BEFORE THE INDEPENDENT HEARING PANEL
APPOINTED BY HAMILTON CITY COUNCIL

IN THE MATTER	of the Resource Management Act 1991 (**Act**)
AND	
IN THE MATTER	of hearing submissions on Plan Change 5 to the Hamilton City District Plan
BETWEEN	**THE ADARE COMPANY LIMITED** **Submitter #53**
AND	**HAMILTON CITY COUNCIL** **Local authority**

EVIDENCE IN CHIEF OF DR STUART PARSONS FOR THE ADARE COMPANY LIMITED

ECOLOGY – LONG-TAILED BAT BIOLOGY

16 SEPTEMBER 2022

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SUMMARY OF EVIDENCE

1. My name is Dr Stuart Parsons and I am a zoologist specialising in bat biology. I am providing evidence in relation to the biology of long-tailed bats.

2. I summarise my evidence, according to the key headings in this statement as follows:

Biology and Ecology of Long-tailed bats relevant to Plan Change 5 to the Hamilton City District Plan (Page 6)

(a) Long-tailed bats have a conservation status of Threatened - Nationally Critical, having a high ongoing or predicted decline and being conservation dependent.

(b) Threats to the species include degradation and loss of habitat, and predation from introduced mammals.

(c) In and around Hamilton, the highest levels of bat activity tend to be around remnant gullies, the Waikato River, and parks. The bats roost in both native and exotic vegetation.

(d) Within the Peacocke Structure Plan Area (PSPA), bat activity is highest around the east-west shelterbelt of the Amberfield site, along the riparian margins of the Waikato River and two sites in the north-west of the PSPA on the margins of the Mangakotukutuku Gully.

(e) Communal roosts, that are of highest conservation value for the bats, have been found within the PSPA and along its margins. Four other roosts found within the PSPA are solitary or night roosts.

(f) Radio-tracking has shown the bats prefer native and exotic vegetation within their home ranges, as were parks, agricultural areas and lifestyle blocks. Pasture was avoided.

Importance of landscapes for bats (Page 9)

(g) Bats are highly mobile and are able to cover large areas of the landscape as they forage and move between roost trees. The bats tend to navigate along linear features such as hedgerows and treelines. Landscape features such as treelines and hedgerows can also provide important foraging habitat for the bats and shelter them from negative environmental conditions such as high wind.

(h) Because of their mobility, bats are sensitive to changes across the landscape. Such changes may include loss of natural foraging and roosting habitat and the severing of movement corridors.

(i) Because of their mobility, a change in the health of a population may be detected in and area distant from the cause of the effect, making the source difficult to identify.

(j) Population-level effects that restrict the movement of the bats can reduce the fitness of the population and gene flow. Both effects can drive a population to extinction.

Landscape associations of long-tailed bats in Hamilton (Page 11)

(k) Home ranges of bats in and around Hamilton City tend to be smaller than those found in natural areas such as Fiordland, with their habitat associations noted above.

(l) Bats are likely using the Amberfield site predominantly as a commuting route for movement between the Mangaonua and Mangakotukutuku gullies, via the Waikato River. It is highly likely that linear landscape features within the broader PSPA also assist the bats to commuting through the area.

(m) Radiotracking data for bats over the PSPA support this assessment, and show the importance of native and exotic vegetation as well as the Waikato River within the core ranges of multiple individuals.

The PC5 provisions in light of Long-tailed bat ecology (Page 13)

(n) Bats must be managed over their full range, i.e. at the landscape level. Without such management, effects of anthropogenic changes will be extremely difficult to identify and manage.

(o) As a result, I support management of the Long-tailed bat population by Hamilton City Council (at a city level), and surrounding district councils and Waikato Regional Council (respectively at a district and regional level). I do not support management of the population at the level of PSPA.

(p) I support the standards suggested for managing the interface between urban development and existing or proposed Long-tailed bat habitat.

INTRODUCTION

1. My full name is Dr Stuart Parsons.

2. I am the director of Walkingbats, an environmental consulting company specialising in bats. I am also Professor and Dean of the School of Science, Technology and Engineering at the University of the Sunshine Coast, Australia.

