REPORT

Tonkin+Taylor

Ecological Impact Assessment Report

Central City Reservoir Project

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Hamilton City Council
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Executive Summary

Hamilton City Council (HCC) has received financial investment from central government under the Infrastructure Acceleration Fund (IAF) to facilitate development within the city. As part of this funding, two new central city reservoirs are proposed near the existing reservoir at Ruakiwi. A change to the existing designation boundary is required to enable the proposed reservoir development.

This report presents a Terrestrial Ecological Impact Assessment (EcIA) of the proposed designation change and subsequent reservoir development at the proposed site, undertaken in general accordance with the EcIA guidelines (Roper-Lindsay et al. 2018). This report includes a desktop assessment of existing relevant ecological data and site surveys to provide quantitative assessments of habitats and fauna values within the proposed site.

The ecological values associated with the proposed site are summarised in Table 1, along with our assessment of the magnitude of effects on these values as a result of the proposed activity. Potential effects on the terrestrial ecological values have been assessed in this EcIA, including effects associated with impacts to vegetation, birds and bats expected to be or detected within or near the proposed site.

Several effect management measures have been proposed to avoid, minimise, remedy, or mitigate impacts associated with the designation and subsequent reservoir development at the proposed site. Providing that these measures are implemented the effects on most terrestrial values can be managed to be **low** to **very low**. However, there is one **moderate** residual effect that could not be avoided, minimised, remedied or mitigated, specifically the permanent loss of terrestrial vegetation that represents potential roosting and foraging habitat for long-tailed bats. A Biodiversity Compensation Model was used to assess and calculate an appropriate quantum of ecological compensation work to address this moderate residual effect. Recommended ecological compensation work comprises planting, pest mammal control, artificial roost boxes and artificial roost features.

Table 1: Summary of ecological values, magnitude of effect and overall ecological effects at the proposed site, Ruakiwi

Terrestrial effect	Ecological values affected	Ecological value	Magnitude of effects before measures to avoid, minimise remedy and mitigate	Proposed measures to avoid, minimise, remedy and mitigate	Magnitude of effects after measures to avoid, minimise, remedy, and mitigate	Overall level of effect (after measures to avoid, minimise, remedy and mitigate)
Permanent loss of terrestrial habitat.	• Removal of 0.58 ha of habitat. • Mature exotic trees. • One tarata.	**Negligible**	**Moderate**	• Minimise removal of trees through detailed design. • Transplant native trees were feasible.	**n/a**	**Very low**
Permanent loss of habitat for threatened fauna (native bats and birds).	• Removal of 0.58 ha of roosting and foraging habitat. • Removal of 14 mature trees that provide roosting and/or nesting habitat.	**Low to Moderate**	**Low to Moderate**	• Minimise removal of trees through detail design. • Physically delineating works area (in construction phase).	**Very low to Moderate**	**Moderate** (To be addressed by way of ecological compensation, see Section 5).
Injury or mortality to Threatened fauna during vegetation clearance.	• Long-tailed bats. • Lizards. • Birds.	**Low to Very High**	**Low to Very high**	• Implementation of BMP. • Implementation of VRP. • Implementation of AMP.	**Low**	**Low to Very low**

Terrestrial effect	Ecological values affected	Ecological value	Magnitude of effects before measures to avoid, minimise remedy and mitigate	Proposed measures to avoid, minimise, remedy and mitigate	Magnitude of effects after measures to avoid, minimise, remedy, and mitigate	Overall level of effect (after measures to avoid, minimise, remedy and mitigate)
Indirect effects of habitat loss on threatened fauna.	• Light spill into retained foraging and roosting habitats.	**Moderate**	**Moderate**	Implementing a lighting plan.	**Negligible**	**Very low**
Disturbance to avifauna during construction.	• Removal of 0.58 ha roosting, nesting and foraging habitat.	**Low to Moderate**	**Negligible**	N/A.	**Negligible**	**Very low**

1 Introduction

1.1 Background

In November 2002, Hamilton City Council (HCC) secured Government Infrastructure Acceleration Fund (IAF) support for specific infrastructure projects. The purpose of the IAF agreement is to enable infrastructure development that facilitates the delivery of residential housing in the central city. The Reservoirs and Pump Station ("the Project", Figure 1.1) is a critical infrastructure initiative aimed at improving the efficiency of water supply from the reservoir into the central city, thereby supporting residential and commercial/office development along with firefighting water pressure requirements.

This Project is essential to meet the demands of a growing population. Current growth projections and modelling indicate that the 25 megalitre reservoir will be sufficient to meet population needs until at least 2041. Beyond that point, a second 25 megalitre water reservoir will be required to ensure continued service capacity.

HCC in its capacity as a Recruiting Authority (HCC) will undertake the planning work for both reservoirs at this time but will only construct one reservoir under the Agreement. The design and construction of the second reservoir will be determined at a later date based on existing and forecast population growth in the central city.

HCC has conducted a comprehensive investigation and site assessment to identify a preferred location for the new reservoir and an associated booster pump station. The evaluation considered 30 potential sites situated between the existing Waiora Water Treatment Plant (WTP) and the Ruakiwi Road Reservoir (RRR). Each site was assessed based on several key criteria, including land ownership, site size, elevation, proximity to the bulk water network and the WTP, energy efficiency (a critical factor for resilience and operations), distance to the central city, and underlying geological conditions.

Based on the outcomes of the investigations and site assessments, HCC has identified the RRR site as the preferred location. As a result, further investigation and concept design work have been initiated for this site to support the next phase of project development.

A further options analysis was undertaken for the Ruakiwi Road site to refine the site layout to best meet the project objectives while striving to address effects on the Lake Domain Reserve and the surrounding residential area as much as possible, with the concept site layout reflecting that balance.

The purpose of this report is to provide sufficient technical information in relation to ecological impact to inform the Notice of Requirement for an Alteration to Designation.

Figure 1.1: Project location with proposed water reservoirs, pump valve chamber, proposed stormwater pipes and Significant Natural Areas.

1.2 Scope

Tonkin & Taylor Ltd (T+T) has been engaged by Hamilton City Council to undertake an Ecological Impact Assessment (EcIA) to inform an application for a change in designation which would allow for the use of the site for two new reservoirs. The project will require a change to the designation boundary of the existing water storage reservoir at Hamilton Lake Domain.

Detailed design has not yet been finalised and this EcIA addresses potential impacts on terrestrial ecological values within the area shown in Figure 1.1 due to the change in designation and the subsequent construction and operation of two new reservoirs at the site.

This report follows the Ecological Impact Assessment Guidelines (EcIAG) (Roper-Lindsay et al., 2018):

- Describes the values of the existing terrestrial environment and ecology within the site.
- Describes the potential ecological effects expected to result from the change to designation boundary, proposed reservoir project works and ongoing operation.
- Recommends measures to address effects where required/appropriate.
- Presents an overall conclusion as to the level of potential ecological effects of the proposed works after the recommended measures have been undertaken.

This EcIA report has been prepared in accordance with our letter of instruction for services (IFS) with HCC dated 23 January 2025 (T+T ref. 1097546.0000).

1.3 Ecological context

The Project is located on flat but elevated land at the Hamilton Lake Domain (Figure 1.1), just uphill of Lake Rotoroa. This site is located within the Hamilton Ecological District (ED). The Hamilton ED used to comprise of large bogs, scrub, and fern land with a few pockets of swamp forest. The ED has undergone considerable modification since human occupancy, including intensive farming causing clearance of vegetation, landform changes, and ongoing impacts from the continued urbanisation and growth of Hamilton City. The remaining native vegetation is fragmented and often degraded by pest animals and plants.

Hamilton Lake Domain is a recreational area with open grassland and large mature specimen trees scattered throughout. The surrounding area has residential housing to the east, with the lake sitting to the west of the domain. To the north of the existing reservoir is a relatively large intact area of bush. All treeland (exotic and native) in this Domain falls within a proposed Significant Natural Area C31 (SNA) within the Hamilton City District Plan Change 9. The area of intact bush is in the proposed SNA due to it providing significant fauna habitat (including steppingstone or corridor habitats), including regularly used habitats by long-tailed bats (LTB) which are nationally 'Threatened – Nationally Critical' indigenous (O'Donnell et al., 2023). This area could also provide ecological buffering to a regionally or nationally important SNA according to the Hamilton City Operative District Plan.

Hamilton is a known stronghold for LTB, and these have been recorded throughout Hamilton City and the surrounding area. There are known roosts throughout Hamilton City, including in artificial roost boxes.

2 Assessment methods

2.1 Desktop review of available information

Publicly available information and databases were reviewed to inform the methodology and approach to the ecological assessment and to establish the ecological context of the Project. This included a review of the following available information:

- Bat records from the New Zealand distribution database (DOC) (updated 23 August 2024).
- Ecological observations from iNaturalist database (https://iNaturalist.org) (accessed on 10 February 2025).
- Ecological observations from eBird (https://ebird.org) within the proposed project site and immediate vicinity (accessed on 10 February 2025).
- DOC NZ herpetofauna Atlas Database (updated 5 December 2024).
- Hamilton City Operative District Plan geographic information system (GIS) (http://hamilton.isoplan.co.nz) (accessed on 10 February):
  - Significant Natural Areas (SNA) layer.
  - Notable tree (Schedule 9D) layer.
  - Notable trees – protected root zone layer.

2.2 Site visit

Several site visits were undertaken to inform this report. Site visits activities are summarised in Table 2.1. During each site visit any birds that were seen or heard were recorded.

Table 2.1: Site visits and activity at proposed project site

Date	Activity
10 February 2025	• Deploy tracking tunnels for lizard survey. • Deploy ten Acoustic Bat Monitors (ABMs).
13 February 2025	• Deploy further six ABMs.
17 February 2025	• Change over tracking cards in tracking tunnels and rebait. • Manual search for lizards. • Map vegetation.
24 February 2025	• Tracking tunnel and tracking cards collected. • Manual searching for lizards. • Battery changeover for ABMs.
10 March 2025	• Collect all ABMs.
9 May 2025	• Technical Expert met project team on-site to review footprint of designation and reservoirs.
30 May 2025	• Visual tree assessments for potential bat roosts. • Met arborist onsite to discuss climbing impacted trees to examine bat roost potential in trees.

