BEFORE THE HEARING PANEL

IN THE MATTER OF	The Resource Management Act 1991 ("the Act")
and	
IN THE MATTER OF	an Application by Weston Lea Limited for land use and subdivision consents for the development of approximately 105 hectares of land at 337 – 461 Peacockes Road, Hamilton
AND	
IN THE MATTER OF	a submission on this application by the Director-General of Conservation.

STATEMENT OF EVIDENCE IN CHIEF OF KERRY MAREE BORKIN
FOR THE DIRECTOR-GENERAL OF CONSERVATION
23 APRIL 2019

Department of Conservation
Private Bag 3072, Hamilton 3240
Counsel Acting: Victoria Tumai
E-mail: vtumai@doc.govt.nz
Phone: 07 838 5687
Submission Number: 59

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Introduction

1. My full name is Kerry Maree Borkin.

2. I am a Senior Ecologist with Wildland Consultants Ltd, based in Taupō. I have been employed as a consultant ecologist with Wildlands since 2011.

3. Wildland Consultants has been engaged by the Director-General of Conservation to provide an independent assessment and advice regarding the proposed Amberfield subdivision with respect to potential effects on long-tailed bats.

Qualifications and Experience

4. My qualifications include a PhD in Biological Sciences from the University of Auckland (2010). This research focussed on the ecology of long-tailed bats in plantation forest. Over the period 2006-2010, my PhD research involved the capture and radio-tracking of long-tailed bats, as well as monitoring of their activity (comparison of activity between habitat types), observations at roosts and of roost emergence, and training of others in these skills.

5. I have a Postgraduate Diploma in Wildlife Management, with Distinction, from the University of Otago (1999). This included surveying the distribution of long-tailed bats throughout the Waikato Region for the Department of Conservation. My research dissertation for the Diploma focussed on feral cat diet and cat responses to prey abundance changes.

6. I also have a BSc (Zoology and Ecology) from Massey University (1997).

7. I am certified as a “Trainer” (Class E level) by the Department of Conservation’s Bat Recovery Group, which means that I am considered highly competent at locating bat roosts, capturing and handling bats using a variety of techniques, and undertaking bat monitoring and surveys. I also have the ability to train others to do these tasks. This is the highest level of certification.

8. In my current role with Wildland Consultants I have been involved in the oversight and interpretation of bat monitoring surveys at various sites throughout New Zealand. I have also provided technical input and advice into the design of mitigation packages, and the development and implementation of management, mitigation, restoration, and monitoring plans that focus on bats.

9. I was recently a member of the panel of experts that reviewed the threat classifications of New Zealand bat species for the Department of Conservation.

10. I have previously appeared as an expert witness on behalf of the Waikato Regional Council regarding bat-related matters for the Hamilton Section of the Waikato Expressway.

11. I have published 13 peer-reviewed scientific papers; eight focused on New Zealand bats. I have acted as a peer reviewer for scientific papers regarding bats, their home range, and welfare, for international and New Zealand-based journals. In 2017, I co-authored a report for the New Zealand Transport Agency that focussed on the effects of roads and linear transport infrastructure on New Zealand bat species.

12. In total I have 21 years' experience in ecological management and research, including about 14 years focused specifically on New Zealand bats.

13. Recently, I was an author of three reports regarding long-tailed bat activity and monitoring in the southern Hamilton area:

    - Wildland Consultants 2018a: Baseline acoustic monitoring of long-tailed bats for the Southern Links roading project, Hamilton: 2017 and 2018. *Wildland Consultants Ltd Contract Report No. 4192d*. Prepared for Aecom, New Zealand. 37 pp.
    - Wildland Consultants 2018b: Thermal image monitoring of long-tailed bats for the Southern Links roading project in Hamilton: 2017 and 2018. *Wildland Consultants Ltd Contract Report No. 4192c*. Prepared for Aecom, New Zealand. 63 pp.
    - Wildland Consultants 2017: Thermal imaging of long-tailed bats at Riverlea, Hamilton: March 2017. *Wildland Consultants Ltd Contract Report No. 4285*. Prepared for Aecom, New Zealand. 12 pp.

14. I was part of the Wildlands team that developed the design of this monitoring. I led the field work, analysed the bat detector and thermal imaging recordings, and was co-author of the reports that described the key findings.

15. I also was part of the team that captured and radio-tracked long-tailed bats to determine roost locations, home ranges, and key linkages throughout southern Hamilton in January and March 2018[1].

16. I am a member of the Australasian Bat Society.

Code of Conduct

17. While this is not an Environment Court hearing, I have read the Environment Court "Code of conduct for expert witnesses", and I agree to abide by it. I have prepared this Statement in accordance with that Code. I confirm that my evidence is within my area of expertise. I have not omitted to consider any material facts known to me that alter or detract from the opinions I express in this Statement. I have acknowledged the material used or relied on in forming my opinions and in the preparation of this Statement.

Executive Summary

18. Long-tailed bats (*Chalinolobus tuberculatus*; Threatened-Nationally Critical) appear to be largely restricted to the southern parts of Hamilton. Habitats of particular importance include those around wooded areas, the southern Hamilton gully system, and along the Waikato River.

19. Long-tailed bats are present throughout the proposed Amberfield subdivision site, and are known to use the site for commuting, foraging, and roosting.

20. There are three known bat roosts within the Amberfield site, and these may be communal or solitary. The Applicant notes that, in addition to this, there are multiple potential roosts at the site, including individual roosts and trees that are likely to be important to the local bat population.

[1] Davidson-Watts I. 2018: Long-tailed bat trapping and radio tracking baseline report Southern Links, Hamilton. Report prepared for Aecom NZ Ltd.

21. Changes proposed at the Amberfield site are likely to result in reduced bat activity because of increases in urbanisation, lighting, traffic, and roading network density.

22. Loss of vegetation and trees at the site may result in a smaller bat population, with smaller home ranges, and with fewer roosts.

23. A number of mitigation measures are proposed by the Applicant but with sparse detail. Given that there has been little investigation of the likely effectiveness of many of the proposed mitigation measures, it is unclear whether these will adequately address adverse effects.

24. It is likely that there will be significant residual adverse effects.

Matters Considered

25. In March 2019, I undertook a high level review of bat-related aspects of the proposed Amberfield subdivision application for the Department of Conservation**.** This included reviews of the following documents:

    - Assessment of environmental effects: Amberfield application for subdivision and land use consents for development (Adare 2018).
    - Assessment of Environmental Effects: Addendum Received 26-02-2019 (Adare 2019).
    - Amberfield - Peacocke Structure Plan: Terrestrial Ecological Assessment (Boffa Miskell 2018a).
    - Memorandum to Weston Lea Ltd: Amberfield project - Hamilton City Council s92 response. Terrestrial ecology16-08-2018. (Boffa Miskell 2018b).
    - Amberfield: Ecological Assessment Addendum. Report prepared by Boffa Miskell for Weston Lea Ltd (Boffa Miskell 2019).

26. Subsequent to this initial high-level review, I have also reviewed the following documents:

    - Statement of Evidence of Gerardus Henricus Anthonius Kessels, 2 April 2019 (downloaded from Hamilton City Council website 5 April 2019).

    - Evidence in Chief of Georgia Thelma Rose Cummings for Weston Lea Limited, 12 April 2019 (downloaded from the Hamilton City Council website 15 April 2019).

- Evidence in Chief of Stuart Parsons for Weston Lea Limited, 12 April 2019 (downloaded from the Hamilton City Council website 15 April 2019).

- I have also reviewed the Joint Statement of the Ecology Witnesses dated 18 February 2019, but was not part of that caucusing.

