard activity and increase the likelihood of detection and capture.
- Lizard survey methodology should comprise a range of methods to maximise potential to capture indigenous lizards. Capture must be undertaken using a combination of the following:
    - Artificial refuges
    - Baited pitfall traps
    - Funnel traps
    - Visual searches
    - Destructive habitat searches
- Selection of survey tools must follow Department of Conservation Inventory and Monitoring Toolbox: Herpetofauna guidelines (DOC 2013) or subsequent best practice guidelines.
- Traps must be checked in the morning and must contain a moist sponge and a mesh layer to reduce stress on animals, and as far as possible exclude predators.
- Lizard capture will be based on depletion trapping. Trapping must be carried out over at least 3 successive days until no lizards are caught. If lizards are still being caught after 3 days, continue over subsequent days until no lizards are caught.
- Clearance of vegetation (identified in the site specific Lizard Management Plan - Implementation Plans for each LDPA) likely to be occupied by lizards should be supervised by a qualified herpetologist (destructive habitat searches), and the remaining indigenous lizards removed during works if the development schedule allows. Destructive habitat searches will apply to swards of rough grass, large wood piles and pampas that are cleared by machinery.

All captured indigenous lizards will be transferred directly to an approved release site unless one is not available (Section 6.0). If a release site is not available, captured lizards should be held in an approved captive facility (e.g., Massey University Albany Campus).

# 5.0 Transfer and Live Storage

The following procedures must be followed for the transfer of indigenous lizards.

- Lizards must be transferred between capture and release habitats in individual cloth bags in appropriately sized, well-ventilated containers with secure lids.

- The storage container must be cleaned and thoroughly disinfected prior to use and will contain habitat elements (grass, cover objects) to reduce stress.
- While contained, lizards will be kept in a cool place, and transferred within 6 hours of capture to an approved release site.
- Lizards from each LDPA shall be stored separately to reduce stress and the likelihood of possible territorial/dominance behaviours.

# 6.0 Release Site

## 6.1 Design and Habitat Requirements

A lizard release site will be designed to accommodate lizards within grassland habitats, similar to those from which they were captured. A release site may be selected that requires habitat creation and enhancement (e.g. placement of rock piles, logs and cover objects), re-vegetation, and predator control.

Re-vegetation should be carefully planned to include indigenous endemic species that provide habitat and refuges (e.g., *Muehlenbekia complexa*), and food (e.g., fruiting species such as *Coprosma robusta*) throughout the year. Predator control, should include rodent and mustelid management and may include both trapping and poison baits. Any proposed predator control should align with the wider management of the release site, taking into account the location and other site uses.

Key considerations for lizard release sites include:

- **Suitable existing habitat:** the release site should provide habitat appropriate to the lizards captured with the Ruakura South site. The site may or may not be currently occupied by lizards.
- **Long term security:** the release site should be outside of any known or predicted development area or access route during development.
- **Accessibility:** the release site must be accessible for lizard population monitoring and pest control.
- **Enhancement potential:** it must be possible to add lizard-friendly habitat elements to the existing habitats to accommodate additional lizard populations over time as future lizard salvage operations are completed.

Two potential release sites that meet these criteria have been identified, these are within Chelmsford Park and within an 'Open Space' area in Ruakura South. These sites are described in Section 6.2 and 6.3 below and identified in Figure 4 (Appendix A). The proposed lizard release site at Chelmsford Park requires agreement with Hamilton City Council and integration of lizard management into the existing Neighbourhood and Amenity Reserves Management Plan provisions (Section 6.2.6).

The proposed Ruakura South Open Space release site (Basin 1) will be integrated into the landscape design for the Ruakura South development, and will be designed specifically to house lizards salvaged from the Ruakura South property. Use of either the Chelmsford Park or Basin 1 release sites will be at the discretion of the project herpetologist and will take into account habitat suitability at the time of release and estimated population density.

## 6.2 Proposed Release Site: Chelmsford Park

### 6.2.1 Site Description

Chelmsford Park is a 'neighbourhood park' located in the suburb of Hillcrest, approximately 0.3 km south of the southern boundary of Ruakura South (Figure 4, Appendix A). Chelmsford Park borders a northern tributary of Mangaonua Gully which is the subject of a restoration programme led by Hamilton City Council (Gully Restoration Programme) and managed under the provisions of the Gully Reserves Management Plan.

Chelmsford Park is 2.53ha, the majority of which comprises well-maintained turf bordered by trees and housing on three sides. The Park is fringed by mature trees, dominated by large Eucalyptus with lower stature native shrubs including *Coprosma* spp, matai and fern underneath. This vegetated fringe is approximately 10m wide, bordering a steep gully and waterway. The terrestrial layer was very damp at the time of survey (and likely most of the year), well shaded and dominated by *Tradescantia fluminensis* with a shallow layer of leaf litter and debris. Woody debris was generally rare on the forest floor.

Although the park will continue to be managed as amenity parkland with mown turf, there is scope for development of a lizard habitat area near existing restoration planting on the south eastern edge. This 0.1ha area borders Mangaonua Gully and has been replanted with kanuka, flax, hebe and cabbage trees. Plantings are well-spaced and the ground layer does not presently have a deep organic layer, leaving lizards exposed to predators. Development of this area as a release site would require habitat enhancement, as detailed below (Section 6.2.2).

### 6.2.2 Habitat Enhancement

Enhancement of the proposed lizard release site at Chelmsford Park should include expanding the area around the restoration planting on the south western fringe by planting with low stature divaricating shrubs (*Muehlenbeckia* and *Coprosma* species) into existing turf. The grass in this area should be allowed to grow rank around the shrubs providing additional cover for lizards.

The restoration planting area at the release site contains very little leaf litter and other refugia, this should be supplemented by leaf litter, soil, wood discs, logs and rocks that would be salvaged from the development site. These elements would contribute both habitat and prey items.

Park management practises should take into account best practise methods for managing lizard habitats. In particular weed control and revegetation practises should preclude the use of weed matting, mulching and broadcast spraying.

### 6.2.3 Predator Control

Pest control within the release site should complement the existing pest management regime and seek to reduce rodent and mustelid density (see Section 7.3). We note that cats and chickens observed in the area are both significant predators of skinks, but cannot be easily controlled in an urban environment. Both of these are opportunistic, visual predators and it is anticipated that the proposed habitat enhancement described above will provide sufficient cover for skinks allowing them to move around without being detected. Further detail regarding predator control is provided in Section 7.3.

### 6.2.4 Suitability for likely lizard species

At present, the proposed lizard release area appears to have low habitat value due to insufficient cover from plants or other refugia. In addition, the invertebrate community is also likely to be supressed because of mulching around restoration plantings. For this reason, it is unlikely to be occupied by high numbers of indigenous lizards at present, and the potential for competition from a resident lizard population is low.

Ornate skinks occupy habitats including leaf litter, ground tier vegetation (including weedy species such as *Tradescantia*) and grasslands. In particular, ornate skinks are often found in high densities at bush-grassland interface (Chapman, 2010). This habitat would provide such an interface with the proposed grassland/low shrub and the Managonua Gully bush. Copper skinks occupy similar, but more open and dry habitats provided cover is available (dense grass, logs, rocks).

Provided that habitat enhancement occurs as set out above, Chelmsford Park will provide sufficient habitat of suitable quality for indigenous lizards salvaged from Ruakura South.

### 6.2.5 Release site capacity

The proposed release site is approximately 0.1ha with scope to expand if required. Lizards are also able to move freely into the denser bush/scrub behind the proposed release site, or into the native grass margin along the southern fence line.

Based on published lizard density estimates, 0.1ha of grassland habitat and forest/non-forest areas (without additional refuges, or pest control) could sustain 90 – 250 copper skinks (~900/ha – 2500/ha, Porter 1987 and Towns and Elliott 1996, respectively) or 56 ornate skinks (566/ha Whitaker 1968). With the habitat enhancement noted in Section 6.2.2, the 0.1ha release area will provide habitat for up to 200 lizards. This area could be expanded to provide habitat for a larger number of animals.

