APPENDIX 12 ECOLOGICAL ASSESSMENT

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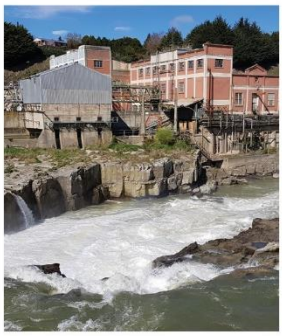

December 2023

Masterton Agrivoltaic Facility
Assessment of Ecological Effects

Submitted to:
NZ Clean Energy Ltd

water fauna flora land

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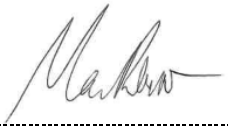
	Mark Roper Ecologist	
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Status: Final v6 **Issued:** 20 December 2023

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1.0 Introduction

1.1 Background

New Zealand Clean Energy are seeking resource consents to construct an agrivoltaic facility, also known as a solar farm, on predominantly pastoral land located at 3954A State Highway 2, Waingawa ('the Site') on the outskirts of Masterton (Figure 1). The proposed development would supply renewable electricity to the New Zealand market and help achieve the country's 100% renewable electricity target by the target date of 2030.

Ecological Solutions Limited was engaged by New Zealand Clean Energy to undertake baseline terrestrial and aquatic surveys and prepare an Assessment of Environmental Effects (AEE) to form part of the resource consent application. Based on the results of ecological surveys undertaken, the AEE also provides recommendations to avoid, remedy and/or mitigate any adverse ecological effects of the proposed agrivoltaic facility.

1.2 Site Description

The Site lies within the jurisdiction of the Carterton District Council (CDC) and Greater Wellington Regional Council (GWRC). Located approximately 6 km south-west of Masterton, the Site is bound by SH2 to the north, Cornwall Road to the east, and Hughes Line to the south (Figure 1).

Between 1910 and 1990 the Waingawa Freezing Works operated on part of the Site (Baker, 2017). While much of the Site has since been reclaimed, several historic freezing work features remain including an extensive artificial dike irrigation system and the remnants of fellmongery/settling ponds that were decommissioned sometime after the freezing works were decommissioned. Currently, the entire Site is used for sheep and cattle grazing.

Two sections of the Taratahi Water Race network direct water through the Site. The water races were engineered and constructed approximately 100 years ago to irrigate the Taratahi Plains (CDC, 2023).

Vegetation at the time of survey within and immediately surrounding the Site was dominated by exotic species typical of the modern New Zealand farmscape (e.g., grazed pasture, pine and macrocarpa shelterbelts), with almost no native vegetation present. Five scattered kānuka trees (*Kunzea robusta*) were the only native trees on the Site.

Natural wetlands were present on the Site with vegetation comprising species typically found in highly modified pasture environments such as grazed rushes (*Juncus* spp.), hydrophytic grasses, and aquatic plants associated with ponding.

1.3 Proposed Agrivoltaic Development

This application seeks to establish an approximately 138 ha agrivoltaic development within the Site (~143 ha). This will include erecting solar panels (photovoltaic modules), inverters, transformers, battery energy storage system (BESS), a substation, and a site office (Figure 2). The proposal will also include establishing security fencing and undertaking landscaping in appropriate places. Access to the Site will be from Cornwall Road.

The proposal seeks to establish approximately 155,000 photovoltaic (PV) modules mounted on approximately 1,825 single-axis tracking tables (bases) set out in a rectilinear array. Each PV tracking table is proposed to be oriented north-south along its long axis, enabling it to track the sun in an east-west direction. The PV tracking tables will be approximately 2.94 m high at a maximum tilt (60° tilt) and 2.3 m wide at a minimum tilt (0^0 tilt). Each row of PV tracking tables is proposed to have a 2.7 m (approximate) wide perimeter clearance, to allow for access and maintenance.

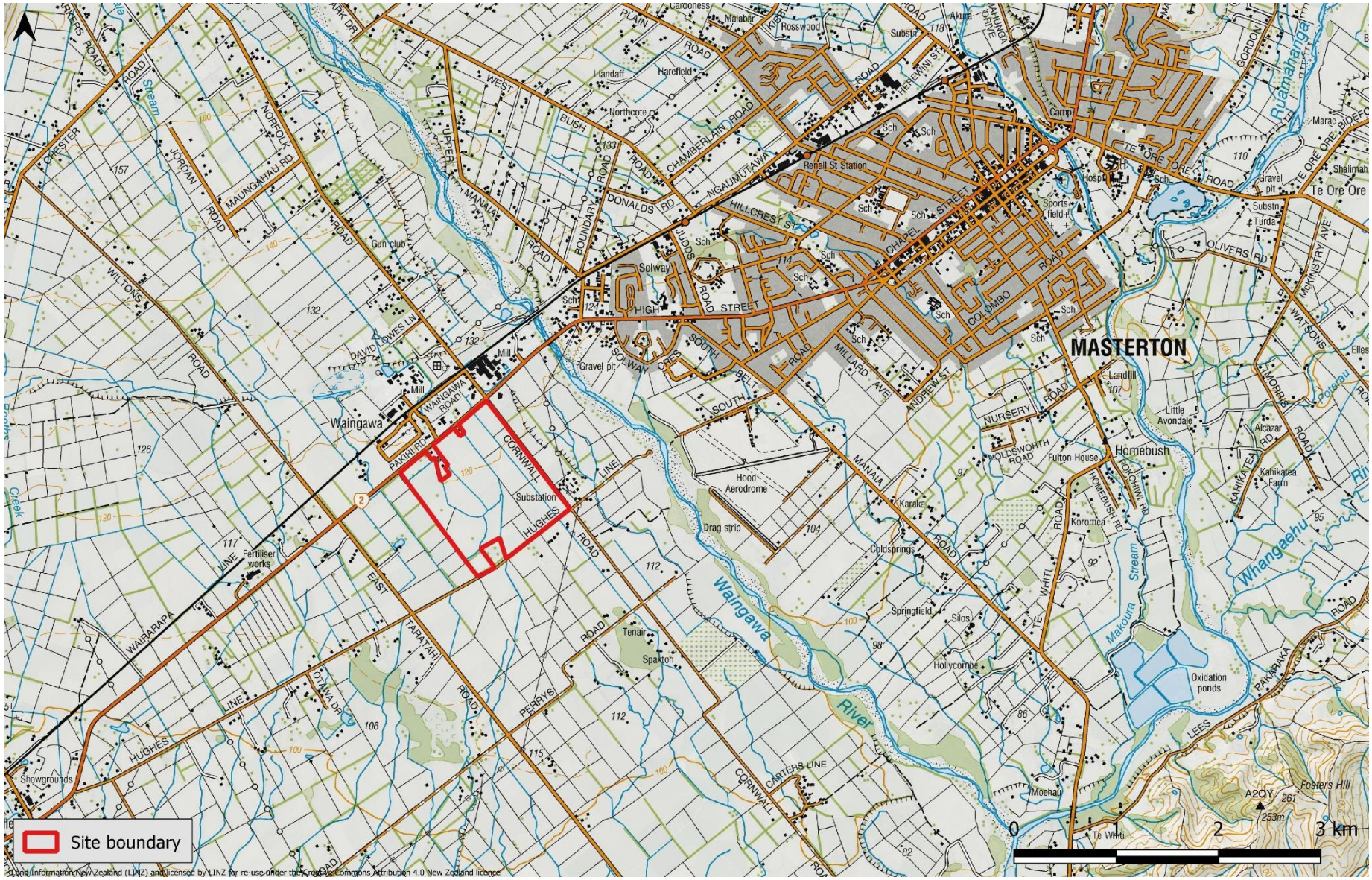

Figure 1: Location of the proposed agrivoltaic facility at 3954A State Highway 2, Waingawa.

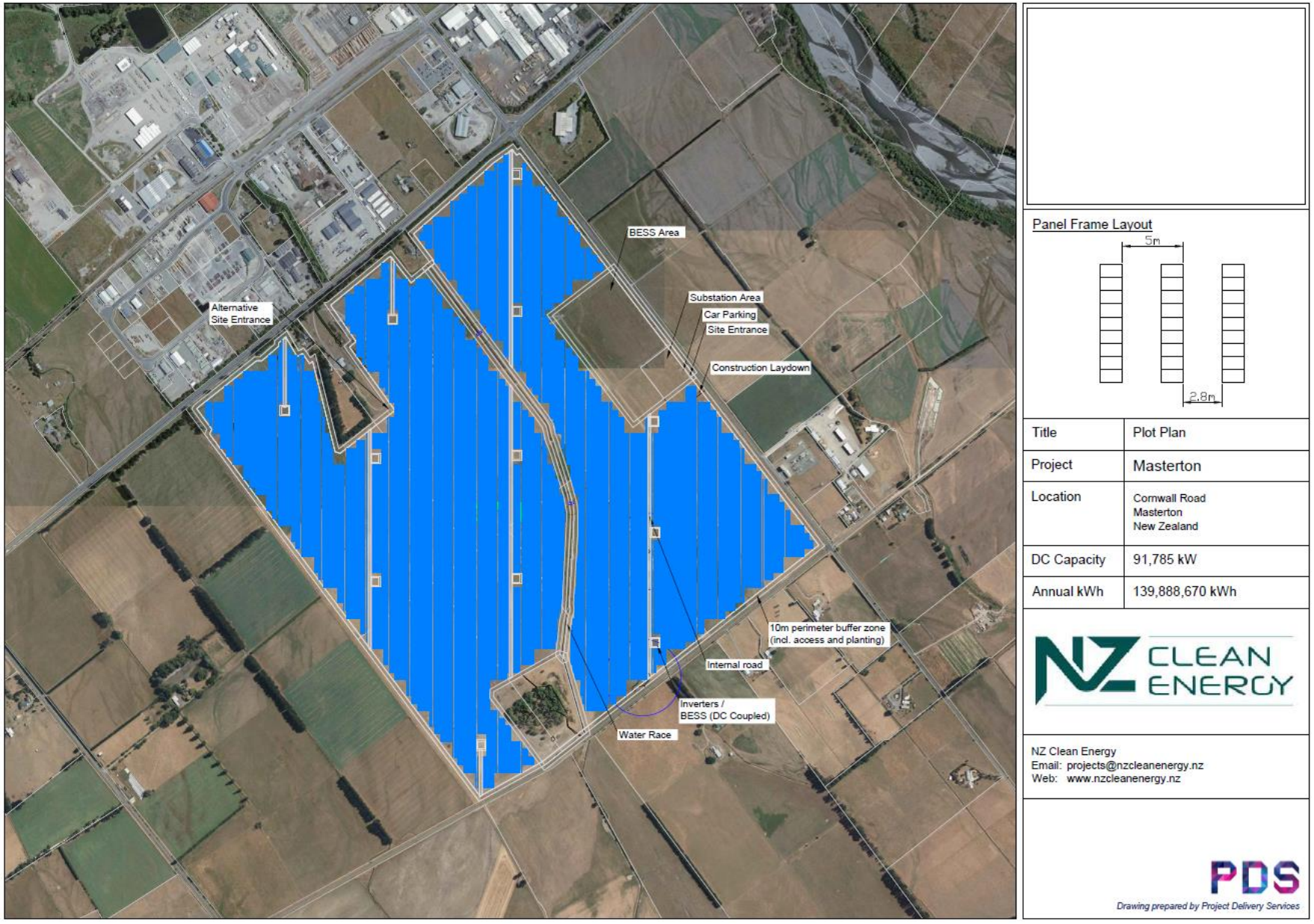

Figure 2: Proposed agrivoltaic facility site design (NZ Clean Energy 2023).