- I am aware that there is a report in preparation by Ian Davidson-Watts regarding recent capture and radio-tracking of individual long-tailed bats within the Southern Hamilton area. Communication from Hamilton City Council on 15 April 2019 suggested that this would be made available between the submission of this evidence and attendance at the hearing. Should this report be available at this time, I intend to include a discussion of relevant information from this report when I present this evidence at the hearing.

Scope of Evidence

27. The scope of my evidence will cover the following matters:
    a. Context for the local long-tailed bat population.
    b. Roosts used locally, including the locations of roosts and roost types within Amberfield, and the value of trees locally.
    c. Flight patterns and habitat use.
    d. Potential effects of light, noise, urbanisation, and traffic (based on local and international research).
    e. Potential population-level effects.
    f. Potential residual effects, and how these may be managed.

28. Because the offset/compensation package proposed by the Applicant, as at 15 April 2019, which lacks detail, I identify the key issues with it, but cannot provide definitive conclusions. Currently there is insufficient information to do so.

Overview of Local Long-Tailed Bat Population, and Their Distribution

29. The New Zealand long-tailed bat (*Chalinolobus tuberculatus*) is an endemic bat, which means that it is found only in New Zealand. It is considered to be vulnerable to extinction and is ranked as "Threatened-Nationally Critical" which is the highest threat ranking in the Department of Conservation's threat classification system. It meets

this threat ranking because it is undergoing a "very high ongoing or predicted decline (> 70%)." [2]

30. Long-tailed bats are present throughout much of the Waikato Region[3]. A lack of reporting of bats by the general public, with few records after the 1920s and 1930s[4,5], led to the incorrect belief that long-tailed bats had become extinct in urban habitats. The long-tailed bat population within the Hamilton area is now considered to be one of the few New Zealand populations that reside in and utilise cities. Dekrout (2009)[6] confirmed the presence of long-tailed bats within Hamilton using systematic surveys of green spaces, and the capture and radio-tracking of individual bats to locate roosts and home ranges. This study confirmed their apparent reliance on gully systems in southern Hamilton and the peri-urban area, i.e. the landscape interface between town and country, the rural-urban transition zone.

31. A home range is the area that an individual bat uses relatively regularly.[7,8] The extent of an individual's home range is usually determined by capturing an individual and attaching a radio-transmitter. Individuals can then be followed and the extent of area that they use is estimated.

32. Long-tailed bat home ranges can be large. In and around Hamilton, Dekrout (2009) found that male long-tailed bats have home ranges from 25.9 hectares to 871.0 hectares, and 0.8 to 7.3 kilometres across.[9] More recently, Davidson-Watts (2018) found that female long-tailed bats in the southern Hamilton area used areas from 137.8 hectares to 1609.4 hectares in size, and 3.3 to 6.6 kilometres across.[10] Whilst these areas may appear large it is likely that they do not include

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2 O'Donnell C.F.J., Borkin K.M., Christie J.E., Lloyd B., Parsons S., Hitchmough R.A. 2018: Conservation status of New Zealand bats, 2017. *New Zealand Threat Classification Series 21*. Department of Conservation, Wellington, New Zealand. 4 pp.

3 Department of Conservation's Bat Distribution (Database Version received 10 May 2018).

4 O'Donnell C.F.J. 2005: New Zealand long-tailed bat. Chapter In: C. M. King (Ed.): The Handbook of New Zealand Mammals, Second Edition. Pp 98-109. Oxford University Press, Melbourne.

5 Dekrout A.S., Clarkson B.D., and Parsons S. 2014: Temporal and spatial distribution and habitat associations of an urban population of New Zealand long-tailed bats (*Chalinolobus tuberculatus*). *New Zealand Journal of Zoology.* DOI: 10.1080/03014223.2014.953551

6 Dekrout A.S. 2009: Monitoring New Zealand long-tailed bats (*Chalinolobus tuberculatus*) in urban habitats: ecology, physiology and genetics. *Unpublished PhD thesis*. University of Auckland, Auckland, New Zealand. 168 pp.

7 Burt W. H. 1943. Territoriality and home range concepts as applied to mammals. *Journal of Mammalogy 24*: 346–352.

8 Powell R. A., Mitchell M. S. 2012. What is a home range? Journal of Mammalogy, 93(4):948-958 http://dx.doi.org/10.1644/11-MAMM-S-177.1

9 Dekrout A. S. 2009. Monitoring New Zealand long-tailed bats (*Chalinolobus tuberculatus*) in urban habitats: ecology, physiology and genetics. *Unpublished PhD thesis*, University of Auckland, Auckland, New Zealand. Pp 168

10 Davidson-Watts I. 2018: Long-tailed Bat Trapping and Radio Tracking Baseline Report Southern Links, Hamilton. Report prepared for AECOM NZ Ltd.

entire home ranges because of the relatively short timeframe over which radio-tracking usually takes place (normally 1-2 weeks).

33. Hamilton's bat population is found mainly in the southern part of the City and the adjoining peri-urban area.[11,12] Since 2010, the Waikato Museum has run tours highlighting the use of southern Hamilton by long-tailed bats, and particularly Hammond Park which lies immediately across the River from Amberfield, Hammond Park is considered an important location for bats in Hamilton. Dekrout (2009) captured the majority of the bats in her study in this park, and located three of the 12 roosts found during her research in this green space.[13] However, the assumption that Hammond Park is of higher value to bats than Amberfield is not supportable. Recent radio-tracking confirmed three roosts at the Amberfield subdivision, compared to one roost within Hammond Park[14]. It should be noted, however, that radio-tracking only samples a small sub-set of roosts; transmitters are only attached to bats for a short period, and there may be more roosts within the area.

34. There have been numerous intensive surveys and monitoring studies of long-tailed bats in the area surrounding Amberfield. These surveys include acoustic monitoring[15,16,17], thermal imaging[18], and capture and radio-tracking of individual bats[19,20]. The surveys, and the modelling of survey results, confirmed the importance of both the wider peri-urban

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11 Dekrout A.S., Clarkson B.D., and Parsons S. 2014: Temporal and spatial distribution and habitat associations of an urban population of New Zealand long-tailed bats (*Chalinolobus tuberculatus*). *New Zealand Journal of Zoology.* DOI: 10.1080/03014223.2014.953551

12 Le Roux D.S., Le Roux N.S., and Waas J.R. 2013: Spatial and temporal variation in long-tailed bat echolocation activity in a New Zealand city. *New Zealand Journal of Zoology*. DOI:10.1080/03014223.2013.827125

13 Dekrout A. S. 2009. Monitoring New Zealand long-tailed bats (*Chalinolobus tuberculatus*) in urban habitats: ecology, physiology and genetics. *Unpublished PhD thesis*, University of Auckland, Auckland, New Zealand. 168 pp.

14 Aecom 2019: Letter to Nathanael Savage Hamilton City Council: Bat roosts identified during radio tracking completed in January, March and December 2018 Aecom Reference: \\nzham1fp001.au.aecomnet.com\projects\601x\60164546\4. tech work area\4.25 nzta emmp\7.0 reports_final\bat roost data issued\ltr bat roosts sites identified during radio tracking.docx

15 Le Roux D.S. and Le Roux N.S. 2012: Hamilton City Bat Survey 2011-2012. Report prepared by Kessels & Associates Ltd for Project Echo (project partners: Waikato Regional Council, The University of Waikato, Hamilton City Council, Department of Conservation, Waikato Tree Trust). 22 pp. Document Ref: \\server files\Hamilton City Council\Bat survey city wide\city wide survey report_240512.

16 Wildland Consultants 2018a: Baseline acoustic monitoring of long-tailed bats for the Southern Links roading project, Hamilton: 2017 and 2018. *Wildland Consultants Ltd Contract Report No. 4192d*. Prepared for Aecom, New Zealand. 37 pp.