Date	Activity
5 June 2025	• Supervised arborists climbing trees to inspect potential bat roosts that have been visually identified.
9 July 2025	• Site visit to inspect new route of underground pipeline from reservoir to lake. Assessed five trees for bat roosting habitat potential that are marked to be removed as well as a visual assessment for lizards for a patch of agapanthus that will need to be removed.

2.3 Specific field methods

2.3.1 Vegetation

During site visits, vegetation on site was assessed and documented, including the likely presence of regionally (Brandon et al., 2004) and nationally 'Threatened' or 'At Risk' plants (de Lange et al., 2024). A broad description of vegetation types was made, and plant species observed were compiled into a list (Table Appendix A.1). Georeferenced aerial imagery was used in conjunction with field notes, photographs and GPS records made during field surveys.

2.3.2 Bats

2.3.2.1 Database records

The National Bat Database administered by DOC was accessed on 3 February 2025 to identify bat records within a 25 km radius of the proposed Project area. Records from the database show numerous records of LTB within a 25 km radius of the proposed Project footprint with the closest confirmed record in 2021 being within 150 m of the current water reservoir (see map in Appendix F).

Potential bat roosting, commuting, and foraging habitats were visually assessed throughout the Project. Long-tailed bats prefer to utilise large trees (greater than 15 cm in DBH) with the following characteristics for roosting:

- Hollows, cavities, knot holes, cracks.
- Flaking or peeling bark.
- Broken or dead brunches or trunk.
- Large epiphytes, particularly perching epiphytes.

2.3.2.2 Acoustic Bat Monitors

To detect potential LTB presence and to assess activity levels, 15 ABMs were deployed[1] across the Project (refer to Figure 2.1). ABMs were deployed in habitat where bat activity was considered most likely, targeting potential roost trees.

ABMs operate by recording and storing echolocation calls (bat passes) as image files, along with the date and time of the event. The acoustic survey followed best practice directed by DOC's bat inventory and monitoring toolbox (Sedgeley et al., 2013). Each ABM was set to record from one hour before sunset until one hour after sunrise. Ten ABMs were deployed for a four-week period (10 February 2025 until 10 March 2025) with six being deployed three days later due to potential Project plan change (13 February 2025 until 10 March 2025).

[1] ABMs were deployed by a suitably competent bat ecologist (Nicki van Zyl), T+T, bat competency level 3.1. Certified under the national bat competency authorisation (Bat Recovery Group, 2022).

Figure 2.1: Vegetation types (native trees and shrubs, exotic trees and grassland), tracking tunnels, lizard searching and ABM placement across the Project.

2.3.2.3 ABM data analysis

Audio recordings from the ABMs were processed using a machine learning tool developed by T+T to automatically detect LTB calls (AutoBat version 0.3[2]). Recordings identified as potentially containing long-tailed bat calls, or cases which were sufficiently ambiguous (<0.95 'prediction confidence' as determined by the software) are then manually reviewed for quality assurance purposes.

Results were manually checked and updated as necessary using the DOC BatSearch 3.11 programme. Analysis of bat data was undertaken by a bat ecologist[3] in accordance with best practice methodologies (Lloyd, 2017). The analysis of ABM data provides the following information:

- Presence or absence of bats within the development area during the survey period.
- Distribution of bat activity within the development area during the survey period.
- The number of bat echolocation calls within the detection radius of each ABM (c. 50 m).
- Foraging echolocation calls (commonly called a 'feeding buzz') within the detection radius of each ABM.

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

[2] The tool's performance has been verified against a database of more than more than 26,000 manually classified recordings obtained at a variety of locations. For this database, on average 98 % of bat calls are successfully detected using the tool.

[3] Data was checked by a suitably competent T+T bat ecologist (Nicki van Zyl), who holds Competency Level 3.1, certified under Department of Conservation national bat competency authorisation scheme (Bat Recovery Group, 2022).

Bat activity is influenced by certain weather conditions (O'Donnell, 2000; NZ DOC Bat Recovery Group, 2024). As such, weather data from the survey period was reviewed to ensure conditions were suitable for long-tailed bats to be active. Weather data (rain, wind and temperature) during the survey period was collected from MetService.

The DOC bat roost protocols (NZ DOC Bat Recovery Group, 2024) outline weather conditions that are required to consider a survey night 'valid' for bat detection. These conditions include:

- Temperature 8 °C or greater for the first four hours after official sunset.
- Ideally no to very little precipitation within the first four hours after official sunset, although a light mist or occasional drizzle may be acceptable as assessed by an ecologist accredited with Competency 3.1.
- Little to no wind within the first four hours after official sunset.

Nights that did not meet the weather criteria outline above (i.e., invalid nights) were noted but included as part of the analysis as the purpose of this survey is absence/presence. This survey was not for roost watching or felling, therefore all data was included.

2.3.2.4 Roost assessments

Visual bat roost assessments

Visual bat roost assessments[4] were done on the ground using binoculars to search for any potential bat roost features (see section 2.3.2.1) in trees marked to be removed. Trees with potential roost features were marked using a small metal tag for ease of identification by arborists and ecologists in future (see Figure 2.2).

Climbing

Seventeen trees, within the site were marked to have potential bat roosting features and were climbed by arborists and all potential features were inspected using a burrow scope (Wireless Inspection Camera – Signet) where feasible. All work was overseen by a suitably experienced ecologist[4] who could confirm that the feature could be used for roosting. The number of verified features identified in each tree following inspection was recorded.

[4] Bat roost assessments and supervision for climbing were completed by T+T bat ecologists Nicki van Zyl and Tumanako Ritchie, both of whom hold Competency Level 3.3 under the Department of Conservation bat handling competencies authorisation scheme (Bat Recovery Group, 2022).

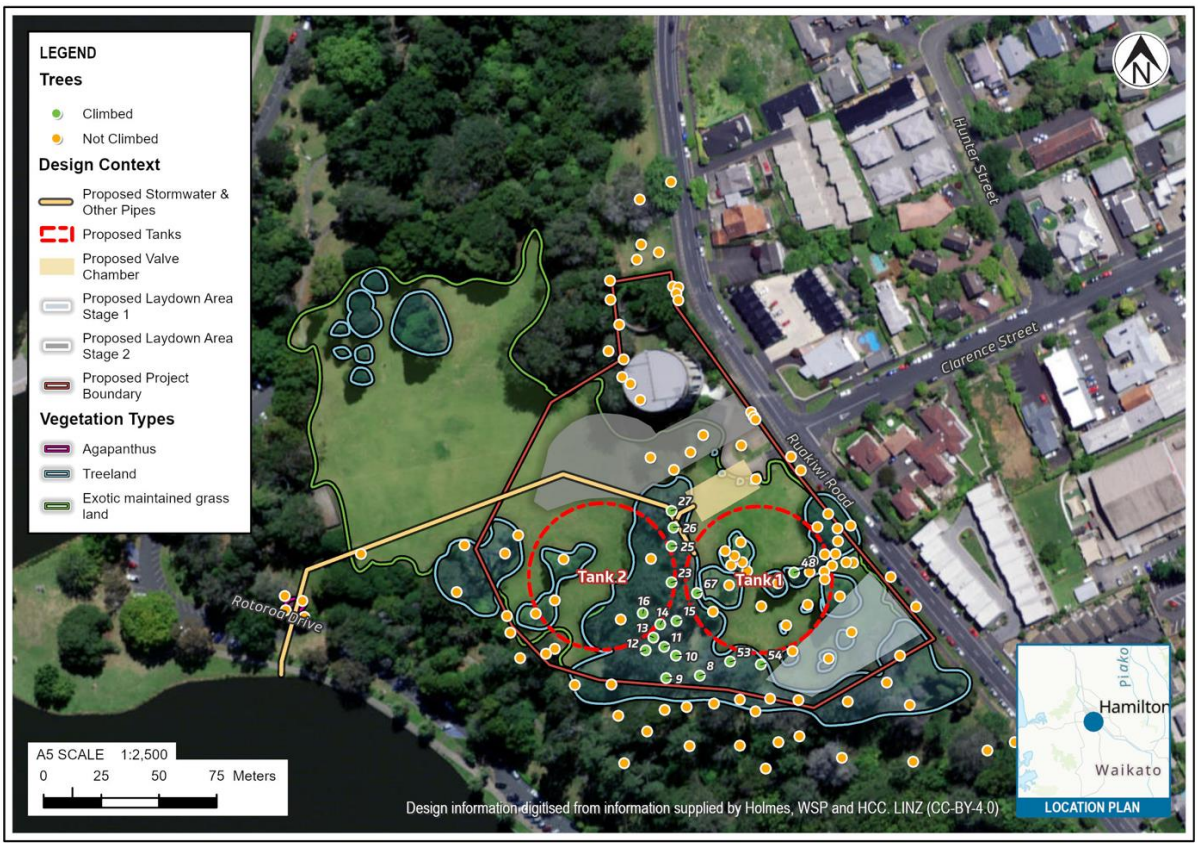


Figure 2.2: Vegetation types (native trees and shrubs, exotic trees and grassland) and trees labelled for climbing by arborist for roost feature confirmation.

2.3.3 Birds

All bird species seen or heard during site visits were recorded. On-site observations were combined with records of bird species previously observed within the site and surrounding area identified in the desktop review.

2.3.4 Lizards

Online records of lizard species within the proposed Project site and surrounding area (up to 5 km away), were compiled into a species list ahead of the site visits. A qualitative assessment of habitat values for native lizards (skinks and geckos) was completed on 10 February 2025. The habitat assessment focussed on identifying suitable ground refugia for lizard species as well as micro-habitats such a scrub vegetation, dense ground cover or native vegetation.

