REPORT

# APPENDIX L

Tonkin+Taylor

# Peacocke Structure Plan Area: Ecological Significance Assessment

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# Executive summary

Tonkin & Taylor Ltd (T+T) has been engaged by Hamilton City Council (HCC) to undertake an assessment of significance of indigenous biodiversity within the Peacocke Structure Plan Area (PSPA) against the criteria for determining significance of indigenous biodiversity set out in Section 11A of the Waikato Regional Policy Statement (WRPS).

The assessment will assist the plan change process to support a land use change from rural and semirural to intensive residential and commercial uses in the PSPA. This assessment is informed in part by the PSPA bat report (Mueller et al. 2021). Collectively, the assessment and bat report contribute to the PSPA Biodiversity Management Framework (Baber and Kessels, 2021), which seeks to assist with achieving No Net Loss outcomes for indigenous biodiversity values across the PSPA and surrounding landscape.

In 2012 HCC identified several significant natural areas (SNAs) within the PSPA based primarily on the presence of significant indigenous vegetation (Cornes *et al*., 2012). However, we understand that the 2012 study did not assess potentially significant habitats for indigenous fauna or all wetlands.

Ecological surveys indicate that a number of animals listed as nationally 'At Risk' or 'Threatened', notably the 'Nationally Critical' long-tailed bat, use a range of habitats in the PSPA as part of their habitat requirements. This habitat can include exotic vegetation such as willows or exotic pine species in gully, wetland, shelter belt, stream or river edge habitat. Indigenous animals, particularly long-tailed bat, can rely on such exotic habitats as essential components of their life cycles, for breeding, moving through the landscape between core habitats, since indigenous vegetation is so depleted within this landscape. This exotic habitat will therefore be used even if it is of marginal quality. The WRPS ecological significance criteria do not differentiate between indigenous and exotic plants as habitat for these native animals.

To assess significance of indigenous biodiversity in the PSPA, we:

- Conducted a desktop review of all available information within the PSPA and immediate surrounds, including recent bat studies in the locality, along with a review of up-to-date aerial imagery; and
- Assessed the proposed sites against the WRPS ecological significance criteria for each site, along with maps and associated data shapefiles identifying those sites.

The Mangakōtukutuku Gully and Waikato River margin areas comprise a mixture of indigenous and exotic vegetation. These areas provide important habitat for the nationally threatened long-tailed bat and many indigenous bird and fish species. Consequently, a number of areas of indigenous vegetation or habitats within the PSPA have been identified in this assessment as significant habitat for indigenous biodiversity. This includes areas that provide existing habitat for indigenous fauna and areas that are critical for protecting the long-term viability of such through the maintenance of ecologically connectivity, i.e., ecological corridors.

Key findings associated with this ecological significance assessment are that:

1 The analysis has identified an increase in extent of ecologically significant habitats compared to those identified as SNAs in the operative District Plan. These areas now collectively include habitats of significant indigenous fauna, as well as significant indigenous vegetation and wetlands.

2 Areas identified as ecologically significant include those that currently provide significant indigenous vegetation or habitat for significant indigenous fauna, and areas considered critical to the long-term persistence of these significant habitats through buffering and/or the maintenance of ecologically connectivity in the landscape (particularly for long-tailed bats).

3 Ecological knowledge of the PSPA is incomplete. Planning mechanisms need to acknowledge and account for incomplete scientific knowledge and incorporation of new information which may alter the results of the ecological significance analysis presented in this report.

# 1 Introduction

## 1.1 Background and context

Tonkin & Taylor Ltd (T+T) has been engaged by Hamilton City Council (HCC) to undertake an assessment of significance for indigenous biodiversity within the Peacocke Structure Plan Area (PSPA). The assessment will provide technical information for the plan change process to support a land use change from rural and semirural to intensive residential and commercial uses in the PSPA. The assessment is informed by the PSPA bat report (Mueller *et al*., 2021) and other literature and databases relating to indigenous biodiversity values in the PSPA area and immediate surrounds. In turn, these documents contribute to the PSPA Biodiversity Management Framework (Baber & Kessels, 2021), which seeks to assist with intended No Net Loss objectives for indigenous biodiversity values across the PSPA and surrounding landscape.

The PSPA comprises approximately 750 ha of rural land on the southern fringe of Hamilton and was initially zoned in 2007 to provide a framework for guiding urban development (Figure 1.1). The Peacocke Structure Plan (PSP) was originally developed in 2009 to provide a framework for guiding development within the PSPA. The PSPA is Hamilton City's primary growth area and when fully developed, is likely to accommodate up to 7,500 homes.

HCC is currently reviewing the PSP to address changes in the infrastructure needs of the city in this locality and to accommodate changes in the policy framework to which the PSP must adhere. This framework includes a requirement to protect areas of significant indigenous vegetation and significant habitats of indigenous fauna (section 6(c) Resource Management Act 1991) in accordance with the criteria for determining significance of indigenous biodiversity set out in Section 11A (Table 11-1) of the Waikato Regional Policy Statement (WRPS) (herein 'WRPS criteria'). These criteria are set out in Table 2.1.

We understand the structure plan process will then consider the further protection or management of areas assessed as being ecologically significant as part of this analysis (over and above land already set aside for amenity or conservation purposes, such as esplanade reserves and stormwater wetlands, as well as other areas for urbanisation or infrastructure already consented). For example, areas that will be used for roading and ecological mitigation associated with the Southern Links designation have not been mapped in this assessment, but these areas will require coordinated consideration during the plan change process.

The PSPA presently includes four Significant Natural Areas (SNAs) already identified in the Operative Hamilton City District Plan:

- SNA 56 is situated within the mid-lower section of the Peacocke's Mangakōtukutuku sub-catchment;
- SNA 55 is situated within the Te Anau sub catchment; and
- SNA 48 and SNA 54 are located within the Waikato River corridor.

Other SNAs have been identified by the Waikato Regional Council in neighbouring districts outside the PSPA (Figure 1.1).

The existing SNAs were identified as having significant ecological character or value based primarily on indigenous vegetation. However, the PSPA has yet to be assessed against the WRPS criteria relating to significant habitat for fauna or for all wetland types.

The identification and protection of these areas of significant habitat for indigenous fauna is particularly important for the long-term persistence of the nationally 'Threatened' long-tailed bat (*Chalinolobus tuberculatus*) given that it has a threat status of 'Nationally Critical', i.e. the highest possible threat category. Furthermore, because long-tailed bats are a highly mobile, wide-ranging

species and use a diversity of habitat types, this species also serves as an 'umbrella species' whereby efforts to address effects on bats also serve to protect all or most other biodiversity values in the landscape.

Figure 1.1 shows the current extent of SNAs within the HCC boundary (red), as well as within Waipa District (orange) and Waikato District (yellow). The map indicates that SNA assessments in the adjacent Waipa and Waikato districts include a number of gully, stream and river margins identified as significant because of the significant indigenous fauna habitats they provide.

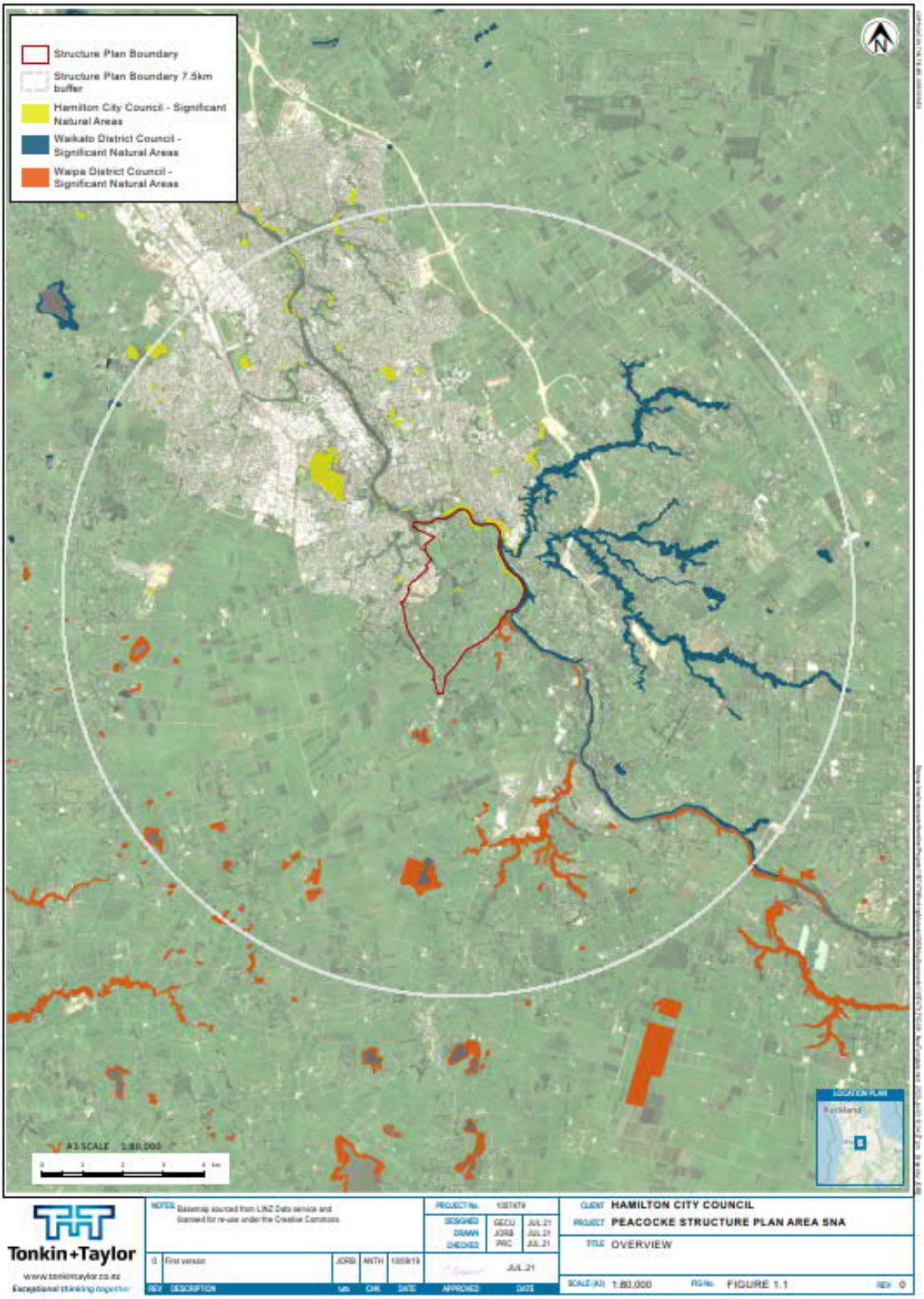


*Figure 1.1: Previously mapped SNAs in relation to the PSPA.*

## 1.2 Report purpose and scope

This report provides an assessment of significance for indigenous biodiversity to inform HCC's plan change process for the PSPA. The report will assist HCC with policy and rule development as it relates to Council's obligations under section 6(c) of the Resource Management Act 1991 (RMA), and associated policies and objectives of both the Operative Hamilton City District Plan and the Waikato Regional Policy Statement (WRPS). This assessment contributes directly to the PSPA Biodiversity Management Framework (Baber & Kessels, 2021), which seeks to assist with intended No Net Loss objectives for indigenous biodiversity values across the PSPA and surrounding landscape.