17 Dekrout A.S., Clarkson B.D., and Parsons S. 2014: Temporal and spatial distribution and habitat associations of an urban population of New Zealand long-tailed bats (*Chalinolobus tuberculatus*). *New Zealand Journal of Zoology.* DOI: 10.1080/03014223.2014.953551

18 Wildland Consultants 2018b: Thermal image monitoring of long-tailed bats for the Southern Links roading project in Hamilton: 2017 and 2018. *Wildland Consultants Ltd Contract Report No. 4192c*. Prepared for Aecom, New Zealand. 63 pp.

19 Dekrout A. S. 2009. Monitoring New Zealand long-tailed bats (*Chalinolobus tuberculatus*) in urban habitats: ecology, physiology and genetics. *Unpublished PhD thesis*, University of Auckland, Auckland, New Zealand. Pp 168

20 Davidson-Watts I 2018: Long-tailed bat trapping and radio tracking baseline report Southern Links, Hamilton. Report prepared for Aecom NZ Ltd.

area in southern Hamilton, and of the Amberfield area itself[21,22]. This is because very few records of bats were located outside of southern Hamilton.[23]

35. Indeed, Crewther and Parsons (Page 20)[24] noted that bats are most often detected: *"on the periphery of urban Hamilton, predominantly in the south and southeast, and only extending north to the east of the city in areas of pasture containing linear features such as hedges, and where housing and street lighting density is very low"*

36. Other monitoring has included thermal imaging, which is a relatively recently-developed technique in New Zealand. *"Thermal imaging cameras record the apparent temperature of objects. Bats are generally warmer than their surroundings at night and their behaviours are therefore identifiable through analyses of thermal imaging camera footage by a suitably-trained operator"*[25]

37. Relatively high numbers of long-tailed bats were recorded in thermal imaging surveys within Amberfield (Wildland Consultants 2018b), based on 18 hours of recorded thermal imaging footage at Hammond Park, looking across the Waikato River towards Amberfield (Refer to Attachment A of this evidence). This study confirmed the importance of Amberfield for the local bat population: this site was the location of 68% and 81% of confirmed bat recordings at the six sites located along the Waikato River in the 2017 and 2018 sampling sessions, respectively.

38. The Waikato River, and all of the southern Hamilton gully systems, are considered to be important habitat for bats and provide key linkages between roosting and foraging areas[26,27].

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21 Dekrout A.S., Clarkson B.D., and Parsons S. 2014: Temporal and spatial distribution and habitat associations of an urban population of New Zealand long-tailed bats (*Chalinolobus tuberculatus*). *New Zealand Journal of Zoology.* DOI: 10.1080/ 03014223.2014.953551

22 Crewther K. and Parsons S. 2017: Predictive modelling of long-tailed bat distribution in the Hamilton area. *Walkingbats Consultancy report.* Prepared for Project Echo (a collaboration between Hamilton City Council, Department of Conservation, Waikato Regional Council, and Riverlea Environment Society Inc.).

23 Mueller H., Ulrich C., and Purcell A. 2017: Draft Hamilton City long-tailed bat survey 2016-2017. A report prepared by Kessels and Associates Ltd for Project Echo (project partners: Waikato Regional Council, The University of Waikato, Hamilton City Council, Department of Conservation, Waikato Tree Trust). Pp 25.

24 Crewther K. and Parsons S. 2017: Predictive modelling of long-tailed bat distribution in the Hamilton area. Walkingbats Consultancy report prepared for Project Echo (a collaboration between Hamilton City Council, Department of Conservation, Waikato Regional Council, and Riverlea Environment Society Inc.).

25 Wildland Consultants 2017: Thermal image of long-tailed bats at Riverlea, Hamilton: March 2017. *Wildland Consultants Ltd Contract Report No. 4285* A report prepared for Aecom NZ Ltd.12pp.

26 Davidson-Watts I. 2018: Long-tailed bat trapping and radio tracking baseline report Southern Links, Hamilton. Report prepared for Aecom NZ Ltd

39. Little bat activity appears to occur within parts of Hamilton which are highly urbanised[28]. Le Roux and Le Roux's (2012) survey of Hamilton found that when road and street light density was considered together with housing density, there was a significant effect on long-tailed bat activity. Whilst they called this "human activity", it could be considered to be a proxy for "urbanisation". They also found that with a slight increase in housing density (from their lowest recorded score of less than one house per hectare to less than five) that bat activity declined by 42%. Earlier work by Dekrout (2009)[29] also found a significant negative correlation between long-tailed bat activity in Hamilton and housing and street light density. Modelling by Crewther and Parsons (2017[30]) also supported this and suggested that long-tailed bats may be using the "*quieter areas on the outskirts* [of the city] *rather than the Waikato River as it enters more populous, noisy and well-lit parts of the city"* (Page 20).

40. Effects of urbanisation on long-tailed bats are therefore likely to be significant at far lower levels of housing intensification than anticipated by the Peacocke Structure Plan[31,32]. The Peacocke Structure Plan would enable 15-20 houses per hectare in residential areas and 30 dwellings per hectare in identified high density housing areas.

Roost Use and Population Size

41. The southern Hamilton long-tailed bat population includes at least 61 bats. This number is based on counts that took place at three active

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27 Dekrout A.S., Clarkson B.D., and Parsons S. 2014: Temporal and spatial distribution and habitat associations of an urban population of New Zealand long-tailed bats (*Chalinolobus tuberculatus*). *New Zealand Journal of Zoology.* DOI: 10.1080/03014223.2014.953551

28 Le Roux D.S. and Le Roux N.S. 2012: Hamilton City Bat Survey 2011-2012. Report prepared by Kessels & Associates Ltd for Project Echo (project partners: Waikato Regional Council, The University of Waikato, Hamilton City Council, Department of Conservation, Waikato Tree Trust). 22 pp. Document Ref: \\server files\Hamilton City Council\Bat survey city wide\city wide survey report_240512.

29 Dekrout A.S. 2009: Monitoring New Zealand long-tailed bats (*Chalinolobus tuberculatus*) in urban habitats: ecology, physiology and genetics. *Unpublished PhD thesis*. University of Auckland, Auckland, New Zealand. 168 pp.

30 Crewther K. and Parsons S. 2017: Predictive modelling of long-tailed bat distribution in the Hamilton area. Walkingbats Consultancy report prepared for Project Echo (a collaboration between Hamilton City Council, Department of Conservation, Waikato Regional Council, and Riverlea Environment Society Inc.).

31 Hamilton City Council. 2007: Peacocke Structure Plan. https://www.hamilton.govt.nz/our-council/council-publications/operativedistrictplan/Documents/Variations/Variation%2014/Microsoft_Word_-Peacocke_Structure_Plan_2007.pdf Downloaded 16 April 2019.

32 This plan was developed with the purpose of outlining "*an urban design vision for the future urban development of the Peacocke area and to provide a strategic framework to guide the development process* (Page 3)".

roosts on 16 January 2018[33]; and the population was estimated using the Minimum Number Alive method[34].

42. Only three known roosts in artificial roost boxes are adequately protected from predators with predator exclusion bands. As most roosts are not protected adequately from predators, it is likely that this population is declining. This is because in places without adequately large areas of predator control (i.e. that protect all known roosts), bat population sizes are likely to be decreasing.[35,36]

43. Male and female long-tailed bats often choose different roosts, and this may be due to their differing energetic requirements.[37] Female bats are thought to form communal groups when their pups are young, and male bats largely roost alone elsewhere. However, this is not exclusively the case. Male bats are captured at least occasionally exiting roosts shared with females (pers. obs.), and in Fiordland, male and female bats frequently switched between communal and solitary roosts.[38]

44. Use of the Amberfield subdivision site by long-tailed bats for commuting and foraging[39,40], and roosting[41] has been confirmed.

