BEFORE THE WAIPĀ DISTRICT COUNCIL

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of Proposed Plan Change 20 – Airport Northern Precinct Extension to the Operative Waipā District Plan

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STATEMENT OF EVIDENCE OF GEORGIA THELMA ROSE CUMMINGS

(ECOLOGY – LONG-TAILED BATS)

28 FEBRUARY 2023

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INTRODUCTION

Qualifications and experience

1. My name is Georgia Thelma Rose Cummings.

2. I am an ecologist and bat specialist at Tonkin & Taylor Ltd (T+T), Environmental and Engineering Consultants in Hamilton. I hold the qualifications of Bachelor of Science (Biology and Environmental Science), and a Master of Science with first class honours (Biosecurity and Conservation), from the University of Auckland. My MSc research focussed on the lesser short-tailed bat (*Mystacina tuberculata*), and its spatial ecology and pollination services in Pureora Forest in the central North Island.

3. I have published two peer-reviewed scientific papers on the endemic lesser short-tailed bat.

4. I have been an ecological consultant for over 9 years, providing consultancy services for a range of clients around New Zealand, including local authorities, land developers, and the infrastructure and power sectors.

5. My relevant experience includes:

   (a) Region-wide long-tailed bat surveys to assist Auckland Council in determining the distribution and habitat preferences of long-tailed bats across parts of Auckland. Reporting and providing recommendations on improving population viability as well as suggestions for further research.

   (b) I have undertaken bat surveys, assessments of ecological effects, and produced bat management plans for various large-scale developments such as Ruakura Inland Port, Moir Hill Subdivision, Warkworth to Wellsford: the second section of the Ara Tūhono – Pūhoi to Wellsford road of national significance, and Te Ahu a Turanga: Manawatū Tararua Highway Project.

   (c) I was engaged as a bat specialist to provide an assessment of effects on long-tailed bats of the Amberfield development, a 105ha subdivision on the margin of the Waikato River within the Peacocke Structure Plan area, south Hamilton. This project included designing and undertaking long-tailed bat surveys, preparing an assessment of effects, working with the project team to minimise impacts and develop an appropriate mitigation package, and giving evidence at a council hearing and Environment Court.

6. I have presented expert evidence before independent hearings panels and the Environment Court for the Amberfield development.

7. I have been certified by the Department of Conservation (**"DOC"**) competent bat ecologist in Levels 1, 2.1, 2.4, and 3. These certifications reflect my competency in: deploying acoustic bat monitors (ABM), analysing ABM data, identifying short-tailed bat and long-tailed bat roosts, and capturing and handling bats.

8. I am familiar with the Proposed Plan Change 20 application site (**"PC20 site"**) and the surrounding locality. I have read the relevant parts of: the application; submissions; further submissions and the Section 42A Report.

Involvement in Proposed Plan Change 20

9. I have been engaged by Titanium Park Limited (**"TPL"**) and Rukuhia Properties Limited ("**RPL**") to prepare evidence for Proposed Plan Change 20 (**"PC20"**). I am not the author of the T+T Ecology Assessment associated with TPL/RPL's request. However, I have reviewed the assessment. I have been involved with the PC20 project since November 2022. My primary involvement has been advising changes to the proposed structure plan and PC20 provisions to address actual and potential effects on long-tailed bats and undertaking a further ABM survey of the TPL, RPL and Hamilton Airport properties.

10. I am familiar with the PC20 locality and have visited the PC20 site on 14 November and 19 December 2022. I visited the proposed compensation site which TPL has conditionally purchased on 21 February 2023.

11. I attended expert conferencing on the Ecology and Bat Habitat topic on 8 February 2023 and signed the joint witness statement (**"JWS"**) that was produced at the conferencing session.

Code of Conduct

12. I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note (2023) and I agree to comply with it. In that regard, I confirm that this evidence is written within my expertise, except where I state that I am relying on the evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

SCOPE OF EVIDENCE

13. In my evidence, I:

(a) Provide an executive summary of my key conclusions;

(b) Provide a description of the PC20 site and a brief overview of long-tailed bat ecology, and the south Hamilton bat population that is potentially impacted by the land use change that would be enabled through PC20;

(c) Summarise how bats are using the existing environment of the PC20 site in relation to the findings of the ecology report that informed the lodged version of the PC20 application, and an additional survey undertaken in December 2022/January 2023.

(d) I use the above findings, in combination with other research undertaken on the bat population in question, and generally accepted bat ecology, to assess the value of the habitats identified on the PC20 site. This value assessment is used to undertake a significance assessment under the Waikato Regional Policy Statement (**"WRPS"**).

(e) Summarise the actual and potential effects of the land use changed associated with PC20 on long-tailed bats;

(f) Summarise the relevant aspects of PC20 with respect to long-tailed bats and comment on how the PC20 Structure Plan and provisions manage effects on long-tailed bats;

(g) Address relevant submissions; and

(h) Respond to the Section 42A Report.

EXECUTIVE SUMMARY

14. Long-tailed bats are classified as Threatened – Nationally Critical. A population of long-tailed bats occur in the southern fringe of Hamilton City and into the Waipa District (where the PC20 site is located) and Waikato District.

15. Long-tailed bats are wide ranging. While mature forest is considered preferred habitat, they can adapt to use various habitat types across modified landscapes as is the case with this bat population. While they can persist in modified agricultural landscapes, they are sensitive anthropogenic disturbance, namely artificial light.

16. Varying levels of bat activity have been recorded across the PC20 site in all of the five acoustic bat surveys undertaken. While I don't consider any of the habitat in the PC20 site meets the threshold of significant under the WRPS, the site is located among multiple habitats that I consider significant in the surrounding landscape. Additionally, although higher value habitats occur outside of the PC20 site, removal of large areas of low and moderate value bat habitat will still result in a very high level of effect on long-tailed bats if not appropriately managed. Accordingly, PC20 needs to protect bats from the potential impacts of urbanisation resulting from the proposed land-use change.

17. The proposed PC20 Structure Plan and provisions have been revised considerably since the notified version in relation to long-tailed bat effects management. Habitat which is amongst the highest value located on the PC20 site is now proposed to be protected through the inclusion of Bat Habitat Areas (**"BHAs"**) in the amended Structure Plan. Potential effects associated with the interface between BHAs and surrounding urbanisation will be avoided and minimised through habitat enhancement in the BHAs, lighting standards and building setbacks. Residual impacts will be addressed through compensation.

18. A compensation site has been provisionally secured by TPL. The compensation site is located on the Waikato River and in proximity to significant habitats identified in the surrounding landscape (being only approximately 500 m from the PC20 site itself). I consider the proposed compensation site is an excellent opportunity to instigate habitat protection and restoration and/or enhancement, and expand connective linkages at a landscape scale.

CONTEXT AND BACKGROUND

Site Description

19. The PC20 site comprises approximately 130 ha[1] of predominantly agricultural land located immediately west of the Hamilton Airport, approximately 8 km south-east of Central Hamilton. Approximately 41ha of the PC20 site is zoned Airport Business Zone and the remainder is zoned Rural. The PC20 site is within the northern extent of Waipa District, but close to the border with the adjoining Hamilton City and Waikato District.

20. The predominant vegetation cover is maize and pasture. Isolated areas of exotic trees are found across the PC20 site, with some native trees also present. Two large exotic

[1] 131.6ha.

shelterbelts have been removed since the original ecological investigations were undertaken in 2020. There are no natural streams flowing through the PC20 site, but a network of artificial watercourses has been established for drainage.

21. The topography of the PC20 site is generally flat except for two small hills in the eastern portion. The northern hill is approximately 9m high with a stand of mostly exotic trees associated with a residential dwelling present. This is where the "Hub" is proposed to be located on the PC20 Masterplan. The southern hill is approximately 11.5m high. This is currently in maize cropping and it is proposed to be levelled.

22. The PC20 site also contains four dwellings, various farm sheds and a research facility for Genetic Technologies which is located near State Highway 3 on the RPL site.

23. Except for the airport and business activities within the existing Airport Business Zone and Industrial Zone immediately to the east, south-west and north of the airport, the surrounding landscape beyond the PC20 site is also largely comprised of agricultural land, on which several small kahikatea forest remnants are situated. The area is interspersed with residential land uses. The Waikato River is approximately 1.2km to the east and north.

24. Several large road corridors surround the site. Ohaupo Road (SH3, classified as a Major Arterial Route) traverses the area to the west of the site, Airport Road (SH21, classified as a Major Arterial Road) to the east, and Raynes Rd (classified as a Local Road) to the north. The Southern Links Designation is also located close to the northern and western boundaries of the PC20 site.

Long-tailed bat ecology

25. Long-tailed bats are classified as 'Threatened – Nationally Critical'[2] due to habitat degradation and loss, and predation from introduced predators. There is another species of bat in New Zealand, the lesser short-tailed bat. The lesser short-tailed bat is an obligate forest species and is not considered further in this brief of evidence. Henceforth the term "bat" refers specifically to long-tailed bats.

26. Bats are primarily associated with mature forest. While there are several populations existing in agricultural and peri-urban areas, this is not considered preferred habitat for the species.

[2] O'Donnell et al., (2018). The conservation status of New Zealand bats. Department of Conservation. Wellington, NZ.

27. Bats are highly mobile and move between roost sites and foraging grounds which are often kilometres apart.[3] In forested environments they often move roosts on a nightly basis, but they do reuse the same roost for varying lengths of time depending on reproductive status and roost availability in the landscape.[4] They will often visit multiple foraging grounds each night that can be kilometres apart.

28. Bats generally roost in cavities in the oldest, and largest trees in the landscape. In saying this, as more bat research is undertaken in more modified environments, it has become apparent that bats will roost in a variety of places including crevices in rock faces, under the skirts of tree ferns, and in farm sheds. [5] It is unlikely that the latter roost sites provide favourable characteristics compared to cavities in old-growth trees, particularly for maternity[6] roosts used by pregnant and lactating females rearing their pups.

29. Bats use roosts with different characteristics during different stages of their life cycle. This is thought to be linked to the varying thermal properties of different roosts.[7] Bats generally select tree cavities that are well insulated and remain warmer through the night as maternity roosts. Roosts that are less insulated from ambient temperatures are more commonly used as solitary roosts outside of the breeding season.

