



APPENDIX E

Ecological Impact Assessment



Co-creating a thriving ecosystem

T4 Growth Cell Private Plan Change

Ecological Impact Assessment

Rev. 1

Prepared for Lyn Cudby and LY&NZ Investments Limited



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Executive Summary

Morphum Environmental Limited were engaged by Mitchell Daysh, on behalf of Lyn Cudby and LY&NZ Investments Limited, to undertake an Ecological Impact Assessment in relation to a private plan change application at 540 Wallace Terrace and 5 Pokuru Road, Te Awamutu.

The 27-hectare site is currently utilised for a range of agricultural and horticultural activities. The proposed plan change seeks to re-zone the site from its current 'Deferred Residential' Zoning to 'Medium Density Residential' Zoning. It is noted the site is part of the Te Awamutu Future Growth Cell 'T4', under Appendix S1 of the Waipā District Plan, and therefore, has been identified as an area for future urban expansion.

This assessment has been undertaken in accordance with the Environmental Institute of Australia and New Zealand EclA Guidelines (2018, second edition). The methodology included a desktop assessment of site plans, as well as, available ecological databases and geospatial resources to initially identify potential ecological values. Two site visits were also undertaken, one in March and one in June 2023, to make observations and collect data on site ecological values.

This assessment has identified wetland and stream habitat, particularly along the southern boundary and through the centre of the site. The freshwater habitats are all highly modified due to longstanding land uses; however, longfin eel (*Anguilla dieffenbachii*) and black mudfish (*Neochanna diversus*), both classified as 'At-Risk – Declining' were detected in eDNA samples. Longfin eels were detected within the stream channels and black mudfish were detected within the eastern-most wetland (Wetland 1).

As a result of the At-Risk fish, the streams and Wetland 1 have been assessed to be of Moderate ecological value. The other wetlands on-site have been assessed to be of Low (current) ecological value, having been assessed as being of low across the representativeness, diversity/patterns and ecological context attributes and providing limited aquatic habitat.

Onsite vegetation is reflective of the highly modified agricultural environment, dominated by pasture grass and exotic weeds, as well as, individual mature exotic trees and shelterbelts of *Pinus* spp. along boundaries.

Common native birds utilise the site and mature exotic trees as habitat. The rank pasture grass and scattered logs and farm debris may provide low value habitat for the native copper skink (*Oligosoma aeneum*), classified as 'At-Risk – Declining'. Long-tailed bats (*Chalinolobus tuberculatus*), Threatened – Nationally Critical, may forage over the field and utilise the stream corridors as movement pathways. However, the condition of site vegetation and lack of connectivity to any forested areas, as well as, the regular disturbance associated with the existing land use, is considered likely to restrict the species present onsite.

Potential ecological effects facilitated by the plan change (and subsequent enabled development) are considered as the following:

- Erosion and sedimentation of waterbodies from earthworks.
- Vegetation clearance and effects on terrestrial fauna (including habitat loss and injury and mortality).
- Injury and mortality to freshwater fauna.
- Degradation of freshwater habitat
- Ongoing anthropogenic disturbances from the urban environment.
- Increased imperviousness and urban stormwater effects on freshwater environments.
- Residual loss of stream and wetland habitat.

It is noted that earthworks, streamworks, and associated activities required for the development would likely require resource consents and an effects assessment at the resource consent stage.

To provide for the development, current designs show that approximately 0.35 ha of natural inland wetland will be lost to primarily provide for roading, as well as, a small portion of residential development, resulting in a loss in extent and value of wetland habitat. Additionally, approximately 75 m of stream will require culverting for road development, resulting in further modification and impact on freshwater values. Such impacts represent residual adverse effects that will need to be addressed through a combination of on-site and off-site actions.

A high-level assessment has been undertaken to demonstrate that it is possible to adequately address these anticipated residual effects through enhancement onsite. The Biodiversity Compensation Model has been utilised to assess the adequacy of identified areas for restoration and enhancement compared to loss of wetland values and extent, and the Environmental Compensation Ratio has been utilised to calculate the required stream offsetting. It is anticipated that more detailed assessments would be required at the resource consenting stage to account for any design revisions.

It is considered the restoration of the retained wetland and stream habitat, as well as, the creation of new wetland habitat with the additional riparian and terrestrial planting, that would be undertaken in association with the development would enhance indigenous biodiversity values onsite and likely result in ecological gains.

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1. Introduction

1.1. Purpose and Scope

Morphum Environmental Limited (Morphum) were engaged by Mitchell Daysh, on behalf of Lyn Cudby and LY&NZ Investments Limited, to undertake an Ecological Impact Assessment (EclA) in relation to a private plan change application at 540 Wallace Terrace and 5 Pokuru Road, Te Awamutu (the site, Figure 1). The proposed plan change seeks to rezone the site from its current 'Deferred Residential' Zoning to 'Medium Density Residential' Zoning. New provisions are also proposed to enable commercial activities with the zone, and as a result of this ecological assessment, to manage any potential impact on the any potential bat population.

This assessment has been undertaken in accordance with the Environmental Institute of Australia and New Zealand EclA Guidelines (2018, second edition) (EIANZ Guidelines). The scope of this EclA is limited to the proposed plan change and the associated effects and is based on the T4 Structure Plan layout provided by the client in May 2024 (Revision G).



Figure 1: Overview of the T4 Growth Cell, Te Awamutu.

1.2. Site Overview and Ecological Context

The site is identified as part of the Te Awamutu Future Growth Cell 'T4', under Appendix S1 of the Waipā District Plan, and contains two properties covering approximately 27 ha in total, in the southwest of Te Awamutu. The site is currently utilised for a combination of crop production, as well as, pasture grass for cattle grazing and keeping horses.

Lyn Cudby is the owner of the southern land parcel within the T4 Growth Cell (approximately 18 ha). Lyn Cudby has formed an agreement with LY&NZ Investment Limited, who are the owner of the northern parcel (approximately 9 ha). Under the terms of their agreement, we understand Lyn Cudby and LY&NZ Investment Limited have agreed to jointly be one party for the purposes of technical assessments and for the private plan change application.

The site contains no Significant Natural Areas (SNA). The closest SNA recorded by Waipā District Council is 1.1 kilometres to the south, the Te Mawhai Puniu River willow wetland margins. The Te Mawhai Puniu River willow wetland margins (id 221; Site No. WP323) have been recognised for the willow dominated riparian marginal strip which is considered likely to provide habitat for wetland species (Waipā District Council, 2023).

The site is bordered by low density residential dwellings to the east. To the west the site is bordered by the North Island Main Trunk railway line, beyond which the land use is similarly rural. North of the site is Centennial Park, and further residential development. The rural land uses continue to the south.

The site is within a sub-catchment of the Punui River. The sub-catchment is approximately 5.7 ha, of which approximately 4.1 ha is in rural land uses similar to the subject site, with the balance being in low density residential urban land use. The Punui River is a tributary of the Waipā River. The Waipā River is a major tributary of the Waikato River.

The site is located within the Waipā Ecological District (WED). Pre-European indigenous vegetation was mostly comprised of scrub and ferns, with some kahikatea forest remnants; now the WED is almost entirely farmed (Department of Conservation, 1987).

1.3. Methodology

The ecological assessment for the plan change was undertaken in two stages.

1.3.1. Stage 1

A desktop assessment was undertaken to review available information and data relating to the ecological values of the site. This included the following documents and databases:

- Landcare Research Land Cover Database (LCDB) v5.0 – Landcare Research, 2018.
- Waikato Regional Plan – Waikato Regional Council, 2007.
- Waikato Maps – Waikato Regional Council, 2023.
- Waipā District Plan Maps Online – Waipā District Council, 2023.
- NZ river centrelines – Land Information New Zealand (LINZ), 2022.
- Current Wetland Extent, 2013 – Ministry for the Environment, 2017.
- Freshwater Ecosystems of New Zealand (FENZ) Wetlands – Department of Conservation, 2010.
- New Zealand Freshwater Fish Database (NZFFD) – NIWA, 2022.
- Waikato long-tailed bat distribution – Waikato Regional Council, 2023.
- Amphibian, Reptiles Distribution Scheme – Department of Conservation, 2023.

- eBird.
- iNaturalist.

Following the desktop review, a site walkover was undertaken, on 15 March 2023. The purpose of the site walkover was to assess the current ecological values of the subject site, including undertaking initial wetland delineations and stream classifications. The character of site vegetation, habitat values, and any fauna observations were recorded. Weather at the time of the site visit was clear, and there had been no recorded rainfall from the nearest weather station (approximately 2 km from the site) for the preceding 4 days (Waikato Regional Council, 2023a).

Wetland assessments were undertaken in accordance with the Ministry for the Environment Wetland Delineation Protocols (WDP, 2020) in each area of the site identified as a potential wetland. At least one 2 x 2 m plot was established in each notably different vegetation community within the potential wetland area. Plant lists were compiled in accordance with the Plot Sampling Procedure described in Clarkson (2013). Soil samples were taken at these plots in accordance with the Hydric Soils – Field Identification Guide (Fraser et al., 2018).

Morphum's Stage 1 involvement and design feedback to the client was used to inform updates to the Structure Plan layout, to accommodate natural habitat wherever possible. The Stage 1 project also involved discussions with Waikato Regional Council to provide them with an understanding of the project and potential impacts, as well as, to gather feedback on the design.

1.3.2. Stage 2

Following the updates to the Structure Plan, Morphum returned to site to collect more detailed information on ecological values of the site to inform the Ecological Impact Assessment to accompany the plan change application. The follow-up site visit was undertaken on 1 June 2023 and included the following methodologies for data collection:

- Additional wetland delineations to refine wetland boundaries.
- Assessment of condition within each identified wetland in accordance with Clarkson *et al.* (2003).
- Three eDNA samples collected from site watercourses.
- Two Stream Ecological Valuations (SEVs) (Storey *et al.*, 2011).
- Two Macroinvertebrate Community Index (MCI) samples (Stark *et al.*, 2001).

Weather at the time of the second site visit was overcast. 0.5 mm of rain was recorded at the same Waikato Regional Council (WRC) weather station the day prior to the site visit, with approximately 21 mm recorded across the preceding 72 hours.

Each sample location point was georeferenced. Recorded wetland delineation points, as well as, site contours, aerial imagery, and river geospatial datasets were all added to a geospatial workspace and used to determine wetland extents. Sample points and wetland extents are mapped in Appendix 2.

Following the Stage 2 assessment and subsequent discussion with the project civil engineers and planner, further amendments were made to the Structure Plan. That layout was used to inform an initial stream and wetland impact modelling exercise that was used to further refine the Structure Plan over several stages.

This assessment has been undertaken in accordance with the Environmental Institute of Australia and New Zealand EclA Guidelines (2018, second edition) (EIANZ Guidelines). The EIANZ Guidelines provide a standardised framework and matrix allowing a consistent and transparent assessment of ecological effects (refer to Appendix 3 for details). The guidelines were used to establish the following:

- The ecological values within the impact area and immediate surrounds;
- The magnitude of ecological effects; and
- The overall level of effects to determine where avoidance, remediation or mitigation is required and if any residual adverse effects remain that require further assessment.

2. Current Ecological Values

2.1. Terrestrial Values

2.1.1. Vegetation

The LCDB describes the entire site as high producing exotic grassland, which is an accurate high-level description (refer to the aerial photograph in the map provided as Appendix 1). Landcover on the southern-most property is primarily in pasture grass (*Lolium perenne*) as well as paspalum (*Paspalum dilatatum*), and the associated herbaceous vegetation buttercup (*Ranunculus repens*), clover (*Trifolium repens*), and dock (*Rumex obtusifolius*) (Figure 2). The northern property is utilised for crop production; at the time of the March 2023 site visit the property was predominantly exposed soils due to the recent harvesting of maize (Figure 3).

Prominent vegetation elsewhere onsite includes sporadic mature exotic trees; predominantly London plane (*Platanus x acerifolia*) and willow (*Salix spp.*), as well as birch (*Betula spp.*) and gum trees (*Eucalyptus spp.*). There are also shelter belts of exotic pine trees (*Pinus spp.*) on the north and south boundaries of the northern property, as well as, patches of gorse (*Ulex spp.*) and pampas grass (*Cortaderia spp.*) scattered across the site.

Table 1 below provides an assessment of the ecological values of the terrestrial vegetation within the site utilising the assessment matters from the EIANZ guidelines. The ecological value of the terrestrial vegetation on site has been considered Low.

Table 1: Assessment of current terrestrial vegetation values onsite.

Assessment matter	Ecological value (EIANZ, 2018)	Reasoning
Representativeness	Very Low	The current vegetation community is primarily pasture grass, crops, and associated exotic weeds, as well as, exotic mature trees and shelter belts. There is minimal native vegetation present. The vegetation present is not considered representative of the natural vegetative cover.
Rarity/distinctiveness	Low	None of the species present are considered threatened, nor of botanical note. All vegetation species observed are commonly found in rural/agricultural habitat.
Diversity and pattern	Very Low	The current native species diversity is below the expected level of natural diversity for the site that would have been present before human modification.
Ecological context	Low	Some of the vegetation present may provide low-quality roosts and connection pathways for a range of native fauna foraging across the wider rural landscape.



