Boffa Miskell

Amberfield

Ecological Assessment Addendum
Prepared for Weston Lea Ltd

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Appendices

1.0 Report scope

This addendum provides a summary of the revised mitigation package to address the potential effects of the Amberfield Development (hereafter 'the Project') on long-tailed bats as well as an updated assessment of ecological effects which considers the effects of the Project in light of updated mitigation package.

This addendum should be read in conjunction with the following documents:

- Boffa Miskell Ltd. 2018. Amberfield – Peacocke Structure Plan: Terrestrial Ecological Assessment. Prepared for Weston Lea Ltd;
- Boffa Miskell Ltd. 2018a. Amberfield project – Hamilton City Council s92 response: Terrestrial ecology. Prepared for Weston Lea Ltd;
- Harrison Grierson. 2019. Amberfield: North-East Area Alterations - Civil Engineering Infrastructure. Prepared for Weston Lea Ltd;
- Boffa Miskell Ltd. 2019. Amberfield: Open Space Framework Peacocke, Hamilton. Prepared for Weston Lea Ltd.
- Boffa Miskell Ltd. 2019a. Amberfield: Landscape / Visual Effects / Open Space Addendum Report. Prepared for Weston Lea Ltd.

2.0 Proposed long-tailed bat mitigation package

2.1 Background

The proposed mitigation package discussed below seeks to avoid, remedy and mitigate the adverse effects of the Project on long-tailed bats and has been updated in response to matters raised in submissions and in discussions with HCC's ecological advisors. A summary of the ecological concerns related to long-tailed bats which have been raised include:

1. Potential impacts of the development on Hammond Bush, an important long-tailed bat roosting area;
2. Light spill into the Waikato River corridor, an important commuting corridor for long-tailed bats; and
3. Lack of detail provided around design measures to minimise light spill into the surrounding environment.

Further to the above, it is widely recognised that the urbanisation of the Peacocke Structure Plan Area (PSPA) as a whole (within which the Project site is located) could potentially have a significant impact of the Hamilton long-tailed bat population. The original Assessment of Ecological Effects (Boffa Miskell Ltd., 2018) stated that an integrated long-tailed bat mitigation

package should be developed for the entirety of the PSPA to ensure landscape connections are maintained for long-tailed bats. Since lodgement of the Project application, HCC has engaged specialists to develop a Biodiversity Management Framework which aims to facilitate cohesive ecological management and mitigation across the whole PSPA. The framework includes a biodiversity compensation model. The objective of the model is to inform development design and mitigation across the various sites being individually developed that comprise the PSPA. Although the development of the Biodiversity Management Framework is still in its early stages, as the first developer within stage 2 of the PSPA to apply for resource consent, Weston Lea has engaged closely with HCC to attempt to achieve a consistent approach with the PSPA Biodiversity Management Framework under development.

In response to the above, changes are now proposed to the recommended mitigation measures included in the resource consent application lodged with Hamilton City Council on 15 June 2018. Key changes include:

1. A significant redesign of the North Eastern (NE) extent of the Project site opposite Hammond Bush. The redesign includes the realignment of roads, the removal of 27 lots and the establishment of a much wider reserve on the lower terrace adjacent to the Waikato River;

2. A detailed concept plan for the aforementioned reserve. This plan has been specifically formulated to establish a light-filtering vegetation buffer as fast as practicable, and to incorporate bat foraging habitat into the planting design;

3. Except for two road crossings, Weston Lea are now proposing to retain the E-W shelterbelt and buffer it's northern edge to maintain this flight corridor through the development. This will entail retaining the trees through the Knoll Reserve and redesign of lots to the west;

4. Artificial lighting standards to ensure the artificial light spill from the development is minimised. Key areas of focus for the bat-sensitive lighting design are areas adjoining the Waikato River corridor and the proposed revegetation areas; and

5. Recommendation for Consent Conditions that promote early establishment of buffer planting along the existing margin of the riparian vegetation. This will be achieved by establishing the riparian buffer planting which is located outside of the earthworks extent as early as practicable.

The updated mitigation package was also formulated in consultation with HCC with the aim of general consistency with the Biodiversity Management Framework for the PSPA which is currently under development.