For this assessment, this report presents the findings of:

- A desktop review of available ecological information within the PSPA and immediate surrounds along with a review of up-to-date aerial imagery to identify potential candidate sites for further assessment; and
- An assessment of the ecological values of each candidate site against the WRPS ecological significance criteria (Table 2.1).

# 2 Methodology

## 2.1 Background

While the WRPS ecological significance criteria set out the ecological matters to be considered for the determination of significance, a methodology, including 'qualifying threshold criteria', is required to provide a robust and transparent framework for this assessment.

Previous SNA assessments for Waikato Regional Council (WRC) and other territorial authorities have developed best practice which is appropriate for the Waikato region (e.g. Kessels et al, 2010; van der Zwan & Kessels, 2017). WRC has also provided guidelines to allow interpretation of the WRPS significance criteria. Specifically, in 2002, WRC produced guidelines to assist with the application of assessment criteria and the determination of relative importance (or value) of each SNA (WRC and Wildland Consultants, 2002). A recently updated version of these guidelines (WRC and Wildland Consultants, in prep.) has also been used to assist in the determination of ecological significance and relative importance of ecologically significant areas for this study. While these guidelines have no legal status, they are helpful in the assessment of ecological significance as applied in this instance.

In addition, the draft National Policy Statement on Indigenous Biodiversity (NPS-IB, 2019) was also used to inform the determination of thresholds for ecological significance within the PSPA.

## 2.2 Determination of candidate sites

Available literature, databases and maps were reviewed to identify candidate sites for subsequent assessment of ecological significance (i.e. potentially significant sites). A list of key information sources used for this literature review is provided in Appendix A. GIS shapefile data of the previously mapped HCC SNA sites and orthorectified aerial imagery of the PSPA was provided by WRC.

A series of spatial datasets were overlaid on the PSPA to provide a combined dataset. Vegetation coverage was established using three key tools: orthorectified aerial photography, Land Information New Zealand (LINZ) topographic spatial data and the draft WRC Biodiversity Validation dataset (BIOVEG, 2017), to establish preliminary polygon boundaries. In addition, all vegetation (exotic and indigenous) was differentiated by spatial analysis using Aerial Photography, ArcGIS, and google earth imagery.

Normalised Difference Vegetation Index raster generation was used to obtain a vegetation mapping layer for the PSPA. Definitions and examples of vegetation/habitat structural classes and broad

vegetation types are as defined in Atkinson (1985). Indigenous vegetation type classifications were classified based on Singers and Rogers (2014), where applicable.

For the purposes of this project the minimum mapping unit was 0.05 ha (500 $m^2$) per individual polygon, rounded to the nearest 0.01 ha (100 $m^2$). Areas of indigenous vegetation or habitats smaller than 0.05 ha were not mapped or assessed unless such areas were determined to have a significance level of at least "Regional" (see Section 2.4).

## 2.3 Candidate site assessments

The information on each candidate site was then collated to inform the subsequent assessment of ecological significance.

Attribute data for each candidate site were presented in the form of an Excel spreadsheet to collate site description and significance assessment information. This spreadsheet (hereafter referred to as the 'Master dataset') included the following information to inform the assessment of each site:

- Site name and number;
- Protection status;
- Land Environments classification;
- Pre-European vegetation cover, recent vegetation cover and vegetation history;
- Ecological District Bioclimatic Zone;
- Aerial map and oblique photography review;
- Area (ha) and mid-point grid reference;
- Where available, source literature references for ecological information;
- Nationally 'Threatened' and/or 'At-risk', or regional rare or endemic fauna and flora known or likely to be present within the area assessed as ecologically significant;
- WRPS significance criteria met or likely to be met;
- Other distinctive features;
- Relative significance (i.e. either international, national, regional, local or 'not significant') and level of confidence (see section 2.6 below); and
- Explanation/justification.

The methodology used for each key stage, including assessment of each candidate site against the WRPS significance criteria (Table 2.1), is described in more detail in the sections below.

## 2.4 Significance assessment and relative level of significance

In determining whether a site is significant in terms of section 6(c), ecologists apply a set of criteria in conjunction with professional judgement. The following section outlines the approach used when determining a suitable qualifying threshold for ecological significance of candidate sites within the PSPA.

Each candidate site was assessed to determine its significance in relation to Section 6(c) of the RMA and to assign a relative level of significance in a Waikato region context. Relevant attributes were completed in the Master Dataset.

To determine whether a candidate site was significant, the following 11 criteria defined in Section 11A of the WRPS were used to identify areas of significant indigenous biodiversity and their characteristics as they existed when the criteria were applied.

Criteria may be specific to a habitat type including water, land or airspace or be more inclusive to address connectivity, or movement of species across habitat types.

A site was considered significant if at least one of the criteria were met.

Table 2.1: Criteria for determining significance of indigenous biodiversity Waikato Regional Policy Statement (Table 11-1 WRPS)

| Criteria | |
|---|---|
| 1 | It is indigenous vegetation or habitat for indigenous fauna that is currently, or is recommended to be, set aside by statute or covenant or by the Nature Heritage Fund, or Ngā Whenua Rāhui committees, or the Queen Elizabeth the Second National Trust Board of Directors, specifically for the protection of biodiversity, and meets at least one of criteria 3-11. |
| 2 | In the Coastal Marine Area, it is indigenous vegetation or habitat for indigenous fauna that has reduced in extent or degraded due to historic or present anthropogenic activity to a level where the ecological sustainability of the ecosystem is threatened. |
| 3 | It is vegetation or habitat for indigenous species or associations of indigenous species that are:<br>• classed as threatened or at risk, or<br>• endemic to the Waikato region, or<br>• at the limit of their natural range. |
| 4 | It is indigenous vegetation, habitat or ecosystem type that is under-represented (20% or less of its known or likely original extent remaining) in an Ecological District, or Ecological Region, or nationally. |
| 5 | It is indigenous vegetation or habitat that is, and prior to human settlement was, nationally uncommon such as geothermal, chenier plain, or karst ecosystems, hydrothermal vents or cold seeps. |
| 6 | It is wetland habitat for indigenous plant communities and/or indigenous fauna communities (excluding exotic rush/pasture communities) that has not been created and subsequently maintained for or in connection with:<br>• Waste treatment;<br>• Wastewater renovation;<br>• Hydro-electric power lakes (excluding Lake Taupō);<br>• Water storage for irrigation; or<br>• Water supply storage;<br>unless in those instances they meet the criteria in Whaley et al. (1995). |
| 7 | It is an area of indigenous vegetation or naturally occurring habitat that is large relative to other examples in the Waikato region of similar habitat types, and which contains all or almost all indigenous species typical of that habitat type. Note this criterion is not intended to select the largest example only in the Waikato region of any habitat type. |
| 8 | It is aquatic habitat (excluding artificial water bodies, except for those created for the maintenance and enhancement of biodiversity or as mitigation as part of a consented activity) that is within a stream, river, lake, groundwater system, wetland, intertidal mudflat or estuary, or any other part of the coastal marine area and their margins, that is critical to the self-sustainability of an indigenous species within a catchment of the Waikato region, or within the coastal marine area. In this context "critical" means essential for a specific component of the life cycle and includes breeding and spawning grounds, juvenile nursery areas, important feeding areas and migratory and dispersal pathways of an indigenous species. This includes areas that maintain connectivity between habitats. |

| Criteria | |
|---|---|
| 9 | It is an area of indigenous vegetation or habitat that is a healthy and representative example of its type because:<br>• its structure, composition, and ecological processes are largely intact; and<br>• if protected from the adverse effects of plant and animal pests and of adjacent land and water use (e.g. stock discharges, erosion, sediment disturbance), can maintain its ecological sustainability over time. |
| 10 | It is an area of indigenous vegetation or habitat that forms part of an ecological sequence, that is either not common in the Waikato region or an ecological district, or is an exceptional, representative example of its type. |
| 11 | It is an area of indigenous vegetation or habitat for indigenous species (which habitat is either naturally occurring or has been established as a mitigation measure) that forms, either on its own or in combination with other similar areas, an ecological buffer, linkage or corridor and which is necessary to protect any site identified as significant under criteria 1-10 from external adverse effects. |

Whaley et al. (1995) listed the following core ecological concepts which should be considered when determining ecological significance across all of the relevant WRPS criteria listed above:

- Representativeness: How representative is the area of the full range of ecological diversity in the present natural landscape?;
- Diversity and pattern: What is the diversity of the ecological units and pattern of vegetation types represented?;
- Rarity/special features: Presence of locally or nationally threatened species or ecosystems;
- Naturalness/intactness: Extent of indigenous species and natural communities in the area;
- Size and shape: Influence of size and shape of the area on ecological viability;
- Inherent ecological viability/long-term sustainability: Will the features of the area maintain themselves in the long-term?;
- Buffering/surrounding landscape/connectivity: Extent to which an area is buffered from modifying influences. Distance from modifying influences and other natural areas;
- Fragility and threat: Threat process and agents, effects of proposed modification; and
- Management input: Nature and scale/intervention necessary & restoration potential.

The application of these core concepts to determine qualifying thresholds for key WRPS criteria is described in further detail below.

## 2.5 Qualifying Threshold Criteria relevant to PSPA

### 2.5.1 Determining significant habitats for nationally at-risk, threatened species, or regionally rare species (Criterion 3)

Relevant species for the assessment of this vegetation or habitat include those that are 'Threatened' or 'At Risk' within the New Zealand Threat Classification System (Townsend *et al.* 2008) or those that are regionally rare species in the Waikato Region (Overdyck, 2019). As part of the ecological significance assessment process, past records of threatened indigenous fauna species were reviewed. However, many species, such as NZ kākā and NZ falcon, are only occasional users of the PSPA area as part of their vast home ranges; their occasional presence in highly modified habitat is therefore not considered sufficient to assign WRPS criterion 3 and hence to assess an area as ecologically significant.

Other fauna species, such as the long-tailed bat, regularly use or are dependent on the PSPA throughout the year. Qualifying thresholds are required to determine which areas or habitats are significant and which are not, often on the basis of an incomplete understanding of the animals' usage of this landscape (see below). Importantly, the significance of a habitat for 'Threatened' or 'At Risk' species is often heavily dependent on ecological context i.e., all else being equal, similar habitat types may differ markedly in their significance for 'Threatened' or 'At-Risk' species based on surrounding landuse dynamics and ecological connectivity.

Mueller *et al*. (2021) has determined habitat for bats based on where bat home ranges and core areas were located, combined with known roost sites. Where data was lacking, mature exotic tree shelterbelts and stands likely to provide habitat were included, both within and adjacent to the PSPA. This dataset has been used to assist in the assessment of significant habitats for long-tailed bats within the PSPA.

