REPORT

Tonkin+Taylor

Northern Precinct Expansion

Assessment of Ecological Effects

Prepared for
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1 Introduction

Titanium Park Ltd and Rukuhia Properties Ltd have engaged Tonkin & Taylor Ltd (T+T) to prepare an assessment of ecological effects associated with a plan change request to Waipa District Council (WDC) for the expansion of the Northern Precinct Area as part of the Airport Business Zone (Figure 1.1), 9.7 km south of Hamilton City (Figure 1: Appendix A). The objective of the plan change request is to achieve the co-ordinated expansion of the Northern Precinct within the Airport Business zone and to enable it to be developed in line with what has been envisaged by the Northern Precinct Masterplan.

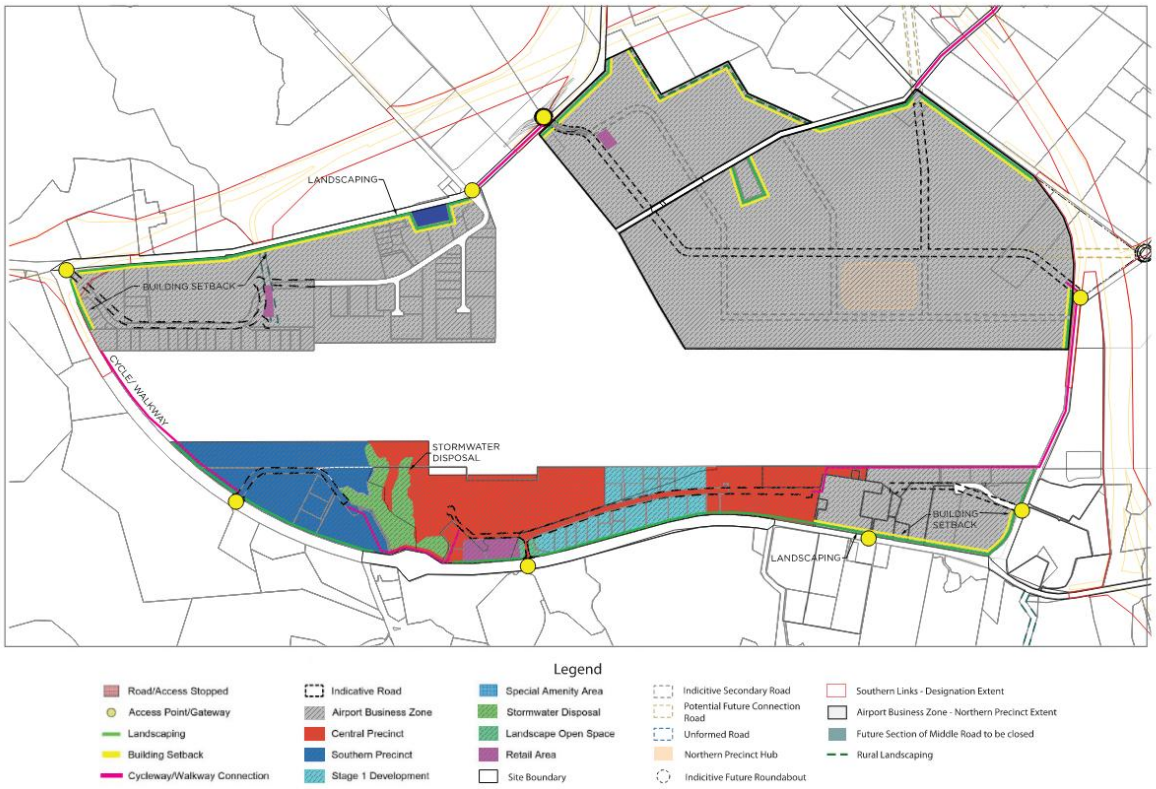

Figure 1.1: Proposed extension of the Northern Precinct of the Airport Business Zone.

The proposed plan change request involves the retention of the existing 41 ha within the Northern Precinct that is zoned Airport Business and rezoning approximately 89 ha of adjoining Rural zoned land to Airport Business zone. This will result in the Northern Precinct Area increasing to comprise approximately 130 ha.

The spatial extent of the Northern Precinct that already comprises a live Airport Business zoning is shown by the orange outline in Figure 1.2 below, which of relevance to our assessment, demonstrates that just over half of the Hub is already zoned Airport Business and can (currently) be developed in accordance with the existing District Plan provisions.

The current land use in the area proposed to be rezoned is agricultural and cropping with the predominant vegetation cover being maize and pasture. Isolated areas of exotic and native trees are found across the site and a network of artificial watercourses have been established for drainage purposes.

The proposed plan change will result in the conversion of the current land use to predominantly industrial with a retail and amenity hub. The Northern Precinct masterplan (refer Figure 1.2 below)

identifies an avenue of large specimen trees along the spine road[1] with the amenity hub and boundary being landscaped with specimen trees that will be capable of reaching larger heights.

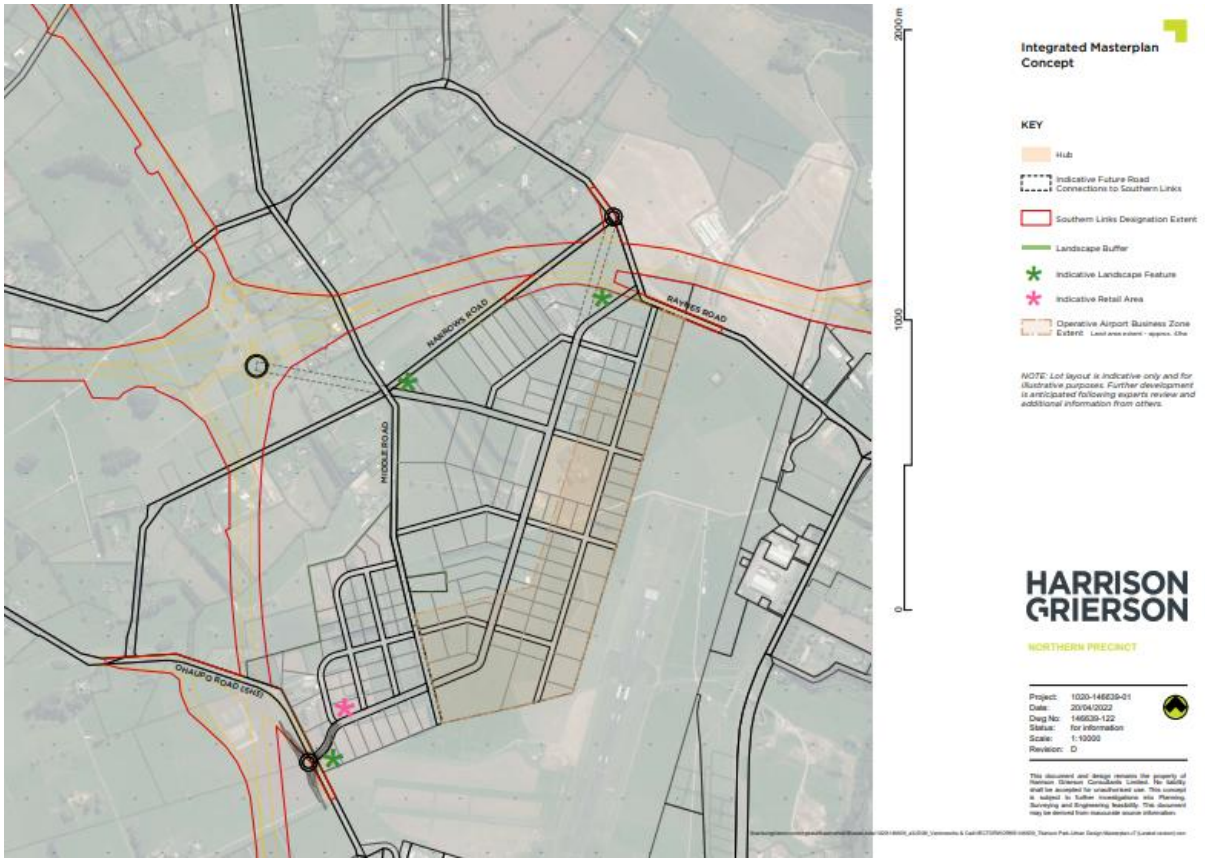

Figure 1.2: Northern Precinct Masterplan.