### 6.2.6 Long term protection and management

Chelmsford Park is owned and managed by Hamilton City Council. TGH is in the process of formalising an agreement for use of part of the park as an indigenous lizard release site in partnership with HCC. Chelmsford Park is managed under provisions of the Neighbourhood and Amenity Parks Reserves Management Plan (RMP).

When the RMP is reviewed, HCC will seek to include provisions for Chelmsford Park to relating to the management of indigenous lizard habitat areas. Proposed management provisions are likely to include:

- Delineation of indigenous lizard management areas.
- Plant specifications for planting within those areas (e.g. fruiting divaricating vine species such as *Muehlenbeckia* and *Coprosma*).
- Fencing or bollards to prevent mowing of rank grass areas.
- Ongoing pest management to supplement or complement the existing pest management regime.
- Ongoing addition of habitat features for native lizards including logs, wood discs and rocks.

Until changes to RMP can be implemented through the RMP statutory review process, to provide certainty regarding lizard management, TGH will establish a Memorandum of Understanding (MOU) or similar instrument between HCC and TGH. This document will serve as an interim measure to establish the lizard management areas while also defining the responsibilities of the parties in contributing to site management. The MOU will specify:

- The parties to the agreement,
- The lizard management areas,
- Habitat enhancement to be undertaken by the parties,
- Pest/predator management to be undertaken by the parties, and
- Change in current reserve management required (e.g. mowing/spraying exclusion areas) and signage.

## 6.3 Proposed Release Site: Basin 1

### 6.3.1 Site Description

An area of Basin 1 (BS1) is proposed for the creation of a lizard release site. BS1is located to the south east of development area, immediately adjacent to Mangaonua Gully. BS1 is approximately 8 ha in total, and is currently grazed pasture (Figure 4, Appendix A). Vegetation cover is minimal at present, but the area will be replanted as part of the landscape and urban design for the wider area.

An area of the site, yet to be determined, will be planted and managed as a specifically designed lizard release site within a wider industrial/logistics development. Development of some of this area as a lizard release site would require habitat enhancement, as detailed below (Section 6.3.2).

### 6.3.2 Habitat Enhancement

Enhancement of the proposed lizard release site within BS1 should include planting with low stature divaricating shrubs (*Muehlenbeckia* and *Coprosma* species). The grass in this area should be allowed to grow rank around the shrubs providing additional cover for lizards.

In addition to planting, habitat enhancement should include leaf litter, soil, wood discs, logs and rocks that would be salvaged from the development site and elsewhere if required. These elements would contribute both habitat and prey items.

Development of the release site should take into account of best practise methods for managing lizard habitats. In particular weed control and revegetation practises should preclude the use of weed matting, mulching and broadcast spraying.

### 6.3.3 Predator Control

Pest control within the release site should seek to reduce rodent and mustelid density (see Section 7.3). We note that cats are a significant predator of skinks, but cannot be easily controlled in an urban environment. They are opportunistic, visual predators and it is anticipated that the proposed habitat enhancement described above will provide sufficient cover for skinks allowing

them to move around without being detected. Further detail regarding predator control is provided in Section 7.3.

### 6.3.4 Suitability for likely lizard species

At present, the proposed Ruakura South BS1 lizard release area has very low lizard habitat value due to insufficient cover from plants or other refugia. In addition, the invertebrate community is also likely to be supressed because of land-use practises. For this reason, it is unlikely to be occupied by indigenous lizards at present, and the potential for competition from a resident lizard population is very low. As described in Section 6.2.4 ornate and copper skinks occupy marginal habitats at bush-grassland interface. Provided that habitat enhancement occurs as set out above, Ruakura South BS1 release site will provide sufficient habitat of suitable quality for indigenous lizards salvaged from Ruakura South.

### 6.3.5 Release site capacity

The area of the proposed release site is still yet to be determined, but is likely to be approximately 0.6ha. This habitat is connected to a larger open space corridor (Mangaonua Gully), and there may be potential for lizards to move into this area.

Based on published lizard density estimates, 0.6ha of grassland habitat and forest/non-forest areas (without additional refuges, or pest control) could sustain 540 – 1500 copper skinks (~900/ha – 2500/ha, Porter 1987 and Towns and Elliott 1996, respectively) or 340 ornate skinks (566/ha Whitaker 1968). We note that lizards will not reach this density, but demonstrate that there is ample potential for population expansion within the site. With the habitat enhancement noted in Section 6.3.2, the 0.6ha release area will provide habitat for a minimum of 300 lizards.

### 6.3.6 Long term protection and management

The Ruakura South BS1 is owned by TGH and will be a dedicated open space/stormwater treatment site within the development area, with ongoing pest control and long term protection from development.

# 7.0 Ongoing Management and Monitoring

## 7.1 Background

Capture and release of more than 20 individuals (including multi-species groups) within a year will trigger monitoring.

We note that lizard survey and monitoring tools have poor detection rates at low population densities. As such, it is unlikely that lizards will be released in sufficient numbers to evaluate the success of translocated individuals over the extended period of development (in excess of 20 years) and hence if less than 20 individuals are released no future monitoring will be required.

However, if sufficient numbers of lizards are released (i.e. >20 individuals), biennial lizard inventory surveys will be carried out in the release site to detect resident lizard populations. This survey will be used as a proxy for monitoring of the health of the released individuals themselves. Post-

release monitoring will aim to indicate the population viability of skinks within the release site whereby detection of lizards of different age classes will indicate that the habitat continues to be suitable for lizards.

## 7.2 Monitoring

Release site monitoring methods[3] include:

- **Artificial retreats (ARs):** Onduline ARs will be installed in release sites to monitor skinks. AR density will be based on habitat suitability and the number of lizards released.
- **Pitfall traps:** pitfall traps, baited with pear or banana will be installed in release sites to monitor skinks. Traps will be checked daily for two days and will be closed when not in use. Trap density will be based on habitat suitability and the number of lizards released.
- **Habitat searching:** Refuges, including dead wood and rocks will be searched opportunistically where available. Habitat searches will focus on elements added as part of habitat enhancement.

Traps will be removed when not in use.

## 7.3 Predator Control

Predator control for rodents and mustelids will be carried out by a suitably qualified contractor at the release site. Predator control will include an initial 'knockdown' phase of high intensity baiting and trap checks 3 months prior to lizard release, followed by continued suppression for up to five years following release of lizards. Predator control will be undertaken in conjunction with that already undertaken by HCC at Chelmsford Park. The predator control regime will be determined by the contractor in consultation with the herpetologist at the release sites during site setup. Bait stations will be inspected and re-baited quarterly in the first year, thereafter to be reviewed annually and maintained as appropriate.

## 7.4 Adaptive management and response

This section outlines a process for adaptive management of native lizards at Ruakura South, acknowledging that there may be unknown factors that affect lizard survival within created lizard habitats.

Where the monitoring described in Section 7.2 fails to detect lizards following release, the survey effort will be increased (in area and trapping effort) until such time as the monitoring conditions are met, or the monitoring survey period exceeds 1 week. The release site will be reviewed, and a new one will be chosen if required.

[3] Monitoring methods are described in Department of Conservation Inventory and Monitoring Toolbox: Herpetofauna (DoC 2012).

# 8.0 NLMP Implementation

## 8.1 NLMP Implementation Report

At least 3 months before site development commences in a LDPA, a NLMP Implementation Report shall be prepared by a suitably qualified and experienced herpetologist for each Ruakura South development stage. The Implementation Report shall:

- Identify all potential lizard habitats within the development stage on a plan.
- Set out the proposed timeframe for:
    - Commencement of construction within the stage.
    - Trap establishment (minimum of 8 weeks prior to salvage operation).
    - Lizard salvage
    - Anticipated lizard release (dependent on habitat establishment).