There are proposed to be 24 solar inverters, coupled with small transformers located regularly at approximately 350 m to 400 m intervals across the agrivoltaic development. Approximately 150 individual battery energy storage system (BESS) units are proposed to be located within repurposed shipping containers in the eastern part of the Site.
A substation and parking area is proposed to be located immediately south of the BESS area (Figure 2).

The development will require internal and perimeter access tracks (the latter being 10 m wide) to service and maintain the facility. Construction of the proposed access track would require the replacement of three existing culvert crossings of the Taratahi Water Race.

Site works associated with the construction of the agrivoltaic facility include earthworks, tree trimming and, in places removal. Vegetation clearance required would include the removal of a small number of mature exotic trees, five native kānuka trees, areas of weedy shrubland (blackberry, broom and gorse) from within the Site and the disturbance (by machinery passes) of grazed pasture within the proposed footprint during construction. Shelterbelts/hedgerows on the Site's boundary and the woodlot in the southern area of the Site are to be retained, although the external shelterbelts would be trimmed to as low as 3 m high. Proposed landscape buffer planting (within the 10 m perimeter access trackway) would provide additional screening where necessary around the Site's perimeter. The existing/new screening plantings would be backed by a security fence extending around the perimeter of the Site.

Minimal artificial lighting is required at the facility and will only be necessary at the Site entrance. Lighting design will seek to avoid light spill. Continuation of sheep grazing beneath the solar panels is planned.

The preparation of this AEE has been undertaken based upon plans provided by NZ Clean Energy (Figure 2).

2.0 Ecological Context

The Site is located within the Wairarapa Plains Ecological District which extends from the Ruamahanga River near Mount Bruce in the north, to Palliser Bay in the south. It is bound by the Remutaka and Tararua Ranges to the west, and the eastern Wairarapa Hills and Aorangi Ranges to the east. The Wairarapa Plains is primarily a sedimentary basin produced by marine and alluvial deposition. It also contains localised low hills, with several gravel-bed streams draining the surrounding ranges into the Ruamahanga River. To the east of the Site, the Waingawa River is a major tributary of the Ruamahanga River.

The Wairarapa Plains Ecological District was previously mostly covered in indigenous forest, however much of the district has been modified for sheep and cattle grazing, with occasional areas cultivated for short-rotation cropland (Figure 3). The former indigenous terrestrial ecosystem expected to have occurred naturally on the Site includes tōtara (*Podocarpus totara*) – tītoki (*Alectryon excelsum*) forest (MF1) and tawa (*Beilschmiedia tawa*), tītoki, podocarp forest (WF3) (Singers and Rogers 2014[1]). Few areas of indigenous habitat now remain within the Ecological District, but those still present include small remnants of kahikatea (*Dacrycarpus dacrydioides*) forest, relatively large areas of mānuka (*Leptospermum scoparium* agg.) – kānuka shrubland, and extensive wetlands around the lower Wairarapa (McEwen, 1987; LCDB v5.0, Figure 4).

[1] GIS data - Singers Forest Classification - Historic Forest Extent.

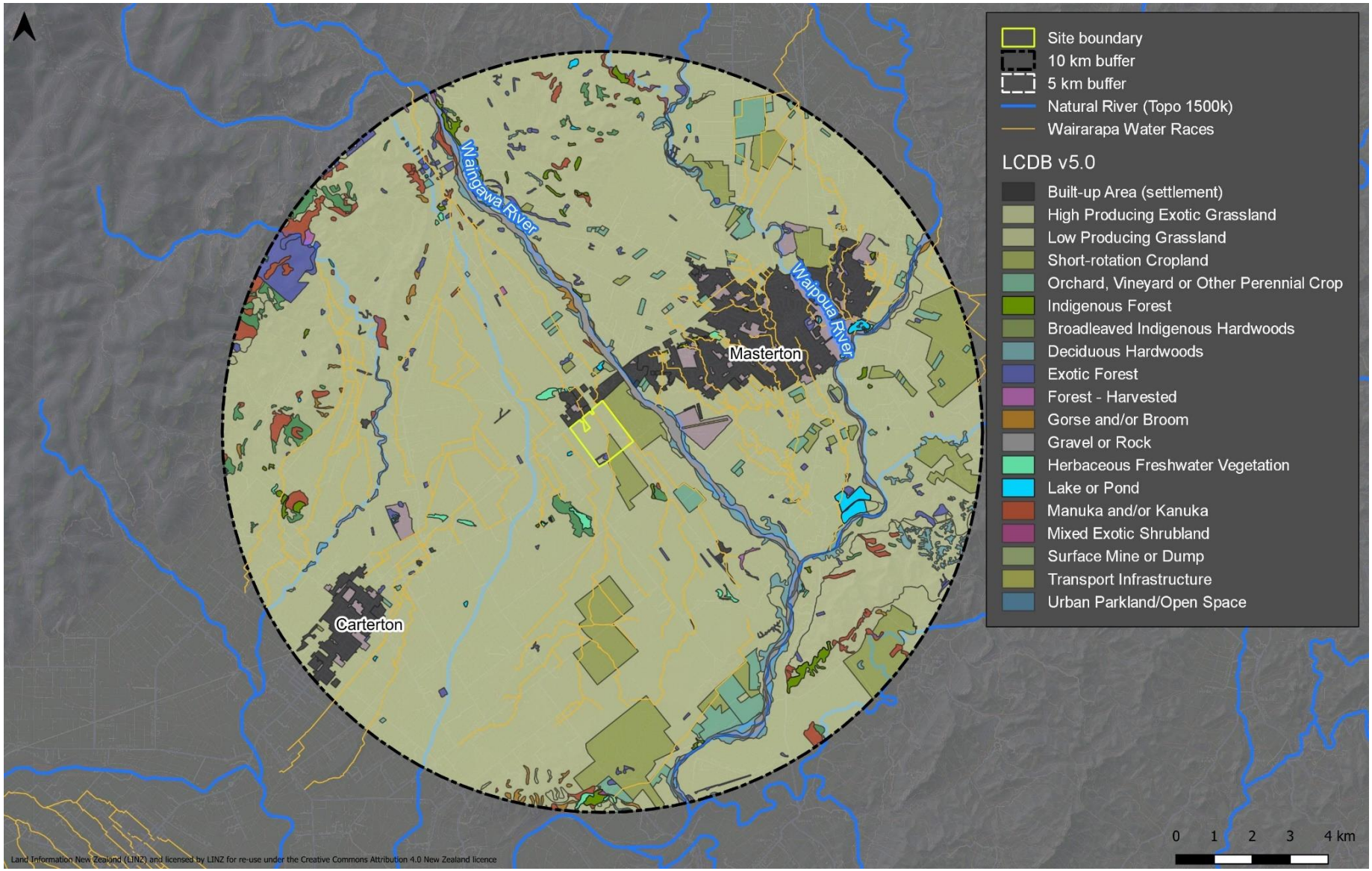

Figure 3: Vegetation cover as recorded in the New Zealand Land Cover Database (LCDB v5.0).

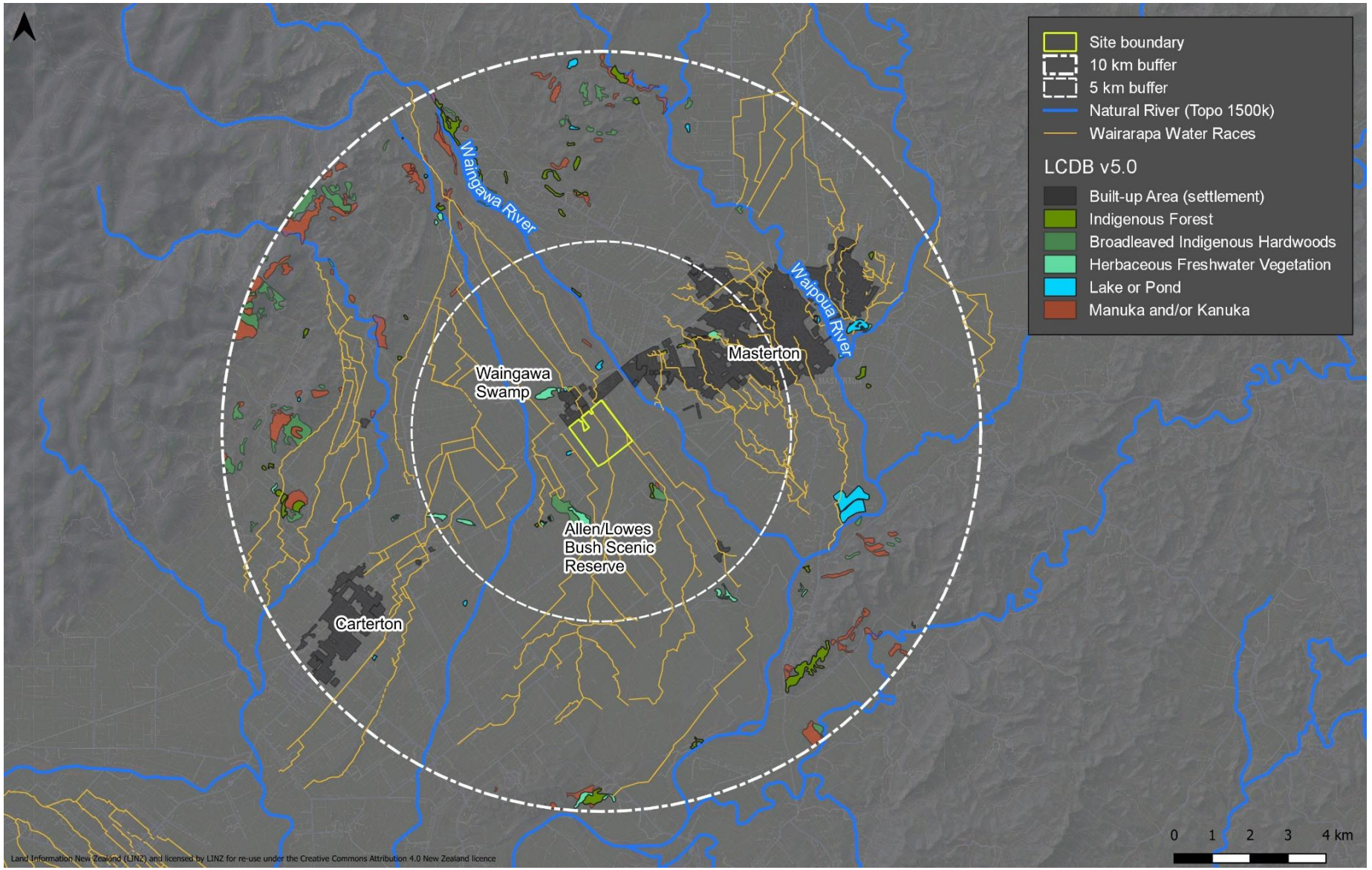

Figure 4: Indigenous land and habitat cover (LCDB v5.0).

Much of the remaining indigenous forest is located within the conservation estate and forest park of the Tararua Ranges, approximately 12 km west of the Site. Allen/Lowes Bush Scenic Reserve located c. 1.3 km south-west of the Site contains one of the last kahikatea swamp forest remnants within the Taratahi Plains (NZEnvC, 2021).