Figure 2: Looking southwest from the farm race across pasture fields with sporadic mature exotic trees on the southern property.



Figure 3: Looking south across the northern property from the northern boundary; visible recent crop harvest.

2.1.2. Avifauna

No formal surveys were undertaken for avifauna. Incidental avifauna observed onsite were recorded and are presented in Table 2 below; all were either exotic or common native species.

No 'Threatened', 'At-Risk', or otherwise locally uncommon species were observed, and no records within the Te Awamutu area were noted during a review of iNaturalist and eBird.

Not observed or recorded, but considered potentially present, are kingfisher (*Todiramphus sanctus*, Not Threatened) and nocturnal native birds with morepork (*Ninox novaeseelandiae*, Not Threatened) being most likely. Kingfisher are cavity nesters and as such could nest in individual shade trees during the nesting season whilst feeding on invertebrates in the wider surrounds. Morepork are known to thrive in such modified environments where their preferred prey (such as mice) can be abundant and more easily preyed upon.

It is recognised that native birds may forage over open fields, and the shelter belts/trees may act as temporary roosting habitat for birds foraging across the landscape. Due to the regular disturbances associated with the rural land uses, as well as, the isolated nature and lack of connectivity to forested areas, the current terrestrial vegetation will provide limited habitat provision.

Given the species observed and recorded on-site, as well as the habitat values present, it was considered that additional survey effort would yield little additional species.

Considering there were no observations of Threatened or At-Risk native avifauna during the site visits, the absence of online records of any such species within the site or immediate surrounds, and a lack of suitable habitat to support them, the ecological value of avifauna is considered Low.

Table 2: Site Avifauna Observations.

Common Name	Scientific Name	Threat Status (Robertson et al. 2021)
White faced heron	<i>Egretta novaehollandiae</i>	Not Threatened
Tūī	<i>Prosthemadera novaeseelandiae</i>	Not Threatened
Pūkeko	<i>Porphyrio melanotus melanotus</i>	Not Threatened
Sparrow	<i>Paser domesticus</i>	Introduced and naturalised
Mallard	<i>Anas platyrhynchos</i>	Introduced and Naturalised
Blackbird	<i>Turdus merula</i>	Introduced and Naturalised

2.1.3. Herpetofauna

The Department of Conservation ARDS database shows no records within the site. The nearest records, this century, are for the native copper skink (*Oligosoma aeneum*) approximately 5.3 km to the north, and 6.6 km to the northwest. There are numerous other records for the exotic *Litoria* (Australian) frogs, in the wider area. Over 8.5 km from the site, there are historic records in the ARDS database for elegant gecko (*Naultinus elegans*) from the 1960s. Given the current habitat values in these areas (desktop assessed) and the time lapse since the records it is doubtful that such populations of elegant gecko have continued to survive.

Herpetofauna were not systematically searched for due to the quality and quantity of habitat on site. Occasional searching of potentially suitable habitat was undertaken during the March site visit; however, no lizards were sighted. The weather and climatic conditions during the June site visit were not conducive to lizard searching.

In general, habitat was limited to isolated logs, tree stumps, debris, and rank grass scattered throughout the site, which can provide habitat for native skinks (Figure 4). The site is not considered to contain any potential gecko habitat.

There is potential that the site is inhabited by the copper skink (*Oligosoma aeneum*) based on the habitat on-site and records within similar habitat in the wider area. Copper skinks are found throughout the North Island, and live amongst leaf litter, under rocks, logs, and debris, as well as in rank pasture.

Copper skinks are classified as At-Risk - Declining (Hitchmough *et al.* 2021), and correspondingly have a High ecological value. Copper skink can inhabit modified habitats, such as rank grasses, leaf litter and hedge rows. Accordingly, it is considered that copper skink may persist in such modified habitats where they are found (in low abundance across the site).

Given the species considered to be potentially present, as well as, the habitat values present on site, it was considered that additional survey effort would yield little additional value.



Figure 4: Examples of potential skink habitat.

2.1.4. Bats

From a review of the Waikato long-tailed bat distribution map (Waikato Regional Council, 2023b), there were no records of native bat activity within the site. The nearest records of long-tailed bats (*Chalinolobus tuberculatus*) were approximately 2 km to the northeast, within similar rural habitat and adjacent to the Mangaohoi Stream. This is likely to reflect a lack of dedicated survey effort, rather than confirmation of a lack of presence.

Long-tailed bats (*Chalinolobus tuberculatus*) have a threat status of 'Threatened – Nationally Critical' (O'Donnell *et al.*, 2017) and correspondingly would have an ecological value of Very High. Considering the exposed nature of the site trees, and lack of connectivity to larger areas of dense vegetation, the likelihood of bats being routinely present onsite is considered low. Furthermore, the vegetation onsite is a very small proportion of abundant similar habitat across the wider landscape.

Whilst long-tailed bats prefer densely forested vegetation for roosting, they are known to forage in relatively open spaces, including farm paddocks where prey can be abundant, and utilise linear features such as streams and shelterbelts for travel corridors.

Stream 1 originates within the rural site, and Stream 2 within the residential neighbourhood to the northeast. Stream 3 extends approximately 800 m to the northwest through similar agricultural landscape. Accordingly, there is little by way of habitat for bats upstream of the site beyond foraging opportunities along Stream 3. Two dedicated surveys have been undertaken in the 'T2' growth cell, approximately 1.8 kilometres to the north-west and bordering the Mangapiko Stream in similar habitat as part of proposed plan change 12 (PPC12, now granted) (Ecology NZ, 2020a and Ecology NZ 2020b). The monitoring conducted in T2 did indicate the presence of bats on a foraging basis, with no indications of roosting behaviour, and was considered to be comparatively low habitat value relative to other areas in the Waikato.

Given the acknowledged presence of long-tailed bats nearby, but the lack of maternity roost trees within the site, dedicated acoustic surveys were not undertaken. Rather the approach has been to acknowledge the site could potentially provide foraging opportunities for long-tailed bats in the wider landscape.

No records of short-tailed bats (*Mystacina tuberculata aoupourica*, 'Threatened – Nationally Vulnerable') were identified for the area. The species is known to prefer deep-forest habitat and are associated with old growth indigenous forest. As such, their presence within, or in close proximity to, the subject site is considered unlikely.

2.2. Freshwater Values

2.2.1. Macroinvertebrates

Macroinvertebrate samples were collected in two locations associated with the SEV sampling sites (refer to Appendix 1). The Macroinvertebrate Community Index (MCI) provides biotic indices used to assess stream health.

The full results are presented in Appendix 4, and the summary statistics in Table 3 below. The results are indicative of high modified freshwater environments.

A MCI-sb score of 80-99, and a QMCI-sb 4.00-1.99 fall within the 'Fair' quality class, which Stark (2007) describe as 'Probable moderate pollution'. The scores below are on the lower end of the range above and

only slightly above the threshold for 'Poor' and 'Probably severe pollution'. These findings are consistent with other watercourses in modified pastoral environments.

The presence of only one species from the Ephemeroptera, Plecoptera and Trichoptera (EPT) orders, those species most sensitive to water quality degradation, further lends weight to this assessment.

Table 3 Macroinvertebrate Sampling Summary Statistics

Taxa	S1	S2
Number of Taxa	19	20
EPT Value	0	1
Number of Individuals	369	592
% EPT	0	0.34
% EPT Taxa	0	5
Sum of recorded scores	81	87
Count of recorded scores	19	20
Sum of individuals with scores	369	592
MCI Value	85.26	87
Sum of abundance load	1452	2843
QMCI Value	3.93	4.80
Sum of recorded scores	73.4	78.2
Count of recorded scores	17	18
Sum of individuals with scores	277	74
SBMCI Value	86.35	86.89
Sum of abundance load	808.4	271.4
QMCI-sb Value	2.92	3.67

The ecological value of the site's macroinvertebrate community is therefore assessed as Low.

2.2.2. Freshwater Fish

Three eDNA samples were collected from across the waterbodies within the site during the June site visit. Results of freshwater fish species detected in eDNA results are presented in Table 4, locations of the eDNA samples are included on the map in Appendix 1.

Two species listed as 'At-Risk – Declining' (Dunn *et al.*, 2017) were detected through the eDNA sampling; longfin eel (*Anguilla dieffenbachii*) and black mudfish (*Neochanna diversus*). As per the EIANZ Guidelines, an 'At-Risk – Declining' species has a corresponding High ecological value; Not Threatened species are ascribed an ecological value of Low.

Table 4: Freshwater fish detected in eDNA results.

Common Name	Scientific Name	Conservation Status (Dunn <i>et al.</i> , 2017)	S1	S2	S3
Black mudfish	<i>Neochanna diversus</i>	At Risk - Declining	Y	-	-
Longfin eel	<i>Anguilla dieffenbachii</i>	At Risk - Declining	-	Y	Y
Shortfin eel	<i>Anguilla australis</i>	Not Threatened	Y	Y	Y
Mosquito fish	<i>Gambusia affinis</i>	Introduced and Naturalised	-	Y	Y

The NZFFD contains one record of shortjaw kōkopu (*Galaxias postvectis*) ('Threatened – Nationally Vulnerable'), from 1998, within the Punui River, upstream of the confluence with the streams on site. However, stream habitat and conditions onsite are considered unsuitable for shortjaw kōkopu, and as they were not identified in eDNA samples, it is considered unlikely they would be present within the streams on site.

The results of the eDNA sampling and desktop review were considered sufficient to inform an assessment of the aquatic community, without the need for more invasive, and potentially lethal, overnight trapping techniques.

2.2.3. Streams

Three stream reaches were identified onsite, the streams are displayed on the map in Appendix 1.

Stream 1 is a perennial headwater watercourse that flows along the southeast boundary of Wetland 1 for about 65 m before discharging offsite through a 700 mm concrete culvert. The stream is part of Wetland 1 onsite as there is visible flowing water, but no clearly defined streambed or banks. Downstream of the culvert the stream possesses defined banks consistent with a stream channel.

Stream 2 commences within the stormwater wetland off Ava Mae Drive, to the northeast, and flows in a southerly direction through the centre of the site. The stream is perennial, soft-bottomed, ranges between 0.3 – 1.5 m wide, and has moderate habitat diversity; mostly riffle habitat downstream of the farm race, with deeper pools and run habitat upstream. Stream 2 converges with Stream 1 on the property to the south and flows generally southwest for approximately 2 km before converging with the Punui River.

Stream 3 has its headwaters in the agricultural land to the northwest of the site and flows in a general southeast direction. The stream enters the site near the southwest boundary and flows through the site for approximately 280 m before converging with Stream 2 onsite, near the southern boundary. The stream is perennial, soft-bottomed, approximately 0.5 m wide, 0.3 m deep, and relatively uniform riffle habitat.

An SEV assessment was undertaken in Streams 2 and 3; as there was no defined channel for Stream 1, no SEV was undertaken here. Stream 2 had an overall SEV score of 0.37, while Stream 3 had an overall SEV score of 0.38; these scores are consistent with the observed modified environment, and consistent with scores for similar quality reference rural streams across the Waikato and Auckland Regions (Auckland Council, 2011; Eivers & Phillips, 2020).

A summary of SEV category scores is provided in Table 5; as the results are so similar, the higher of the two SEVs (Stream 3) has been used in impact analysis to increase conservatism. The full SEV function scoring for Stream 3 is provided in Appendix 5.

Table 5: Summary SEV scores.

Function Category	Stream 2	Stream 3
Hydraulic function mean score	0.64	0.64
Biogeochemical function mean score	0.26	0.27
Habitat Provision function mean score	0.13	0.17
Biodiversity function mean score	0.36	0.35
Overall mean SEV score	0.37	0.38
Overall mean SEV score (excl. Fish/MCI)	0.36	0.36

Table 6 below provides an assessment of the ecological values of the streams on site, representative photos are presented in Figure 5 to Figure 8. Due to the presence of At-Risk fish within each stream reach, the overall ecological value for the streams is determined to be Moderate.

Table 6: Assessment of stream ecological values onsite.

Assessment matter	Ecological value (EIANZ, 2018)	Reasoning
Representativeness	Low	Perennial streams through highly modified rural catchment, not considered to reflect the expected natural environment. Soft bottomed with areas of unnatural sediment build-up from streambank erosion. High coverage of exotic macrophytes such as mercer grass (<i>Paspalum distichum</i>), water celery (<i>Helosciadium nodiflorum</i>), and water pepper (<i>Persicaria hydropiper</i>). SEV scores indicative of a modified environment.
Rarity/distinctiveness	High	Small catchments predominantly modified for rural and residential land use. Limited shading as well as unnatural sediment and nutrient inputs. However, 'At-Risk – Declining' species were noted in eDNA results for all three streams.
Diversity and pattern	Low	Limited habitat diversity, mostly shallow riffles; Stream 2 has some areas of deeper pool/run habitat. Stream 2 and 3 channels likely straightened in areas. Highly modified riparian margin for agricultural use.
Ecological context	Low	Low (1 st to 2 nd) order watercourses, limited instream habitat diversity and minimal riparian cover. Dense macrophyte coverage. Low value habitat, however, noted to support At-Risk fauna.