2.2 NE terrace redesign

To provide more certainty around the avoidance of light spill into the Waikato River corridor and the Hammond Bush roosting area, a major redesign of the NE extent of the site has been undertaken. The redesign includes the realignment of roads, the removal of 27 lots on the lower NE terrace and the creation of a wider reserve which will be landscaped to create bat habitat immediately adjacent to the existing riparian vegetation along the Waikato River. The description below provides an overview of the habitat creation for the reserve, refer to Appendix 1 for a detailed concept plan and cross sections of the area.

The NE terrace reserve will contribute an additional 2.6 ha to the restoration planting already proposed on the site. The reserve comprises two strips of buffer planting, the first is 20 m wide and situated directly adjacent to the eastern boundary of the development in this area, the second strip is 10 m wide and adjoins the existing riparian vegetation. Naturalised meadows containing shelterbelts of specimen trees will be located between the two buffer plantings. These meadows have been included as long-tailed bats are edge specialists that preferentially forage over grassland adjacent to forest edges (O'Donnell, 2000). The meadows have been included to promote insect abundance and diversity for foraging bats. The specimen tree shelterbelt has been included to provide structural complexity to the meadows and potential roosting habitat in the future. The horizontal offset between the buffer planting strips has been designed with the goal of capturing as much light as possible from multiple elevations and angles to avoid light spill into the river corridor.

Shared cycling/pedestrian paths, a stormwater raingarden basin, and a wastewater pump station will also be located within the meadow areas. These features will be completely unlit. The stormwater raingarden basin will be planted with wetland vegetation and provide an alternative foraging habitat to the reserve.

2.3 Vegetation strategy

The objective of the vegetation strategy is to design a detailed planting plan that includes individually designed planting mixes for key locations across the Amberfield site. These planting mixes have been designed for specific purposes and include:

1. Buffer planting – A mix of fast growing, densely foliated native plants that block light across multiple structural tiers;

2. Bank planting – A mix of low-growing native plants that will provide complex understory habitats for lizards as well as variation in canopy height to create bat foraging opportunities;

3. Specimen trees / shelterbelts – Exotic species known to be used by long-tailed bats in Hamilton for roosting and foraging; and

4. Enrichment planting – Tall, densely foliated secondary natives which will be interplanted into the existing riparian vegetation.

Refer to the Open Space Framework (Boffa Miskell Ltd., 2019) for the complete breakdown of the proposed revegetation areas.

In addition to the detailed planting design, the planting has been staged to facilitate the growth and establishment of buffer plantings prior to artificial lighting being required in each development stage. A Landscape Management Plan is to be provided as a condition of consent. This management plan will be written to ensure that the plantings are subject to best-practise management which will promote fast establishment and growth, and healthy assemblages in the long-term. The management plan will include best-practise management and maintenance requirements such as top soil depth, fertiliser application and weed control regimes.

2.4 Retention of the E-W corridor

The results of two seasons of bat surveying across the Amberfield site identified that the E-W shelterbelt (Figure 1) is a key habitat feature that consistently recorded bat activity at similar levels to the Waikato River margin which is a known dispersal corridor for the Hamilton long-tailed bat population. As discussed in the original assessment of effects, I consider the importance of the shelterbelt is that it forms part of a wider vegetative corridor that provides efficient dispersal between the Hammond Bush area and the middle reaches of the eastern branch of the Mangakotukutuku Gully.

Concerns have been raised about the long-term viability of this corridor as it is located entirely within the residential development zone of the PSPA. However, the impacts of the development need to be assessed relative to the existing environment, and the objective of the updated mitigation package is to set a precedent for the protection and enhancement of this corridor by future developers regardless of its lack of formal protection under the PSP.

Given the above, the Open Space Framework (Boffa Miskell, 2019a) has been updated to include the retention of all the shelterbelt trees within the Knoll Reserve (Drawing Number A17134_130 Revision D). Except for the trees required to be felled to facilitate the road works, the remainder of the shelterbelt to the west of Road 002 will also be retained. A 20 m buffer planting strip, similar to what has been described for the buffer planting in the NE terrace, will also be put in place along this section of the shelterbelt. The objective of this buffer planting is to capture light from the surrounding development and maintain a dark corridor along the northern edge of the shelterbelt.

2.5 Street lighting standards

A light specialist has been engaged to provide lighting design advice regarding the requirement to minimise light spill in vicinity to the river edge, the E-W shelterbelt crossings, and the minor gully corridor.