45. There are three confirmed roosts within the Amberfield subdivision[42] (Aecom 2019). These roosts were used by at least one male long-

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33 Davidson-Watts I. 2018: Long-tailed bat trapping and radio tracking baseline report Southern Links, Hamilton. Report prepared for Aecom NZ Ltd

34 The Minimum Number Alive population estimation method involves simply counting all bats seen alive at one point in time. This method has some flaws (or limitations), largely related to the likelihood of not being able to estimate the proportion of the population that is unseen at that time. It is therefore thought to probably underestimate population size (Smith D., Borkin K., Jones C., Lindberg S., Davies F., and Eccles G. 2017: Effects of land transport activities on New Zealand's endemic bat populations: reviews of ecological and regulatory literature. *NZ Transport Agency Research Report 623*. 249 pp.).

35 Pryde M.A, O'Donnell C.F.J., and 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.

36 O'Donnell C.F.J., Pryde M.A., van Dam-Bates P., and Elliott G.P. 2017: Controlling invasive predators enhances the long-term survival of endangered New Zealand long-tailed bats (*Chalinolobus tuberculatus*): Implications for conservation of bats on oceanic islands. *Biological Conservation 214*: 156-167. http://dx.doi.org/10.1016/ j.biocon.2017.08.015

37 Borkin K.M. and Parsons S. 2011: Sex-specific roost selection by bats in clearfell harvested plantation forest: improved knowledge advises management. *Acta Chiropterologica 13*(2): 373-383.

38 O'Donnell C.F.J. and 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.

39 Wildland Consultants 2018b: Thermal image monitoring of long-tailed bats for the Southern Links roading project in Hamilton: 2017 and 2018. *Wildland Consultants Ltd Contract Report No. 4192c*. Prepared for Aecom, New Zealand. 63 pp.

40 Davidson-Watts I. 2018: Long-tailed bat trapping and radio tracking baseline report Southern Links, Hamilton. Report prepared for Aecom NZ Ltd

41 Aecom 2019: Letter to Nathanael Savage Hamilton City Council: Bat roosts identified during radio tracking completed in January, March and December 2018 Aecom Reference: \\nzham1fp001.au.aecomnet.com\projects\601x\60164546\4. tech work area\4.25 nzta emmp\7.0 reports_final\bat roost data issued\ltr bat roosts sites identified during radio tracking.docx

42 Aecom 2019: Letter to Nathanael Savage Hamilton City Council: Bat roosts identified during radio tracking completed in January, March and December 2018 Aecom Reference: \\nzham1fp001.au.aecomnet.com\projects\601x\60164546\4. tech work area\4.25 nzta emmp\7.0 reports_final\bat roost data issued\ltr bat roosts sites identified during radio tracking.docx

tailed bat. It is possible that these roosts were also used by other bats during the radio-tracking period and at other times of year. This is because emergence watches - when people watch roosts count bats as they emerge - did not take place at two of the roosts within the Amberfield area, and on only one night for the third roost[43].

46. In addition to this, acoustic monitoring data, such as that undertaken by the Applicant, cannot be used to determine numbers of bats present at a site, and only indicates relative activity[44]. Dr Parsons (Paragraph 44) states that "*Patterns of bat activity do not indicate that bats are roosting on the site (e.g. peak in activity up to 30 min before dusk, and then shortly after dusk). This is consistent with past radio-telemetry work*.[45]" Clearly, because multiple bat roosts have been confirmed at the site, the use of acoustic monitoring data in this way to suggest that roosts are either not present, or are only used by solitary bats, should be considered to be unreliable.

47. Therefore, there is no data to support the Applicant's assertion that the roosts are likely to be solitary[46,47].

48. Ms Cummings (Paragraph 32) suggests that "*If an active maternity roost was present, it would be expected that the site would form part of the core habitat of multiple tracked bats, particularly breeding females, as has been found with other key areas identified in the radio telemetry studies to date*.[48]" This statement is not supported. Radio-tracking studies, such as those that have taken place in southern Hamilton are

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[43] There appear to be errors in the document (Aecom 2019) that outlines the location of roosts located by radio-tracking of long-tailed bats within the southern Hamilton area. The reporting includes the locations of roosts that were found during three capture and radio-tracking sessions that took place between 15 January 2018 and 5 March 2019. For example, the image (shown as Attachment D, Figure D1) shows three roosts in the Amberfield area (47, 54, and 55). However, a search of the accompanying data sheet shows only two of these were located within this area. Roost '47', which is currently shown in Amberfield, should be shown within the area "10A", a kahikatea stand to the south (shown in Attachment D Figure D2 as the cluster of roosts in the north of "Inset 2"). The data sheet also shows that Roost '45' should be shown in the Amberfield area (Weston Lea).

[44] Hayes J.P., Ober H.K., and Sherwin R.E. 2009: Survey and monitoring of bats. Chapter In: Kunz T.H. and Parsons S. (Eds) Ecological and behavioural methods for the study of bats. 2nd ed. The John Hopkins University Press, Baltimore, Maryland, United States of America. Pp 112-129.

[45] Parsons C. 2019: : Evidence in Chief of Stuart Parsons for Weston Lea Limited, 12 April 2019. https://www.hamilton.govt.nz/our-services/planningguidanceandresourceconsents/publicly-notified-applications/2018%20Document%20folder/Adare%20P9%20Applicant%20Evidence%20-%20Bat%20Ecology%20-%20Stuart%20Parsons.pdf Downloaded April 15, 2019..

[46] Boffa Miskell 2018a: Amberfield - Peacocke Structure Plan: terrestrial ecological assessment. Report prepared by Boffa Miskell for Weston Lea Ltd. https://www.hamilton.govt.nz/our-services/planningguidanceandresourceconsents/publicly-notified-applications/2018%20Document%20folder/Adare%20Application%20-%20Appendix%20G%20-%20Terrestrial%20Ecological%20Assessment%202018-05-15.PDF Downloaded 25 March 2019.

[47] Cummings G. 2019: Evidence in Chief of Georgia Thelma Rose Cummings for Weston Lea Limited, 12 April 2019. https://www.hamilton.govt.nz/our-services/planningguidanceandresourceconsents/publicly-notified-applications/2018%20Document%20folder/Adare%20P8%20Applicant%20Evidence%20-%20Bat%20Ecology%20-%20Georgia%20Cummings.pdf Downloaded April 15, 2019

[48] Cummings G. 2019: Evidence in Chief of Georgia Thelma Rose Cummings for Weston Lea Limited, 12 April 2019. https://www.hamilton.govt.nz/our-services/planningguidanceandresourceconsents/publicly-notified-applications/2018%20Document%20folder/Adare%20P8%20Applicant%20Evidence%20-%20Bat%20Ecology%20-%20Georgia%20Cummings.pdf Downloaded April 15, 2019

short-term glimpses into home range use. For example, bats were radio-tracked on average for three full nights and eight part-nights post-capture as part of the Southern Links project in southern Hamilton. Further, radio-tracking in that study showed that even adult and juvenile female bats captured in close proximity to multiple maternity roosts, at the Narrows, did not always use these areas as part of their core home ranges.[49]

49. Ms Cummings (Paragraph 40) goes onto suggest that "*With the exception of the single male bat roosting on the site, previous radio telemetry surveys have not identified the Amberfield site as core habitat for radio-tracked bats*." This statement is not supported given that the radio-tracking that has taken place provides only a snapshot of information about habitat and roost use by bats; and there is no evidence that the roosts present at the Amberfield site are solely used by one bat, as discussed above.

50. The Applicant has confirmed that there are multiple potential roosts present, in addition to those confirmed by radio-tracking.