The masterplan has been developed to inform the Structure Plan (refer Figure 1.1 and 1.2) and to provide an indication of how the Northern Precinct may be developed in the future. As described in the AEE and for context, the proposed amendments to the existing Airport Business Zone Structure Plan within the District Plan include:

- Updating the extent of the Airport Business zone and Northern Precinct extent to match the rezoning request and result in the full 130 ha of the Northern Precinct being included within the Structure Plan.
- Amending the indicative roading pattern to align with the pattern developed through the master planning process. This includes two indicative Primary Roads, one of which will extend from Raynes Road down to Ingram Road, and another which will extend from the Narrows Road/Middle Road intersection to the centre of the Northern Precinct.
- Extending the landscaping and setback controls to apply on the external boundaries of Northern Precinct that adjoin the Rural zone. Both these controls are also applied to the boundaries of 141 Middle Road given that the applicants does not currently own the property (but noting that they may be removed during the process if the applicants was to acquire it). These work in conjunction with the Airport Business zone provisions.
- Introducing the Hub within the centre of the Northern Precinct, which is a key feature of the Northern Precinct. The Hub is intended to be a higher amenity space within the precinct that

[1] Draft Northern Precinct Urban Design Assessment, Titanium Park Limited and Rukuhia Properties Limit. Prepared by Harrison Grierson, dated 15 March 2022 (R001V19_146639).

will provide a limited extent of retail to support the convenience needs of people visiting and working within the precinct. Its inclusion also works in conjunction with the Airport Business zone provisions.

- Introducing a small retail area within the western extent of the Northern Precinct to both complement the role of the Hub but also to provide a more balanced urban form that more efficiently provides for the convenience needs of workers and visitors within this portion of the precinct.
- Introducing the two new access points / gateways onto State High 3 and Raynes Road that are located at either end of the Main Spine Road through the precinct.
- Illustrating the walking and cycling connections that will be established between the Northern Precinct and the Raynes / Southern Precincts.
- Illustrating the walking and cycling connection that is being promoted between the Northern Precinct and the Peacocke growth cell to the north.
- Illustrating the operative designation extent and corridor for Southern Links to provide a holistic and comprehensive view of how the Airport Business zone can be integrated into Southern Links when it is constructed.

1.1 Purpose and scope

The purpose of this report is to provide an assessment of ecological effects to accompany the plan change request for the Northern Precinct.

This assessment includes the following:

- Characterisation of the ecological values.
- An assessment of ecological effects of the proposed plan change and associated activities on ecological values.
- Recommendations to avoid, remedy or mitigate potential adverse effects of the future development of the site.

The expansion of the Northern Precinct Area ("the site") primarily consists of two properties owned by Titanium Park Limited (TPL) and Rukuhia Properties Limited (RPL) (Figure 2 Appendix A)[2]. Where relevant, to distinguish the two properties, ecological features and results of ecological surveys are reported separately throughout this report.

2 Methods

A combination of desktop assessments and site visits were used to determine the ecological values of terrestrial and freshwater habitats and features across the site. The following sections briefly describe the methodologies used for assessing the ecological values.

2.1 Desktop assessment

A desktop assessment was undertaken to review available information and data regarding the ecological values that relate to the site or immediate surrounds. This included the following documents and databases:

[2] As noted above, 141 Middle Road is within the area of the plan change request, however TPL does not own the property. The ecological assessment of 141 Middle Road has been undertaken by way of desktop analysis and observation of any features from the adjacent property. Our assessments have not identified ecological features of significance.

- Aerial imagery of the project area (including historic) to assess habitat suitability for terrestrial fauna[3].
- Amberfield – Peacocke Structure Plan: Terrestrial Ecological Assessment[4].
- Long-tailed Bat Trapping and Radio Tracking Baseline Report 2018 and 2019 Southern Links, Hamilton[5].
- eBird database.
- Department of Conservation (DOC) New Zealand Bat Distribution Database.
- DOC New Zealand Herpetological Database.
- DOC Threatened Plants Database.
- Retrolens.
- NIWA New Zealand Freshwater Fish Database (NZFFD).
- Significant Natural Areas of the Waikato District: terrestrial and wetland ecosystems[6].
- iNaturalist species observations.

2.2 Site visits

T+T ecologists have visited the site on multiple occasions since 2020 to fully characterise ecological values considering seasonal variation. Site visits occurred during the following periods:

Titanium Park Limited:

- February, March, and April 2020 – long-tailed bat (*Chalinolobus tuberculatus*) assessment.
- April 2021 – terrestrial assessment.
- May 2021 – freshwater assessment.
- March 2022 – long-tailed bat assessment.

Rukuhia Properties Limited:

- August 2021 and April 2022 – terrestrial and freshwater assessment.
- November and December 2021 - long-tailed bat assessment.

[3] Retrolens and Google Earth.

[4] Boffa Miskell Limited. (2018). Amberfield - Peacocke Structure Plan: Terrestrial Ecological Assessment. Report prepared by Boffa Miskell Limited for Weston Lea Ltd.

[5] Davidson-Watts Ecology. (2019). Long-tailed Bat Trapping and Radio Tracking Baseline Report 2018 and 2019 Southern Links, Hamilton. Technical report prepared for AECOM.

[6] Van der Zwan, W. & Kessels, G. (2017). Significant natural areas of the Waikato District: Terrestrial and wetland ecosystems. Prepared for Waikato Regional Council by Kessels Ecology.

2.2.1 Terrestrial assessment

Rapid surveys were undertaken across the site to identify the following:

- Broad vegetation types.
- Any threatened indigenous plants[7] or pest plants[8].
- Any potential habitat values present for fauna, particularly with respect to lizards and birds.
- Native and exotic birds opportunistically encountered.

The terrestrial ecology assessments were conducted on 16 April 2021 and 10 August 2021 for the TPL and RPL properties respectively.

2.2.2 Long-tailed bat assessment

Long-tailed bat assessments (surveys) were undertaken to understand how they utilise both the TPL and RPL properties and, if so, to what extent.

Acoustic bat surveys were undertaken using Acoustic Bat Monitors (ABMs) deployed across both TPL and RPL properties (Figure 2 Appendix A) in areas where bats would most likely utilise based on habitat characteristics (predominantly large mature trees and shelterbelts). The ABMs were set to record from one hour prior to sunset to one hour after sunrise following best practice as outlined in DOC's bat inventory and monitoring toolbox[9].

The ABM recordings were processed using an automated AI-based tool developed by T+T, which identifies long-tailed bat recordings. A subset of results was then manually checked and compared to the AI-based tool as part of a quality assurance process. The data analysis was undertaken according to best-practice methodologies[10] using the DOC BatSearch 3.11 programme. The analysis of ABM data provides the following information:

- Presence or absence of bats within the site during the survey periods.
- Distribution of bat activity within the site during the survey periods.
- The number of bat echolocation calls within the detection area of each ABM (c. 50 m radius).
- Foraging echolocation calls within the detection area of each ABM.
- Activity that may be indicative of roosting.

The above analysis was also undertaken on recordings within times of optimal weather conditions as outlined below. Weather conditions outside of the optimal can influence bat behaviour[11] [12].

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

[7] As classified in: Lange, J. Rolfe, J. Barkla, J. Courtney, S. Champion, P. Perrie, L. Beadel, S. Ford, K. Breitwieser, I. Schönberger, I. Hindmarsh-Walls, R. Heenan, P. and Ladley, K. (2018). *Conservation status of New Zealand indigenous vascular plants, 2017.* Department of Conservation, Wellington.

[8] As classified in the Waikato Regional Council Regional Pest Management Plan 2014-2024.

[9] Sedgeley, J & O'Donnell, C. (2012). Bat inventory and monitoring. Biodiversity inventory and monitoring toolbox. Department of Conservation, Wellington, New Zealand.

[10] Lloyd, B. 2017. Bat Call Identification Manual for DOC's Spectral Bat Detectors. Department of Conservation, Wellington.

[11] Le Roux, D., Le Roux, N. & Waas, J. 2014. Spatial and temporal variation in long-tailed bat echolocation activity in a New Zealand city. New Zealand Journal of Ecology, 41:1, 21-3.

[12] O'Donnell, C. 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.

It is noted that the use of ABMs as a survey tool provides an index of bat activity, rather than bat abundance as the number of bat calls does not necessarily correlate with the number of individual bats encountered. Furthermore, ABM surveys do not provide an absolute indication of roosting (temporary or maternal) behaviour and only an indicative or potential result can be interpreted based on technical judgement.

Weather data during the survey period was collected from the NIWA CliFlo website from the Hamilton Airport weather station (Agent No. 2112), as this was the nearest weather station to both TPL and RPL properties.

Any trees on both the TPL and RPL properties offering potential as bat roosts were identified as part of field assessments and mapped. Potential bat roost trees are defined as being ≥ 15cm Diameter at Breast Height (DBH), with one or more of the following features:

- Cracks, crevices, cavities and/or fractured limbs large enough to support roosting bat(s).
- Sections of loose flaking bark large enough to support roosting bat(s).
- Hollow trunk, stem or branches.
- Deadwood in a canopy or stem of sufficient size to support roost cavities or hollows.
- Bat droppings, grease marks and/or urine staining around cavities.