3. My following qualifications and experience are relevant to this evidence:

   (a) I hold a BSc (Hons) and PhD in zoology from the University of Otago;

   (b) My PhD research focused on the acoustic ecology of New Zealand bats. Following this, I worked as a post-doctoral research fellow at the University of Bristol (UK), again, on the biology and bioacoustics of bats;

   (c) From 2001 – 2014 I was a Senior Lecturer and then Associate Professor in Biological Sciences at the University of Auckland. From 2014 – 2020 I was Professor and Head of the School of Earth, Environmental and Biological Sciences at Queensland University of Technology (**QUT**) in Brisbane, Australia and from 2020-2021 I was Professor and Head of the School of Biology and Environmental Sciences, also at QUT. Since January 2022 I have been employed as the Dean of the School of Science, Technology and Engineering at the University of the Sunshine Coast in Australia. My duties include strategic leadership of the school and University. I also teach (undergraduate and postgraduate), conduct high-quality original scientific research, and provide services to the University and community (such as committee membership and community outreach);

(d) I have published more than 100 scientific publications, including 89 peer-reviewed papers, two books edited and contributed chapters to a further eight. I am currently a member of the IUCN Species Survival Commission Bat Specialist Group (IUCN-SSG-BSG), and I co-chaired the BSG's working party on minimising human to bat transfer of SARS-CoV-19. I am a member of the Scientific Advisory Board of Bat Conservation International, and I am the President of the Australian Council of Environmental Deans and Directors;

(e) I have 30 years' experience in studying bat biology. My areas of research expertise include the ecology and behaviour of bats in New Zealand and overseas (including: Australia, South Africa, China, Taiwan, UK, Trinidad and Tobago, and Belize). I have supervised 31 postgraduate student research projects to completion, of which 8 PhD, 7 Masters and 2 Honours students focused on aspects of the biology of bats;

(f) My experience includes the assessment of bat activity and potential effects at the site of a proposed quarry extension at Puni (near Port Waikato); the effects of a runway extension at Hamilton International Airport on the roosting site of long-tailed bats; assessing and advising on the impacts of 4 sections of the Waikato Expressway on bats as well as the Mt Messenger bypass in Taranaki; assessing and advising on the impacts on bats of the Hauāuru mā raki Wind Farm, and assessing and advising on the potential impacts of the Amberfield development in Hamilton. Many of these assessments have incorporated the development or review of research and management plans, specifically for long-tailed bats;

(g) I have presented expert evidence before independent hearings panels and the Environment Court, including for the Amberfield development.

CODE OF CONDUCT

4. I have read the Environment Court Code of Conduct for expert witnesses and agree to comply with it.

5. I confirm that the topics and opinions addressed in this statement are within my area of expertise except where I state that I have relied on the evidence of other persons. I have not omitted to consider materials or facts known to me that might alter or detract from the opinions I have expressed.

SCOPE OF EVIDENCE

6. In my evidence I will provide an overview of the biology and ecology of Long-tailed bats as they relate to the Peacocke Structure Plan Area (**PSPA**). This includes their conservation status, including threats to their survival; aspects of their movement ecology; diet; habitat preferences; and roosting ecology. I will also demonstrate the importance of the entire landscape over which the bats roam and how the population must be managed at this level. It follows that planning for bat management should not be limited to the PSPA. Finally, I express my support for the standards that seek to manage the interface between urban development and present and future bat habitat.

7. This evidence is structured as follows:

   (a) Biology and Ecology of Long-tailed bats relevant to Plan Change 5 (**PC5**) to the Hamilton City District Plan

   (b) The importance of landscapes for bats

   (c) Landscape associations of Long-tailed bats in Hamilton and its surrounding areas.