51. Roosts outside of indigenous forest are considered to be relatively uncommon[50] because trees in managed landscapes less frequently reach the age and senescence generally required to become potential bat roosts. This is because long-tailed bats are often found using features such as within cavities or splits, or under decorticating (peeling or flaking) bark, and these features are usually not present within young vegetation. The majority of roosts found by Dekrout (2009) within Hamilton were under peeling bark. Whilst these were the roosts of adult males, and therefore considered unlikely to be maternity roosts Dekrout (2009) suggested that it was possible that these roosts were communal because emergence counts may underestimate the numbers of bats emerging[51]. Indeed, in other locations, such as in

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[49] Davidson-Watts I. 2018: Long-tailed bat trapping and radio tracking baseline report Southern Links, Hamilton. Report prepared for Aecom NZ Ltd

[50] Sedgeley J.A. and 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*: 261-276.

[51] Dekrout A.S. 2009: Monitoring New Zealand long-tailed bats (*Chalinolobus tuberculatus*) in urban habitats: ecology, physiology and genetics. *Unpublished PhD thesis*. University of Auckland, Auckland, New Zealand. 168 pp.

exotic plantation forest, maternity roosts have been located under the peeling or flaky bark of exotic trees.[52,53]

52. In locations with an abundance of roosts these appear to be re-used infrequently. For example within Fiordland's indigenous forest, 10.1% of roosts were re-used in the same summer.[54] This does not appear to be the case in other habitat types where roosts are uncommon. In the Hamilton area, Dekrout (2009) found that of the 11 bats she radio-tracked, all but two used only one roost throughout the entire radio-tracking period (5-19 days, and the remaining two used only two roosts)[55]. This pattern of high rates of re-use of roosts both within the same summer and between years, is supported by other research outside of indigenous forest where roosts are also uncommon (for example in exotic plantation forest[56]).

53. Dekrout (2009)[57] confirms that "*it is likely that each individual old tree is important* (Page 85)" to long-tailed bats because of the unexpectedly high fidelity (faithfulness) to individual trees as roosts. This finding is also supported by international research showing the importance of trees to urban bats[58].

54. Consequently, each known roost within the Hamilton area is likely to be of high value to the local bat population, and should therefore be protected.

55. The use of trees as roosts in this area should therefore not be considered "*opportunistic*", as suggested by both the Applicant[59] and also Mr Kessels in his evidence[60]. Mr Kessels understates the importance of the trees as roosts when he claims the trees do not "*appear to be used for roosting*". The trees <u>are</u> used as roosts, as

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52 Borkin K.M. and Parsons S. 2011: Sex-specific roost selection by bats in clearfell harvested plantation forest: improved knowledge advises management. *Acta Chiropterologica 13*(2): 373-383.

53 Borkin K.M. 2010: Ecology of New Zealand long-tailed bat (*Chalinolobus tuberculatus*) in exotic plantation forest. *Unpublished PhD thesis*. University of Auckland, Auckland, New Zealand. 172 pp.

54 O'Donnell C.F.J. and 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.

55 Dekrout A.S. 2009: Monitoring New Zealand long-tailed bats (*Chalinolobus tuberculatus*) in urban habitats: ecology, physiology and genetics. *Unpublished PhD thesis*. University of Auckland, Auckland, New Zealand. 168 pp.

56 Borkin K.M. 2010: Ecology of New Zealand long-tailed bat (*Chalinolobus tuberculatus*) in exotic plantation forest. *Unpublished PhD thesis*. University of Auckland, Auckland, New Zealand. 172 pp.

57 Dekrout A.S. 2009: Monitoring New Zealand long-tailed bats (*Chalinolobus tuberculatus*) in urban habitats: ecology, physiology and genetics. *Unpublished PhD thesis*. University of Auckland, Auckland, New Zealand. 168 pp.

58 Straka T.M., Wolf M., Gras P., Buchholz S., and Voigt C.C. 2019: Tree cover mediates the effect of artificial light on urban bats. Frontiers in Ecology and Evolution 7:91. doi: 10.3389/fevo.2019.00091

59 Boffa Miskell 2018a: Amberfield - Peacocke Structure Plan: Terrestrial Ecological Assessment. Report prepared by Boffa Miskell Limited for Weston Lea Ltd. 75 pp.

60 Kessels G. 2019: Statement of Evidence of Gerardus Henricus Anthonius Kessels, 2 April 2019 (downloaded from Hamilton City Council website 5 April 2019).

shown by the results of radio-tracking long-tailed bats at the Amberfield site.

56. Roosts used within the Hamilton area are largely within exotic trees, perhaps due to the scarcity of older indigenous trees. Species used include black locust/false acacia (*Robinia pseudoacacia*) and crack willow (*Salix fragilis*). Black locust is listed as an advisory plant under the Waikato Regional Pest Management Plan[61], and crack willow (*Salix fragilis*) is also included in the Pest Management Plan and is recommended for site-led management. Aspects of this Plan should be reconsidered. Any pest plant control that takes place throughout the Waikato Region should be carefully considered in terms of any potential benefits for bats associated with these species, which should be done on a case-by-case basis.

57. There are known roosts within the gully system to the south of the most southern rural balance lots that are mapped in Adare (2018)[62]. If this area is developed, it is likely that there will be adverse effects for bats using this area (shown in Attachments B and C of this evidence). This area, and the other balance lot shown in Adare (2018), is not included within the assessments provided by Boffa Miskell (2018a&b, 2019). This is presumably because of the advice provided by Hamilton City Council, as outlined by Adare (2018):

"The scheme plan of subdivision includes balance lots for land held within the same parent title as that being subdivided (Figure 1.1). It has been confirmed with HCC planning staff that a Master Plan and ICMP is not required to cover rural balance lots that will be created as a result of the subdivision proposal." (Adare 2018, Page 10).

Flight Patterns and Use of Habitat

58. Thermal imaging during the summers of 2017 and 2018 found that the majority of long-tailed bats seen flying through the Amberfield area were flying above canopy height, and were commuting.[63] Foraging

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61 Waikato Regional Council 2014: Waikato Regional Pest Management Plan 2014-2024. https://www.waikatoregion.govt.nz/assets/PageFiles/21542/3583%20-%20RPMP_2014-24.pdf 264 pp.

62 Adare 2018: Assessment of Environmental Effects Amberfield Application for subdivision and land use consents for development https://www.hamilton.govt.nz/our-services/planningguidanceandresourceconsents/publicly-notified-applications/2018%20Document%20folder/Adare%20F5%20-%20Application%20-%20Assessment%20of%20Environmental%20Effects.pdf Downloaded 25 March 2019.

63 Wildland Consultants 2018b: Thermal image monitoring of long-tailed bats for the Southern Links roading project in Hamilton: 2017 and 2018. *Wildland Consultants Ltd Contract Report No. 4192c*. Prepared for Aecom, New Zealand. 63 pp.

flights were also observed at this location in both years of monitoring, and these comprised 20% and 47% of all flights in 2017 and 2018, respectively.

59. At this location, bats were observed both crossing the river to and from Hammond Park, and traversing along the river-side vegetation (pers. obs.). In the majority of cases, these flights were above canopy height.

60. Radio-tracking in southern Hamilton found that core areas of bat home ranges were "*focussed on woodland/tree dominated habitats such as treelines, small copses, gully systems or the wooded margins of the Waikato Rive*r", and that bats also flew, and potentially foraged, over "*areas of pasture with scattered trees*"[64]. This highlights the value of trees, including individual trees, to bats in this landscape.

61. Long-tailed bats are most likely to be detected flying along edges, such as bush-pasture margins or streams.[65,66] Research recording bat activity along edges showed that young regenerating indigenous vegetation did not have as much bat activity as older, and taller, exotic forested areas.[67] Areas without trees (for example pasture) had the least activity. Consequently, older trees should be considered to be important for bats for commuting, foraging, and roosting.