30. Long-tailed bats are aerial insectivores. Their wing morphology and the structure of their echolocation calls are adapted for foraging along vegetation edges and gaps for small flying insects.[8] They forage along forest edges and above tree canopies. In modified areas they forage along vegetation edges including shelter belts and around bush and woodland patches of varying size. While long-tailed bats do not completely avoid open areas such as pasture, it is accepted in literature that they are an edge adapted species and open habitats such as pasture is not preferred, with their use of open habitat largely limited to commuting.

[3] O'Donnell, C. F. J. (2001). Home range and use of space by Chalinolobus tuberculatus, a temperate rainforest bat from New Zealand. Journal of Zoology, 253, 253-264.
[4] Sedgeley, J. A. & O'Donnell, C. F. J. (2004). Roost use by long-tailed bats in South Canterbury: examining predictions of roost-site selection in a highly fragmented landscape. New Zealand Journal of Ecology, 28(1), 1-18; O'Donnell, C. F. J. & Sedgeley, J. A. (1999). Use of Roosts by the Long-Tailed Bat, Chalinolobus tuberculatus, in Temperate Rainforest in New Zealand. Journal of Mammalogy, 80(3), 913-923.
[5] Sedgeley, J. A. & O'Donnell, C. F. J. (2004). Roost use by long-tailed bats in South Canterbury: examining predictions of roost-site selection in a highly fragmented landscape. New Zealand Journal of Ecology, 28(1), 1-18; Borkin, K & Martin, T. (2018). Bats in New Zealand Plantations: Forest management guidance. Report prepared by Wildland Consultants Ltd. for New Zealand Forest Owners Association; Griffiths, K. (2022). Assessment of colonies and roosting sites in the Waipawa area January 2022. Report prepared by The Conservation Company Ltd.
[6] Maternity roosts are also commonly referred to as communal roosts.
[7] Sedgeley, J. A., & O'Donnell, C. F. J. (1999). Roost selection by the long-tailed bat, *Chalinolobus tuberculatus*, in temperate New Zealand rainforest and its implications for the conservation of bats in managed forests. Biological Conservation, 88(2), 261–276.
[8] Parsons et al., (1997). Echolocation Calls of the Long-tailed Bat: A Quantitative Analysis of Types of Calls. Journal of Mammalogy, 78(3), 964-976; O'Donnell, C. F. J. (2000). Influence of season, habitat, temperature, and invertebrate availability on nocturnal activity by the New Zealand long-tailed bat (Chalinolobus tuberculatus). New Zealand Journal of Zoology 27, 207-221; O'Donnell, C. F. J. (2001). Advances in New Zealand mammalogy 1990–2000: Long-tailed bat. Journal of the Royal Society of New Zealand, 31(1), 43-57.

31. Long-tailed bats use linear landscape features such as forest edges, river corridors, and shelter belts (in modified areas) as movement corridors. Bats will disperse across open areas[9] but as stated above it is not considered favoured habitat. Bats require structural cues, such as vegetation edges, to bounce their echolocation calls off to navigate and forage efficiently (as noted above at para. [30]). I am not aware of any scientific literature that categorises open habitats such as pasture and cropland as important long-tailed bat habitat relative to vegetation edges.

The southern Hamilton long-tailed bat population

32. Long-tailed bats have been confirmed to use areas of southern Hamilton and surrounds primarily using ABM surveys (which record bat echolocation calls, providing an index of bat activity) and radiotelemetry (which involves catching individual bats, attaching a radio transmitter, and following their nightly movements).

33. Radiotelemetry research has demonstrated that individual bats range over a large area of southern Hamilton into the Waipa and Waikato Districts, and there is likely a single population occurring across this landscape.[10] Based on information gathered to date, the population's range approximately extends from the Mangakotukutuku and Mangaonua gullies in Hamilton City to south of Hamilton Airport in the Waipa District to east of the Waikato River in the Waikato District.

34. Key bat habitats identified in the vicinity of the PC20 site include:

    (a) Three kahikatea remnants to the west and north-west of the PC20 site (situated between Narrows Rd and Raynes Rd, another key kahikatea remnant is located north of Raynes Rd);

    (b) Meridian Oaks roost site to the north of the PC20 site (immediately adjacent to Waikato River);

    (c) The Narrows Park camping area to the north-east of the PC20 site; and

    (d) The Waikato River to the to the east and north of the PC20 site.

[9] Davidson-Watts Ecology Ltd. (2019). Long-tailed Bat Trapping and Radio Tracking Baseline Report 2018 and 2019 Southern Links, Hamilton. Prepared for AECOM.
[10] Davidson-Watts Ecology Ltd. (2019). Long-tailed Bat Trapping and Radio Tracking Baseline Report 2018 and 2019 Southern Links, Hamilton. Prepared for AECOM.

35. The above habitats have been identified through radiotelemetry studies as core habitat for multiple bats, and/or contain known roosts. They are shown in a context map in **Annexure "A"**.

Long-tailed bats and urbanisation

36. Long-tailed bats are nocturnal and are sensitive to anthropogenic disturbance, with very few populations known to persist within city boundaries. Research on the Hamilton population has demonstrated that within the Hamilton City boundary bats are largely constrained to the southern rural-urban fringe, and that bats avoid areas with increased anthropogenic disturbance associated with urbanisation.[11]

37. It remains unclear what aspect(s) of anthropogenic disturbance the bats are avoiding. However, studies have found a negative correlation between long-tailed bat activity and increasing housing, road, and streetlight density,[12] all of which are interrelated variables.

38. Experimental studies on other bat species, and research undertaken on the Hamilton bat population, suggest that along with direct removal of habitat, increased ambient light also affects bat activity. Anthropogenic noise does not appear to significantly alter long-tailed bat activity,[13] or the activity of other bats with similar ecomorphological characteristics[14] studied overseas.[15]

39. In saying the above, parkland located within or immediately adjacent to urbanised areas within Hamilton has been identified as important bat habitat using both radiotelemetry and acoustic monitoring. These areas include Sandford Park, Fitzroy Park, Hammond Park, and the Hamilton Gardens.[16]

40. The above parks are all either directly adjacent to the Waikato River, or connected to the river via the Mangakotukutuku Gully, which provides a vegetated movement corridor that buffers the bats from the impacts of the surrounding urbanised land. Conversely, bats are rarely recorded using other parks in Hamilton which are not connected to the river

[11] Kessels Ecology (2017). Hamilton City Long-tailed Bat Survey 2016-2017; Kessels Ecology (2012). Hamilton City Long-tailed Bat Survey 2011-2012; Crewther, C. and Parsons, S. (2017). Predictive modelling of long-tailed bat distribution in the Hamilton area. Report prepared for Hamilton Regional Council by Walkingbats Specialist Consulting.
[12] Kessels Ecology (2012). Hamilton City Long-tailed Bat Survey 2011-2012.
[13] Borkin et al. 2019. Baseline Acoustic Monitoring of Long-Tailed Bats for The Southern Links Roading Project, Hamilton: 2017 And 2018. Report no. 4192d prepared by Wildlands for AECOM; Le Roux & Waas (2012). Do Long-Tailed Bats Alter Their Evening Activity in Response to Aircraft Noise? Acta Chiropterologica, 14(1), 111-120.
[14] Parsons et al., (1997). Echolocation Calls of the Long-tailed Bat: A Quantitative Analysis of Types of Calls. Journal of Mammalogy, 78(3), 964-976.
[15] Bunkley et al., (2015). Anthropogenic noise alters bat activity levels and echolocation calls. Global Ecology and Conservation, 3, 62-71.
[16] Davidson-Watts Ecology Ltd. (2019). Long-tailed Bat Trapping and Radio Tracking Baseline Report 2018 and 2019 Southern Links, Hamilton. Prepared for AECOM.

via a vegetated corridor (i.e., these parks are surrounded by development on all four sides).[17]

41. In my opinion the above demonstrates that while the bats appear to avoid directly utilising urban spaces, they will move through the urbanised landscape to access habitat such as the parks listed above, if there are vegetated dispersal routes that buffer the bats from adjacent development.

USE OF THE PC20 SITE BY LONG-TAILED BATS

42. As described in paragraphs [19] – [24], the existing land use of the PC20 site is primarily agricultural, although as noted earlier 41ha of the PC20 site is already zoned Airport Business Zone. Therefore, bats currently will be subject to limited anthropogenic disturbance such as light within the PC20 site.

Findings from previous ecology report

43. The information below is summarised from the ecology report that informed the PC20 application (Appendix 8 of the PC20 application). I was not a part of the original ecological investigations and did not author this report, however, I am familiar with it. Mr Markham sets out the contributors to the ecology report in his evidence.

44. Four acoustic bat surveys were undertaken between February 2020 and April 2022. Three of these surveys were focussed on the TPL property and one in the RPL property which together comprise the PC20 site.[18]

45. Varying levels of activity were recorded across different parts of the PC20 site and during different survey periods. The surveys demonstrate that long-tailed bats are using the PC20 site with high levels of activity (averaging more than 10 bat passes per survey night) recorded during surveys undertaken in 2020 in areas associated with groups or rows of large trees.

46. Feeding activity was also recorded, demonstrating bats were foraging in the PC20 site. While the surveys did not target the open areas, it can be assumed that bats may at times move across the open areas while travelling between habitats within the PC20 site, and habitats in the surrounding landscape.

[17] DOC National Bat Database.
[18] Refer to Figure 2 in the ecology report for an overview of the PC20 site including the two property boundaries.

47. Bat activity levels decreased considerably in the surveys undertaken post-2020 after two large shelterbelts were removed on the TPL property.

48. Acoustic surveys cannot confirm whether bat roosts are located in the PC20 site, and generally speaking, confirming the presence, and particularly the absence, of roosts in a defined area is very difficult to achieve. As outlined in paragraphs [27] – [30], long-tailed bats generally use a large pool of solitary roosts outside of the breeding season which they move between often on a nightly basis. As such, it is my opinion that the presence of bat roosts, particularly solitary roosts, cannot be ruled out on any site regularly used by bats where trees with potential roost features are available. Notwithstanding the above, the low levels of bat activity recorded in the two surveys undertaken in late spring and early summer[19] (when female bats are gathering in maternity roosts) suggests that no maternity roosts are present on the PC20 site.