Some indigenous plant species which are otherwise common in the wider landscape or ecological region/district are listed as nationally 'Threatened' or 'At Risk' due to the threat posed by myrtle rust, which can infect species in the Myrtaceae family. The presence of these species alone will not necessarily trigger criterion 3 in this assessment. However, given the rarity of kānuka forest (and in fact any indigenous forest remnant) in the Hamilton ED, kānuka forest triggers criterion 4 because it is considered significant as an under-represented vegetation community type (rather than because of its 'At-Risk' status due to myrtle rust).

### 2.5.2 Determination of under-representation (Criterion 4)

Criterion 4 of the WRPS significance criteria requires assessment of ecosystem types that are under-represented (20% or less of it is known or likely original extent remaining) in an Ecological District, Ecological Region, or nationally (Singers & Rogers 2014).

### 2.5.3 Determination of significant wetland habitat (Criterion 6)

For the purpose of this assessment for the PSPA, criterion 6 of the WRPS significance criteria has been used to determine ecologically *significant* wetlands in relation to section 6c of the RMA. These wetlands include Riverine, Palustrine and Ephemeral Spring or Seep wetlands[1].

We determined what constitutes a significant wetland following the approach used by Whaley *et al*. (1995). Generally, wetlands were determined to be significant where it was apparent that indigenous wetland vegetation formed the predominant vegetation cover and/or it was known habitat for aquatic or wetland indigenous fauna species.

Determination of wetland presence and extent requires implementation of the Ministry for the Environment (MfE) wetland delineation protocols (MfE, 2020). Additionally, determination of what constitutes a 'natural wetland' is defined by the National Policy Statement for Freshwater Management (NPS-FM). We consider not all 'natural wetlands' as defined by the NPS-FM are significant as assessed against criterion 6, which requires its own assessment. Determination of wetland presence, extent, and significance, in many instances cannot be verified or detected based on desktop analysis of aerial photography. Wetland determination would require specific field surveys to validate and/or improve certainty of this desk-top assessment. Also of key importance, we note that the National Environmental Standards Freshwater 2020 regulations may significantly constrain development in or near to wetlands regardless of wetland values.

[1] Wetland definitions are as defined by Johnson, P. & Gerbeaux, P. 2004. Wetland Types in New Zealand. Science & Research Unit, Science Technology and Information Services, Department of Conservation, Wellington

### 2.5.4 Determination of aquatic habitat that is critical to an indigenous species (Criterion 8)

Criterion 8 requires an assessment of aquatic habitat[2] (excluding certain artificial water bodies,) that is critical to the self-sustainability of an indigenous species within a catchment of the Waikato Region, or within the coastal marine area. In this context 'critical' means essential for a specific component of the life cycle and includes breeding and spawning grounds, juvenile nursery areas, important feeding areas and migratory and dispersal pathways of an indigenous species. This includes areas that maintain connectivity between habitats.

The application of this criterion in relation to the PSPA focussed on the aquatic habitats of Mangakōtukutuku Gully Stream and the Waikato River, both of which provide critical habitat for the life-cycles of a number of freshwater fish species (refer to section 4.5.2 for a summary of the fish species found within waterways within or adjacent to the PSPA).

### 2.5.5 Determination of habitat that provides ecological corridors or buffers (Criterion 11)

Ecological buffers and corridors are required within the PSPA to protect ecologically significant habitats for a number of indigenous fauna species, most importantly for long-tailed bats (Mueller *et al*., 2021). The adverse effects of urbanisation associated with the PSPA are the primary trigger for criterion 11 requiring consideration within the PSPA ecological significance assessment. With respect to protecting significant habitat for long-tailed bats within the PSPA, the Mueller *et al*. (2021) report recommends:

- buffering of key habitat features (such as the Waikato River and Mangakōtukutuku Gully) to protect these key habitats and to create foraging and commuting habitats; and
- creating bespoke 'bat' corridors to link key bat habitats through urban areas and to also create additional habitat.

## 2.6 Assignment of significance categories for each candidate site

For each criterion, each candidate site was assessed as either:

- "Significant", because there was sufficient evidence for the site to trigger at least one of the 11 WRPS significance assessment criteria (Table 11-1 – WRPS);
- "Likely" to be significant where the information available indicated the site had a high likelihood of meeting one or more of the 11 criteria, but where this needed to be verified with more information, such as from field surveys;
- "Indeterminate" where there was insufficient information to determine if the site could meet any of the 11 criteria, or be classified in the "Likely" or "Not significant" categories. More information is needed for these sites, preferably from a field survey if possible; or
- "Not significant" where, based on the information available, it was certain that the site did not meet any of the 11 criteria.

The assessment of each criterion followed Table 2.1 of "Guidelines for determining areas of significant indigenous vegetation and habitats of indigenous fauna in the Waikato Region" (WRC and Wildland Consultants, 2019 – in prep.). If a site was found to be significant, then it was further assessed to determine a level of significance, i.e. "International", "National", "Regional", or "Local", following Table 2.1 of these guidelines.

[2] 'Aquatic habitat' in this context includes habitat within a stream, river, lake, groundwater system, wetland, intertidal mudflat or estuary, or any other part of the coastal marine area and their margins.

## 2.7 Confidence levels

Since this assessment was based on desktop information rather than on detailed investigations, it was important to distinguish between those sites that were expected or likely to be assessed as ecologically significant based on field investigations, versus those sites that were unlikely to be significant. This distinction in categories recognises that this may change as further information comes to light.

Confidence levels are applied to reflect the quality and quantity of information available for a given site. For each area deemed to be ecologically significant, a confidence level is applied to each criterion depending on the degree of information available. Assigned confidence levels are:

- High – well-researched sites, where ecological information about the site is comprehensive, reliable, applicable and/or recent, and site specific;
- Medium - Ecological information about the site is relatively comprehensive, reliable, not entirely applicable/ recent, and/or more likely to be general than site-specific, e.g. the information applies to a larger tract of indigenous vegetation, of which the site is a relatively small part; and
- Low – sites with little available ecological information. Information is not comprehensive, is unreliable, out-dated or general.

Sites with lower confidence levels, e.g. most sites on private land, are higher priority for field surveys than those with higher confidence levels. The qualifying thresholds for confidence levels are defined in Appendix B.

# 3 Ecological Context

## 3.1 Indigenous Vegetation Communities

The PSPA is situated within the Hamilton Ecological District (ED). Within this flat to gentle rolling hill landscape, low mounds or ridges of alluvial plains emerge by moderately to well-drained alluvium from the Hinuera formation which predominantly supported mixed conifer-broadleaf forest. In shallow depressions or swales the alluvium has more silt and clay and the poorer drainage in these soils created boggy areas that were dominated by kahikatea semi-swamp forests. In lower terraces beside the Waikato River, the alluvium has more sand and gravel and is better drained. These well drained areas suited totara-matai-kowhai forest types (Clarkson *et al.,* 2007). Very few peat areas are situated in the PSPA, but areas of poorly drained gley-soils, as well as the small areas of peat historically hosted a range of vegetation types including submerged vegetation, swamp forest, sedgelands, shrublands and restiad bogs (Clarkson *et al*., 2007).

As Cornes *et al*. (2012) states:

> "*Hamilton City, at 11,080 ha, makes up 7.0% of the 159,375 ha of Hamilton Ecological District (ED). Hamilton ED is confined to the Hamilton Basin with some of the surrounding hills and foothills included (McEwen, 1987). Leathwick et al. (1995) found less than 2% of natural vegetation that once existed in the ecological district pre 1840s still remains. Wetlands and conifer forests were the dominant ecosystems of Hamilton ED before human settlement (Harding, 1997). These two ecosystems also suffered the highest percentage reduction through anthropogenic activities. All past vegetation types are less than 2% cover within the district*."

Gullies are a feature of Hamilton City. It is estimated that these were formed about 15,000 years ago through a process called 'spring sapping'. As the Waikato River cut down into its banks, small streams were exposed which eroded steep-sided troughs that eventually became Hamilton's gully system. Gullies have two main land units: the steep gully sides, and the gully floor. On the sides, soil

material is well-drained, generally from the Hinuera formation and once supported totara-matai-kowhai forest. The gully floors are more poorly drained and were dominated by kahikatea-pukatea-swamp maire forest (Clarkson *et al*., 2007). These gully systems comprise the Mangaone, Mangaonua, Mangakōtukutuku and Mangaharakeke gullies in the proximity of the PSPA. The Mangakōtukutuku Stream gully complex traverses the western side of the PSPA. Vegetation in this gully is now dominated by exotic treeland and pastureland, with almost no indigenous vegetation remaining. Despite the large portion of exotic vegetation, the gully system provides important habitat for a range of indigenous fauna species.

Evidence from soil core samples and pollen analysis suggests that historically, most of the PSPA was once covered in conifer-broadleaf forest (Newnham *et al.* 1989). On slightly elevated mounds and ridges rimu/tawa forest would have been typical, and kauri and hard beech forests would have been found in the northern extent of the Hamilton ED. In the PSPA, kahikatea semi-swamp forest would have been dominant in the wetter, low-lying areas). The well drained terraces adjacent to the Waikato River would once have sustained totara-matai-kowhai forest.

## 3.2 Nationally Threatened Land Environments

Taking a wider national perspective on the importance of the remaining natural values within Hamilton City, Land Environments of New Zealand (LENZ) threat classification system can be used to show the scarcity of habitats left for maintaining biodiversity. LENZ is a surrogate for the likely past (pre-human) pattern of terrestrial ecosystems and their associated biodiversity. The LENZ classification system has been used to classify "National Priority 1" threatened environments (MfE, 2007a, 2007b): those with 20 percent or less remaining in indigenous cover. The maps of National Priority 1 show land environments with 20% or less remaining indigenous vegetation from a New Zealand wide perspective. These land environments have been deemed to be the most critically threatened and of highest priority for protection in New Zealand (Walker *et al*., 2015).

Figure 3.1 shows that the vast majority of Hamilton City is categorised as 'Acutely Threatened'- National Priority 1 and thus any significant habitats of indigenous flora and fauna in this category are the most threatened at a national level.