Initial advice from the lighting specialist confirms that the specifications can reduce light spill into the NE Terrace Reserve to 0 lux in maximum of 12.2 m. This calculation does not take further light screening provided by the proposed buffer planting into consideration.

2.6 Planting phasing recommendations

The ecologists have worked with the project landscape architects and engineers to provide guidance on early buffer planting opportunities. This is reflected in the NE Terrace Concept Plan (Appendix 1) which identifies areas of planting where natural ground will be retained (no earthworks required) that can be planted in the first planting season after consent is granted.

To avoid light spill into the Waikato River corridor, the buffer planting along the margin of the existing riparian vegetation corridor has been deemed the primary area to establish plantings as early as possible before artificial light sources are introduced to the site. This is particularly the case in the northern extent of the site where construction is scheduled to start. However, conditions are recommended that specify establishing the riparian buffer (outside of the EW extent) as early as practicable across the site to ensure a well-established buffer along the margin of the Waikato River well in advance of construction in the southern extent of the site.

Based on construction timeframes discussed with project engineers, the lots closest to the river margin[1] will ready for release of title three years following grant of consent. If the riparian buffer planting is established in the first planting season after resource consent is granted, the plants will have established for a minimum of three planting seasons prior to building commencing on these lots. This time delay between planting and house occupancy will increase as the staging progresses providing increasingly more protection from light spill as the development progresses.

I consider the three-planting season time delay between planting and release of title sufficient as it provides enough time to assess the establishment of the plantings and rectify any defects in the planting. The success of the planting will be assessed in the second season and initial establishment issues will be rectified. The successful establishment of plantings can then be confirmed in the third season prior to artificial light sources being put in place in these areas.

It is recognised that three years of growth will not provide sufficient height to capture light from residential sources. It is likely that there will be a time lag of at least 10 years prior to vegetation reaching a sufficient height to capture artificial light. To account for this time-lag, the proposed scheme plan has been designed to increase the set-back of residential lots from the river margin. The proposed design currently contains only a single lot whose eastern margin sits within 50 m of the river edge.

[1] Stage 3 and Stage 5 of the indicative staging plan, refer to Harrison Grierson Drawing Number 141842-1046 Revision 4.

Hammond Bush

Mangakotukutuku Gully

Legend

- E-W Shelterbelt
- Potential E-W corridor beyond Amberfield
- Riparian
- Gully Slope
- Grassed Areas
- Minor Gully
- Amenity and Buffer
- Bat Habitat Reserve
- Neighbourhood Reserves
- Peacocke Structure Plan Boundary

Peacockes Structure Plan Zoning

- Existing Reserve
- Future Reserve

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0 500 m
1:13,000 @ A3

Data Sources: Hamilton City Council, Harrison Grierson, Boffa Miskell Ltd., LINZ (aerials).

Projection: NZGD 2000 New Zealand Transverse Mercator

AMBERFIELD DEVELOPMENT

Figure 1: Context Map - Proposed Mitigation Planting

Date: 19 February 2019 | Revision: 1

Plan prepared for Weston Lea by Boffa Miskell Limited

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3.0 Updated assessment of effects on long-tailed bats

Refer to the Assessment of Ecological Effects for a complete description of potential effects of the Project on the Hamilton long-tailed bat population. The original Assessment of Ecological Effects (Boffa Miskell Ltd., 2018) concluded that urbanising the Project site would have a significant negative impact on the Hamilton South bat population resulting from unavoidable habitat loss. Due to the extensive development proposed for the wider PSPA, offsite mitigation was originally proposed.

Most of the habitat loss identified does not result from vegetation removal but instead is functional loss due to increased anthropogenic disturbance effectively making the site impermeable to bats. Although the site has not been identified as high-quality bat habitat relative to other areas of southern Hamilton, the habitat of the Hamilton bat population is already highly restricted and ongoing habitat loss could impact the viability of the population.

Below is a recap of the potential effects, and given the above, the effects of the project on the long-tailed bat population are broken down into onsite and offsite effects.

3.1 Potential offsite effects

3.1.1 Light spill into important long-tailed bat habitats adjacent to the site

The development of the site will result in a significant increase in artificial light across the site. If unmitigated, this light could spill into surrounding areas and result in a decrease in habitat value of key offsite habitats: the Waikato River corridor and Hammond Bush roosting area. In severe cases such disturbance could lead to long-tailed bats avoiding these habitats. Avoidance of the Waikato River could lead to isolation from large areas of the population's current range while avoidance of Hammond Bush could result in the loss of roost trees, a limiting resource for long-tailed bats. Both scenarios would have significant adverse effects on the Hamilton long-tailed bat population.

