

**BEFORE INDEPENDENT HEARING COMMISSIONERS
APPOINTED BY THE HAMILTON CITY COUNCIL**

IN THE MATTER of the Resource Management Act 1991 (**Act**)
AND

IN THE MATTER of an application for subdivision and land use
consent for the Amberfield development
pursuant to the Act.

APPLICANT Weston Lea Limited

CONSENT AUTHORITY Hamilton City Council

**EVIDENCE-IN-CHIEF OF GEORGIA THELMA ROSE CUMMINGS
FOR WESTON LEA LIMITED**

Dated: 12 April 2019

Solicitors on Record

WYNN WILLIAMS LAWYERS
SOLICITOR — LUCY DE LATOUR

PO Box 4341, Christchurch 8140
P 03 379 7622 F 03 379 2467 E lucy.delatour@wynnwilliams.co.nz

Counsel

R A MAKGILL
BARRISTER

PO Box 77-037, Mt Albert, Auckland 1350
P 09 815 6750 E robert@robertmakgill.com

SUMMARY OF EVIDENCE

1. My name is Georgia Thelma Rose Cummings and I am a terrestrial ecologist and bat specialist. I summarise my evidence, according to the key headings in this statement, as follows:

Site Context

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- (a) The site is adjacent to the Waikato River, an important foraging and dispersal corridor for long-tailed bats. The site is also located between other landscape features considered important to the long-tailed bat population including maternity roosting sites.
- (b) Long-tailed bats use linear features as movement corridors. The site comprises pasture interspersed with patches of exotic trees, a partially vegetated minor gully, a degraded riparian margin. I do not consider the habitat features existing on the site are high quality. Yet the current (undeveloped) land-use of the site enables bats to disperse along the Waikato River and through some parts of the site that are suitable for navigation to important habitat features in the surrounding landscape.
- (c) The site is within the Peacocke Structure Plan area (**PSPA**) which contains a mosaic of habitat features that the bats forage, roost and disperse along.
- (d) Given the zoning of the PSPA for urbanisation, the impacts of the Amberfield development cannot be viewed in isolation of the future development of the PSPA and ancillary infrastructure upgrades such as the Southern Links project.

Long-tailed bat ecology

(Page 10)

- (e) I have summarised the key points of long-tailed bat ecology relevant to the potential effects of the development including:
 - (a) Long-tailed bats sensitivity to anthropogenic disturbance; and
 - (b) Roosting, foraging and dispersal behaviour.

Survey and assessment methodology*(Page 12)*

- (f) I used desktop analyses and site investigations to complete the ecological assessment for long-tailed bats. Acoustic surveys were used to determine activity at representative landscape features across the site which informed an assessment of the relative value of differing features to long-tailed bats. The assessment of values was used to determine the level of effects as per the EIANZ (2018) Ecological Impact Assessment guidelines.

Existing long-tailed bat values on the proposed development site*(Page 12)*

- (g) Bat activity was recorded across all habitats surveyed including open pasture close to individual trees. However, there were notable differences between activity levels with the highest activity being recorded along the E-W shelterbelt and the Waikato River Margin.
- (h) Activity along the E-W shelterbelt suggests the shelterbelt is part of a corridor that bats use to disperse between core habitats: the Waikato River and the Mangakotukutuku Gully.
- (i) The very low activity over open pasture supports previous findings that long-tailed bats prefer edge habitats and I consider the open pasture is of low value to bats.
- (j) Other features were used on site, but activity levels were low. I consider the discovery of a solitary male bat roosting in three mature exotic trees on, or adjacent to, the proposed development site means that the mature exotic vegetation on the site has potential to be important to individual bats.

Effects of the proposed development on long-tailed bats*(Page 15)*

- (k) The development of the site will result in the permanent removal of 2.6 ha of trees of varying ages. This includes the removal of a single known solitary male roost..

- (l) I do not consider the removal of open pasture will have an adverse effect on bats. Though the land use change will result in anthropogenic disturbance of the on adjacent habitat being retained onsite, as well as the adjacent Waikato River **if unmitigated**.
- (m) The direct removal of mature vegetation as well as potential disturbance of both onsite and offsite habitat features could have very high adverse effects on bats **if unmitigated**.

Proposed mitigation

(Page 17)

- (n) Proposed mitigation includes the provision of 18.5 ha of planting within the site designed to provide high-quality bat habitat in the medium to long term. The quantum of mitigation above also includes planting vegetative buffers to protect retained features from disturbance associated with the adjacent housing.
- (o) Restoration and enhancement are planned in four key areas that currently comprise pasture or degraded gully:
 - (a) The north-east (NE) terrace opposite Hammond Bush;
 - (b) Extending/ buffering the existing riparian margin of the site;
 - (c) The minor gully in the south of the site; and
 - (d) The east-west (E-W) shelterbelt.
- (p) The time lag between the buffer planting becoming effective has been minimised as far as possible through early planting and delaying building development along the riverside portion of the development until the planting has reached appropriate height and density (proposed Condition 87 in Mr Serjeant's evidence).
- (q) I consider that implementation of Condition 91(b) will adequately mitigate for the removal of a single solitary roost on site and potential removal of undiscovered roosts, if any are subsequently discovered.
- (r) City wide surveys indicate that long-tailed bats are sensitive to urbanisation and avoid the more developed areas of Hamilton. Yet,

more recent and detailed radio telemetry surveys show bats extensively using green spaces adjacent to medium density housing provided that the area has connectivity to the Waikato River (either directly or via vegetated gullies). Given the location of the site adjacent to the Waikato River, I consider that bats will continue to use the retained and enhanced features of the site as is observed in the wider landscape. However, there are no scientific studies exploring how bats respond to urbanisation - on a site by site basis - and I acknowledge there is uncertainty given the scale of the development. Conditions 93-95 respond to this uncertainty through the implementation of a robust monitoring programme and adaptive management, and offset mitigation, if the monitoring demonstrates such initiatives are required.

Issues raised in submissions

(Page 21)

- (s) Extensive changes have been made to the mitigation package compared to what was presented at lodgement. I consider these changes have addressed the majority of matters raised in submissions about effects on long-tailed bats.
- (t) Points of disagreement with regards to potential effects and the quantum of mitigation that is considered appropriate have been further addressed individually.
- (u) I also address key points of agreement and disagreement I have with Dr Stirnemann's evidence which was included as an Appendix B of the RESI submission.

Issues raised in the Section 42A report

(Page 24)

- (v) The primary issue raised by Mr Kessels in the s 42A report is the consideration that the time lag between effects and mitigation have not been addressed and that residual effects remain which should be offset or compensated offsite.
- (w) I disagree with Mr Kessels' view and consider that the temporary effects caused by the time lag have been minimised and will not result in a residual effect on the long-tailed bat population.

- (x) I consider that the proposed quantum of restoration, in combination with proposed staging, lighting and development deferral conditions adequately addresses both the permeant removal of a small amount of vegetation on site **and** the potential temporary disruption to the use of habitat features being retained onsite. I do not consider there any residual effects that will need to be offset or compensated.
- (y) Given the finding of a solitary roost in the proposed development area I do agree with Mr Kessel's recommendation of the installation of artificial roosts, as required under Condition 91(b), in the existing riparian margin. If additional solitary roosts are identified in the proposed development extent, then pest control in addition to supply of artificial roosts would be appropriate mitigation.

Conclusion

(Page 25)

- (z) I consider that the proposed mitigation will avoid anthropogenic disturbance adversely affecting bats using the Waikato River corridor and facilitate continued dispersal along the E-W shelterbelt.
- (aa) I consider that the removal of 2.6 ha of trees of varying maturity, and the temporary disturbance to bat habitat being retained on site is adequately mitigated through the restoration of 18.5 ha of habitat.
- (bb) I consider that implementation of Condition 91(b) will adequately mitigate for the removal of a single solitary roost on site and potential removal of undiscovered roosts. I consider onsite pest control would be appropriate mitigation if more solitary roosts are removed because of the proposed development.
- (cc) I consider the implementation of a robust monitoring programme and the triggering of adaptive management and/or offset (if required) accounts for the uncertainty as to whether bats will continue to utilise the habitat features retained and enhanced on the site to the same extent once the area is developed.