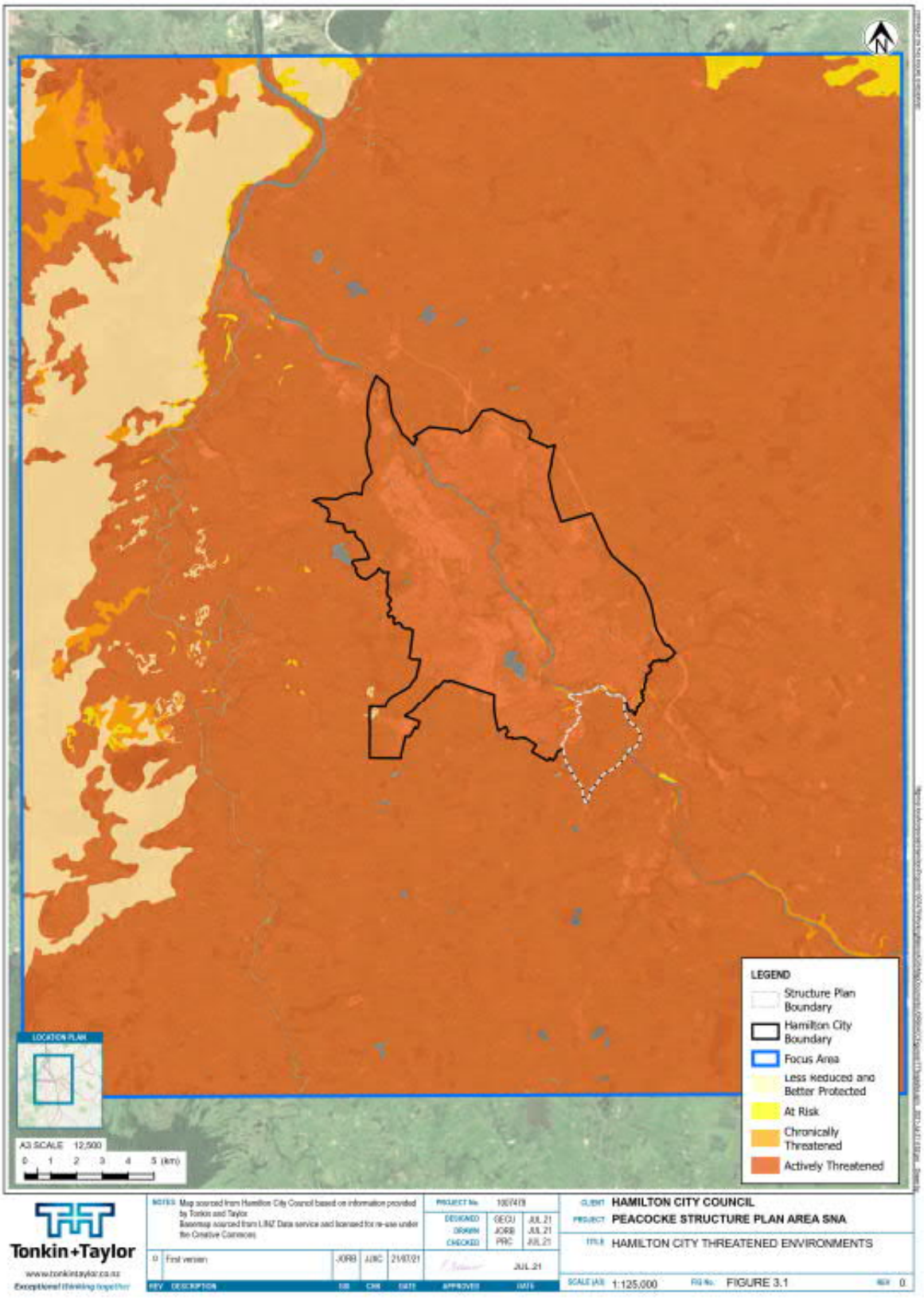


*Figure 3.1: National Priority 1 Threatened Environments within The Upper Waikato basin including Hamilton City (after Kessels Ecology 2016 – expert evidence for development of the Hamilton City District Plan)*

# 4 Ecological Significance Assessment

## 4.1 Extent of ecologically significant areas

A wide range of vegetation or habitats for indigenous fauna have been identified being ecologically significant within the PSPA based on WRPS significance criteria. These significant ecological areas have been assigned into ecological significance categories based on the ecological values they provide.

Table 4.1 provides a summary of the various habitat types found within the PSPA including their areal extent, key ecological attributes and which WRPS significance criteria they trigger.

Figure 4.1 and Figure 4.2 show the spatial distribution of these different ecological significance categories over the PSPA. As discussed in Section 2, the original assessment of significance undertaken for HCC focussed on indigenous vegetation habitats, and as Figure 4.1 shows, the SNAs identified in that study (Cornes *et al*., 2012) covered a small portion of the PSPA. However, section 11A of the WRPS requires that habitat of significant indigenous fauna and wetland habitats is also assessed, which has greatly increased the extent of identified ecologically significant areas within the PSPA.

Table 4.1: Key ecological features within the PSPA, their ecological significance, location relative to the development footprint and areal extent (a considerable amount of this will be permanently lost due to southern links; refer to section 2.6 for definitions of significance categories).

| Key Ecological Features and their aerial extent | General location | Description | Ecological characteristics and values | Key WRPS Ecological Significance Criteria Triggered |
|---|---|---|---|---|
| Ecologically significant areas of indigenous biodiversity | | | | |
| Significant indigenous terrestrial and freshwater fauna habitat: Riparian margins and associated waterways (58.74 ha) | Mostly outside the current development footprint | This includes mostly exotic forest and shrubland vegetation present along the Waikato River, Mangakōtukutuku Gully and associated tributaries in the PSPA. There are areas of wetland and stream habitats interspersed throughout. Most of this vegetation is exotic though small areas of habitat is dominated by indigenous vegetation in places and exotic dominated vegetation typically also includes native species. | These habitat types provides significant habitat for indigenous vegetation and fauna present on site, and are particularly important as roost, foraging and flyway habitat for the 'Threatened' (nationally critical) long-tailed bat and important for At Risk bird species including kākā, pied shag, little shag, little black shag, black shag and New Zealand dabchick. The waterways in this habitat complex also provide habitat for several 'At Risk' fish species, while the riparian margins enhance or protect the waterway habitat. It may also provide habitat for indigenous lizard species. | Criterion 3: Long-tailed bats and 'At Risk' fish species have been confirmed to use these habitats.<br>Criterion 4, criterion 6, criterion 8: Under-represented stream and riparian margin habitat is utilised by a range of aquatic species.<br>Criterion 11: Parts of this habitat provide an ecological buffer, linkage and corridors which are necessary to protect significant habitat from external adverse effects. |
| Significant indigenous terrestrial fauna habitat: non-riparian linear features (ecological corridors) (20.49 ha) | Mostly Inside the current development footprint | This includes shelterbelts that provide connectivity across the landscape. The vegetation is largely exotic. | This is important foraging and flyway habitat for long-tailed bats and indigenous bird species. | Criterion 3: Long-tailed bats have been confirmed to use, or likely to use, these habitats.<br>Criterion 11: This habitat provides an ecological buffer, linkage and corridors necessary to protect significant habitat from external adverse effects. |
| Significant indigenous bat | Mostly Inside the | This includes any vegetation, including pasture, within 20 m of | This is foraging and flyway habitat for long-tailed bat. | Criterion 3: Long-tailed bats have been confirmed to use, or likely to |

| Key Ecological Features and their aerial extent | General location | Description | Ecological characteristics and values | Key WRPS Ecological Significance Criteria Triggered |
|---|---|---|---|---|
| habitat: non-riparian habitat ecological buffers (56.59 ha) | current development footprint | significant riparian margins and associated waterways and significant non-riparian linear features | | use, these habitats for foraging and as flyways.<br>Criterion 11: This habitat provides an ecological buffer, linkage and corridors necessary to protect significant habitat from external adverse effects. |
| Significant Indigenous vegetation remnants (4.5 ha*) | Mostly outside development footprint | This includes small fragments, groups or individual mature indigenous trees along the margins of the Waikato River and associated tributaries in the PSPA. | This vegetation is important due to its rarity in the landscape, and provides important habitat for native flora and fauna as well as native vegetation, and fauna present on site and is potentially important as roosting, foraging and flyway habitat for the 'Threatened' (nationally critical) long-tailed bat. | Criterion 4: These small indigenous remnants are under-represented within the Hamilton Ecological District.<br>Criterion 3: Long-tailed bats have been confirmed to use, or likely to use, these habitats |
| Ecologically Significant wetlands and wetlands where significance is Likely or Indeterminate | | | | |
| Wetlands (7.3 ha) including Riverine & Palustrine wetlands (5.6 ha*) and Ephemeral Seep or Spring wetlands (1.7 ha). | Mostly outside the development footprint, but some wetlands are within pasture areas within the development footprint | The wetland areas comprise a mixture of exotic and native rushes and sedges, sometimes with a canopy of exotic deciduous trees, and native tree ferns. | Wetlands are threatened ecosystem types and may include wetland associated 'Threatened' or 'At Risk' species and are potentially important as roosting, foraging and flyway habitat for 'Threatened' (nationally critical) long tailed bat. | Significant. Some wetland areas are Likely or Indeterminate until further site-specific surveys are undertaken. Criterion 4, criterion 6, criterion 8: Under-represented wetlands and wetland habitat which is utilised by a range of aquatic and terrestrial indigenous species. |

| Key Ecological Features and their aerial extent | General location | Description | Ecological characteristics and values | Key WRPS Ecological Significance Criteria Triggered |
|---|---|---|---|---|
| Long-tailed bat habitats assessed as Indeterminate | | | | |
| Potential long-tailed bat habitat: Linear features or groups of trees non-riparian and non-buffer linear features (shelterbelts) (40.95 ha) | Mostly Inside development footprint | This includes shelterbelts or groups of trees that provide connectivity across the landscape for long-tailed bats or roosting. The vegetation is largely exotic. | This is deemed to be potentially utilised for bat roosting, foraging or commuting based on structural characteristics of the linear or groups of trees, but where survey data is inconclusive in terms of determining habitat usage (Mueller et al. 2021). | Significance status is Indeterminate until further site-specific surveys are undertaken. Criterion 3: Long-tailed bats may use these habitats but there is currently no evidence to validate usage.<br>Criterion 11: These treescapes could provide an ecological buffer, linkage and corridors necessary to protect significant habitat from external adverse effects, but there is no evidence at this point in time to validate these ecological functions. |
| Long-tailed bat habitats assessed as Indeterminate or Not Significant | | | | |
| Bat habitat: predominantly scattered trees, pasture grass and existing built structures (561 ha) | Mostly inside the development footprint | This includes open grassland, scattered trees, houses, roads and other built structures that are > 20 m (Mueller et al. 2021) away from any significant habitat types. Further survey is required to validate the status of these areas | Where not directly adjacent to (further than 20 m from) identified bat habitats, pasture areas are unlikely provide significant habitat for long-tailed bats, noting that these habitats may still be used sporadically for foraging or commuting. | Significance status Indeterminate until further site-specific surveys are undertaken or Not Significant in terms of build structures.<br>Much of these open pasture may be used occasionally by indigenous fauna, but are not likely to provide significant habitat for indigenous long-tailed bats. However, further studies may indicate that long-tailed bats require specific parts of these areas. Should further studies identify regular usage of some localities within the PSPA not |

| Key Ecological Features and their aerial extent | General location | Description | Ecological characteristics and values | Key WRPS Ecological Significance Criteria Triggered |
|---|---|---|---|---|
| | | | | identified as significant, then criterion 3 and/or criterion 11 could be triggered. Build areas are not significant habitats for indigenous fauna. |

NB: *Existing SNA and some wetlands have been included in the sum total for riparian margins and associated waterways therefore the overall spatial extent of ecologically significant areas is less than the sum of all significant areas

## 4.2 Terrestrial Indigenous Plant Communities

Leathwick *et al*. (1995) calculated the decline in indigenous vegetation since 1840 and current percentage cover. Since 1840, the Hamilton ED has had a 97.8% reduction in indigenous vegetation. Percentage cover of indigenous vegetation in 1995 was about 1% forest and less than 1% scrub and wetland for the entire Hamilton ED. Therefore, any structurally intact plant communities dominated by indigenous vegetation within the PSPA are considered ecological significant in accordance with criterion 4 of the WRPS significance criteria ("*It is indigenous vegetation, habitat or ecosystem type that is under-represented (20% or less of its known or likely original extent remaining) in an Ecological District, or Ecological Region, or nationally*").