   (d) The PSPA provisions in light of Long-tailed bat ecology

Biology and Ecology of Long-tailed bats relevant to Plan Change 5 to the Hamilton City District Plan

8. The Long-tailed bat, *Chalinolobus tuberculatus*, belongs to the widespread family Vespertilionidae. It is one of only two bat species in New Zealand (a third is likely extinct) and is listed by the Department of

Conservation as Threatened - Nationally Critical[1], having a high ongoing or predicted decline and being conservation dependent. The species is found throughout the North and South Islands, as well as on several offshore islands[2].

9. Threats to Long-tailed bats include habitat fragmentation, degradation and loss; and predation from introduced mammals such as ship rats and cats.

10. There is little information on the number and distribution of Long-tailed bats in the Waikato Region, although concerted survey effort, usually associated with infrastructure projects around the Hamilton region, has located several populations.

11. Within the Hamilton City and surrounding environments, areas with moderate to high levels of bat activity include Hammond Park, Sandford Park, Te Anau Park, the riparian zone along the Waikato River to the south of Hamilton, and various gullies in and around Hamilton City[3,4].

12. Modelling of potentially suitable habitat for long-tailed bats within the wider Hamilton City area has also identified the Waikato River, gully systems and a number of parks and reserves as potential habitat[5].

13. Within the PSPA, moderate levels of activity have been detected along the riparian margins of the Amberfield development site as well as the feature known as the "East-West Shelterbelt".[6] Acoustic sampling as part

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1 O'Donnell, C.F.J, Borkin, K.M., Christie, J.E., Lloyd, B.D., Parsons, S., Hitchmough, R.A. (2018). Conservation status of New Zealand Bats, 2017. New Zealand Threat Classification Series 21, New Zealand Department of Conservation, Wellington. 4 pp.

2 O'Donnell, C.F.J. (2000). Conservation status and causes of decline of the threatened New Zealand Long-tailed Bast *Chalinolobus tuberculatus* (Chiroptera: Vespertilionidae). Mammal Review, 30(2): 89-106.

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

4 Borkin et al. 2019. Baseline Acoustic Monitoring of Long-Tailed Bats for The Southern Links Roading Project, Hamilton: 2016 and 2017. Report no. 4192d prepared by Wildlands for AECOM.

5 Crewther 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.

6 The East-West Shelterbelt is an exotic shelterbelt on the Amberfield site that runs between the Waikato River and Peacockes Road.

of the Southern Links project[4] found moderate levels of activity at monitoring sites 4A (median calls per night = 15.0) and 5B (median calls per night = 25.5) within the PSPA as shown in **Appendix 1** of my evidence. Both sites are along the western boundary of the PSPA, along the margin of the Mangakotukutuku gully. The site with the highest median bat activity, 8B (208 passes per night, located in the neighbouring Waipa District) is on the southern boundary of the PSPA. Results from 2020 (February to March) acoustic monitoring of the Amberfield site and Hammond Park revealed a mean of 36.6 passes per night along the east-west shelterbelt, 83.3 passes per night within Amberfield immediately along the Waikato River riparian margin adjacent to Hammond Park (the highest activity recorded on the Amberfield site during the survey), and 134.1 passes per night in Hammond Park.

14. Within native forest, Long-tailed bats roost during the day in holes and other suitable locations in trees. During the day bats go into torpor[7] (a daily hibernation), which means trees used as roosting sites (particularly for pregnant and lactating bats) must be old enough to have developed deep knot holes or loose bark so that the bats have something to roost in, or clasp onto. Within exotic trees, the bats have been reported living in holes, under peeling bark of trees less than 25 years old, or in dead branches of trees of similar age.

15. Long-tailed bats have been found to use a range of native and exotic tree species for roosting and have not been found to discriminate between tree species or forest types. They have been documented roosting in near-pristine, large old growth forests, in small, degraded tree stands or isolated trees within an urban or agricultural setting, and in commercial pine forest. Individual bats normally have a number of trees in which they may roost on any given day and are not restricted to a single roost tree. They will also regularly change favoured roost trees.

16. Maternity or communal roosts in which females gather in relatively large numbers and where they may give birth to and raise young, are the most

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7 McNab, B.K., O'Donnell, C.F.J. (2018). The behavioural energetics of New Zealand's bats: daily torpor and hibernation, a continuum. Comparative Biochemistry and Physiology A, 223:18-22.

important for conservation[8]. High quality "maternity" trees are also a limiting resource for long-tailed bat populations due to their specific thermal requirements[9].