INTRODUCTION

2. My name is Georgia Thelma Rose Cummings.

Qualifications and experience

3. I am a senior ecologist and bat specialist at Boffa Miskell Limited (Boffa Miskell) in Auckland, a national firm of consulting planners, ecologists and landscape architects. 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 short-tailed bat (*Mystacina tuberculata*), and its spatial ecology and pollination services in Pureora Forest in the central North Island.
4. I have published two peer-reviewed scientific papers; both focused on the endemic short-tailed bat.
5. I have been an ecological consultant for over 5 years, providing consultancy services for a wide range of clients around New Zealand, including local authorities, land developers, and the infrastructure and power sectors.
6. My 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 also 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 and Warkworth to Wellsford: the second section of the Ara Tūhono – Pūhoi to Wellsford road of national significance.

7. I have been certified by the Department of Conservation (**DOC**) as a class A, B, C1, C2, and D bat ecologist. These certifications reflect competency in: deploying acoustic bat monitors (ABM), analysing ABM data, identifying short-tailed bat and long-tailed bat roosts, and capturing and handling bats.

Involvement in the proposed development

8. I have been retained by Weston Lea Limited to prepare a statement of evidence on its application for land use and subdivision consent from the Hamilton City Council for the Amberfield development (**proposed development**).
9. My role in the proposed development has been to assess the habitat value of the site for long-tailed bats, and the potential effects of the proposed development on long-tailed bats. In addition, I have provided recommendations to mitigate potential adverse effects.
10. I am familiar with the application site and surrounding environment. I have visited the site on four occasions including site walkovers and to undertake acoustic bat surveys, and I am familiar with key bat habitats in the vicinity of the site through literature review and discussions with Hamilton-based bat ecologists.
11. In preparing this evidence I have read the following documents:
 - (a) Statement of evidence prepared by Dr Stuart Parson;
 - (b) Statement of evidence prepared by Mr Andrew Blayney;
 - (c) Statement of evidence prepared by Ms Rachel de Lambert;
 - (d) Submissions, including the statement of evidence prepared by Ms Rebecca Liv Stirnemann attached to the submission of Riverlea Environment Society Inc (**RESI**); and
 - (e) Council officer's report, including Mr Gerry Kessels Evidence in Chief included as Appendix E.

CODE OF CONDUCT

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

SITE CONTEXT

12. The proposed development site covers 105 ha. It primarily comprises open pasture interspersed with exotic amenity trees and shelterbelts. There are patches of native trees associated with the minor gully and the riparian margin of the Waikato River which forms the eastern margin of the site.
13. The proposed development is located on the western margin of the Waikato River, across the river from Hammond Bush. The Mangakotukutuku gully is located approximately 1 km to the west (see Figure 1 in Appendix 1).
14. The Waikato River, Hammond Bush, and the Mangakotukutuku gully are important landscape features for the long-tailed bat population. The former being an important commuting and foraging corridor while the latter two also provide high-quality foraging habitat and contain maternity roosts.
15. The development site forms part of the Peacocke Structure Plan Area (**PSPA**), an area covering 720 ha zoned for future urban development. The Amberfield development covers 15% of the PSPA.
16. The PSPA stretches from beyond the western margin of the Mangakotukutuku Gully to the margin of the Waikato River, as shown on Figure 1 attached under **Annexure "A"**. Once the development of the PSPA is completed, it will contribute to large scale urbanisation across a landscape that is currently used by the long-tailed bat population. The PSPA area is an important area because features of the semi-rural landscape allow the movement of bats between the three important habitat features described above:
 - (a) Hammonds Bush;

- (b) Waikato River: and
- (c) Mangakotukutuku Gully.

LONG-TAILED BAT ECOLOGY

17. Long-tailed bats are classified as Threatened – Nationally Critical¹ due to habitat degradation and loss, and predation from introduced predators.
18. Long-tailed bats are nocturnal and are sensitive to anthropogenic disturbance. Previous research on the Hamilton population has demonstrated that the bats are largely constrained to the southern rural-urban fringe of the city, and that bats avoid areas with increased anthropogenic disturbance associated with urbanisation^{2,3}.
19. It is unclear what aspect(s) of anthropogenic disturbance the bats are avoiding as there has been little scientific investigation beyond the negative correlation of long-tailed bat activity with increasing housing, road, and street light density⁴.
20. Experimental studies on other bat species, and research undertaken on the Hamilton bat population⁵, suggest that along with direct removal of habitat, increased ambient light effects bat activity. Anthropogenic noise does not appear to significantly alter long-tailed bat activity or other bats with similar ecomorphological characteristics⁶ studied overseas⁷.

¹ O'Donnell et al., (2018). The conservation status of New Zealand bats. Department of Conservation. Wellington, NZ.

² Kessels Ecology (2017). Hamilton City Long-tailed Bat Survey 2016-2017; Kessels Ecology (2012). Hamilton City Long-tailed Bat Survey 2011-2012; Dekrout (2009). Monitoring New Zealand long-tailed bats (*Chalinolobus tuberculatus*) in urban habitats: ecology, physiology and genetics. Unpublished PhD thesis, University of Auckland.

³ Dekrout (2009). Chapter 2 "The Distribution of Chalinolobus Tuberculatus in the City of Hamilton New Zealand". In Monitoring New Zealand long-tailed bats (*Chalinolobus tuberculatus*) in urban habitats: ecology, physiology and genetics. Unpublished PhD thesis, University of Auckland.

⁴ Kessels Ecology (2012). Hamilton City Long-tailed Bat Survey 2011-2012

⁵ Le Roux & Waas (2012). Do Long-Tailed Bats Alter Their Evening Activity in Response to Aircraft Noise? *Acta Chiropterologica*, 14(1), 111-120.

⁶ 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.

⁷ Bunkley et al., (2015). Anthropogenic noise alters bat activity levels and echolocation calls. *Global Ecology and Conservation*, 3, 62-71.

21. Long-tailed bats are also highly mobile and move between roost sites and foraging grounds which are often kilometres apart.
22. The Hamilton population has been able to persist in the southern outskirts of Hamilton City due to the topography of the area⁸. Hamilton contains a network of incised gully systems that surround the tributaries of the Waikato River. These gullies provide a network of vegetated, dark, corridors that are naturally buffered from the majority of the surrounding light spill due to their topography. The Waikato River and the gullies facilitate the dispersal of bats through a modified landscape to access distant habitat features.
23. High quality “maternity roost” trees used for breeding are a limiting resource for all long-tailed bats populations due to the specific thermal requirements necessary for high quality roosts⁹. Long-tailed bats generally select the oldest, largest trees available as maternity roosts,¹⁰ in both natural and modified environments.
24. Outside of the breeding season long-tailed bats roost solitarily in a broader range of trees and other structures. Solitary roosts do not require the same thermal properties as maternity roosts and trees with appropriate characteristics are less limited in the landscape compared to maternity roosts.
25. Long-tailed bats move roosts on a regular, often nightly basis. This has also been demonstrated in a rural landscape where the availability of roost trees is more limited compared to forested environments¹¹.
26. Long-tailed bats are edge specialists. They are adapted to forage along edges and above vegetation canopies. They use linear landscape features as movement corridors, notably the Waikato River and its tributaries in Hamilton.

⁸ Dekrout (2009). Chapter 2 “The Distribution of *Chalinolobus Tuberculatus* in the City of Hamilton New Zealand”. In *Monitoring New Zealand long-tailed bats (Chalinolobus tuberculatus) in urban habitats: ecology, physiology and genetics*. Unpublished PhD thesis, University of Auckland.

⁹ Sedgely, 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.

¹⁰ Also referred to as a breeding roost or a maternity roost. Roosts where female bats congregate to give birth and raise pups before they are old enough to fly.

¹¹ Sedgely & O'Donnell. (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.

However, recent research has demonstrated that bats will also disperse across open agricultural land.¹²

SURVEY AND ASSESSMENT METHODOLOGY

27. My assessment methodology included both literature review and field surveys over two seasons. A detailed summary of the methodology I employed is attached as **Annexure “B”**.