A summary of each acoustic long-tailed bat survey for the TPL and RPL properties is provided below:

<u>TPL Property:</u>

- Survey 1:
  - Undertaken between 5 and 24 February 2020.
  - Seven ABMs (Figure 2 Appendix A) were deployed and left for 19 nights.
  - Deviations from optimal weather conditions were minimum overnight relative humidity starting below 70% for nine of these survey nights (but humidity was greater than 70% within two hours after sunset on all nights).
- Survey 2:
  - Undertaken between 18 March and 5 April 2020.
  - Eight ABMs (Figure 2 Appendix A) were deployed and left for 18 nights.
  - Deviations from optimal weather conditions were minimum overnight relative humidity below 70% on one survey night with minimum temperature of 8.8 °C on a separate night. Rainfall in the first two hours after sunset exceeded 2.5 mm on 23 March and 4 April 2020.
- Survey 4:
  - Undertaken between 21 March and 13 April 2022.
  - Ten Acoustic Bat Monitors (ABMs) were deployed between 21 March and 13 April 2022 (Figure 2 Appendix A). ABMs deployed on 21 March were left for 22 nights, while those deployed on the 25 March were left for 18 nights. All ABMs were retrieved on 12 April. One ABM stopped recording after 17 nights (D1). Deviations from optimal weather conditions where minimum overnight relative humidity below 70% were observed on 10 of the survey nights, however bats were still detected on these nights.

- In addition to the three above surveys, further surveys have been undertaken on the TPL property by Gerry Kessels of Bluewattle Ecology[13] to inform the supervision of tree felling as noted in section 3.1 below. A summary of this survey includes:
  - Seven ABMs were deployed between 28 October to 22 March 2020 and left up to 26 nights.
  - Four ABMs were deployed between 20 October to 2 November 2021 and left up to 14 nights.
  - The only deviations from optimal weather conditions occurred on 3 of the 14 nights between 20 October to 2 November 2021.

RPL Property:

- Survey 3:
  - Conducted between 17 November and 8 December 2021.
  - Five ABMs (Appendix A) were deployed and left for 21 nights.
  - Deviations from optimal weather conditions were three nights with minimum temperatures of 10 °C.

Other than specified above, weather conditions on all other nights were within the optimal range when bats would likely be active (Appendix C).

2.2.3 Freshwater assessment

All watercourses were assessed and classified across both TPL and RPL properties based on the Waikato Regional Plan (WRP) definitions. Furthermore, the presence of any natural wetlands (as defined by the Natural Policy Statement for Freshwater Management 2020 (NPS:FM) was investigated and determined using wetland delineation protocols[14].

A summary of specific detail regarding the watercourse and wetland assessments conducted on the TPL and RPL properties are outlined below:

TPL Property:

- Assessments were undertaken on 16 April 2021 and again on 17 and 31 May 2021 after 15.6 mm and 12.8 mm of rainfall within a 48-hr period respectively.

RPL Property:

- Assessments were undertaken on 10 August 2021 following 23.8 mm of rainfall within a 48-hr period which occurred on 7 and 8 August 2021 and the reassessment of potential wetland area which occurred on 12 April 2022.

2.2.4 Assessment of ecological effects

The method applied to this assessment of ecological effects broadly follows the Ecological Impact Assessment Guidelines (EcIAG Guidelines[15]). Using a standard framework and matrix approach such as this provides a consistent and transparent assessment of ecological effects. Any deviations or adaptions from the methodology are identified within each section as appropriate.

[13] Hamilton Airport, Bat monitoring for tree felling October – November 2020 & November – December 2021 188 Narrows Road. Prepared by Gerry Kessels.

[14] Wetland delineation protocols, Clarkson. 2018, Manaaki Whenua Landcare Research and the Ministry for the Environment 2020 'Wetland Delineation Protocols'.

[15] Ecological Impact Assessment (EcIA), EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd Edition, May 2018.

The EcIAG guidelines have been used to ascertain the following:

- The level of ecological value of the environment.
- The magnitude of ecological effect from the proposed activity on the environment.
- The overall level of effect to determine if mitigation is required.

Further detail regarding these guidelines and the metrics used is included in Appendix B.

3 Ecological values

3.1 Terrestrial assessment

Most of the site is currently managed in a maize and pasture rotation resulting in the vegetation across the site being typical of most farm environments (around houses, driveways, shelterbelts and for shade for livestock). Photographs of both TPL and RPL properties are displayed in Figure 3.1 and 3.2 below. For conciseness, all pasture grasses, pest plants and environmental weed species have been excluded from the vegetation descriptions below and are referenced in Appendix D.

TPL Vegetation:

- Cypress (*Cupressus* sp.), alder (*Alnus glutinosa*), casuarina (*Casuarina cunninghamiana*), totara (*Podocarpus totara*) and crack willow (*Salix fragilis*) forming smaller shelterbelts on the northern portion of the property.
- Pin oak (*Quercus palustris*), maple (*Acer* sp.), Persian silk tree (*Albizia julibrissin*), callery pear (*Pyrus calleryana*), kohuhu (*Pittosporum teniofolium*) in a small discrete area immediately west of the homestead.
- Kauri (*Agathis australis*), London plane (*Platanus* x *acerifolia*), oak (*Quercus robur*), liquid amber (*Liquidambar styraciflua*), and common ash (*Fraxinus excelsior*) as individual large specimen trees scattered across the property.
- Citrus trees (*Citrus* spp.), cherry trees (*Prunus* sp.), cabbage trees (*Cordyline australis*), ginkgo (*Ginkgo biloba*), mamaku (*Cyathea medullaris*), buxus shrubs (*Buxus sempervirens*), karo (*Pittosporum eugenioides*) and avocado (*Persea americana*) in and around the homestead and Bruntwood nursery.
- Rank grass along farm races and around farm sheds.
- Necklace poplar (*Populus deltoides*) which formed two main shelterbelts approximately 430 m and 250 m in length (c. 0.9 ha and c. 0.45 ha respectively) on the western portion of the property, but which have since been removed in 2021.

Figure 3.1: Shelterbelt of necklace poplars within TPL property which have since been removed.

Figure 3.2: Pasture within TPL property, established native/exotic near homestead on right of photo.

Since the terrestrial assessment of the TPL property, the two necklace poplar shelterbelts (as denoted by the purple outline in Figure 2) were removed between 12 and 19 November 2021 for safety reasons as part of farming operations. Due to the potential presence of bats, these shelterbelts were removed following best practice tree removal protocols under the supervision of a qualified bat ecologist[16] and following a specific bat survey using ABMs. Therefore, bat activity in these areas also needs to be considered being in mind that at the time of the surveys the necklace poplar shelterbelts were in situ. For completeness the two necklace poplar shelterbelts have been discussed in the report for context in terms of bat results. However, as they are no longer part of the existing environment, they have not been incorporated into this report's ecological effect sections for vegetation and do not form part of the conclusions.

RPL Vegetation:

- Chestnut (*Catanea sp.*) grove approximately 0.25 ha exists on the western portion of the property (we note that the majority of this grove (0.47 ha) extends into the Southern Links designation and therefore outside the plan change request and rezoning area for the Northern Precinct).
- Black alder (*Alnus glutinosa*) hedgerow approximately 200 m on the northern property boundary.
- Mānuka (*Leptospermum scoparium*), flax (*Phormium tenax*), swamp astelia (*Astelia grandis*), lacebark (*Hoheria sp.*), kahikatea (*Dacrycarpus darcridioides*), rimu (*Dacrydium cupressinum*) and silver beech (*Lophozonia menziesii*) in three small discrete planted areas.
- Pine (*Pinus sp.*) and gum (*Eucalyptus sp.*) trees in individual locations.

[16] Hamilton Airport, Bat monitoring for tree felling October – November 2020 & November – December 2021 188 Narrows Road. Prepared by Gerry Kessels and which concluded that bats were not roosting in the poplar shelterbelts.

Figure 3.3: Native plantings along RPL property boundary.

Figure 3.4: Pasture within RPL property with chestnut grove in background.

Lizards

The only native lizard considered to possibly be present across both TPL and RPL properties, albeit it likely in low densities, is the copper skink (*Oligosoma aeneum*) which is classified as At Risk – Declining[17]. Both TPL and RPL properties contain low quality isolated areas of suitable skink habitat which includes rank grass, log piles, leaf litter under vegetation and buildings. No native gecko habitat was recorded on either property.

Avifauna

Both TPL and RPL sites provide low quality habitat for a range of common native and introduced bird species (Table 3.1) that are typical of agricultural environments.

Based on field observations and habitat availability, it is considered unlikely that any At Risk or Threatened bird species[18] inhabit the TPL and RPL properties.