49. Potential bat roost trees (or groups of trees) were identified and mapped in Figure 2 of the ecology report. Since the removal of the two large shelterbelts in 2021 and an alder hedgerow which was located next to the RPL property,[20] most potential roost trees are now located around the homestead where the 'Hub' is proposed to be located, as well as a Chestnut grove which is located near SH3 on land which is largely beyond the PC20 site and within the Southern Links designation. Additional individual trees have been identified as potential roost trees including the specimen trees along the driveway leading from Middle Rd to the cow shed.

Findings from site visit and acoustic survey December 2022/January 2023

50. I undertook a fifth bat survey in December 2022/January 2023. The objectives of this bat survey were the following:

    (a) Undertake bat monitoring over the breeding period when pregnant and lactating females, and their pups are gathering in maternity roosts;

    (b) Monitor the relative bat activity levels between the vegetated features and 'open habitat'. This was achieved through a paired survey design, i.e., placing acoustic monitors along vegetation edges with a corresponding monitor located approximately 100 m into the cropland;

[19] Survey 3 undertaken on the RPL property between 17 November and 8 December 2021 (see results in the T+T ecology report submitted with the application) and the follow-up survey undertaken by myself between 19 December 2022 and 9 January 2023 (see results in Annexure "B").
[20] I have been advised that the large shelterbelts on the TPL property were removed for health and safety reasons, while the alder hedgerow next to the RPL property is outside of the PC20 site.

(c) Monitor activity along the north-eastern boundary of the PC20 site, and the open habitat north of the airport runway, to gain information about potential east-west movement across the site by bats moving between key habitats in the wider landscape; and

(d) Undertake additional monitoring in the RPL property. A single survey had been undertaken on the RPL property prior to the PC20 application being lodged.

51. I deployed 30 automatic bat monitors (ABMs) on 19 December 2022, the ABMs were collected on 10 January 2023. A map of the survey locations, and the survey results are included in **Annexure "B"**.

52. The ABMs recorded for a total of 22 nights of which 16 were considered "optimal weather nights" as defined in the previous ecology report.[21] Exceptions were survey locations 01B, 16 and 19 where data was not recorded due to equipment failure. Additionally, the ABMs at survey locations 05A, 05B and 13 recorded for less than 22 nights due to battery failure and therefore the data was averaged over 7, 8, and 9 nights respectively.

53. The survey location with the highest average number of bat passes per night was 9A (mean = 0.50 passes), followed by survey location 10A (mean = 0.44 passes). These were both located on the TPL property along the driveway lined with a hedgerow and mature specimen trees (Figure 1, Annexure "B"). Only one feeding buzz was detected at survey location 10A on the TPL property. No feeding buzzes were detected on the RPL property.

54. Bat activity at the RPL property was low (≤ 0.5 passes per night). Activity was similar or slightly higher compared to the previous survey at the RPL property in 2021, which also recorded low activity.

55. Activity across the TPL property was considerably lower than the two surveys undertaken prior to the shelterbelts being removed. Activity previously recorded in March/April 2022, after the shelterbelts were removed, was variable across the area, but generally speaking, activity was lower in this most recent survey as well.

56. The reason for the low activity across the PC20 site in this survey may be a combination of habitat loss (shelterbelt removal) and survey timing (undertaking the survey in early

[21] See Table 2 in Annexure "B" for weather data and the definition of "optimal weather conditions" as defined in the ecology report that informed the PC20 application.

summer compared to late summer/ autumn when the previous surveys on the TPL property were undertaken).

57. Most of the PC20 site was in maize cropping at the time of the survey. Consequently, all of the survey locations that were intended to be placed in 'open habitat' as outlined in Paragraph [50(b)] were instead located amongst maize that was 2+ m tall. Only sites 11, 12 and 13 were located in mown grass immediately north of the existing airport runway. These three sites recorded no bat activity[22] while the 'open habitat' sites amongst the maize did record some bat activity, albeit at very low levels. The maize sites generally recorded slightly less than their 'vegetation edge' counterparts but not by a considerable amount.

58. The general understanding of long-tailed bat behaviour is that they are edge adapted, preferentially utilising along vegetation edges, but also moving across open habitat to a lesser degree. The survey results align with this generally accepted understanding. The survey confirmed the assumption that bat activity is not limited to the edges of woody vegetation. Except for one ABM pair (6A and 6B), bat activity was the same or higher along vegetation edges compared to the corresponding survey location in the cropland.

59. No bat activity was recorded to the east of the PC20 site in the Hamilton Airport runway extension area (sites 11, 12 and 13[23] in Figure 1, Annexure "B"). This suggests that bats were not crossing this area to reach the Narrows or the Waikato River from the west during the Dec 2022/ Jan 2023 survey period.

Bat habitat value assessment and Significance under the WRPS

60. Table 28 in APP 5 of the WRPS lists criteria for determining significance of indigenous biodiversity. To be identified as significant, an area needs to meet one or more of the criteria listed in Table 28. Of these criteria, Criterion 3 is the most relevant to the PC20 site due to the confirmed presence of long-tailed bats:

"It is vegetation or habitat that is currently habitat for indigenous species or associations of indigenous species that are:

- classed as threatened or at risk, or
- endemic to the Waikato region, or

[22] Noting that the ABM deployed at site 13 only recorded for 10 nights before the batteries failed.
[23] As per footnote above.

- at the limit of their natural range."

61. Long-tailed bats are classed as 'Threatened-Nationally Critical' and they range over a wide area using various habitats within a landscape to different degrees, including highly modified exotic-dominated habitats with otherwise low biodiversity values. Criterion 3 does not differentiate between indigenous and exotic-dominated vegetation or habitat and applying this criterion without qualification would likely lead to a considerable portion of land within the home range of any long-tailed bat population in the Waikato Region being classified as significant under the WRPS due solely to the presence of bats. As noted in Paragraph [33], the bat population in question ranges from the southern extent of Hamilton City to south of Hamilton Airport in the Waipa District and into Waikato District to the east of the Waikato River. Bats have also been recorded in fully urbanised parts of Hamilton City such as Lake Rotoroa (Hamilton Lake) during every annual Hamilton City bat survey since the 2016/2017 season. There are several bat populations that occur in modified landscapes across the Waikato Region including, but not limited to, near Raglan, Cambridge, Te Kuiti, and Pokeno. They also occur in pine plantations.

62. Mueller et al. (2021)[24] used professional judgement to classify the relative value of habitats in the Peacocke Structure Plan area to bats for recent assessments for Hamilton City Council in relation to Plan Change 5 (**"PC5"**). The relative habitat value was then used to assign significance under the WRPS. I agree with this approach, and I think it is important to maintain a consistent approach across the bat population's range.

63. Mueller et al., (2021) mapped the Peacocke Structure Plan area and assigned a value to long-tailed bat habitats of 'high value', 'moderate value' or 'low value' as follows:

(a) 'High value' habitats included the margins of the Waikato River, Mangakōtukutuku Gully and known roost sites;

(b) 'Moderate value' habitats included areas containing:

(i) Established woody vegetation,

(ii) edge pasture habitat near high value habitat which may be utilised by bats as commuting corridors,

(iii) foraging habitats, or

(iv) potential bat roost trees

[24] Peacocke Structure Area Plan Change: Long-tailed bat report. (2021). Prepared by 4Sight Consulting for Hamilton City Council.

(c) ‘Low value’ habitats included areas of open pasture and scattered trees which may provide occasional foraging or commuting habitat for bats.

64. I have used the same general rules as above but modified the ‘high value’ habitat definition to remove references to features such as the Mangakōtukutuku Gully that are specific to the Peacocke Structure Plan area. As such my high value habitat classification is as follows:

(a) High value habitats include:

(i) Confirmed roost sites,

(ii) Vegetated riparian areas including the gullies systems associated with the Waikato River and its tributaries,

(iii) Native-dominated forest remnants,

(iv) Other vegetated habitats where data from landscape-level surveys (e.g. city-wide bat surveys and radio-tracking studies) suggest these are core habitats for the bat population, and

(v) Linear landscape features such as shelterbelts which form part of any largely uninterrupted movement corridor which enhances connectivity between the above ‘high value’ habitats.

65. Based on the above classifications there are several habitat features surrounding the PC20 site that I would classify as ‘high value’ habitat:

(a) The kahikatea remnants to the NW of the site between Narrows Rd and Raynes Rd

(b) The Waikato River

(c) The ‘Meridian Oaks’ roost site

(d) The ‘Narrows camp’ roost site, and

(e) The Mystery Creek gully system

66. I have classified the habitat types in the PC20 site as having ‘moderate’ and ‘low’ value to bats. There are no ‘high value’ habitat features in the PC20 site.

67. The ‘moderate value’ habitat incorporates areas of established woody vegetation and associated “open edge” including the tree-lined driveway, the treeland surrounding the ‘hub’ area, and the shelterbelts on the boundary of the nursery property. The remainder

of the site is characterised by cropland or pasture with scattered trees, young native plantings, and dwellings and other infrastructure (farm races etc.). I have classified these areas as 'low value' habitat except for the dwellings and other infrastructure which I consider to be of negligible value to bats.

68. It is my opinion that the 'moderate' and 'low' value habitats within the PC20 site do not meet the threshold of significant habitat of indigenous fauna under the WRPS. Notwithstanding this, BHAs have been identified in the PC20 site which, with enhancement and management of potential disturbance resulting from the surrounding future development, may achieve significance under the WRPS in the future.

POTENTIAL EFFECTS OF THE PROPOSED PLAN CHANGE ON LONG-TAILED BATS

Physical and functional habitat removal

69. The proposed urbanisation of the PC20 site will result in the physical or functional removal of large areas of open cropland and/or pasture. It is also likely that some of the medium and large stature trees currently remaining in the PC20 site outside of the proposed BHAs will need to be removed to facilitate future development.

70. In areas where bat habitat is retained, disturbance (particularly light) from surrounding development would potentially decrease the quality of any habitat physically retained, and potentially exclude bats from using it. This would result in functional habitat loss despite the physical retention of habitat.