62. It should be noted that whilst detection rates of long-tailed bat echolocation calls are low in open pasture compared to other habitats, radio-tracking in southern Hamilton has found bats both foraging and commuting over open pasture[68]. It is likely that if open pasture habitats are lost, then activity rates will decrease due to concomitant increases in effects related to urbanisation (see below for further discussion).

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64 Davidson-Watts I. 2018: Long-tailed Bat Trapping and Radio Tracking Baseline Report Southern Links, Hamilton. Report prepared for AECOM NZ Ltd. Page 15

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

66 O'Donnell C.F.J., Christie J.E., and Simpson W. 2006: Habitat use and nocturnal activity of lesser short-tailed bats (*Mystacina tuberculata*) in comparison with long-tailed bats (*Chalinolobus tuberculatus*) in temperate rainforest. New Zealand. *Journal of Zoology 33*(2): 113-124.

67 Borkin K.M. 2010: Ecology of New Zealand long-tailed bat (*Chalinolobus tuberculatus*) in exotic plantation forest. *Unpublished PhD thesis*. University of Auckland, Auckland, New Zealand. 172 pp.

68 Davidson-Watts I. 2018: Long-tailed Bat Trapping and Radio Tracking Baseline Report Southern Links, Hamilton. Report prepared for AECOM NZ Ltd

Evidence for Potential Effects on Bats

Roading Networks and Traffic

63. The proposed development will result in an increase in roads, and traffic during the night. This is likely to result in serious adverse effects on long-tailed bats. Long-tailed bat activity decreases with increases in overnight traffic[69]. A Hamilton-wide bat survey showed that bat activity decreased by 86% when road density increased slightly from their lowest recorded density[70]. There is a significant negative relationship between the presence of a road and bat activity in the southern Hamilton area, which suggests that there is an already existing effect of roads on bat activity at these sites[71].

64. This means that whilst there is the possibility that bats will continue to use areas that have increases in roading networks and traffic, it is likely that use would be reduced significantly.

65. Installation of tall plantings close to either side of roads may reduce the likelihood of collisions between bats and vehicles. This is only likely to be effective, however, if gaps in the vegetation above the road are small, lighting is minimised, and plantings align with previously-identified bat flight paths.[72]

Lighting

66. The potential adverse effect of light on long-tailed bats is likely to have been understated by the Applicant. This is because there is no estimate of the likely total increases in light, including that by individual home owners, against which to determine the likelihood of mitigation being successful.

67. Whilst the classification of long-tailed bats as light-sensitive is not definitive, a growing body of New Zealand-based research suggests

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69 Smith D., Borkin K., Jones C., Lindberg S., Davies F., and Eccles G. 2017: Effects of land transport activities on New Zealand's endemic bat populations: reviews of ecological and regulatory literature. Appendix C: The relationship between traffic intensity and long-tailed bat activity along New Zealand highways. *NZ Transport Agency Research Report 623*. Pp 146-159.

70 Le Roux D.S. and Le Roux N.S. 2012: Hamilton City Bat Survey 2011-2012. Report prepared by Kessels & Associates Ltd for Project Echo (project partners: Waikato Regional Council, The University of Waikato, Hamilton City Council, Department of Conservation, Waikato Tree Trust). 22 pp. Document Ref: \\server files\Hamilton City Council\Bat survey city wide\city wide survey report_240512.

71 Wildland Consultants 2018a: Baseline acoustic monitoring of long-tailed bats for the Southern Links roading project, Hamilton: 2017 and 2018. *Wildland Consultants Ltd Contract Report No. 4192d*. Prepared for Aecom, New Zealand. 37 pp.

72 Smith D., Borkin K., Jones C., Lindberg S., Davies F., and Eccles G. 2017: Effects of land transport activities on New Zealand's endemic bat populations: reviews of ecological and regulatory literature. *NZ Transport Agency Research Report 623*. 249 pp.

that this may be the case. Research into the effect of light on the southern Hamilton bat population found that as light increased, bat activity decreased[73]. Wildland Consultants (2018a) found that at sites in peri-urban southern Hamilton where mean lux (light) were above 1.0, there was little or low bat activity, whilst from 0.5-0 lux there was a tapered increase in bat activity. This is supported by a Hamilton-wide bat survey that found bat activity to be lower where street light density is higher; bat activity decreased by 72% when street light density increased slightly from their lowest recorded density[74]. Modelling by Crewther and Parsons (2017) also suggests that the probability of the presence of long-tailed bats in Hamilton increases with distance from street lights (from 0-100 metres)[75].

68. Increasing light at a given site may therefore result in less use of that site by long-tailed bats.

69. Zeale *et al.* (2018; Page 1)[76] noted that it is "essential to preserve dark corridors to mitigate the impacts of artificial light at night on bat activity and movements."

70. Azam *et al*. (2018; Page123)[77] investigated the effect of lighting on bat activity in France and recommended "separating street lights from ecological corridors by at least 50 m and avoiding vertical light trespass beyond 0.1 lux to ensure their use by light-sensitive bats".

71. Consequently, any proposed buffer for lighting should be conservative, and should provide a greater than 50 metre buffer between lighting and habitat likely to be used by long-tailed bats. Any buffer created by planting is unlikely to be effective for many years, and a short-term approach, such as using artificial buffers, should be implemented in tandem with a long-term planting approach.

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[73] Wildland Consultants 2018a: Baseline acoustic monitoring of long-tailed bats for the Southern Links roading project, Hamilton: 2017 and 2018. *Wildland Consultants Ltd Contract Report No. 4192d*. Prepared for Aecom, New Zealand. 37 pp.

[74] Le Roux D.S. and Le Roux N.S. 2012: Hamilton City Bat Survey 2011-2012. Report prepared by Kessels & Associates Ltd for Project Echo (project partners: Waikato Regional Council, The University of Waikato, Hamilton City Council, Department of Conservation, Waikato Tree Trust). 22 pp. Document Ref: \\server files\Hamilton City Council\Bat survey city wide\city wide survey report_240512.

[75] Crewther K. and Parsons S. 2017: Predictive modelling of long-tailed bat distribution in the Hamilton area. Walkingbats Consultancy report prepared for Project Echo (a collaboration between Hamilton City Council, Department of Conservation, Waikato Regional Council, and Riverlea Environment Society Inc.).

[76] Zeale M.R.K., Stone E.L., Zeale E., Browne W.J., Harris S., and Jones G. 2018: Experimentally manipulating light spectra reveals the importance of dark corridors for commuting bats. Global Change Biology 1-10. DOI: 10.1111/gcb.14462

[77] Azam C., Le Viol I., Basa Y., Zissis G., Vernet A., Julien J-F., Kerbiriou C. 2018: Evidence for distance and illuminance thresholds in the effects of artificial lighting on bat activity. Landscape and Urban Planning 175: 123-135

72. Other methods of managing the effects of lighting should also be considered. Straka *et al.* (2019)[78] recommend the following:
    - Avoiding and minimising light in areas close to trees
    - Avoiding light in areas of high habitat quality
    - Adding dense vegetation to highly lit areas to buffer effects, and
    - Turning off lights when the area is not in use.

73. With the current lighting proposed, and the lack of detail provided, it is unclear what light levels are likely to occur and whether the proposed mitigation will be effective at maintaining bat activity levels.

Noise

74. Recent research in southern Hamilton has found no clear relationship between long-tailed bat activity and noise[79]. A study into long-tailed bat activity at a site near Hamilton Airport found that, in comparison with pre-aircraft rates, echolocation rates were reduced when aircraft passed overhead and for a short time afterwards. However, these differences were not statistically significant. The authors did note that their sample sizes were very small[80], so any differences could be obscured.

75. Consequently, the relationship between noise and long-tailed bat activity is not clear and a precautionary approach would be prudent.