The Implementation Report shall be submitted to:

- Waikato Regional Council (WRC) – Resource Use Directorate
- Department of Conservation (DOC, if required)
- Hamilton City Council (HCC) – City Planning Manager
- WTTEU

A lizard capture record template is provided in Appendix A.

## 8.2 Lizard Capture – Prior Notification

For each lizard capture, the following notification is required:

- Every person intending to enter any part of the site under the control of a site/construction manager for the purposes of lizard capture shall notify the site/construction manager at least 1 week prior to undertaking the work, and shall undertake any site induction required.
- At least 24hrs prior to lizard capture commencing, confirmation of site access must be made to site/construction manager.
- Any person undertaking lizard management activities within the Ruakura South area shall complete a Health & Safety plan.

## 8.3 Lizard Capture - Reporting

### 8.3.1 Lizard Capture Information

For every lizard capture event, the herpetologist responsible for lizard capture shall record the following information:

- DOC Wildlife Permit number and details

- Species and number caught
- Size
- Health/condition
- Location of capture (GPS coordinates)
- The live storage facility the lizards were transferred to
- Additional information required on ARDS cards (weather, habitat etc.).

A lizard capture record template is provided in Appendix B.

Within 1 month following the lizard capture event, these records must be submitted to DOC Herpetofauna database.

### 8.3.2 Lizard Salvage Notification

At least 48 hours before construction commences, the herpetologist responsible for lizard capture shall confirm in writing by email that lizard salvage has been undertaken within the LDPA to be developed. The following parties shall be notified:

- WRC – Resource Use Directorate
- HCC – City Planning Manager
- LDPA Construction manager

## 8.4 Ruakura-Wide Annual Reporting

BML shall prepare an annual advisory report on lizard management. This will be submitted to:

- DOC – Local Partnerships Ranger
- WRC – Resource Use Directorate
- WTTEU
- HCC – City Planning Manager

The report shall set out:

- The permit numbers under which lizard capture/release was undertaken.
- The location (GPS coordinates), number and species of lizards caught, and a map showing this.
- The containment facility that captured lizards were transferred to and the person/organisation with responsibility for their storage/maintenance (if applicable).
- The location of the release site and the results of any subsequent monitoring.

# 9.0 Analysis of Risk Related to this NLMP

## 9.1 Types of Risk

Rule 25H.11.1 xi (d) requires that this NLMP contains an "analysis of risk relating to timing of collection, containment and translocation". Although poor timing is a risk to successful lizard

salvage, there are several other risks with respect to the implementation of this plan. These are described below.

## 9.2 Poor timing

Indigenous lizard salvage and monitoring should be carried out in fine weather between September to May (preferably September – December, March-May) to ensure maximum likelihood of lizard detection. Likewise, if it is not possible to release lizards immediately, they should be released in the summer months. Precautions must be taken with gravid females where handling and release may cause additional stress. In this case, lizards should be released after giving birth.

## 9.3 Out-of-season Contingency and Incidental Finds

Any indigenous lizards captured from supervised vegetation clearance during autumn and winter months (May through July) will be held in a DOC-approved captive facility until the following spring. They will be released into appropriate release site during stable warm weather (August - April) to enhance the chances of survival and establishment.

Should incidental finds of indigenous lizards occur outside of the proposed rescue/salvage programme, the project herpetologist will be notified to advise a course of action.

## 9.4 Stress to Lizards

Stress associated with trapping, handling, captive keeping (if required) and release will be managed as follows:

**Handling:** Lizard handling will be kept to a minimum and will only be carried out by trained and experienced staff. Lizards will be released as soon as possible and within 24 hours.

**Trapping:** Pitfall traps will be covered and will contain debris to provide refuge for lizards. Traps will be checked daily, in the morning.

**Captive keeping:** Indigenous lizards will be maintained in captivity by experienced, trained and permitted keepers. Body condition and health will be monitored to ensure that lizards are released in as good as, or better condition that they were caught in.

**Release site:** Indigenous lizards will only be released into habitat that is the same as, or better than where they were captured. This will be assessed by an experienced herpetologist. Lizards will be released in the same groups as they were captured, and juveniles born in captivity will be released to the same release site as their mother.

## 9.5 Injury and Mortality during Clearance

There is a risk of injury and mortality to lizards if lizards are overlooked during the survey and salvage operations. The approach taken in this NLMP is to focus resources on areas most likely to be inhabited by indigenous lizards. The methods described above (destructive searching, trapping) will provide the best chance to capture lizards prior to construction.

# 10.0 References


Anderson P, Bell T, Chapman S, Corbett K. 2012. New Zealand Lizards Conservation Toolkit – A resource for conservation management of the lizards of New Zealand. A SRARNZ Miscellaneous Publication. Society for Research on Amphibians and Reptiles of New Zealand.

Board of Enquiry 2014. Proposed Ruakura Development Plan Change. Final Report and Decision of the Board of Enquiry into the Proposed Ruakura Development Plan Change. 9 September 2014.

Boffa Miskell 2011. *Ruakura Estate Environmental Framework - Draft.* Prepared for Tainui Group Holdings and Chedworth Park Limited.

Chapman S 2010. Auckland Region Reptile Report. Report prepared for Auckland Regional Council. 25 pp.

DOC 2012. Department of Conservation Bioweb Herpetofauna Database. Accessed 20 July 2012.

DOC 2012b. Department of Conservation Inventory and Monitoring Toolbox: Herpetofauna. http://www.doc.govt.nz/publications/science-and-technical/doc-procedures-and-sops/biodiversity-inventory-and-monitoring/taxa-modules/herpetofauna/

Hitchmough R, Anderson P, Barr B, Monks J, Lettink M, Reardon J, Tocher M, Whitaker A 2013. *New Zealand Threat Classification Series 2*. 16 p.

Landcare 2012. New Zealand Lizards Database. http://nzlizards.landcareresearch.co.nz/. accessed 20 July 2012.

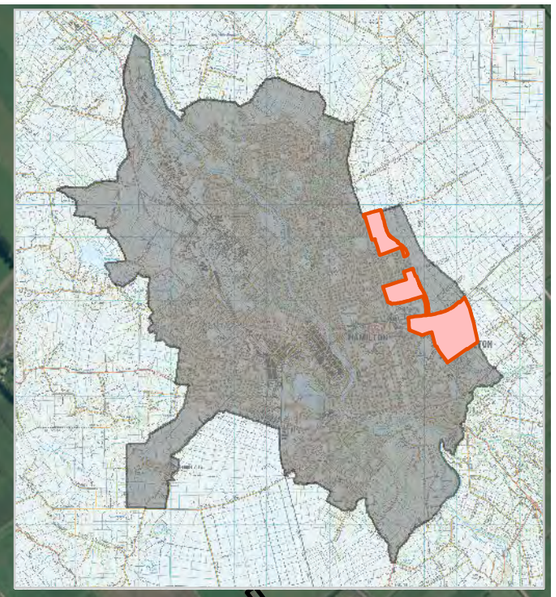
Porter R 1987. An ecological comparison of two Cyclodina skinks (Reptilia: Lacertilia in Auckland, New Zealand. New Zealand Journal of Zoology 14: 493-507.

Towns DR and Elliott GP 1996. Effects of habitat structure on distribution and abundance of lizards at Pukerua Bay, Wellington, New Zealand. Journal of Ecology 20 (2):191-206.

van Winkel D 2009. Shakespear Regional Park lizard monitoring report. Report prepared for Auckland Regional Council, Auckland. 50p.

Whitaker AH 1968. The lizards of the Poor Knights Islands, New Zealand. New Zealand Journal of Science 11 (4): 623-651.