71. As outlined above, because bats can move roosts on a nightly basis, it is very difficult to confirm that the mature trees in the PC20 site are not used as bat roosts on occasion. The removal of potentially undiscovered roosts could result in death or injury to individual bats, and/or increase energetic costs if bats are forced to use lower quality roost trees in the landscape. It could also lead to increased predation if bats are reusing roosts at a higher rate due to a decrease in the pool of available roosts.

72. Such habitat removal will contribute to the cumulative habitat loss at a landscape level. There are several large-scale developments that are either occurring or planned across the bat population's range. Notable projects include the urbanisation of the Peacocke Structure Plan area, and Southern Links roading project.

Fragmentation of habitat in the surrounding landscape

73. The PC20 site is positioned between habitats located across the wider landscape that are high value at the population level. These key habitats off-site are described in Paragraphs [34] and [35] above and mapped in Annexure "A".

74. Currently there are no continuous habitat features (e.g. a vegetated river corridor, or uninterrupted shelterbelt vegetation) traversing the PC20 site that would provide direct habitat connectivity for long-tailed bats through the PC20 site between these off-site habitats in the surrounding landscape. However, based on the position of the PC20 site relative to these habitats, and the bat activity recorded across the area, it is likely that bats are currently traversing across the area when moving between key habitats in the surrounding landscape.

75. As discussed above, physical and functional habitat removal and disturbance within the PC20 site could exclude bats from traversing the area and consequently result in further fragmentation of the habitat available in the wider landscape. However, as Mr Inger notes, the Waipa District Plan (**"WDP"**) does not restrict the removal of habitat currently in the PC20 site, either within the 41ha of the TPL site that is already zoned Airport Business or within the Rural zoned land.

76. I note that bats would still be able to access habitats in the surrounding landscape without traversing the PC20 site, but this may result in higher energetic costs to individual bats as they establish alternative, potentially longer, commuting routes to access these habitats.

Increased predator densities

77. Densities of mammalian predators tend to increase with increased human activity. Hence the proposed land use change could increase predation pressure on long-tailed bats in the area. While this is likely true for the transition from pastural land to residential (as with the Peacocke Structure Plan area), the connection is less clear in this instance where the transition will be from cropland (primarily maize) and pasture to industrial land use.

78. Rodents are a known pest of crops including maize and are likely to already be present across the PC20 site in high densities at least seasonally. Additionally, industrial land use is less likely to contribute the same food sources for mammalian pests that residential land uses are known to. Such sources will likely be limited to food waste associated with staff meals which will generally be disposed of in a secure manner. This

is in contrast to household food waste disposed of in compost bins that can be accessed by rodents.

79. Furthermore, domestic pets are unlikely to be an issue in an industrial area.

80. It is my opinion that there is little evidence to suggest that the proposed land use change enabled by PC20 will increase the density of mammalian predators leading to increased predation rates on long-tailed bats. To the contrary, there may be a reduction of mammalian predators within the PC20 site.

Summary of potential effects on bats arising from the proposed plan change

81. As concluded in the ecology report lodged with the PC20 application, if unmitigated, the cumulation of the effects outlined above could result in an overall very high level of impact on the long-tailed bat population arising from the land use change associated with PC20. Key potential impacts are:

    (a) Increased energetic costs and reduced reproductive success resulting from:

        (i) Physical removal of foraging, commuting, and potentially roosting habitat;

        (ii) Functional habitat loss resulting from anthropogenic disturbance; and

        (iii) Habitat fragmentation.

    (b) Injury or death occurring during the removal of a roost tree(s).

82. While not specifically addressed in the ecology report, it is my opinion that cumulative effects also need to be taken into account. Cumulative effects of habitat loss and fragmentation will likely result from multiple large-scale developments occurring across the bat populations range. Potential opportunities for a co-ordinated approach should be considered to manage cumulative effects at a landscape-scale.

OVERVIEW OF THE PLAN CHANGE

83. PC20 proposes to rezone approximately 89ha of predominantly agricultural land to the northwest of Hamilton Airport from Rural to Airport Business Zone. As noted earlier the PC20 site also covers an additional 41ha of land already zoned as Airport Business Zone. The proposed plan change also seeks to:

    (a) Amend the Airport Business Structure Plan (Appendix S10 of the WDP).

    (b) Amend the Airport Business Zone (Titanium Park) provisions contained in Section 10 of the WDP.

(c) Amend the infrastructure, Hazards, Development and Subdivision provisions contained in Section 15 of the WDP.

(d) Amend the Assessment Criteria and information requirements contained within Section 21 of the WDP.

84. Mr Inger outlines the relevant provisions of the WDP relating to bats together with a summary of the proposed bat PC20 provisions which are included in Annexure 2 of Mr Grala's evidence (hereafter referred to as the "revised provisions"). As noted by Mr Inger, the WDP currently contains few specific planning provisions relating to bats.

85. My evidence focuses on changes to the provisions that relate to bats since the lodgement of PC20. I have worked alongside Mr Inger and Mr McKensey to revise the PC20 provisions and amendments to the PC20 Structure Plan, to enable potential impacts on long-tailed bats to be better addressed. The revised provisions were the subject of conferencing and I comment on the Joint Witness Statement later in my evidence.

86. Proposed Policy 10.3.2.2A in Section 10 - Airport Business Zone of the WDP has been revised to:

(a) Require the provision of BHAs within the Northern Precinct;

(b) Require controls on the location of buildings and light spill to be implemented to minimise potential anthropogenic disturbance within the BHAs; and

(c) Clearly step through the effects management hierarchy from avoid (with a particular focus on the BHAs) through to offsetting and compensation to achieve no net loss of bat habitat values.

87. A key post-lodgement revision is the identification of BHAs on the amended Structure Plan with the purpose of protecting and enhancing the existing habitat in the 'Hub' area of the PC20 site, and facilitating bat movement through the PC20 site to maintain connectivity between the 'Hub' and habitats in the wider landscape. The BHAs are made up of the corridor and the 'Hub', which are described as follows:

(a) The proposed corridor is required to be in general accordance with Figures 1 and 2 in Appendix S10, which are landscaped cross-sections. It comprises a 50 m wide BHA corridor centred on an existing tree row and is a 2.23ha in size. The BHA corridor design is discussed further in Paragraph [96] below;

(b) The 'Hub' is a 2.72ha area, situated around a group of existing trees with a 20 m buffer around the outside of the trees. These BHAs will protect and enhance existing significant habitat and create a cohesive vegetated corridor that is buffered from the adjacent development with the goal of facilitating continued use of BHAs by bats once the area is urbanised.

88. Proposed Rule 10.4.2.14A in Section 10 - Airport Business Zone of the WDP has been added to provide detailed lighting standards. These standards shall apply at the boundary of the BHAs and to fixed artificial outdoor lighting within 100 m of BHAs. These standards are adapted from the standards proposed in the changes to the Peacocke Structure Plan (**"PC5"**). The revisions also provide certainty about the efficacy of the lighting controls as the standards are outlined up front instead of these standards being formulated in a Lighting Management Plan later.

89. Proposed Rule 10.4.2.14B (previously included in Rule 10.4.2.14A in the lodged PC20 provisions) has been revised to provide additional detail about what is required in the Ecological Management Plan (**"EMP"**). The EMP must include a Bat Management Plan (**"BMP"**) which is required to be prepared by a suitably experienced bat ecologist. The BMP now requires:

(a) Planting specifications, and an implementation programme for habitat enhancement within the BHAs. The implementation programme shall ensure that habitat enhancement occurs as early as practicable;

(b) Details of how planting and light spill will be managed where transport corridors are proposed to cross BHAs;

(c) Identification of all confirmed or potential roost trees and assessment of whether the retention of these trees is practical and appropriate having regard to specified criteria;

(d) Where confirmed or potential roost trees cannot be retained, methodology for managing tree felling with regard to DOC protocols[25];

(e) Details of offset or compensation measures to contribute to a no net loss outcome if residual effects on long-tailed bat habitat values remain after avoidance and mitigation;

[25] Department of Conservation 'Protocols for Minimising the Risk of Felling Bat Roosts' (Version 2: October 2021).

(f) The legal mechanisms proposed for protection of BHAs and any other long-tailed bat habitat which is proposed to be created or retained;

(g) Details pre- and post-development monitoring for long-tailed bats, including how the monitoring could be co-ordinated with other monitoring occurring within the known home range of the local long-tailed bat population; and

(h) Outline of procedures for reviewing and amending the BMP.

90. The revised BMP provisions, in combination with the new lighting standards, ensure that a considerable proportion of what I consider to be the highest value (albeit still low to moderate value) bat habitat existing within the PC20 site will be protected and provide considerably more detail about how actual and potential effects of the proposed land use change on long-tailed bats will be managed compared to the lodged PC20 provisions (and the existing Airport Business Zone provisions in the WDP).

Proposal for managing effects on long-tailed bats

91. Below I summarise the proposed approach to manage effects of the PC20 on bats. The approach follows the mitigation hierarchy as outlined below:

(a) Avoidance through protection of bat habitat within BHAs, including lighting and vegetation removal rules for BHAs;

(b) Mitigation through the other planning provisions, including habitat enhancement within the BHAs; and

(c) Compensating residual effects through off-site habitat restoration and/or enhancement.

Avoidance and protection of bat habitat

92. As outlined in Paragraph [87] above, the proposed Airport Business Zone Structure Plan has been revised to include BHAs. The purpose of the BHAs is to protect and enhance the areas of the PC20 site that are amongst the highest value habitat for long-tailed bats and that provide the best opportunities for protection and enhancement. The BHAs have been designed and located to enable continued use of these habitat areas by bats once the PC20 site is urbanised.

93. As shown in Figure 1 in Annexure “C”, the BHAs covers the existing tree land habitat surrounding a house on the PC20 site (within the area referred to as the ‘Hub’) and a

tree-lined driveway that extends eastward from the western boundary of the PC20 site toward the Hub area. I understand it is intended that the house and driveway will be removed.

94. As outlined in Paragraphs [62] – [67], I consider established woody vegetation that provides structural edges for bats to forage along, as well as potential roost habitat, has higher value habitat for bats compared to open habitat and less established vegetation. The tree land within the Hub is the largest patch of mature woody vegetation on the PC20 site and it contains potential roost trees. As such, it is my opinion that protection and enhancement of this tree land is key to avoiding effects on bats. To maintain the functionality of this habitat for bats, a corridor is necessary to provide a movement route which is buffered from the surrounding development that connects the Hub to key bat habitat in the surrounding landscape.