17. Within Hamilton City and surrounding areas, radio-tracking as part of the Southern Links roading project[3] identified 13 communal roosts (>2 individuals). Within the PSPA, one maternity (roost 8) and two potential (roosts 9 and 10) maternity roosts were located as shown in **Appendix 2** of my evidence. The four other roosts found in the PSPA were either solitary day or night roosts.

18. Other studies have also identified communal roosts in Hamilton City and surrounding areas, including the Oak stand on the banks of the Waikato River near the airport (which is within the neighbouring Waipa District).

19. Throughout the year Long-tailed bats enter daily torpor[6] while in their day roosts, and may also go into true hibernation over the cold winter months (June to August inclusive). This may make them particularly vulnerable to disturbance during this time, as they may be unable to warm in time to leave the roost in the event of disturbance.

20. Long-tailed bats feed nocturnally on flying insects, particularly flies and moths. Bats feed over open areas, along waterways and bush edges. They tend to use linear landscape features such as gullies, bush edges or tracks to transit between feeding and roosting sites. They prefer to hunt in more open areas since their ability to manoeuvre in dense bush is limited. Thus, Long-tailed bat foraging occurs:

    (a) along forest edges;

    (b) over low density regenerating Kanuka and Manuka;

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8 Neubaum, D.J., Navo, K.W., Siemers, J.L. (2017). Guidelines for defining biologically important bat roosts: a case study from Colorado. *Journal of Fish and Wildlife Management*, (1): 272–282.

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

(c) above wetlands; and

(d) over open water and along roads and clearings (lined with mature vegetation).

21. Specific information exists as to habitat preferences for bats in and around Hamilton City, including over the PSPA.[3] Radio-tracking studies combined with home range analysis showed the importance of native and exotic trees as well as river and open water habitat. Parks, agricultural areas, and lifestyle blocks, were also used, likely due to the presence of trees and treelines in these areas. Four bats were shown to have core areas (areas in which they spent a significant amount of time) within the PSPA.

22. Dekrout's[10] analysis of core areas of bat movement showed a significant aversion to pasture and a preference for river and gully habitat.

23. Dekrout[8] also suggested that the Hamilton population has been able to survive the effects of urbanisation due to the topography of the area, most notably the incised and vegetated gully systems linked with the Waikato River. This has led to the bats being largely constrained to the southern rural-urban fringe (although noting the results of surveys for bats to the north and west of the city by Dixon[11]).

Importance of landscapes for bats

24. Bats are highly mobile species, and are able to cover large areas in a relatively short period of time. However, the ability of bats to move across a landscape is affected by their biology and ecology. Some bats are slow but highly manoeuvrable fliers and exploit small, densely forested, areas. As an example, whiskered bats (*Myotis mystacinus*) are slow but manoeuvrable fliers with home ranges varying from 22 ha to 26 ha, as they travel along linear features such as scrubby banks of streams and tree lines to reach forest patches.[12]

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[10] Dekrout, A. (2009). Monitoring New Zealand long-tailed bats (*Chalinolobus tuberculatus*) in urban habitats: ecology, physiology and genetics. PhD thesis, University of Auckland.

[11] Dixon, O. (2020). Spatial distribution suirvey of long-tailed bats (*Chalinolobus tuberculatus*) north of Hamilton City. Report prepared for Waikato Regional Council. P16.

[12] Kurek K., Gewartowska O., Tołkacz K., Jędrzejewska B., Mysłajek R.W. (2020) Home range size, habitat selection and roost use by the whiskered bat (*Myotis mystacinus*) in

25. In contrast, median home ranges of Long-tailed bats in native forest (Fiordland) are among the largest published for insectivorous bats[13], with adult males = 1589 ha, post-lactating females = 1361 ha, and non-reproductive females = 657 ha. Ranges of lactating females = 330 ha.