# Appendix 1: Maps and Photographs




LINZ and Eagle Technology

Boffa Miskell
www.boffamiskell.co.nz



0 0.25 0.5 km

1:12,500 @ A3

*Data Sources: LINZ and Eagle Technology Aerials, Boffa Miskell*

Legend

- Plan Change Area
- Tainui Land Use
  - Residential General
  - Residential Medium Density
  - Commercial, Retail
  - Employment, Industrial, Powerlines
  - Innovation Park
  - Ag Research
  - Logistics Zone
  - Open Space
  - Private Land
  - Expressway Designation
  - LDP Boundary

**A15111 TAINUI RUAKURA STRUCTURAL PLAN AREA**

# Figure 1: Location/Context Map

**Date: 10 August 2015 | Revision: 0**

Plan Prepared by Boffa Miskell Limited

*Author:* SGa | *Checked:* KMu

*Figure 2: Potential lizard habitats within Ruakura South development footprint.*

**Rank grass, weedfield and pampas**

**Vegetation around waterways**

**Isolated wood and debris piles**

**Lizard habitat around buildings**


Boffa Miskell
www.boffamiskell.co.nz



0 0.25 0.5 km

1:12,500 @ A3

*Data Sources: LINZ and Eagle Technology Aerials, Boffa Miskell*

Legend

- Lizard Habitats
  - Rank Grass, weedfield and pampas
  - Vegetation around waterways
  - Isolated wood and debris piles
  - Lizard habitat around buildings
- Plan Change Area

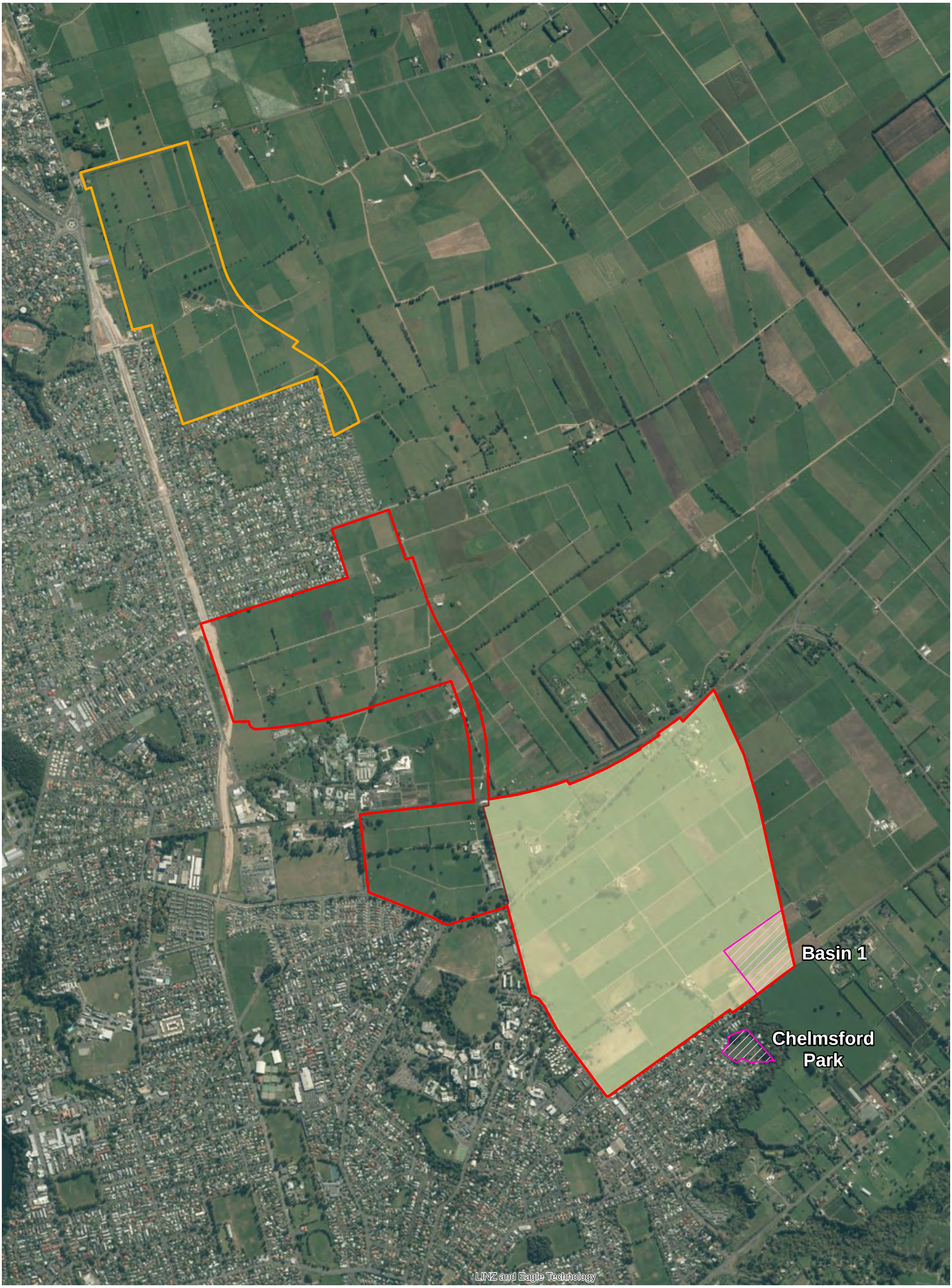
**A15111 TAINUI RUAKURA STRUCTURAL PLAN AREA**

# Figure 3: Potential Lizard Habitats in Ruakura South

**Date: 10 August 2015 | Revision: 0**

Plan Prepared by Boffa Miskell Limited

*Author:* SGa | *Checked:* KMu






Boffa Miskell
www.boffamiskell.co.nz

0 250 500 m
1:17,500 @ A3

*Data Sources: LINZ and Eagle Technology Aerials, Boffa Miskell*
*Projection: NZGD 2000 New Zealand Transverse Mercator*

Legend
- Plan Change Area
- Ruakura North Property
- Ruakura South Property
- Potential Lizard Release Site
- Area A

**A15111 TAINUI RUAKURA STRUCTURAL PLAN AREA**

# Figure 4: Potential Lizard Release Sites

**Date: 2 June 2016 | Revision: B**
Plan Prepared by Boffa Miskell Limited
*Drawn:* JWa | *Checked:* KMi

# Appendix 2: NLMP Implementation Report Template

# RUAKURA SOUTH NATIVE LIZARD MANAGEMENT

Implementation Report for Land Development Plan Area XX

Prepared for [insert client name here]

Click here to enter a date.

Boffa Miskell

## Document Quality Assurance

| | | |
|---|---|---|
| **Bibliographic reference for citation:**<br>[Company] Click here to enter a date.. *RUAKURA SOUTH NATIVE LIZARD MANAGEMENT: Implementation Report for Land Development Plan Area XX*. Report prepared by [Company] for [insert client name here]. | | |
| Prepared by: | NAME<br>ROLE<br>[Company] | |
| Reviewed by: | NAME<br>ROLE<br>[Company] | |
| Status: [Status] | Revision / version: 1 | Issue date: Click here to enter a date. |



Template revision: 20120608 0000

*Cover photograph: Ruakura and Hamilton City, © Tainui Group Holdings Ltd.*

File ref: T13094_001_Riparian_Mgmt_Report_20130716_LC.docx

# CONTENTS



# Glossary

| | |
|---|---|
| BML | Boffa Miskell Ltd |
| HCC | Hamilton City Council |
| LDPA | Land development plan area |
| MPI | Ministry for Primary Industries |
| NLMP | Native Lizard Management Plan |
| WRC | Waikato Regional Council |

# 1.0 Introduction

This Implementation Report has been prepared for Land Development Plan Area (LDPA) XXX.

It sets out the methods that will be used to meet the requirements of the Ruakura South Native Lizard Management Plan (NLMP) to retain native lizard populations within the LDPA. This report supplements the NLMP (BML 2015).

The objective of the Implementation Report is to guide lizard management activities within the context of each LDPA. This report contains details that specify the survey and salvage methods to be implemented prior to site development and describes procedures for holding lizards during construction (if required) and reintroducing them to a release site as soon as possible. In addition, project management procedures and responsibilities are outlined. This Report is based on the template provided in Appendix 1 of the NLMP and has been prepared to meet the requirements of section 25H11.2 (k) Landscape Concept and Ecological Enhancement Plan bullet 10 of the Ruakura Plan Change.