EXISTING LONG-TAILED BAT VALUES ONSITE

Bat activity in relation to different habitats

28. Results of the acoustic survey identified that:
- (a) Acoustic recorders detected bat activity across the proposed development site at multiple features (see **Annexure “C”** for acoustic survey results).
 - (b) Bats were detected around shelterbelts, exotic specimen trees, the partly vegetated minor gully, open pastureland with single trees, the inland riparian margin, and the margin of the Waikato River.
 - (c) Long-tailed bats preferentially move along the Waikato River corridor compared to the inland riparian margin within the site.
 - (d) Within the site, bats focus activity along the margins of vegetated features, particularly the shelterbelts, and the riparian bush margin and the partly-vegetated minor gully to a lesser extent.
 - (e) With the exception of the Waikato River margin and the linear shelterbelt features, I consider the activity across the other vegetated features is low, averaging less than two echolocation calls per night over both survey periods.

¹²

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

- (f) Activity levels in the open pastureland was lowest with units placed in open pasture averaging 0.56 echolocation calls per unit per night over both survey periods.
- (g) The most frequent activity was recorded along the shelterbelt that traverses the site east to west (henceforth referred to as the **E-W shelterbelt**) compared to other onsite habitats surveyed.¹³ I also recorded activity along the shelterbelt corridor extending west beyond the site towards the Mangakotukutuku Gully (see Figure 1 under **Annexure “C”**).
- (h) I consider that the higher activity levels along the E-W shelterbelt indicate that this shelterbelt is used as a commuting corridor / flyway for bats moving between the Waikato River and the middle reaches of the eastern branch of the Mangakotukutuku gully.

Bat roost assessment

- 29. Potential roost trees were identified within the site during the visual roost assessment and consequently the activity recorded on site indicates that bats may roost solitarily in these trees.
- 30. Radio telemetry surveys have been undertaken on the Hamilton long-tailed bat population¹⁴. The most recent of these studies being undertaken as part of the Southern Links Project¹⁵. As a result of the more recent studies 55 roosts have been identified¹⁶.
- 31. A single adult male was observed roosting in three different trees on, or adjacent to the proposed development site. Two of these trees are in the riparian vegetation on the margin of Waikato River and will not be impacted by the proposed works. The third roost is in the proposed development extent.

¹³ Note this excludes the river margin survey locations which is considered offsite habitat.

¹⁴ Dekrout, A. (2009). Monitoring New Zealand long-tailed bats (*Chalinolobus tuberculatus*) in urban habitats: ecology, physiology and genetics. Unpublished PhD thesis, University of Auckland – see Chapter 3.

¹⁵ Davidson-watts Ecology Ltd. (2018). Long-tailed Bat Trapping and Radio Tracking Baseline Report Southern Links, Hamilton. Prepared for AECOM.

¹⁶ Four of the roosts identified are night roosts, trees used between foraging bouts during a bat's evening activity but not used as shelter during the day.

Refer to roosts 45, 54 – 55 in Figure 2 (provided by AECOM) in Appendix 1 of my evidence.

32. There is no evidence that maternity roosts are located on the proposed development site. 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 date¹⁷.

Summary of bat values

33. Notwithstanding the finding of a single bat roosting solitarily on the site, it is my opinion that the value of the site for the bat population is its location relative to important habitats including Hammond Park, the Waikato River, the Mangakotukutuku Gully.
34. The E-W shelterbelt is part of an important, but not the only¹⁸, vegetated corridor that facilitates movement between the key habitats above which are located east and west of the site.
35. Bats were active around other vegetated features of the site but to a lesser extent. I consider the riparian margin important as it provides a buffer to the Waikato River. I consider the minor gully is important as its topography provides an opportunity for restoration to a high-quality habitat feature which could act as an important E-W movement corridor in the future.
36. I consider solitary roost trees to be important to individual bats, particularly in modified environments where the availability of mature trees is more limited.
37. Pasture is the dominant land use in the site with patches of tall stature trees and linear shelterbelt features (Figure 1 in Annexure “A”). The bat activity across different features of the site suggest that open pasture is of low value to bats.

¹⁷ Davidson-watts Ecology Ltd. (2018). Long-tailed Bat Trapping and Radio Tracking Baseline Report Southern Links, Hamilton. Prepared for AECOM.

¹⁸ Refer to Figure 5 under Annexure “A”

38. The level of bat activity I detected across the site is **not** notably higher than many other locations across southern Hamilton where bats have been surveyed using acoustic recorders.¹⁹
39. The results of the radio telemetry studies^{20, 21} and the acoustic surveys suggest that bats disperse through the site to reach important habitats in the wider landscape, but the site itself is not one of these important habitats. Consequently, habitat features within the site that are not related to movement corridors are not critical to the persistence of the Hamilton long-tailed bat population.
40. 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.

EFFECTS OF THE PROPOSED DEVELOPMENT ON LONG-TAILED BATS

41. The urbanisation of the proposed development site will result in the physical or functional removal of a large area of pasture assessed as low value long-tailed bat habitat.
42. The proposed development of the site will also include the removal of 2.6 ha of vegetation excluding pasture, but including individual trees present in the pasture. Most of this vegetation comprises exotic trees of varying ages.
43. The features on the site which have been identified as important for maintaining the movement of bats between key habitats in the landscape are being retained and enhanced. These features are the riparian margin, the minor gully and the E-W shelterbelt.
44. Land use change could result in anthropogenic disturbance decreasing the quality of the on adjacent habitats. These habitats include the edges of vegetation being retained onsite, and the Waikato River and Hammond Bush.

¹⁹ Kessels & Associates Ltd., 2017; Le Roux & Le Roux, 2012; Opus International Consultants Ltd., 2014, 2016.

²⁰ Dekrout, A. (2009). Monitoring New Zealand long-tailed bats (*Chalinolobus tuberculatus*) in urban habitats: ecology, physiology and genetics. Unpublished PhD thesis, University of Auckland – see Chapter 3.

²¹ Davidson-watts Ecology Ltd. (2018). Long-tailed Bat Trapping and Radio Tracking Baseline Report Southern Links, Hamilton. Prepared for AECOM.

Disturbance to the Waikato River resulting in the severance of a key commuting corridor and avoidance of Hammond Bush would have very high adverse effects on bats and should be avoided.

45. A single solitary roost has been confirmed in a mature exotic tree within the development extent of the site, and there is an unquantified likelihood that other trees are occasionally used by roosting bats. The roosting behaviour of long-tailed bats makes avoidance of solitary roosts difficult to achieve at the design phase of a project.
46. Given the size and nature of the proposed development, it was not feasible to avoid every mature tree on the proposed development site.
47. In my opinion, 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.
48. Based on acoustic recorder data and the radio telemetry studies, I consider there is a very low likelihood of maternity roosts on the site.
49. With the exception of the river margin, the majority of bat activity recorded on site was along the E-W shelterbelt. The E-W shelterbelt provides efficient dispersal between the Waikato River and the middle reaches of the eastern branch of the Mangakotukutuku Gully. Two residential roads will sever this corridor but most of the shelterbelt will be retained and enhanced. Radio telemetry studies demonstrate that the Hamilton long-tailed bats regularly cross roads including state highways and arterial roads. Consequently, I consider that the long-tailed bats will continue to use this corridor in the presence of these roads.

PROPOSED MITIGATION

Retention, protection and enhancement of key bat habitats

50. The development will avoid the riparian margin of the Waikato River and all other areas dominated by native vegetation (except for a small patch of juvenile planted kahikatea).
51. Long-tailed bat habitat restoration and enhancement is proposed in four key areas of the proposed development site:
 - (a) The NE terrace opposite Hammond Bush.
 - (b) Extending/ buffering the existing riparian margin of the site.
 - (c) The minor gully in the south of the site.
 - (d) The E-W shelterbelt.
52. A vegetated buffer ranging between 7 m and 53 m in width will be established around the entirety of the riparian margin (Figure 3 and Figure 4 under Annexure "A").
53. In many sections of the buffer where the width of planting is reduced, grass or meadow areas and open space reserves is proposed between the development and the existing vegetation. Thus, the development is generally set back from the existing riparian vegetation further than width of the buffer itself. Refer to Figure 3 and Figure 4 as shown under Annexure "A".
54. The minor gully, which is currently only partly vegetated and dominated by exotic species, will be restored. This in combination with the buffer planting will result in 18.5 ha of high-quality bat habitat being created onsite in the long-term. This area is 7 times greater than the area of vegetation being removed.
55. The minor gully is part of the future reserve network shown in Figure 2-1 of the PSPA. I envision that as the remainder of the PSPA gets developed, the restored minor gully will form part of a new vegetated corridor that can be used by bats to disperse between the Waikato River and the middle reaches of the Mangakotukutuku Gully.