26. While bats can roam over large areas, they favour smaller areas within their home range in which they spend the majority of their time. These are known as core areas. Movement throughout their home range, and between core areas is an important aspect of their movement ecology.

27. Bats tend to use landscape features to assist them when navigating across their home ranges. Such features may include tree lines as in the case of *M. mystacinus* above, or human-made structures such as canals as in the case of *Myotis dacyneme*[14].

28. Linear landscape features not only provide landmarks which assist with navigation, but also help to shelter the animals from the effects of the wind, thus reducing the energetic cost of flying. Some may also provide foraging opportunities.

29. Because bats can travel long distances, they may also be sensitive to changes in the broader landscape; while one habitat may remain unchanged, impacts in other areas of the home range may prevent or restrict their movement.

30. Changes in landscape features that affect bats include the loss of important natural foraging or roosting habitat such as forests and trees[15], and the severing of movement routes. For example, the loss of linear

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human-dominated montane landscapes. PLoS ONE 15(10): e0237243. https://doi.org/10.1371/journal.pone.0237243

13 O'Donnell, S.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.

14 Verboom, B., Boonman, A., Limpens, H. (1999). Acoustic perception of landscape elements by the pond bat (*Myotis dasycneme*). *Journal of Zoology, 248*(1), 59-66. doi:10.1111/j.1469-7998.1999.tb01022.x

15 Law, B.S., Anderson, J., Chidel, M. (1999). Bat communities in a fragmented forest landscape on the south-west slopes of New South Wales, Australia. Biological Conservation, 88(3): 333-345.

features such as tree lines or hedgerows[16] or building of large roads[17],[18] can prevent bats from moving from one area of their home range to another.

31. Severing of landscape features important for the movement of bats can have severe effects on the sustainability of a population and may even drive it to extinction. Impacts can include reduced fitness because access to important foraging grounds have been lost[19], through to genetic bottlenecks and declines in genetic diversity[20].

32. Some anthropogenic landscape features can also pose a direct threat to bats. For example, bats may be hit by vehicles as they attempt to cross a roadway[21].

33. The risk of collision with vehicles is higher where roads are close to or bisect other linear features, including tree lines, hedges or rivers, and bats are more likely to be killed where roads pass through high-quality habitats or close to scarce and fragmented foraging locations, such as waterbodies and riparian habitats[18].

Landscape associations of long-tailed bats in Hamilton

34. Long-tailed bats are highly mobile, and (as noted above) their range is one of the highest when compared to species with similar wing morphologies[10].

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16 Stebbings, R. E. (1988). *Conservation of European bats.* London, UK: Christopher Helm.

17 Bhardwaj, M., Soanes, K., Lahoz-Monfort, J.J., Lumsden, L.F., van der Ree, R. (2021) Insectivorous bats are less active near freeways. PLOS ONE 16(3): e0247400. https://doi.org/10.1371/journal.pone.0247400

18 Kerth, G. & Melber, Markus. (2009). Species-specific barrier effects of a motorway on the habitat use of two threatened forest-living bat species. Biological Conservation. 142. 270-279. 10.1016/j.biocon.2008.10.022.

19 Bontadina, F., Schmied, S.F., Beck, A. Arlettaz, R. (2008), Changes in prey abundance unlikely to explain the demography of a critically endangered Central European bat. Journal of Applied Ecology, 45: 641-648. https://doi.org/10.1111/j.1365-2664.2007.01417.x

20 Collevatti, R., Vitorino, L., Vieira, T., & Oprea, M., Telles, M. (2020). Landscape changes decrease genetic diversity in the Pallas' long-tongued bat. Perspectives in Ecology and Conservation. 18. 10.1016/j.pecon.2020.06.006.

21 Fensome, A.G. and Mathews, F. (2016), Roads and bats: a meta-analysis and review of the evidence on vehicle collisions and barrier effects. Mammal Review, 46: 311-323. https://doi.org/10.1111/mam.12072

35. In contrast with data from Fiordland presented above, home ranges are smaller around Hamilton where female bats have home ranges of approximately 952 ha while those of males were 477 ha[3].