95. The location of the corridor portion of the BHA was selected because it incorporates a row of mature trees that are higher-value habitat compared to the surrounding cropland, and this route provides a relatively direct linkage between the Hub and the southernmost kahikatea remnants identified as key bat habitat in the surrounding landscape (Figure 1 in Annexure "A"). Multiple roosts have been confirmed in these southernmost kahikatea remnants.[26]

96. A 20 m buffer is proposed around the outer edge of the trees in the Hub portion of the BHA to minimise effects such as light from surrounding development. The corridor portion of the BHA is proposed to be 50 m wide and will be designed in accordance with Figures 1 and 2 proposed to be included in Appendix S10 of the WDP. The corridor design is similar to the corridors proposed in the Peacocke Structure Plan area, and will include linear bands of vegetation with internal edges for bats to use that are buffered from adjacent development.

97. Under Proposed Rule 10.4.2.14A, no fixed lighting will be permitted within the BHAs (with limited exceptions for lighting for emergency works related to infrastructure) and effects of light spill from sources outside of the BHAs will be required to be avoided by requiring a maximum light level of 0.3 lux to be achieved at the BHA boundaries.

98. Vegetation which is within BHAs and has a diameter greater than 150mm measured at 1.4m in height above ground level will be protected by Proposed Rule 10.4.2.1.4D which

[26] See Figure 9 in Davidson-Watts Ecology Ltd. (2019). Long-tailed Bat Trapping and Radio Tracking Baseline Report 2018 and 2019 Southern Links, Hamilton. Prepared for AECOM.

will prevent trimming, pruning or removal unless a resource consent has been granted for those activities.

Mitigation through the other planning provisions

99. The updated PC20 provisions provide a multifaceted approach to mitigating potential effects on bats as outlined below.

100. The proposed design of the BHAs will enhance the existing habitat being protected. The corridor BHA will be planted to transform a single line of widely spaced trees along a gravel driveway to a 50 m wide habitat corridor with two additional lines of vegetation interspersed with low growth vegetation to create internal edges for foraging and commuting. The 20 m buffer around the exiting trees in the Hub BHA will also be planted to increase the habitat available here and to protect the core habitat from anthropogenic disturbance. Additional enhancement of this area could include underplanting the existing trees with native vegetation.

101. Multiple PC20 provisions are intended to control the interface between the BHAs and the surrounding development to mitigate potential disturbance effects on bats. In addition to avoidance of light effects within BHAs (see Paragraph [97]), the mitigation will include:

(a) The lighting standards proposed in Rule 10.4.2.14A which impose additional restrictions on lighting which is within 100m of a BHA;

(b) Rule 10.4.2.3A which requires a minimum building setback of 5 m from the boundary of a BHA; and

(c) Various aspects of the BMP as outlined in paragraph [89]. The BMP will detail:

(i) How BHA enhancement planting will be implemented;

(ii) How the potential disturbance of road crossings through the BHAs will be minimised;

(iii) How potential injury or mortality to bats will be avoided through tree felling protocols of potential roost trees; and

(iv) A monitoring programme which is coordinated with other monitoring occurring in the area. Coordination of monitoring across projects will be important for understanding how the bat population is responding to changes occurring at a landscape level.

Compensating for residual effects

102. The post-lodgement amendments to the proposed provisions have been designed to avoid or mitigate many of the potential impacts of the proposed land-use change on long tailed bats. These amendments are discussed above and in detail in Mr Inger's EIC.

103. However, long-tailed bats range over wide areas and utilise various habitats including open areas such as pasture or cropland. An unavoidable consequence of PC20 is transforming approximately 89 ha[27] of low value open habitat and limited areas of moderate value vegetation into an urban area. While I consider the vast majority of the area included in the proposed development envelope to be low value for long-tailed bats (refer to paragraphs [62] – [67]), the loss of that area cannot be effectively mitigated on-site. Furthermore, the proposed land use change contributes to cumulative habitat loss across the landscape.

104. Given these impacts cannot be fully avoided, remedied or mitigated within the PC20 site, it is my opinion that off-site habitat protection and restoration and/or enhancement measures are required to manage residual effects on long-tailed bats. Mr Markham's EIC contains a preliminary assessment of the likely compensation package required to address residual effects of PC20 on long-tailed bats. It includes:

(a) 11ha of vegetation restoration and/or enhancement outside of the PC20 site for the purpose of establishment of commuting and foraging corridors for long-tailed bats.[28, 29]

(b) 80ha of pest animal control over a 10-year period in areas that long-tailed bats are known to frequent.

105. This preliminary compensation package has been determined using the Biodiversity Compensation Model ("BCM") to test the compensation actions are likely to result in net gain biodiversity outcomes when balanced with the level of proposed impact (see Mr Markham's EIC for further detail about the BCM).

106. An 11ha site has been conditionally purchased by TPL for the purpose of off-site habitat enhancement (see Annexure "D" for photos of the site). This parcel is shown in Annexure "C" and is henceforth referred to as the "compensation site". The compensation site is

[27] Noting that 41ha of the PC20 site is already zoned as Airport Business Zone in the WDP.
[28] This is in addition to 4.9ha of habitat enhancement of Bat Habitat Areas ("BHA") within the PC20 site which is mitigation.
[29] The off-site habitat restoration and/or enhancement will also provide potential roost habitat in the long-term, however given the timeframe of the BCM outcomes it has not been formally included as a compensation outcome.

currently in maize and includes scattered mature trees and shelterbelts, much the same as the PC20 site albeit with higher values than the PC20 site due to its location adjacent to the Waikato River. I also noted a number of mature trees which have potential bat roost features.

107. The compensation site is located approximately 500 m from the north-western corner of the PC20 site. Its eastern boundary is directly adjacent to the Waikato River and it extends from there to Raynes Road. The northernmost kahikatea remnant which I have identified as key bat habitat in the surrounding landscape (Annexure "A") is located approximately 250 m to the southwest and the 'Meridian Oaks' roost site is approximately 500 m to the east.

108. The site is also located almost entirely within the Biodiversity Corridor shown on Map 49 of the WDP.

109. The size of the compensation site is considerable compared to many of the key bat habitats identified in the surrounding landscape. Furthermore, the position of the compensation site relative to the Waikato River, a key movement corridor for the bat population, as well as other key bat habitats identified in the surrounding landscape, provides a valuable opportunity protect and enhance this area for future use by bats.

110. Effective protection of the bat population requires management actions at a landscape scale and will need to involve multiple agencies as well as private developers. The enhancement of this compensation site right on the Waikato River will provide an excellent starting point for a habitat corridor that could be continued beyond the site to connect multiple key bat habitats in the surrounding landscape. The plan in Annexure "C" shows the land owned by the Crown associated with the Southern Links designation. There is considerable potential for such a corridor to be extended west as part of the Southern Links mitigation, and north towards PC5 as part of the compensation package required for that project.

Assessment of the adequacy of the bat management measures proposed in PC20

111. It is my opinion that the updated PC20 provisions are a significant improvement in addressing potential effects on bats compared to the notified version. I note this was agreed by all ecology and planning experts in the Joint Witness Statement dated 8 February 2023 ("JWS").

112. I consider that off-site compensation is necessary to address residual effects associated with habitat loss, including the contribution of PC20 to cumulative habitat loss across the bat population's home range.

113. I support the residual effects management package outlined in Mr Markham's evidence which was tested using the BCM which is recognised as a reputable compensation tool used across New Zealand.

114. It is my opinion that protection and restoration and/or enhancement of the proposed compensation site is a valuable opportunity to safeguard a large area of habitat that is strategically placed relative to the Waikato River and other key bat habitats in the surrounding landscape. Having a compensation site already identified and secured by the TPL increases the certainty that compensation will be adequately address the potential impacts, and means that off-site habitat restoration and/or enhancement can potentially be initiated prior to impacts occurring.

RESPONSE TO SUBMISSIONS RAISED

115. Submitter comments with respect to long-tailed bats are generally summarised below:

(a) Some submitters consider that the wording of Policy 10.3.2.2A and Rule 10.4.2.14A (as notified) does not prioritise avoidance of bat habitat and is unduly focussed on potential roost trees as opposed the full spectrum of habitats used by bats;

(b) Some submitters noted that cumulative impacts at a landscape scale were not addressed with respect to maintaining connectivity through the PC20 site between key bat habitats in the surrounding landscape;

(c) Some submitters suggested ensuring a suitably qualified bat ecologist is involved in the preparation of management plans relating to bat protection;

(d) Concerns were raised by some submitters about noise impacting long-tailed bats;

(e) More detailed and robust lighting specifications were sought by some submitters to avoid impacts on bats;

(f) Some submitters identified that potential impacts of increased mammalian predator densities not addressed;

(g) Monitoring of long-tailed bats was recommended by some submitters, with triggers if impacts are detected;

(h) Some submitters considered that more detail required regarding off-setting or compensation for residual impacts on long-tailed bats; and

(i) Some submitters seek bat avoidance and mitigation measures that align with those proposed in the Peacocke Structure Plan.

Prioritising avoidance of bat habitat through the provisions in the plan change

116. The post lodgement revisions to Policy 10.3.2.2A and Rule 10.4.2.14A address concerns raised in several submissions.[30] These concerns largely relate to the lodged provisions not prioritising avoidance of bat habitat in the first instance, and that they are not detailed enough to provide certainty that effects will be adequately managed.

117. The proposed Airport Business Zone Structure Plan has been revised to include BHAs. The purpose of the BHAs is to protect and enhance higher value habitat within the PC20 site and to enable continued use of BHAs by bats once the site is urbanised. The revised provisions also clearly articulate the effects management hierarchy (with a particular focus on avoidance of effects on BHAs) and remove the uncertainty about the requirement to maintain and enhance significant long-tailed bat habitat values.

118. Avoidance of important bat habitat is a priority, but I do note that to develop the PC20 site for its intended purpose large areas of open cropland/ pasture (low value bat habitat) as well some moderate value vegetation must be removed. Furthermore, the roading network proposed for the area on the revised Structure Plan identifies that there will a road crossing required through the proposed BHA. It is my understanding that redesigning the proposed road network to avoid all road crossings through the BHA is impractical and this matter was addressed by Mr Grala in the Ecology JWS at section 3.1.2.