Within the PSPA only very small and scattered fragments of indigenous forest, shrubland and wetland remain, all of which are secondary growth and modified to some extent. These SNAs were identified and mapped by Cornes *et al*., (2012) as shown Figure 4.1 and have been included in the Master Dataset as being ecologically significant.

## 4.3 Significant vascular plant species

Table C1, Appendix C, lists the nationally 'At-Risk' and 'Threatened' plant species found or likely to be found within the PSPA.

Poroporo (*Solanum aviculare var. aviculare*), which is 'Threatened – Nationally Vulnerable' (de Lange *et al*., 2018), has been recorded as being present in the vicinity of the PSPA. While this species could potentially be present within the PSPA, it has not been recorded there.

Aside from this species, several species now classified as 'Threatened' due to the threat posed by Myrtle rust are present and naturally occurring, in particular kānuka and mānuka. However, as discussed in section 2.5.1 above, these species have been listed as 'At-Risk' due to the risk posed by myrtle rust, and sites where these species are present are not considered to be significant habitat in terms of the WRPS criteria on this basis alone. However, given its rarity in the Hamilton ED, kānuka forest is considered ecologically significant and is one of the four sites mapped as an SNA by Cornes *et al*. (2012; Figure 4.1) and is hence included in the Master Dataset.

## 4.4 Ecologically significant wetlands & habitats of freshwater indigenous fauna

Wetlands, waterways and artificially created ponds have been mapped as shown on Figure 4.2. However, it is key to note that the composition of wetland vegetation cover, especially for small wetlands cannot be determined accurately through GIS desktop analysis. Many of the wetlands mapped as artificially created areas, such as 'detention ponds', 'culvert damming' 'farm pond' or aesthetic pond' are unlikely to meet criterion 6 of the WRPS significance set (but could trigger other criteria, such as criterion 3). Ground truthing is required to determine a more accurate representation of ecologically significant wetlands within the PSPA.

For the purposes of this desktop assessment, all areas identified as Riverine, Palustrine, Ephemeral Spring or Seep wetlands (as defined by Johnson & Gerbeaux 2004) are considered ecologically significant, meeting criterion 6 of the WRPS criteria, and the specific areas have been assigned as such in the Master Dataset.

As discussed in section 4.5.2, indigenous fish and freshwater invertebrates listed as nationally 'At Risk' or 'Threatened' by the Department of Conservation use freshwater streams and wetland habitats in the PSPA as part of their full life cycle requirements. Where this habitat is buffered by well-vegetated riparian margins, often exotic, these areas are considered to trigger either criterion 3, criterion 6, criterion 8 or criterion 11 of the WRPS significance criteria. These areas have been

assigned as being significant, either being captured in the significant wetland layer or the significant bat habitat GIS layers, and have also been included in the Master Dataset.

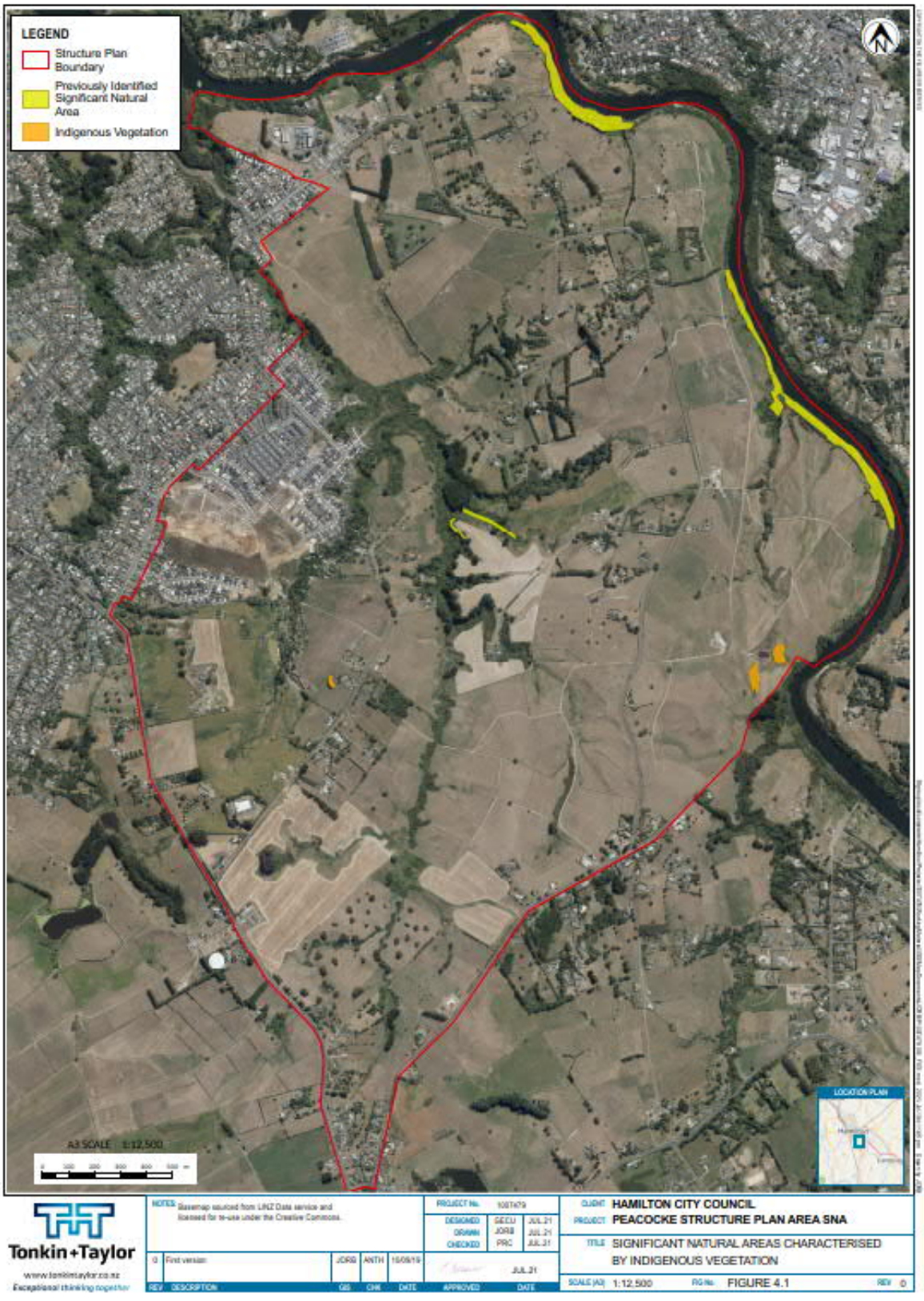


*Figure 4.1: Existing mapped SNA and indigenous vegetation SNA within the Peacocke Structure Plan Area (as identified by Cornes et al., 2012)*

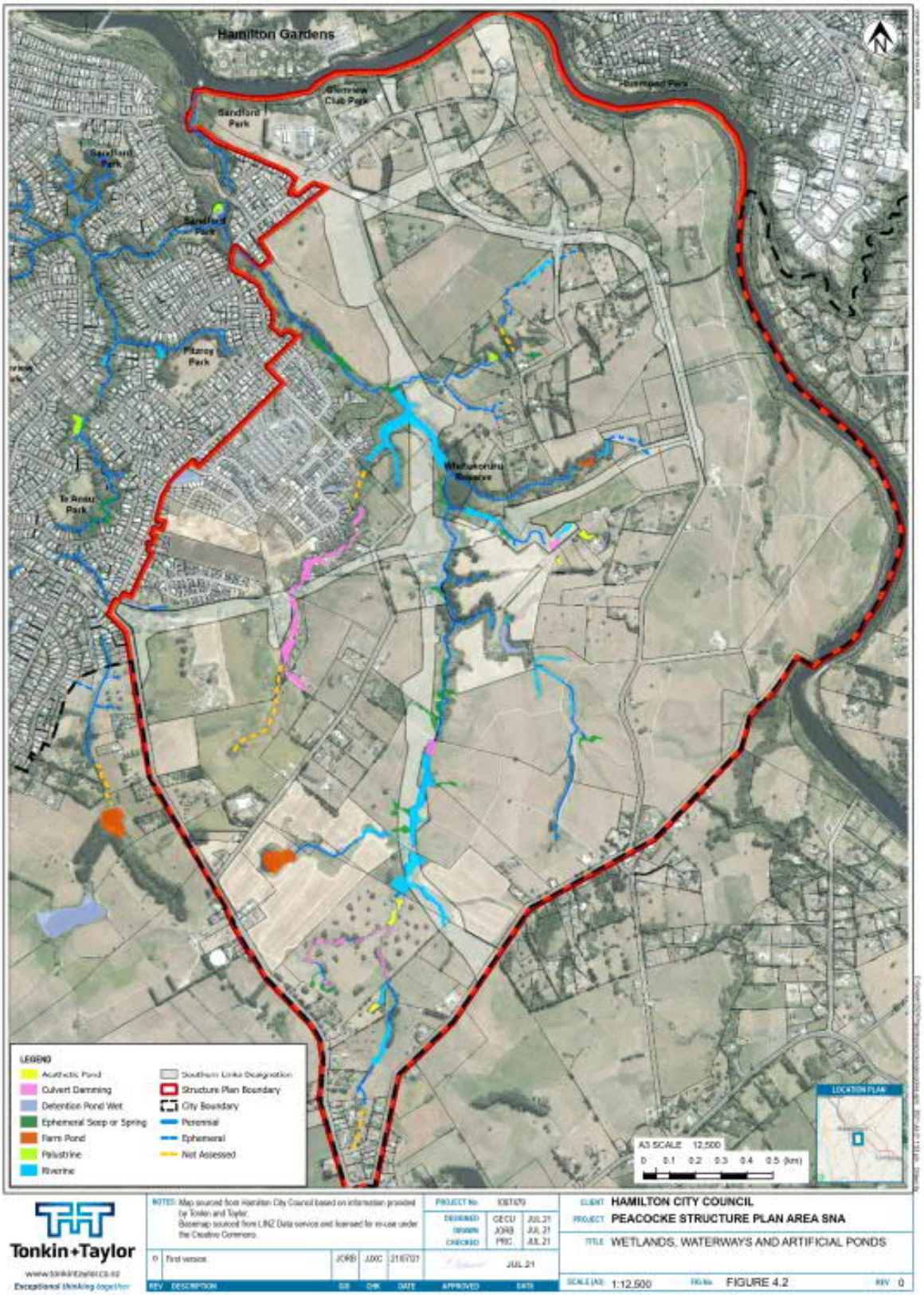


*Figure 4.2: Wetlands found within the Peacocke Structure Plan Area*

## 4.5 Ecologically significant habitat for indigenous fauna

Within the PSPA, indigenous animals rely on exotic habitats as essential components of their life cycles, for breeding or migration, or buffering waterways. Because indigenous vegetation is so depleted within this landscape, this habitat is the only habitat available, even if it is of marginal habitat quality and is very weedy. The WRPS significance criteria do not differentiate between indigenous and exotic plants as habitat for these 'At Risk' and 'Threatened' animals.