3.1.2 Fragmentation of movement corridors across the site

Bat surveys across the site identified that the main shelterbelt (henceforth referred to as the E-W shelterbelt) is regularly used by bats to commute and forage along. The comparatively high activity levels along this shelterbelt are likely because it comprises part of a network of linear vegetation features that provide efficient dispersal between the Waikato River and the middle reaches of the eastern branch of the Mangakotukutuku Gully.

Physical removal or functional isolation[2] of this shelterbelt will sever the wider commuting corridor. Bats will still be able to disperse between the Mangakotukutuku Gully, the Waikato

[2] In this case functional isolation would be light spill onto the corridor that prevents long-tailed bats from using the shelterbelt to move along.

River, and the Hammond Bush/ Manganoa Gully area via the mouth of the Mangakotukutuku Gully to the north of the Amberfield site. Research undertaken as part of the Southern Links project has confirmed this alternative route is currently used by bats (Davidson-Watts Ecology (Pacific) Ltd, 2018). However, this route is less efficient for bats accessing the middle reaches of the eastern branch of the Mangakotukutuku Gully from the Hammond Bush area. Consequently, the removal of the E-W shelterbelt will lead to decreased foraging efficiency and increased energetic costs for bats that currently utilise the corridor; in other words, bats will need to use alternative, less efficient routes to move between roosting sites and foraging sites, thus expending more energy.

3.1.3 Addressing offsite effects

Below is a summary of the mitigation embedded into the proposed development design to avoid and mitigate the above-described effects.

1. Removal of existing riparian vegetation has been avoided;

2. Development is set back from the river corridor by a minimum of 25 m and maximum of 180 m Waikato River margin.

3. A vegetative buffer will be established to the east of the development (Drawing Number A17134_054 Revision H (page 10), Boffa Miskell Ltd., 2019) to minimise light spill into the river corridor and Hammond Bush;

4. A reserve with bat habitat will be established on the NE terrace opposite Hammond Bush. As described above, the reserve will include 30 m of additional buffer planting interspersed with meadows designed to promote bat foraging habitat;

5. This redesign has facilitated an additional set-back of 54 m of the development from the river margin at the reserve's widest point;

6. A vegetation strategy has been created to ensure the planting mixes will provide effective light buffering and best-practise management of these plantings will be specified as a condition of consent. Best practise management will promote fast growth and facilitate dense, healthy plantings in the long-term;

7. Enrichment planting within the existing riparian vegetation to provide more native tree cover opposite Hammond Bush;

8. In addition to the additional planting described in Point 4, a 2.5 m planted buffer strip will be planted along the west side of the riverside road (Road 02) on the northern terrace (close to Hammond Bush). This buffer will be immediately adjacent to the first row of lots on the northern terrace and will block light from residential dwellings. This planted buffer comprises the third buffer strip in this NE terrace area. The objective of having multiple separate buffers as opposed to a single buffer of equivalent width is to capture as much light as possible from multiple angles and elevations. Separate plantings also create more edges, a preferred foraging habitat for long-tailed bats;

9. Consent conditions will be drafted that will specify planting a minimum of 10 m buffer planting along the existing riparian as early as practicable. The objective of this is to provide more certainty around the successful establishment of buffer planting prior to occupation of houses;

10. Except for a single lot, all residential lots are located more than 50 m from the river margin;

11. The E-W shelterbelt will be retained and enhanced with a 20 m buffer planting along the northern edge (outside of Knoll Reserve) to maintain a dark corridor;

12. The minor gully is part of the open space framework shown in Figure 2-1 – 'Land Use' of the PSP. It is considered likely that as the remainder of the area 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;

13. A lighting specialist has been engaged to design a bat-sensitive lighting regime which will be implemented along the: riverside roads, the roads adjacent to the minor gully, the roads crossing the E-W shelterbelt, and the minor gully crossings. Initial advice confirms that lighting can be designed by the lighting specialist in collaboration with ecologists and landscape architects.