56. I have worked closely with Mr Blayney and the Landscape Architects to create a planting concept that specifically provides for the ecology and behaviour of long-tailed bats. This includes:
- (a) closely planted buffer vegetation with densely foliated, tall-stature, evergreen trees comprising the canopy species;
 - (b) beyond the buffer vegetation, the vertical structure of the plantings will be varied to create potential flyways and foraging corridors for bats;
 - (c) Some non-native plant species have been included to ensure tall-stature trees establish as fast as possible; and
 - (d) Finally, meadows have been included in the design to promote insect diversity and provide foraging openings for bats.
57. The planting of the Northeast terrace and the E-W shelterbelt will be established within the **first** planting season post the granting of consent, except for the areas where earthworks need to be completed prior to planting. In such areas, buffer planting will be established in the first planting season after earthworks has been completed.
58. In addition to the planting of the NE terrace, a further 10 m of buffer planting will also be established along the eastern margin of the southern extent of the site in the **first** planting season (Condition 79(b) in Mr Serjeant's evidence). This will occur from construction stage 7 onwards.
59. All planting to be undertaken in areas requiring earthworks will be established in the **first** planting season after earthworks has been completed (Condition 79(d) in Mr Serjeant's evidence).
60. The staging of the planting described above will minimise, as far as is practicable, the time lag between artificial light being introduced to the site and the plantings reaching a height and density that will effectively block light. I recognise that, as with all mitigation involving revegetation, this time lag cannot be completely avoided. However, early planting across the eastern margin of the whole site will avoid time lag issues at the later stages of development.

61. To account for the increased time lag before the vegetation buffer is effective in the earlier construction stages, a significantly wider setback has been put in place between the Waikato River and the earlier development stages, i.e. the NE terrace (Refer to North Eastern Terrace Concept Plan and the AEAA for details the mitigation measures proposed here). This is in addition to lighting adjacent to key habitats being designed to minimise light spill (Paragraphs 65 - 67 of my evidence).
62. The E-W shelterbelt forms part of a corridor that provides an efficient movement route between Hammond Bush and the Waikato River, to the middle reaches of the Mangakotukutuku Gully (Figure 1 under Annexure "A"). Two residential roads will traverse this shelterbelt, but most trees will be retained through the Knoll Park and via the removal of two lots to the west of Road 02 and revegetation of this area.²² This is additional to the avoidance and mitigation put forward when the application for resource consent was originally lodged in June 2018.
63. Solitary roosts have been identified on the site and there is potential that bats occasionally use other trees scheduled for removal as solitary roosts. The roosting behaviour of bats means that all roosts cannot be identified during the design phase of the project.
64. To account for the uncertainty of potential impacts created by the removal of currently undiscovered roost sites, Condition 91(b) has been proposed which includes the creation of alternative roost habitat if active roosts are discovered during tree-felling protocols. If required, I recommend placement of alternative roost habitat in the existing riparian margin where other solitary roost trees have also been identified. This is in addition to tree felling protocols to avoid injury or mortality.

Minimising the impacts of lighting

65. The lighting of roads and public spaces adjacent to bat habitat being retained and enhanced will be designed to minimise light spill. Design features will

²²

Indicative shelterbelt planting strategy plan Revision B, dated 8 March 2019.

include highly directional LED lighting and will be designed by a qualified lighting specialist (proposed Condition 86 in Mr Serjeant's evidence) .

66. I recommend that the lighting of the bridge and culvert crossing the minor gully should be specifically designed to direct light onto the carriageway to promote bats dispersing above the height of cars, thus minimising potential for being hit.
67. Analysis by a lighting specialist has demonstrated that under the proposed lighting conditions outlined above, light spill from street lights will be reduced to 0 lux (no spill) within 12.2 m from the light source. This calculation does not take further light screening provided by the proposed buffer plantings into consideration.
68. To provide further assurance that light spill into important habitat features will be avoided, Condition 87 is proposed in Mr Serjeant's evidence. This Condition delays building development adjacent to the riparian margin and the northern margin of the E-W shelterbelt until buffer vegetation has met height and canopy closure performance criteria.

Earthworks and construction phase mitigation measures

69. As per Conditions 89 - 91 in the proposed conditions presented in Mr Serjeant's evidence, potential impacts on long-tailed bats will be managed during the construction phase of the project.
70. Management actions include the demarcation of potential roost trees and the implementation of tree-felling protocols to prevent bat mortality in the instance that bats are roosting in trees scheduled for removal. I also recommend restrictions on artificial lighting during the construction phase.

Ongoing monitoring and management of residual effects

71. Proposed Conditions 93 – 95 detail a monitoring regime that will be designed to identify and assess changes in bat activity that may occur as a result of development and future land uses.
72. If residual effects on long-tailed bats are discovered during monitoring, adaptive management will be implemented or offset mitigation if required.

Summary of effects with mitigation

73. Across the 105 ha site, the development will result in the permanent loss of 2.6 ha of primarily exotic woody vegetation, and a potential short-term reduction in the functionality of other habitats onsite due to anthropogenic disturbance (namely light spill) before the vegetative buffering becomes effective. Measures to minimise this time lag, and the extent of light spill, are included in the proposed conditions.
74. It is my opinion that the avoidance and further buffering of the riparian vegetation will ensure that the impacts of light spill into the key offsite habitats, the Waikato River corridor and Hammond Park, is avoided.
75. The creation of the North Eastern Terrace Reserve, the restoration of the minor gully, and the riparian buffer planting will, in the long-term, provide high-quality alternative commuting, foraging and roosting areas totalling 18.5 ha. This calculation does not include the open space reserves as they are not specifically designed for ecological mitigation. However, as with other parks in Hamilton City, these could also provide important habitat in the future.
76. The temporary reduction in functionality of the habitats on site will likely require some individuals to shift some their commuting routes and foraging areas. The development of the site will also result in the loss of one solitary roost tree, and potentially others. The above impacts will negatively affect individual bats; however, I consider these impacts are mitigated through proposed Condition 91(b).
77. I consider the 7x multiplier for habitat replacement will account for both the permanent removal of 2.6 ha of habitat, as well as the time-lag before this vegetation matures which could result in temporary loss of functionality of the habitat being retained onsite. Particularly given that the habitat created in the long-term will be of significantly higher quality than the existing habitat on site.

ISSUES RAISED IN SUBMISSIONS

Increased ecological buffering along the eastern margin of the site

78. In relation to the potential effects on long-tailed bats, submitters raised the following matters:

- (a) Increased ecological buffers opposite Hammond Bush;
- (b) Inclusion of bat sensitive lighting;
- (c) Removal of potential roost habitat;
- (d) Delaying development to reduce time lag between planting and disturbance;
- (e) Removal of the E-W corridor;
- (f) Ensuring the proposed mitigation is complied with and maintained; and
- (g) Pest control.

79. Considerable additions have been made to the proposed mitigation since lodgement. With the exception of specific issues discussed below, I consider the above matters have been addressed through the updated mitigation package described in Paragraphs 50 – 81 of my evidence and through proposed conditions 77 – 69 presented in Mr Serjeant’s evidence. I consider that these developments also address the matters regarding lack of detail and certainty about proposed mitigation.