Table 3.1: Avifauna species observed or likely to be present within the TPL or RPL properties

Common Name	Scientific Name	Threat Status	Property observed / Potentially Present
Grey warbler	*Gerygone igata*	Not Threatened	TPL
Morepork	*Ninox novaeseelandiae*	Not Threatened	Potentially Present
NZ fantail	*Rhipidura fuliginosa*	Not Threatened	TPL
Paradise shelduck	*Tadorna variegata*	Not Threatened	TPL
Pied stilt	*Himantopus himantopus*	Not Threatened	Potentially Present
Pukeko	*Porphyrio melanotus*	Not Threatened	TPL
Sacred kingfisher	*Todiramphus sanctus*	Not Threatened	TPL
Silvereye	*Zosterops lateralis*	Not Threatened	Potentially Present

[17] New Zealand Threat Classification Series 35, Conservation Status of New Zealand Reptiles, 2021. Department of Conservation, Wellington.

[18] New Zealand Threat Classification Series 19, Conservation Status of New Zealand Birds, 2016. Department of Conservation, Wellington.

Common Name	Scientific Name	Threat Status	Property observed / Potentially Present
Swamp harrier	*Circus approximan*	Not Threatened	TPL & RPL
Tui	*Prosthemadera novaeseelandiae*	Not Threatened	Potentially Present
Welcome swallow	*Hirundo neoxena*	Not Threatened	TPL
California quail	*Callipepla californica*	Introduced/Naturalised	TPL
Goldfinch	*Carduelis*	Introduced/Naturalised	TPL & RPL
Magpie	*Gymnorhina tibicen*	Introduced/Naturalised	TPL
Pheasant	*Phasianus colchicus*	Introduced/Naturalised	TPL
Rock pigeon	*Columba livia*	Introduced/Naturalised	TPL
Sparrow	*Passer domesticus*	Introduced/Naturalised	TPL
Spotted dove	*Streptopelia chinensis tigrina*	Introduced/Naturalised	TPL
Black bird	*Turdus merula*	Introduced/Naturalised	Potentially Present
Myna	*Acridotheres tristis*	Introduced/Naturalised	Potentially Present
Spur-winged plover	*Vanellus miles*	Introduced/Naturalised	Potentially Present

3.2 Long-tailed bats assessment

A summary of results for each acoustic bat survey undertaken at the TPL and RPL properties is outlined below. Mean number of bat passes (indication of activity) detected per night per ABM is provided in Table 3.2 and locations of ABMs shown in Figure 2 Appendix A.

TPL Property:

- Survey 1 (5 – 24 February 2020):
  - 1,686 total bat passes across the seven ABMs over 19 survey nights with optimal weather conditions (12.7 bat passes / per ABM / per night).
  - The highest level of activity was detected by ABM A03 in and around the vegetation at the homestead location with a mean number of bats passes per night of 37.1.
  - ABM A04 and ABM A06 in and around the (now removed) necklace poplar shelterbelt also recorded high activity with mean number of bats passes per night of 21.37 and 18.74 respectively.
  - Peak activity was recorded between 6 to 10 hours after sunset indicating that bats were not roosting on the TPL property.
  - The lowest level of activity was detected by ABM A07 in and around a stand of isolated common ash (*Fraxinus excelsior*) trees near the northern boundary with a mean number of bats passes per night of 0.6.
- Survey 2 (18 March – 5 April 2020):
  - 4,007 total bat passes across eight ABMs over 18 survey nights with optimal weather conditions (27.8 bat passes / per ABM /per night).
  - The highest levels of bat activity were recorded in and around the (now removed) Necklace poplar shelterbelt by ABM BO1, ABM BO2, ABM B05, ABM BO6 and ABM B07 with mean number of bats passes per night of 35, 24.3, 44.6, 64.9 and 42.5 respectively.
  - Peak activity was recorded between 3 to 8 hours after sunset.
  - The lowest level of activity was detected by ABM BO3 and ABM BO4 (homestead location) with a mean number of bats passes per night of 2.2 and 2.3 respectively.

Feeding 'buzzes' were detected by the ABMs at the homestead and shelterbelt locations in both survey 1 and 2, confirming vegetation in these locations as likely foraging habitat.

High level of bat activity is also referenced in the tree felling surveys undertaken by Gerry Kessels suggesting that those features may have been used as a flyway at the time. No roosting behaviour was identified, or physical roosts found within inspected trees in the tree felling survey. Based on survey 2 data it is possible that temporary roosting had occurred based on the level of bat activity detected after sunset and in the 0 to 3 hours before sunrise.

- Survey 4 (21 March and 13 April 2022):
  - 556 total bat passes across ten ABMs over between 18 and 22 survey nights (2.5 bat passes / per ABM /per night).
  - The highest number of bat passes were recorded by ABMs at locations D8 and D9 (Figure 2 Appendix A). ABM D9 was deployed in a large London planetree (*Platanus x acerifolia*) at the entrance to 105 Middle Road and D8 was located approximately 400 m to the east of the property entrance in a black locust (*Robinia pseudoacacia*) by an old shed. These two ABM locations are linked by a straight, gravel driveway lined by a hedge on the north side and a row of London planetree specimen trees on the south side. Bats may be using this line of specimen trees as a flyway. The highest levels of feeding activity were recorded by these two ABMs.
  - Peak activity was recorded between 11pm and 2 am, with no bat activity recorded within 30 minutes of sunset. This indicates that bats may have been roosting elsewhere during the survey and commuting to and/or through the property. This does not mean that bats do not roost on the property, or at these locations at other times outside the survey period.
  - Feeding activity was recorded by ABMs at four locations (D8 and D9, along with D2 and D10). D2 was in a London planetree at the junction of the driveway of 1/188 Narrows Road and the internal driveway to the old milking shed. D10 was in a macrocarpa (*Cupressus macrocarpa*) beside Middle Road. This is past the end of one of the former hedgerows that was removed, but which is now resprouting. D10 recorded the next highest activity after D8 and D9.
  - The lowest level of activity was detected by ABM D1, ABM D4, ABM D5 and ABM D6

<u>RPL Property:</u>

- Survey 3 (17 November – 8 December 2021):
  - A total of six bat passes were recorded over the duration of the 21-night survey (Table 1) with a low level of activity recorded.
  - None of the passes were indicative of swarming or feeding behaviours. This indicates that although bats were present within the RPL property they are not active in a way that represents the likely use of vegetation as roosting or feeding habitat.
  - Long-tailed bats were likely using the RPL property as a flight path, and the low number of bat passes recorded over the relatively long duration of the survey indicates that bats are not frequently using this area.

Table 3.2: Summary of long-tailed bat activity detected across all bat surveys on both TPL and RPL properties

TPL - bat survey 1 (5 – 24 February 2020)		TPL - bat survey 2 (18 March – 5 April 2020)		TPL - bat survey 4 (21 March and 13 April 2022)		RPL - bat survey 3 (17 November – 8 December 2021)	
ABM	Mean no. of bat passes detected per night	ABM	Mean no. of bat passes detected per night	ABM	Mean number of bat passes per night	ABM	Total number of bat passes for the survey
A01*	5	B01*	35	D1	0.5	C1	2
A02*	3.3	B02*	24.3	D2	1	C2	0
A03	37.1	B03	2.3	D3	0.6	C3	2
A04*	21.4	B04	2.2	D4	0.5	C4	1
A05	2.7	B05	44.6	D5	0.4	C5	1
A06*	18.7	B06*	64.9	D6	1.6		
A07	0.6	B07*	42.5	D7	1.6		
		B08	6.7	D8	9.6		
				D9	9.1		
				D10	2.4		

Note: *ABM locations on the TPL property where the two necklace poplar shelterbelts (as denoted by the purple outline in Figure 2) were removed between 12 and 19 November 2021 for safety reasons as part of farming operations.

The above bat surveys on both TPL and RPL properties have confirmed that long-tailed bats have utilised both properties during the surveys with reduced levels of bat activity detected on the TPL site between survey 2 and 4.

Although acoustic surveys cannot confirm whether bats have roosted at a particular site, the level and timing of bat activity can give an indication of roosting behaviour (high activity just after dusk when bats leave roosts). It is considered that roosting within the TPL property was not occurring during the Survey 1 and Survey 4 period, but the timing of activity recorded at some ABMs within the first hour following sunset in Survey 2 means that roosting at that time could not be conclusively ruled out. As noted earlier the Bluewattle Ecology assessment prepared prior to the shelterbelt tree felling concluded that there was no roosting occurring in those trees at the time of that survey.

Survey 3 indicates that long-tailed bats frequent the RPL site less frequently with no indication of roosting, swarming, or feeding behaviours.