This Report applies to all potential lizard habitats (i.e., all vegetated areas, wood and debris piles and around buildings) within LDPA XXX.

# 2.0 Existing Habitats

## 2.1 Description

LDPA XXX covers an area of XX ha (Figure 1).

Within that, there are XX ha of existing lizard habitat comprised of:

| Description | Area (ha) | % of LDPA |
|---|---|---|
| Open rank grass margins | X | X |
| Shaded rank grass | X | X |
| Rank grass under exotic trees | X | X |
| Lizard habitat around buildings | X | X |
| Large wood piles | X | X |
| Active cropland/grazed pasture | X | X |
| **Total** | **X** | **100** |

## 2.2 Native Lizard Habitat

Based on the information provided in NLMP Figure XX, the LDPA areas described in Section 2.1 provide habitat for: [select applicable options].

- Copper skink (Oligosoma aeneum)
- Ornate skink (O. ornatum).

The total area of habitat available for native lizard prior to development within the LDPA is estimated to be X ha.

## 2.3 Pre-construction Lizard Survey

A minimum of 2 weeks before the commencement of earthworks the habitats identified in Section 2.1 will be surveyed for the presence of native lizards. Depending on the characteristics of the habitat, the following methods will be used:

- Artificial cover objects (ACOs)[1]
- Funnel traps
- Pitfall traps

All lizard surveys must be conducted during the period of September to May (preferably September – December, March-May) outside of extreme heat, but when higher temperatures facilitate high lizard activity and increase the likelihood detection and capture.

## 2.4 Lizard Salvage Methods

After the pre-construction lizard survey and immediately prior to the commencement of earthworks, a lizard salvage operation will be undertaken in habitats where native lizards were confirmed present. The following methods will be employed to salvage native lizards from these areas:

- Artificial cover objects (ACOs)
- Funnel trapping
- Pitfall trapping

# 3.0 Lizard Release

Lizard release sites will be designed to accommodate lizards within grassland habitats, similar to those from which they were captured. A release site may be selected that requires restoration work including habitat creation and enhancement (e.g., placement of rock piles, logs and cover objects), re-vegetation and predator control. Two lizard release sites (Ruakura South Open Space, and Chelmsford Park) have been identified. The lizard release site used depends on the condition of the habitat during the lizard salvage.

[1] Artificial cover objects will be used in open habitats and left in situ for a minimum of 2 months to 'settle in'. Lizard salvage can begin after this settling in period.

The following is a checklist that must be completed by an appropriately experienced herpetologist, prior to lizard capture and release.

| | |
|---|---|
| Date of release | XX |
| Released from LDPA | XX |
| Herpetologist in charge: | XX |
| Release site location | XX |
| Release site condition | Excellent/Good/Stable/Poor |
| Pest control requirements met | Yes/No |
| Additional habitat enhancement required | Yes/No |

# 4.0 Roles and Responsibilities

The following table sets out the roles and responsibilities associated with the development of LDPA XX in relation to native lizard management.

Items 3-9 must be carried out by, or under the direct supervision of, an appropriately experienced herpetologist.

Item 6 must be provided by a native lizard live holding facility with appropriate experience.

*Table 1 Roles and responsibilities associated with the Ruakura North NLMP*

| Item No. | | **Organisation** | **Contact Person** | **Contact Details** |
|---|---|---|---|---|
| 1. | The LDPA landowner is: | | | |
| 2. | The construction manager responsible for LDPA development will be: | | | |
| 3. | Notifications and reporting required by the NLMP will be completed by: | | | |
| 4. | Lizard capture and removal from existing habitats will be carried out by: | | | |
| 5. | The lizards will be transferred to the live holding facility at: | | | |
| 6. | Certification of release sites as suitable for lizard release under the criteria | | | |

| | | | | |
|---|---|---|---|---|
| | specified in the NLMP will be carried out by: | | | |
| 7. | Lizard transfer and release will be carried out by: | | | |
| 8. | Post release pest control in the LDPA release habitats will be carried out by: | | | |
| 9. | Post release lizard monitoring will be carried out by: | | | |

# 5.0 Permits

The following permits are required to undertake the activities described in this report:

- DOC Wildlife Act permit for native wildlife handling and transfer: [Number]

Copies of this document are provided in Appendix XX and will be carried with ecologists at all times during lizard handling and transfer.

# 6.0 Timeframes

[Insert GANTT chart showing start/finish dates of the tasks listed below and any other tasks considered relevant to native fish management:

- Pre-Construction lizard survey
- Lizard salvage period
- Submission of capture records to Herpetofauna database and BML.
- Notification of lizard salvage completion.
- Commencement of construction across the LDPA.
- Anticipated lizard release date (if not immediate).
- Post-release lizard monitoring.]

# 7.0 Conclusion

This Implementation Report demonstrates the methods by which the provisions of the Ruakura Plan Change have been given effect to within the specifications of the Ruakura North Native Lizard Management Plan. We therefore consider that the design for LDPA XX will minimise mortality to lizards during site development.

# Appendix 1: Plans

# Appendix 2: Permits

Department of Conservation
*Te Papa Atawbai*

# Wildlife Act Authority for wildlife on non-public conservation land

Authorisation Number: 47995-FAU

**THIS AUTHORITY** is made this 5th day of May 2016

**PARTIES:**

**The Director-General of Conservation and where required the Minister of Conservation** (the Grantor)
**AND**

**Tainui Group Holdings Limited** (the Authority Holder)

**BACKGROUND:**

A. The Director-General of Conservation is empowered to issue authorisations under the Wildlife Act 1953.

B. The Authority Holder wishes to exercise the authorisation issued under the Wildlife Act 1953 subject to the terms and conditions of this Authority.

**OPERATIVE PARTS**

In exercise of the Grantor's powers the Grantor **AUTHORISES** the Authority Holder under Section 53 (Taking or Killing of Wildlife for Certain Purposes of the Wildlife Act 1953, subject to the terms and conditions contained in this Authority and its Schedules.

SIGNED on behalf of the Grantor by ***Ray Scrimgeour, Operations Manager, Hamilton***

acting under delegated authority

in the presence of:

Witness Signature

Witness Name: Paul F Hardy

Witness Occupation: Community Ranger

Witness Address: 73 Rostrevor St Hamilton NZ.

A copy of the Instrument of Delegation may be inspected at the Director-General's office at 18-32 Manners Street, Wellington.

# SCHEDULE 1

| | | |
|---|---|---|
| 1. | **Authorised activity (including the species, any approved quantities and collection methods).**<br>(Schedule 2, clause 2) | Survey, salvage and transfer of copper skink (*Oligosoma aeneum),* ornate skink (*Oligosoma ornatum)* and other unexpected lizard species found at development site. This involves:<br>- Catching and handling lizards on site;<br>- Transferring lizards no more than 500m from their source site; and/or<br>- Killing lizards (incidental kills) |
| 2. | **The Land**<br>(Schedule 2, clause 2) | Ruakura South, including the central and southern areas of the Ruakura R1 Structure Plan Area between Powells Road and Sheridan Street. |
| 3. | **Personnel authorised to undertake the Authorised Activity**<br>(Schedule 2, clause 3) | - Katherine Muchna;<br>- Georgia Cummings;<br>- Kieran Miller; and<br>- Other qualified personnel as supervised by the Authority Holder |
| 4. | **Term**<br>(Schedule 2, clause 4) | Commencing on and including 1 May 2016 and ending on and including 30 November 2025 |
| 5. | **Authority Holder's address for notices**<br>(Schedule 2, clause 8) | The Authority Holders address in New Zealand is:<br>Tainui Group Holdings Limited<br>c/- Boffa Miskell , 82 Wyndham Street, Auckland 1010<br>New Zealand<br>Phone: 09 358 8648<br>Email: Katherine.Muchna@boffamiskell.co.nz |
| 6. | **Grantor's address for notices** | The Grantor's address for all correspondence is:<br>Permissions Team<br>Level 4, 73 Rostrevor Street,<br>Hamilton 3204<br>Email: permissionshamilton@doc.govt.nz |

# SCHEDULE 2

## STANDARD TERMS AND CONDITIONS OF THE AUTHORITY

### 1. Interpretation

1.1 The Authority Holder is responsible for the acts and omissions of its employees, contractors or, agents. The Authority Holder is liable under this Authority for any breach of the terms of the Authority by its employees, contractors or agents as if the breach had been committed by the Authority Holder.