Figure 5: Stream 1 looking north from the southern boundary of the site.



Figure 6: Stream 2 looking north from the northern-most stream crossing.



Figure 7: Pool habitat in Stream 2, looking south from the northern-most stream crossing.



Figure 8: Stream 3 looking northwest from the site stream crossing.

2.2.4. Wetlands

Five wetlands were delineated across the site, these have been given a reference number (1, 2, 2.1, 3, and 4) and are identified on the map in Appendix 1.

Ecological values for each wetland were determined based on assessment of wetland condition as per Clarkson *et al.* (2003), as well as, consideration of the freshwater attributes as discussed in the Environmental Institute of Australia and New Zealand Ecological Impact Assessment Guidelines (EIANZ 2018).

During the site visits, standing water was observed in hollows within the wetland areas. The presence of iron floc in the water in wetlands 1 and 3 indicate sustained presence and interaction with groundwater. All wetlands featured saturated soils near the surface. Based on vegetation, the wetland ecosystem type would be considered Exotic Wetland – EW. A more detailed framework is offered by Johnson & Gerbeaux (2004), and an assessment using this framework has been used and is presented below in Table 7.

Table 7: Wetland classification assessment utilising Johnson & Gerbeaux (2004)

Classification Attribute	Classification
Hydrosystem	Palustrine – wetland fed by a combination of groundwater and surface water interaction.
Wetland Class	Marsh - fed by groundwater or surface water (or a combination of both) with slow flows, and evidence of fluctuating/seasonal water table/level. Generally occur alongside the streams.
Wetland Form	Riparian – wetland is not influenced by tidal waters being inland, is not raised above the surrounding land, adjacent to slow flowing stream.
Structural Class	Rushland / Grassland, depending on the area sampled vegetation community would be dominated by <i>Juncus</i> or grasses.
Composition of vegetation	Exotic rush / grass.

Table 8 provides a summary assessment of the ecological value of Wetland 1.

Table 8: Summary of ecological values for Wetland 1.

Assessment matter	Ecological value (EIANZ, 2018)	Reasoning
Representativeness	Low	Wetlands dominated by exotic pasture vegetation and facultative / obligate wetland species (soft rush (<i>juncus effusus</i>), mercer grass), not representative of the expected natural wetland community. Accessible to stock for grazing and pugging. Wetlands characteristic of a first order stream/wetland environment common throughout the region.
Rarity/distinctiveness	High	Headwater wetland. Wetland habitat is threatened regionally and nationally. At-Risk black mudfish identified in eDNA results from adjacent stream; aquatic habitat present within wetland away from stream channel.
Diversity and pattern	Low	Small, highly modified, catchment, limited biodiversity comprising mostly exotic species.
Ecological context	Moderate	Wetland has experienced a high level of modification and stock damage resulting in limited ecological function. Buffered by areas of modified agricultural land. Reasonable area of aquatic habitat to support the identified black mudfish.

Table 9 provides a summary of the ecological value of Wetlands 2 – 4. Representative photos of the habitats are provided in Figure 9 to Figure 14. Wetland 1 was determined to have an overall ecological value of Moderate, based on the eDNA results returned for At-Risk species; whilst Wetlands 2, 2.1, 3, and 4 all had an overall ecological value of Low.

Table 9: Summary of ecological values for Wetlands 2 - 4

Assessment matter	Ecological value (EIANZ, 2018)	Reasoning
Representativeness	Low	Wetlands dominated by exotic pasture vegetation and facultative / obligate wetland species (soft rush, water pepper, mercer grass), not representative of natural wetland community. Generally accessible to stock for grazing and pugging. Wetlands characteristic of a first order stream/wetland environment common throughout the region.
Rarity/distinctiveness	Moderate	Riverine/palustrine wetlands with little diversity of aquatic habitat, mostly just ponding at the surface. Although At-Risk species (longfin eel) identified from stream eDNA samples adjacent to wetland habitat, there is considered to be limited aquatic habitat within these wetlands to support highly diverse freshwater fauna. Wetland habitat is threatened regionally and nationally.
Diversity and pattern	Low	Small, highly modified, catchment, limited biodiversity comprising mostly exotic species.
Ecological context	Low	Wetlands have experienced a high level of modification and stock damage resulting in limited ecological function. Wetlands buffered by areas of modified agricultural land and provide limited aquatic habitat.



Figure 9: Looking east from within Wetland 1.



Figure 10: Looking south from above Wetland 1; site boundary fence through the middle of the photo.



Figure 11: Looking northwest at Wetland 2 on the true left bank of Stream 3.



Figure 12: Looking west across Wetland 2.1.



Figure 13: Looking northwest across Wetland 3 from the wetland boundary.



Figure 14: Looking south across Wetland 4.

2.2.5. Ponds

An approximately 130 m² pond (Pond 1) was located to the east of the Stream 2, near Wetland 3. Pond 1 has been artificially constructed as a result of a bund built at the southern extent. A pipe through the bund discharges the pond to the stream network; the pipe outlet is perched roughly 0.5 m above the stream. Pond 1 is surrounded by exotic pest plants such as pampas, willow, and canna lily (*Canna indica*).

Another pond (Pond 2) is located toward the eastern boundary, in the middle of the site. This has been determined artificial due the lack of any connected watercourse or catchment to supply the pond, as well as no clear presence in historic imagery. The pond is densely covered by macrophytes, including water lily (*Nymphaea alba*), soft rush, water pepper, and other exotic grasses. Pond 2 is approximately 60 m² and has an overland discharge to the constructed stormwater pond to the east of the site.

A number of artificially constructed drains were also observed onsite around Wetland 4, as well as, along the southeast boundary. These drains were all visibly excavated, likely historically to drain the paddocks.

As the ponds and drains have been determined artificial, they are considered to be of Negligible ecological value. The ponds could provide low-quality refugia habitat for Anguilliformes that could surmount the fish passage barriers; however, inhabitation by any other species is considered unlikely, and no pest or aquarium species were observed within the ponds.

2.3. Summary of Ecological Values

The current ecological values of the site have been described based on site observations and collected samples, as well as, a review of the available literature and databases, and are summarised in Table 8.

Table 8: Summary of Ecological Values

Feature	Ecological Value (EIANZ, 2018)	Reasoning
Terrestrial Vegetation	Low	Vegetation consists of low diversity exotic pasture grass and weeds, as well as individual and strands of mature exotic trees, there are no Significant Natural Areas (SNA) within the site, and no indigenous biodiversity that would be qualify as SNA. None of the species are threatened, nor of botanical note, but may provide roosting or nesting habitat for the common native birds observed onsite.
Avifauna	Low	All species observed onsite are generally common within rural landscapes.
Herpetofauna	High	Due to potential presence of copper skinks, classified as At-Risk – Declining. However, it is considered unlikely native herpetofauna would inhabit the site.
Bats	Very High	Due to potential presence of long-tailed bats; classified as Threatened – Nationally Critical. However, it is considered unlikely bats would use the site for anything more than occasional foraging habitat.
Macroinvertebrate's	Low	Species common within rural landscapes, lack of EPT taxa and community indicating poor water quality.
Other - Not Threatened Freshwater Fish	Low	Species common within rural landscapes.
Threatened Freshwater Fish	High	At-Risk – Declining species identified in eDNA sampling.
Streams	Moderate	Low value and diversity of habitat, highly modified environment; however, At-Risk species present.
Wetland 1	Moderate	Highly modified habitat impacted by agricultural land use, not reflective of natural wetland environment, but eDNA detected black mudfish (At-Risk – Declining)
Wetlands 2-4	Low	Highly modified habitat impacted by agricultural land use, not reflective of natural wetland environment. Little aquatic habitat to support fauna.
Ponds	Negligible	Artificially constructed.

3. Plan Change Proposal and Potential Effects

The private plan change seeks to rezone the site from its current Deferred Residential Zoning to Medium Density Residential Zoning, to enable development of the site for urban purposes, including approximately 192 dwellings and associated infrastructure. It is understood that the Deferred Residential zoning means that the land has already been identified for future residential development.

The current Structure Plan is the result of design input and feedback from various specialist areas, including the initial ecological findings from the Stage 1 assessment, and subsequent ecological modelling. The layout of the development has been amended to avoid as much of the natural hydrological features as possible, as demonstrated by the Structure Plan evolution in Figure 15 which demonstrates 3 of the previous revisions of the structure plan that all reduce the impact on streams and wetlands. The finalised layout and how it interacts with site freshwater features is displayed in Figure 16.



Figure 15: Structure Plan layout evolution to accommodate natural features; residential development is displayed in yellow, with open space in green and stormwater management areas displayed in blue.

From an ecological perspective, under the Waipā District Plan, the key changes enabled by the plan change would be:

- An increase in permitted building coverage of a site from 3% (for sites more than 1 ha) to 40%.
- A maximum of 60% of the net site area is permitted to be in impervious surfaces (an activity not specifically regulated for rural zoned land).
- A reduction in permitted activity thresholds for earthworks from 1,000 m³; to 25 m³ and/or 250 m² in a single activity or calendar year.

Activities in relation to water bodies would remain regulated under Part F, Section 26 of the Waipā District Plan, as well as, Chapter 4 of the Waikato Regional Plan and, therefore, would be unaffected by the plan change.

Although likely to require resource consent application(s), which in itself would require an impact assessment, the below outlined construction activities are recognised as being necessary for the

development for which the plan change is sought. Therefore, the potential impacts of these activities are acknowledged within this assessment as being anticipated through the plan change:

- Earthworks and vegetation clearance to facilitate site development (including wetland reclamation).
- Construction of residential dwellings, roads, and services (including culverting of streams, the location of which are shown in The Stormwater Structure Plan: Stormwater).
- Operational activities (including onsite and catchment-wide stormwater management, as well as, noise, light and traffic movements associated with the change in land use).

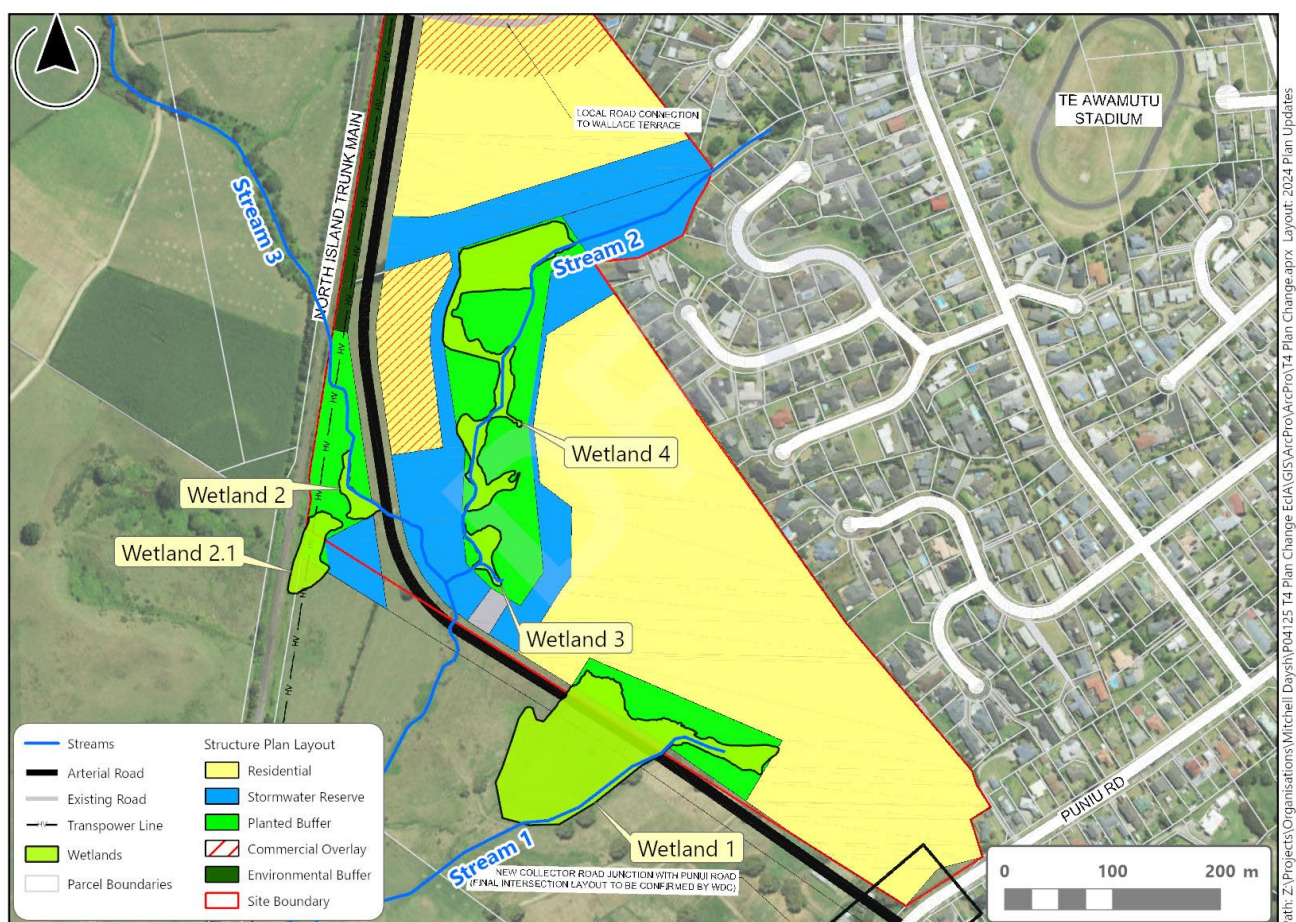


Figure 16: Site freshwater features overlaid on the proposed Structure Plan layout.