3.1.4 Offsite effects assessment

To my knowledge, there is no quantitative research into the minimum horizontal distance that a light source needs to be from long-tailed bat habitat to ensure the light spill does not disturb bats using the habitat. In fact, there is very little quantitative research to this effect for any bat species. Consequently, it is difficult to remove uncertainty around the potential impacts of the development on adjacent habitats.

However, the set-back of the development from the river margin, and the associated width of vegetative screening, is comparable between what is proposed on the Amberfield site and what is already established on the opposite side of the river. Furthermore, to the best of my knowledge development on the opposite bank was not designed with comparable bat mitigation principles that will be employed in the Amberfield development. Given that long-tailed bats are extensively using the Waikato River and the major gullies which have a similar level of development on both margins, it is reasonable to assess that the light spill from the Amberfield development will have **less than minor** effects on the adjacent river corridor and Hammond Bush.

As above, there is no quantitative data on the buffering and set-back requirements to ensure the functional retention of the E-W shelterbelt. The known bat corridors in Hamilton that are located within developed areas all occur in gully landforms. The incised landform likely provides light protection in addition to the remnant vegetation that occurs in these gullies. Consequently, there are no comparable corridors from which to draw a comparison. However, it is known that long-tailed bats cross roads in Hamilton and roost adjacent to SH1 in Tamahere. Consequently, it is reasonable to assume they will continue to use key habitat features in the presence of elevated levels of artificial light. Furthermore, initial calculations from the lighting specialist demonstrate that light spill from the road corridors under the bat-sensitive light regime are able to reach zero lux at a maximum of approximately 12.2 m from the light source in the absence of plant screening. Given the above, I have assessed that the physical retention and 20 m buffering of the shelterbelt will be sufficient to maintain a dark corridor for commuting bats. I cannot provide certainty that the shelterbelt's functionality will be fully retained. However as discussed above, this corridor is not the only route used by bats to access the Mangakotukutuku Gully. It has been confirmed that bats move along the Mangakotukutuku Gully to the confluence with the Waikato River and disperse along the river corridor (Davidson-

Watts Ecology (Pacific) Ltd, 2018). Bats will also be able to disperse through other areas of the PSPA that have not yet been developed as well as entering the Mangakotukutuku Gully from the south which is another dispersal route that has been confirmed via radio tracking (Davidson-Watts Ecology (Pacific) Ltd, 2018).

To conclude, the updated proposal will likely maintain connectivity through the site. However, if this is not the case, or if the use of the E-W shelterbelt is notably reduced, this will not result in a complete barrier to the movement of bats between Hammond Bush area and the Mangakotukutuku Gully. Connectivity will be retained outside of the site in the short-term, and restoration of the minor gully will provide a new, high quality corridor in the long-term.

In summary, offsite impacts have been avoided.

3.2 Potential onsite effects

3.2.1 Physical and functional removal of long-tailed bat habitat

The development of the Amberfield site will result in both physical and functional removal of long-tailed bat foraging and commuting habitat. This is a result of a combination of direct habitat removal and increased artificial light, which will likely result in bats avoiding the areas where development occurs, at least until the proposed plantings to buffer the existing inland riparian corridor and restore the minor gully are well established (expected to be 5 – 10+ years).

There is also a potential for the removal of bat roost trees, but this has been assessed as low potential. To date three radio tracking studies have been undertaken in Hamilton as part of the Southern Links long-tailed bat mitigation package over a period of two summers (AECOM, 2019; Davidson-Watts Ecology (Pacific) Ltd, 2018). These studies entailed capturing long-tailed bats from multiple high-activity and/or roost sites in vicinity of the Amberfield site and tracking them to different roost sites. During these studies 36 roosts have been located. None of these roosts are located on the Amberfield site.

As discussed in the Assessment of Ecological Effects, the habitat on the Amberfield site is largely considered to be of relatively low value to the long-tailed bat population. However, the Hamilton long-tailed bat population is constrained to modified habitats on the peri-urban fringe of southern Hamilton because of high levels of human disturbance. Consequently, all habitat regularly used by long-tailed bats in this area is significant and further habitat loss could lead to a decline in the bat population if alternative habitat is not established.

3.2.2 Addressing onsite effects

Below is a summary of the mitigation embedded into the proposed development design to avoid and mitigate the above-described effects. Some of the mitigation measures address both offsite and onsite effects and have been repeated below as necessary.