Soils within the Site are mostly dry and shallow, typically well drained yellow-brown silt loams on a gravel substrate (Baker 2017). Towards the south, poorly drained silt loam over clay soils (gley soils) and yellow grey silty loam (perch-gley) soils are present, which are susceptible to seasonal ponding during winter.

3.0 Methodology

This AEE has been prepared using the information available at the time of preparation. As such it does not necessarily include assessment of any actual or potential adverse environmental effects identified in other expert reports (e.g., stormwater)."

3.1 Terrestrial Ecology

3.1.1 Vegetation

An initial desktop assessment was carried out using aerial imagery (Google Earth, Retrolens, topographic maps and GIS datasets[2]) to assist in determining historic land use, landcover and vegetation types, and hydrological patterns that might correspond with potential wetlands.

A survey was carried out at the Site on 14 September 2023. Plant species encountered were recorded and terrestrial habitats described and photographed.

3.1.2 Avifauna

Existing avifauna survey records within 10 km of the Site were obtained from the New Zealand eBird database to inform which species are likely to be present at the Site. All birds seen or heard during the site visit were recorded and potential avian habitats were identified during the walk-through survey undertaken on 14 September 2023.

3.1.3 Herpetofauna

Existing lizard records within 10 km of the Site were obtained from the Department of Conservation's (DOC) Bioweb database to inform which lizard species are likely to be present on the Site. Potential lizard habitat within the Site was identified by a walk-through survey undertaken on 14 September 2023.

3.1.4 Bats

Long-tailed bat (*Chalinolobus tuberculatus*) survey records within 25 km of the Site were obtained from the Department of Conservation (DOC) database to assess the likelihood of long-tailed bats utilising the Site. This information informed a desktop identification of habitat features within or near the Site that may be important to long-tailed bats for navigation (e.g., roads, hedgerows, rivers), feeding (e.g., edges of tall vegetation, wetlands, rivers) or roosting (e.g., trees >15 cm diameter at breast height (DBH) likely to exhibit typical roost features such as crevices).

[2] Landcover Database Version 5 (LCDB v5) and Greater Wellington Regional GIS Maps; Singers Forest Classification - Historic Forest Extent dataset (2019).

A survey of potential roost trees on the Site was carried out on 14 September 2023. As this type of survey is not dependent on bat activity, it can be undertaken at any time of the year. The survey identified trees that could potentially provide suitable communal roost sites for long-tailed bats. Trees ≥15 cm DBH within the survey area were systematically assessed to identify trees that contain one or more of the following features:

- Hollows.
- Cavities.
- Knot holes.
- Cracks.
- Flaking, peeling, and decorticating bark.
- Epiphytes.
- Broken or dead branches or trunk.
- Cavities/hollows/shelter formed by double leaders.

Trees with any of the features listed above were deemed to potentially provide suitable communal roost sites for long-tailed bats (noting that loose bark and epiphyte characteristics are not typically associated with communal roosts).

3.2 Wetlands

Identification and delineation of wetlands at the Site was undertaken on 14 September 2023 to confirm whether there were any wetlands present at the Site or within 100 m of the Site which would meet the definition of a "natural inland wetland" provided in the National Policy Statement for Freshwater Management (NPS-FM 2020).

The wetland assessment was undertaken in accordance with the delineation protocols set out in the relevant guidelines which applied at the time of the assessment (Clarkson 2014, Fraser et al. 2018, Clarkson et al. 2021, MfE 2021, 2022, 2022b). Potential wetlands within 100 m of the Site were identified via desktop assessment and are indicative only.

The NPS-FM (MfE 2020, updated December 2022) defines natural inland wetlands to be a wetland (as defined in the Act[3]) that is **not**:

(a) in the coastal marine area; or

(b) a deliberately constructed wetland, other than a wetland constructed to offset impacts on, or to restore, an existing or former natural inland wetland; or

(c) a wetland that has developed in or around a deliberately constructed water body, since the construction of the water body; or

(d) a geothermal wetland; or

(e) a wetland that:

  (i) is within an area of pasture used for grazing; and

  (ii) has vegetation cover comprising more than 50% exotic pasture species (as identified in the National List of Exotic Pasture Species using the Pasture Exclusion Assessment Methodology (see clause 1.8)); unless

  (iii) the wetland is a location of a habitat of a threatened species identified under clause 3.8 of this National Policy Statement, in which case the

[3] Resource Management Act 1991. *Wetland includes permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions*.

exclusion in (e) does not apply.

Pasture species are those identified within MfE (2022b).

For plot-based surveys the vegetation dominance threshold for wetland classifications is met if more than 50% of the dominant plant species within the plot are obligate, facultative wetland or facultative as described in Clarkson et al. (2021):

- Obligate wetland (OBL) – almost always in wetlands, rarely in uplands;
- Facultative wetland (FACW) – usually occurs in wetlands but occasionally found in uplands;
- Facultative (FAC) – commonly occurs in either wetlands or uplands;
- Facultative upland (FACU) – occasionally occurs in wetlands but usually in uplands;
- Upland (UPL) – rarely occurs in wetlands, almost always in uplands.

The prevalence index is a plot-based algorithm derived from the unique combination of obligate to upland plants and their cover. The vegetation is considered to be hydrophytic[4] if the prevalence index is less than or equal to 3.0.

To pass the rapid assessment test all the dominant species within the plot must be classified as FACW or OBL plants. If any of the three vegetation tests is passed, the area is considered to be a natural wetland. For plots with marginal vegetation tests, or where conditions are not typical, the presence of hydric soils and/or hydrological indicators are used to confirm or exclude wetland presence.

3.3 Freshwater Ecology

3.3.1 Watercourse Classification

Watercourses draining the Site were classified on 14 September 2023 in accordance with criteria outlined in the Greater Wellington Natural Resources Plan (GWNRP, 2023) (provided in Appendix B) following the guidance document for classifying watercourse types '*How to determine a watercourse is a river, ephemeral watercourse, highly modified river or stream, or artificial watercourse*' (GWRC, 2021). All watercourse classifications, with the exception of artificial, are subject to the rules of the GWNRP (2023).

General stream habitat characteristics were recorded (e.g., channel width, water depth, substrate type and size, freshwater habitat type, and the amount of riparian shading) and described in order to assist with the assessment of ecological values.

3.3.2 Fish Fauna

A search of New Zealand Freshwater Fish Database (NZFFD) and Wilderlab's collection of publicly available environmental DNA (eDNA) data was carried out to check for fish records within the Site and wider area. The NZFFD search included records since 1985, while Wilderlab's database only includes records since 2021.

Two passive eDNA samplers were deployed during a site visit on 14 September 2023 for >8 hours to provide an indication of the fish species present and as such assist with the assessment of ecological values. Samples were collected and preserved according to Wilderlab's protocols and sent to Wilderlab laboratory for multi-species analysis.

[4] Hydrophytic plants grow in water or in soil that is consistently wet.

3.4 Assessment of Ecological Values

Terrestrial and freshwater ecological values within the Site were determined following the approach outlined in the Ecological Impact Assessments Guidelines (EcIAG) (Roper-Lindsay et al. 2018) published by the Environment Institute of Australia and New Zealand (EIANZ). The approach for assigning ecological value to terrestrial and freshwater environments involves the assessment of four matters that include 'representativeness, rarity/ distinctiveness, diversity and pattern and ecological context' and with consideration of the attributes listed in the EcIAG. Overall value is assigned to a given feature based on the four matters listed above and the scoring system outlined in the EcIAG.

3.5 Assessment of Environmental Effects

3.5.1 Approach

The effects assessment approach used in this report followed the method outlined in the EcIAG (Roper-Lindsay et al. 2018). The EcIAG assist with assessing values and effects in a consistent and transparent way and requires professional judgement when applying the framework and matrix approach. The method involves assigning values to ecological features and assessing the magnitude of effect of the proposed activity to determine an overall level of effect using the matrix provided in the EcIAG.

3.5.2 Magnitude of effect

The magnitude of effect on each ecological value was considered in relation to the scale of the effect, extent of habitat loss or modification in relation to remaining habitat, duration of the effect, extent of the effect on species at the population level, impact on the sustainability of the ecosystem and intensity of the unmitigated effect. The magnitude of effect associated with each activity was evaluated based on the criteria outlined in Table 8 of the EcIAG reproduced as Table 1 below. The magnitude of effects ranges between negligible and very high.

Table 1: Criteria for describing magnitude of effect (Roper-Lindsay et al. 2018).

Magnitude	Description
Very high	Total loss or very major alteration to key elements/ features of the baseline conditions such that the post development character/ composition/ 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 baseline (pre-development) conditions such that post development character/ composition/ 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 baseline conditions such that post development character/composition/attributes of baseline 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 baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline condition will be similar to pre-development circumstances/patterns; AND/OR having a minor effect on the known population or range of the element/feature.
Negligible	Very slight change from 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.

3.5.3 Overall level of effect

The overall 'level of effect' for each activity on ecological features was determined using the matrix approach outlined in the EcIAG. The matrix approach matches ecological values with the magnitude of effect associated with each proposed activity to derive an overall 'level of effect'. The level of effect for each proposed activity was determined both with mitigation and without mitigation. This assessment framework allows for effects to be ranked on a gradient from 'very low' to 'very high' and provides justification for avoidance, mitigation and offsetting requirements (Table 2).

Table 2: Criteria for describing level of effect (Roper-Lindsay et al. 2018).

Magnitude ▼	Ecological value ▶				
	Very high	***High***	***Moderate***	***Low***	***Negligible***
Very high	Very high	Very high	High	Moderate	Low
High	Very high	Very high	Moderate	Low	Very low
Moderate	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

4.0 Terrestrial Ecology

4.1 Vegetation

A list of plant species recorded at the Site is provided in Appendix A. Vegetation across most of the site comprised pasture grasses, exotic shelterbelts and shrubs, occasional stand-alone exotic trees and a woodlot. The location of these vegetation types is shown on Figure 5. A review of historic aerials shows parts of the Site have been used historically for cropping[5]. There were no areas of established native vegetation and only low-quality habitats were present within the Site.

Typical pasture species included perennial rye grass (*Lolium perenne*) and white-clover (*Trifolium repens*), with browntop (*Agrostis capillaris*), kikuyu (*Cenchrus clandestinus*), sweet vernal (*Anthoxanthum odoratum*) and cocksfoot (*Dactylis glomerata*). An example of this vegetation is shown on Figure 6.

[5] As seen on historic google imagery and classified on LCDB v5.0

Figure 5: Ecological features at the Site.

Figure 6: Example of derelict remains and shelterbelts amongst grazed pasture.

Shelterbelts along the Site's north-western boundary comprised pine (*Pinus radiata*), macrocarpa (*Cupressus macrocarpa*) and Leyland cypress (*Cupressus* × *leylandii*), with scattered tree lucerne (*Chamaecytisus palmensis*) as shown on Figure 7. Short rows of poplar (*Populus* sp.) (some moribund) and pine occupied a few south-western paddocks as shown on Figure 8. One gum tree (*Eucalyptus* sp.) and one London plane (*Platanus* × *hispanica*) were also present. A woodlot (c. 1.4 ha) near the Site's southern corner, comprised willow (*Salix* sp.) treeland. The average DBHs for the most common shelterbelt species were as follows: macrocarpa, 65 cm (but there were occasional examples up to 80 cm encountered); pine, 57 cm; poplar, 32 cm and; woodlot willow, 47 cm.

Figure 7: Example of pine shelterbelt.

Figure 8: Example of a poplar tree row.