4. Ecological Effects Management

4.1. Construction Effects

4.1.1. Land Disturbance

Earthworks will be required to prepare the building platforms, roads, accessways, and services and would be assessed at the time of resource consenting. Earthworks construction activities would involve the use of machinery that could generate dust, noise, and vibrations for the duration of construction that may reduce the habitat quality for any species present and lead to their avoidance of the area.

Additionally, for all land disturbance activities, there is a risk of uncontrolled sediment discharge to the receiving environment. Sediment is a contaminant as defined in the Resource Management Act (RMA) and has the potential to cause a range of adverse effects in the receiving environment including smothering of benthic habitat, direct mortality of native freshwater fish through asphyxiation from clogged gills, and changes to water quality, including physio-chemical indicators pH and clarity.

The magnitude of any impact within the watercourses within the site would be 'Low' given the existing unnatural accumulation of soft sediments, and indicators of nutrient enrichment it is unlikely to be a change from the current ecological conditions.

However, large volumes of sediment discharge has the potential to be of a higher magnitude, on a shorter-time period and for individual aquatic fauna.

The potential for erosion to occur, and the management of any residual sediment generated, can be managed by implementing the industry best practice erosion and sediment control measures contained in Waikato Regional Council's TR2009/02 document Erosion and sediment control: guidelines for soil disturbing activities (Waikato Regional Council, 2009). It would be standard practice for conditions of consent be applied to any future regional earthworks consent to ensure that this is the case.

With appropriate erosion and sediment control, the magnitude of effect of land disturbance activities would remain Low. With the magnitude of sediment discharges being low within the site, the magnitude would be considered Negligible in the context of the wider receiving environment given the scale of the earthworks likely required relevant to the size of, and land uses within, the wider catchment.

4.1.2. Vegetation Clearance

Vegetation to be cleared for site development would primarily consist of pasture grass and associated shrubs, as well as, exotic pest species such as gorse and pampas. Mature trees outside of the proposed open space reserves could also be removed.

The existing terrestrial vegetation on site has been assessed to be of low ecological value, and low habitat value for native fauna (birds, bats and lizards). Regardless, vegetation removal may affect the fauna that utilise this area, either directly due to injury or mortality during removal, or indirectly through the loss of foraging and/or nesting habitat.

Whilst it is likely that only low numbers of native species would be present in the available habitat on site, the potential exists for the loss of individuals of protected native species. Therefore, it is considered that

whilst there would be an impact on the individual, this would be barely discernible at a community level for the native fauna. Therefore, the magnitude of effect of vegetation clearance would be Low.

For individuals, management would be required under the Wildlife Act (1953), as well as, potentially under resource consent provisions for the development. If deemed necessary at the time of consenting, effects of the vegetation clearance on terrestrial fauna could be adequately managed through undertaking pre-clearance inspections. Any individuals found could be either avoided until they naturally left the area or potentially managed in accordance with the Wildlife Act, and should consents be required for this vegetation clearance then such measures could be stipulated and reinforced through conditions of consent.

With appropriate terrestrial fauna management, the magnitude of effect of vegetation clearance would be Low.

For native bats, given the current ecological value of Very High, a magnitude off effect of Low results in an overall level of effect of 'Moderate'. EIANZ (1028) considers that a level of effect in the 'High and Moderate' adverse category represent a level of effect that requires careful assessment and analysis of the individual case, and that such an effect could be managed through avoidance, design, or extensive offset or compensation actions. Wherever adverse effects cannot be avoided, no net loss of biodiversity values would be appropriate.

For vegetation removal, the direct impact on bats is avoidable through a further risk assessment of all trees proposed for removal be undertaken closer to construction to identify any possible roost trees. If roost features are present, then tree removal protocols need to be implemented by an appropriately qualified bat ecologist to avoid harm to roosting bats. The management of the bats would be a matter for consideration under the Wildlife Act; however, the assessment for potential roosts could be reinforced through the plan change. Potential mechanisms to this effect have been outlined in section 6 that would highlight the need for further investigations closer to the time of any vegetation clearance.

4.1.3. Works within Watercourses

The Structure Plan design would require crossings (likely culverts) across all three streams on site, as well as, works within wetland habitat to construct roads and a portion of the residential development.

The works within the waterbodies has the potential to result in direct injury and mortality to freshwater fauna during construction works and the subsequent loss of aquatic habitat. For freshwater fish, whilst there would be an impact on the individual, this would be barely discernible at a community level for the species. Therefore, the magnitude of effect of any streamworks would be Low.

Direct effects on native freshwater fish would be assessed at the time of resource consenting for the development, but could be managed through the provision and implementation of a Native Fish Capture and Relocation Plan (NFCRP). Due to the presence of black mudfish, the NFCRP will need to consider life-cycle constraints in relation to undertaking fishing to avoid times when the Stream 1/Wetland 1 area may have dried out, and when mudfish may be aestivating.

It is considered there would be sufficient retained habitat within Wetland 1 to provide for relocation of any captured mudfish within the site. Additionally, site streams, particularly within Stream 1, would provide potential relocation habitat for other species.

It would be a normal practice that such measures would be reinforced through the regional consenting process.

Additionally, there are works proposed that would create new wetland habitat, which would benefit particularly black mudfish which adds conservatism to the assessment above.

Indirect effects, such as the potential for a spill or discharge of construction materials to a watercourse, could have an impact on the physiochemical composition of the stream. The exact magnitude would be dependent on the nature and volume of any discharge, the most probably risk is from the use of concrete or grouts used in the construction of the culverts.

Whilst the magnitude of any uncontrolled discharge of construction materials to the watercourses would be 'Moderate'; changes to the water quality are possible however are influenced by the current water quality attributes.

Spills and discharges can be managed through the construction methodology at the time of resource consenting. Management would likely require temporary damming of stream reaches and over-pumping during works, timing of works to coincide with minimal stream flows/water levels (where practicable with fishing considerations), operating machinery outside the wetted width of the waterbody, ensuring any refuelling is undertaken within an appropriate setback distance from waterways, and maintaining a spill kit onsite and training staff in its use. With the above outlined management measures, the magnitude of effect on freshwater fauna, including mudfish, would be reduced to Low.

The magnitude and overall level of effect on aquatic habitat would be Moderate, due to the loss of instream habitat. There is considered to be a residual adverse effect, as the impact cannot be fully avoided, remedied or mitigated (at the point of impact). Residual effects are discussed in further detail below.

The artificial ponds could be retained, or removed. Regardless, given the magnitude of any effect is considered Negligible in the context of the sites freshwater systems given the values and extent present.

4.2. Post-Construction Activities

4.2.1. Anthropogenic Disturbances

The urban development will increase anthropogenic disturbances associated with increased traffic, noise, and lighting. Such disturbances could reduce the quality of retained or enhanced vegetation as habitat for native species, reducing habitat quality through the detriment of nesting, roosting, and foraging sites.

The effect of such disturbances will depend on the extent of natural habitat retained, as well as, the landscaping of the site following construction and the buffers that this provides. Nonetheless, it is considered there would remain a large extent of similar open rural habitat within the surrounding area which would ensure the magnitude of effect would largely be Negligible, being barely discernible from the baseline (existing) condition.

The exception is for bats that are known to use stream/riparian margins as movement pathways; thus a decrease in the quality of the habitat such as through the plan change area could disrupt bats migrating across the landscape.

A potential increase in artificial light may lead to decreased activity, a change in habitat utilisation by bats, or complete avoidance of the site by bats. This has been conservatively considered as having a Moderate magnitude of effect, given the existing habitat quality on site. With a Very High Ecological value, Moderate magnitude of effect the overall level of effect is 'High'.

As utilised with T2, (proposed plan change 12) the level of effect can be reduced through the incorporation of low lumen, directional lighting design for external lighting and street lighting. A bat sensitive lighting

regime should be developed in conjunction with a suitably qualified and experienced Bat Ecologist and a suitably qualified and experienced Lighting Practitioner and provided as part of the detailed design package. The closest to a recognised industry best practice standard to which the lighting design should be in accordance with is EUROBATS Publication Series No. 8 – Guidelines for consideration of bats in lighting projects.

With the development following the structure plan, including the open space and created wetlands around the streams/wetlands and the lighting mitigation in place it is considered that the magnitude of effect would be reduced to 'Negligible', and the level of effect to Low.

4.2.2. Increased Imperviousness and Stormwater Management

The increase in buildings and other impervious surfaces associated with the change in land zoning will have implications for stormwater runoff (quantity and quality).

An increase in impervious surfaces arising from urban development would be anticipated to lead to an increased runoff following rainfall events. An increase in impervious surfaces would generally prevent infiltration via ground. Consequently, such additional flows are usually captured in a stormwater networks and transported away from where they fall as fast as practicable for disposal elsewhere. Accordingly, there can be changes to the hydrological inputs to the natural freshwater systems. This could result in the wetlands being drier for longer periods of the year, allowing a shift in the vegetation away from wetland-adapted species and potentially invasion by pest species. This would ultimately result in a further reduction in the ecological value of these systems.

In addition, with impervious surfaces replacing the current agricultural paddocks, there would be a shift from common agricultural contaminants such as nitrogen and phosphorus to a more urban contaminant profile, particular zinc and copper.

See reporting of Harrison Grierson (2024) for specific design details of the water sensitive stormwater management solution for the site. The stormwater management proposed includes managed wetlands, that have been designed in a manner sensitive to existing watercourses; i.e setback off-line and with outlets to areas of natural wetland.

With this stormwater management solution implemented it is considered changes to water quality and quantity would be managed such that the magnitude of effect would be barely discernible from current conditions, which is ascribed as Low.

Further design work will need to be undertaken at the time of detail design, and appropriate consents sought at which point in time the relevant best practice design standard Waikato Regional Council Technical Report 2020/07 *Waikato Stormwater Management Guideline*, is considered sufficient provision to ensure this remains the case.

4.3. Positive Effects

The design plans for the development include an extensive blue-green network following the existing stream and wetland alignments, and consisting of open space, stormwater management infrastructure, stream riparian planting, and wetland restoration. Planting would utilise native species to restore and enhance habitats that are currently highly modified and degraded as a result of longstanding agricultural land use. The development of the site, therefore, has the potential to improve ecological values.

4.4. Summary of Activities and Effects

Table 9 summarises the level of effects based on implementation of planned and recommended management measures.

Table 9: Summary of effects associated with the plan change

Attribute	Ecological value	Magnitude of effect (from the plan change only)	Level of effect	Effects management	Post-development level of effect
Terrestrial vegetation	Low	Low	Very Low	No further effects management required through the plan change. Details to be addressed through resource consenting.	Remains Very Low
Avifauna	Low	Low	Very Low	No further effects management required through the plan change. Details to be addressed through resource consenting and the Wildlife Act.	Remains Very Low
Herpetofauna	High	Low	Low	No further effects management required through the plan change. Details to be addressed through resource consenting and the Wildlife Act.	Remains Low
Bats	Very High	Moderate	High	Inclusion within the plan change for provision of a detailed roosting assessment and bat sensitive lighting design. Details to be addressed through resource consenting and the Wildlife Act.	Can be reduced to Low
Macroinvertebrate	Low	Negligible	Very Low	No further effects management required	Remains Very Low
Not Threatened Freshwater Fish	Low	Low	Low	No further effects management required through the plan change. Details to be addressed through resource consenting	Remains Low
Threatened Freshwater fauna	High	Low	Low	No further effects management required through the plan change. Details to be addressed through resource consenting.	Remains Low
Instream habitat	Moderate	Moderate	Moderate	Managed through biodiversity offsetting/compensation – see the discussion below, with details to be addressed through resource consenting	Whilst the impact still occurs, the effect can be counterbalanced by a mixture of onsite enhancement actions.
Wetland 1 habitat	Moderate	Moderate	Moderate		
Wetland 2-4 habitat	Low	Moderate	Low		
Artificial Ponds	Negligible	Negligible	Very Low	No further effects management required	Remains Very Low

5. Residual Adverse Effects

The Effects Management Hierarchy (EMH) of the NPS:FM sets out a sequenced framework for managing adverse effects on the extent and values of wetlands and rivers. Effects should be avoided where practicable; where adverse effects cannot be avoided, they are minimised; then they are remedied. Where more than minor residual adverse effects cannot be avoided, minimised, or remedied, aquatic offsetting and/or compensation is provided for.

Efforts have been made to avoid impacts on ecological values, particularly streams and wetlands. Issue A of the Structure Plan did not contain any reference to the potential impact on streams and wetlands. Issue C inferred 0.9 ha of wetland loss and considered that constructed stormwater devices could be used to address the residual adverse effects. Revision D amended the roading layout with the effect that wetland reclamation was reduced to 0.66 ha (and constructed stormwater devices were removed from the discussion of biodiversity effects management), and the creation of new wetland areas was first proposed. The current revision (G) has the wetland reclamation reduced to 0.35 ha, with further wetland habitat to be retained and created on-site. This has been achieved through altered roading and subdivision layout, which has come at a reduction in the developer's lot yield. It is noted the proposed loss of Wetland 1 area is due to the functional and operational need to provide for the western arterial road, as per Appendix S1 of the District Plan.