80. I disagree with submissions stating that an increased vegetation buffer is required across the remainder of the eastern margin (south of the NE terrace) to avoid disruption of bats using the river corridor. Bats currently commute along parts of the Mangakotukutuku Gully which have medium density housing on both margins. The staging of the development in combination with the early planting means that an effective buffer will be established prior to development in the southern extent of the site. Further surety is provided through the proposed lot development deferral Condition (87 in Mr Serjeant’s evidence)

81. DOC’s submission (no. 59) implies that there are maternity roosts located in the proposed development site. As per Paragraph 32 of my evidence, I found no evidence of maternity roosts on the site.

82. Given the large increase in protection and enhancement of bat habitat onsite compared to what was proposed at lodgement, I consider that effects can be

managed on the proposed development site and offset mitigation is no longer proposed.

83. In addition to extensive mitigation being proposed onsite, a statistically robust monitoring programme has been proposed (Condition 92 in Mr Serjeant's evidence). This condition stipulates adaptive management, or appropriate offset mitigation will be agreed if changes in activity indicate the development has contributed to significant adverse effects on the bat population. I note the applicant has proposed more intensive monitoring than what was put forward in the Conditions provided in the s42A report.

Issues raised in Dr Stirnemann's Evidence (included in the RESI submission no. 72)

84. I agree with Section 4 of Dr Stirnemann's evidence that long-tailed bats are wide ranging and preferentially use edge habitat. I also agree that Hammond Bush is a key habitat for the bat population. I agree that city wide surveys suggest an inverse relationship between bat activity and increasing urbanisation. However, I note that recent radio telemetry studies have shown bats extensively using areas adjacent to medium density housing. Hammond Park itself is bordered by medium density housing on its eastern margin.
85. I agree with Section 5 of Dr Stirnemann's evidence outlining the potential effects of the development on long-tailed bats, and I consider these effects have been addressed through the proposed mitigation. I disagree that edge effects are a potential impact of the development. As agreed by both Dr Stirnemann and myself, bats preferentially use edge habitat. Furthermore, the main habitat used by bats on the site is a single row of trees.
86. I agree in principle with Section 7 of Dr Stirnemann's evidence:
 - (a) I agree with Paragraph 7.2 that the location of the site in relation to the Waikato River suggests the creation of bat habitat on the NE Terrace and restoration and enhancement of the existing riparian margin and the minor gully will have significant benefits for the bat population in the long term.
 - (b) Paragraphs 7.3 and 7.4 of Dr Stirnemann's evidence state that the bat habitat created across from Hammond Bush should be 125 m in width.

This assertion is based on (uncited) studies²³ linking changes in predator abundance and invertebrate communities to edge effects. As noted in Paragraph 85 of my evidence, bats preferentially use edge habitat and consequently I do not consider the recommended dimensions necessary. I note that all the vegetation patches retained on the site are currently narrow and will be enhanced via buffer plantings.

- (c) I agree with Paragraph 7.8 and consider that our proposed mitigation will facilitate long-tailed bats to continue using the mosaic of important bat habitats that the proposed development site sits within.

ISSUES RAISED IN SECTION 42A REPORT

87. The primary ecological issue raised in the s 42A report is the difference of opinion between Mr Kessels and me regarding the temporary residual effect on long-tailed bats and whether offset mitigation or compensation is required.
88. Paragraph 144 in the s 42A report²⁴ states that Mr Kessels does not accept the conclusion that the residual effect requires no mitigation. Specifically, the residual effect discussed by Mr Kessels is due to the time lag between the mitigation planting being implemented and when it will become effective (Paragraph 146 of the section 42A report). Mr Kessels considers there is a risk that anthropogenic disturbance from the development could exclude bats from using the river corridor while the proposed buffer plantings are establishing.
89. Paragraph 145 of the s 42A report requests that the applicant demonstrates the level of residual effects.
90. I disagree that there is a residual effect. I acknowledge that in addition to the permanent loss of a small amount of habitat on the site, the development of the site will result in temporary disturbance to existing vegetation edges that are being retained while the proposed buffer planting establishes. However, I consider the effect is adequately mitigated as part of the already proposed

²³ The single study cited by Dr Stirnemann does not investigate invertebrate abundance or predator abundance. Its findings demonstrate effects on microclimate variables for up to **20 m** in native forest adjacent to grazed pasture.

²⁴ I note that the italicised statement in Paragraph 144 in the S42A report is not a direct quote from Section 3.3.3 of the AEAA. Residual effects are not referred to in the AEAA.

mitigation package, and accordingly there will be no residual effect. Adverse effects on the river corridor will be avoided, and I consider that the proposed habitat restoration at a 1:7 ratio mitigates the permanent loss of a small amount of habitat **and** the temporary loss of functionality of the habitat being retained on site.

91. It is my opinion that the temporary functional loss of habitat on site will not have residual effects on the long-tailed bat population. The reasons for this are:
 - (a) The site does not contain maternity roosts.;
 - (b) Although bats regularly use features on the site, radio telemetry and acoustic studies do not indicate that the site is core habitat for the population; and
 - (c) The recent radio telemetry studies have demonstrated that there are alternative corridors to the E-W shelterbelt that will allow bats to disperse east and west of the site (see Figure 5 under Annexure "A").
92. I consider that the quantum of onsite mitigation (habitat restoration at a 1:7 ratio of that being permanently removed) adequately mitigates this effect. It should also be noted that the habitat restoration in the long-term will be of much higher quality than what is being removed on site.
93. Given the finding of a solitary roost within the proposed development extent, Condition 90(b) will be triggered, requiring the provision of alternative roosting habitat further to the mitigation already proposed. I consider the existing riparian margin is the most beneficial location to provide alternative roost habitat because two other solitary roosts (used by the same bat) have been identified here.
94. I do not consider habitat enhancement outside of this location will be more effective in offsetting or compensating for the loss of roosts or the time lag issue identified by Mr Kessels and myself.

CONCLUSION

95. In summary, I conclude that:

- (a) The Amberfield site is located close to key landscape features used by the Hamilton long-tailed bat population;
- (b) The site currently provides an E-W connective linkage between some of these key habitats, namely the Waikato River and Hammond Bush, and the Mangakotukutuku gully;
- (c) As well as commuting across the site, a bat has been recorded foraging and solitary roosting on the site;
- (d) The majority of potential commuting, foraging and roosting habitat has been retained through the proposed development design;
- (e) Potential habitat features to be removed include 2.6 ha of exotic trees of varying maturity. Restoration of 18.5 ha of the site is proposed to mitigate the removal of these trees. This will result in the creation of high-quality commuting, foraging and roosting habitat in the long term;
- (f) I consider the multiplier of 7x mitigates the temporary loss of functionality of onsite habitat due to the time lag in plantings maturing;
- (g) Solitary roosts have been identified onsite, but the roosting behaviour of long-tailed bats means that all roost trees cannot be identified and avoided during the design phase;
- (h) To account for the uncertainty around the impacts of potentially removing undiscovered solitary roosts, Condition 91(b) is proposed requiring additional provision of roosting habitat if active roosts are encountered during tree-felling protocols;
- (i) If additional bats are found roosting solitarily within the proposed development extent, I consider onsite pest control, in addition to the installation of artificial roosts, will be appropriate mitigation;
- (j) I acknowledge that there is inherent uncertainty about how long-tailed bats will respond to urbanisation of the site. Landscape scale studies in Hamilton inferred that urbanisation correlates with decreased bat activity. Conversely, recent radio telemetry studies show long-tailed bats extensively using gullies and parks that are surrounded by

residential housing, indicating bats may be more tolerant of urbanisation than previously envisaged.

- (k) Proposed conditions 93 and 95 include a statistically robust monitoring programme that will enable assessment of changes in bat activity associated with the development, and initiation of adaptive management, and offset mitigation if required.
- (l) Given the above, I disagree with Mr Kessels assertion that offset mitigation is required prior to the development commencing. I agree that artificial roost boxes should be included in the onsite mitigation package as per Condition 91(b).
- (m) I consider the proposed onsite mitigation package, with the additional establishment of artificial roosts, in combination with the statistically robust bat monitoring programme will adequately mitigate for the effects on bats. It will also respond to unforeseen impacts due to the uncertainty surrounding how bats respond to urbanisation on a site by site basis.