Due to the transient nature of bats, all potential bat roost trees across both properties are depicted as either individual trees or clusters of trees in Figure 2 Appendix A.

3.3 Freshwater assessment

Watercourses across both TPL and RPL properties are heavily modified by historical agricultural land use and generally degraded. All watercourses across both properties have been classified as either artificial or overland flow paths[19] (Figure 3 Appendix A). The artificial channels or overland flow paths ultimately flow into the Nukuhau Stream. The following section provides a summary of the freshwater features of the TPL and RPL properties.

TPL Property

At the time of the site visit (16 April 2021) at the TPL property no water was observed in most of the identified artificial channels (Figure 3.5). The exception to this was one small (less than 40 m in length) reach which had shallow standing water and a small reach (10 m in length) on the northern boundary, which had flowing water before entering the neighbouring property. The same observations were made before and after rain events across multiple site visits following rainfall on 17 May 2021 (15.6 mm in previous 48-hr period) and 31 May 2021 (12.8 mm in previous 48-hr period).

RPL Property

Two artificial channels have been identified on the RPL property and meet this classification as they contain no natural portions from their confluence with a river or stream to their headwaters[20].

The first artificial channel was located along the eastern boundary connecting to the northern boundary where it enters a perched culvert approximately 0.5 m in diameter which is currently being supported by tyres. This artificial channel is approximately 2 m in width with standing pools of water with a 5 - 10 cm range of depth.

[19] A watercourse that contains no natural portions from its confluence with a river or stream to its headwaters and includes irrigation canals, water supply races, canals for the supply of water for electricity power generation and farm drainage canals. Waikato Regional Plan.

[20] Based on the Waikato Regional Plan-artificial watercourse definitions.

The second artificial channel is located along the northern boundary and connects with the eastern boundary. This channel was dry, however there was flowing water (15 cm deep) for approximately 10 m before it enters the neighbouring property.

The artificial channels were mostly bordered by pasture or maize. Some reaches run adjacent to the recently removed exotic shelterbelts or hedgerows. In summary, these artificial channels have little to no habitat value for indigenous fauna due to the lack of water along most of the lengths of channel.

Multiple overland flow paths were observed within the northern portion of the RPL property (Figure 3.6). These were classified as overland flow paths based on the following criteria:

- Rooted terrestrial vegetation established across the width of the channel.
- No surface/pooling water observed.
- No distinguishable banks.
- No evidence of substrate sorting; or
- No organic debris resulting from flood observed on the floodplain.

Figure 3.5: Example of an artificial channel through the TPL property.

Figure 3.6: Example of an overland flow path through the RPL property.

A small area in the north-eastern corner of the site was identified as a potential natural wetland based on a site assessment undertaken on the 10 August 2021 (after a significant rainfall event 23.8 mm within a 48-hr period). At this time the area was identified as a potential natural wetland based on marginally meeting the prevalence (PI 2.6) hydrophytic vegetation test and having saturated soils (inconclusive hydric soil) and standing water being present.

However, due to the significant rainfall prior to this assessment and surrounding land features (run off from a driveway) that may have accentuated the results (ponding water, saturated soil and vegetation composition) another assessment was considered necessary under normal conditions.

The second assessment was undertaken on the 12 April 2022, which identified significantly higher coverage of non-hydrophytic vegetation largely perennial ryegrass (*Lolium perenne*), hairy crabgrass (*digitaria sanguinalis*), summer grass (*Digitaria sanguinalis*), broad-leaved dock (*Rumex obtusifolius*) and narrow-leaved plantain (*Plantago lanceolata*).

Based on this second assessment under normal conditions, the potential wetland area failed all three hydrophytic vegetation tests and no hydrologic features were present and therefore we are satisfied that this area is not a natural wetland and therefore does not require any further assessment under the NPS-FM or NES-F.

Aquatic fauna

A desktop review of the surrounding freshwater environment was carried out using the New Zealand Freshwater Fish Database (NZFFD). There are no NZFFD records from within the site. The NZFFD shows a range of native fish and invertebrate species present within Nuhukau Stream catchment with four of these species classified as At Risk-Declining[21] [22] (Table 3.3). Based on the available habitat for freshwater species being restricted within the artificial channels across both TPL and RPL properties and most of the reaches being dry all year round, it is highly unlikely that these species are present.

Table 3.3: Fish species present within Nuhukau Stream (source: NZFFD)

Species	Common Name	Threat Status
Anguilla australis	Shortfin eel	Not threatened
Anguilla dieffenbachii	Longfin eel	At risk – Declining
Galaxias argenteus	Giant kokopu	At risk – Declining
Galaxias brevipinnis	Koaro	At risk – Declining
Galaxias fasciatus	Banded kokopu	Not threatened
Gobiomorphus cotidianus	Common bully	Not threatened
Invertebrates present within the Nuhukau Stream catchment		
Hyridella menziesi	Freshwater mussel	Declining
Paranephrops spp.	Koura	Not threatened
Paratya curvirostris	Freshwater shrimp	Not threatened

3.4 Summary of ecological values across all assessments

Bat activity has been recorded on the TPL site and to a lesser extent on the RPL site, and a number of mature trees may provide potential roosts for bats resulting in a very high ecological value as a consequence of those trees. The preparation and implementation of a bat management plan at the resource consent stage and adherence to industry standard tree best practice removal protocols has therefore been recommended and provisions incorporated into the Plan Change.

Due to the dominance of exotic and pest plant species, vegetation within the site has been assessed as having low ecological value (other than those trees that may provide potential bat roosts).

Limited and isolated areas of habitat for a skink species and no specific habitat for gecko species results in the site having a low ecological value for lizard species.

All bird species observed or potentially inhabiting the site, are relatively common in most agricultural landscapes and none are considered at risk or threatened, therefore the site has a low ecological value for bird species.

Artificial channels across the site have low ecological value for freshwater species.

The low ecological values (except for potential bat roosts and bats) across both TPL and RPL properties is like those in the wider rural landscape which reflect a high degree of modification and low biodiversity.

[21] New Zealand Threat Classification Series 24, Conservation Status of New Zealand Freshwater Fishes, 2017. Department of Conservation, Wellington.

[22] New Zealand Threat Classification Series 28, Conservation Status of New Zealand Freshwater Invertebrates, 2018. Department of Conservation, Wellington.

4 Ecological effects

This section provides an ecological effects assessment of the plan change from the sites' (both TPL and RPL properties) current state to that state of the future development envisaged by the proposed Plan Change.

4.1 Terrestrial assessment

Vegetation

Most of the site is currently managed in a maize and pasture rotation, resulting in the vegetation across the site being typical of most farm environments (around houses, driveways, shelterbelts and for shade for livestock) with a mix of exotic and native species.

Even if all vegetation is removed and no additional vegetation planted (which it is not what is proposed) the magnitude of this effect would be moderate. A low level of ecological value and moderate magnitude of effect results in the overall level of ecological effect of low for vegetation removal (excluding potential bat roost trees). However, we expect that a large number of trees will be planted across the site as part of developing the Northern Precinct (based on the proposed landscape requirements). If the majority of these are native tree species and targeted at providing suitable biodiversity value, then this is likely to result in a positive magnitude of effect with the overall level of ecological effect considered to be a net gain.

Lizards

The rotating between maize and pasture across the site significantly reduces the amount of habitat availability (rank grass) for native skinks with other potential habitat across the site (rank grass, woody debris, and leaf litter) being of low value and isolated. A low level of ecological value and low magnitude of effect results in the overall level of ecological effect of very low for lizards.

Birds

Vegetation removal has the potential to directly disturb, injure or kill birds that maybe utilising the site. Native birds are particularly vulnerable to disturbance during the breeding season, when adult nesting birds, chicks, and eggs can be lost or displaced. A low level of ecological value and low magnitude of effect results in the overall level of ecological effect of very low for bird species. Furthermore, the low magnitude of effect has been assigned based on a minor shift from baseline conditions considering the future landscaping that is likely to be accommodated throughout the Northern Precinct based on road typologies and landscaping requirements.

Notwithstanding the above, the site provides scope for a future landscape planting that could result in more trees than current baseline conductions. If the majority of these are native tree species and targeted at providing suitable biodiversity value, then this is likely to result in a positive magnitude of effect with the overall level of ecological effect is considered a net gain regarding bird species.

Long tailed bats

Modification of the landscape has the potential to impact long-tailed bats by the removal of potential bat roost trees (habitat removal) and deterring bats utilising this area for foraging or commuting due to an increase in artificial lighting and density of buildings[23] [24]. The removal of trees can currently occur irrespective of the Plan Change request. If all potential bat roost trees are

[23] Le Roux, D., & Le Roux, N. 2012. Hamilton City Bat Survey 2011 - 2012. Prepared by Project Echo and Kessels & Associates Ltd.