119. Revised Rule 10.4.2.14B requires the BMP to provide details of how planting and light spill will be managed where transport corridors are proposed to cross BHAs to limit potential effects on bats. Such details could include minimising vegetation clearance associated with road crossings as far as practical.

120. Where physical or functional removal of habitat cannot be avoided, mitigation and compensation is recommended. See Paragraphs [99] – [110] for additional detail.

[30] Submission numbers: 7, 11, 20, 23, and 25.

121. The most recent bat survey demonstrated that bats were active across the PC20 site including in the cropland. The nature of the project means it is not feasible to protect all habitat used by bats, but I consider that the revisions outlined above address concerns raised in submissions by setting aside important habitat in the Structure Plan that will be protected and enhanced. The revised provisions also detail more specifically how bat values will be maintained and enhanced compared to the notified provisions.

Landscape scale impacts and maintaining habitat connectivity for bats through the PC20 site

122. As noted in paragraphs [73] – [76] I outlined the potential impacts on the long-tailed bat population of increased habitat fragmentation resulting from the land use change. I agree that maintaining connectivity between key bat habitats in the landscape is vital for the persistence of the long-tailed bat population as parts of the population's home range become urbanised.

123. The PC20 site is located between multiple key bat habitats in the surrounding landscape. While the preferred movement routes of bats between key habitats is not known, the location of the PC20 site relative to these habitats suggests that urbanisation of the site could impact movement between the kahikatea remnants to the west and the Narrows camp to the east (although no movements were detected across the Hamilton Airport runway extension area in the latest survey).

124. As outlined above, the purpose of the BHAs is to protect and enhance higher value habitat within the PC20 site and to enable continued use of BHAs by bats once the site is urbanised. However, a corridor providing complete east – west connectivity through the site is not proposed. Along with aeronautical safety complications associated with habitat creation along the boundary the PC20 site shares with the airport (which could lead to increased bird strike), the primary limiting factor is that urbanisation of the land to the northeast and east of the site (beyond the airport) is either already developed, or is zoned and consented for development[31] without any ecological requirements facilitating bat movement.

125. Given the above, it is my opinion that there is little utility in providing an east – west movement corridor through the PC20 site, if there is no certainty that connectivity will be continued beyond the site to the key bat habitat to the east (i.e. the Narrows camp). As such, the applicant would be building 'a road to nowhere'.

[31] Mr Inger has advised me that the industrial-zoned Meridian 37 land immediately north of Raynes Rd has an approved Comprehensive Development Plan (CDP) resource consent. This consent does not include a wildlife corridor or any other ecological requirements.

126. I consider the off-site compensation package will provide a superior outcome compared to minimisation of habitat fragmentation on-site in this instance. As outlined in Paragraph [106], the compensation site has direct connectivity to the Waikato River. The Waikato River is a known important movement corridor that is protected from inappropriate development that would impact its use by bats through various policy provisions. As with the PC20 site itself however, the applicant cannot control development that occurs beyond the boundary of the compensation site.

127. However, protecting and enhancing the compensation site will send a strong positive signal to future developers and regulatory agencies as to the possibility of creating landscape-scale linkages westward from the Waikato River. The habitat being created at the compensation site will provide a very good starting point, from which additional habitat restoration and/or enhancement can expand upon to create a landscape linkage that connects multiple key bat habitats in the surrounding landscape.

128. As noted in Paragraph [110] multiple parcels of land west of the compensation site are owned by the Crown in relation to the Southern Links Designation. The Designation conditions require measures to off-set impacted bat habitat via restoration, and to minimise fragmentation of bat habitat[32]. As above, the compensation site proposed by the applicant is strategically placed for the Southern Links project to expand upon if the project is realised.

129. A key feature of the ecological management package proposed in the PC5 provisions is off-site compensation through habitat restoration and/or enhancement and pest control. HCC discuss the opportunity such approach creates to establish and integrated, landscape wide approach to protecting bat habitat. I agree that this approach is important to protect the bat population from the cumulative impacts of urbanisation in the population's range. I consider the compensation site identified for the PC20 project would be an important initial step in contributing to a multi-agency, landscape wide approach to bat habitat protection and restoration and/or enhancement.

Ensuring a suitably qualified bat ecologist is involved in the preparation of management plans relating to bat protection

130. Rule 10.4.2.14A in the notified PC20 has been updated (now rule 10.4.2.14B) to require that a suitably experienced bat ecologist leads the preparation of the BMP.

[32] NZ Transport Agency Notice of Requirement in Waipa District. Accessed here: https://www.nzta.govt.nz/assets/projects/southern-links/docs/NZTA-Southern-Links-Decision-Waipa-168.pdf

131. I note that submitters have referred to a suitably *qualified* bat ecologist. DOC has framework where the NZ Bat Recovery Group can certify ecologists (and other practitioners) as competent bat handlers. These competencies are field-based and do not evaluate the applicant's expertise in bat ecology and management. Aside from this competency framework there is no qualification that NZ ecology practitioners can gain that is bat-specific. As such it is my opinion that an ecologist's experience in working with, and managing bats is more relevant than their qualifications. The proposed wording of the amended Rule 10.4.2.14A (now 10.4.2.14B) reflects this.

Concerns about noise impacting long-tailed bats

132. Several submitters raised concerns about noise impacts on long-tailed bats.[33] As outlined in Paragraph [38], research on this matter does not indicate that anthropogenic noise significantly impacts bats. Research has been specifically undertaken to determine whether long-tailed bats active near the Hamilton airport are impacted by aircraft noise.[34] This research found that bat activity during and after planes flying overhead was not significantly different compared to pre-flight activity.

133. There is no evidence to suggest that changes in anthropogenic noise associated with the proposed plan change will negatively impact bats. Hence it is my opinion that provisions relating to mitigating noise impacts on bats are not necessary.

More detailed and robust lighting specifications are required to avoid impacts on bats

134. Several submitters consider that detailed lighting specifications are required to ensure that the habitat being retained in the PC20 site is not degraded by light spill from the surrounding development[35]. Several lighting performance standards have recently been imposed through the Amberfield resource consent, and in the provisions of PC5. Through these hearings multiple bat, and lighting, experts provided extensive evidence on the efficacy and viability of lighting standards to minimise impacts of light on bats.

135. Rule 10.4.2.14A has been revised to remove the requirement for a Lighting Management Plan. Instead, detailed lighting standards are specified including a limit of 0.3 lux at the boundary of the BHAs. These standards are generally consistent with those in the provisions of PC5. The main difference is that the standards proposed in the PC20 provisions apply to indoor and fixed outdoor lighting within 100 m of a BHA. Indoor lighting has been accounted for because of the increased variability in building size and

[33] Submission numbers: 07, 10, 13 and 20.
[34] Le Roux & Waas (2012). Do Long-Tailed Bats Alter Their Evening Activity in Response to Aircraft Noise? Acta Chiropterologica, 14(1), 111-120.
[35] Submission numbers: 07, 10, 13, 20, 22, 23 and 25.

design, and potential for night works, associated with industrial activity compared to what is expected in the majority residential PC5 area.

136. As outlined in Mr McKensey's EIC,[36] the standards proposed in combination with the proposed buffer will avoid light spill into the interior of the BHAs in the PC20 site, minimising the effects of light disturbance on long-tailed bats. These standards are preferable to the Lighting Management Plan proposed in the notified provisions as it provides certainty up front of the lighting management measures required.

137. Forest & Bird also raised the potential effects of car headlights in their submission (no. 07). Evidence presented during the consenting of the Amberfield subdivision showed that the penetration of car headlights into bat habitat is very hard to control and measure. As such, the lighting standards only apply to fixed outdoor lighting, not vehicle headlights. Instead, I consider the most appropriate way to manage the potential effect of vehicle headlights on bats is through measures such as limiting road crossings through bat habitat and providing roadside screening. Rule 10.4.2.14B requires that the BMP "Provides details of how planting and light spill will be managed where transport corridors are proposed to cross Bat Habitat Areas". This is also included in the ecology assessment criteria 21.1.10.19 (b) in the revised Section 21.

Potential impacts of increased mammalian predator densities

138. Several submitters have suggested that on-site predator control is required to address the impacts of increased predator densities resulting from the plan change. As discussed in Paragraphs [77] – [80], I disagree that the proposed change in land use will result in increased predator densities.

139. Bats are known to be vulnerable to mammalian predators. However, predator control to protect long-tailed bats is most effective over large areas[37], or high intensity targeted control at high value habitats such as roost sites.

140. Pest control is captured in the preliminary compensation package (as well as habitat creation, see Mr Markham's EIC). It would be most effectively undertaken in coordination with other long-term pest control efforts if this is possible.

[36] McKensey EIC [para1.27].

[37] Pryde, M.A., O'Donnell, C.F.J., Barker, R.J. (2005). Factors influencing survival and long-term population viability of New Zealand long-tailed bats (*Chalinolobus tuberculatus*): implications for conservation. *Biological Conservation* 126: 175-185.

Long-tailed bat monitoring requirements

141. Several submitters have recommended monitoring of long-tailed bats pre- and post-development. I agree that both bat monitoring and compliance monitoring (monitoring lux levels at the BHA boundaries for example) should be undertaken. It is my opinion however that it is not feasible to use the results of bat monitoring from a single site to accurately determine "triggers" at which the PC20 development should be halted as is recommended by one submitter. [38]

142. The South Hamilton bat population is subject to numerous development-related pressures across its range. As the bat population ranges over a wide area with core habitats dispersed across the landscape, there is little utility in attempting to draw conclusions on population-level effects from monitoring undertaken at a single site. As proposed in the PC5 provisions, it is my opinion that landscape level monitoring is the best monitoring option.

143. The submission on behalf of the Director-General of the Department of Conservation ("**DOC**"), proposes a *"Set on-going monitoring obligations and triggers for a halt to development if it is determined non-trivial effects on threatened species are occurring"*. As above, I agree monitoring of long-tailed bats is required and this is included in the updated provisions. However, as outlined in Paragraph [142], it is my opinion that the potential impacts on the bat population cannot be accurately attributed to a single development when development is happening concurrently across other areas of the bat population's range. For this reason, I disagree that triggers to halt the development if effects on bats are detected are appropriate. It would be appropriate, however, to review the BMP on a regular basis which is proposed to be a requirement under Rule 10.4.2.14B(a)(ix).