It is considered that wetland reclamation cannot be remedied, as once reclaimed the area becomes land (in this case a road); nor cannot it be mitigated as mitigation is by definition at the point of impact which is now occupied by that road.

Accordingly, the loss of area is a residual adverse effect that needs to be addressed to ensure no net loss of ecological values.

The remaining loss of stream and wetland area represents an effect of the development that is necessary to provide for a well-functioning urban environment and cannot be further avoided, remedied or mitigated.

It is recognised that offsetting of impacts on stream and wetland values and extent would be a regional consenting matter under the Waikato Regional Plan and National Environmental Standards for Freshwater (NES:F). Nonetheless, it is considered beneficial at the plan change level to demonstrate the likely required offsetting and how this can be achieved.

This assessment provides a high-level analysis of the loss of values and extent against the proposed measures to be undertaken with the development. The restoration and planting proposed to offset residual freshwater adverse effects is provided specifically to achieve biodiversity enhancements, and is in addition to that proposed for stormwater management. It is anticipated that the proposal would be examined in greater detail at the resource consenting stage.

5.1. Streamworks

Based on the current Structure Plan layout, culvert lengths of approximately 42 m at Stream 2, and 33 m at Stream 3 will be required to facilitate construction of the main collector roads along the southern and western boundaries. It is noted a culvert will also be required for Stream 1, however, as this stream forms part of Wetland 1, the area has been included in the wetland offsetting analysis in Section 5.2.

Based on the SEV undertaken in Stream 3, an Environmental Compensation Ratio (ECR, Storey *et al.*, 2011) has been calculated to indicate the required area of stream enhancement that would be required to

address the loss of stream habitat value due to the culverts. The ECR details are summarised in Table 11 and show that a stream bed area of 176 m² would be required to be enhanced to address the reduced value of 52.5 m² of stream bed area. Based on an average stream width of 0.7 m measured on site this equates to 251 m of stream length enhancement. Full function SEV scoring is provided in Appendix 4, and a list of assumptions made under the potential SEV scenarios for the ECR (SEVi-P and SEVm-P) is provided in Appendix 6.

As noted in Section 2, although two SEVs were undertaken, the scores were very similar (0.37 and 0.38 for Streams 2 and 3, respectively). Furthermore, when biotic metrics (fish and invertebrates) are excluded, as is required for compensation analysis, the scores are essentially identical (0.36). Therefore, only one ECR has been required for the overall stream impact area.

Table 10: SEV Environmental Compensation Ratio and Stream Offsetting.

Average stream width (m)	0.70
Stream loss length (m)	75
Stream area (m²)	52.5
SEVi-P (ex. biotics)	0.78
SEVi-I	0.2*
SEVm-P (ex. biotics)	0.62
SEVm-C (ex. biotics)	0.36
ECR	3.35
Compensation area (m²)	176
Compensation length (m)	251

*Note: SEVi-I of 0.2 is a conservative score applied for a culverted stream, to avoid false positives within the SEV methodology that would otherwise inflate the overall SEV score (and reduce the required enhancements).

Figure 17, below, displays the areas that have been identified as providing the necessary stream length and area to achieve the required offsetting. The effects management areas would provide approximately 290 m of stream length and, therefore, adequately meet the requirements of the ECR. The below assumptions are applied to the stream areas providing offsetting:

- At least 10 m of riparian planting is available on both stream banks to undertake riparian planting using a mixture of common native riparian and wetland species, such as cabbage trees, flaxes, and sedges.
- Instream habitat creation is to be undertaken through the construction of log cross vanes or similar to enhance pool and riffle habitat.

5.2. Wetland Loss

Of the five wetlands within the site, two will require some degree of modification (loss) to facilitate the development (Wetlands 1 and 2); for construction of roading. It is noted the proposed loss of Wetland 1 area is due to the functional and operational need to provide for the western arterial road, as per Appendix S1 of the District Plan.

A summary of the wetland areas (within the Structure Plan area), ecological values, and expected loss of extent based on the current design, is presented in Appendix 7 and Table 11.

Table 11: Summary of wetland areas and approximate loss of extent within the T4 Structure Plan.

Wetland Reference	Total Area (within Structure Plan) (ha)	Area retained & enhanced (ha)	Loss of extent (ha)	Ecological Value (EIANZ, 2018)
1	0.65	0.29	0.35	Moderate
2	0.08	0.07	<0.01	Low
2.1	0.11	0.11	0.00	Low
3	0.09	0.09	0.00	Low
4	0.81	0.81	0.0	Low
Total	1.74	1.37	0.35	

In addition to the restoration of the retained wetlands, new wetland area is proposed to be created around the existing wetlands (Refer to structure plan, provided as Appendix 7). An additional 2.12 ha is proposed to be created, locating these new wetlands proximate to existing wetlands gives a degree of confidence that wetland hydrology can be sustained in these areas. 1.61 ha has been used in Table 12 below to avoid 'double-counting' the benefit from this enhancement, with that being used within the SEV/ECR assessment.

Additional riparian buffer planting within the remaining open space is also proposed.

To determine whether the proposed restoration and enhancement actions are sufficient to offset the impact of wetland loss a Biodiversity Compensation Model has been undertaken (BCM, Barber *et al.*, 2021). Table 12 provides a summary of the BCM details, the full model is provided in Appendix 8.

Table 12: Wetland Impact Management Summary and BCM scores.

Areas	Impact	Offset*
Loss of low value wetland (ha)	<0.01	
Loss of moderate value wetland (ha)	0.35	
Restoration of low value wetland (ha)		1.08
Restoration of moderate value wetland (ha)		0.29
New wetlands created (ha)		1.61
BCM Outputs		
Total Impact Score	-0.37759	
Total Compensation Score	0.69829	
Net Gain Outcome	84.9%	

*Excludes restoration and riparian planting areas which were used in ECR analysis for impacts on streams (10m either side of stream 2).

Although Wetlands 2 - 4 were determined to be of low ecological value, it is considered the potential ecological value of these habitats needs to be accounted for when addressing effects, particularly on freshwater systems. The low value wetlands could potentially be enhanced to moderate ecological value if restoration was undertaken, within the existing land use context. Therefore, an impact value equivalent to moderate - high ecological value has been used in the BCM to account for the loss of this potential.

To avoid double-counting offset actions, wetland areas within 10 m from streams 2 and 3 have been excluded from the area of wetland restoration in the wetland effects management actions. This is because the stream area including Wetland 2 has been considered to provide offsetting for stream loss within the ECR. Counting this area for both offset types would not meet with the concept of additionality.

An end point of 15-years was applied for the realisation of biodiversity gains (planting established and self-sustaining). Ecological value of habitat at the end point was assessed as 'High to Very High' for Wetland 1 and 'High' for the other wetlands.

As per the BCM methodology, the default target to be comfortable of achieving no net loss is a 10% net gain outcome from the model. The BCM scenario undertaken for this assessment achieved greater than the 10 % net gain outcome. Furthermore, the impact wetland values used, the selected end point for realisation of benefits, as well as the selected impact risk and uncertainty contingency scores mean the model can be considered a fairly conservative approach.

Whilst it is considered the BCM provides sufficient evidence to demonstrate the required effects management can be achieved within the site so that there would be no net loss of biodiversity values, or extent of natural wetlands. It is anticipated a detailed model would be undertaken at the resource consenting stage.

6. Summary and Recommendations

This Ecological Impact Assessment has been prepared to support the lodgement of a proposed plan change application to the Waipā District Council to rezone approximately 27 ha of land on the southwest extent of Te Awamutu from its current 'Deferred Residential' zoning to 'Medium Density Residential' zoning to enable urban development.

The site is identified as cell T4 of the Te Awamutu Future Growth Cells, under Appendix S1 of the Waipā District Plan, which indicates it has already been earmarked for future residential development.

An assessment utilising the EIANZ Ecological Impact Assessment Guidelines (2018) has been undertaken in order to determine the ecological values of the site, as well as, the magnitude and level of effect resulting from the plan change, associated future construction activities and urban land use.

Onsite vegetation is reflective of the highly modified agricultural environment. None of the vegetation within the site is currently classified as, or would be considered representative of, Significant Natural Areas, and the site is not connected to any such area. Terrestrial fauna observed was limited to common native and exotic avifauna.

The site does contain wetland and stream habitat which are all highly modified due to longstanding land use, and a lack of stock exclusion. However, At-Risk freshwater fauna were detected in eDNA samples from each of the three stream catchments onsite, including black mudfish in the eastern-most stream/wetland complex (Wetland 1).

As a result of the At-Risk fish, the streams and Wetland 1 have been assessed to be of Moderate ecological value; the remaining site wetlands have been assessed to be of Low ecological value and are considered to possess limited aquatic habitat.

Potential effects facilitated by the plan change are considered as the following:

- Erosion and sedimentation of waterbodies from earthworks.
- Vegetation clearance and effects on terrestrial fauna (including habitat loss and injury and mortality).
- Injury and mortality to freshwater fauna.
- Degradation of freshwater habitat
- Ongoing anthropogenic disturbances from the urban environment.
- Increased imperviousness and urban stormwater effects on freshwater environments.
- Residual loss of stream and wetland habitat.

It is noted that earthworks, streamworks, and associated activities required for the development would likely require resource consents and an effects assessment at the resource consent stage.

To reflect the actions required to avoid impact on bats the following provisions could be included within the plan change (most likely as rules or standards specific to the T4 area).

- X1.** Prior to the commencement of any tree removal works within the 'T4 growth cell' a site-specific survey for the presence of long-tailed bat in accordance accepted methods and protocols for determining the presence of bats (based on industry best practice survey methods) must be provided to Council.
- X2.** If the presence of long tail bats is confirmed through **X 1**, A Bat Management Plan must be prepared and implemented. The Bat Management Plan must include details of how bat connectivity (including suitable indigenous restoration / mitigation planting and measures to manage the effects of light spill) will be maintained or improved as far as practicable as well as pre-vegetation clearance vegetation surveys for the presence of roosting trees and roosting bats.

Management in line with best practice erosion and sediment control, stormwater management, and spill response at the time of resource consent and construction will ensure effects on the natural environment are barely discernible from the baseline associated with the existing rural operation of the site. In addition, the provision of a Native Fish Capture and Relocation Plan at the time of consenting will ensure effects on freshwater fish are managed.

In order to facilitate the development, approximately 0.35 ha of natural inland wetland will be lost to provide for roading and a small portion of residential development, resulting in a loss in extent and value of wetland habitat. Additionally, approximately 75 m of stream will require culverting for road development, resulting in further loss of freshwater values. The losses represent residual adverse effects that will need to be addressed.

It is recognised that works within a watercourse (and their effects management) would be regional consent considerations at the time of construction, however, a high-level analysis has been undertaken to demonstrate that the plan change contains sufficient area to provide the necessary offsetting within the constraints of the site, and that no off-site effects management actions would be required.

To address the loss of wetland habitat and stream value, the applicant has proposed restoration of remaining freshwater habitat, as well as, enhancement planting with native species of an extensive area of riparian margin around the wetlands and streams. This restoration and planting is provided specifically to achieve biodiversity enhancements, and is in addition to that proposed for stormwater management.

In this assessment, the Ecological Compensation Ratio (ECR) and Biodiversity Compensation Model (BCM) have been utilised to assess the sufficiency of the proposed offsetting measures.

The ECR produced a required stream length of 251 m (176 m²) to compensate for the culverting of 75 m (52.5 m²) of streams, to enable road construction. This offsetting has been demonstrated to be provided for by approximately 290 m of stream length through the southwest of the site.

The BCM compensation actions include enhancement of the retained wetland habitat, as well as restoration planting within the riparian margins around each of the wetlands. The BCM applied is considered to represent a conservative scenario and achieved a Net Gain Outcome which exceeds the default 10% threshold advised by the BCM methodology.

At a high-level, it has been demonstrated that the anticipated restoration and enhancement actions proposed in association with the plan change and site development would account for the loss of freshwater habitat required to facilitate the development. It is anticipated that a more detailed model, would be required at the resource consenting stage to account for any design revisions.

Furthermore, it is considered the restoration of the retained wetland and stream habitat, as well as, the riparian buffer planting, that will be undertaken in association with the development would enhance indigenous biodiversity onsite; likely resulting in ecological gains.

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Appendix 1 Mapping

SITE OVERVIEW



- Wetland Points

 - Not Wetland
 - Wetland
- ▲ eDNA Sample
 - Streams
 - Artificial Drains
 - SEV Reach
- Wetlands
 - Ponds
 - Site Boundary

Client **MITCHELL DAYSH**
Project **T4 PRIVATE PLAN CHANGE**



Project no. **P04125**
Date **6 Jul 2023**

Drawn **PZ**
Approved **JS**

This plan may contain errors or omissions or may not have the spatial accuracy required for some purposes. There may be other information relating to the area shown on this map which is unknown to Morphem Environmental Ltd. This map may contain Crown copyright data. Please consult Morphem Environmental Ltd if you have any queries.