36. In the case of Long-tailed bats, strong associations have been made with tree lines (as is the case within the Amberfield site), waterways such as the Waikato River, and the gully systems of southern Hamilton.

37. Dekrout[8] showed that Long-tailed bats were strongly associated with the remnant gully systems found around Hamilton, and also with the Waikato River.

38. Results from acoustic surveys at the Amberfield site also show a strong association between bat activity and the riparian vegetation and linear features of the site, the most notable being the east-west shelterbelt running across the site.

39. While it can only be assumed that bats are using the Amberfield site predominantly as a commuting route, as they move between the Mangaonua and Mangakotukutuku gullies, this was a widely accepted view from experts involved in the Amberfield hearing. If this assumption is held to be correct, then the wider landscape of the PSPA and its linear landscape features are highly likely to be playing an important role in facilitating the movement of bats within Hamilton.

40. This assumption is supported by the results of radio-tracking work completed as part of the Southern Links project which showed the Long-tailed bats were roaming widely over southern Hamilton and its surrounding areas, with individuals moving between core areas. In some cases, individual bats overlap in core areas, highlighting the importance of these areas which are likely to be centred on native and exotic trees as well as river and open water habitat[3].

41. The Southern Links work reinforces the important role of the Waikato River as a movement corridor for bats. It also identified bats using shelterbelts and trees in the area of the "Peacocke Urban Expansion"[22].

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22 See citation 3, Page 28, Paragraph 4.1.6.

The PC5 provisions in light of Long-tailed bat ecology

42. Effective management of Long-tailed bat populations in the Hamilton area must encompass all areas over which the bats move, i.e. at a landscape level.

43. Results from several radio-tracking studies[3, 10] supports the conclusion that the bats range over very large areas meaning that management must extend beyond the boundaries of the PSPA. Restricting management to this relatively small part of the bats' range (i.e. the PSPA) would leave them vulnerable to disturbance from negative anthropogenic effects outside the boundaries of PSPA.

44. Without management of the entire home range of the bat population, it will also be extremely difficult, if not impossible, to identify and mitigate the factors (or adverse effects) that are causing a decline in the population.

45. Therefore, I support Hamilton City Council and Waikato Regional Council, managing the Long-tailed bat population at a city-wide and regional landscape level, respectively. Although management should be integrated across the region, the Council can plan for the management of the city-wide population according to its urban boundaries. I do not support management of the population at the level of individual properties or the PSPA.

46. Management of the city-wide Long-tailed bat population should be strategically overseen by a group that represent mana whenua, experts in bat biology / ecology and the impacts of urbanisation, as well as those with a responsibility for developing the city. The management group should advocate for and support research work that improves our knowledge of the biology and ecology of the bats, and the impacts of urbanisation. Other research could focus on strategies and technologies that minimise or remove impacts of urbanisation on the bats.

CONCLUSIONS

47. Long-tailed bats are an endemic Threatened – Nationally Critical species. It is a wide-ranging species with home ranges spread over hundreds to thousands of hectares.

48. Ecologically, Long-tailed bats are associated with edge habitat, and often commute and feed along the edge of natural features such as tree lines and waterways. The bats are also dependent on native and exotic trees for roosting.

49. Numerous studies including acoustic surveys and radio-tracking have supported this association for Hamilton and the PSPA.

50. There are core areas within Long-tailed bat home ranges where the bats spend the majority of their time while away from their roosts. It is these areas that are most strongly associated with the natural features stated above.

51. Evidence strongly suggests that Long-tailed bats rely on linear landscape features for movement across their home ranges. Within the PSPA, this includes the Waikato River and its riparian margin, gullies and native and exotic vegetation.

52. Loss of native and exotic vegetation, as well as access to important landscape areas through degradation or removal of linear features could have serious negative effects on the local population of Long-tailed bats. Thus, appropriate avoidance or mitigation of potential effects, at an appropriate scale, is vital. This requires management at the city-wide and regional landscape level, which is proactively co-ordinated and overseen with expert support.