Scattered shrub weeds included gorse (*Ulex europaeus*) and to a lesser extent, broom (*Cytisus scoparius*). These weeds were generally confined to northern pastures within the historic pond basin, although gorse was also present around the woodlot's northern edges and the southern parts of the Taratahi Water Race as shown on Figure 9. Rank blackberry (*Rubus fruticosus* agg.) formed thickets scattered within pastures to the south-west of the woodlot.

Figure 9: Exotic gorse on the riparian margins of Taratahi Water Race.

Native terrestrial vegetation was limited to five kānuka (*Kunzea robusta*) trees in the north-western paddocks, three of which are shown on Figure 10 and grazed rushes (*Juncus sarophorus*, *J. edgariae*), which were typically scattered as pasture weeds. Water fern (*Azolla rubra*), duckweed (*Lemna disperma*) and waxweed (*Hydrocotyle heteromeria*) were present in the natural wetlands in the southern area.

Figure 10: Isolated kānuka trees.

4.2 Avifauna

Birds seen or heard at the Site during the 14 September 2023 survey included grey duck × mallard hybrid (*Anas superciliosa* × *platyrhynchos*), skylark (*Alauda arvensis*), blackbird (*Turdus merula*) and song thrush (*Turdus philomelos*), all of which are common species typical of rural/pastoral settings.

A total of 92 species were listed in the eBird database (accessed 28/11/23) within 10 km of the Site. Twenty-four of those species are of conservation interest (Table 3), many of which are coastal birds or typically associated with waterbodies such as the nearby Waingawa and Ruamahanga Rivers.

Between 1950 and 1970 several 'Threatened' and 'At Risk' birds were recorded within the Site including black-billed gull (*Chroicocephalus bulleri,* At Risk – Declining), banded dotterel (*Charadrius bicinctus,* At Risk – Declining), black-fronted dotterel (*Elseyornis melanops,* At Risk – Declining) and grey duck (*Anas superciliosa,* Threatened – Nationally Vulnerable). Greater Wellington Regional Council's Selected Land Use Register reports that part of the Site had previously been occupied by the wastewater treatment ponds of the former Waingawa Freezing Works so it is not unusual to have records of these types of water birds within the Site.

The 'Threatened' and 'At Risk' species recorded in the database also include forest birds such as kakariki (*Cyanorampus auriceps*) and kākā (*Nestor meridionalis*) and sea birds

such as Salvin's mollymawk (*Thalassarche salvini*). The lack of forest within the Site means that these birds are unlikely to use the Site currently.

Of the species listed in Table 3 only the New Zealand pipit (*Anthus novaeseelandiae*) is considered likely to use the habitats present at the Site. Pipits are considered to be 'At Risk – Declining' (Robertson et al. 2021).

Table 3: Birds of conservation interest recorded within 10 km of the Site.

Common name	Scientific name	Conservation status (Robertson et al. 2021)
Banded Dotterel	*Charadrius bicinctus*	At Risk – Declining
Bar-tailed Godwit	*Limosa lapponica*	At Risk – Declining
Black-billed Gull	*Chroicocephalus bulleri*	At Risk – Declining
Black-fronted Dotterel	*Elseyornis melanops*	At Risk – Naturally Uncommon
Black Shag	*Phalacrocorax carbo*	At Risk – Relict
Caspian Tern	*Hydropogne caspia*	Threatened – Nationally Vulnerable
Eurasian Coot	*Fulica atra*	At Risk – Naturally Uncommon
Grey Duck	*Anas superciliosa*	Threatened – Nationally Vulnerable
Little Black Shag	*Phalacrocorax sulcirostris*	At Risk – Naturally Uncommon
Little Pied Shag	*Microcarbo melanoleucos*	At Risk – Relict
Long-tailed Cuckoo	*Eudynamys taitensis*	Threatened – Nationally Vulnerable
New Zealand Dabchick	*Poliocephalus rufopectus*	Threatened – Nationally Increasing
New Zealand Falcon	*Falco novaeseelandiae*[1]	Threatened – Nationally Increasing
New Zealand Kaka	*Nestor meridionalis*	At Risk – Recovering
New Zealand Pipit	*Anthus novaeseelandiae*	At Risk – Naturally Uncommon
Pied Shag	*Phalacrocorax varius*	At Risk – Recovering
Red-billed Gull	*Chroicocephalus novaehollandiae*	At Risk – Declining
Royal Spoonbill	*Platalea regia*	At Risk – Naturally Uncommon
Salvin's Mollymawk	*Thalassarche salvini*	Threatened – Nationally Critical
South Island Pied Oystercatcher	*Haematopus finschi*	At Risk – Declining
Spotless Crake	*Zapornia tabuensis*	At Risk – Declining
Wrybill	*Anarhynchus frontalis*	Threatened – Nationally Increasing
White Heron	*Ardea alba*	Threatened – Nationally Critical
Yellow-crowned Parakeet	*Cyanoramphus auriceps*	At Risk – Declining

Note: [1]Assumed to be bush falcon (*Falco novaeseelandiae ferox*).

4.3 Herpetofauna

Herpetofauna records within 10 km of the Site included copper skink (*Oligosoma aeneum,* 'At Risk – Declining'), northern grass skink (*O. polychroma*, 'Not Threatened'), Raukawa gecko (*Woodworthia maculata,* 'Not Threatened') (Hitchmough et al. 2021), and the introduced southern bell frog (*Ranoidea raniformis*). The location of these records are shown on Figure 13. Records from 1967-74 included Newman's speckled skink (*O.*

newmani), although according to The New Zealand Herpetological Society[6], that species is restricted to the South Island from the western Marlborough Sounds through Nelson/Tasman, and down the West Coast. Records in the Wairarapa are more likely to be the species now regarded as Kupe skink (*Oligosoma* aff. *infrapunctatum* 'southern North Island', 'Threatened - Nationally Critical') (Hitchmough et al. 2021).

Potential lizard habitat at the Site included a boulder pile and areas of blackberry located in the south-west, as well as a stonefield located in the north (Figure 11 and Figure 12). Each of these features potentially provides suitable habitat for copper skink, northern grass skink, Kupe skink and Raukawa gecko. However, although lizards are mobile and capable of colonising sites from nearby undisturbed sites, the high level of modification (i.e., heavily grazed farmland) and lack of remnant vegetation in the Site surrounds make it less likely that native lizards will be present within the Site in high numbers.

Figure 11: Boulder pile providing potential lizard habitat.

Figure 12: Blackberry in grazed pasture providing potential lizard habitat.

[6] https://www.reptiles.org.nz/ (accessed 28/11/23).

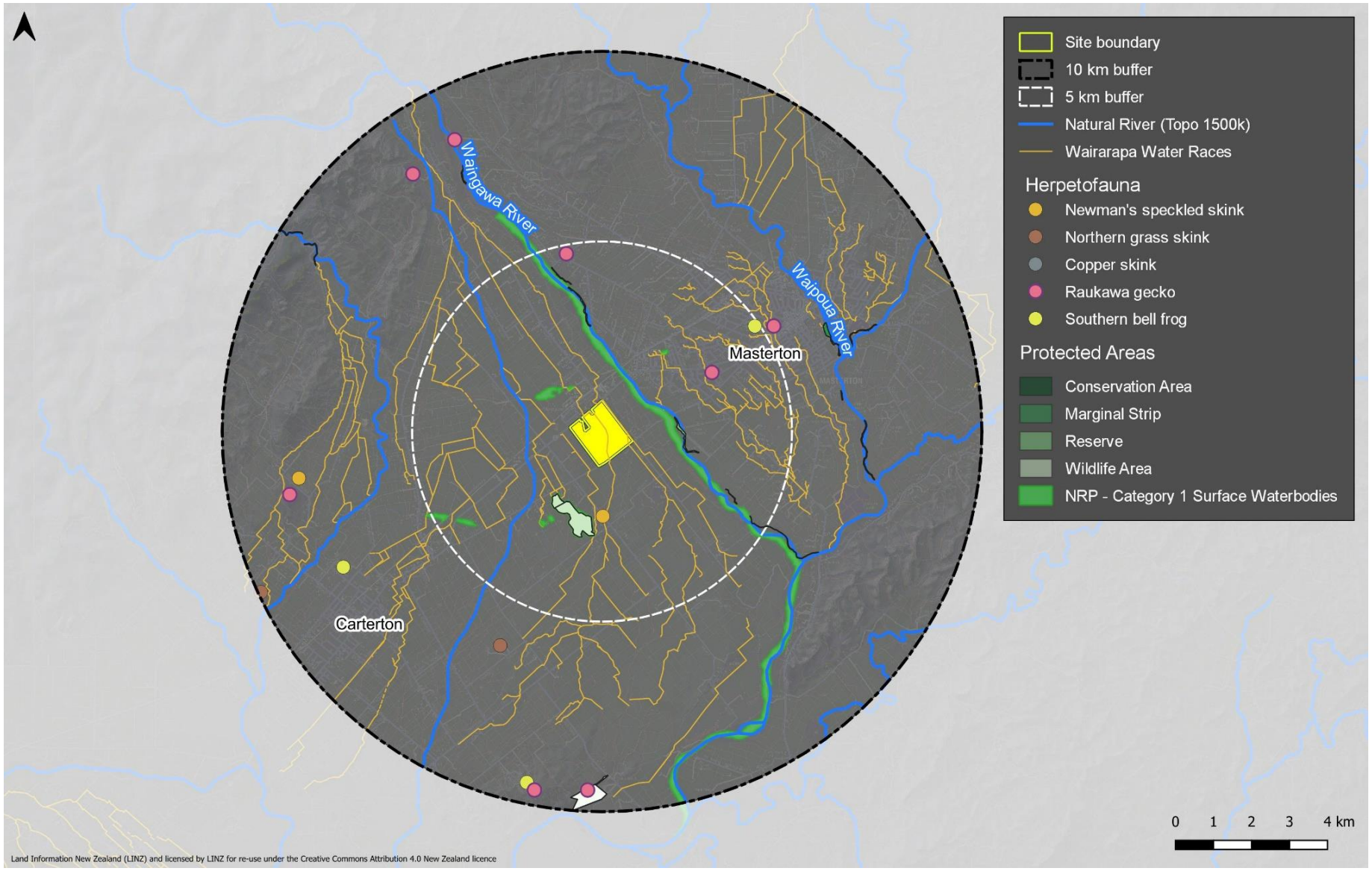

Figure 13: The location of lizard records within 10 km of Site.

4.4 Bats

Long-tailed bats have been recorded approximately 11 km west of the Site near Mangatarere Road and the Tararua Ranges (Figure 14). Long-tailed bat colonies have large home ranges (>150 km^2) and individuals are highly mobile, with straight line distances between roosts and foraging grounds of 10–>25 km (O'Donnell et al., 2023). The Site lies within the ranging distance of long-tailed bats from the Tararua Ranges as shown on Figure 14.

Long-tailed bats are classified as 'Threatened - Nationally Critical' by O'Donnell et al. (2023), which is the highest threat classification. Long-tailed bat populations are declining at a rate of 5–9% per annum, equating to an 84–96% decline over three generations (estimated as 36 years).

The Taratahi Water Race and wetland areas within the Site could also be important habitat features for long-tailed bats. The types of habitats used by bats are shown on Figure 15 and Figure 16. These features could be used for navigation (bats often use linear features such as roads or rivers for this purpose) and as feeding areas (bats are aerial insectivores often feeding on hatched aquatic insects such as mayflies and caddisflies).