A lizard survey was conducted in suitable habitat using 37 baited lizard tracking tunnels. Tracking tunnels were deployed for two weeks from 10 February to 24 February 2025 with cards and bait replaced on 17 February 2025. Tracking tunnels were placed on ground to target areas of high-quality lizard habitat such as dense ground cover or woody debris. Locations of tracking tunnels are provided on Figure 2.1.

In addition to lizard surveys, a total of two hours of manual and visual searching was also undertaken in areas identified as suitable habitat (under logs and debris) (Figure 2.1).

Another site visit was conducted on 9 July, due to an addition of a storm water pipe to the project plan on 1 July 2025. Visual habitat assessments were completed to identify if the vegetation marked for removal are suitable for refugia for lizard species. No lizard survey was conducted due to seasonal constraints.

2.3.5 Invertebrates

The site consists mostly of maintained exotic grassland and lacks substantial leaf litter or woody debris. As such, no 'Threatened' or 'At Risk' terrestrial invertebrate species were expected to be present and specific invertebrate surveys were not undertaken.

2.4 Approach to Ecological Impact Assessment

2.4.1 Impact assessment

The method applied to this Ecological Impact Assessment report broadly follows the Ecological Impact Assessment Guidelines 2018 (EcIAG) published by the Environmental Institute of Australia and New Zealand as well as the National Policy Statement for Indigenous Biodiversity (NPS IB) (Ministry for the Environment, 2023). The guidelines provide a standardised framework and matrix allowing a consistent and transparent assessment of ecological effects.

The guidelines were used to establish the following:

- The ecological values within the proposed project site (refer to Table Appendix B.1 and Table Appendix B.2).
- The magnitude of effect to determine whether measures to avoid, minimise, remedy, and mitigate are required (refer to Table Appendix B.3 and Table Appendix B.4) on ecological values from the proposed project works in absence of any controls.
- The overall level of effects to determine whether measures to avoid, minimise, remedy, and mitigate (refer to Table Appendix B.5).
- The magnitude of effect and overall level of effect, taking into consideration the additional measures to avoid, minimise, remedy and mitigate effects and whether there are residual adverse effects that should be offset or compensated.

Refer to Appendix B for the criteria and tables used in this assessment.

2.4.2 Residual effects approach

It is generally accepted that if after all efforts to avoid, minimise, remedy and mitigate effects, there remains an overall effect of **moderate** or higher, then further efforts are required to address these residual adverse effects by way of offset or compensation.

A Biodiversity offset is a 'measurable conservation outcome' that meets certain principles and balances adverse residual effects that cannot be reasonably avoided, minimised, remedied and/or mitigated to a no net loss/net gain standard (Baber et al., 2021a, b, c). Biodiversity offsetting uses quantifiable information to address residual adverse effects. Biodiversity compensation differs from offsetting in that the information used to address residual adverse effects is usually qualitative and should be implemented only after attempts to offset have been exhausted.

LTB are cryptic, highly mobile and hard to monitor and therefore neither losses due to residual adverse effects nor gains due to offset measures can be quantified with adequate precision required for a Biodiversity Offset Accounting models (BOAM). Therefore, using a Biodiversity Compensation Model (BCM) is appropriate, as it provides a decision-making mechanism and clear justification for the choice and quantum of compensation measures that are proposed to achieve the desired net gain outcome. Unlike biodiversity offset which aims for no net loss/net gain, biodiversity compensation aims for predicted net gain to compensate for the inherent uncertainties due to inability to accurately measure losses and gains and provide greater certainty that net gain will be achieved (Baber et al., 2021a).

A Biodiversity Compensation Model (BCM) has been applied to estimate the amount of ecological compensation required to address adverse residual effects on terrestrial environment comprising the loss of LTB foraging and roosting habitat. Specifically, the BCM aims to guide the quantum of restoration and enhancement work required to address the effects on bats due to roosting habitat and foraging habitat not being replaceable or achievable in the short-term on site.

The details of the BCM methods can be found in Section 5.

3 Terrestrial ecology characteristics and values

3.1.1 Vegetation

Vegetation across the site is predominantly maintained exotic grassland with areas of mixed exotic/native treeland. Exotic grassland is considered to have negligible ecological value and will therefore not be considered further. However, it should be noted that all treeland within this area is encompassed by the proposed SNA (Figure 2.1).

The treeland largely comprises exotic tree species, with the largest trees being a cluster of approximately 14 macrocarpa (*Hesperocyparis macrocarpa)* (Photograph 3.1 to Photograph 3.3). Other exotic species observed included Norfolk pine (*Araucaria heterophylla*), Japanese cedar (*Cryptomeria japonica*), sweetgum (*Liquidambar stryraciflua*), lodgepole pine (*Pinus contorta*), European beech (*Fagus sylvatic*a), Douglas fir (*Pseudotsuga menziesii*) and holm oak (*Quercus ilex*). A Mexican cypress (*Cupressus lusitanica)* (Photograph 3.4) in close proximity to tank 1 (Figure 2.1) has been designated a 'notable tree' under the Hamilton District Plan. Notable trees are individual trees or groups of trees that are 'notable' due to their link to the community, scientific importance, species type, age and/or the contribution they make to the city. This means that this tree is protected under the Hamilton District plan.

Fifteen native tree species were recorded, with most appearing to be recently planted. Native species present include kahikatea (*Dacrycarpus dacrydioides*), mapou (*Myrsine australis*), large tarata (*Pittosporum eugenioides*), and houpara (*Pseudopanax lessonii*). All planted native trees within the treeland are classed as 'Regionally Uncommon' (Waikato Regional Council (WRC), 2020); however, none are classified as nationally 'Threatened' or 'At-Risk' (de Lange et al., 2024).

A full list of plant species observed is provided in in Table Appendix A.1.

The treeland is dominated by exotic species and as such has **negligible** ecological value botanically. However, it provides habitat for native fauna and in accordance with the EIANZ guidelines the treeland is considered to have **low** ecological value.

Photograph 3.1: Clump of large macrocarpa trees.

Photograph 3.2: Looking uphill at the maintained grassland, toward the large clump of macrocarpa trees and other exotics.

Photograph 3.3: Looking towards the lake from the Ruakiwi Road. This photo shows the newly planted native trees in front of the old macrocarpa.

Photograph 3.4: Mexican Cypress (Cupressus lusitanica) that is scheduled as a 'Notable Tree' under the Hamilton City Council Plan Change 9.

3.1.2 Fauna

3.1.2.1 Bats

Twelve of the 15 ABMs deployed recorded bat passes (see Table 3.1). The highest activity was recorded at R7 with an average of 6.9 passes a night (see figure in Appendix D)

While weather data was collected as per best practice (see Table Appendix C.1), no data was excluded in the analysis due to weather, as bats were still detected on those nights. Weather data is important for tree felling or roost watching protocols but impact on absence/presence surveys is low.

Seventeen trees were identified as having potential roost features for LTB. Following inspection by climbing arborists, 13 macrocarpa and one pine were confirmed to have good roosting habitat in the form of cracks, cavities, hollows, flaking or peeling bark, and broken or dead branches (Photograph 3.5 to Photograph 3.8). It should be noted that the mature trees outside of proposed site footprint also had potential roost features when assessed from the ground. These trees were not climbed because they are not within the proposed footprint. Trees can also develop features that are suitable for roosting over time and visual assessments should be repeated prior to trees being removed.

While arborists were assessing the trees, they noted three possums hiding in cavities. Possums are a predation risk for bats and will limit the success of roosting for LTB.

Due to their threat classification, LTB are considered to have **very high** ecological value. The value of treeland at the site as habitat is considered **moderate**. This is because no active roosts were located

during climbing inspections and the presence of pest mammals reducing the value of roost features due to LTB predation risk.

Table 3.1: Summary of long-tailed bat activity recorded during the ABM survey

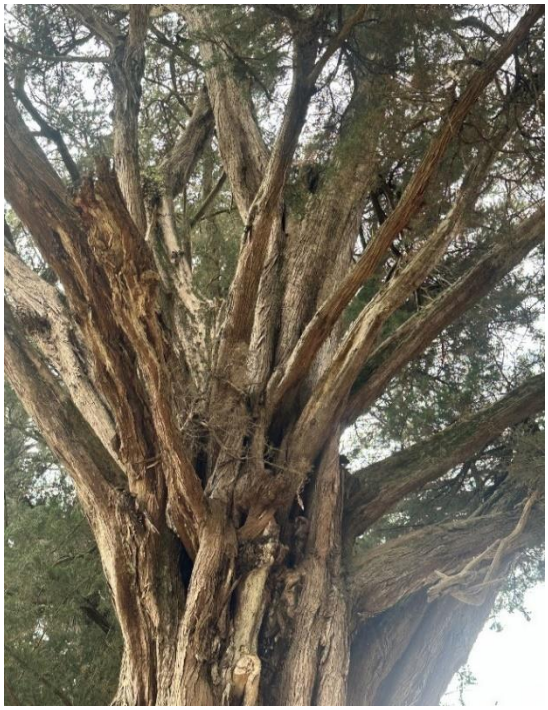
ABM ID	Location		Number of recording nights*	Number of bat passes	Average number of bat passes per night	Number of feeding buzzes
	Easting	Northing				
R9	1800523	5814441	2	1	0.5	0
R13	1800461	5814489	14	25	1.8	0
R14	1800463	5814463	23	47	2.0	0
R12	5814532	1800502	1	0	0	0
R11	5814497	1800497	6	0	0	0
R10	5814476	1800521	25	8	0.3	0
R7	5814299	1800572	27	185	6.9	5
R15	5814420	1800453	9	2	0.2	0
R8	5814416	1800532	2	0	0	0
R6	5814308	1800598	28	35	1.3	0
R5	5814251	1800669	28	66	2.4	0
R4	5814248	1800599	28	180	6.4	0
R3	5814247	1800553	5	2	0.4	0
R2	5814270	1800506	6	2	0.3	0
R1	5814298	1800460	18	26	1.4	0

*Some ABMs did not record every night due an error with the ABM or the ABM not being triggered that night.