Dated this 12th day of April 2019

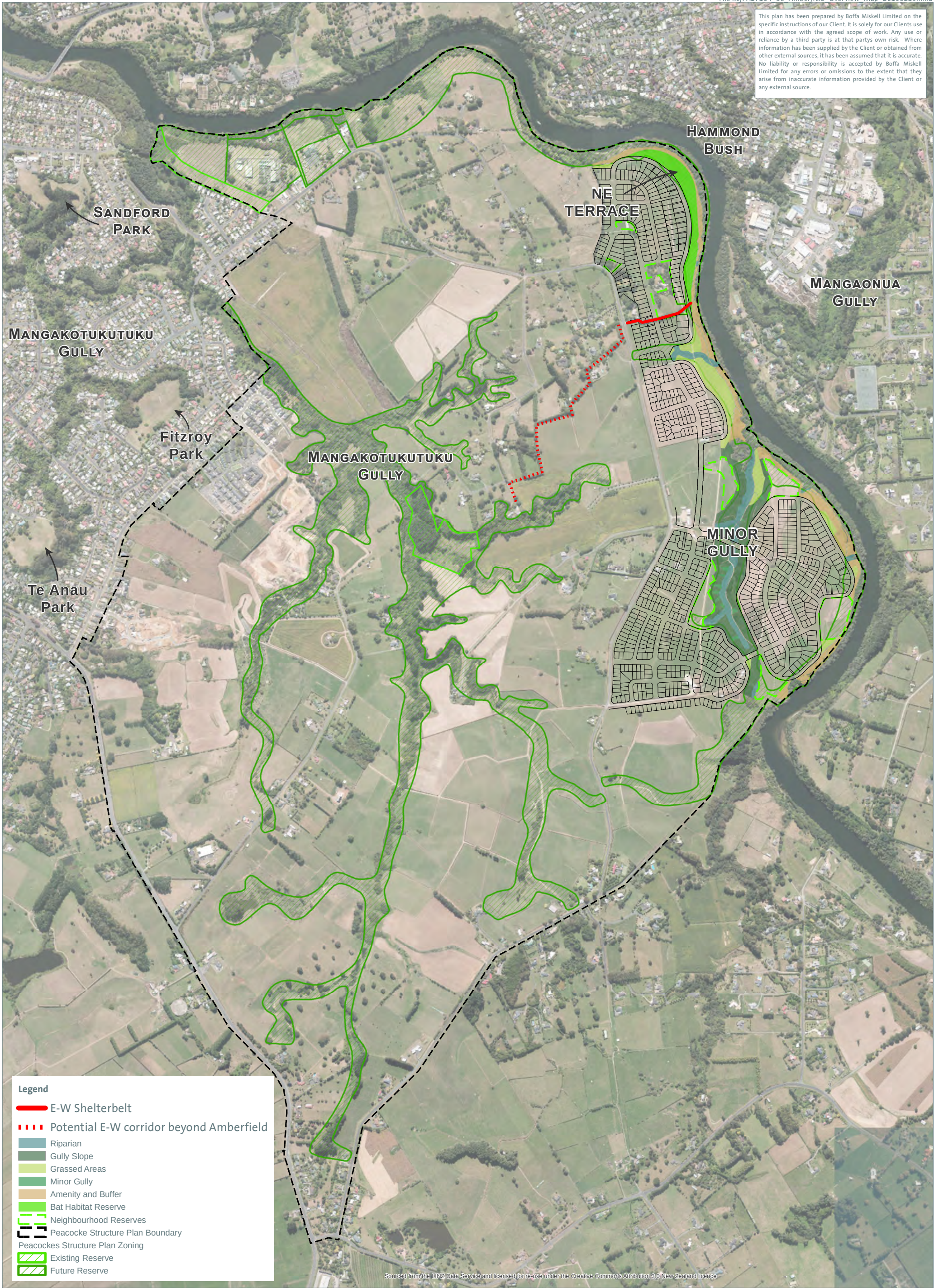


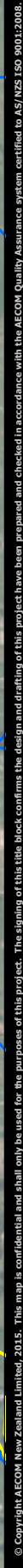
Georgia Cummings

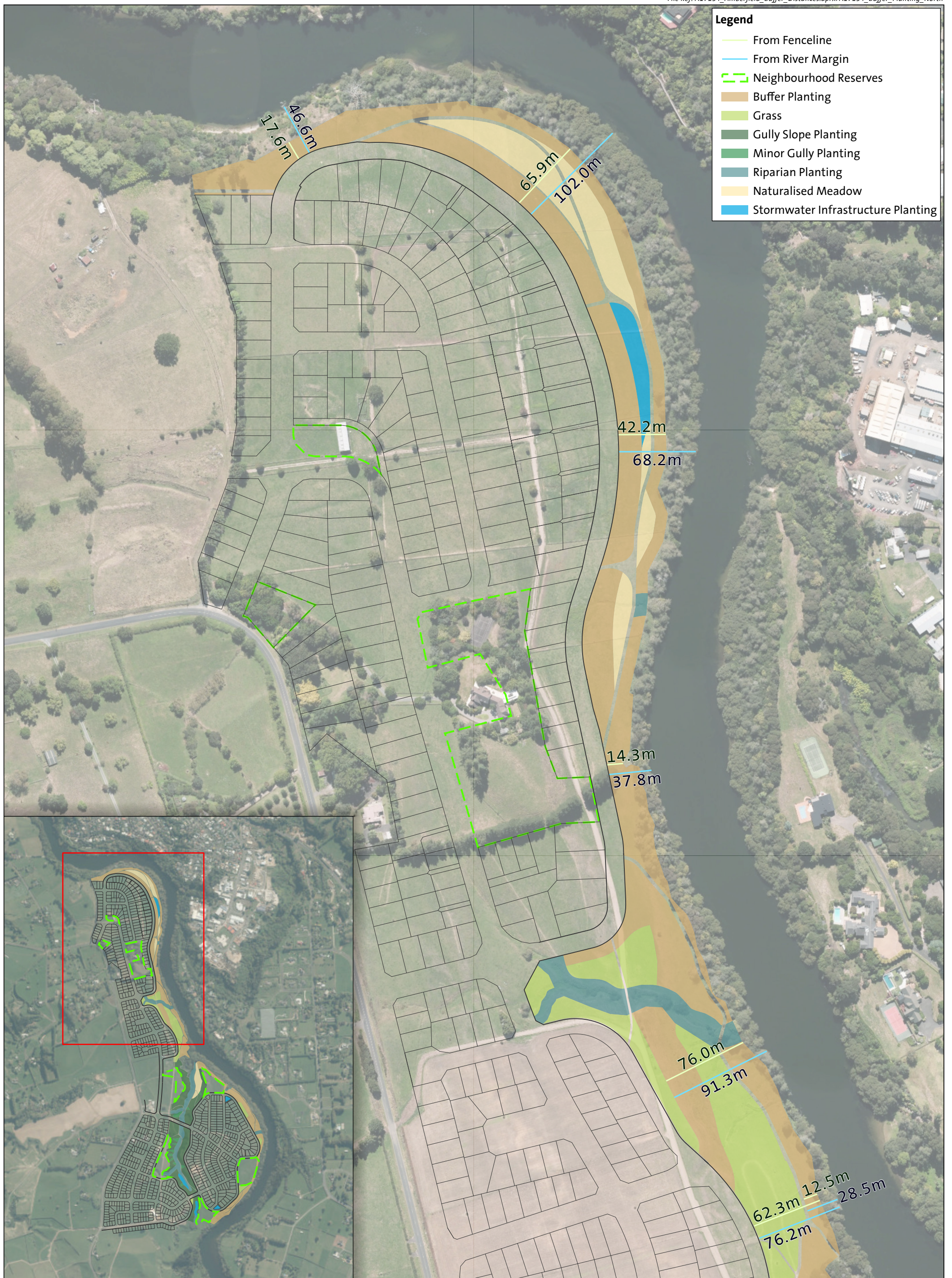
ANNEXURE “A’

Figures

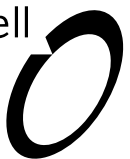
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Data Sources: Hamilton City Council, Harrison Grierson, Boffa Miskell, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