1.2 Where obligations bind more than one person, those obligations bind those persons jointly and separately.

### 2. What is being authorised?

2.1 The Authority Holder is only allowed to carry out the Authorised Activity in the Land described in Schedule 1, Item 2.

2.2 The Authority Holder must advise the Department of Conservation's local Operations Manager(s) one week prior to carrying out the Authorised Activity in the District, when the Authority Holder intends to carry out the Authorised Activity.

2.3 Any arrangements necessary for access over private land or leased land are the responsibility of the Authority Holder. In granting this authorisation the Grantor does not warrant that such access can be obtained.

2.4 The Authority Holder and Authorised Personnel must carry a copy of this Authority with them at all times while carrying out the Authorised Activity.

2.5 The Authority Holder may publish authorised research results.

2.6 The Authority Holder must immediately notify the Grantor of any taxa found which are new to science. In addition, the Authority Holder must lodge holotype specimens and a voucher specimen of any new taxa with a recognised national collection.

### 3. Who is authorised?

3.1 Only the Authority Holder and the Authorised Personnel described in Schedule 1, Item 3 are authorised to carry out the Authorised Activity, unless otherwise agreed in writing by the Grantor.

### 4. How long is the Authority for - the Term?

4.1 This Authority commences and ends on the dates set out in Schedule 1, Item 4.

### 5. What are the liabilities?

5.1 The Authority Holder agrees to exercise the Authority at the Authority Holder's own risk and releases to the full extent permitted by law the Grantor and the Grantor's employees and agents from all claims and demands of any kind and from all liability

which may arise in respect of any accident, damage or injury occurring to any person or property arising from the Authority Holder's exercise of the Authorised Activity.

5.2 The Authority Holder must indemnify the Grantor against all claims, actions, losses and expenses of any nature which the Grantor may suffer or incur or for which the Grantor may become liable arising from the Authority Holder's exercise of the Authorised Activity.

5.3 This indemnity is to continue after the expiry or termination of this Authority in respect of any acts or omissions occurring or arising before its expiry or termination.

## 6. What about compliance with legislation and Grantor's notices and directions?

6.1 The Authority Holder must comply with all statutes, bylaws and regulations, and all notices, directions and requisitions of the Grantor and any competent Authority relating to the conduct of the Authorised Activity. Without limitation, this includes the Conservation Act 1987 and the Acts listed in the First Schedule of that Act and all applicable health and safety legislation and regulation.

## 7. When can the Authority be terminated?

7.1 The Grantor may terminate this Authority at any time in respect of the whole or any part of Authorised Activity if:

(a) the Authority Holder breaches any of the conditions of this Authority; or

(b) in the Grantor's opinion, the carrying out of the Authorised Activity causes or is likely to cause any unforeseen or unacceptable effects.

7.2 If the Grantor intends to terminate this Authority in whole or in part, the Grantor must give the Authority Holder such prior notice as, in the sole opinion of the Grantor, appears reasonable and necessary in the circumstances.

## 8. How are notices sent and when are they received?

8.1 Any notice to be given under this Authority by the Grantor is to be in writing and made by personal delivery, by pre paid post or email to the Authority Holder at the address, fax number or email address specified in Schedule 1, Item 5. Any such notice is to be deemed to have been received:

(a) in the case of personal delivery, on the date of delivery;

(b) in the case of post, on the 3rd working day after posting;

(c) in the case of email, on the date receipt of the email is acknowledged by the addressee by return email or otherwise in writing.

8.2 If the Authority Holder's details specified in Schedule 1, Item 5 change then the Authority Holder must notify the Grantor within 5 working days of such change.

## 9. What about the payment of costs?

9.1 The Authority Holder must pay the standard Department of Conservation charge-out rates for any staff time and mileage required to monitor compliance with this Authority and to investigate any alleged breaches of the terms and conditions of it.

## 10. Are there any Special Conditions?

10.1 Special conditions are specified in Schedule 3. If there is a conflict between this Schedule 2 and the Special Conditions in Schedule 3, the Special Conditions will prevail.

## 11. Can the Authority be varied?

11.1 The Authority Holder may apply to the Grantor for variations to this Authority.

# SCHEDULE 3

## SPECIAL CONDITIONS

### 1. Lizard capture and survey

1.1 Only non-destructive search methods may be used unless the Area is to be impacted and is subject of a consented or permitted activity under the Resource Management Act or Conservation Act.

1.2 Capture and handling of lizards must involve only techniques that minimise the risk of infection or injury to the animal.

1.3 The Authority Holder must ensure all live capture traps are covered to protect lizards from exposure and minimise stress. Damp leaf litter or other material must be provided to reduce desiccation risk and the bottom of the pit-fall trap must be perforated to allow drainage of water.

1.4 The Authority Holder must ensure all live capture traps, (e.g. pitfall traps and G-minnow traps), are checked at least every 24 hours.

1.5 The Authority Holder must sterilise any instruments that come in contact with the lizards and/or are used to collect or measure lizards between each location. A separate holding bag must be used for each animal. All gear should be thoroughly cleaned and dried between sites.

1.6 The Authority Holder must ensure lizards are held temporarily in a suitable container (e.g. breathable cloth bag), and held out of direct sunlight to minimise the risk of overheating, stress and death.

### 2. Salvage, transfer and incidentally kill wildlife

2.1 The Authority Holder is only permitted to release wildlife:

a. that are classified as Not Threatened or At Risk species under the current threat classification system;

b. into release site(s) that are assessed by a qualified herpetologist [or other expert] as being of similar or better habitat than the source location, and capable of supporting that lizard species;

c. into release site(s) that are within five hundred (500) metres of the development footprint (or with consultation and agreement with the relevant DOC Services Manager);

d. into release site(s) where habitat for that species of wildlife has been enhanced and approved prior to relocation, using accepted techniques such as provision of extra refuges suitable for the species providing protection from predators (e.g. complex rock stack), or long-term predator control; and

e. into release site(s) where the site has long-term security from development or modification (e.g. Council or DOC- managed Reserves, covenants or District Plan provisions).

## 3. Lizard Salvage Reporting

3.1 A report is to be submitted in writing to the DOC Operations Manager, Hamilton Office, Level 4, 73 Rostrevor Street, by 30 June each year for the life of this Authorisation, summarising outcomes in accordance with the Species Specific Management Plan. Each report must include:

a. the species and number of any animals collected and released;
b. the GPS location (or a detailed map) of the collection point(s) and release point(s);
c. copies of approved Species Specific Management Plans; and
d. results of all surveys, monitoring or research.

Completed Amphibian and Reptile Distribution System (ARDS) cards for all herpetofauna sightings and captures (http://www.doc.govt.nz/conservation/native-animals/reptiles-and-frogs/species-information/herpetofauna-data-collection/ards-card/) must be sent to Herpetofauna, Department of Conservation, National Office, PO Box 10420 Wellington 6143 or herpetofauna@doc.govt.nz

## 4. Incidentally kill wildlife

4.1 The Authority Holder is permitted to kill wildlife provided reasonable efforts have been made to meet all of the terms and conditions expressed and implied in this Authority.