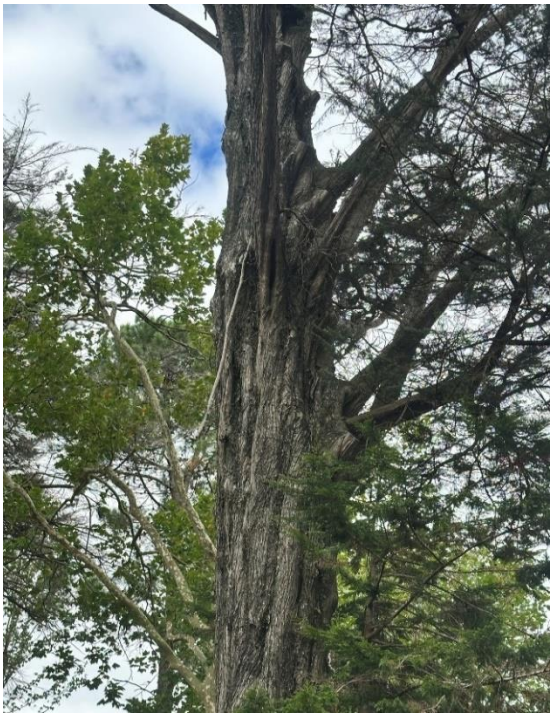
Note: ABMs R9,13,14,12,11,10 and 7 were out from 13 February to 10 March 2025 with all other ABMs being deployed from 10 February to 10 March 2025.

Photograph 3.5: Macrocarpa showing cracks and crevices in main trunk and side branches which is potential bat roosting habitat.

Photograph 3.6: Macrocarpa showing a few potential bat roosting habitat features (cracks, crevices and deadwood) in the main trunk and side branches.



Photograph 3.7: Macrocarpa showing potential bat roosting habitat (cracks, crevices and deadwood).



Photograph 3.8: Macrocarpa showing crevices in main trunk and side branches which is potential bat roosting features.

3.1.2.2 Lizards

Three native lizard species were identified as occurring within five kilometres of the site during the desktop exercise. No lizard species were observed at the site during manual searches and no skink footprints were observed on tracking cards. Pest mammal footprints were recorded on almost all cards.

Following the inclusion of an underground stormwater pipe to the project plans on 1 July 2025, an area of approximately 25 m^2 of agapanthus were identified as potential low-quality habitat for lizards.

Two of the three lizard species identified during the desktop exercise are 'At-Risk-Declining' and are considered of **high** ecological value, with the third being of **low** ecological value.

Table 3.2: Native lizards recorded or observed within five kilometres of the proposed project

Common name	Species name	National threat classification (Hitchmough et al. 2021)	Ecological value	Recorded during site visit
Copper skink	*Oligosoma aeneum*	At Risk-Declining	**High**	No
Pacific gecko	*Dactylocnemis pacificus*	Not Threatened	**Low**	No
Goldstripe gecko	*Woodworthia chrysosiretica*	At Risk-Declining	**High**	No

3.1.2.3 Birds

Two native terrestrial bird species (pūkeko (*Porphyrio melanotus*) and pīwakawaka/NZ fantail (*Rhipidura fuliginosa*)) were recorded during site visits and a further three were considered likely to utilise the proposed project site (Table 3.3). Habitat for terrestrial birds would include the exotic-maintained grassland and the mature treeland (specifically the mature exotic trees) for nesting and feeding opportunities. All terrestrial bird species at the potential project site are classified as nationally 'Not Threatened' (Robertson et al. 2021).

All 'Not-Threatened' and 'Introduced and Naturalised' species are considered of **low** ecological value except for kererū (*Hemiphaga novaeseelandiae*) which is considered **moderate** ecological value due to being an important seed disperser.

Table 3.3: Native birds recorded or observed at or within five kilometres of the proposed project

Common name	Species name	National threat classification (Roberston et al. 2021).	Ecological Value	Recorded during site visit
Pūkeko	*Porphyrio melanotus*	Not Threatened	**Low**	Yes
Pīwakawaka/ New Zealand fantail	*Rhipidura fuliginosa*	Not Threatened	**Low**	Yes
Kererū	*Hemiphaga novaeseelandiae*	Not Threatened	**Moderate**	No

Common name	Species name	National threat classification (Roberston et al. 2021).	Ecological Value	Recorded during site visit
Kōtare New Zealand kingfisher	*Todiramphus sancus*	Not Threatened	**Low**	No
Spur-winged plover	*Vanellus miles*	Not Threatened	**Low**	No

3.2 Summary of ecological values

A summary of the ecological values that will be included in the assessment in Section 4 are in Table 3.4 below.

Table 3.4: Summary of ecological values within the site and surrounding areas

Habitat attribute/species/threat status	Ecological value
Terrestrial Vegetation	
Treeland - botanical value Treeland – roosting and foraging habitat for bats	**Low** **Moderate**
Lizards	
At Risk-Declining	**High**
Not threatened	**Low**
Birds	
Kererū	**Moderate**
All ‘Not threatened’ or ‘Introduced and Naturalised’ species	**Low**
Bats	
Pekapeka	**Very high**

4 Assessment of ecological effects

This section describes the proposed activities and the potential effects of those activities, before and after effect management measures, on the ecological features and values discussed above. Measures to address those effects are included within the relevant section and conclusions are drawn as the overall effects.

4.1 Proposed project activities and summary of actual and potential ecological effects

The project includes a change of designation of the existing water storage reservoir at Hamilton Lake Domain to allow construction of further water storage reservoirs to support the housing intensification within Hamilton city.

The change of designation to allow for further water storage reservoirs and subsequent construction and use of the site for that purpose will have the following potential adverse ecological effects:

- Loss of terrestrial habitat resulting from vegetation clearance to allow for water storage reservoirs.
- Potential disturbance, injury and/or mortality of birds, lizards and long-tailed bats during vegetation clearance.
- Loss of potential bat roosting habitat from vegetation clearance.

4.2 Permanent loss of terrestrial vegetation

The project is still in design phase and the total quantum of vegetation loss required for to the designation change is still unknown. Based on Figure 2.1, and other construction drawings (Revision C, dated 29 April 2025) provided by Holmes Group Ltd, approximately 0.58 ha of treeland vegetation will need to be removed, which will result in the permanent loss of habitat for LTB and native birds. Potential impacts on native fauna are addressed in the Sections 4.3 to 4.6 below.

Efforts to avoid and minimise the potential adverse ecological effects for the proposed designation change should include reducing the number of trees required to be removed at the design phase and also physically delineating works areas to ensure trees outside of the project footprint are not inadvertently removed when it comes to construction.

Recognition of the vegetation at the Hamilton Lake domain as coming under an SNA is noted and will be taken into account in the mitigation proposed for this project.

Most mature trees identified for removal are exotic species, with the exception of a single tarata. The native trees present within the site are species that are commonly found and widely distributed throughout the region. We understand that consideration is being given to the transplantation of younger native specimens to alternative location within the domain, in order to mitigate the need for their complete removal.

Removal of the exotic trees will change the character of the site and as such, removal is considered to constitute a **moderate** magnitude of effect. The ecological value of this exotic habitat is **negligible**. As a result, the **negligible** botanical ecological values combined with a **moderate** magnitude of effects results in a **very low** overall effect. Therefore, no mitigation is required for the loss of exotic trees at this site.

4.3 Permanent loss of habitat for threatened fauna

Trees within the site provide confirmed foraging habitat and potential roosting habitat for LTB. With the proposed designation change, approximately 0.58 ha of habitat will need to be permanently

removed, including 14 trees with features confirmed as being suitable for LTB roosting. The ecological value of the vegetation as habitat for LTB is considered to be **moderate,** and the magnitude of effect of removing this habitat is **moderate.** Therefore, overall level of effect of the permanent loss of roosting and foraging habitat is **moderate**. It is not possible to avoid, remedy or mitigate this loss of habitat, and this **moderate** residual effect will need to be addressed through compensation in the form of planting, pest mammal control artificial roost boxes and artificial roost bat features. The quantum of compensation required was determined using the biodiversity compensation model (BCM) (refer to Section 5).

For birds, foraging and nesting habitat in the mature trees will also be lost, and the ecological value of this habitat is considered **low** for the bird species recorded at site. Mature exotic trees are well represented in the surrounding area and the magnitude of effect of this permanent loss of exotic habitat is considered **low**. A **low** ecological value and a **low** magnitude of effect result in an overall effect on indigenous birds of **very low**.

4.4 Injury or mortality of indigenous fauna during vegetation clearance

The proposed designation change will require trees to be removed; there is a risk that LTB are accidentally killed or injured if occupied roosts are felled. Without any avoidance and/or minimisation measures in place, the magnitude of effect of removal of potentially occupied bat roosts is considered **very high.**

To minimise the risk of accidental injuring or killing bats in occupied roosts, a Bat Management Plan (BMP) incorporating Vegetation Removal Protocols (VRP) will need to be prepared by a qualified bat ecologist before any works commence. This should be based on the 'Protocols for minimising the risk of felling occupied bat roosts' produced by the NZ DOC Bat Recovery Group (NZ DOC Bat Recovery Group, 2024). Implementation of a BMP and VRPs will reduce the magnitude of effects of tree felling to **low**. Conservation status of LTB does not influence the effectiveness of the BMP or VRP and it is considered that full implementation of the management plans reduces the overall level of effect in LTB to **low**.

LTB have a **very high** ecological value leading to an overall level of effect of **low**.