Dated this 16th day of September 2022

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Dr Stuart Parsons

Appendix 1 – Monitoring locations

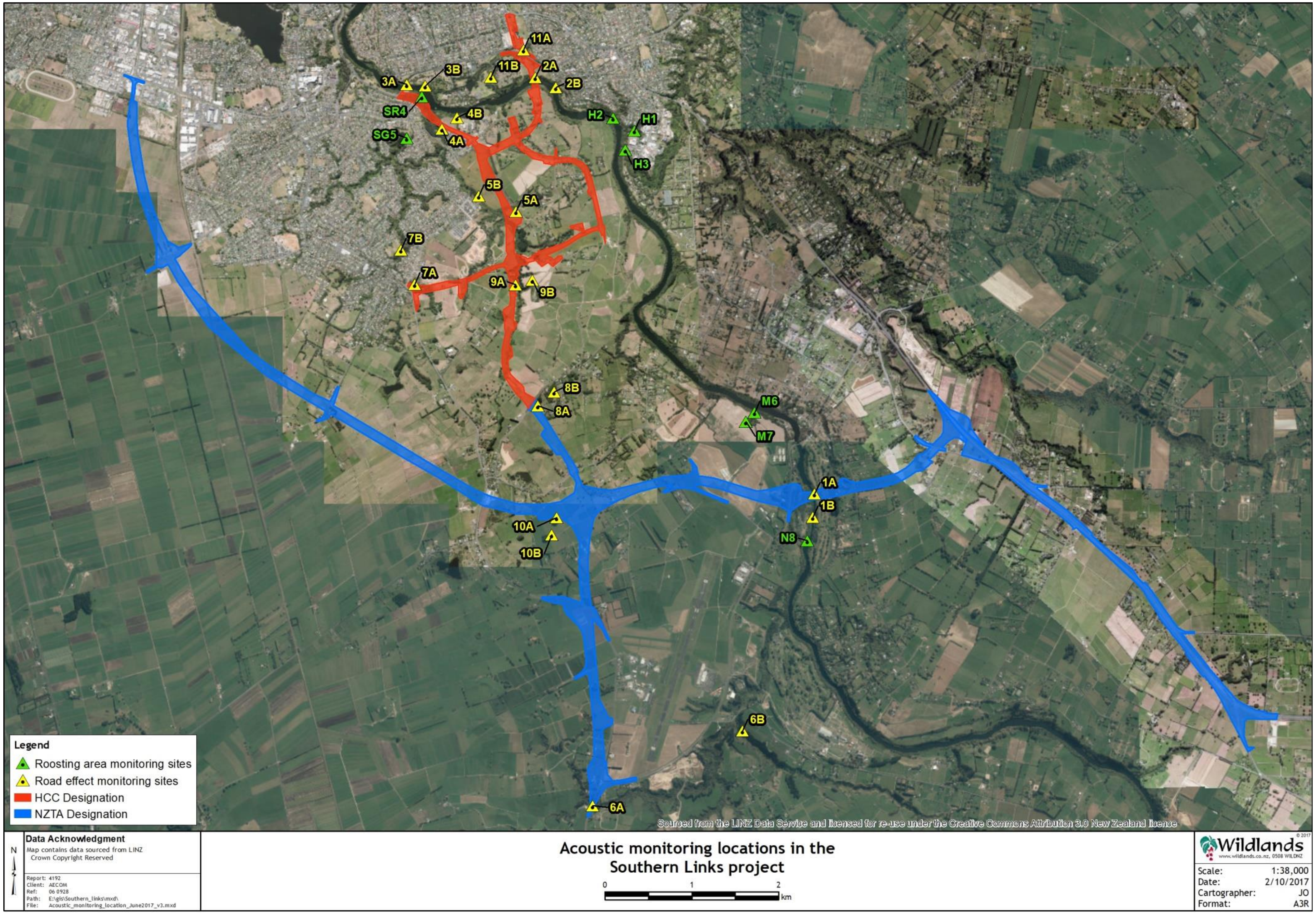

Figure 1: Acoustic monitoring locations within the Southern Links project area, Hamilton. Note that Site 10A is both a road monitoring site and a roost monitoring site.