Potential Population-Level Effects

76. Potential population-level effects may include a reduction in colony size due to tree felling. This may occur because colony sizes of long-tailed bats have been found to be smaller in areas where logging of exotic plantation forest has recently occurred, compared with areas where logging is less recent.[81]

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78 Straka T.M., Wolf M., Gras P., Buchholz S., and Voigt C.C. 2019: Tree cover mediates the effect of artificial light on urban bats. *Frontiers in Ecology and Evolution 7:91. doi: 10.3389/fevo.2019.00091*

79 Wildland Consultants 2018a: Baseline acoustic monitoring of long-tailed bats for the Southern Links roading project, Hamilton: 2017 and 2018. *Wildland Consultants Ltd Contract Report No. 4192d*. Prepared for Aecom, New Zealand. 37 pp.

80 Le Roux D. S., Waas J. R. 2012. Do long-tailed bats alter their evening activity in response to aircraft noise? *Acta Chiropterologica 14*(1): 111–120.

81 Borkin K.M., O'Donnell C.F.J., and Parsons S. 2011: Bat colony size reduction coincides with clear-fell harvest operations and high rates of roost loss in plantation forest. *Biodiversity and Conservation 20*(14): 3537-3548.

77. Following tree felling, bats also used fewer roosts[82] and had smaller home ranges[83] than those bats in areas that had not had trees felled recently.

78. Therefore, the opinion of Ms Cummings (Paragraph 47) that "*the removal of a known, and potentially undiscovered, solitary roosts will adversely affect individual bats but will not have adverse effects at the population level*." is not supported.

Potential Residual Effects, and How These May be Managed

79. Whilst avoiding effects on long-tailed bats would be the best option for the local bat population, under the current proposal there are likely to be residual adverse effects, as discussed below.

80. The development of Amberfield as an urban area, with concomitant increases in roading, overnight traffic, and lighting, and, at least in the short-term, decreases in tree cover, may result in a smaller long-tailed bat population that has access to fewer roosts and has smaller home ranges. The home ranges of individual bats will be affected. Fragmentation of the wider population is likely to be increased by the effects of urbanisation, including increases in light, roading, and overnight traffic and decreases in the vegetation that they fly along and use as roosts. So, it is likely that post-mitigation efforts there will be residual adverse effects.

Conclusion

81. It is uncertain whether the mitigation and compensation proposed by the Applicant is adequate to protect the long-tailed bat population in this area, and whether bats will continue to use the area in a similar way to that currently. This is because:

    - There is no evidence to document or support the likely effectiveness of most of the mitigation measures proposed for

[82] Borkin K.M., O'Donnell C.F.J., and Parsons S. 2011: Bat colony size reduction coincides with clear-fell harvest operations and high rates of roost loss in plantation forest. *Biodiversity and Conservation 20*(14): 3537-3548.

[83] Borkin K.M. and Parsons S. 2014: Effects of clear-fell harvest on bat home range. *PLoS ONE 9*(1): e86163 doi:10.1371/journal.pone.0086163

bats, i.e. investigations have not been undertaken to evaluate their effectiveness[84] .

- The compensation measures proposed appear to rely on other parties for both direction and implementation.

82. Consequently, even with the mitigation proposed there may still be significant adverse residual effects on long-tailed bats. Most of the mitigation measures proposed should therefore be considered to be relatively experimental and will need to be monitored in a manner that addresses this lack of certainty.

Kerry Maree Borkin

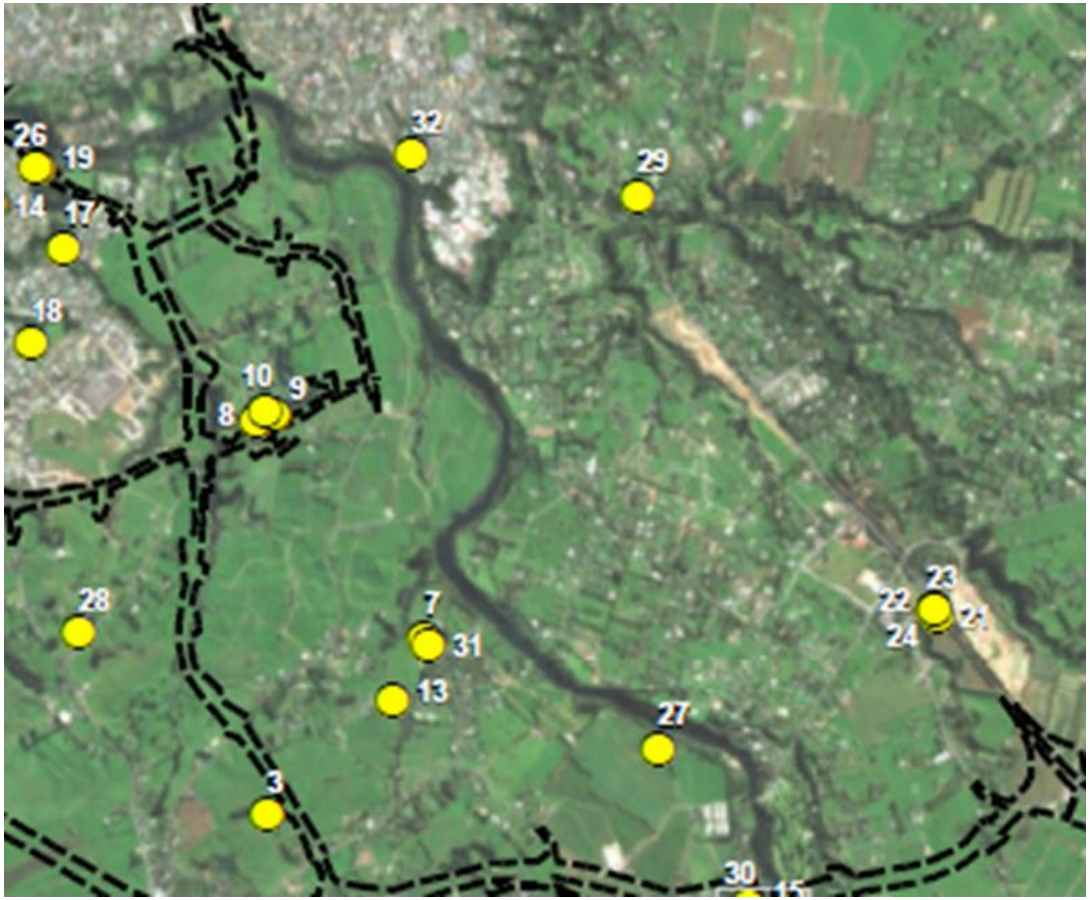
DATE: 23 April 2019

[84] Smith D., Borkin K., Jones C., Lindberg S., Davies F., and Eccles G. 2017a: Effects of land transport activities on New Zealand's endemic bat populations: reviews of ecological and regulatory literature. *NZ Transport Agency Research Report 623*. 249 pp.

ATTACHMENT A

Approximate thermal imaging site at Hammond Park, Hamilton, with approximate direction of field of view. Thermal imaging took place at a site immediately across the river from Amberfield, looking in the direction as shown approximately in Attachment 1. Long-tailed bats were recorded frequently, both crossing the river and traversing the Amberfield site.

ATTACHMENT B



Roosts (yellow dots 7, 31, and 13) found during capture and radio-tracking of long-tailed bats in the area immediately adjacent to the southern-most rural balance lot. These roosts may be adversely affected if this area is developed. Image from Aecom 201985.

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85 Aecom 2019: Letter to Nathanael Savage Hamilton City Council: Bat roosts identified during radio tracking completed in January, March and December 2018 Aecom Reference: \\nzham1fp001.au.aecomnet.com\projects\601x\60164546\4. tech work area\4.25 nzta emmp\7.0 reports_final\bat roost data issued\ltr bat roosts sites identified during radio tracking.docx

ATTACHMENT C

Southern rural balance lot Amberfield from Adare (2018)86. Known long-tailed bat roosts are located within the Nukuhau Gully system, as shown in Attachment B above. Nukuhau gully system provides a key habitat linkage to the Waikato River for the local long-tailed bat population as shown by Davidson-Watts 201887.