Terrestrial birds will also be impacted by the loss of approximately 0.58 ha of potential nesting habitat due to the designation change. If this work commences, and removal of habitat occurs within peak bird breeding season (September to January inclusive), an avifauna management plan (AMP) will need to be prepared and implemented by a suitably qualified ecologist to minimise the risk of direct harm to nests, eggs, and nestlings. Implementation of an AMP reduces the magnitude of effect on terrestrial birds to **low**. A **low** to **moderate** ecological value of the terrestrial birds found at site, combined with **low** magnitude of effects results in an overall **low** to **very low** level of effect for terrestrial birds.

There is a very low possibility of indigenous skinks being present in an area of agapanthus near Rotoroa Drive. Approximately 27 m^2 of this vegetation will need to be removed to construct the pipe. In order to minimise the risk of killing or injuring a lizard within this vegetation, all clearance will be undertaken using hand tools. By using hand tools to undertake the clearance the magnitude of effects will be **low**. A **low** to **high** ecological value, combined with a **low** magnitude of effects results in an overall **low** to **very low** level of effects on lizards (if present).

4.5 Indirect effects of habitat loss on threatened fauna

Lighting of the new tanks and associated walkways could spill into adjacent LTB foraging and roosting habitat at the site leading to these habitats become utilised less or abandoned entirely. Artificial light at night (ALAN) can influence roost departure timing, selection of foraging areas and movement patterns in bats due to the perceived increase in predation risk (Schamhart et al, 2023).

The magnitude effect of this could be **moderate** if bats are having to fly to a new area to forage or roost. To minimise ALAN effects on bats a lighting plan would need to be implanted and include the light strength, time and location around the site. By implementing a lighting plan designed to minimise light spill into retained habitats, the magnitude of effect would be **negligible.** The **moderate** ecological effect of removing the habitat and the **negligible** magnitude of effect after implementing a lighting plant gives an overall **very low** effect.

4.6 Disturbance to avifauna during construction

Noise generated by vegetation clearance is likely to disturb indigenous avifauna and cause them to disperse from the area. No indigenous birds are expected to nest within the proposed site footprint and disturbance will be limited to birds foraging in the area. As the disturbance will be temporary and there is a large amount of similar habitat in the immediate vicinity of the proposed site, the magnitude of effect of disturbance to avifauna is considered **negligible**. The ecological value of birds observed at the site range from **low** to **moderate**, resulting in an overall level of effect of **very low**.

4.7 Summary of effects

Table 4.1 below sets out the potential overall level of effects for each ecological feature after efforts to avoid, minimise or mitigate for effects. The level of residual effects ranges from **very low to moderate.** Compensation measures will be required to manage effects of moderate or higher.

Table 4.1: Summary of assessment of ecological effects including management measures and overall level of effects

Terrestrial effect	Ecological values affected	Ecological value	Magnitude of effects before measures to avoid, minimise remedy and mitigate	Proposed measures to avoid, minimise, remedy and mitigate	Magnitude of effects after measures to avoid, minimise, remedy, and mitigate	Overall level of effect (after measures to avoid, minimise, remedy and mitigate)
Permanent loss of terrestrial habitat.	• 0.58 ha foraging and roosting habitat. • Mature exotic trees. • One tarata.	**Negligible**	**Moderate**	• Minimise removal of trees through detailed design. • Transplant native trees were feasible.	**n/a**	**Very low**
Permanent loss of habitat for threatened fauna (native bats and birds).	• 0.58 ha of roosting and foraging habitat. • 14 mature trees that provide roosting and/or nesting habitat.	**Low to Moderate**	**Low to Moderate**	• Minimise removal of trees through detail design. • Physically delineating works area (in construction phase).	**Very low to Moderate**	**Moderate** (To be addressed by way of compensation, see Section 5).
Injury or mortality to Threatened fauna during vegetation clearance.	• Long-tailed bats. • Lizards. • Birds.	**Low to Very High**	**Low to Very high**	• Implementation of BMP. • Implementation of VRP. • Implementation of AMP.	**Low**	**Low to Very low**

Terrestrial effect	Ecological values affected	Ecological value	Magnitude of effects before measures to avoid, minimise remedy and mitigate	Proposed measures to avoid, minimise, remedy and mitigate	Magnitude of effects after measures to avoid, minimise, remedy, and mitigate	Overall level of effect (after measures to avoid, minimise, remedy and mitigate)
Indirect effects of habitat loss on threatened fauna.	• Light spill into retained foraging and roosting habitats.	**Moderate**	**Moderate**	Implementing a lighting plan.	**Negligible**	**Very low**
Disturbance to avifauna during construction.	• Bird foraging and nesting behaviour.	**Low to Moderate**	**Negligible**	N/A.	**Negligible**	**Very low**

5 Residual effects management

Compensation for loss of LTB habitat is recommended due to the overall moderate level of effects on the species. A BCM was used to determine the quantum of planting, pest mammal control, artificial roost box, and artificial bat roost feature provision required to compensate for habitat loss.

The model has been prepared to reflect the final draft of the project footprint for the proposed designation change and the results presented in Appendix E. Compensation requirements include, as a minimum, the following:

Loss of potential foraging habitat:

- **0.58 ha** of planting.
- **7.4 ha** pest mammal control.

Loss of potential roost habitat:

- **21** artificial roost boxes.
- **21** artificial roost bat features (creation of cavities, holes, and/or crevices in live trees, or moving existing roost features in a section of tree trunk to a new location).

If one compensation measure, such as pest mammal control, is reduced or omitted, a proportional increase in planting will be required to achieve an equivalent ecological compensation outcome. This compensatory relationship also applies to mitigation for roost habitat loss.

Undertaking 0.58 ha of planting is recommended and will provide a one-to-one ratio for compensation. Planting near the project site, ideally around the proposed designation and Hamilton Lake Domain area is recommended. Planting of suitable native (e.g., tī kōuka (*Cordyline australis*), kānuka (*Kunzea robusta*), tōtara (*Podocarpus totara)*, kahikatea (*Dacrycarpus dacrydioides*)) and non-weedy exotic (e.g., macrocarpa (*Cupressus macrocarpa*), oak (*Quercus* spp.), tulip tree (*Liriodendron tulipifera*) is recommended to provide habitat in the medium to long term (NZ DOC Bat Recovery Group, 2024).

It is recommended that 7.4 ha of pest mammal control be carried out within the Hamilton Lake Domain, specifically in the bush adjacent to the current reservoir (see Figure 5.1). This relatively intact habitat supports a mix of native and exotic tree species, which may offer suitable roosting and foraging habitat for LTB. Possums are a known predator of LTB and terrestrial birds and were confirmed to be present in the mature trees at the proposed site.

Figure 5.1: Map showing potential area for pest control at the Hamilton Lake Domain.

Installing 21 artificial roost boxes and 21 artificial roost features is recommended to compensate for the loss of roost trees. Artificial bat roost boxes should be installed within the proposed designation and around the Lake Domain area. More than one box could be placed on a single tree. Artificial roost boxes should be placed 6-18 m above ground (Robinson et al., 2023), with predator proof metal banding above and below each box.

Artificial roost features have been trialled extensively in Australia and have been shown to be successful for several bat species (Griffith et al, 2023; Best et al, 2022). Artificial roost features are created by an arborist using a chainsaw to make cracks or crevices in a live tree to mimic a natural roost features. In some cases, a chamber is constructed within the trunk before being covered with a face plate. Multiple natural roosts can be established within a single tree. Existing roost features can be removed as a big chunk and moved and attached to a new tree where it can be secured into place. If it is not possible to create sufficient artificial roost features due to concerns around impacts to tree health, additional roost boxes will be required.

6 Summary and conclusion

Hamilton City Council is seeking a designation change to the existing water storage reservoir at Hamilton Lake Domain to allow construction of further water storage reservoirs to support housing intensification within Hamilton City.

The ecological value of the Project site is consistent with those typical in urban space. Vegetation at the site consists mostly of maintained exotic grassland with areas of mixed exotic/native treeland. The recognition of the vegetation as coming under an SNA is noted and will be taken into account in the mitigation proposed for this project. The fauna present at the site mostly consists of "Not Threatened" status, with only one Threatened – Nationally Critical' species present, the LTB.

Potential adverse effects on certain fauna species can be appropriately managed (avoided, remedied, minimised or mitigated) through the implementation of species-specific management plans to an overall very low level of effect. However, one residual ecological effect remains moderate, and cannot be fully avoided, minimised, remedied, or mitigated through standard measures. This effect will be addressed through compensation measures.

In summary, the proposed measures to compensate for moderate residual effects of potential bat roost and foraging habitat includes:

- Providing 21 artificial bat roost boxes with predator-proof banding above and below.
- Providing 21 artificial roost bat features with predator-proof banding above and below.
- 7.4 ha of pest mammal control.
- 0.58 ha of planting to provide foraging habitat in the short and long term.

7 Applicability

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

We understand and agree that our client will submit this report as part of an application for resource consent and that Hamilton City Council as the consenting authority will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd
Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
	
.....	.....
Nicki van Zyl	Dean Miller
Terrestrial Ecologist	Project Director

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Appendix A Species table

Table Appendix A.1: Vegetation, birds and lizards recorded to be within or nearby the project site and their conservation threat status

Common name	Species name	National threat status	Recorded during site visit
Herpetofauna			
Copper skink	*Oligosoma aeneum*	At Risk-Declining	No
Goldstripe gecko	*Woodworthia chrysosiretica*	At Risk-Declining	No
Pacific gecko	*Dactylocnemis pacificus*	Not Threatened	No
Plague skink	*Lampropholis delicata*	Introduced and Naturalised	No
Southern bell frog	*Ranoidea raniformis*	Introduced and Naturalised	No
Plants			
Common alder	*Alnus glutinosaq*	Exotic	Yes
Cyprus	*Cupressaceae*	Exotic	Yes
Elm	*Ulmus sp.*	Exotic	Yes
English oak	*Quercus robur*	Exotic	Yes
European mountain ash	*Sorbus × latifolia*	Exotic	Yes
Harakeke	*Phormium tenax*	Not Threatened	Yes
Holm oak	*Quercus ilex*	Exotic	Yes
Houpara	*Pseudopanax lessonii*	Not Threatened	Yes
Japanese cedar	*Cryptomeria japonica*	Exotic	Yes
Jelecote pine	*Pinus patula*	Exotic	Yes
Kahikatea	*Dacrycarpus dacrydioides*	Not Threatened	Yes
Liquidambar	*Liquidambar styraciflua*	Exotic	Yes
Lodgepole pine	*Pinus cortorta*	Exotic	Yes
Mexican cypress[5]	*Cupressus lusitanica*	Exotic	Yes
Monterey cypress	*Cupressus macrocarpa*	Exotic	Yes
Norfolk Island pine	*Araucaria heterophylla*	Exotic	Yes
Pin oak	*Quercus palustris*	Exotic	Yes
Pūriri	*Vitex lucens*	Not Threatened	Yes
Red maupo	*Myrsine australis*	Not Threatened	Yes
Tarata, lemonwood	*Pittosporum eugenioides*	Not Threatened	Yes
White cypress pine	*Callitris glaucophylla*	Exotic	Yes
Agapanthus	*Agapanthus praecox subsp. Orientalis*	Exotic	Yes
Terrestrial birds			
Australian coot	*Fulica atra*	Naturally uncommon	No

[5] This tree is listed as a Notable Tree by the Hamilton City Council in their Plan Change Section 9.