Appendix 2 Wetland Plot Investigations

Point 1

The Point 1 quadrat was located toward the southeastern extent of the site, just north of the farm race, within a visibly wet area dominated by wetland vegetation.

Table 13: Point 1 vegetation.

Common Name	Scientific Name	Fidelity to Wetlands (Clarkson et al. 2021)	Biostatus Origin (Clarkson et al. 2021)	Abundance (%)
Water pepper	<i>Persicaria hydropiper</i>	Exotic	FACW	40
Mercer grass	<i>Paspalum distichum</i>	Exotic	FACW	30
Soft rush	<i>Juncus effusus</i>	Exotic	FACW	20
Creeping buttercup	<i>Ranunculus repens</i>	Exotic	FAC	10
Total				100

Rapid Test: Pass, all dominant species are FACW (Figure 18).

Indicators of hydric soils: No soil sample was taken due to presence of surface water and wetland vegetation.

Conclusion: Presence of aquatic vegetation and ponded surface water, indicates the area is a wetland.



Figure 17: Point 1 vegetation plot.

Point 2

The Point 2 quadrat was located approximately 8 m southwest of Point 1, and approximately 1 m elevated, within a dry section of the paddock containing a visibly different vegetation community.

Table 14: Point 2 vegetation.

Common Name	Scientific Name	Fidelity to Wetlands (Clarkson <i>et al.</i> 2021)	Biostatus Origin (Clarkson <i>et al.</i> 2021)	Abundance (%)
Ryegrass	<i>Lolium perenne</i>	Exotic	FACU	80
Creeping buttercup	<i>Ranunculus repens</i>	Exotic	FAC	10
Broad-leaved dock	<i>Rumex obtusifolius</i>	Exotic	FAC	5
Hawkesbeard	<i>Crepis capillaris</i>	Exotic	FACU	5
Total				100

Rapid Test: Fail.

Dominance test: Fail.

Prevalence Index: Fail (3.85)

Indicators of hydric soils: No. Field notes describe the soils at 0 – 100 mm as topsoil (10YR 3/6), at 100 – 300 mm transition to light, friable, clay (10YR 4/6) with no mottles or nodules; and at 300 – 500 mm slight increase in plasticity, but still dry and friable, no mottles or nodules (10YR 3/4). See Figure 19.

Conclusion: The vegetation and soils are not reflective of hydric conditions. This area is not a wetland.

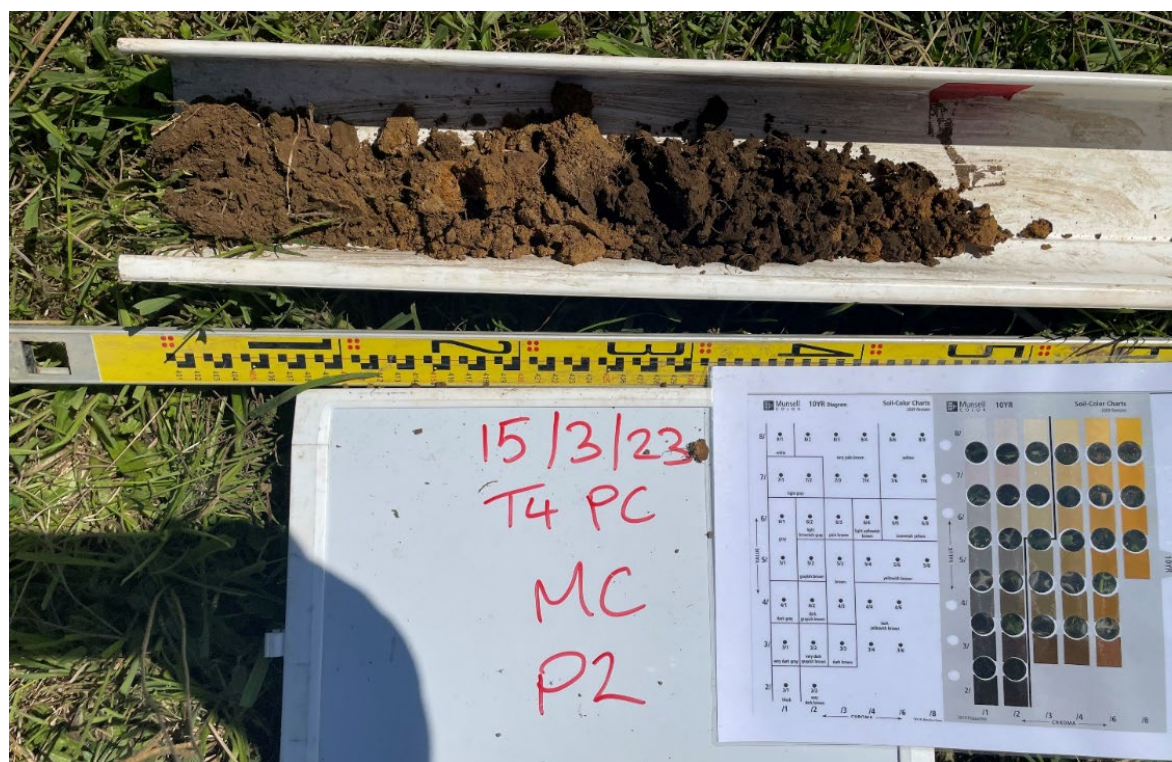


Figure 18: Point 2 soil profile.

Point 3

The Point 2 quadrat was located toward the southeastern extent of the site, along the eastern boundary, within an area identified on geospatial mapping as a stream, with noted presence of wetland vegetation.

Table 15 : Point 3 vegetation.

Common Name	Scientific Name	Fidelity to Wetlands (Clarkson <i>et al.</i> 2021)	Biostatus Origin (Clarkson <i>et al.</i> 2021)	Abundance (%)
Ryegrass	<i>Lolium perenne</i>	Exotic	FACU	30
Water pepper	<i>Persicaria hydropiper</i>	Exotic	FACW	30
Creeping buttercup	<i>Ranunculus repens</i>	Exotic	FAC	25
Broad-leaved dock	<i>Rumex obtusifolius</i>	Exotic	FAC	10
Soft rush	<i>Juncus effusus</i>	Exotic	FACW	2.5
White clover	<i>Trifolium repens</i>	Exotic	FACU	2.5
Total				100

Rapid Test: Fail.

Dominance test: Fail.

Prevalence Index: Inconclusive (3.0)

Indicators of hydric soils: No. Field notes describe the soils as relatively uniform from 0 – 500 mm, dry, friable, with no mottles or nodules. 0 – 300 mm 10YR 3/3, 300 – 500 mm 10YR 3/4, See Figure 20.

Conclusion: The vegetation and soils are not reflective of sustained hydric conditions reflective of wetland habitat. The area is indicative of an overland flowpath.



Figure 19: Point 3 soil profile.

Point 4

The Point 4 quadrat was located within the centre of the site, near the termination of the farm race, within the paddock to the north; within a visibly wet area dominated by wetland vegetation.

Table 16: Point 4 vegetation.

Common Name	Scientific Name	Fidelity to Wetlands (Clarkson <i>et al.</i> 2021)	Biostatus Origin (Clarkson <i>et al.</i> 2021)	Abundance (%)
Soft rush	<i>Juncus effusus</i>	Exotic	FACW	40
Mercer grass	<i>Paspalum distichum</i>	Exotic	FACW	25
Creeping buttercup	<i>Ranunculus Repens</i>	Exotic	FAC	25
Birdsfoot trefoil	<i>Lotus corniculatus</i>	Exotic	FACU	10
Total				100

Rapid Test: Fail, dominant species are a combination of FACW and FAC.

Dominance Test: Pass, all dominant species either FAC or FACW (Figure 21).

Indicators of hydric soils: No soil sample was taken due to presence of surface water and wetland vegetation.

Conclusion: Dominance of facultative wetland vegetation and ponded surface water, indicates the area is a wetland.



Figure 20: Point 4 vegetation plot.

Point 5

The Point 5 quadrat was located approximately 8 m south of Point 4, and approximately 0.5 m elevated, within a dry section of the paddock containing a visibly different vegetation community.

Table 17: Point 5 vegetation.

Common Name	Scientific Name	Fidelity to Wetlands (Clarkson <i>et al.</i> 2021)	Biostatus Origin (Clarkson <i>et al.</i> 2021)	Abundance (%)
Ryegrass	<i>Lolium perenne</i>	Exotic	FACU	50
Paspalum	<i>Paspalum dilatatum</i>	Exotic	FACU	30
Creeping buttercup	<i>Ranunculus repens</i>	Exotic	FAC	10
Broad-leaved dock	<i>Rumex obtusifolius</i>	Exotic	FAC	5
Water pepper	<i>Persicaria hydropiper</i>	Exotic	FACW	5
Total				100

Rapid Test: Fail.

Dominance test: Fail.

Prevalence Index: Fail (3.75)

Indicators of hydric soils: No. Field notes describe the soils at 0 – 100 mm as topsoil (10YR 3/4), at 100 – 350 mm transition to light, friable, 10YR 4/4 sandy soils with no mottles or nodules; and at 350 – 500 mm slight increase in plasticity, but still light with no mottles or nodules (10YR 6/4). See Figure 22.

Conclusion: The vegetation and soils are not reflective of hydric conditions. This area is not a wetland.



Figure 21: Point 5 soil profile.

Point 6

The Point 6 quadrat was located near the southwest corner of the site, within a visibly wet area dominated by wetland vegetation and connected to the western tributary.

Table 18: Point 6 vegetation.

Common Name	Scientific Name	Fidelity to Wetlands (Clarkson <i>et al.</i> 2021)	Biostatus Origin (Clarkson <i>et al.</i> 2021)	Abundance (%)
Creeping buttercup	<i>Ranunculus repens</i>	Exotic	FAC	30
Soft rush	<i>Juncus effusus</i>	Exotic	FACW	20
Mercer grass	<i>Paspalum distichum</i>	Exotic	FACW	20
Gypsywort	<i>Lycopus europaeus</i>	Exotic	OBL	15
Birdsfoot trefoil	<i>Lotus corniculatus</i>	Exotic	FACU	15
Total				100

Rapid Test: Fail, dominant species are a combination of FACW and FAC.

Dominance Test: Pass, all dominant species either FAC or FACW (Figure 23).

Indicators of hydric soils: No soil sample was taken due to presence of surface water and wetland vegetation.

Conclusion: Dominance of facultative wetland vegetation and ponded surface water, indicates the area is a wetland.

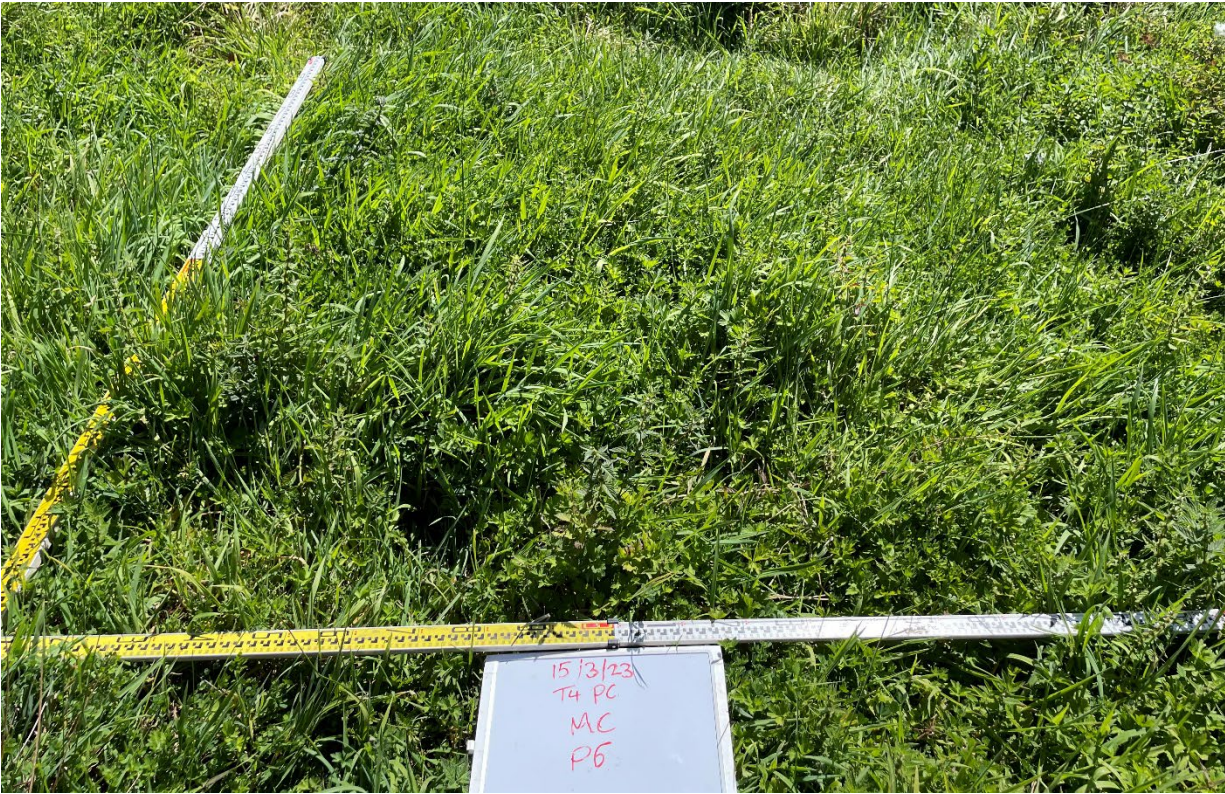


Figure 22: Point 6 vegetation plot.