1. Removal of existing riparian vegetation has been avoided;

2. Buffer planting along the inland edge of the existing riparian vegetation has been designed to include multiple structural tiers with the objective of maintaining vegetation edges for foraging that are buffered from the new development. Refer to the Open Space Framework (Boffa Miskell, 2019) for further detail;

3. A reserve with bat habitat will be established on the NE terrace opposite Hammond Bush. This area currently comprises grazed pasture which is not considered quality foraging habitat. The reserve will include a total of 30 m of buffer planting interspersed with areas such as naturalised meadows and a stormwater raingarden basin, designed to promote bat foraging habitat. This will comprise 2.6 ha of habitat and an additional set-back of 54 m from the river margin (at the Reserve's widest point) in addition to the planting proposed at lodgement;

4. The minor gully will be restored to provide alternative, high-quality, foraging area. This will comprise approximately 10 ha of new habitat. As above this area has been specifically designed to provide effective light buffering whilst also including changes in height to create edges within the gully and facilitate long-tailed bat foraging;

5. The proposed plantings will replace the vegetation removed at a ratio of approximately 1:7. In addition to this, the vast majority of vegetation removed is ornamental exotic trees which are used by bats in modified environments, but are not their preferred habitat. Not only will the replacement plantings cover a significantly larger area, they will also provide higher-quality habitat in the long-term; and

6. An Ecological Management Plan (EcMP) will be developed to manage potential impacts on long-tailed bats and other native flora and fauna during the construction phase of the project. This EcMP will include:
    a. Management actions to prevent damage to all vegetation that is to be retained;
    b. Restrictions on artificial lighting across the site during construction; and
    c. The demarcation of potential roost trees and the implementation of tree-felling protocols to prevent bat mortality in the unlikely instance that bats are roosting in trees scheduled for removal.

3.2.3 Onsite effects assessment

The planting proposed for the Amberfield site totals approximately 18.5 ha[3]. This is approximately 7 times larger than the 2.6 ha of habitat[4], comprising exotic shelterbelts, ornamental trees, and very small areas of planted native vegetation, that will be physically and functionally[5] removed.

The site is comprised primarily of pastureland interspersed with exotic ornamental trees and shelterbelts. There are small 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. Although bats were recorded across the site, the relative activity levels identified that the E-W shelterbelt is a key habitat feature. This shelterbelt forms part of the vegetation corridor connecting the Waikato River to the middle reaches of the eastern branch of the Mangakotukutuku Gully. It is used by bats to both commute and forage along. Other vegetated parts of the site including the shelterbelt along the north western boundary of the property, the inland margin of the riparian vegetation, and the minor gully where also used by bats, but the relative activity was lower across both survey periods. Acoustic surveys demonstrated that bat activity was very limited in

[3] This includes meadows but excludes all other grassed areas and reserves as they are not buffered by buffer or gully plantings.

[4] Pastureland is not included in this area calculation as it is not considered important bat habitat.

[5] Functionally removed habitat includes the ornamental trees that will be retained within the proposed reserves (e.g. the Knoll Reserve) but will be isolated from the Waikato River by the surrounding development.

open pasture and no feeding activity was recorded in this habitat (Boffa Miskell, 2018). Feeding activity was low across most other habitats on the site and all locations where feeding activity was recorded are being physically retained.

The activity levels described above indicate that the bats are primarily dispersing through the site using the E-W shelterbelt as a corridor to access other, more important, habitats that are located to the east and west of the site. These habitats include Hammond Bush, the Waikato River, the Mangakotukutuku Gully and the Mangaonua Gully.

To summarise, there will be a small (2.6 ha) amount of low quality habitat lost on the site. Furthermore, the updated design which includes the retention and enhancement of the E-W shelterbelt seeks to avoid the key onsite impact of the development for long-tailed bats.

I acknowledge that although the updated design avoids the physical removal of most available habitat, it is not possible to avoid short-term functional loss[6] of some habitat while maintaining the density of the development as specified in the PSP. This is because of the time-delay between buffer planting establishing to a height and density which will sufficiently capture light. In key habitats such as the river margin and the E-W shelterbelt, this short-term impact will be minimised by applying set-backs of the development. With exception of the road crossings, there will be a setback of a minimum of 20 m from the E-W shelterbelt, and minimum 25 m from the river margin.