Common name	Species name	National threat status	Recorded during site visit
Australian magpie	*Gymnorphina tibicen*	Introduced and Naturalised	Yes
Blackbird	*Passer domesticus*	Introduced and Naturalised	Yes
Canada goose	*Branta canadensis*	Introduced and Naturalised	No
Goose	*Turdus merula*	Introduced and Naturalised	No
House sparrow	*Egretta novaehollandiae*	Not Threatened	No
Kererū	*Hemiphaga novaeseelandiae*	Not Threatened	No
Kōtare New Zealand kingfisher	*Todiramphus sancus*	Not Threatened	No
Little shag	*Microcarbo melanoleucos*	Relict	No
Mallard	*Anas platyrhynchos*	Introduced and Naturalised	Yes
Pīwakawaka/ New Zealand fantail	*Rhipidura fuliginosa*	Not Threatened	Yes
Pūkeko	*Porphyrio melanotus*	Not Threatened	Yes
Rock pigeon	*Columba livia*	Introduced and Naturalised	Yes
Spur-winged plover	*Vanellus miles*	Not Threatened	No
White-faced heron	*Egretta novaehollandiae*	Not Threatened	No

Appendix B Ecological Impact Assessment (EINZ Guidelines)

B1 Assigning ecological value

Ecological values are assigned on a scale of 'Low' to 'Very High' based on species, communities and habitats present within the project site and immediate surroundings (Table Appendix B.1). Values are assessed in terms of:

- Representativeness of the habitat including species assemblages.
- Rarity/distinctiveness, whether the area represents a threatened ecosystem (naturally or induced), rarity of the species the area supports.
- Diversity and pattern, biotic and abiotic diversity.
- Ecological context, how the area contributes to ecosystem functioning through its relationship with the surrounding landscape.

Table Appendix B.1: Ecological values assigned to species and habitats (adapted from Roper-Lindsay et al., 2018)

Value	Species values	Habitat values
Very high	Nationally Threatened - Endangered, Critical or Vulnerable.	Supporting more than one national priority type. Nationally Threatened species found or likely to occur there, either permanently or occasionally.
High	Nationally At Risk - Declining.	Supporting one national priority type or naturally uncommon ecosystem and/or a designated significant ecological area in a regional or district Plan. At Risk - Declining species found or likely to occur there, either permanently or occasionally.
Moderate	Nationally At Risk - Recovering, Relict or Naturally Uncommon.	A site that meets ecological significance criteria as set out in the relevant regional or district policies and plans.
Moderate	Not Nationally Threatened or At Risk, but locally uncommon or rare.	A site that does not meet ecological significance criteria but that contributes to local ecosystem services (e.g., water quality or erosion control).
Low	Not Threatened Nationally, common locally.	Nationally or locally common with a low or negligible contribution to local ecosystem services.
Negligible	Not Threatened Nationally, common locally, poor habitat with few species.	Nationally or locally common with a negligible contribution to local ecosystem services.

Table Appendix B.2: Ecological values assigned to habitats (adapted from EIANZ, 2018)

Attributes to be considered when assigning ecological value or importance to a site or area of vegetation/habitat/community	
Matters	**Attributes to be considered**
Representativeness	Attributes for representative vegetation and aquatic habitats: • Typical structure and composition. • Indigenous species dominate. • Expected species and tiers are present. Attributes for representative species and species assemblages: • Species assemblages that are typical of the habitat. • Indigenous species that occur in most of the guilds expected for the habitat type.
Rarity/distinctiveness	Attributes for rare/distinctive vegetation and habitats: • Naturally uncommon, or induced scarcity. • Amount of habitat or vegetation remaining. • Distinctive ecological features. • National priority for protection. Attributes for rare/distinctive species or species assemblages: • Habitat supporting nationally Threatened or At-Risk species, or locally uncommon species. • Regional or national distribution limits of species or community. • Unusual species or assemblages. • Endemism.
Diversity and Pattern	• Level of natural diversity, abundance, and distribution. • Biodiversity reflecting underlying diversity. • Biogeographical considerations – pattern, complexity. • Temporal considerations, considerations of lifecycles, daily or seasonal cycles of habitat availability and utilisation.
Ecological context	• Site history, and local environmental conditions which have influenced the development of habitats and communities. • The essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience (from "intrinsic value" as defined in RMA). • Size, shape, and buffering. • Condition and sensitivity to change. • Contribution of the site to ecological networks, linkages, pathways and the protection and exchange of genetic material. • Species role in ecosystem functioning – high level, key species identification, habitat as proxy.

B2 Assessment of magnitude of effects

Magnitude of effect is a measure of the extent or scale of the effect of an activity and the degree of change that it will cause. The magnitude of an effect is scored on a scale of 'Negligible' to 'Very High' (Table Appendix B.3) and is assessed in terms of:

- Level of confidence in understanding the expected effect.
- Spatial scale of the effect.
- Duration and timescale of the effect (Table Appendix B.4).
- The relative permanence of the effect.
- Timing of the effect in respect of key ecological factors.

The spatial scale for effects is considered in the context of the local and landscape scale effects as appropriate. The magnitude of effects is assessed after measures to avoid, minimise and mitigate are applied.

Table Appendix B.3: Criteria describing magnitude of effect (Roper-Lindsay et al., 2018)

Magnitude	Description
Very high	Total loss of, or very major alteration to, key elements/features/ of the existing baseline[1] 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 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 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 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 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 the 'no change' situation; AND/OR Having negligible effect on the known population or range of the element/feature.

Note:

1 Baseline conditions are defined as 'The conditions that would pertain in the absence of a proposed action' (Roper-Lindsay et al., 2018).

Table Appendix B.4: Timescale for duration of effects (Roper-Lindsay et al., 2018)

Timescale	Description
Permanent	Effects continuing for an undefined time beyond the span of one human generation (taken as approximately 25 years).
Long-term	Where there is likely to be substantial improvement after a 25-year period (e.g., the replacement of mature trees by young trees that need > 25 years to reach maturity, or restoration of ground after removal of a development) the effect can be termed 'long term'.
Temporary[1]	Long term (15-25 years or longer – see above). Medium term (5-15 years). Short term (up to 5 years). Construction phase (days or months).

Note: In the context of some planning documents, 'temporary' can have a defined timeframe.

B3 Assessment of the level of effects

An overall level of effects (Table Appendix B.5) is identified for each activity or habitat/fauna type using a matrix approach that combines the ecological values with the magnitude of effects after measures to avoid, minimise and remedy are applied.

The matrix describes an overall level of effect on a scale of 'Negligible' to 'Very High'. Positive effects are also accounted for within the matrix.

The level of effect is then used to guide the extent and nature of further ecological management response required which may include offsetting or compensation.

Table Appendix B.5: Criteria for describing overall levels of ecological effects (Roper-Lindsay et al., 2018)

Ecological value / Magnitude	Very high	High	Moderate	Low	Negligible
Very high	Very high	Very high	High	Moderate	Low
High	Very high	Very high	Moderate	Low	Very low
Moderate	High	High	Moderate	Low	Very low
Low	Moderate	Low	Low	Very low	Very low
Negligible	Low	Very low	Very low	Very low	Very low
Positive	Net gain	Net gain	Net gain	Net gain	Net gain

Appendix C Terrestrial Ecology Characteristics

Table Appendix C.1: Vegetation assessment in accordance with EIANZ guidelines

Ecosystem type	Assessment matters	Summary value
Treeland	**Representativeness** Vegetation comprises a sparse canopy of exotic trees over managed exotic grassland, and this is not representative of a native ecosystem. This area has been modified by the impacts of human and dog access. None of the native tree species identified at site were nationally 'Threatened' or 'At Risk'. All native species have been recently planted and are somewhat scattered throughout the site. Therefore, the native tree species does not provide a representative ecosystem in this area. Area rates **negligible** for this assessment matter.	Area rates **negligible** for two of the assessments and **moderate** for the other two. Therefore, this area is of **Low** ecological value.
	Rarity/distinctiveness Exotic species are common throughout the wider landscape and is not rare or distinctive. Mature exotic trees provide potential habitat for a 'Threatened – Nationally Critical' species. (Long tailed bats). The planted native trees are classed as regionally 'uncommon', but none are classed as Nationally 'Threatened' or 'At Risk'. Area rates **moderate** due to providing potential roosting habitat for bats.	
	Diversity and Pattern Exotic trees are widely distributed throughout this area which is predominantly maintained exotic grassland. All native trees are recently planted and therefore does not add to diversity of this site. Area rates **negligible** for this assessment matter.	
	Ecological Context The site context is one of significant modification. Exotic trees are mature and may provide linkage habitat for LTB. Mature trees provide habitat for bird species. Area rates **moderate** for this assessment matter.	