As Wildlands & WRC (in prep.) state: "*Areas of vegetation and habitats of indigenous fauna are not static in the environment; they will change with natural processes, climatic changes, and as a result of active management. Consequently the ecological values of a site can change over time and a site which may previously have been assessed as Not Presently Significant may be assessed as Significant or of Indeterminate Significance at a later date*."

Where habitat is shown to be regularly used by nationally 'Threatened' and 'At Risk' fauna, criterion 3 of the WRPS is met, making those areas ecologically significant. Appendix C contains tables which list the nationally 'Threatened' and 'At Risk' fauna species recorded as being present, or likely to be present, in the PSPA. The following sections provide a summary of the key indigenous fauna, including nationally 'At-Risk' and 'Threatened' species, present or potentially present in the PSPA.

### 4.5.1 Invertebrates

Two terrestrial invertebrate species listed as regionally uncommon – Auckland tree weta and velvet worm (*Peripatus novaezelandiae*) – may be present within forested vegetation (Overdyk *et al*., 2019). Although they have not been recorded within the PSPA, they are found in the Hamilton Ecological District and indigenous vegetation remnants in the gully areas may be suitable habitat for these species.

In terms of freshwater invertebrates, kākahi – freshwater mussel (*Echyridella menziesii*) - At Risk – Declining, and the freshwater snail – (*Austropeplea tomentosa)* – Data Deficient - have been recorded within waterways in proximity to the PSPA and may be present in the Mangakōtukutuku Gully Stream and the Waikato River.

### 4.5.2 Fish

The Hamilton Ecological District is home to a wide range of fish species as identified in Dunn *et al*. (2018) and those species potentially found within the PSPA are summarised in Table C3, Appendix C. The New Zealand Freshwater Fish Database (NZFFDB) indicates the presence of longfin eel (*Anguilla diefenbachii*), lamprey (*Geotria australis*), īnanga (*galaxias maculatus*), giant kōkopu (*Galaxias argenteus*), shortjaw kōkopu (*Galaxias postvectis*), torrentfish (*Cheimarrichthys fosteri*), redfin bully (*Gobiomorphus huttoni*), koaro (*Galaxias brevipinnis*), and black mudfish (*Neochanna diverus*), all classified as 'At Risk' or 'Threatened'.

The presence of 'At Risk' or 'Threatened' indigenous fish within the streams and wetlands of the PSPA triggers criterion 3, criterion 6 and criterion 8 of the WRPS ecological significance criteria.

### 4.5.3 Lizards

Three lizard species have been recorded in the locality (DOC BioWeb database). The most common of these is the copper skink, (*Oligosoma aeneum*), which is widespread in the Waikato and not threatened (Hitchmough *et al*., 2016). Faecal material attributed to forest gecko (*Mokopirirakau granulatus*) has been reported in the Hakarimata Ranges, some 30 km to the north. DOC also has a

record of the threatened elegant gecko (*Naultinus elegans*) from Hakarimata (BioWeb database). Ornate skink (*O. ornatum*) may also be present as may Pacific gecko (Dactylocnemis pacificus).

Only copper skink and the introduced Australian plague skink (*Lampropholis delicata*) are known to be present within the PSPA footprint. The presence of copper skink in the PSPA, not being an 'At Risk' or 'Threatened' species, does not trigger any of the WRPS ecological significance criteria.

### 4.5.4 Birds

The PSPA has a diverse bird assemblage, which includes both terrestrial species, and species associated with wetland/water habitats, reflecting its location directly adjacent to the Waikato River. In terms of abundance, the avifauna assemblage is dominated by naturalised introduced species which are common in the agricultural landscape surrounding Hamilton (Fitzgerald & Innes, 2013). Common indigenous birds, such as tūī (*Prosthemadera novaeseelandiae novaeseelandiae*), kererū (*Hemiphaga novaeseelandiae*), grey warbler (*Gerygone igata*), shining cuckoo (*Chrysococcyx lucidus lucidus*), fantail (*Rhipidura fuliginosa placabilis*) and kingfisher (*Todiramphus sanctus vagans*), are found throughout the Hamilton Basin area, particularly within the larger areas of bush, and are all found in the PSPA, particularly in the gully and river habitats. The 'At Risk (naturally uncommon) Long-tailed cuckoo (*Eudynamys taitensis*) may also be present on occasion.

Table C5 in Appendix C lists a range of 'Threatened' and 'At Risk' bird species which have been recorded in proximity to the PSPA, but not specifically within the PSPA. These species include grey duck *(Anas superciliosa)*, pipit *(Anthus novaeseelandiae novaeseelandiae)*, kōtuku *(Ardea modesta)*, Australasian bittern *(Botaurus poiciloptilus)*, fernbird (*Bowdleria punctata vealeae)*, banded rail (*Gallirallus philippensis assimilis)*, pied oystercatcher (*Haematopus finschi)*, dabchick *(Poliocephalus rufopectus)*, black billed gull (*Larus bulleri)*, red billed gull *(Larus novaehollandiae scopulinus*), royal spoonbill (*Platalea regia)*, marsh crake (*Porzana pusilla affinis)* & spotless crake (*Porzana tabuensis tabuensis)*. While habitat is available for these species, there is not data confirming their presence or absence at this point in time.

Several 'At Risk' bird species that have been regularly detected in the wider Hamilton City area and are potentially present within the PSPA include the North Island kākā (*Nestor meridionalis septentrionalis)*, karearea (*Falco novaeseelandiae ferox)*, and pied shag *(Phalacrocorax varius varius*), all of which are classified as 'At Risk – recovering'; and the little black shag (*Phalacrocorax sulcirostris)* and black shag (*Phalacrocorax carbo novaehollandiae)*, both of which are classified as 'At Risk – Naturally Uncommon'. The riparian margin vegetation along the Waikato River may be utilised by the shag species for roosting and/or nesting. Like other rural and urban parts of the Hamilton area, kākā may visit the site when dispersing during winter, or as a short visit, but are unlikely to inhabit the area for long periods (Fitzgerald & Innes, 2013). Therefore, the occasional use of habitat in the PSPA by kākā or kārearea is not considered sufficient to trigger criterion 3 of the WRPS criteria as containing significant habitats for these species.

### 4.5.5 Long-tailed bat habitats

The New Zealand long-tailed bat is considered vulnerable to extinction and is ranked as 'Threatened - Nationally Critical', which is the highest threat ranking in the Department of Conservation's threat classification system. The species meets this threat ranking because it is undergoing a "very high ongoing or predicted decline (> 70%)." (O'Donnell *et al*., 2018).

Mueller *et al*., (2021) summarise several studies which show long-tailed bats use a variety of habitats within the PSPA for roosting, commuting, and foraging as shown in Figure 4.3. These are likely to be important habitats for long-tailed bats in this locality. The variety of inter-connected habitats in this southern part of Hamilton means this is the most important locality for long-tailed bat habitat within Hamilton City.

The Mueller *et al*., (2021) report considers that the most valuable bat habitats are those dominated by indigenous or exotic forest, open water, water ways, and parkland habitats. Research shows that the least selected habitats for long-tailed bats are pastoral, urban and industrial areas. While research demonstrated that bats will disperse across open grassland, this is not preferred habitat since even when flying over pasture bats appear to require structural cues, such as vegetation edges, to bounce their echolocation calls off to navigate and to forage efficiently. This foraging mostly occurs in pasture adjacent to shrubland, trees and open water adjacent to linear features, edges and gaps (Mueller *et al*., 2021).

Nonetheless, Mueller *et al*., (2021) state that shelterbelts and clusters of mature trees within the existing pastoral landscape of the PSPA are likely an important part of bat habitat. The connectivity of the tree networks has been found to be important to allow bats to commute across the landscape. These treescapes (usually exotic) can just be a single line of trees but they still provide structural cues, shelter from the wind, and darkness so bats can move along the edges of them without being detected by predators.

The Mueller *et al*., (2021) report provides a detailed summary of the roosting habitat preferences of long-tailed bats, particularly in relation to the PSPA. Long-tailed bats preferentially roost in the oldest and largest trees in the landscape (exotic and indigenous species). They switch roosts often and use roosts with different characteristics during different stages of their life cycle. Communal roosts are known to be frequented by reproductive females and their young, whilst solitary roosting bats are mainly males and post-lactating females.

Thus, the most important habitats for bats appear to be riparian and gully margins, with dense indigenous and exotic trees and shrubs associated with riverine and gully landscapes, as well as mature tree shelter belts and stands of trees (exotic or indigenous). Bats depend on access to key resources associated with these environments. In particular, these habitats provide:

- Mature exotic and indigenous vegetation for roosting purposes;
- Emergent aquatic insect prey for foraging;
- Freshwater for drinking; and
- Linear features providing corridors for movement and navigation.

On this basis, the Mueller *et al*., (2021) report mapped and assigned a value to long-tailed bat habitats of 'high value', 'moderate value' or 'low value' (see Figure 4.3) as follows:

- 'High value' habitats included the margins of the Waikato River, Mangakōtukutuku Gully and known roost sites;
- 'Moderate value' habitats included areas containing:
  - vegetation,
  - edge pasture habitat near high value habitat which may be utilised by bats as commuting corridors,
  - foraging habitats, or
  - potential bat roost trees
- 'Low value' habitats included areas of open pasture and scattered trees which may provide occasional foraging or commuting habitat for bats.

Human-made structures, such as buildings and roads, are highly unlikely to provide habitat for bats.