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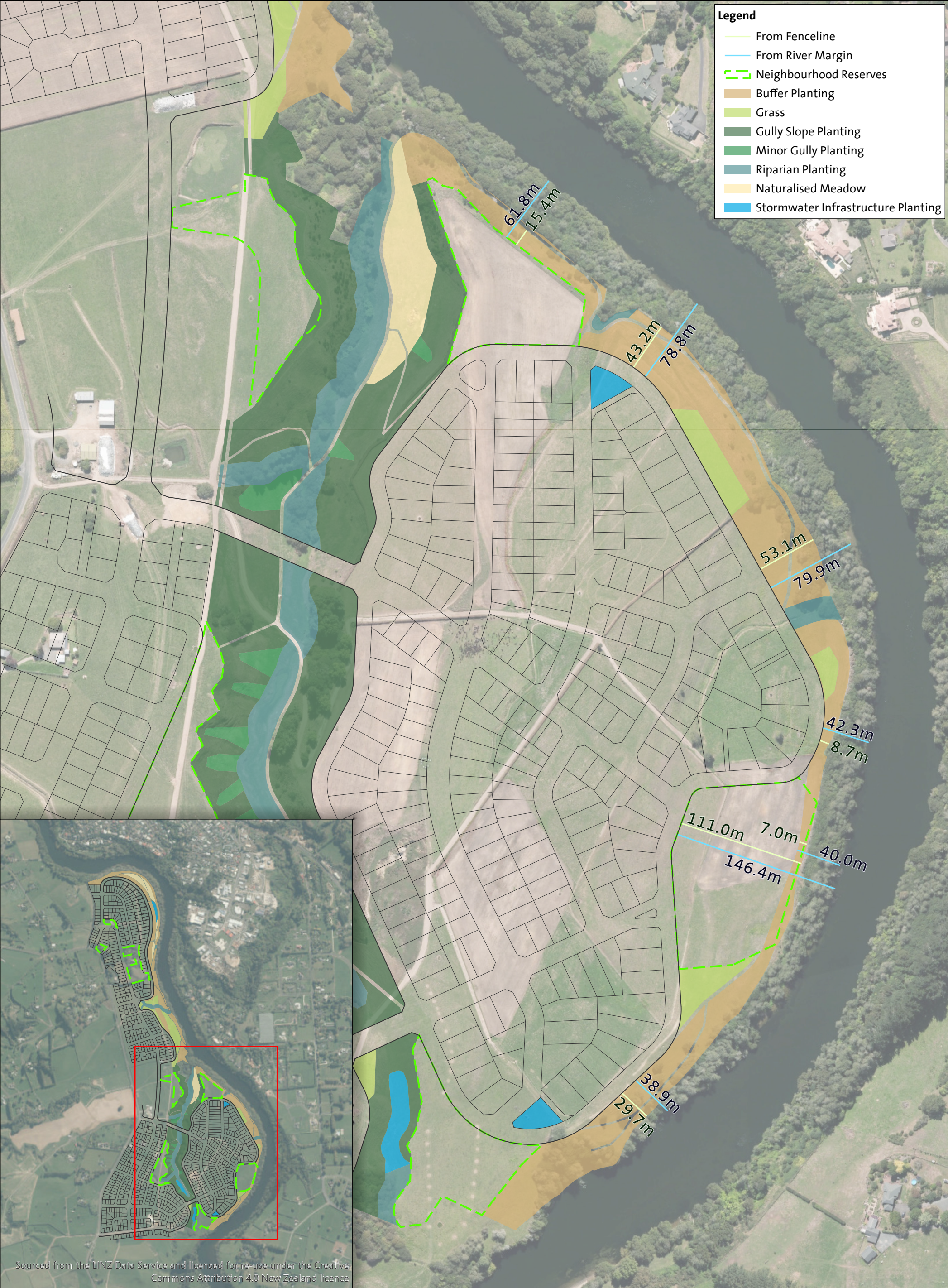
A17134 AMBERFIELD DEVELOPMENT

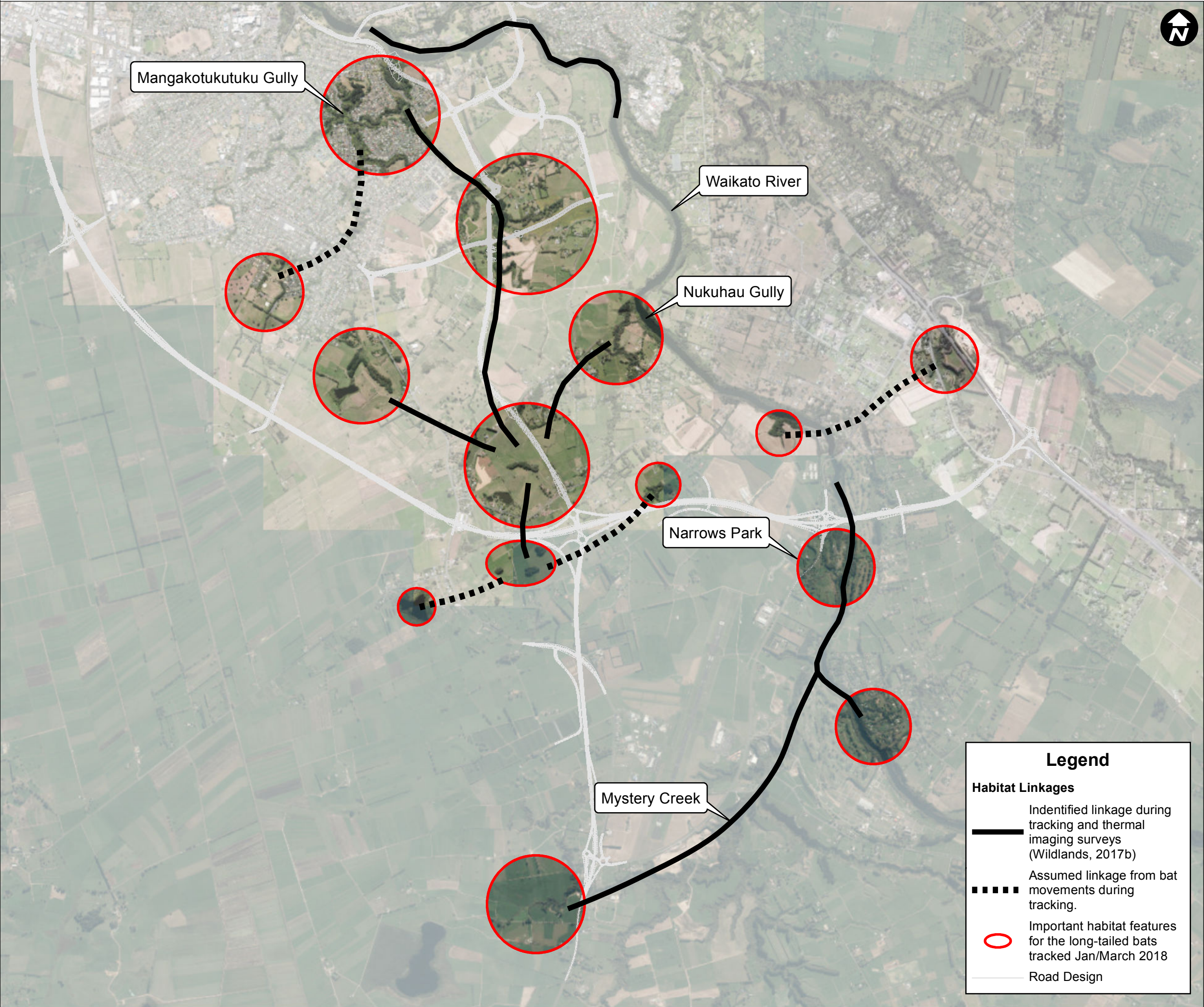
Buffer Planting - North

Date: 11 March 2019 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Rachel.deLambert@boffamiskell.co.nz | Drawn: ATy | Checked: GCU





Legend

Habitat Linkages

- Identified linkage during tracking and thermal imaging surveys (Wildlands, 2017b)
- Assumed linkage from bat movements during tracking.
- Important habitat features for the long-tailed bats tracked Jan/March 2018
- Road Design

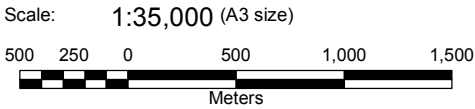


PROJECT
Southern Links

CLIENT
Hamilton City Council, NZ Transport Agency and Department of Conservation.