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86 Adare 2018: Assessment of Environmental Effects Amberfield Application for subdivision and land use consents for development https://www.hamilton.govt.nz/our-services/planningguidanceandresourceconsents/publicly-notified-applications/2018%20Document%20folder/Adare%20F5%20-%20Application%20-%20Assessment%20of%20Environmental%20Effects.pdf Downloaded 25 March 2019.

87 Davidson-Watts I. 2018: Long-tailed Bat Trapping and Radio Tracking Baseline Report Southern Links, Hamilton. Report prepared for AECOM NZ Ltd

ATTACHMENT D

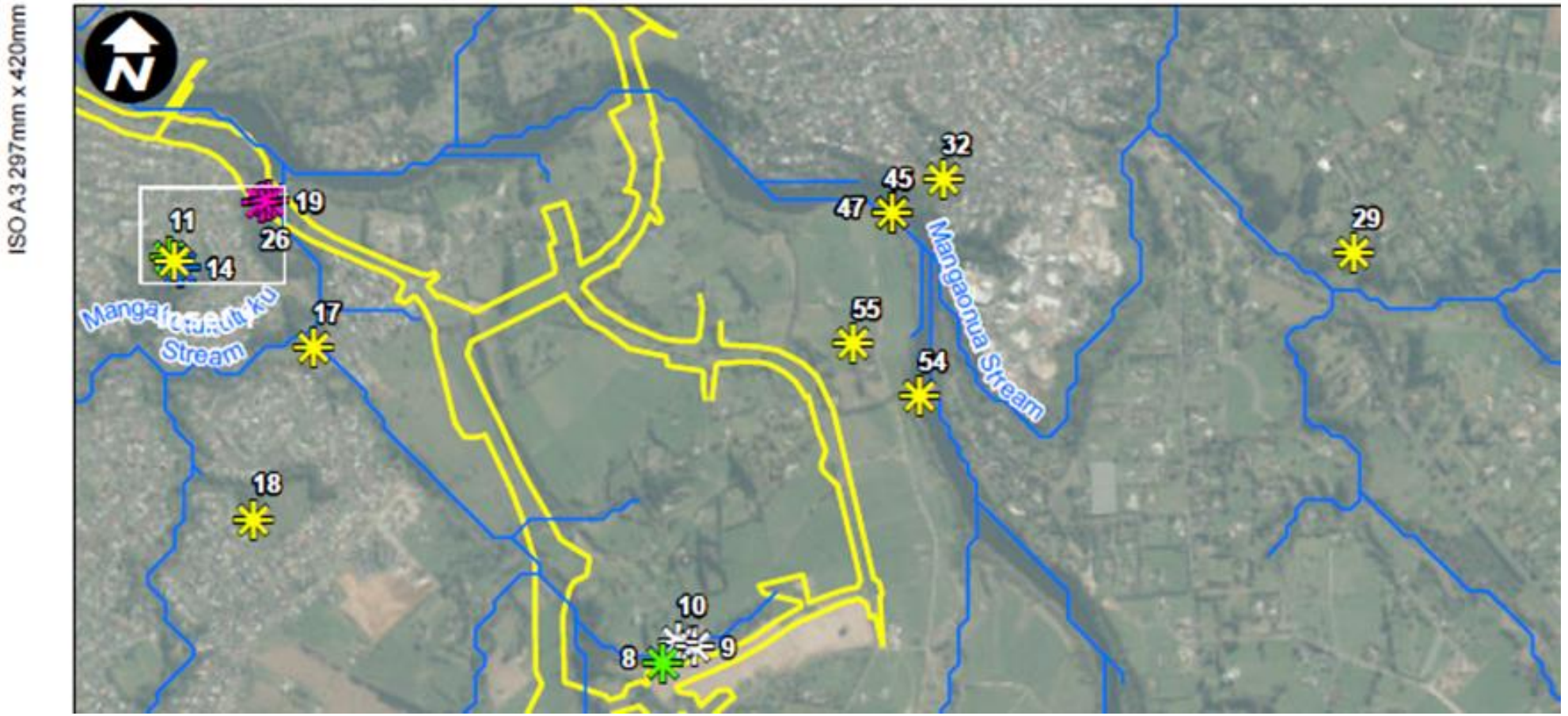

Figure D1: Roosts found at 10A and surrounding areas (contains errors). Yellow asterisks indicate the location of day roosts; pink asterisks are night roosts; green asterisks are maternity roosts; blue asterisks are maternity and day roosts; and white asterisks indicate roosts considered to be potential maternity roosts.

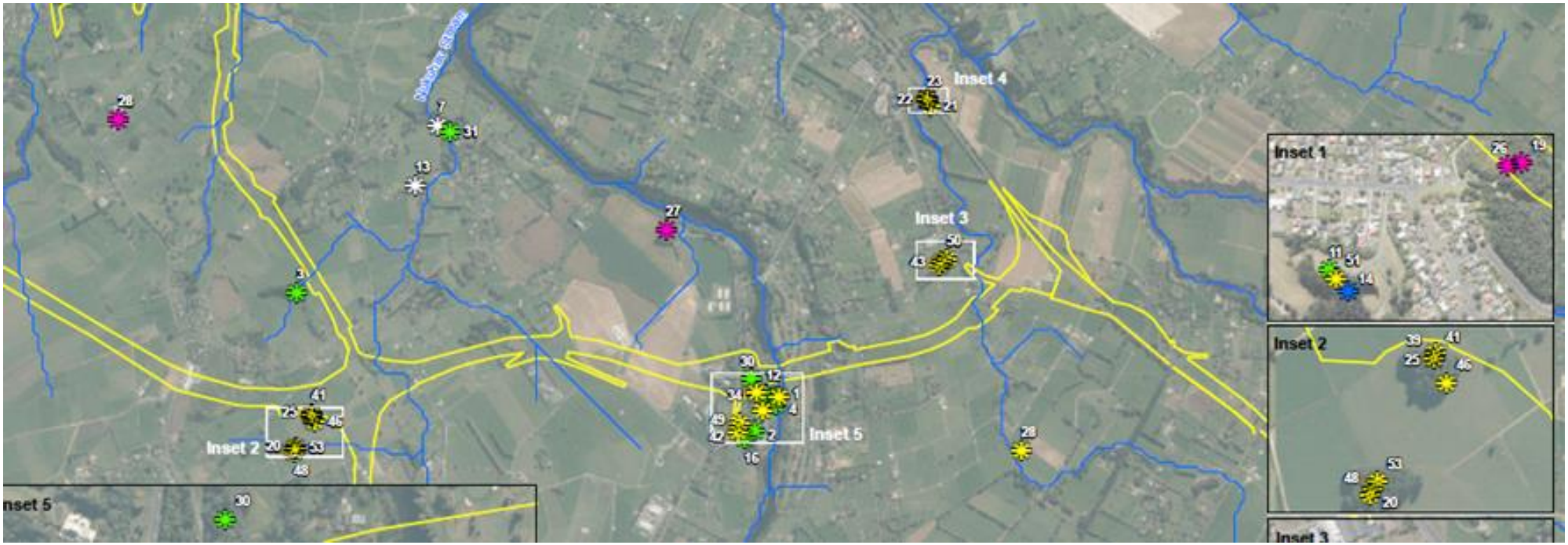

Figure D2: Roosts found at 10A and surrounding areas (contains errors). Yellow asterisks indicate the location of day roosts; pink asterisks are night roosts; green asterisks are maternity roosts; blue asterisks are maternity and day roosts; and white asterisks indicate roosts considered to be potential maternity roosts.