Off-setting or compensation for residual impacts on long-tailed bats.

144. The preliminary compensation package proposed to address residual impacts on bats is detailed in Paragraphs [104] – [105]. I consider that off-site habitat protection and restoration and/or enhancement measures are required to manage residual effects on bats and I support the preliminary compensation package. As outlined in Paragraphs [106] – [112], I consider the proposed compensation site is a valuable opportunity in enhance a large parcel of land to become high value bat habitat in the future. It is also

[38] The submission on behalf of the Director-General of the Department of Conservation (submission no. 20).

strategically placed on the Waikato River and close to other key bat habitats in the surrounding landscape.

Bat avoidance and mitigation measures should align with those proposed in the Peacocke Structure Plan

145. Several submitters either directly requested alignment with the PC5 proposed provisions, or recommended changes that have been sought through the PC5 process.

146. The bat population in question ranges over a wide area and it is my opinion that the most effective way to manage actual or potential impacts on the population is at a landscape level.

147. Consequently, where appropriate (given the differences in size, proposed land uses *et cetera*), aligning management and monitoring proposed in PC20 with the provisions recommended in PC5 will be the most effective means of protecting the bat population. As such the proposed PC20 provisions have been updated to be more consistent with those proposed for the PC5 area. Mr Inger, notes similarities with the recommended PC5 provisions in his summary of the amended PC20 provisions in his EIC.

148. It is my opinion that some potential effects are likely to differ between the PC5 area and PC20 site, such as pest densities and ambient artificial light at night for example. The revised PC20 bat-related provisions are generally consistent with what is proposed at PC5, but do contain differences which are outlined in the relevant sections above.

RESPONSE TO THE SECTION 42A REPORT

149. The Section 42A Report groups matters raised in submissions into topics and sub-topics which are commented on in Section 9. The sub-topics which are most relevant to my evidence are 2.2 Bat Habitat & Biodiversity and 3.2 Lighting. I comment on these matters as well as bat ecology matters which are raised in the Landscape Review[39] as follows:

[39] Landscape Review by Angela Brown (Align) dated 21 February 2023 (Section 42A Report, Appendix 4).

(a) The Section 42A Report recommends acceptance of the amended provisions in full with respect to ecology matters.[40] No further ecology related changes have been recommended in the Section 42A Report.

(b) No additional information is identified as being required in the Section 42A Report with respect to the sub-topics referred to above.

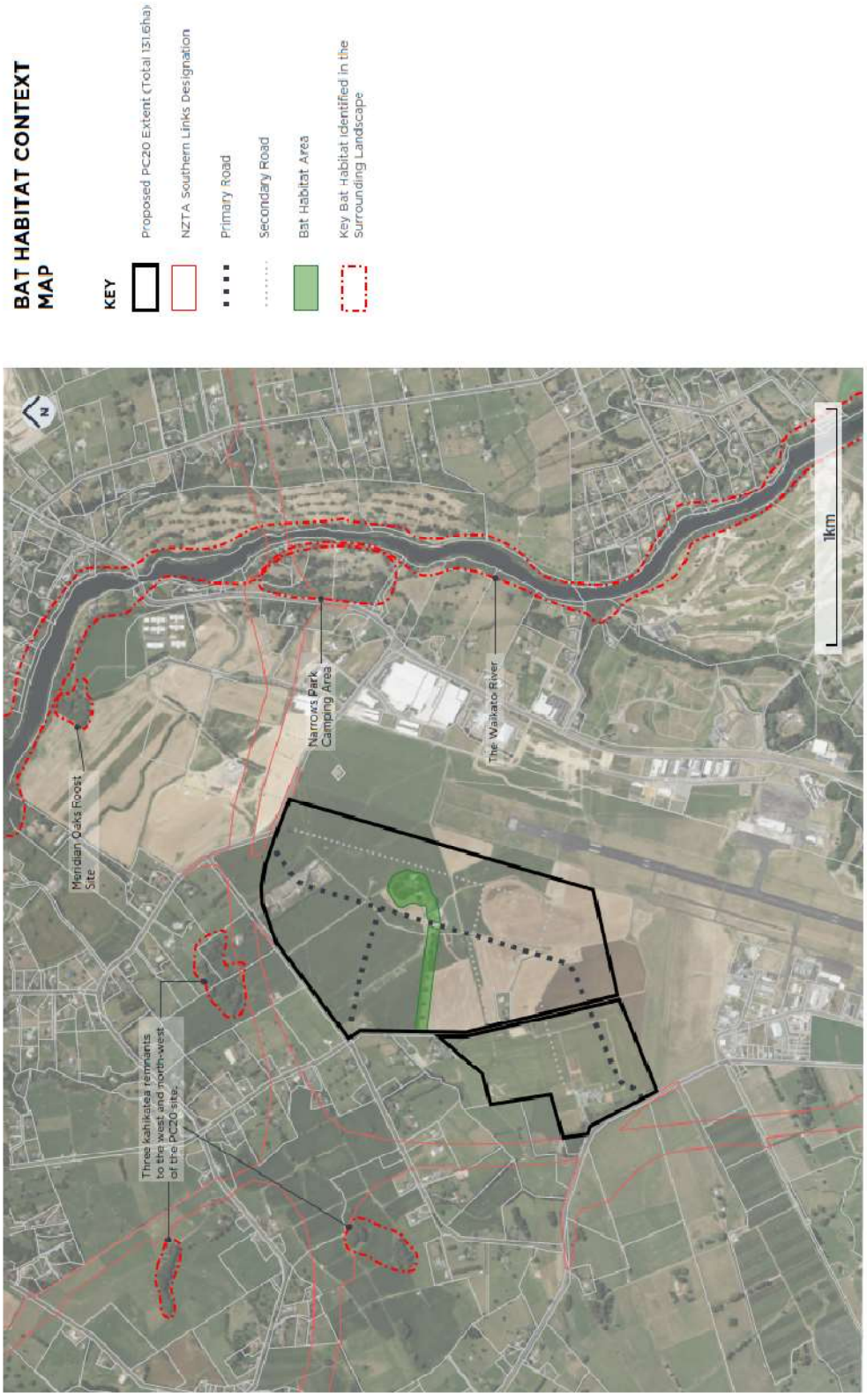
(c) The Landscape Review recommends that internal street and tree planting should integrate recommendations in terms of species which will support bat habitat and passage[41]. Long-tailed bats are sensitive to light, and while long-tailed bats will cross roads[42], they generally avoid moving directly over urbanised areas. Bats choose instead to use dark, well vegetated areas to disperse through otherwise urbanised landscapes. This aspect of bat ecology is the basis for the design of the BHAs, and the lighting and building set-back provisions which apply to the BHAs. Choosing tree species on the basis of providing habitat for bats outside of the BHAs will be of little utility to bats. These trees will provide physical habitat that is not functionally available to bats using the area because of the lack of protection from anthropogenic disturbance such as light. I therefore do not support the suggestions made in the Landscape Review relating to bats.

Georgia Cummings
Tonkin and Taylor Limited

28 February 2023

[40] The recommended track change amendments in Appendix 1 of the s42A Report are the same as the amended provisions which are included in Annexure 2 of Mr Grala's EIC.
[41] Landscape Review, para. [41].
[42] Bats are also occasionally observed foraging around street lights, but this is generally an exception to the rule of bats avoiding well-lit areas.

Annexure "A"


BAT HABITAT CONTEXT MAP
KEY
Proposed PC20 Extent (Total 131.6ha)
NZTA Southern Links Designation
Primary Road
Secondary Road
Bat Habitat Area
Key Bat Habitat identified in the Surrounding Landscape
N
Meridian Oaks Roost Site
Narrows Park Camping Area
The Waikato River
Three kahikatea remnants to the west and north-west of the PC20 site.
1km

Annexure "B"

Table 1: Results of the follow-up acoustic bat survey undertaken across the PC20 site during December 2022 and January 2023.

Survey location	Property	Habitat type	Survey duration	Total no. of bat passes	Mean no. of bat passes per night*	No. of feeding buzzes
01A	TPL Property	Vegetation edge	19 December 2022 – 9 January 2023 (22 nights)	1	0	0
01B		Open habitat (maize cropping)	0 (equipment failure)	-	-	-
02A		Vegetation edge	19 December 2022 – 9 January 2023 (22 nights)	1	0.06	0
02B		Open habitat (maize cropping)	19 December 2022 – 9 January 2023 (22 nights)	1	0.06	0
3		Open habitat (maize cropping + drain)	19 December 2022 – 9 January 2023 (22 nights)	1	0	0
4		Open habitat (maize cropping + drain)	19 December 2022 – 9 January 2023 (22 nights)	1	0	0
05A		Vegetation edge	19 – 25 December 2022 (7 nights) Battery malfunction	0	0	0
05B		Open habitat (maize cropping)	19 – 26 December 2022 (8 nights) Battery malfunction	0	0	0
06A		Vegetation edge	19 December 2022 – 9 January 2023 (22 nights)	2	0.06	0
06B		Open habitat (maize cropping)	19 December 2022 – 9 January 2023 (22 nights)	4	0.25	0
07A		Vegetation edge	19 December 2022 – 9 January 2023 (22 nights)	2	0.13	0
07B		Open habitat (maize cropping)	19 December 2022 – 9 January 2023 (22 nights)	1	0.06	0
08A		Vegetation edge	19 December 2022 – 9 January 2023 (22 nights)	3	0.13	0
08B		Open habitat (maize cropping)	19 December 2022 – 9 January 2023 (22 nights)	2	0.06	0
09A		Vegetation edge	19 December 2022 – 9 January 2023 (22 nights)	8	0.50	0
09B		Open habitat (maize cropping)	19 December 2022 – 9 January 2023 (22 nights)	3	0.19	0

Survey location	Property	Habitat type	Survey duration	Total no. of bat passes	Mean no. of bat passes per night*	No. of feeding buzzes
09C		Open habitat (maize cropping)	19 December 2022 – 9 January 2023 (22 nights)	4	0.19	0
10A		Vegetation edge	19 December 2022 – 9 January 2023 (22 nights)	9	0.44	1
10B		Open habitat (maize cropping)	19 December 2022 – 9 January 2023 (22 nights)	6	0.19	0
10C		Open habitat (maize cropping)	19 December 2022 – 9 January 2023 (22 nights)	0	0	0
11		Open habitat (mown grass)	19 December 2022 – 9 January 2023 (22 nights)	0	0	0
12		Open habitat (mown grass)	19 December 2022 – 9 January 2023 (22 nights)	0	0	0
13		Open habitat (mown grass)	19 – 28 December 2022 (10 nights) Battery malfunction	0	0	0
14		Open habitat (maize cropping + drain)	19 December 2022 – 9 January 2023 (22 nights)	2	0.13	0
15	RPL Property	Vegetation edge (recent native plantings)	19 December 2022 – 9 January 2023 (22 nights)	1	0.06	0
16		Vegetation edge (recent native plantings)	0 (equipment failure)	-	-	-
17		Vegetation edge (recent native plantings)	19 December 2022 – 9 January 2023 (22 nights)	3	0.19	0
18		Vegetation edge	19 December 2022 – 9 January 2023 (22 nights)	6	0.38	0
19		Vegetation edge	0 (equipment failure)	-	-	-
20		Vegetation edge (recent native plantings)	19 December 2022 – 9 January 2023 (22 nights)	0	0	0

* For comparison purposes the mean number of bat passes per night is calculated using only passes from nights classed as having “optimal weather conditions” in the ecology report that informed the PC20 application (see page 5 of Appendix 8 of the PC20 application).