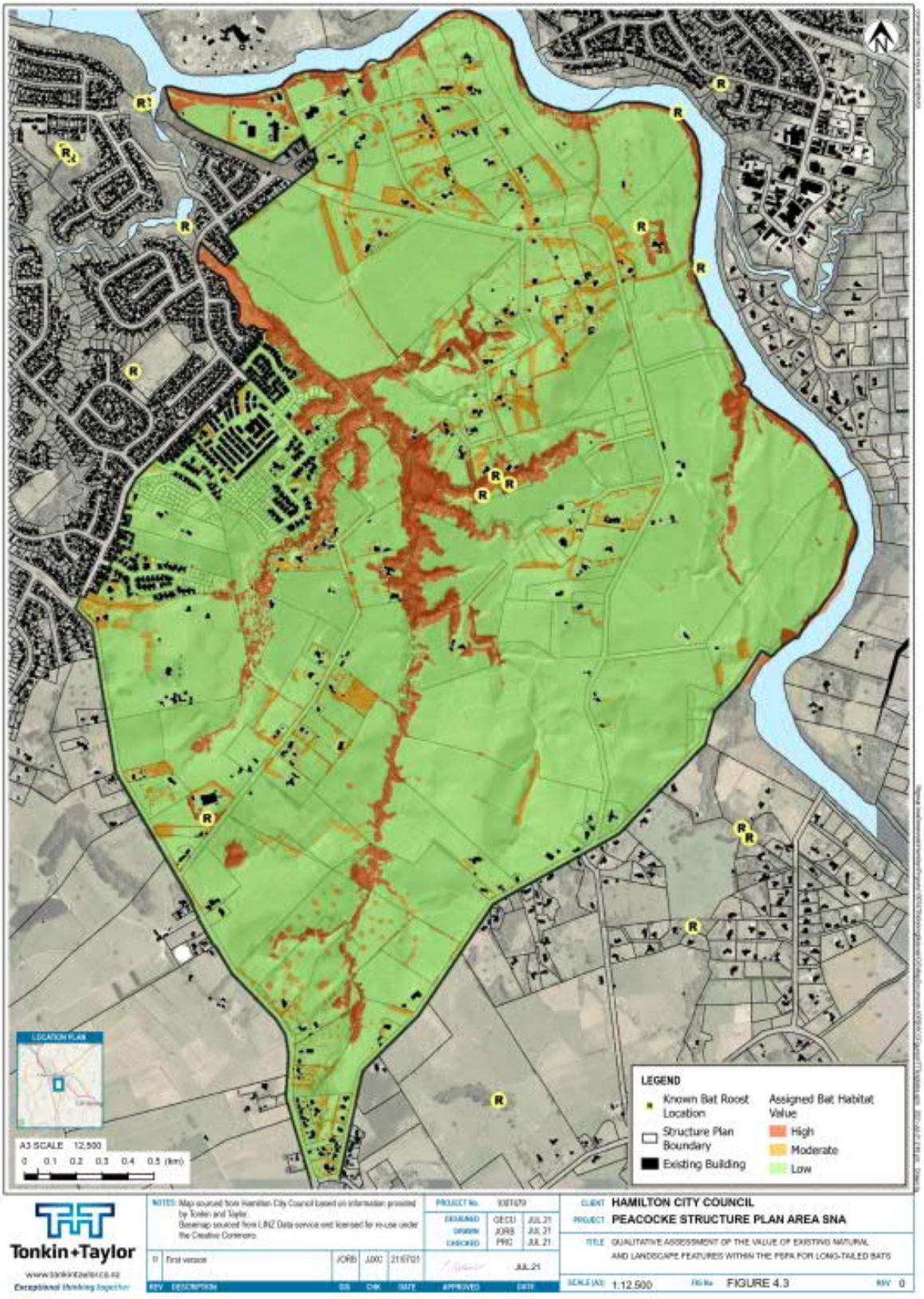


*Figure 4.3: Qualitative assessment of the value of existing natural and landscape features within the PSPA for long-tailed bats. (from Mueller et al., 2021).*

### 4.5.6 Protection of long-tailed bat habitat

The habitat identification and assignment applied by the Mueller *et al*., (2021) report, and shown in Figure 4.3, was used to apply the WRPS criteria to determinate ecological significance. Applying the Mueller *et al*., (2021) habitat valuation assessment, the following habitat protection areas for long-tailed bats are recommended (Figure 4.4):

a) Significant Bat Habitats: Significant Bat Habitats have been determined on the basis of known roost sites and/or known clearly defined habitats regularly used by bats for foraging, flyway navigation as identified in the Mueller *et al*.(2021) report as "High" value habitat – refer to Figure 4.3. These habitats include Waikato River and Mangakōtukutuku Gully and known roost sites. The Significant Bat Habitats also include areas where acoustic surveys or radio tracking of bats indicates regular use of vegetation for aids to flyway navigation and/or foraging associated with these habitats. These Significant Bat Habitats meet criterion 3 of the WRPS significance criteria.

b) Significant Bat Buffer Habitat: Adjacent to significant bat habitats, a 20 m Significant Bat Buffer Habitat has been applied as surveys show regular usage by long-tailed bats in these 'eco-tone' margins[3] (see Mueller *et al*., 2021). This buffer area has also been applied to buffer the Significant Bat Habitats and protect the functional attributes of these edge habitats as bat foraging and flyway habitat (Mueller *et al*., 2021). Specific planning consideration will be required to create and restore these buffer habitats over time as the PSPA urbanises. The Significant Bat Buffer areas meet criterion 3 and criterion 11 of the WRPS significance criteria.

c) Bat Corridors: Three indicative Bat Corridors have been mapped. These indicate areas in the landscape where specific planning consideration is required to create and restore habitat over time which promotes flyway corridors between key significant bat habitats as the PSPA urbanises. These are indicatively 50 m wide to allow for protection and creation of bespoke tree corridors and other habitat to facilitate usage by bats (see Mueller et al. 2021). The Bat Corridor areas will meet criterion 3 and criterion 11 of the WRPS significance criteria.

d) Bat Setback Areas: A 5 m Bat Setback area is recommended to be applied on the outside of the Bat Buffer Habitats and Bat Corridor Habitats based on information provided in Mueller et al. 2021. This setback area is a mitigation measure for urbanisation of the PSPA, forms part of the Ecological Buffer Area and hence triggers criterion 11 of the WRPS criteria. Planning mechanisms are recommended in these setbacks to create bespoke measures which assist in the avoidance of adverse effects of land use change activities on Significant Bat Habitats, Bat Buffer Habitats and Bat Corridors, such as adverse effects associated with artificial lighting.

e) Likely or Indeterminate Bat Habitats: The PSPA contain a number of linear and clusters of mature exotic trees which may be potentially utilised by bat for roosting, foraging or commuting, but where existing studies suggest these areas are likely to be of 'moderate' to 'low' value habitat for long-tailed bats (Mueller et al. 2021). However, survey data is currently inconclusive in terms of determining the significance of this habitat usage for bats.

[3] An ecotone is a transition area between two biological communities, where two communities meet and integrate. It may be narrow or wide, and it may be local (in this case the zone between pasture and forest/treeland) or regional (the transition between forest and grassland ecosystems). An ecotone may appear on the ground as a gradual blending of the two communities across a broad area, or it may manifest itself as a sharp boundary line.

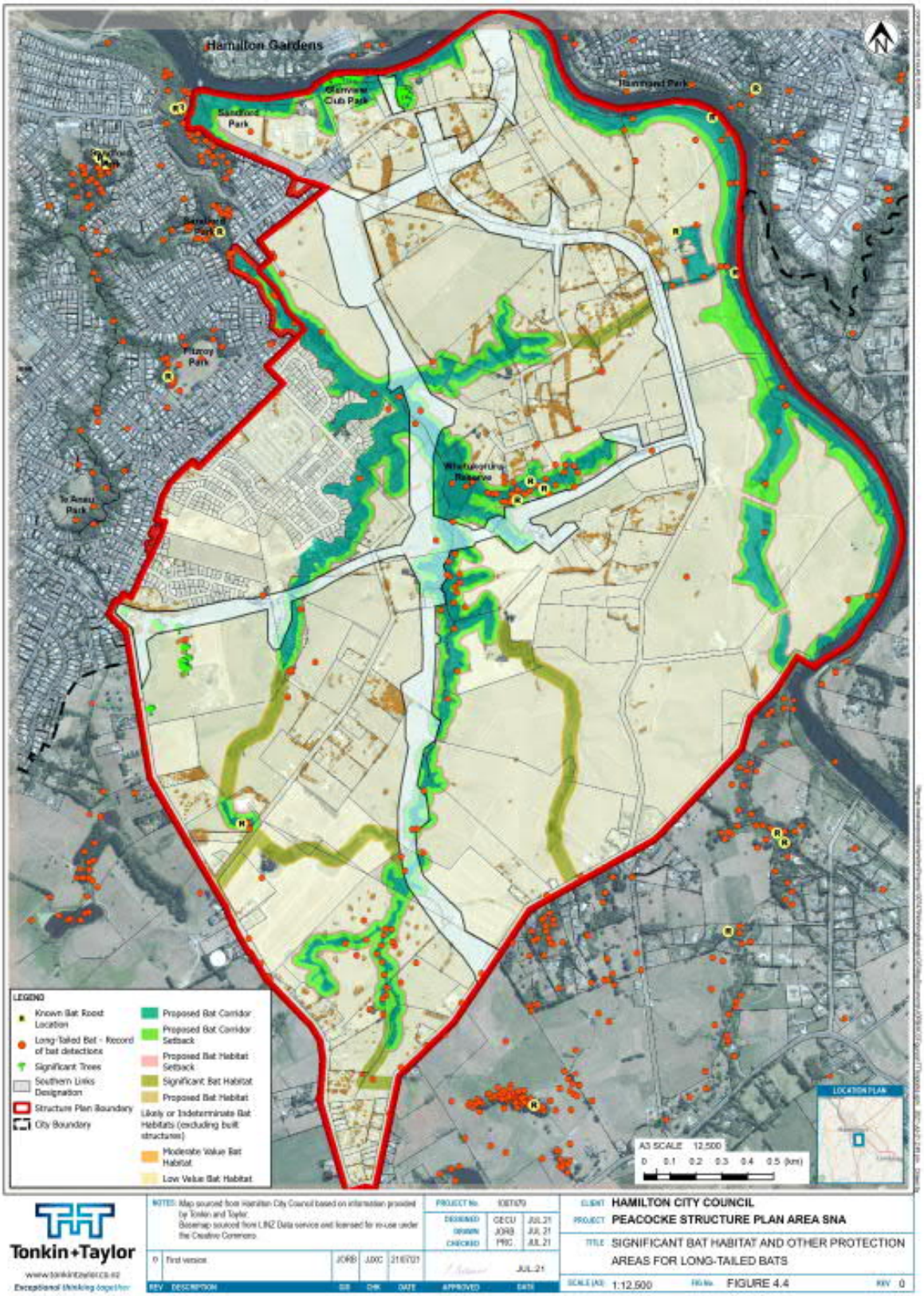


*Figure 4.4: Significant Bat Habitats within the Peacocke Structure Plan Area*

# 5 Conclusion & recommendations

The Mangakōtukutuku Gully and Waikato River margins comprise a mixture of indigenous and exotic vegetation. These areas contain remnant wetlands, forest fragments, and provide important habitat for many indigenous bird and fish species, as well as for long-tailed bats. The ecological significance criteria of the WRPS do not differentiate between indigenous and exotic ecosystems as significant habitat for these 'At Risk' and 'Threatened' plants and animals.

This assessment of significance of indigenous biodiversity within the PSPA highlights several ecological management aspects which likely will require consideration at the policy and regulatory level for HCC in the preparation of the Peacocke Structure Plan change. These are:

1 This analysis recommends a much greater and wider extent of ecologically significant areas than previously identified in the HCC SNA report (Cornes *et al*., 2012). In addition, buffer and corridors are recommended to protect habitats for long-tailed bats. These ecologically significant areas identify buffer zones and future corridors to protect the functional values of key habitats for bats as the structure plan area becomes urbanised. Many of these habitats are dominated by exotic vegetation or are situated within private ownership.