[24] Le Roux, D., Le Roux, N. & Waas, J. 2014. Spatial and temporal variation in long-tailed bat echolocation activity in a New Zealand city. New Zealand Journal of Ecology, 41:1, 21-3.

removed (which is not proposed) and bats are deterred from using the site, then the displacement of bats may occur. The magnitude of this effect would be high.

As long-tailed bats are classified as critically endangered, they are assessed as having very high ecological value. Based on a very high level of ecological value and high magnitude of effect, the overall level of ecological effect is considered very high if no avoidance, or mitigation measures were adopted.

To avoid or mitigate the overall ecological effect on long-tailed bats the following recommendations should be adopted by the plan change request:

- Incorporation of suitable tree species for bat roost habitat into the landscape planting design and the retention of as many as practicable identified potential bat roost trees in and around the proposed hub (currently around the homestead).
- Incorporation of bat sensitive lighting in the form of Light Management Areas.
- Prepare and adopt a Bat Management Plan to include (but not necessarily be limited to):
  - Standard Department of Conservation tree removal protocols[25] for the removal of any of the identified potential bat roosts.
  - An approach and pathway to determine appropriate mitigation, offset or compensation for the loss of any potential roost trees identified.

By implementing the above (as we understand the Plan Change request has done), the magnitude of effect would be reduced to negligible with the overall level of ecological effect reduced to low (which equates in RMA terms to nil effects after mitigation, offset, or compensation is applied.

This level of effect is reflective of the already removed necklace poplar shelterbelt which was utilised by bats as a flyway and anticipated by the current Airport Business Zone as this covers more than half of the Hub area (as denoted in Figure 1.2 above).

4.2 Freshwater assessment

Modification of the landscape has the potential to permanently remove these artificial channels and cause uncontrolled discharges of sediment laden water into adjoining streams off the properties.

As most of the artificial channels across the site had no water present during any of our site visits, it is considered that there is little, to no habitat value. A low level of ecological value and negligible magnitude of effect results in the overall level of ecological effect of very low for all artificial channels.

It is noted that earthworks activities have the potential to result in an uncontrolled discharge of sediment laden water into artificial channels and transportation into any adjoining stream channels located in the wider landscape if no sediment management is undertaken. Increased sediment in the receiving environment can impact water quality within the freshwater environment and result in sediment deposition, changing habitat features. A sediment and erosion control plan should be implemented to avoid any ecological effects associated with an uncontrolled discharge of sediment laden water into the artificial channels and therefore into adjoining streams.

[25] Protocols for minimising the risk of felling bat roosts (Bat Roost Protocols (BRP), version 2, October 2021, approved by the New Zealand Department of Conservation's Bat Recovery Group.

5 Conclusion

The ecological values of the site are consistent with those anticipated within rural land use within this area.

The long-tailed bat assessments undertaken have identified that the TPL property is utilised by long-tailed bats for foraging and feeding, specifically around the area of the proposed hub (currently the homestead) in one survey and the shelterbelt prior to their removal. Due to the presence and activity of bats and their transient nature, all potential roost trees have been identified with recommendations made for the implementation of a bat management plan and adherence to industry standard best practice tree removal protocols for both TPL and RPL properties (that would apply to certain trees within the precinct). Furthermore, based on the level of bat activity across the TPL property, additional measures such as the inclusion of native specimen trees within landscape planting should be included to provide an alternative to the existing habitat for bats. We also recommend managing the lighting associated with the development within certain parts of the precinct which has been identified as Light Management Areas that will encourage the continued commuting of bats across the precinct.

Most of the vegetation within the site is currently managed in a maize and pasture rotation with small, isolated areas of mixed exotic and native species. We expect that considerably more trees will be planted across the site as part of the proposed development and landscape planting, which can potentially result in an increase in native biodiversity value in terms of vegetation.

The rotation between maize and pasture across the site significantly reduces the amount of habitat availability (rank grass) for native skinks with other potential habitat across the site (rank grass, woody debris, and leaf litter) being isolated.

Vegetation removal has the potential to directly disturb, injure or kill birds that maybe utilising the site. Native birds are particularly vulnerable to disturbance during the breeding season, when adult nesting birds, chicks, and eggs can be lost. We expect that considerably more trees will be planted across the site as part of the proposed landscape planting (compared to what currently exists). If the majority of these are native tree species and targeted at providing suitable biodiversity value, then this is likely to result in a benefit and increased food source for many native bird species that frequent this area.

All watercourses across the site have been assessed as either artificial channels or overland flow paths with most of them having no water present. As discussed above most of the artificial channels across the site had no water present during any of our site visits, it is considered that there is little, to no habitat value. The overall level of ecological effect on these artificial channels is very low and doesn't warrant any further mitigation.

Overall, it is considered that the potential ecological effects of the change in land use and the development of the Northern Precinct can be appropriately avoided, minimised, mitigated, offset, or compensated and as such, the overall level of effects are low to very low, with no net loss and potential net gains in biodiversity value due to ecological outcomes recommended in the District Plan, see section 7 below.

6 Policy interpretation relevant to ecological matters

Part 2 of the RMA provides the purpose and principles regarding the promotion of sustainable management of natural and physical resource including the use, development and protection of natural and physical resources.

Section 11 of the Waikato Regional Policy Statement (WRPS) also provides criteria to be used to identify areas of significant indigenous biodiversity and their characteristics specifically relating to habitat type and connectivity.

Based on information provided within this report, the provision of bat habitat resulting in bat commuting pathways should be provided across the TPL property to safeguard the ability for bats to continue to traverse through the landscape. Based on the threat classification of bats, it is considered that the vegetation across the TPL property meets criteria 3 of the WRPS for determining significance in biodiversity.

Based on the findings and conclusions of the report and direction of Part 2 and Section 6 of the RMA and Section 11 of the WRPS, it is considered necessary to provide recommended provisions to be included in the District Plan to guide future development of the Northern Precinct.

7 Recommended ecological outcomes to be included in the District Plan

It is recommended that the following be included in the District Plan to guide future development of the Northern Precinct.

- A process / framework outlining the development of a Bat Management Plan for the whole Northern Precinct which identifies potential bat roost trees, tree removal protocols and appropriate offset or compensation to address potential residual effects.
- The need for specific lighting requirements within identified Light Management Areas which should create low light levels / directional lighting.
- The integration of large native specimen trees (such as totara, puriri or any other large native specimen trees which will develop bat habitat characteristics) into landscaped areas within the Hub and along the landscaped boundary edges. It is important that layout design of these areas provide flight paths for bats and habitat for birds.

8 Applicability

This report has been prepared for the exclusive use of our client Titanium Park Ltd & Rukuhia Properties Ltd, 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.

Tonkin & Taylor Ltd

Report prepared by:

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Fieldwork and technical components of this report were provided by Adam Purcell, Stephanie Angove-Emery, Laura Francis, and Abi Quinnell. Technical Review completed by Liz Curry and Dean Miller.