CONSULTANT
AECOM New Zealand Limited
AECOM HOUSE
8 MAHUHU CRESCENT
AUCKLAND
+64 9 967 9200 tel +64 9 967 9201 fax
www.aecom.com

SPATIAL REFERENCE



Map features depicted in terms of NZTM 2000 projection.

Data Sources:
Cadastral Boundaries – LINZ NZ Cadastral Dataset 2016

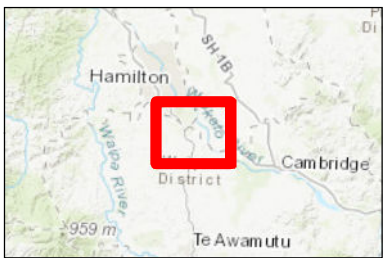
PROJECT MANAGEMENT

Approved		Date	
Checked		Date	
Designed		Date	
Drawn		Date	

ISSUE/REVISION

A	14.05.18	Draft	
Rev	Date	Description	

KEY PLAN



PROJECT NUMBER
60164546

SHEET TITLE
Key habitats and linkages used by long-tailed bats in 2018

MAP NUMBER

Figure i.

© Copyright AECOM New Zealand Limited, 2015. This map is confidential and shall only be used for the purposes of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM Quality Assurance system certified to AS/NZS ISO 9001:2008.

ANNEXURE “B”

Summary of Assessment Methodology

1. My assessment methodology included both literature review and field surveys over two seasons.
2. My literature review included:
 - (i) Relevant district and regional plans including:
 - i. Hamilton City Council’s (**HCC**) District Plan;
 - ii. Waikato Regional Council’s (**WRC**) plans and policies;
 - (j) Previous research on the Hamilton long-tailed bat population (Dekrout et al 2014; Kessels & Associates Ltd. 2017; Le Roux & Le Roux 2012).
3. I undertook an initial site walkover to familiarise myself with the potential bat habitats on 30 September 2017. Also present were members of the project team and Mr Andrew Styche from DOC.
4. I used acoustic recorders to survey the relative bat activity across different habitats within the site, as well as the adjacent river corridor, and a vegetation corridor extending west of the site comprising multiple shelterbelts which were identified as having potential to provide connectivity across the site from the Waikato River to the Mangakotukutuku Gully (as shown in Annexure C).
5. Two rounds of acoustic recorder monitoring were then undertaken, in late spring 2017 and early Autumn 2018. The survey design was formulated after initial discussions with Colin O’Donnell, a bat expert from DOC, and the methodology I employed followed DOC’s best practise guidelines.²⁵
6. During the deployment of the acoustic recorders, trees within the site were visually assessed for features such as cavities, dead wood and loose bark which could support roosting bats.

²⁵

Sedgeley, J. (2012). Counting away from roosts: Automatic bat detectors (Inventory and Monitoring Toolbox: Bats No. DOCDM-590733). Wellington: Department of Conservation.

7. The assessment of ecological effects followed the EIANZ Ecological Impact Assessment Guideline,²⁶ and involved assessing the magnitude of the Project's potential adverse effects combined with the site's ecological values to determine the level of effect. The Ecological Impact Assessment Guidelines have been updated since the initial assessment was completed. My revised ecological impact assessment as stated in the Ecological Assessment Addendum, dated 20 February 2019, follows the revised guidelines.²⁷

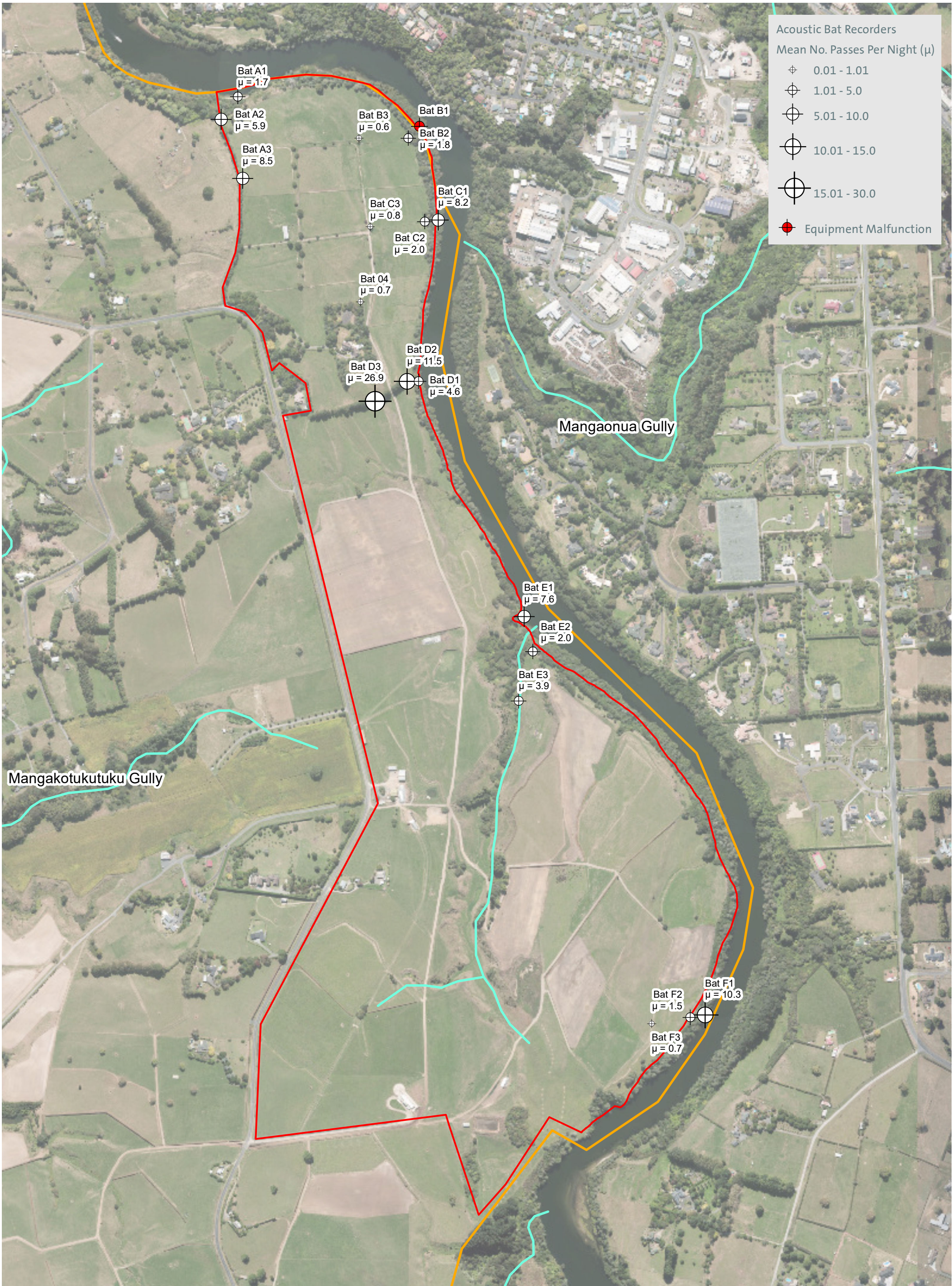
²⁶ Environment Institute of Australia and New Zealand 2015. Ecological Impact Assessment (EcIA) – EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. EIANZ, Melbourne.

²⁷ Environment Institute of Australia and New Zealand 2018. Ecological Impact Assessment (EcIA) – EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems (2nd edition). EIANZ, Melbourne.

ANNEXURE “C”

**Maps Showing Results of Acoustic Long-Tailed Bat Surveys Undertaken on The
Proposed Development Site over Two Seasons: Summer and Autumn**

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