4.2 If any lizards are injured as part of the Authorised Activity, the Authority Holder shall contact a suitably qualified herpetologist to get advice on management of the lizard. The Authority Holder is authorised to euthanise injured animal(s) on recommendation of the qualified herpetologist.

# Appendix 3: Lizard Capture Reporting Templates

| **Ruakura South Lizard Capture Checklist** | | ☑ | **Date** |
|---|---|---|---|
| **LDPA ID:** | | | |
| **1. Prior to capture**<br>Notify intention to remove native lizards from specified area. | WRC – Resource Use Directorate | | |
| | Waikato-Tainui Tribal Environment Unit | | |
| | Lizard storage facility (if required) | | |
| | LDPA Construction Manager | | |
| | Site access permission obtained | | |
| **2. Lizard capture** | DOC permits obtained | | |
| | H&S Plan completed | | |
| | Habitat isolated | | |
| | Lizard capture records completed for each capture event | | |
| **3. After capture complete**<br>Notify that lizard removal from specified habitat has been completed. | WRC – Resource Use Directorate | | |
| | HCC – City Planning Manager | | |
| | LDPA Construction Manager | | |
| **4. Submit records** | Lizard capture records submitted to BML. | | |
| | Records submitted to DOC Herpetofauna Database. | | |

| **Ruakura South Lizard Capture Record – Database Submission Form** | | | |
|---|---|---|---|
| Date | Supervising Ecologist: | Personnel | |
| **Permits:**<br><br>DOC Permit No. for lizard handling:<br><br>DOC Permit No. for lizard transfer: | | | |
| **Ruakura South LDPA:** | | | |
| Habitat ID:<br><br>GPS co-ordinates: | | **Copper skink** | **Other** |
| | Number | | |
| | SVL | | |
| | Health | | |
| | Capture method | | |
| Habitat ID:<br><br>GPS co-ordinates: | Number | | |
| | SVL | | |
| | Health | | |
| | Capture method | | |
| Habitat ID:<br><br>GPS co-ordinates: | Number | | |
| | SVL | | |
| | Health | | |
| | Capture method | | |
| Habitat ID:<br><br>GPS co-ordinates: | Number | | |
| | SVL | | |
| | Health | | |
| | Capture method | | |
| Live storage facility (if required) | | | |
| Release site:<br><br>Description:<br><br><br>GPS co-ordinates | | | |

## Ruakura South Lizard Capture Notification

| | | |
|---|---|---|
| Waikato Tainui Tribal Environmental Unit<br><br>Email: TBA | Department of Conservation<br><br>Waikato Services Manager<br><br>Email: TBA | Waikato Regional Council – Resource Use Directorate<br><br>rugq@waikatoregion.govt.nz |

To whom it may concern:

In accordance with the Ruakura South Native Lizard Management Plan and the LDP NLMP Implementation Report, the following lizard species were captured within the LDPA as follows using the methods and permit numbers specified below:

| | | |
|---|---|---|
| **Ruakura South LDPA** | **Habitat ID** | **GPS co-ordinates** |
| | **1.** [Habitats identified as per LDPA Lizard Implementation Plan] | |
| **DOC permit number** | **2.** [Habitats identified as per LDPA Lizard Implementation Plan] | |
| | **3.** [Habitats identified as per LDPA Lizard Implementation Plan] | |

The following lizards were captured and transferred to a live storage facility/ predetermined release site [select as appropriate]:

| **Species** | **Number** | **Method (tick ☑)** | | | | |
|---|---|---|---|---|---|---|
| | | **Pitfall trap** | **AR** | **Funnel trap** | **Hand search** | **Other** |
| **Copper skink**<br><br>**Other** | | | | | | |
| **Copper skink**<br><br>**Other** | | | | | | |
| **Copper skink**<br><br>**Other** | | | | | | |
| **Copper skink**<br><br>**Other** | | | | | | |

I verify that lizard capture was been undertaken as set out above, and that lizard capture information has been submitted to the DOC database for reporting.

| **Name:** | **Title:** | **Signature:** |
|---|---|---|
| | | |

| **Ruakura South Lizard Removal Confirmation** | | |
|---|---|---|
| Waikato Regional Council – Resource Use Directorate<br><br>rugq@waikatoregion.govt.nz | Hamilton City Council<br><br>City Planning Manager<br><br>districtplanteam@hcc.govt.nz | LDPA Construction Manager |
| To whom it may concern:<br>In accordance with the LDP Lizard Implementation Plan, lizard removal was completed on waterways as follows: | | |
| **Ruakura South LDPA:** | **Waterway ID:** **GPS coordinates:** | |
| | **1.** [Habitats identified as per LDPA Lizard Implementation Plan] | |
| | **1.** [Habitats identified as per LDPA Lizard Implementation Plan] | |
| | **1.** [Habitats identified as per LDPA Lizard Implementation Plan] | |
| The following lizards were captured and transferred to a live storage facility/ suitable habitat downstream [select as appropriate]: | | Number |
| [Habitat ID] | Copper skink:<br><br>Other: | |
| [Habitat ID] | Copper skink:<br><br>Other: | |
| [Habitat ID] | Copper skink:<br><br>Other: | |
| I verify that fish removal has been completed on the waterways listed above and construction can commence. | | |
| Name | Title | Signature/Date |
| | | |

## Attachment E: Evidence of Iwi Consultation

2 October 2014

Dave Slaven
Boffa Miskell
PO Box 91250
Auckland 1142

Dear Dave

**Ruakura – Application to Handle Native Lizards**

The Waikato-Tainui tribe is made up of the descendants of the 33 Waikato haapu, represented by, at the date of this letter, 68 marae. There are approximately 64,572 registered members of Waikato-Tainui. The rohe of Waikato-Tainui extends considerably beyond, but includes all of the district of the Hamilton City Council in terms of the Local Government Act 2002 and the RMA. The land at Raukura is located centrally within the rohe and is a site a site a specific interest to Waikato-Tainui

Thank you for your Preliminary Report detailing the proposal to trap and handle Native Lizards as part of the Native Lizard Management Plan required to enable the development of the land at Ruakura. We have reviewed the proposal and your attached report and agree that the proposal is consistent with the objectives and policies of our Environmental Plan.

Please keep me updated on the progress of this work.

Regards,

Tim Manukau
Environment Manager
Waikato-Tainui Te Kauhanganui Incorporated

# Lizard Survey – Assessment against the Waikato – Tainui Environmental Plan

Finalised Preliminary Report in support of DoC Consent Application

7 October 2014

Boffa Miskell

## Document Quality Assurance

| | | |
|---|---|---|
| **Bibliographic reference for citation:**<br>Boffa Miskell Limited 2014. *Lizard Survey – Assessment against the Waikato – Tainui Environmental Plan:* Report prepared by Boffa Miskell Limited for Tainui Group Holdings Limited and Chedworth Park Limited. | | |
| Prepared by: | John Carter<br>Associate Principle/Planner<br>Boffa Miskell Limited |  |
| Reviewed by: | Dave Slaven<br>Director/Ecologist<br>Boffa Miskell Limited |  |
| Status: Final | Revision / version: [1] | Issue date: 7 October 2014 |