Point 7

The Point 5 quadrat was located approximately 10 m south of Point 6, and approximately 0.5 m elevated, within a dry section of the paddock containing a visibly different vegetation community.

Table 19: Point 7 vegetation.

Common Name	Scientific Name	Fidelity to Wetlands (Clarkson <i>et al.</i> 2021)	Biostatus Origin (Clarkson <i>et al.</i> 2021)	Abundance (%)
Ryegrass	<i>Lolium perenne</i>	Exotic	FACU	30
Paspalum	<i>Paspalum dilatatum</i>	Exotic	FACU	25
White clover	<i>Trifolium repens</i>	Exotic	FACU	15
Creeping buttercup	<i>Ranunculus repens</i>	Exotic	FAC	15
Broad-leaved dock	<i>Rumex obtusifolius</i>	Exotic	FAC	10
Aristea	<i>Aristea ecklonii</i>	Exotic	N/A	5
Total				100

Rapid Test: Fail.

Dominance test: Fail.

Prevalence Index: Fail (3.74)

Indicators of hydric soils: No. Field notes describe the soils at 0 – 200 mm as light, friable topsoil (10YR 4/6); from 200 – 500 mm small increase in plasticity but still relatively light and friable clay (10YR 6/6) with low (5%) orange mottles (2.5YR 5/8) and no nodules. See Figure 24.

Conclusion: The vegetation and soils are not reflective of hydric conditions. This area is not a wetland.

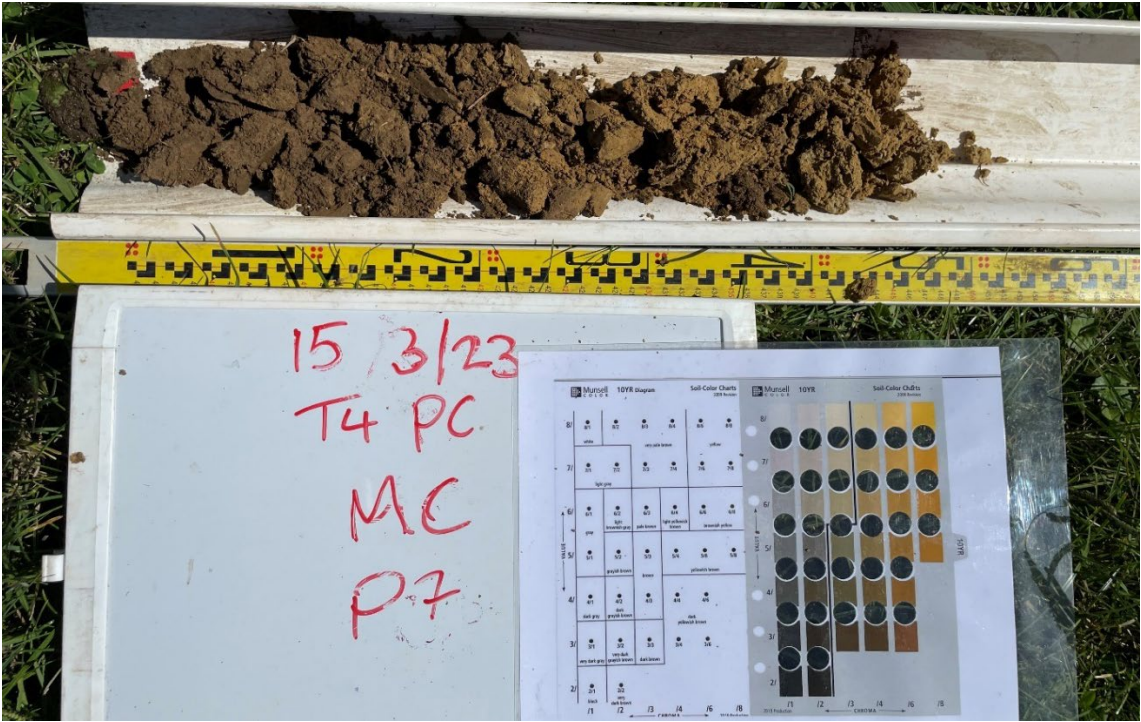


Figure 23: Point 7 soil profile.

Point 8

The Point 8 quadrat was located approximately in the middle of the southern boundary of the site, within the same wetland-type habitat as Point 1 but situated in the adjacent paddock and slightly elevated (~0.5 m). The surrounding area contained visible ponded water and wetland vegetation.

Table 20: Point 8 vegetation.

Common Name	Scientific Name	Fidelity to Wetlands (Clarkson et al. 2021)	Biostatus Origin (Clarkson et al. 2021)	Abundance (%)
Water pepper	<i>Persicaria hydropiper</i>	Exotic	FACW	30
Soft rush	<i>Juncus effusus</i>	Exotic	FACW	30
Mercer grass	<i>Paspalum distichum</i>	Exotic	FACW	15
White clover	<i>Trifolium repens</i>	Exotic	FACU	15
Paspalum	<i>Paspalum dilatatum</i>	Exotic	FACU	5
Water speedwell	<i>Veronica anagallis-aquatica</i>	Exotic	OBL	5
Total				100

Rapid Test: Pass, all dominant species are FACW (Figure 25).

Indicators of hydric soils: No soil sample was taken due to presence of surface water and wetland vegetation.

Conclusion: Dominance of facultative wetland vegetation and ponded surface water, indicates the area is a wetland.



Figure 24: Point 8 vegetation plot.

Point 9

Point 9 was located adjacent to the southwest corner of the site within a visibly wet topographical low point connected to the offsite patch of raupō, and approximately in the middle of a glyceria and juncus-dominated area of vegetation.

Table 21: Point 9 vegetation.

Common Name	Scientific Name	Fidelity to Wetlands (Clarkson <i>et al.</i> 2021)	Biostatus Origin (Clarkson <i>et al.</i> 2021)	Abundance (%)
Ryegrass	<i>Lolium perenne</i>	FACU	Exotic	40
Glyceria	<i>Glyceria maxima</i>	OBL	Exotic	40
Soft rush	<i>Juncus effusus</i>	FACW	Exotic	10
Swamp millet	<i>Isachne globosa</i>	OBL	Exotic	2.5
Buttercup	<i>Ranunculus repens</i>	FAC	Exotic	2.5
Clustered dock	<i>Rumex conglomeratus</i>	FAC	Exotic	2.5
Gorse	<i>Ulex europaeus</i>	FACU	Exotic	2.5
Total				100

Rapid Test: Fail, dominant species FACU & OBL.

Dominance Test: Fail, as per 50/20 rule, only 50% of dominant (>20% coverage) species are OBL.

Prevalence Index: Pass (2.5). Vegetation is indicative of wetland.

Indicators of hydric soils: Yes. Saturated, dark (10YR 2/1), peaty soils throughout the top 500 mm; water-logged with high organics content, no nodules or mottles (see Figure 26).

Conclusion: Vegetation and soil assessment indicates that this area is wetland.



Figure 25: Point 9 soil profile.

Point 10

Point 10 was located north of Point 9, elevated about 0.3 m, and within a visibly different vegetation community, dominated by creeping buttercup and clover. Point 10 was utilised to distinguish the effect of topography indicating wetland status within this area of the site.

Table 22: Point 10 Vegetation

Common Name	Scientific Name	Fidelity to Wetlands (Clarkson <i>et al.</i> 2021)	Biostatus Origin (Clarkson <i>et al.</i> 2021)	Abundance (%)
Creeping buttercup	<i>Ranunculus repens</i>	FAC	Exotic	50
White clover	<i>Trifolium repens</i>	FACU	Exotic	35
Ryegrass	<i>Lolium perenne</i>	FACU	Exotic	35
Paspalum	<i>Paspalum dilatatum</i>	FACU	Exotic	2.5
Water pepper	<i>Persicaria hydropiper</i>	FACW	Exotic	2.5
Clustered dock	<i>Rumex conglomeratus</i>	FAC	Exotic	2.5
Total				127.5

Rapid Test: Fail, dominant species FAC/FACU.

Dominance Test: Fail, dominant species FAC/FACU.

Prevalence Index: Fail (3.5). Not indicative of wetland vegetation.

Indicators of hydric soils: Yes. 0-150 mm is dark damp topsoil (10YR 5/2) with low density (~10%) of orange mottles (2.5YR 3/6). 150-300 mm transition to lighter coloured (10YR 6/1) clay soils, moderate plasticity, with similar density of orange mottles (2.5YR 3/6). From 300 - 500 mm transition to gleyed (10YR 7/2) soils with increased density (~40%) of light orange mottles (2.5YR 6/8) (see Figure 27).

Conclusion: Although the soil assessment indicates hydric features at depth, the vegetation community present excludes this area from being a wetland.



Figure 26: Point 10 Soil profile.

Appendix 3 EIANZ Assessment Methodology

Table 23: Assigning value to species, vegetation, and habitats (summarised from EIANZ, 2018).

Value	Species Values	Vegetation/Habitat Values
Very High	Nationally threatened species found in the (Zone of Influence) ZOI ¹ either permanently or seasonally	Area rates High for 3 or four attributes (Representativeness, Rarity/distinctiveness, Diversity and pattern, Ecological context). Likely to be national important and recognised as such
High	Species listed as At Risk – Declining, found in the ZOI either permanently or seasonally	Area rates High for 2 of the attributes, Moderate and Low for the remainder, or Area rates High for 1 assessment matters, Moderate for the remainder Likely to be regionally important and recognised as such
Moderate	Species listed as any other category of At Risk, found in the ZOI either permanently or seasonally, or Locally (ED) uncommon or distinctive species	Area rates High for 1 assessment matters, Moderate and Low for the remainder, or Area rates Moderate for 2 or more of the attributes, Low or Very Low for the remainder Likely to be important at the level of the Ecological District
Low	Nationally and locally common indigenous species	Area rates Low or Very Low for majority of assessment matters and Moderate for 1 Limited ecological value other than as for habitat for tolerant native species
Negligible	Exotic species, including pest species having recreational value	Area rates Very Low for 3 matters and Moderate, Low or Very Low for remainder

¹ The Zone of Influence (ZOI) refers to all land, water bodies and receiving environments that could be potentially impacted by the project.

Table 24: Criteria for describing magnitude of effect (summarised from EIANZ, 2018)

Magnitude	Description
Very High	Total loss of or major alteration to key features of the baseline condition causing a fundamental change or complete loss of the character, composition, or attributes of the site.
High	Major loss or major alteration to key features of the baseline condition causing a fundamental change of the character, composition, or attributes of the site.
Moderate	Loss or alteration of one or more key features of the baseline condition causing a partial change to the character, composition, or attributes of the site.
Low	Minor shift away from baseline conditions. Change may be discernible, but underlying character, composition, or attributes of the site will be similar to pre-development.
Negligible	Very slight change from existing baseline condition. Change barely distinguishable.

Table 25: Criteria for describing level of effects (from EIANZ, 2018)

Ecological Value	Very High	High	Moderate	Low	Negligible
Magnitude					
Very High	Very High	Very High	High	Moderate	Low
High	Very High	Very High	Moderate	Low	Very Low
Moderate	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

Appendix 4 Macroinvertebrate Summary

Statistics

Table 26 MCI Sampling results

Taxa	MCI Score	MCI-sb Score	Wetland 1	Wetland 4
Caddisfly Oxyethira	2	1.2		8
Caddisfly Polyplectropus	8	8.1		2
Damselfly Xanthocnemis	5	1.2		4
Beetle Elmidae	6	7.2	1	
Beetle Hydrophilidae	5	8	17	4
Beetle Liodessus	5	4.9	2	
Beetle Scirtidae	8	6.4	4	1
True Fly Austrosimulium	3	3.9		15
True Fly Muscidae	3	1.6	1	
True Fly Orthocladiinae	2	3.2	1	12
True Fly Paralimnophila	6	7.4	4	1
True Fly Polypedilum	3	8	1	3
True Fly Zelandotipula	6	3.6	1	2
Crustacea Ostracoda	3	1.9	12	1
Crustacea Paracalliope	5	0	14	508
Crustacea Paraleptamphopus	5	0	78	10
Crustacea Talitridae	5	5		1
MITES (Acari)	5	5.2	1	2
SPIDERS Dolomedes	5	6.2	1	2
Mollusc Physella (Physa)	3	0.1	14	2
Mollusc Potamopyrgus	4	2.1	92	9
Mollusc Sphaeriidae	3	2.9	114	1
OLIGOCHAETES	1	3.8	5	4
PLATYHELMINTHES (Flatworms)	3	0.9	6	
Number of Taxa			19	20
EPT Value			0	1
Number of Individuals			369	592
% EPT			0	0.34
% EPT Taxa			0	5
Sum of recorded scores			81	87
Count of recorded scores			19	20
Sum of individuals with scores			369	592

Taxa	MCI Score	MCI-sb Score	Wetland 1	Wetland 4
MCI Value			85.26	87
Sum of abundance load			1452	2843
QMCI Value			3.93	4.80
Sum of recorded scores			73.4	78.2
Count of recorded scores			17	18
Sum of individuals with scores			277	74
SBMCI Value			86.35	86.89
Sum of abundance load			808.4	271.4
QMCI-sb Value			2.92	3.67

Appendix 5 SEV Function Scores

Table 27: Summary of SEV values for Stream 3 and potential scenarios of the ECR.