Almost all of trees at the Site, including the shelterbelts and the 1.4 ha woodlot, are exotic (pine, macrocarpa, Leyland cypress, tree lucerne, eucalyptus, London plane, poplar and willow) and relatively large with DBHs ranging from 32–65 cm (and occasionally up to 80 cm). Many trees on the Site had features such as hollows, cavities, knot holes, cracks, broken or dead branches or trunk, and cavities/hollows/shelter formed by double leaders (Figure 15) which would make them suitable roost trees. The location of trees with a DBH of >15 cm and any one of these features potentially providing suitable long-tailed bat roost sites are shown on Figure 17.

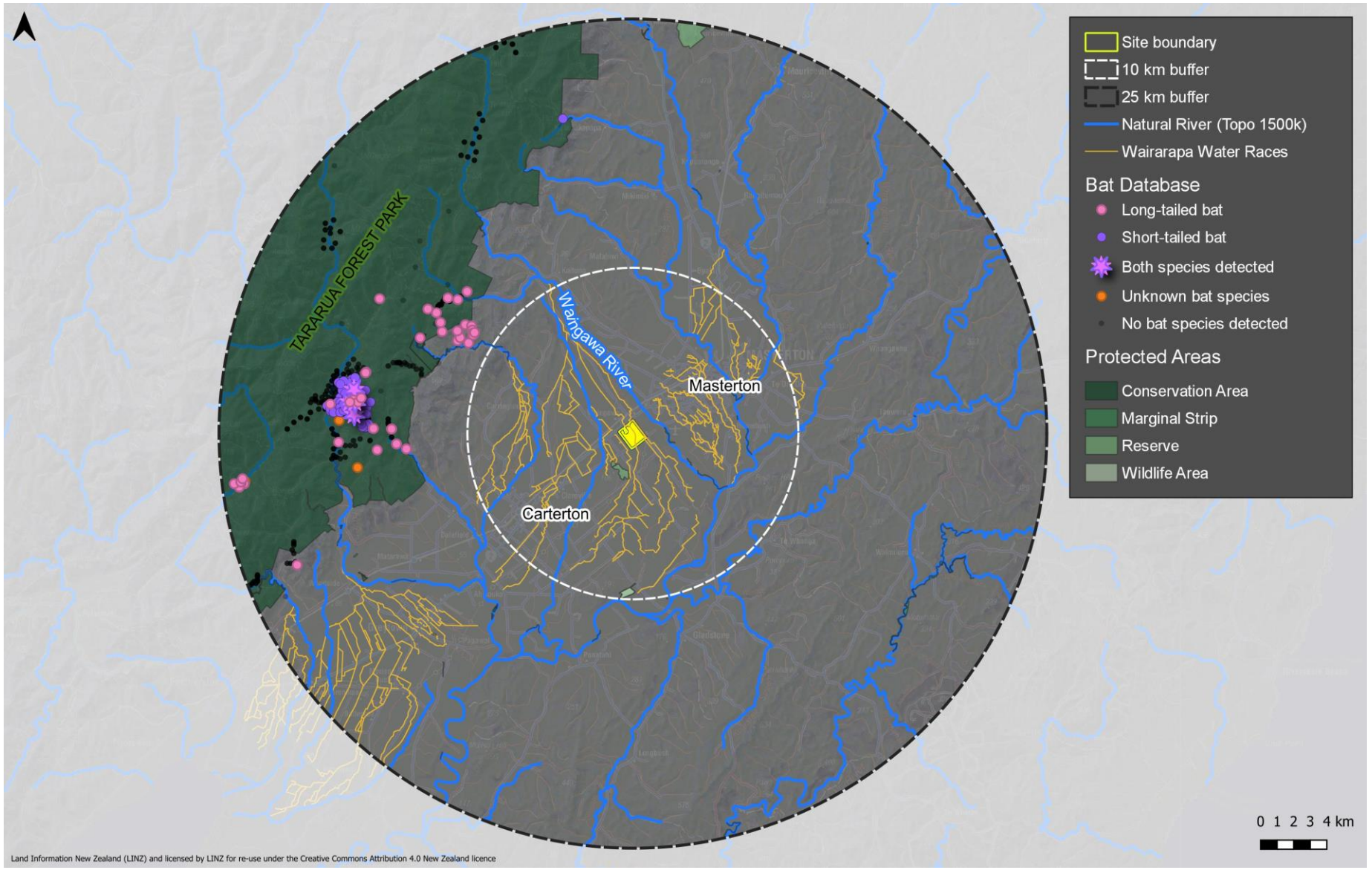

Figure 14: Records of bat activity within 25 km of the Site.

Figure 15: A cavity (potential bat roost) in a >15 cm DBH woodlot willow tree.

Figure 16: The Taratahi Water Race and adjacent to the willow woodlot and Wetland W3.

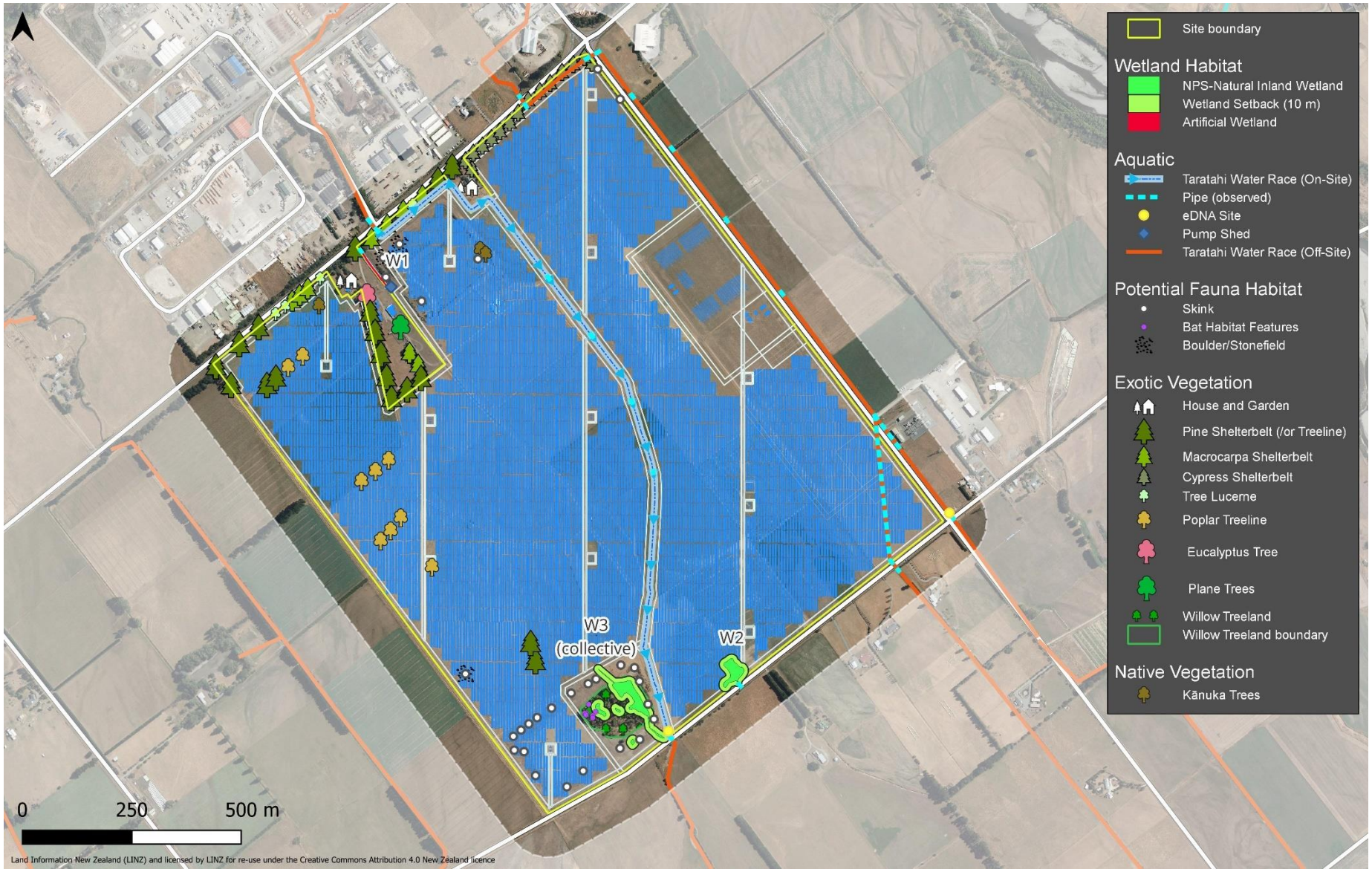

Figure 17: Potential fauna habitat (bats, lizards and fish).

5.0 Freshwater Habitats

5.1 Wetlands

An induced wetland and two natural inland wetlands were identified within the Site ranging in size between 492 m^2 and 3,067 m^2. These wetlands are referred to here as W1, W2 and W3 and are described in more detail below.

5.1.1 Induced Wetland

Wetland W1

One induced wetland (W1, c. 492 m^2) was associated with a driveway in the north of the Site. The wetland is shown on Figure 20 and its location shown on Figure 19. This wetland appears to have developed in and around the freshwater bore/ pump shed and artificial channel associated with the historic Waingawa Freezing Works (Figure 18). Wetlands associated with deliberately constructed water bodies are captured as a natural inland wetland under subpart 3.21 of the NPS-FM (2020) which states a '*natural inland wetland means a wetland (as defined in the Act) that is not: (c) a wetland that has developed in or around a deliberately constructed water body, since the construction of the water body.'*

Figure 18: Historic freshwater bore and pump shed.

5.1.2 Natural Wetlands

Wetland W2

Vegetation within Wetland W2 (c. 1,532 m^2) comprised hydrophytic grasses including *Glyceria declinata* and creeping bent (*Agrostis stolonifera*) and is also subject to ponding as shown on Figure 21. Soils contained gleyed low-chroma soil horizons and four primary hydrological indicators including: areas of pugging, soil saturation, water mark and concave surface.

The area of wetland was clearly demarcated by the extent of the above hydrophytic grasses. The transition to upland pastoral species was distinct, with dryland pasture comprising grazed browntop and kikuyu with scattered rushes. This dryland vegetation is shown on Figure 22. Historic imagery indicates that the area surrounding and including the wetland is subject to occasional cropping and resowing.