Weather data used to determine nights that had "optimal weather conditions" as defined in the ecology report that informed the PC20 application (see page 5 of Appendix 8 of the PC20 application). These optimal weather conditions are:

- 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%.

Weather data was collected from CliFlo (Ruakura EWS, station number 26117[43]). Red highlighted cells indicate weather measurements that do not fall within the 'optimal' conditions for bat activity. These nights were omitted from the analysis of mean bat passes per night in Table 1 above.

Table 2: Weather data for the nights of the follow-up acoustic bat survey undertaken across the PC20 site during December 2022 and January 2023.

Date	Sunrise	Sunset	Min. temp. in first two hours after sunset (°C)	Rainfall in first two hours after sunset (mm)	Min. overnight relative humidity (%)
19/12/2022	05:52	20:39	18	0	73
20/12/2022	05:52	20:39	16.7	0	93
21/12/2022	05:53	20:40	19.5	0	84
22/12/2022	05:53	20:40	19	0	77
23/12/2022	05:54	20:41	18.1	0	81
24/12/2022	05:54	20:41	18.2	0	78
25/12/2022	05:55	20:42	18.7	0	75
26/121/2022	05:55	20:42	16.6	0.2	94
27/12/2022	05:56	20:42	20.4	0.6	67
28/12/2022	05:57	20:43	20.1	0	78
29/12/2022	05:57	20:43	19.8	0	76
30/12/2022	05:58	20:43	19.8	0	65
31/12/2022	05:59	20:43	19.1	0	60
1/01/2023	05:59	20:44	18.5	0	62
2/01/2023	06:00	20:44	18.4	0	69
3/01/2023	06:01	20:44	18.9	0	72

[43] Note there is a Cliflo weather station at Hamilton Airport that is closer to the site. This station was not used because it did not have hourly weather data needed to determine optimal weather conditions.

Date	Sunrise	Sunset	Min. temp. in first two hours after sunset (°C)	Rainfall in first two hours after sunset (mm)	Min. overnight relative humidity (%)
4/01/2023	06:02	20:44	19.0	0.2	81
5/01/2023	06:03	20:44	19.1	0	84
6/01/2023	06:04	20:44	19.2	1.8	92
7/01/2023	06:05	20:44	19.3	0	95
8/01/2023	06:05	20:44	21.8	0	76
9/01/2023	06:06	20:44	18.3	0	64

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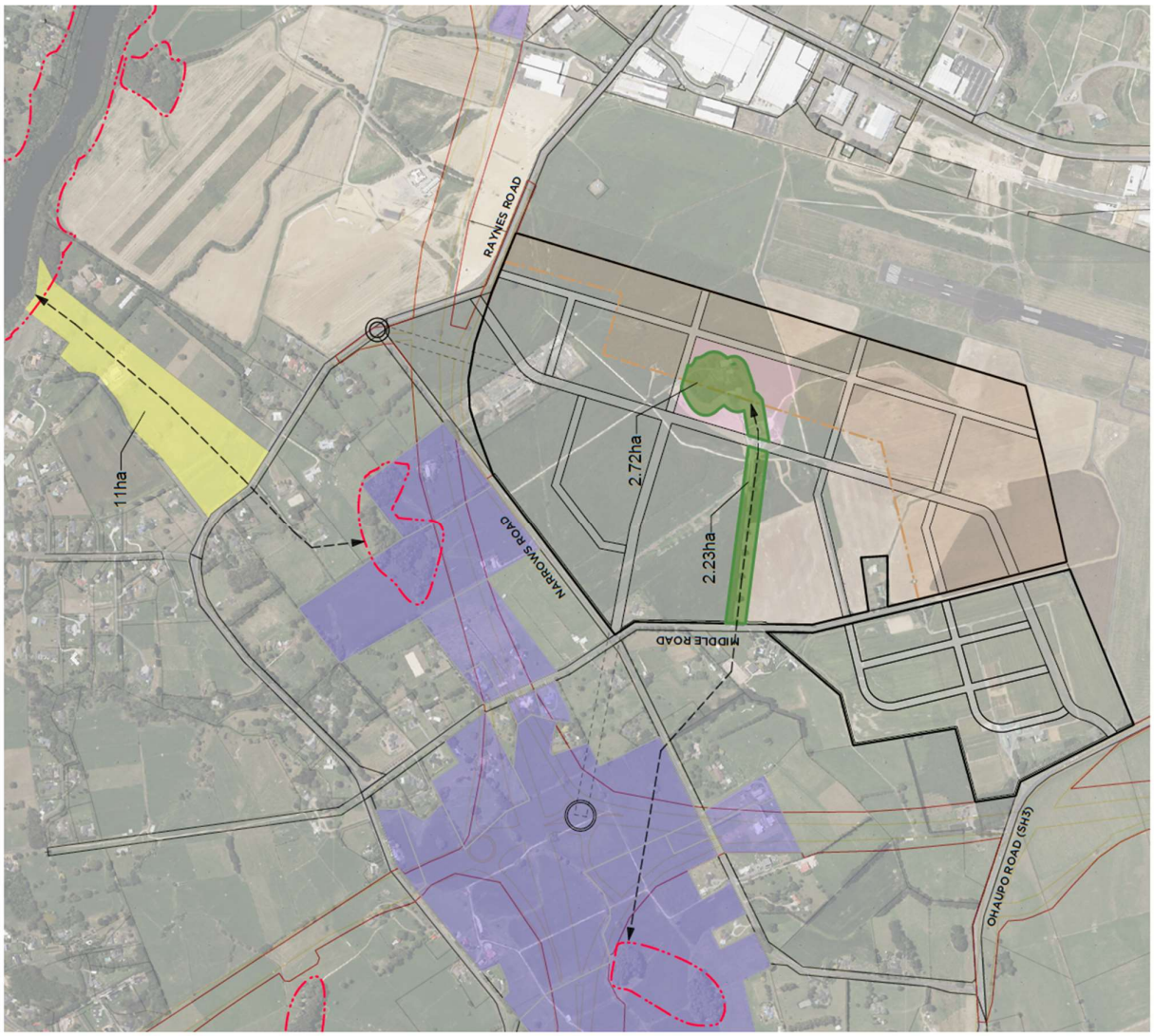
NOTES:
Basemap provided by Harrison Grierson Ltd. Location plan basemap and Hybrid Reference Layer: Esri Community Maps Contributors, LINZ, Stats NZ, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS. NZ Navigation Map: Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors.

REV	DESCRIPTION	GIS	CHK	DATE
0	First version	DRML	JORO	24/02/23

PROJECT No.	1013208.1000	
DESIGNED	DRML	FEB.23
DRAWN	DRML	FEB.23
CHECKED	JORO	FEB.23
APPROVED	24/02/23	DATE

CLIENT TITANIUM PARK LTD
PROJECT NORTHERN PRECINCT PLAN CHANGE
TITLE AUTOMATIC BAT DETECTOR LOCATIONS DECEMBER 2022 TO JANUARY 2023 SURVEY
SCALE (A3) 1:7,000 FIG No. FIGURE 1. REV 0

Annexure “C”


Bat Habitat Area Plan
KEY
PC20 Area (13ha)
Hub
Indicative Future Road Connections to Southern Links
Southern Links Designation Extent
Operative Airport Business Zone Extent Land area extent - approx. 47ha
Bat Habitat Area
Key Bat Habitat identified in the Surrounding Landscape
Bat Habitat Connections
Proposed Compensation Area
Property Owned by The Crown - Outside PC20 Area
NOTE: Lot layout is indicative only and for illustrative purposes. Further development is anticipated following experts review and additional information from others.
HARRISON GRIERSON
NORTHERN PRECINCT
Project: 1020-146639-01
Date: 7/02/2023
Dwg No: 146639-122
Status: for information
Scale: 1:10000
Revision: H
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0
1000
2000 m
11ha
RAYNES ROAD
NARROWS ROAD
2.72ha
2.23ha
MIDDLE ROAD
OHAUPO ROAD (SH3)

Annexure “D”

Figure 1: Looking north towards the river from the south-western corner of the compensation site near Raynes Rd. The very large tree in the background of the photo (see red arrow) corresponds with the largest tree that can be seen in Figure 2 below. This provides some context around the size of the site. Note the shelterbelt along the right-hand side of the photo is on the neighbouring property.

Figure 2: View looking east from the near the north-western corner of the compensation site by the Waikato River.

Figure 3: Looking north from the north-western corner of the compensation site showing where the site adjoins the riparian margin of the Waikato River.

Figure 4: Looking west along the row of mature willows north of the shed. The willows are planted along an open drain, one of two drains observed during my site-walkover.

Figure 5: An example of the potential roost features observed on one of the mature willows described in the photo above. Each willow along the row had multiple potential roost features.