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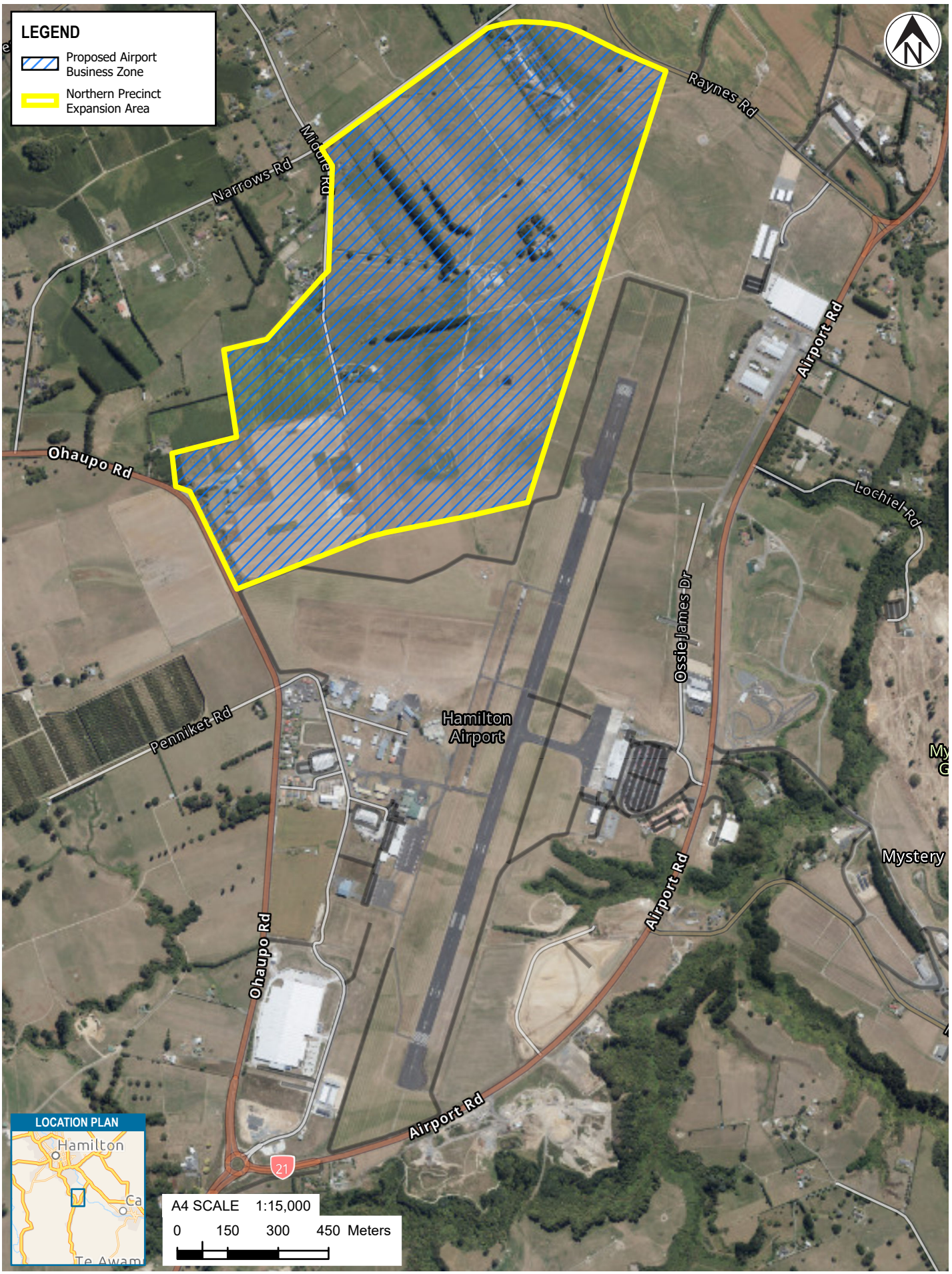
Appendix A: Site plans



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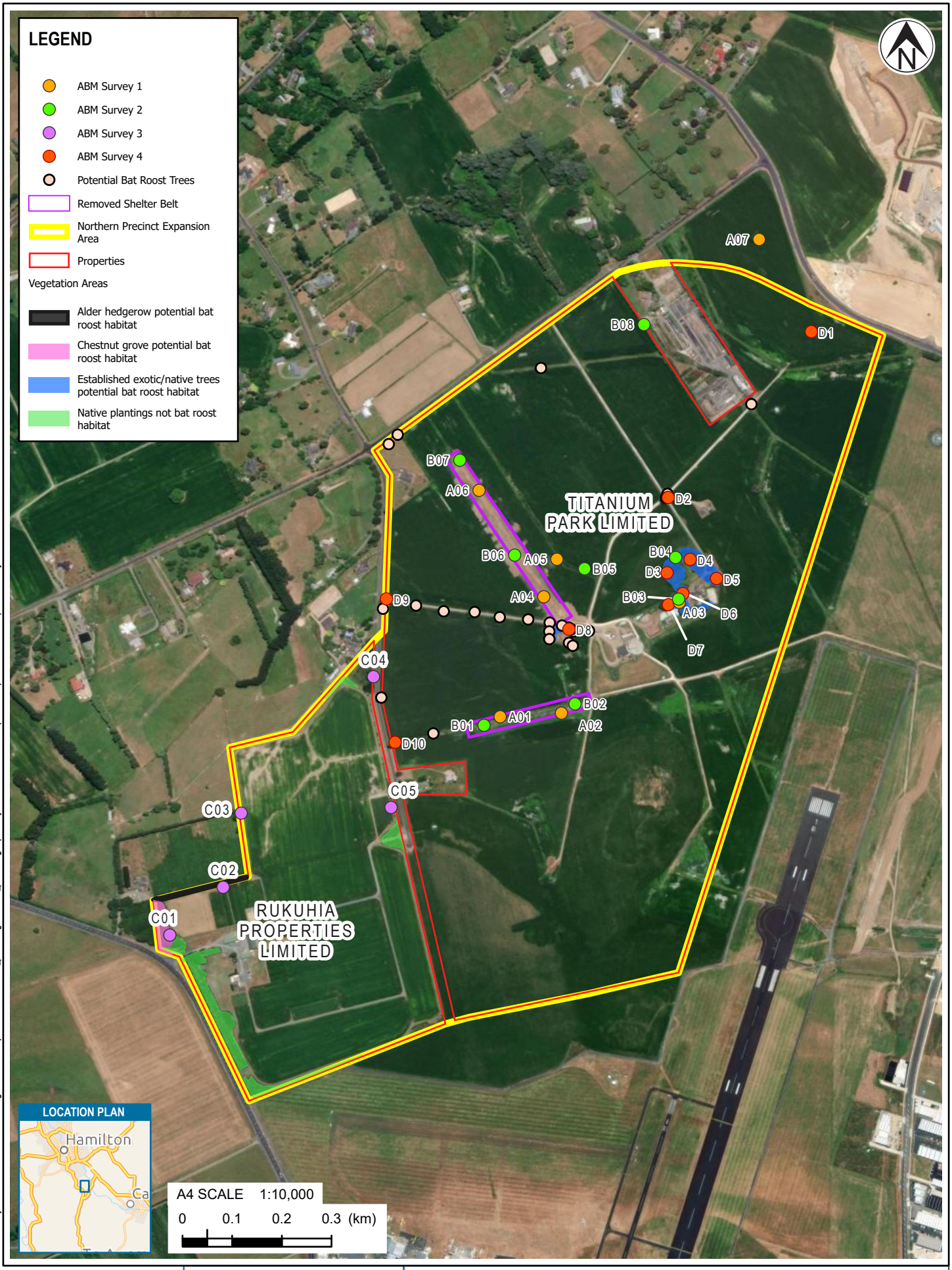
PROJECT **PROPOSED CHANGES TO THE AIRPORT BUSINESS ZONE STRUCTURE PLAN**

TITLE AIRPORT BUSINESS ZONE STRUCTURE PLAN
ECOLOGY ASSESSMENT

SCALE (A4) 1:15,000 FIG No. FIGURE 1. REV 1



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TITLE TERRESTRIAL VEGETATION AND LONG TAIL BAT ASSESSMENT

SCALE (A4) 1:10,000 FIG No. FIGURE 2. REV 1

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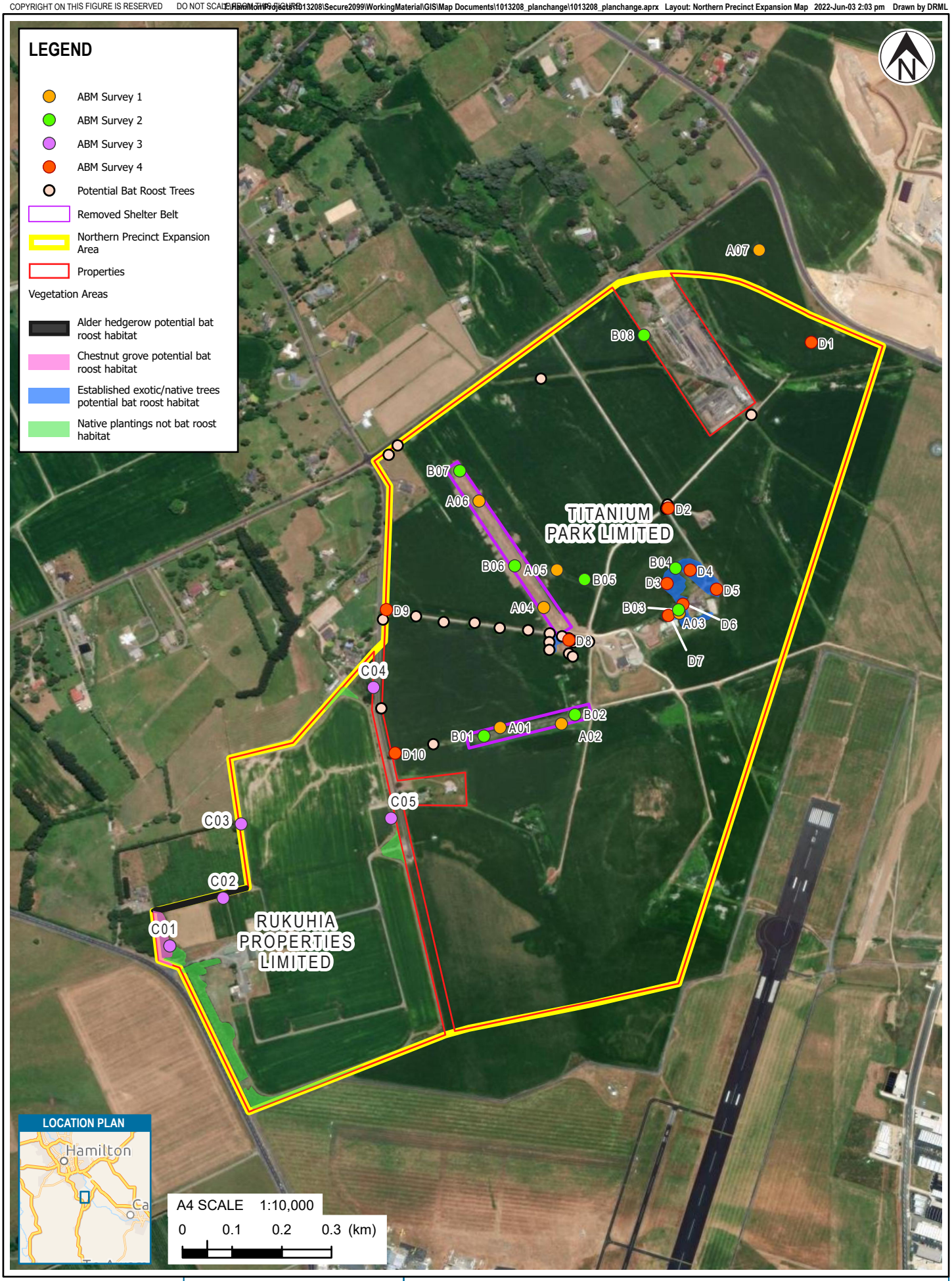