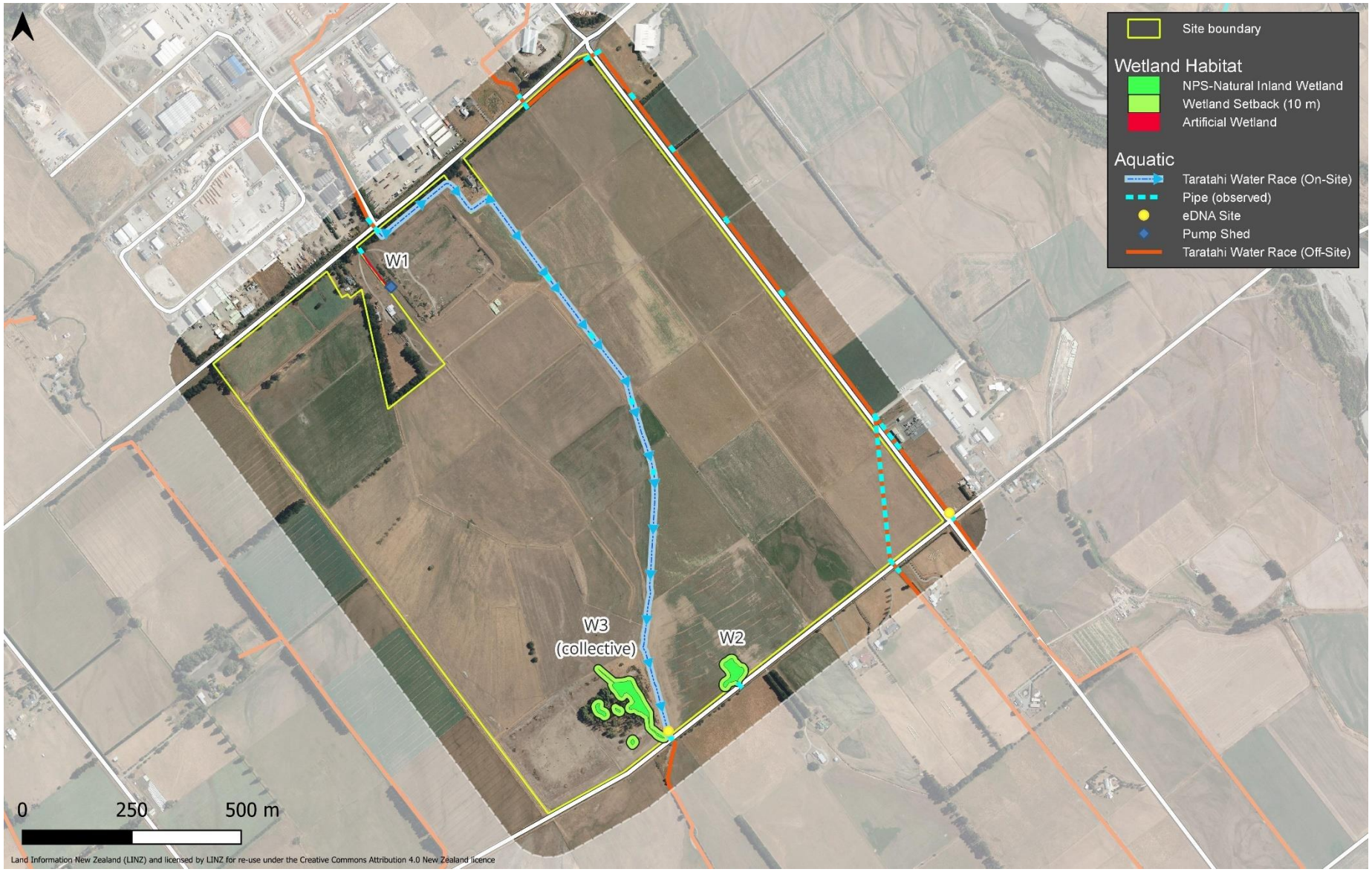

Figure 19: Wetlands and Taratahi Water Race.

Figure 20: View of Wetland W1 associated with freshwater bore.

Figure 21: View of ponding in Wetland W2.

Figure 22: Browntop-kikuyu pasture with scattered rush vegetation.

Wetland W3

The woodlot near the Site's southern corner is shown on Figure 23 and contained three distinct areas of wetland habitat with one small outlying area, collectively referred to as Wetland W3 (c. 3,067 m^2). Aquatic species present included water fern (*Azolla rubra*), starwort (*Callitriche stagnalis*), duckweed (*Lemna disperma*), willow weed (*Persicaria* sp.) and filamentous algae. Hydrophytic grasses included *Glyceria declinata* and creeping bent. Waxweed (*Hydrocotyle heteromeria*) was present in damp shaded areas. The presence of aquatic species within distinct areas of the woodlot suggests the area is subject to seasonal inundation i.e., flooding and ponding as indicated by Figure 24.

The small outlying wetland area is shown on Figure 25 and was characterised as a subtle concave wet hollow subject to seasonal pooling based on the presence of dense *Juncus sarophorus* and starwort. Other common hydrophytic vegetation included creeping bent, pennyroyal (*Mentha pulegium*), scattered water forget-me-not (*Myosotis laxa*), jointed rush (*Juncus articulata*), and occasional toad rush (*J. bufonius*).

Wetland soils contained gleyed low-chroma soil horizons with areas of pugging and a range of primary hydrological indicators including soil saturation, water marks, sediment deposits, algal mat and crust, and a sparsely vegetated concave surface.

Figure 23: Willow woodlot.

Figure 24: View of seasonal inundation within woodlot (Wetland W3).

Figure 25: Outlying wetland which forms part of Wetland W3.

5.2 Watercourses

5.2.1 Taratahi Water Race (T1)

The Taratahi Water Race (T1) shown on Figure 26 bisects the Site flowing in a generally southerly direction for approximately 1.7 km within the Site. The flow is permanent and regulated upstream to provide a constant volume of flow. The wetted width ranges between 1.5–4 m and visually estimated depths ranged between 0.3–0.7 m. Substrate was predominantly fine silt/clay although there were several (albeit small) areas where larger gravels were observed. Nearly the entire length of the watercourse comprised of run habitat, with the only variation in depth/velocity observed upstream/downstream of crossings. On the upstream side of the crossings water depths were increased while velocity slowed. The opposite was typically observed on the downstream side of the crossings.

Figure 26: Taratahi Water Race (below mid-reach).

There were numerous culvert crossings with culvert diameters of 450–600 mm to facilitate vehicle and livestock crossings. These crossings alter the 'natural' flow of the watercourse by constricting channel width which has the effect of increasing water velocity. This alteration could be serving as a velocity barrier to fish movement.

Livestock had unrestricted access along the entire length of the watercourse. This has resulted in significant bank erosion/pugging in places. Several dead newborn lambs were observed within the watercourse. No riparian vegetation was observed over the majority of the watercourse's length with the exception of a shelterbelt along the northern boundary and gorse along the southern boundary which provided low-moderate channel shading.

5.2.2 Taratahi Water Race (T2)

The second section of the Taratahi Water Race within the Site flows along the northeastern boundary of the Site, between State Highway 2 and a tall shelterbelt. T2 flows through the Site in an easterly direction for approximately 174 m (see Figure 19 for the layout of the Site). The flow is permanent and regulated upstream to provide a constant volume of flow. The wetted width ranged between 2–3 m and visually estimated depths ranged between 0.3–0.7 m. The entire length of the watercourse comprised of run habitat with a fine silt/clay substrate.

There were no culvert crossings of T2 within the Site, although there were multiple culvert crossings of the watercourse up and downstream of the Site (e.g., beneath State Highway 2 to the north and Cornwall Road to the east).

Livestock do not have access to T2 as it is fenced. Riparian vegetation comprised rank grass along the roadside and an approximately 15 m tall shelterbelt of Leyland cypress on the true right bank which provides low to moderate channel shading over the majority of the watercourse's length.

5.3 Fish Fauna

There are no NZFFD records within the Site. Fourteen species of fish as well as freshwater shrimp and kōura have been recorded in the NZFFD for the Taratahi Water Race network and the Waingawa River catchment from its headwaters to its confluence with the Waipoua River at the locations shown on Figure 27. Seven native fish species have been recorded from the Taratahi Water Race network including banded kōkopu (*Galaxias fasciatus*), common bully (*Gobiomorphus cotidianus*), Cran's bully (*Gobiomorphus basalis*), shortfin eel (*Anguilla australis*) and upland bully (*Gobiomorphus breviceps*), all of which are considered 'Not Threatened' and brown mudfish (*Neochanna apoda*) and longfin eel (*Anguilla dieffenbachia*) which are considered to be 'At risk – Declining' (Dunn et al. 2018).

Upstream of the Site and within the Waingawa Swamp which is adjacent to the Taratahi Water Race, banded kōkopu have been recorded. Shortfin eel and upland bully have both been recorded within the Parkvale Stream water race near the Waingawa Swamp. Upland bully have also been recorded within Waingawa Swamp. Brown mudfish have been recorded within the stormwater retention pond upstream of the Site and from at least three other locations within the Taratahi Water Race network (Figure 27).

Results of the eDNA sampling within the Site indicated the presence of Kaharore bully (*Gobiomorphus mataraerore*), shortfin eel, and brown trout (*Salmo trutta*). Brown trout DNA was only detected in T1.

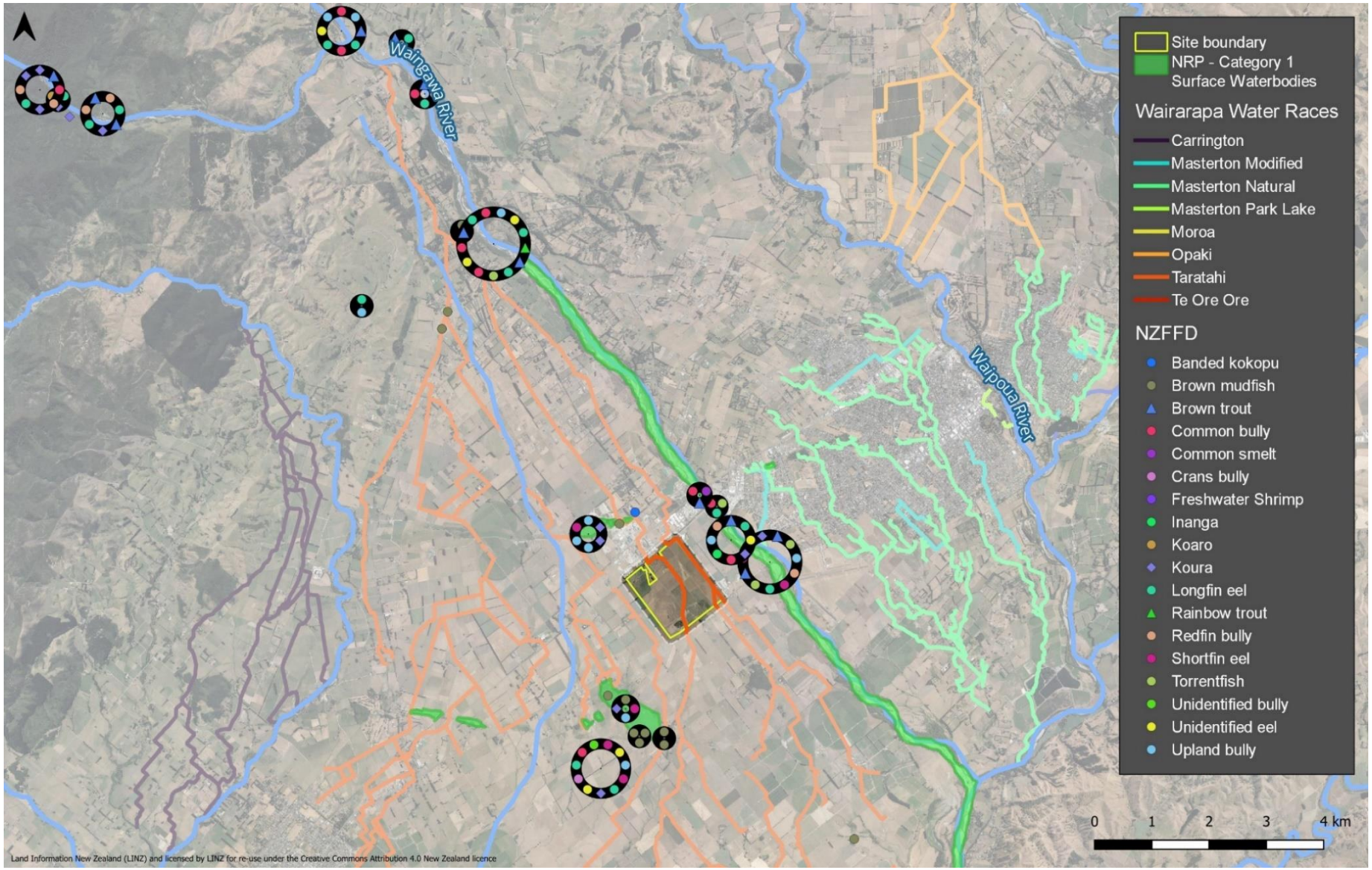

Figure 27: New Zealand Freshwater Fish Database records near the site.