Appendix D Weather data for ABMs

Table Appendix D.1: Raw weather data collected from MetService for ABMs based on protocols (NZ DOC Bat Recovery Group, 2024)

Date	Official sunset time	Minimum temperature for four-hour after sunset (°C)	Rainfall for four-hour period after sunset (mm)	Average wind speed for four-hour period after sunset (km)*	Valid night (Y/N)
10/02/2025	2023	16	0	16	Y
11/02/2025	2022	11	0	13.4	Y
12/02/2025	2021	11	0	22	Y
13/02/2025	2020	12	0	13	Y
14/02/2025	2019	17	0	20.45	N
15/02/2025	2018	17	0	25.7	N
16/02/2025	2017	16	0	22.5	N
17/02/2025	2015	19	0	28	N
18/02/2025	2014	19	0	14.75	Y
19/02/2025	2013	15	0	17.25	Y
20/02/2025	2012	16	0	19	Y
21/02/2025	2010	13	0	23	N
22/02/2025	2009	13	0	13	Y
23/02/2025	2008	12	0	13.5	Y
24/02/2025	2006	13	0	11	Y
25/02/2025	2005	12	0	8.75	Y
26/02/2025	2004	11	0	14.25	Y
27/02/2025	2002	13	0	14.5	Y
28/02/2025	2001	11	0	15	Y
1/03/2025	2000	12	0	12.5	Y
2/03/2025	1958	12	0	16.3	Y
3/03/2025	1957	11	0	13.75	Y
4/03/2025	1955	11	5	21.75	N
5/03/2025	1954	6	0	26.5	N
6/03/2025**	1953	N/A	N/A	N/A	N
7/03/2025	1951	7	0	17.2	N
8/03/2025	1950	9	0	23	N
9/03/2025	1948	11	0	31.4	N
10/03/2025	1947	12	0	14.2	Y

*Protocol states “No to light wind within first four hours after official sunset.” For this purpose, we have noted that any wind over 20 km/h will be over the light wind threshold.

**Outage on MetService, so no data was able to be collected for that period.

Note: No bat data was excluded for this survey (even if “invalid” weather conditions were noted. This was a presence/absence survey and not for felling or roost watching purposes. Therefore, we conclude that all data is important and cannot be excluded due to weather conditions. We note that when doing surveys for felling or roost watching purposes, weather data must be followed as per protocols.

Appendix E Biodiversity compensation models

Table Appendix E.1: Qualitative biodiversity model inputs and outputs for the loss of potential roosting habitat

Model Inputs		
Input descriptors	Input data	
Project/reference name	IAF HCC Reservoir	
Biodiversity type	Long-tailed bats	
Technical expert(s) input	PADY,SHEG	
Benchmark	5	
How many habitat types OR sites are impacted	1	
Number of proposed compensation actions	2	
Net gain target	20%	
Habitat/Site Impact(s)	Roosting habitat	
Impact risk contingency:	4	
Impact uncertainty contingency:	2	
Areal extent of impact (ha):	14	
Value score prior to impact:	3	
Value score after impact:	0.001	
Compensation Action(s)	Artificial bat roosts	Natural bat roosts*
Discount rate:	3.0%	3.0%
Finite end point (years):	3	3
Compensation confidence contingency:	3	3
Areal extent (ha) of compensation type:	21	21
Value score prior to compensation:	0.1	0.1
Value score after compensation:	3	3

Model outputs			
	Total impact score	Roosting habitat	
Impact score	-11.08430	-11.08430	
	Total compensation score	Artificial bat roosts	Natural bat roosts*
Compensation score	13.93303	6.96652	6.96652
Net gain outcome	25.7%		

*Natural bat roost= Artificial bat roost features

Table Appendix E.2: Qualitative biodiversity model justification for the loss of potential roosting habitat

Model input factor	Input value	Justification
Biodiversity type	Long-tailed bat	Species of interest.
Technical expert(s) input	Paul Dyer Sam Heggie-Gracie	Terrestrial Ecologist. Competent bat ecologist[6].
Benchmark	5	Benchmark is always 5.
Habitat types or site impacted	1	Potential roosting habitat (large trees with potential bat roost features).
Number of proposed compensation actions	2	Provision of artificial bat roost boxes and artificial bat roost features.
Net gain target	20 %	Bats are known to be active in the area. A higher net gain target to achieve 20 % exceedance of No Net Loss provides greater certainty that that Net Gain will be achieved.
Impact risk contingency	4	The risk was assessed as 'Very high' because Long-tailed bats are classified as Threatened - Nationally Critical. This equates to a 'Very high' ecological value under EcIAG (Roper-Lindsay *et al*. 2018).
Impact uncertainty contingency	2	Moderate habitat complexity, exotic dominated habitat, good knowledge of adverse effects, however unknown whether bats roosted in the habitat, although they were detected commuting/foraging.
Areal extent of impact	14	14 trees identified for removal have potential bat roost features. Note this number may increase once project footprint has been finalised.
Value prior to impact	3	Good potential roosting habitat, however, the trees have not been identified as being used for roosts, although bats have been detected using the area for commuting/foraging.
Value after impact	0.001	Effectively no habitat remaining after clearance. Model requires 0.001 for calculations (not 0).
Compensation actions	Artificial bat roost boxes Artificial bat roost features	Actions proposed to achieve 20 % biodiversity net gain target.
Discount rate	3 %	Standard recommended rate.
Finite end point (artificial bat roost boxes + artificial bat roost features)	3 years	Studies of artificial bat roost boxes/features in Hamilton suggest that bats can take up artificial roosts as early as 12-18 months (Robinson 2022). Three years has been used as a conservative measure.

[6] Sam Heggie-Gracie is a bat ecologist to Level 3.1 and 3.3 of the Bat Handling Competencies Authorisation document (7/9/2021) approved by the Bat Recovery Group.

Model input factor	Input value	Justification
Compensation confidence contingency (artificial bat roost boxes + artificial bat roost features)	3	Moderate confidence - artificial bat roost boxes are known to have been used by bats in Hamilton; however, not all roost boxes are used and there is a lack of research into how roost boxes can best meet bats needs.
Areal extent of compensation type (artificial bat roost boxes + artificial bat roost features)	21 trees each for both artificial bat roost boxes and artificial bat roost features	21 artificial bat roost boxes + 21 artificial bat roost features is the number required to achieve a Net Gain Target of 20 %.
Value score prior to compensation (artificial bat roost boxes + artificial bat roost features)	0.1	The trees identified for roost enhancement will be large trees without existing bat roosts, hence the low roosting score prior to compensation measure.
Value score after compensation (artificial bat roost boxes + artificial bat roost features)	3	Artificial bat roost boxes + artificial roost bat features are expected to provide new roosting habitat for bats within three years of implementation.

Table Appendix E.3: Qualitative biodiversity model inputs and outputs for the loss of potential foraging habitat

Model Inputs		
Input descriptors	Input data	
Project/reference name	IAF HCC Reservoir	
Biodiversity type	Long-tailed bats	
Technical expert(s) input	PADY,SHEG	
Benchmark	5	
How many habitat types OR sites are impacted	1	
Number of proposed compensation actions	2	
Net gain target	20%	
Habitat/Site Impact(s)	Foraging habitat	
Impact risk contingency:	4	
Impact uncertainty contingency:	2	
Areal extent of impact (ha):	0.58	
Value score prior to impact:	3	
Value score after impact:	0.001	
Compensation Action(s)	Planting	Pest mammal control
Discount rate:	3.0%	3.0%
Finite end point (years):	20	1
Compensation confidence contingency:	2	3
Areal extent (ha) of compensation type:	0.58	7.4
Value score prior to compensation:	1	3
Value score after compensation:	3	3.5

Model outputs			
	Total impact score	Foraging habitat	
Impact score	-0.45921	-0.45921	
	Total compensation score	Planting	Pest mammal control
Compensation score	0.55500	0.10597	0.44903
Net gain outcome	20.9%		

Table Appendix E.4: Qualitative biodiversity model justification for the loss of potential foraging habitat

Model input factor	Input value	Justification
Biodiversity type	Long-tailed bat	Species of interest.
Technical expert(s) input	Paul Dyer Sam Heggie-Gracie	Terrestrial Ecologist. Competent bat ecologist[7].
Benchmark	5	Benchmark is always 5.
Habitat types or site impacted	1	Foraging habitat (tall trees and short vegetation tier habitat).
Number of proposed compensation actions	2	Planting and pest mammal control.
Net gain target	20 %	Bats are known to be active in the area. A higher net gain target to achieve 20 % exceedance of No Net Loss provides greater certainty that that Net Gain will be achieved.
Impact risk contingency	4	The risk was assessed as 'Very high' because Long-tailed bats are classified as Threatened - Nationally Critical. This equates to a 'Very high' ecological value under EcIAG (Roper-Lindsay *et al*. 2018).
Impact uncertainty contingency	2	Moderate habitat complexity, exotic dominated habitat, good knowledge of adverse effects, however unknown whether bats roosted in the habitat, although they were detected commuting/foraging.
Areal extent of impact (ha)	0.58 ha of foraging/commuting habitat.	Approximate value.
Value prior to impact	3	Reasonable potential foraging habitat, bats have been detected using the area for foraging/commuting. However not considered a five due to urban area, pest mammals and exotic vegetation affecting food resource availability and quality.
Value after impact	0.001	Effectively no habitat remaining after clearance.
Compensation actions	Revegetation Pest mammal control	Actions proposed to achieve 20 % biodiversity net gain target.
Discount rate	3 %	Standard recommended rate.
Finite end point (planting)	20	Twenty years of vegetation maintenance proposed. Vegetation at 20 years considered to provide good foraging habitat.

[7] Sam Heggie-Gracie is a bat ecologist to Level 3.1 and 3.3 of the Bat Handling Competencies Authorisation document (7/9/2021) approved by the Bat Recovery Group.