Appendix 2 – Known roost locations

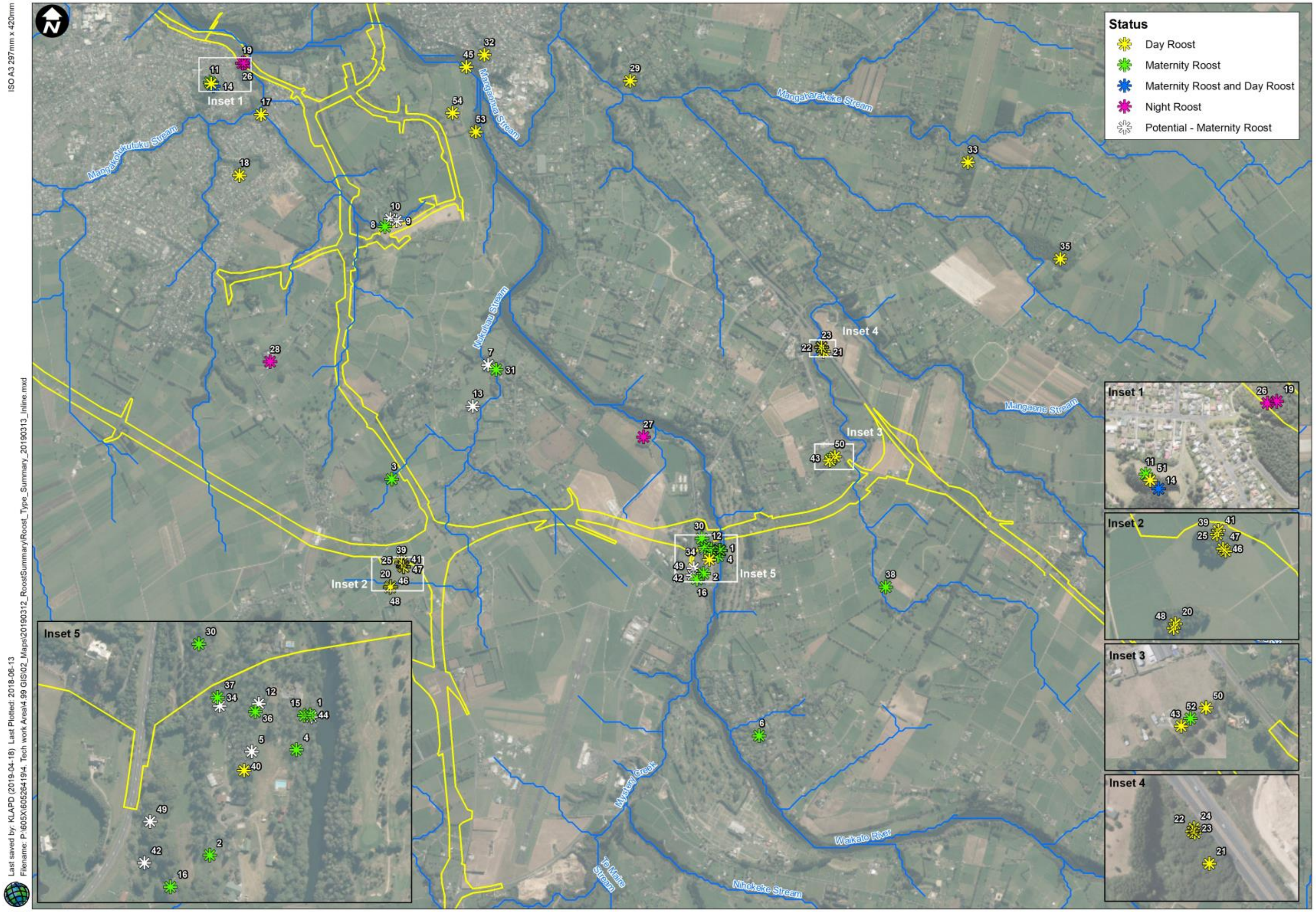

Figure 9 Location of long-tailed bat roosting sites.