There will also be time-lag between the loss of habitat on site and when the created and enhanced habitat will reach an equivalent value. This is an inherent difficulty with any mitigation in the form of habitat creation, particularly when mitigating for native bats which prefer tall stature vegetation which will take 25+ years to mature. To account for this time-lag, a multiplier has been used to determine the area of habitat creation required. I consider the 7x multiplier for habitat created will account for this time-lag, particularly given that the habitat created in the long-term will be of significantly higher quality than the existing habitat on site.

3.3 Assessment of effects on long-tailed bats

I have used the 2018 EIANZ guidelines to assess the overall effect of the development on long-tailed bats taking into consideration the updated mitigation package (Roper-Lindsay et al., 2018). For full details of how the EIANZ methodology is applied refer to the methodology section of the Assessment of Ecological Effects (Boffa Miskell, 2018).

3.3.1 Ecological value

I have assessed that the ecological value of the long-tailed bat habitat on the Amberfield site as **Very High** as per Table 1 which is reproduced below from the 2018 EIANZ guidelines (Roper-Lindsay et al., 2018).

[6] Primarily due to light spill.

Table 1: Assigning value to species for assessment purposes (from EIANZ 2018).

Determining factors	Assigned Value
Nationally Threatened species, found in the ZOI (zone of influence) either permanently or seasonally	Very High
Species listed as At Risk – Declining, found in the ZOI, either permanently or seasonally	High
Species listed as any other category of At Risk, found in the ZOI either permanently or seasonally	Moderate
Locally (ED) uncommon or distinctive species	Moderate
Nationally and locally common indigenous species	Low
Exotic species, including pests, species having recreational value	Negligible

3.3.2 Magnitude of effect

I have assessed the magnitude of the effects of the proposed development on the Hamilton long-tailed bat population to be **Low** as per Table 2 which is reproduced below from the 2018 EIANZ guidelines (Roper-Lindsay et al., 2018). This will then become a positive effect in the long-term (20+ years) as the restoration plantings reach maturity.

Table 2 Criteria for describing magnitude of effect (from EIANZ 2018).

Magnitude	Description
Very High	Total loss of, or very major alteration to, key elements/features/ of the existing baseline conditions, such that the post-development character, composition and/or attributes will be fundamentally changed and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element/feature
High	Major loss or major alteration to key elements/features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element/feature
Moderate	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element/feature
Low	Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns; AND/OR Having a minor effect on the known population or range of the element/feature
Negligible	Very slight change from the existing baseline condition. Change barely distinguishable, approximating to the 'no change' situation; AND/OR Having negligible effect on the known population or range of the element/feature

This magnitude of effects has been assessed as low for the following reasons:

- Most of the site comprises open pastureland which is assessed to be of low value to bats. Consequently, the significance of the site to the long-tailed bat population is its location relative to other high value habitats in the landscape;
- There are small areas of habitat within the site that the bats have been confirmed to commute and forage along. Except for some ornamental trees, these habitats have been physically retained and buffer planting will be established so the majority of habitat will be functionally retained in the short/medium term and improved in the long term as the plantings mature;
- There is uncertainty around the functionality of the E-W corridor along the main shelterbelt once the development occurs around it. However, alternative corridors are known to be present in the landscape and bats have been confirmed using these alternatives to move between known communal roosting sites. Consequently, a reduction in the use of the E-W corridor in question will not lead to fragmentation of the landscape at a population level;

- The restoration of the minor gully in combination with the creation of high quality foraging habitat adjacent to a known maternity roosting site, Hammond Bush, will in the long-term, mitigate for the loss of low-quality habitat on site; and

- I consider that the creation and enhancement of habitat at a 1:7 ratio relative to habitat lost on the site will compensate for the time lag in the proposed mitigation.

Consequently, as described in the EIANZ magnitude of effect table, there will be a discernible loss of habitat compared to baseline conditions in the short term that could have minor effects on the bat population in the area. However, the mitigation proposed will result in an increase in habitat quantity and quality across the site in the long-term.

3.3.3 Overall level of effects on the Hamilton long-tailed bat population

Considering the updated mitigation package described above, the level of effect of the development on the long-tailed bat population, both onsite and offsite, has been assessed as **Moderate** based Table 3 which is reproduced below from the EIANZ guidelines.

Table 3: Criteria for describing level of effect (From EIANZ 2018).