6.0 Assessment of Ecological Values

6.1 Terrestrial Ecological Values

6.1.1 Vegetation

Vegetation at the Site is characterised by high producing exotic grassland (grazed pasture), exotic shelterbelts and trees, exotic shrubland (gorse, broom, blackberry), and an exotic woodlot (c. 1.4 ha). Native vegetation is limited to five kānuka trees in the north-western paddocks, with occasional grazed rushes and waxweed associated with natural wetlands in the southern area.

Vegetation on the Site has 'negligible' to 'low' ecological value across the four attributes assessed, with the overall ecological value of vegetation on the Site assessed as 'low' The ecological values of the Site are summarised in Table 4.

None of the vegetation present within the Site is representative of historic vegetation communities expected to have occurred on the Site (Figure 28). There are no native trees or indigenous species within the Site that warrant specific protection nor enhancement.

6.1.2 Avifauna

While a number of birds with a threatened conservation status have been recorded within 10 km of the Site, the Site offers little or no suitable habitat that cannot easily be found off-site for these species. Providing a relatively homogenous heavily grazed pasture habitat type, with no areas from which livestock are excluded, the Site does not appear to offer opportunities for ground nesting pipits in particular, which typically occupy rough pasture areas and tussockland. Wetland areas at the Site may be utilised for loafing and/or feeding by some species, although the nearby Waingawa River and similar habitats are of much greater ecological value in this regard. Overall, the Site is of 'low' ecological value for avifauna (Table 4).

6.1.3 Herpetofauna

The potential presence of copper skink ('At Risk – Declining'), Raukawa gecko ('Not Threatened') and Kupe skink ('Threatened – Nationally Critical') (Hitchmough et al. 2021) means that the ecological value of potentially suitable lizard habitat on the Site is 'very high' (Table 4). Other habitats which are unsuitable for lizards score 'low' for representativeness, diversity and pattern, and ecological context, which reflects their location in the modern New Zealand farmscape.

6.1.4 Bats

The Site is located 11 km from the closest long-tailed bat detection. Numerous exotic trees on Site were assessed as potentially providing suitable roost sites and there are several potentially valuable feeding areas present. No surveys for long-tailed bats have been undertaken at the Site to date, but we cannot rule out their possible presence.

The potential use of the Site by long-tailed bats (which are regarded as 'Threatened - Nationally Critical') results in a 'very high' ecological value with respect to rarity and distinctiveness (Table 4). If bats do indeed utilise the parts of the Site where the habitat provides potentially suitable roosting/breeding and feeding habitat, the ecological value would also be 'very high' in regard to diversity and pattern and ecological context. This assignment of value reflects the importance of (especially) suitable communal roost sites for the sustainability of local bat populations.

Figure 28: Proposed agrivoltaic facility site design in relation to areas of ecological value.

6.2 Wetland Ecological Values

The Site contained an induced wetland (W1) and two natural wetlands (W2 and W3). All wetlands on the Site are within a modified farm environment subject to grazing pressures and even occasional cropping/land cultivation. No threatened plant species were encountered. Vegetation was dominated by exotic species with native species limited to water fern and duckweed with occasional grazed rushes and waxweed. None of the vegetation present within the wetlands is representative of natural habitat or an association of species that would be expected to occur naturally in the area. There are no indigenous species within the Site that warrant specific protection nor enhancement. All three wetlands on the Site have a 'negligible' or 'low' overall ecological value. The ecological value of the wetlands at the Site is summarised in Table 5.

6.3 Freshwater Ecological Values

The Taratahi Water Race Network is an artificial water body. The reaches located on the Site score low on measures of representativeness, diversity and pattern, and ecological context due to their artificial nature, lack of habitat diversity, and lack of significant contribution to ecological networks/functioning (by virtue of being artificial). However, the potential presence of two 'At Risk – Declining' freshwater fish species (brown mudfish and longfin eel) within the Site score very high in terms of rarity and distinctiveness. Overall, the ecological values of the two reaches of the Taratahi Water Race network on the Site have been assessed as being 'moderate' for the reasons set out in Table 5.

Table 4: Summary of terrestrial ecological values following the approach in EcIA guidelines.

Feature		Representativeness	Rarity and Distinctiveness	Diversity and pattern	Ecological Context	Overall value	Comments
Vegetation	- Exotic grassland - Exotic shrubland - Shelterbelts - Woodlot	- Negligible - Negligible - Negligible - Negligible	- Negligible - Negligible - Negligible - Negligible	- Negligible - Negligible - Low - Negligible	- Low - Low - Low - Low	- Low - Low - Low - Low	Vegetation does not represent any native ecosystem type. It is primarily exotic and is neither rare nor distinctive.
Avifauna		Low	Low	Low	Low	Low	Site offers little to no suitable habitat that cannot easily be found off-site. Heavy grazing pressure reduces likelihood of successful ground nesting by pipit or other species
Herpetofauna		Low	Very high	Low	Low	Moderate	Possible that boulder pile, stonefield may provide habitat for native species.
Bats		Low	Very high	Very high	Very high	Very high	No surveys have been undertaken at the Site to date. The rarity of both the species and roost sites, as well as the representativeness (highly modified habitat) and ecological context of the latter has been factored in to determining ecological value.

Table 5: Summary of freshwater ecological values following the approach in EcIA guidelines.

Feature	Representativeness	Rarity and Distinctiveness	Diversity and Pattern	Ecological Context	Overall value	Comments
Wetland 1 (Artificial)	Low	Low	Low	Low	Low	Low diversity of indigenous species, typical of modified rural environs within the district. Associated with a freshwater historic bore, exits site by perched culvert which impedes connectivity (fish barrier).
NPS-Wetland 2	Low	Low	Low	Low	Low	Area subject to (at least) seasonal pooling. Avifauna unlikely to rely on habitat for important lifecycle processes e.g., breeding/roosting. Small pooling feature, relatively common within pastures. Contained hydrophytic exotic grasses typical of modified environs. No indigenous plant species were present. Hydrological connectivity limited to discharging into roadside drain. Perched culvert impeding connectivity.
NPS-Wetland 3 (collectively includes interior and exterior of Woodlot)	Low	Low	Low	Moderate	Moderate	Exotic dominated, low diversity of indigenous species, few tiny aquatic species common of modified rural environs. Moderate ecological context in relation to potential bat habitat /roosting and wetland foraging features; associated with tall willow treeland - relatively moderate size (c. 1.4 ha), and close proximity (c. 1.3 km from Site) to potential long-tailed bat habitat within Allen/Lowes Bush Reserve. Close proximity to Taratahi Water Race, a linear feature or 'highway' for potential bat foraging for invertebrates from known populations within the forested Tararua Ranges.
Taratahi Water Race	Low	Very high	Low	Low	Moderate	Artificial water race (constructed c. 100 years ago). Wider race network known to contain mudfish and long fin eel populations (At Risk – Declining). Presence of high value species lifts overall ecological value.

7.0 Assessment of Effects

7.1 Introduction

The proposed agrivoltaic facility at 3954A State Highway 2, Waingawa will supply renewable electricity to the New Zealand market and help achieve the country's 100% renewable electricity target by the target date of 2030. The facility will comprise multiple rows of solar panels (approximately 2.2 m wide) mounted on solar tables (approximately 5 m high) and will cover the majority of the 143 ha Site.

The solar tables consist of a single pile driven into the earth which minimises the need for widespread earthworks to prepare the Site. The development will require internal and perimeter access tracks (the latter being 10 m wide and including screening plantings where required) to service and maintain the facility. Construction of the access track requires the upgrade and/or replacement of three existing culvert crossings of the Taratahi Water Race. An area for on-Site energy storage (batteries) and car parking is also required and is planned to be located in the northeast of the Site.

The potential ecological effects identified and assessed in the following section include:

Terrestrial Environment

- Vegetation clearance.
- Effects on avifauna habitat.
- Effects on lizard habitat.
- Effects on bat habitat.

Freshwater Environment

- Effects on wetland habitat.
- Sedimentation effects.
- Effects on fish passage.

7.2 Effects on Terrestrial Environments

7.2.1 Vegetation Clearance

Construction of the agrivoltaic facility will result in the removal of scattered exotic trees within the Site and removal/damage to heavily grazed pasture associated with installing the solar tables/panels. In addition, existing mature vegetation comprising shelterbelts/ hedgerows around particularly the northern site perimeter would be 'trimmed' to a height of approximately 2 m. The willow woodlot located in the southern portion of the Site will be avoided by required infrastructure.

Vegetation within the site was assessed as having 'low' ecological value in and of itself, but as being of 'very high' ecological value in terms of its potential to provide suitable roost sites for long-tailed bats and perhaps lizards. The effect of vegetation removal of long-tailed bats and lizards is discussed in more detail below.

The removal/trimming of exotic trees within the Site to facilitate the construction of the agrivoltaic facility will have a magnitude of effect ranging from 'negligible' to 'moderate' and an overall effect ranging from 'very low' to 'low' (Table 6). No mitigation measures are proposed.

7.2.2 Effects on Avifauna and Habitat

The project will result in the removal/trimming of a number of exotic trees that have potential to provide nesting habitat for common native and exotic bird species typically found in the rural environment. While the majority of birds within the site are expected to be common species of no conservation interest, vegetation clearance or trimming (particularly of mature trees) can adversely affect native species when completed over the breeding season (September-February inclusive). Ideally vegetation clearance should occur within autumn-winter as to not adversely affect the breeding season. If vegetation clearance occurs during the breeding season, other mitigation techniques such as avoiding trees containing nests until chicks have fledged should be employed to minimise effects. With the appropriate level of mitigation, effects on avifauna is assessed as 'low' (Table 6).

7.2.3 Effects on Herpetofauna and Habitat

The location of the access track in the northern portion of the site intersects with potentially suitable lizard habitat. There is an existing farm track through this area of habitat which could be utilised instead of the currently planned route. Doing so would mean effects on the habitat or individual lizards is avoided.

The stonefield in the northern portion of the Site and the large boulder pile in the southwestern portion of the Site could both be affected by the installation of solar platforms. While no specific pile locations for the solar platforms are available, avoidance of these areas of habitat is anticipated such that effects on the habitat or individual lizards is avoided. Doing so would also avoid any adverse impacts of excessively shading areas of potentially suitable lizard habitat at the Site.

The construction and operation of the agrivoltaic facility will have a 'low' magnitude of effect and a 'low' overall effect on herpetofauna and potentially suitable habitat on Site (Table 6). No mitigation measures (other than avoidance of these areas) are proposed.

7.2.4 Effects on Bat Habitat and Direct Injury/Mortality

Bat populations need suitable roosts, foraging, drinking and socialising areas and commuting routes between these sites. Long-tailed bats are edge foragers, typically feeding along the edges and above canopies of trees rather than within a forest's interior. They also use vegetation for commuting between roosting and foraging sites, so loss of vegetation along these routes can potentially fragment and isolate bat communities (Thurley 2020). Bats demonstrate high site fidelity to existing roosts and their specific roosting areas, and they move on a rotation among these.