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TITLE TERRESTRIAL VEGETATION AND LONG TAIL BAT ASSESSMENT

SCALE (A4) 1:10,000 FIG No. FIGURE 2. REV 1

Appendix B: Ecological impact assessment guidelines

Appendix B Table 1: Factors to consider in scoring sites values in relation to species representativeness, rarity, diversity and pattern, and ecological context (adapted from EIANZ, 2018)

Value	Species Values	Vegetation/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-high	Nationally At Risk - Recovering, Relict or Naturally Uncommon.	A site that meets ecological significance criteria as set out 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.

Appendix B Table 2: Summary of the criteria for describing the magnitude of effect (adapted from EIANZ, 2018)

Magnitude	Description
Very High	Total loss or very major alteration to key elements or features of the existing baseline conditions. Loss of high proportion of the known population or range of the element/feature.
High	Major loss or alteration to one or more key elements of existing baseline conditions. Loss of high proportion of the known population or range of the element/feature.
Moderate	Loss or alteration to one or more key elements of existing baseline conditions. 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. Having a minor effect on the known population or range of the element/feature.
Negligible	Very slight change from the existing baseline physical or chemical conditions; change barely distinguishable from the 'no change' scenario. Having negligible effect on the known population or range of the element/feature.

Appendix B Table 3: Criteria for describing overall levels of ecological effects (adapted from EIANZ, 2018)

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

Appendix B Table 4: Interpretation of assessed ecological effects against standard RMA terms

Level of Ecological Effect (refer Table E3)	RMA Interpretation	Description
Very high	Unacceptable adverse effects	Extensive adverse effects that cannot be avoided, remedied or mitigated.
High	Significant adverse effects that could be remedied or mitigated	Adverse effects that are noticeable and will have a serious adverse impact on the environment but could potentially be mitigated or remedied.
Moderate	More than minor adverse effects	Adverse effects that are noticeable and may cause an adverse impact on the environment, but could be potentially mitigated or remedied.
Low	Minor adverse effects	Adverse effects that are noticeable but that will not cause any significant adverse impacts.
Very low	Less than minor adverse effects	Adverse effects that are discernible day to day effects, but which are too small to adversely affect the environment.
Nil	Nil effects	No effects at all.

Appendix C: Acoustic bat survey weather data

Appendix C Table 1: Weather conditions during the two acoustic bat surveys. Data collected from CliFlo (Ruakura EWS, station no. 26117). Yellow highlighted cells indicate weather measurements that do not fall within the 'optimal' conditions for bat activity i.e. •minimum temperature of 10 °C or higher in the first two hours following sunset; ≤ 2.5 mm rainfall over the first two hours after sunset; and minimum overnight relative humidity of 70%

Date	Min. temp. in first two hours after sunset (°C)	Rainfall in first two hours after sunset (mm)	Min. overnight humidity (%)
First survey			
5/02/2020	15.1	0	65
6/02/2020	16.8	0	73
7/02/2020	17.5	0	60
8/02/2020	15.6	0	66
9/02/2020	13.1	0	66
10/02/2020	15	0	71
11/02/2020	14.8	0	66
12/02/2020	17.7	0	69
13/02/2020	16	0	76
14/02/2020	18.4	0	67
15/02/2020	18.4	0	72
16/02/2020	19.3	0	76
17/02/2020	21.4	0	59
18/02/2020	20.5	0	74
19/02/2020	18.6	0	81
20/02/2020	17	0	57
21/02/2020	18.5	0	71
22/02/2020	15.8	0	78
23/02/2020	15	0	76
24/02/2020	16.5	0	67
Second survey			
18/03/2020	8.8	0	80
19/03/2020	11.8	0	75
20/03/2020	15.1	0	83
21/03/2020	14.9	0	82
22/03/2020	17.2	0.5	94
23/03/2020	14.8	4.9	71
24/03/2020	12.1	0	76
25/03/2020	13.2	0	77
26/03/2020	10.4	0	78
27/03/2020	10.7	0	89

Date	Min. temp. in first two hours after sunset (°C)	Rainfall in first two hours after sunset (mm)	Min. overnight humidity (%)
28/03/2020	11.9	0	79
29/03/2020	12.8	0	86
30/03/2020	15.1	0	83
31/03/2020	12.4	0	81
1/04/2020	10.7	0	62
2/04/2020	11.4	0	76
3/04/2020	10.8	0	71
4/04/2020	11.1	8.9	69
Third survey			
17/11/2021	11.5	0	86
18/11/2021	10.2	0	79
19/11/2021	8.8	0	84
20/11/2021	18.2	0	80
21/11/2021	12.5	0	76
22/11/2021	16.8	0	76
23/11/2021	17.9	0	88
24/11/2021	16.3	0	80
25/11/2021	15.2	0	80
26/11/2021	10.2	0	79
27/11/2021	16.8	0	72
28/11/2021	17.8	0	74
29/11/2021	17.6	0	84
30/11/2021	17.2	0.2	86
1/12/2021	18.4	0	86
2/12/2021	19.4	0	83
3/12/2021	17.9	0	84
4/12/2021	17.4	0.6	94
5/12/2021	18.6	0	85
6/12/2021	19.6	0	88
7/12/2021	18.1	0	83
Fourth survey			
21/03/2022	20.0	0	90
22/03/2022	20.1	0	86
23/03/2022	18.3	0	84
24/03/2022	19.7	0	74
25/03/2022	17.0	0	70
26/03/2022	18.1	0	62
27/03/2022	17.3	0	59
28/03/2022	16.7	0	78
29/03/2022	19.9	0	73

Date	Min. temp. in first two hours after sunset (°C)	Rainfall in first two hours after sunset (mm)	Min. overnight humidity (%)
30/03/2022	21.2	0	64
31/03/2022	18.5	0	83
1/04/2022	17.2	0	92
2/04/2022	18.4	0	80
3/04/2022	19.2	0	65
4/04/2022	19.1	0	59
5/04/2022	19.2	0	71
6/04/2022	19.6	0	77
7/04/2022	14.9	0	50
8/04/2022	16.5	0	52
9/04/2022	14.7	0	47
10/04/2022	17.0	0	56
11/04/2022	17.4	0	56

Appendix D: Pest plants and weeds observations

Appendix D Table 1: Pest plants and weeds observed within the site during site visits

Common name	Species name	Classification
Crack willow	*Salix fragilis*	Pest plant
Gorse	*Ulex europaeus*	Pest plant
Tree privet	*Ligustrum lucidum*	Pest plant
Alder	*Alnus glutinosa*	Advisory plant
Apple of Peru	*Nicandra physalodes*	Advisory plant
Blackberry	*Rubus fruticosus agg.*	Advisory plant
Hawthorn	*Crataegus monogyna*	Advisory plant
Holly	*Ilex aquifolium*	Advisory plant
Ivy	*Hedera helix*	Advisory plant
Tradescantia	*Tradescantia fluminensis*	Advisory plant
Canna lily	*Canna indica*	Not listed
Elephants ear	*Alocasia brisbanensis*	Not listed
Inkweed	*Phytolacca octandra*	Not listed

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