Template revision: 20140327 0000

File ref: Document2

# CONTENTS



# Appendices

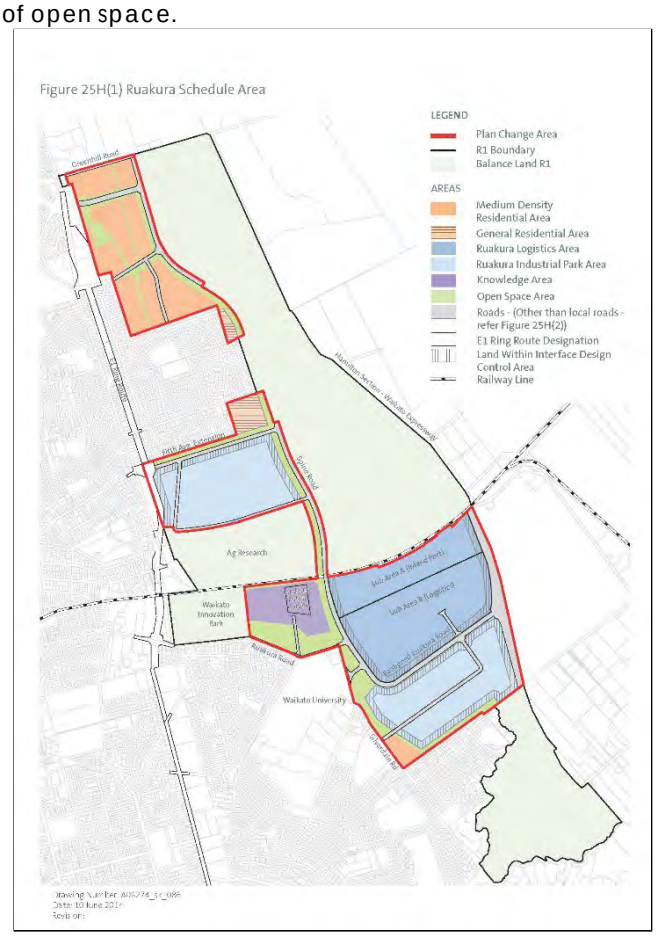
# 1.0 Introduction

The report is a finalised preliminary report to enable a high quality efficient consultation and engagement process with Waikato-Tainui. It has been prepared in line with the Waikato-Tainui Environmental Plan. It is indended to be submitted as a supporting document to the application for a permit to trap, handle and relocate native species of herpetofauna at Ruakura, Hamilton.

# 2.1 Background

On the 9 September 2014 the Board of Inquiry released its final decision approving the Ruakura Plan Change. The Plan Change set out the planning framework for the development of 389 Hectares of land located on the eastern side of Hamilton at Ruakura. The Plan Change consists of the following key elements;

- A logistics area which includes in inland port (the Ruakura Logistics Area)
- An industrial area (The Ruakura Industrial Park Area)
- Two Medium Density Residential Areas
- An expansion of the surrounding educational and innovation activities (the Knowledge Area)
- A 3.01 hectare retail centre located within the Knowledge Area
- 50 hectares of open space.



The plan change is highly strategic in nature. The key component of the development is the creation of an inland port with excellent access to key infrastructure and markets it also aim to provide for best practice in terms of water management and ecology. Development in Ruakura is to be guided by the following vision;

I. The expansion of the City to provide a significant new employment area based around the development of a regional logistics hub which will form a catalyst for further development and attract a wider range of business to the City.

II. Maximise the use of existing infrastructure investment, including the railway network, and align land use patterns with the area's planned infrastructure investment to achieve integrated transport and land use development; with an emphasis on logistics and freight.

III. Create opportunities for the ongoing development of research, learning and innovation activities; recognising the importance of the University of Waikato, the AgResearch Campus and the Waikato Innovation Park to the City and the Region.

IV. Develop comprehensively planned areas of residential housing connecting with Fairview Downs, providing a range of housing choice and affordability.

V. Configure land uses around a comprehensive network of well-connected open spaces that will perform a range of functions including stormwater management, cycleways, and recreation.

VI. An area of new development within the City which is integrated and complementary with the existing and planned land use pattern for the City.

The plan change was initially lodged by Tainui Group Holdings and Chedworth Properties limited on 24 June 2013 with the Environmental Protection Authority. The plan change was then determined to be a matter of national significance by the Minister for the Environment and referred to a Board of Inquiry. The Board of Inquiry subsequently accepted and notified the Plan Change.

# 3.0 Licence to Handle Lizards

A key component in the overall development proposal for the site is effective ecological management and the protection of species of indigenous fauna. The land development plan process includes a requirement to provide methods to ensure implementation of a Native Lizard Management Plan (LiMP) for the wider Ruakura Area. Site specific lizard management for any particular development will need to be in accordance with that LiMP.

Part of the preparation and implementation of the Lizard Management Plan will require the trapping, handling and relocation of Lizards. As there are protected species on the site a permit for this activity is required from the Department of Conservation.

This assessment of this project against Waikato – Tainui's Environmental Plan has been drafted as part of the required consultation with Tangata Whenua for the Department of Conservation permit.

## 4.1 Waikato – Tainui Environmental Plan

The Waikato-Tainui Environmental Plan, Tai Tumu Tai Pari Tai Ao facilitates a number of important functions including to;

- Provide the overarching position of Waikato-Tainui on the environment;
- Consolidate and describe Waikato-Tainui values, principles, knowledge and perspectives on, relationship with, and objectives for natural resources and the environment;
- Underpin the development of a consistent and integrated approach to environmental management within the Waikato-Tainui rohe;
- Describe Waikato-Tainui environmental issues;
- 1.3.5 Provide tools to enhance Waikato-Tainui mana whakahaere and kaitiakitanga, particularly when participating in resource and environmental management through:
  a) Influencing the development of all environmental policies and plans that affect Waikato-Tainui;
  b) Establishing a framework for resource and environmental management to support tribal members, whether as whaanau, marae, hapuu, or whatever grouping Waikato-Tainui, from time to time, choose to adopt;
  c) Providing mechanisms to restore and protect the natural environment of Waikato-Tainui, whilst recognising the reasonable needs of local communities;
  d) Actively contributing to the co-management of the Waikato River;
  e) Influencing local and national decision makers;
  f) Providing a guide for resource users or developers in the Waikato-Tainui rohe;
  g) Affecting how and where development may occur; and
  h) Providing clear and consistent issues statements, policies, and methods to manage natural resources.
- Provide guidance to external agencies regarding Waikato-Tainui values, principles, knowledge and perspectives on, relationship with, and objectives for natural resources and the environment.

## 5.1 Analysis against the Environmental Plan

Section 6.2 of the Environmental Plan details the Consultation and Engagement process sought by Waikato – Tainui. The following section of this report includes an analysis of how the Native Lizard Management Plan proposal aligns or does not align with the Environmental Plan.

Overall the approach to ecology within the overall Raukura Development and in particular the approach proposed to the protection of Native Lizards is highly consistent with the Objectives and Policies of the Plan. The following issues objectives and policies are considered to be particularly relevant.

- Issue 15.2.1 identifies that decreased indigenous biodiversity within Waikato is an identified concern.
- Objective 15.3.1 states “The full range of Waikato ecosystem types found throughout the Waikato-Tainui rohe are robust and support representative native flora and fauna.”
- Policy 15.3.1.1 states “To ensure that the full range of Waikato ecosystem types found throughout the Waikato-Tainui rohe are robust and support representative native flora and fauna.”

Development also should be assessed against Chapter 7 (Towards Environmental Enhancement) of the Waikato-Tainui Environmental Plan. The planning provisions included in the Ruakura Plan Change were supported by detailed ecology evidence. I have attached the Evidence in Chief of David Slaven as **Appendix 1** to this report. This evidence was presented to the Environmental Protection Authority in support of the Ruakura Plan Change on 26 February 2014. Of particular relevance are paragraphs 7.19-7.23 and paragraphs 9.10 and 9.11). It is noted that the measures proposed pursue a best practice enhancement approach that will protect the lizards while still enabling the development which has social, cultural, economic and environmental benefits to proceed.

# 6.0 Conclusion

Overall it is considered that the proposal is aligned with the Waikato – Tainui Environmental Plan and it is not considered that further consultation is required on this particular matter.

**About Boffa Miskell**

Boffa Miskell is a leading New Zealand professional services consultancy with offices in Whangarei, Auckland, Hamilton, Tauranga, Wellington, Christchurch, Dunedin, and Queenstown. We work with a wide range of local and international private and public sector clients in the areas of planning, urban design, landscape architecture, landscape planning, ecology, biosecurity, cultural heritage, graphics and mapping. Over the past four decades we have built a reputation for professionalism, innovation and excellence. During this time we have been associated with a significant number of projects that have shaped New Zealand's environment.