		Ecological Value				
		Very High	**High**	**Moderate**	**Low**	**Negligible**
Magnitude	**Very High**	Very High	Very High	High	Moderate	Low
	High	Very High	Very High	Moderate	Low	Very low
	Moderate	Very High	High	Moderate	Low	Very low
	Low	Moderate	Low	Low	Very low	Very low
	Negligible	Low	Very low	Very low	Very low	Very low
	Positive	Net gain	Net gain	Net gain	Net gain	Net gain

I consider the package to provide a sufficient level of mitigation for the following reasons:

- The ecological value of the site is assessed as **Very High** because it is used by long-tailed bats which are listed as a Threatened – Nationally Critical species (O'Donnell et al., 2018). However, the site is primarily pasture and only a small proportion of the site is used by bats, primarily for commuting across the site. Consequently, the significance of the site for the bat population is its proximity to preferred habitats in the landscape as opposed to the habitat on the site being of particularly high habitat value;

- The updated design includes changes that address the key offsite and onsite impacts. The changes include: habitat creation on the river margin, and further setback of the development from Hammond Bush, as well as retention and enhancement of the E-W shelterbelt with the aim of maintaining connectivity across the site as discussed above; and

- The time lag between the effects of the development and the mitigation planting maturing to a point that it becomes effective is an inherent issue in ecological mitigation planting. However, I consider that short/medium term effects will not have a population-level impact on the Hamilton city bat population and the proposed mitigation will have a net positive effect in the long term (20+ years).

The effects assessment on long-tailed bats has shifted from **Very High** in the original Assessment of Effects to a **Moderate** level of effect. This shift reflects the additional habitat creation on the NE Terrace which will provide certainty around the avoidance of light spill into Hammond Bush and the Waikato River. It also reflects the maintenance of connectivity through the site via the retention and enhancement of the E-W shelterbelt which was the key outstanding impact. Further to the above, the advice from the lighting specialist has provided more certainty that the setbacks and buffer originally proposed will be adequate to avoid light spill from road corridors into adjacent habitats.

4.0 Updated assessment of effects – other terrestrial ecology

The reduction of impact footprint, establishment of a NE reserve, recommendations for early planting where practicable, and enrichment planting of the existing riparian vegetation will also reduce impacts on lizards, birds, and vegetation onsite. The additional buffering, larger planted area will be beneficial for lizards, birds, and vegetation.

Several potential benefits for non-bat fauna and vegetation of the proposed mitigation are:

- Early establishment of a wider buffer in the NE will reduce disturbance of birds using the riparian vegetation for nesting and/or roosting and in reduce disturbance in general using the river corridor for foraging and/or dispersal – this may include at risk species of shags.

- Increase of available habitat for copper skinks. The proposed dense, light blocking vegetation would also create ideal copper skink habitat as in the Waikato they generally persist in complex, vegetative ground cover that provides refugia that maintains moisture throughout the year.

- Increased abundance of native vegetation in both the wider area and progressively in the existing riparian vegetation.

The original ecological assessment concluded that post mitigation effects of this development ranged from neutral to net beneficial for lizards, birds, and vegetation this additional mitigation, although primarily targeted at bats, could provide further net benefits for these fauna and the vegetation onsite.

5.0 Updated assessment of effects – freshwater ecology

The establishment of a reserve (described under the heading “NE terrace redesign”) is the only change described within this document that will directly affect freshwater ecology values. The change will result in a reduction to the extent of earthworks within this area, with only minor earthworks required for some of the landscaping components (i.e. pathway).

There are four waterways within this area including three ephemeral and one intermittent watercourse, all of which have been categorised as having negligible ecological value. The reserve will likely result in smaller proportions of these waterways being removed compared to the previous design. Impacts on freshwater ecology values as a result of this change will be positive, however they are not considered to be substantial.

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Appendix 1: NE Terrace Concept Plan

About Boffa Miskell

Boffa Miskell is a leading New Zealand professional services consultancy with offices in Auckland, Hamilton, Tauranga, Wellington, Christchurch, Dunedin and Queenstown. We work with a wide range of local and international private and public sector clients in the areas of planning, urban design, landscape architecture, landscape planning, ecology, biosecurity, cultural heritage, graphics and mapping. Over the past four decades we have built a reputation for professionalism, innovation and excellence. During this time we have been associated with a significant number of projects that have shaped New Zealand's environment.

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