Model input factor	Input value	Justification
Finite end point (pest mammal control)	1	Pest mammal control expected to benefit bats one year after commencing through increasing food resource availability and quality.
Compensation confidence contingency (planting)	2	High confidence that planting will provide good foraging habitat after 20 years.
Compensation confidence contingency (pest mammal control)	3	Pest mammal control is expected to reduce predation of any bats foraging/roosting at the site (if present) and increase food resource availability and quality.
Areal extent (ha) of compensation type (planting)	0.58 ha	This is the areal extent of planting required to achieve a Net Gain Target of 20 %.
Areal extent (ha) of compensation type (pest mammal control)	7.4 ha	This is the areal extent of pest mammal control required to achieve a Net Gain Target of 20 %. Pest mammal control should be undertaken within existing vegetation within the Lake Domain.
Value score prior to compensation (planting)	1	Exotic dominated habitat in the surrounding area prior to planting provides some marginal long-tailed bat foraging habitat as indicated by the low numbers detected during ABM surveys. The specific planting locations will be into existing grassed areas which provide limited foraging habitat.
Value score prior to compensation (pest mammal control)	3	Foraging values for bats in the proposed pest control area are considered to be of high value. The value is not higher than three due to uncontrolled mammalian predator populations.
Value score after compensation (planting)	3	Effective vegetation foraging habitat expected following 20 years of plant establishment.
Value score after compensation (pest mammal control)	3.5	Increase in overall habitat value due to 7.4 ha of pest mammal control within existing vegetation within the Lake Domain.

Appendix F Figures

- **Historic ecology observations map**
- **Bat survey results**

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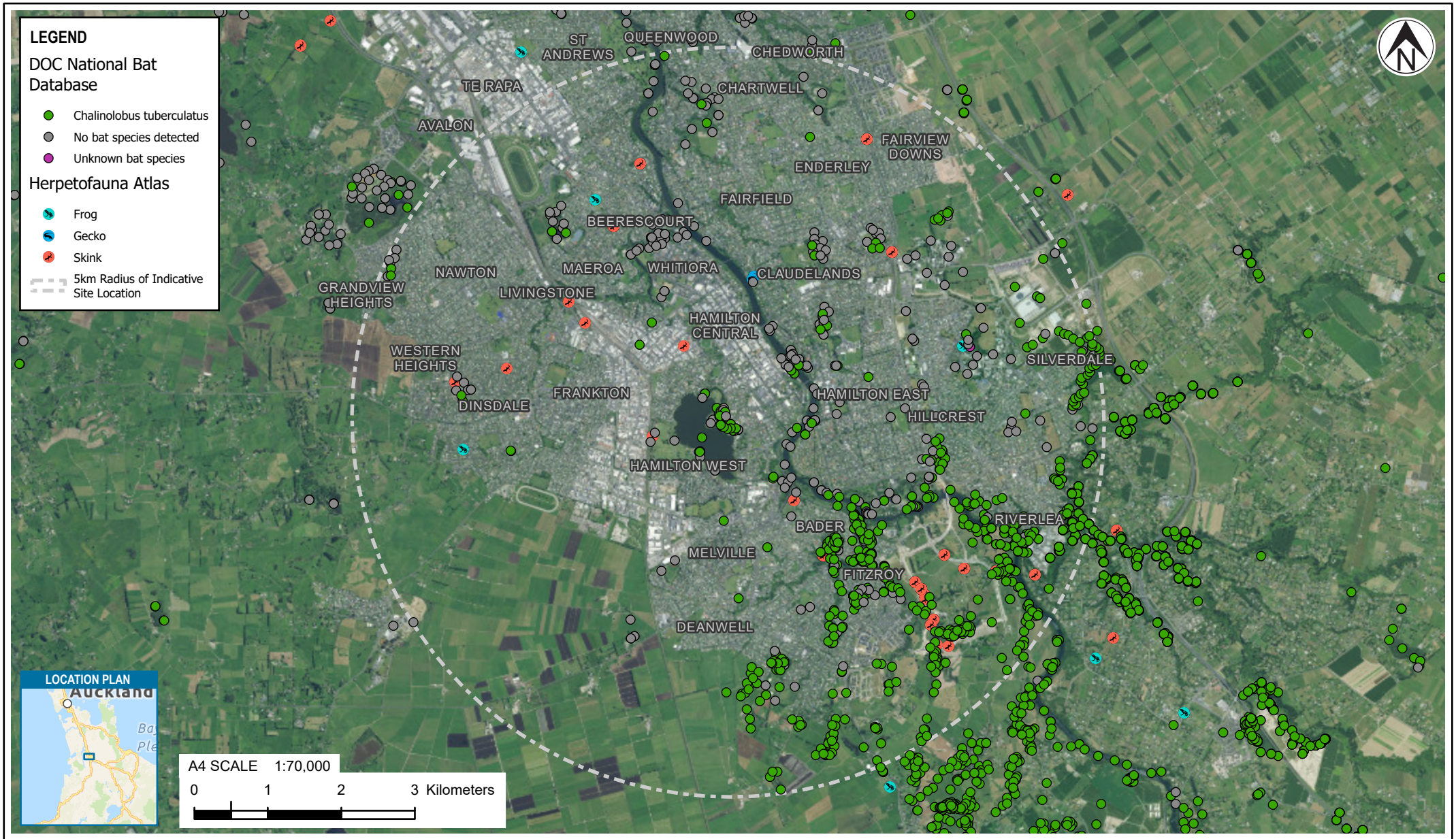

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DRAWN	NIVA	AUG.25
CHECKED	JORB	AUG.25
APPROVED	DATE	

CLIENT **HAMILTON CITY COUNCIL**

PROJECT **IAF HCC RESERVOIR - ECOLOGY**

TITLE HISTORIC ECOLOGY OBSERVATIONS - IAF HCC RESERVOIR

SCALE (A4) 1:70,000 FIG No. FIGURE D.1 REV 0

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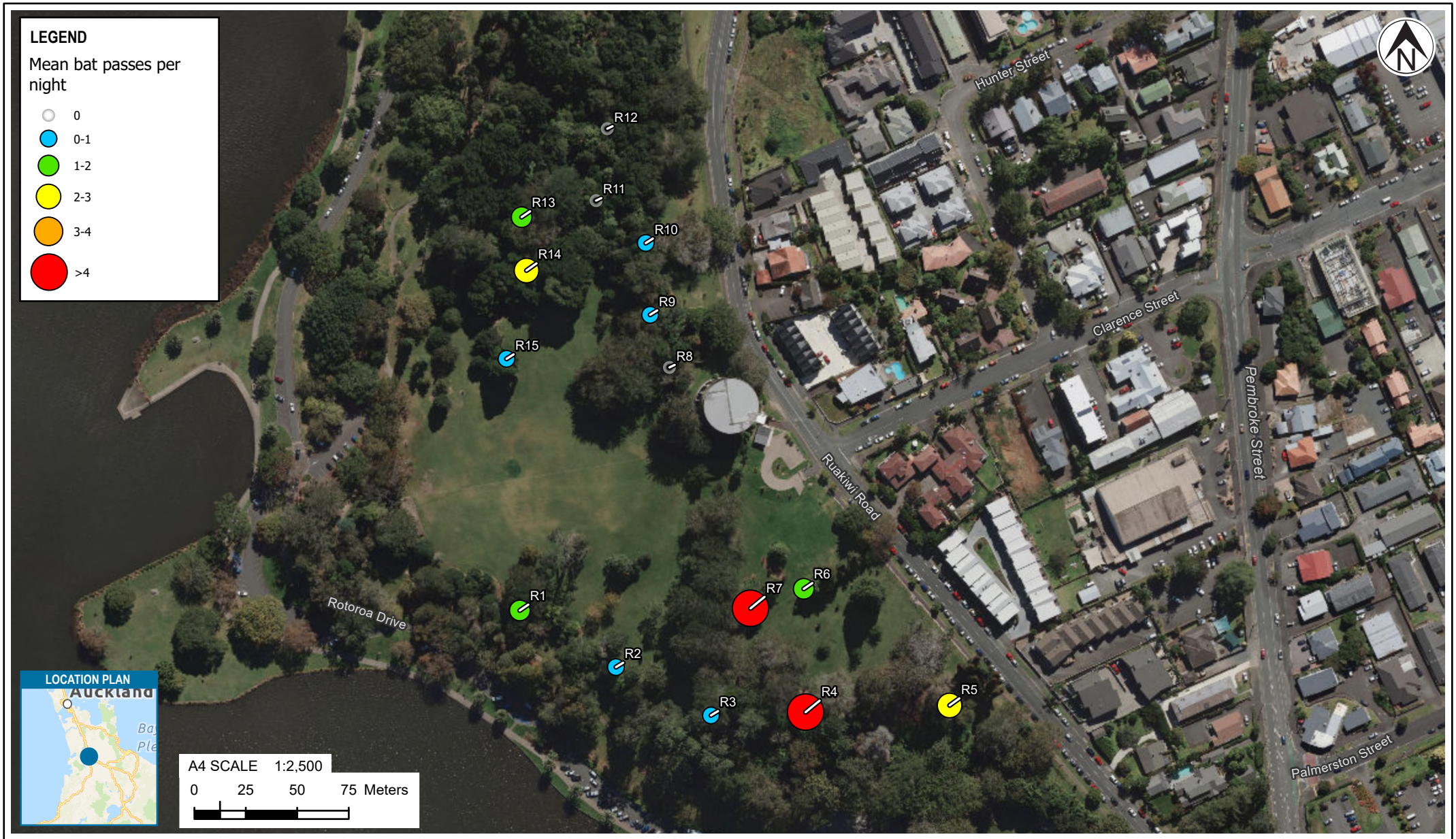

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TITLE 2025 BAT SURVEY RESULTS - IAF HCC RESERVOIR

SCALE (A4) 1:2,500 FIG No. FIGURE D.2 REV 0

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