Because roost trees are likely to be rare, and are occupied to fulfil specialised requirements, felling breeding/communal roost trees (even when bats are absent) could have a disproportionately negative effect on the local bat population. If the number of suitable roosts and their surrounding habitat is reduced in the landscape, bats are forced to use roosts that are less thermally efficient. This means they will use more energy to survive, resulting in reductions in survival and lower reproductive success. In this way, roost removal is likely to result in higher risk of local extinction (Department of Conservation 2021).

Vegetation clearance has the potential to cause injury/mortality to long-tailed bats if they are present when the clearance occurs (e.g., roosting in a felled tree). Due to their (highest possible) 'Threatened – nationally critical' status, the presence of long-tailed bats at the Site would elevate the value of the bat habitats there to 'very high' value. We consider it is likely that bats may use the area. The removal of bat habitat in the form of potential roost trees is assessed as having a 'very high' level of effects without mitigation. With a 'very high' value and a (potentially) 'very high' magnitude of unmitigated effects, the overall level of effects on

bats is considered to be 'very high' at the ecological district scale. Similarly, at the Site scale the magnitude of effect would be 'very high' and the level of effects would be 'very high' as summarised in Table 6.

The reason for the use of the term 'potentially' when evaluating the magnitude of unmitigated effects is due to the inherent uncertainty surrounding whether, and indeed how, bats may be utilising the Site in the absence of specific site-based surveys. The highest level of effect is anticipated to result from the removal of active roost sites[7] and/or the risk of direct injury/mortality during vegetation clearance activities. Determining the presence of active roost sites requires further investigation, which can then be used to feed through to any bat management in the form of mitigation, offset or compensation that may be deemed necessary.

Bat management in the form of restricting the timing of vegetation clearance to warmer months when bats can be expected to be active, providing for additional survey to reduce the risk of bat presence immediately prior to clearance and contingency actions required in the event that bats are detected should be set out in a Bat Management Plan ('BMP') prepared by a suitably qualified and experienced ecologist. The BMP will also likely require a Wildlife Act Authority from the Department of Conservation.

Implementing a BMP prior to clearance will reduce the overall level of effect on bats to 'moderate - low' (Table 6). The post mitigation effect is somewhat uncertain without knowledge regarding whether or not any active bat roosts will be affected by the proposed activity. As such, a conservative level of effect has been applied (i.e., moderate).

7.3 Effects on Wetland Environments

At the time of preparing this report wetlands W2 and W3 were assessed as NPS-FM natural inland wetlands.

Encroachment of the proposed works (e.g., solar panels and vehicle tracks) within areas of wetland include:

- W1 (c. 492 m^2): no expected effect, outside of works footprint.
- W2 (c. 1,532 m^2): shading (c. 130 m^2) and vehicle track (c. 275 m^2): total area affected c. 405 m^2. NB: a portion of the vehicle track (approximately 6 m of 10 m total width) is earmarked for screening plantings.
- W3 (collectively, 3,067 m^2): small portion outside woodlot for vehicle track (area affected c. 27 m^2).

Although the wetland values are very low, effects due to the development on these wetlands, particularly any loss of wetland extent or ecological values, including complete or partial drying need to be avoided.

7.4 Effects on Freshwater Environments

Earthworks and Sedimentation Effects

Physical works associated with installing the solar tables and access tracks has the potential to result in fine sediment mobilisation and runoff into the Taratahi Water Race and wetlands. The addition of fine sediment to stream environments has the potential to alter water chemistry, increase turbidity and decrease light penetration that affects primary production and feeding for some fish species. The deposition of sediment can also smother instream surfaces, decrease interstitial spaces and decrease the amount of suitable habitat

[7] An active roost site in this context means a communal roost site used by bats previously.

available for benthic invertebrates. Sediment deposition in wetlands can smother vegetation and increase weediness.

All works will be carried out in accordance with erosion and sediment control plans prepared in accordance with best practice guidelines. With the implementation of the silt controls and treatment of stormwater the potential effects of earthworks on water quality in the receiving environment during construction will be avoided and the overall level of effect assessed as 'low' (Table 6).

Culverts

Stream works associated with the construction of culverts has the potential to result in the temporary loss of aquatic habitat and injury/mortality to fish and, if incorrectly installed, prevent fish passage. Potential effects on native fish will be managed by preparing and implementing a Native Freshwater Fish Relocation Plan prior to any stream works for the construction of culverts. The plan will be prepared by a suitably qualified and experienced ecologist.

To ensure compliance the National Environmental Standards for Freshwater (NES-F) relating to culverts (Regulation 70), the culverts must provide for fish passage. The final culvert design was not available at the time of writing this report but provided the NES-F standards provided in Regulation 70(2) are met, the overall level of effect is 'very low'.

Table 6: Overall level of effects on ecological values for the proposed agrivoltaic facility before and after mitigation assessed at the Ecological District scale.

Environment	Ecological feature	Effect	Ecological value	Magnitude of effect	Level of effect (no mitigation)	Proposed mitigation measures	Level of effect (with mitigation)
Terrestrial	Exotic grassland	Short term damage	Low	Negligible	Very low	None	Very low
	Exotic shrubland	Loss of vegetation extent and habitat values	Low	Low	Very low	None	Very low
	Shelterbelts	Loss of habitat value	Low	Moderate	Low	None	Low
	Woodlot	None	Low	Negligible	Very low	None	Very low
	Avifauna	Loss of ubiquitous nesting habitat (e.g., shelterbelts)	Moderate	Low	Low	None	Low
	Herpetofauna	Loss of individuals and potential habitat for 'Threatened', At Risk - declining' and common lizards	Moderate	Low	Low	Avoidance of identified lizard habitat (i.e., solar platforms and other infrastructure)	Low
	Bats	Removal and/or 'trimming' of exotic trees with features potentially used by long-tailed bats as communal roost sites	Very high	Very high	Very high	Implement BMP to ensure bats avoid direct injury/mortality as well as quantification of any actual bat roosts removed for offsetting purposes	Moderate - low
Freshwater	Natural inland wetland	Wetland 2 loss of area: 275 m^2 Wetland 3 loss of area: 27 m^2	Low Moderate	High Low	Low Low	Increase quantity (area) & quality of Wetland 3	Net gain Net gain
	Taratahi Water Race	Culvert upgrades causing fish injury/mortality	Moderate	Low	Low	Design culverts in accordance with NES-F guidelines. Implement Native Fish Relocation Plan prior to and during works.	Low
		Sedimentation	Moderate	Moderate	Moderate	Best practise erosion and silt controls	Very low

8.0 Recommendations

8.1 Avoidance of Lizard Habitat

The site layout of the agrivoltaic facility should be modified slightly to avoid areas of potentially suitable lizard habitat identified within the Site. In particular, avoidance should consider the placement of access tracks, solar platform piles, and solar panels (to avoid excessive habitat shading or any habitat removal).

There is an option to provide additional lizard habitat (or potentially relocated existing habitat features should it be required/desirable) in the area surrounding Wetland 3 and the woodlot in the southern portion of the site. This area already has some lizard habitat present (blackberry).

8.2 Additional Bat Surveys

Long-tailed bats may use the Site for feeding, moving through their home range, and could also be roosting in trees evidencing certain features (e.g., knot holes). Additional bat surveys would be beneficial in understanding how bats may be utilising the Site and informing bat management to avoid and/or reduce effects.

8.3 Development of a Bat Management Plan

Bat management in the form of restricting the timing of vegetation clearance to warmer months when bats can be expected to be active, providing for additional survey to reduce the risk of bat presence immediately prior to clearance, contingency actions required in the event that bats are detected, and a plan for offsetting the effect of removing any active bat roosts should be set out in a Bat Management Plan ('BMP') prepared by a suitably qualified and experienced ecologist.

8.4 Avoidance of Wetland Effects

Although the wetland values within the site are generally very low or low, any effects on these wetland areas needs to be avoided to comply with the NES-FM. It is recommended that tracks (including any culverts) be located so as to avoid any loss of wetland extent or complete or partial drying of the wetland areas. It is recommended that solar panels be similarly located so as to avoid any loss of extent of wetland areas or complete or partial drying of the wetland areas.

9.0 References

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APPENDIX A
Plant Species List

Latin Name	Common Name
Gymnosperms - Trees & Shrubs	
Cupressus × leylandii	Leyland cypress
Cupressus macrocarpa	macrocarpa
Pinus radiata	radiata pine
Dicotyledons - Trees & Shrubs	
Chamaecytisus palmensis	tree lucerne
Cytisus scoparius	broom
Eucalyptus sp.	gum tree
Kunzea robusta	kānuka
Platanus × hispanica	London plane
Populus sp.	poplar
Salix sp.	willow
Ulex europaeus	gorse
Dicot - Herbs	
Callitriche stagnalis	starwort
Hydrocotyle heteromeria	waxweed
Mentha pulegium	pennyroyal
Myosotis laxa	water forget-me-not
Trifolium repens	white-clover
Monocot - Herbs	
Lemna disperma	duckweed
Grasses	
Agrostis capillaris	browntop
Agrostis stolonifera	creeping bent
Anthoxanthum odoratum	sweet vernal
Cenchrus clandestinus	kikuyu
Dactylis glomerata	cocksfoot
Glyceria declinata	glyceria
Lolium perenne	perennial rye grass
Lianes and climbers	
Rubus fruticosus agg.	blackberry
Rushes & Allied Plants	
Juncus articulata	jointed rush
Juncus bufonius	toad rush
Juncus edgariae	Edgar's rush
Juncus sarophorus	broom rush
Ferns & Allied Plants	
Azolla rubra	water fern

APPENDIX B
Watercourse Classification Criteria (GWNRP 2023)

Watercourse Classification Categories

- ***River:*** *A continually or intermittently flowing body of fresh water; and includes a stream and modified watercourse; but does not include any artificial watercourse (including an irrigation canal, water supply race, canal for the supply of water for electricity power generation, and farm drainage canal).*

  Note GWRC interprets the term "intermittently flowing body of fresh water" to mean all watercourses that alternate between being dry and flowing. Thus, some ephemeral watercourses (defined above) are considered to be rivers.

- ***Ephemeral watercourse****: means a watercourse that:*

  a. *Has a bed that is predominantly vegetated, and*

  b. *Only conveys or temporarily retains water during or immediately following rainfall events, and*

  c. *Does not convey or retain water at other times, and*

  d. *Is not a wetland.*

- ***Highly modified river or stream:*** *Means a river or stream that has been modified and channelled for the purpose of land drainage of surface or sub-surface water and has the following characteristics:*

  a. *It has been channelled into a single flow, and*

  b. *The channel has been straightened, and*

  c. *The channel is mechanically formed with straight or steeply angled banks, and*

  d. *It exhibits these characteristics for at least its entire length through the property in which the activity is being carried out.*

- ***Artificial watercourse:*** *includes the following:*

  - ***Drain:*** *means any artificial watercourse, designed, constructed, or used for the drainage of surface or subsurface water, but excludes artificial watercourses used for the conveyance of water for electricity generation, irrigation, or water supply purposes.*

  - ***Stock water or irrigation race:*** *Where the watercourse part of a stock water or irrigation race network (i.e., it is identified on the "Water Races" layer on the Greater Wellington GIS server) at least some of the flow will be artificially derived from a surface water diversion. In these cases, advice should be sought from Greater Wellington environmental science staff on whether the watercourse would have existed prior to the diversion. If so the source of flow should be considered natural, otherwise it is artificial.*