2 The Master dataset of candidate areas for ecological significance is based on our desktop review of recent studies and databases, as well as review of recent aerial imagery. However, further surveys and research may provide scientific information which provides greater certainty as to the significance ranking of these sites. In particular, habitats for long-tailed bats and wetlands identified were in some cases, valued as 'likely' or 'indeterminate' as candidate areas for ecological significance because of the lack of absolute certainty associated with a desktop analysis.

3 Planning mechanisms need to acknowledge and account for incomplete scientific knowledge and incorporation of new information which may affect the ecological significance analysis presented in this report.

# 6 Applicability

This report has been prepared for the exclusive use of our client Hamilton City Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

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# Appendix A: Key Source Literature & Databases

| Dataset | Source |
|---|---|
| Biodiversity Vegetation (BIOVEG) 2012 - GIS Layer | The dataset currently contains mapped polygons representing terrestrial vegetation, palustrine wetlands, mangroves, and saline wetlands within Waikato Regional Council boundary. The data set was digitised off the 2012 WRAPS imagery using a simplified version of the Land cover database (LCDB) classifications. This work is licensed under a Creative Commons Attribution 4.0 International License International (CC BY 4.0). © Waikato Regional Council 2017. |
| Aerial Photography – WRAPS 2017 | Colour digital orthophotography for the Waikato region. This work is licensed under a Creative Commons Attribution 4.0 International License. © Waikato Regional Council 2017. |
| Aerial Photography - Kauri Dieback Oblique Imager | This work is licensed under a Creative Commons Attribution 4.0 International License © Waikato Regional Council 2016. Kauri Dieback Surveillance – Oblique Aerial Photography. Surveyed by Biospatial Limited. Licensed under CC BY 4.0. |
| Hamilton City Council Significant Natural Areas | Hamilton City Council |
| Land Environments of New Zealand (LENZ) Threatened Environment Classification (TEC) | Land Information New Zealand (2019) |
| WRC Vegetation Type data (draft – based on Singers & Rogers 2014) | Waikato Regional Council (2018) |
| Protected areas | Land Information New Zealand (2019) |
| Freshwater fish | NIWA NZ Freshwater Fish Database (2019) |
| Bats | DOC National Bat Database (2019)<br>Recent published research as cited |
| Threatened plants | Department of Conservation BioWeb (2012) |
| Herpetofauna | Department of Conservation BioWeb (2012) |
| Bird casual observation records | Department of Conservation BioWeb (2012) |
| Random observations – multiple taxa | iNaturalist (2018; research grade observations only) |
| Summaries of Hamilton City biennial bird counts | Fitzgerald and Innes (2013) and Ornithological Society of New Zealand census summaries (Cornes et al., 2012a) |
| New Zealand Plant Conservation Network plant distribution database information | New Zealand Plant Conservation Network drawn from National Vegetation Survey Database (NVS) |
| Leathwick, J.R.; Clarkson, B.D.; Whaley, P.T. 1995. Vegetation of the Waikato Region: Current and Historical perspectives. | Landcare Research contract report LC9596/022. Waikato Regional Council, Hamilton |
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# Appendix B: Confidence Level Definitions

Definitions and factors to consider when applying a Confidence Level to the significance assessment of a site. (after van der Zwan & Kessels, 2017)

| Confidence level | Definition |
|---|---|
| High | High level of confidence in assessment.<br>Ecological information about the site is:<br>• Comprehensive<br>• Reliable<br>• Applicable and/or recent<br>• Site specific<br>Sites with a high confidence rating include:<br>• Relatively large, well-studied, protected areas.<br>• Protected areas that are well known as habitats for threatened species, e.g. Mahoenui giant weta Scientific Reserve, Mapara Scenic Reserve (a habitat for kokako).<br>• Unprotected sites that have been identified as recommended areas for protection in a protected natural areas survey.<br>• Other sites that have been the subject of fauna and/or flora surveys and the information is comprehensive, reliable, recent and site-specific.<br>Sites with a high confidence level have a low requirement for field survey |
| Medium | Moderate level of confidence in assessment.<br>Ecological information about the site is:<br>• Relatively comprehensive<br>• Reliable<br>• Not entirely applicable/ recent<br>• More likely to be general than site-specific, e.g. the information applies to a larger tract of indigenous vegetation, of which the site is a relatively small part.<br>Sites with a moderate confidence rating include:<br>• Sites where the assessment is based on ecological information that does not meet all of the criteria for a high confidence level.<br>• Sites that are contiguous with a site that has a high confidence level, and information about the contiguous site is assumed to be applicable to the site that is being assessed.<br>• Sites that have been assessed as nationally or regionally significant on the basis of a record of a single species (such as kererū) without meeting other criteria for national or regional significance.<br>• Sites for which incomplete ecological information exists, and for which targeted surveys may result in records of threatened species.<br>Sites with a medium confidence level have a requirement for field survey. |

| Confidence level | Definition |
|---|---|
| Low | Low level of confidence in the assessment.<br>Ecological information about the site is not available or is:<br>• Not comprehensive<br>• Unreliable<br>• Out-dated<br>• General<br>Sites with a low confidence rating include:<br>• Very small protected sites e.g. marginal strips.<br>• Unprotected sites within ecological districts where a protected natural areas survey has not been undertaken.<br>• Sites that have met criteria for national significance, solely on the basis of a record of a species (e.g. kiwi, kokako) that is probably extinct at the site.<br>Sites with a low confidence level have a high requirement for field survey. |

# Appendix C: Nationally At Risk and Threatened Species Lists

## Vascular plants

Appendix C Table C1: Threat status of vascular plant species that have been recorded in the PSPA (or are likely within the PSPA)

| Species Name | Common/Māori Name | Threat Status |
|---|---|---|
| *Kunzea ericoides* | Kānuka | Threatened – Nationally Vulnerable |
| *Leptospermum scoparium* | Mānuka | Threatened – Nationally Vulnerable |
| *Solanum aviculare var. aviculare* | Poroporo | Threatened – Nationally Vulnerable |

## Freshwater invertebrates

Appendix C Table C2: Threat status of freshwater invertebrate species recorded in the locality of the PSPA. (Names and threat status obtained from NZFFDB, Grainger et al., 2014).

| Species Name | Common/Māori Name | Threat status |
|---|---|---|
| *Echyridella menziesii* | Freshwater mussel, kākahi | At Risk – Declining |
| *Austropeplea tomentosa* | Freshwater snail | Data Deficient |

## Freshwater fish

Appendix C Table C3: Threat status of freshwater vertebrate species recorded in the PSPA. (Names and threat status obtained from NZFFDB, Goodman et al., 2014).

| Species Name | Common/Māori Name | Threat status |
|---|---|---|
| *Anguilla dieffenbachii* | Longfin eel, tuna | At Risk – Declining |
| *Cheimarrichthys fosteri* | Torrentfish, piripiripohatu | At Risk – Declining |
| *Galaxias argenteus* | Giant kōkopu, taiwharu | At Risk – Declining |
| *Galaxias brevipinnis* | Koaro | At Risk – Declining |
| *Galaxias maculatus* | Īnanga, inaka | At Risk – Declining |
| *Galaxias postvectis* | Shortjaw kōkopu | Threatened – Nationally Vulnerable |
| *Geotria australis* | Lamprey, kanakana | Threatened – Nationally Vulnerable |
| *Gobiomorphus huttoni* | Redfin bully | At Risk – Declining |
| *Neochanna diversus* | Black mudfish | At Risk – Declining |

## Lizards

Appendix C Table C4: Threat status of herpetofauna species recorded in the vicinity of the PSPA. (Names and threat status obtained from DOC BioWeb Herpetofauna Database 2013, BIMS, Hitchmough et al., 2016).

| Scientific name | Common/Māori name | Threat status |
|---|---|---|
| *Mokopirirakau granulatus* | Forest gecko, moko-piri-rā kau | At Risk – Declining |
| *Naultinus elegans elegans* | Auckland green gecko, elegant gecko, kakariki | At Risk – Declining |
| *Oligosoma ornatum* | Ornate skink | At Risk – Declining |

## Avifauna (Birds)

Appendix C Table C5: Threat status of avifauna species recorded in the vicinity of the PSPA. (Names and threat status obtained from DOC BioWeb Casual Observations Database 2013, BIMS, Robertson et al., 2017).

| Scientific name | Common/Māori name | Threat status |
|---|---|---|
| *Anas superciliosa* | Grey duck, pārera | Threatened – Nationally Critical |
| *Anthus novaeseelandiae novaeseelandiae* | New Zealand pipit, pīhoihoi | At Risk – Declining |
| *Ardea modesta* | White heron, kōtuku | Threatened – Nationally Critical |
| *Botaurus poiciloptilus* | Australasian bittern, matuku hūrepo | Threatened – Nationally Critical |
| *Bowdleria punctata vealeae* | North Island fernbird, mātātā | At Risk – Declining |
| *Eudynamys taitensis* | Long-tailed cuckoo, koekoea | At Risk – Naturally Uncommon |
| *Falco novaeseelandiae ferox* | Bush falcon, karearea | At Risk – Recovering |
| *Gallirallus philippensis assimilis* | Banded rail, moho pererū | At Risk – Declining |
| *Haematopus finschi* | New Zealand pied oystercatcher, tōrea | At Risk – Declining |
| *Larus bulleri* | Black billed gull, tarāpuka | Threatened – Nationally Critical |
| *Larus novaehollandiae scopulinus* | Red billed gull, tarāpunga | At Risk – Declining |
| *Nestor meridionalis septentrionalis* | North Island kaka, kākā | At Risk – Recovering |
| *Phalacrocorax carbo novaehollandiae* | Black shag, kawau | At Risk – Naturally Uncommon |
| *Phalacrocorax sulcirostris* | Little black shag, kawau tūi | At Risk – Naturally Uncommon |
| *Phalacrocorax varius varius* | Pied shag, karuhiruhi | At Risk – Recovering |
| *Platalea regia* | Royal spoonbill, kōtuku ngutupapa | At Risk – Naturally Uncommon |
| *Poliocephalus rufopectus* | New Zealand dabchick, waiwea | At Risk – Recovering |
| *Porzana pusilla affinis* | Marsh crake, koitareke | At Risk – Declining |
| *Porzana tabuensis tabuensis* | Spotless crake, pūweto | At Risk – Declining |

## Mammals

In the vicinity pf the PSPA only one threatened terrestrial mammal exists, the North Island long-tailed bat.

Appendix C Table C4: Threat status of mammal species recorded in the Waikato District. (Names and threat status obtained from DOC BioWeb Casual Observations Database 2013, BIMS, O'Donnell et al., 2017)

| Species Name | Common/Māori Name | Threat status |
|---|---|---|
| *Chalinolobus tuberculatus "North Island"* | North Island long-tailed bat, pekapeka | Nationally Critical |

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