Ecological functions	SEVm-C*	SEVi-P**	SEVm-P***
Hydraulic			
Natural flow regime	0.57	0.83	0.25
Floodplain effectiveness	0.15	0.80	0.70
Connectivity for natural species migrations	1.00	1.00	1.00
Natural connectivity to groundwater	0.84	0.96	0.96
Mean score	0.64	0.90	0.73
Biogeochemical			
Water temperature control	0.24	0.60	0.40
Dissolved oxygen levels	0.40	0.60	0.60
Organic matter input	0.00	1.00	0.50
In-stream particle retention	0.38	0.68	0.68
Decontamination of pollutants	0.33	0.90	0.77
Mean score	0.27	0.76	0.59
Habitat Provision			
Fish spawning habitat	0.05	0.63	0.63
Habitat for aquatic fauna	0.28	0.69	0.53
Mean score	0.17	0.66	0.58
Biodiversity Provision			
Fish fauna intact	0.47	N/A	N/A
Invertebrate fauna intact	0.47	N/A	N/A
Riparian vegetation intact	0.11	0.64	0.42
Mean score	0.35	N/A	N/A
Overall SEV value	0.38	N/A	N/A
Overall SEV value (ex. biotic indices)	0.36	0.78	0.62

*The SEV score for the existing southwest tributary.

**The maximum SEV potential for the tributary, based on instream and riparian enhancements, within the existing land use context.

***The anticipated SEV score for the tributary following enhancement within constraints post-development.

Note: Biotic indices (fish and macroinvertebrates) are excluded from SEVs when undertaking ECR calculations due to uncertainties associated with predicting the future species assemblages.

Appendix 6 SEV Assumptions Table

Table 28: SEV Assumptions

Variable	SEVm-C (Current Scenario for Stream 3)	SEVi-P (Potential SEV score based solely on restoration of stream/riparian margin, allowing 25 years for establishment, within the existing environment)	SEVm-P (Potential score based on current structure plan design, allowing 25 years for establishment)
Scenario	Values taken from June 2023 assessment.	Values taken from June 2023 assessment updated to reflect anticipated remediation as follows: riparian planting to at least 20 m on both banks throughout entire reach; given 25 years for replanting to establish. Woody debris (cross vane) grade control constructed within reach, estimated at transects 2, 5 & 8. Aquatic habitat diversity to be enhanced through creation of pools and riffles around log cross vane. Plantings to consist of a mixture of wetland and small tree/shrubs planting on stream edges and larger canopy trees further back. Within the existing land use context.	Values taken from June 2023 assessment updated to reflect anticipated urban development and stream remediation as follows: riparian planting to at least 10 m on both banks (in future likely greater on TLB), throughout entire reach; given 25 years for replanting to establish. Woody debris (cross vane) grade control constructed within reach, estimated at transects 2, 5 & 8. Aquatic habitat diversity to be enhanced through creation of pools and riffles around log cross vane. Change in surrounding land use and catchment to predominantly urban, including construction of nearby roads and stormwater treatment devices. Sections of the stream around transects 1 and 10 to be culverted for road development. Plantings to consist of a mixture of wetland planting on stream edges and small shrubs and trees on stream banks.
Vsurf	Values taken from measurements at transects. Soft-bottom with sediment deposits from bank erosion and occasional small gravels.	Small reduction in sands/silts and increase in small gravels. Addition of large wood at transects 3, 7, and 10, to reflect log cross vanes for habitat creation. Although riparian planting would stabilise banks, stream is naturally soft-bottomed. Leaf litter added to reflect increased density of presence of vegetation No change to SEV-I scenario.	No substantial changes to SEV-C scenario, addition of large wood at transects 3, 7, and 10, replacing silts/sands, to reflect log cross vanes for habitat creation. Addition of leaf litter added to reflect increased presence of vegetation.
Vdepth	Values taken from measurements at transects.	Remediation to include cross vanes for instream habitat creation, therefore, depths for transects 3, 7, and 10 have been estimated to double to reflect pools around cross vanes. No change has been applied to the other transects for this variable given	Remediation to include cross vanes for instream habitat creation, therefore, depths for transects 2, 5, and 8 have been estimated to double to reflect pools around cross vanes. No change has been applied to the other transects for this variable given

		the already low baseflow depths, and limited impact on overall SEV score. Stream channel generally expected to retain similar depths to that observed. No change to SEV-I scenario.	the already low baseflow depths, and limited impact on overall SEV score. Stream channel generally expected to retain similar depths to that observed.
Vmacro	Values taken from measurements at transects. Generally low macrophyte growth.	Riparian planting anticipated to generally be low stature commonly used species such as sedges, flax, and cabbage trees, therefore limited shading. No significant changes anticipated to macrophyte growth, slight reduction at transects where growth was higher. Minor increase from SEV-I scenario at transects 1 and 10, back to SEV-C scenario, to reflect no culverts in this scenario.	Riparian planting anticipated to generally be low stature commonly used species such as sedges, flax, and cabbage trees, therefore limited shading. No significant changes anticipated to macrophyte growth, slight reduction at transects where growth was higher.
Vveloc	Values taken from measurements at transects	Slight changes expected due to increased roughness elements (log vanes, and riffle habitat), but not anticipated to impact overall SEV scoring. No change from SEV-I scenario.	Slight changes expected due to increased roughness elements (log vanes, and riffle habitat), but not anticipated to impact overall SEV scoring.
Vshade	Values taken from measurements at transects. Existing vegetation provides -no effective stream shading.	Native riparian planting close to stream will consist of a mix of low stature trees and shrubs on stream banks with are for larger canopy trees further back. Expected to increase the level of stream shading compared to the current scenario. Stream shading has been conservatively increased from low/very low to moderate.	Change from SEV-C scenario; planting anticipated to only consist of low stature wetland vegetation/trees/shrubs. Urban development to restrict planting of canopy trees.
Vdecid	As recorded at transects. No canopy, therefore, no deciduous vegetation.	No change from SEV-C scenario.	No change from SEV-C scenario.
Vchann	Observations made during stream assessment; natural channel, but affected by bank erosion and macrophyte growth.	Restoration anticipated to ensure the stream reflects a natural environment with no modification. Bank stabilisation will reduce erosion, but likely there will still be some macrophyte growth.	No change from SEV-P scenario.
Vpipe	Observations made during stream assessment; no piped inflows within survey reach.	No change from SEV-C scenario.	Two stormwater treatment wetlands proposed adjacent to stream, assumed to discharge to SEV reach.

Vbarr	Observations made during stream assessment; no barriers to fish passage present within the reach.	No change from SEV-C scenario.	No change has been applied to this variable; no new barriers to fish passage are expected to result from the proposed works.
Vbank	Observations made during stream assessment; mostly unrestricted for true left bank, some areas of deep stream incision likely restricting connectivity.	Stabilisation of banks to reduce erosion, connectivity likely to be unrestricted for floodplain on true left bank.	Slight change to SEV-P scenario. Stabilisation of banks to reduce erosion and therefore improve connectivity to floodplain. However, proposed culverts will restrict connectivity.
Vlining	Majority of reach impacted by deposited sediment from bank erosion.	Riparian planting would stabilise banks and prevent sediment deposits. Expected there may still be some unnatural sediment deposition in deeper ponds from upstream agricultural land use.	No change from SEV-P scenario.
Vdod	Marginal - small patches of anaerobic sediments/some bubbling and odours; dense macrophytes	Increased to sub-optimal; reduction in deposited sediments and increased aeration from creation of riffle habitat. Likely to still be some macrophyte growth, particularly in summer.	No change from SEV-P scenario.
Vrough	TRB consists primarily of pasture (short) grass and exotic shrubs (gorse). TLB predominantly pasture (short) grass with some grazed wetland vegetation.	Restoration planting assumed mixture of wetland flax/sedges and low stature trees/shrubs; expected to improve Vrough, with short grass replaced by native plantings and stock exclusion to prevent grazing.	No change from SEV-P scenario.
Vripconn	Observations made during stream assessment; no obstructions.	No change from SEV-C scenario.	No change from SEV-P scenario.
Vripfilt	Filtering capacity is very low due to short grass dominating the vegetation.	Variable estimated as very high post-restoration; planting expected to improve groundcover and filtering ability within existing landscape.	Variable estimated as high post-restoration; planting expected to improve groundcover. Creation of impervious surfaces prevents very high rating.
Vripar	Observations made during stream assessment; only occasional gorse bushes.	Overall improvement due to restoration planting. Riparian margin unrestricted and expected to extend full 20 m.	Overall improvement due to restoration planting. Riparian margin expected to extend 10 m from stream (restricted by urban development).
Vgalspawn	Roughly half of the reach considered to provide potential galaxiid spawning habitat; mostly the TLB; TRB too steep.	No change to SEV-C scenario.	No change to SEV-C scenario.

Vgalqual	Survey reach is above the area of tidal influence, scored as 'unsuitable' due to bank slopes, and limited extent of suitable spawning vegetation.	Low quality anticipated due to increased shading from planting (although shading anticipated to be toward the lower end of the medium scale, TLB would be inundated by high rainfall, TRB will be restricted by formation of roads.	No change from SEV-P scenario.
Vphyshab	Reach observed to contain: - poor aquatic habitat diversity due to uniform structure and lacking any no effective vegetation, no woody debris, bank undercuts, or other stable habitats. - poor habitat abundance as reach comprised open channel through pastureland. - poor hydrologic heterogeneity as hydrologic conditions are uniform, low flow run, little velocity, no substantial pools or riffles. - poor channel shade, consistent with Vshade, no meaningful shade provided along reach. - poor riparian vegetation integrity, due to extensive modification of riparian zone for pasture; mostly short grass and exotic pest shrubs.	Considerable improvements expected in SEV-P scenario through restoration planting and creation of instream habitat. - Low-optimal aquatic habitat diversity through creation of cross vane flow control and increase in woody debris/leaf litter. - Low-optimal habitat abundance; expected > 50% favourable habitat including; overhanging vegetation, woody debris, root mats, undercut banks. - High-suboptimal hydrologic heterogeneity due to creation of pools/riffles. - High-suboptimal stream shade; riparian planting expected to be mix of low stature and canopy trees, canopy to mostly cover stream. - High-suboptimal riparian vegetation; expected to cover full 20 m width in SEV-P scenario, however mostly consisting of low stature vegetation.	Considerable improvements still expected in SEV-I scenario through restoration planting and creation of instream habitat. Culverts and urban development will restrict full restoration in accordance with SEV-P scenario. - High-suboptimal aquatic habitat diversity through creation of cross vane flow control and increase in woody debris/leaf litter. - High-suboptimal habitat abundance; expected > 50% favourable habitat including; overhanging vegetation, woody debris, root mats, undercut banks. - Mid-suboptimal hydrologic heterogeneity due to creation of pools/riffles. - Mid-marginal stream shade; riparian planting expected to be low stature, stream shading to only cover banks. - High-marginal riparian vegetation; expected to cover 10 m width due to urban development; vegetation anticipated to be low stature.
Vwatqual	Catchment-wide measure: observed via GIS; upstream catchment classed as 'no shading' as per the SEV methodology - catchment is predominantly open channel through pastureland.	Increased to minimal to reflect restoration of stream reach within the site.	Increased to minimal to reflect restoration of stream reach within the site.
Vimperv	Catchment-wide measure: observed via GIS; less than 10 % imperviousness and no stormwater ponds / dry ponds feeding into catchment.	No change from SEV-C scenario; existing land use context.	Score decreased to reflect the planned urban development within portion of upstream catchment and creation of stormwater management devices.

Vfish	Values taken from eDNA testing.	Biotic indices have not been included in predicted SEV-P scores as not able to reliably predict future values.	Biotic indices have not been included in predicted SEV-I scores as not able to reliably predict future values.
Vmci, Vinvert, Vept	Values taken from site MCI sampling. Species recorded consist of regionally common, pollution tolerant species.	Biotic indices have not been included in predicted SEV-P scores as not able to reliably predict future values.	Biotic indices have not been included in predicted SEV-I scores as not able to reliably predict future values.
Vchanshape	Auto-populated from other variables.	Auto-populated from other variables.	Auto-populated from other variables.
Vretain	Auto-populated from other variables.	Auto-populated from other variables.	Auto-populated from other variables.
Vgobspwn	Auto-populated from other variables.	Auto-populated from other variables.	Auto-populated from other variables.
Vripcond	Auto-populated from other variables.	Auto-populated from other variables.	Auto-populated from other variables.

Appendix 7 Structure Plan: Stormwater

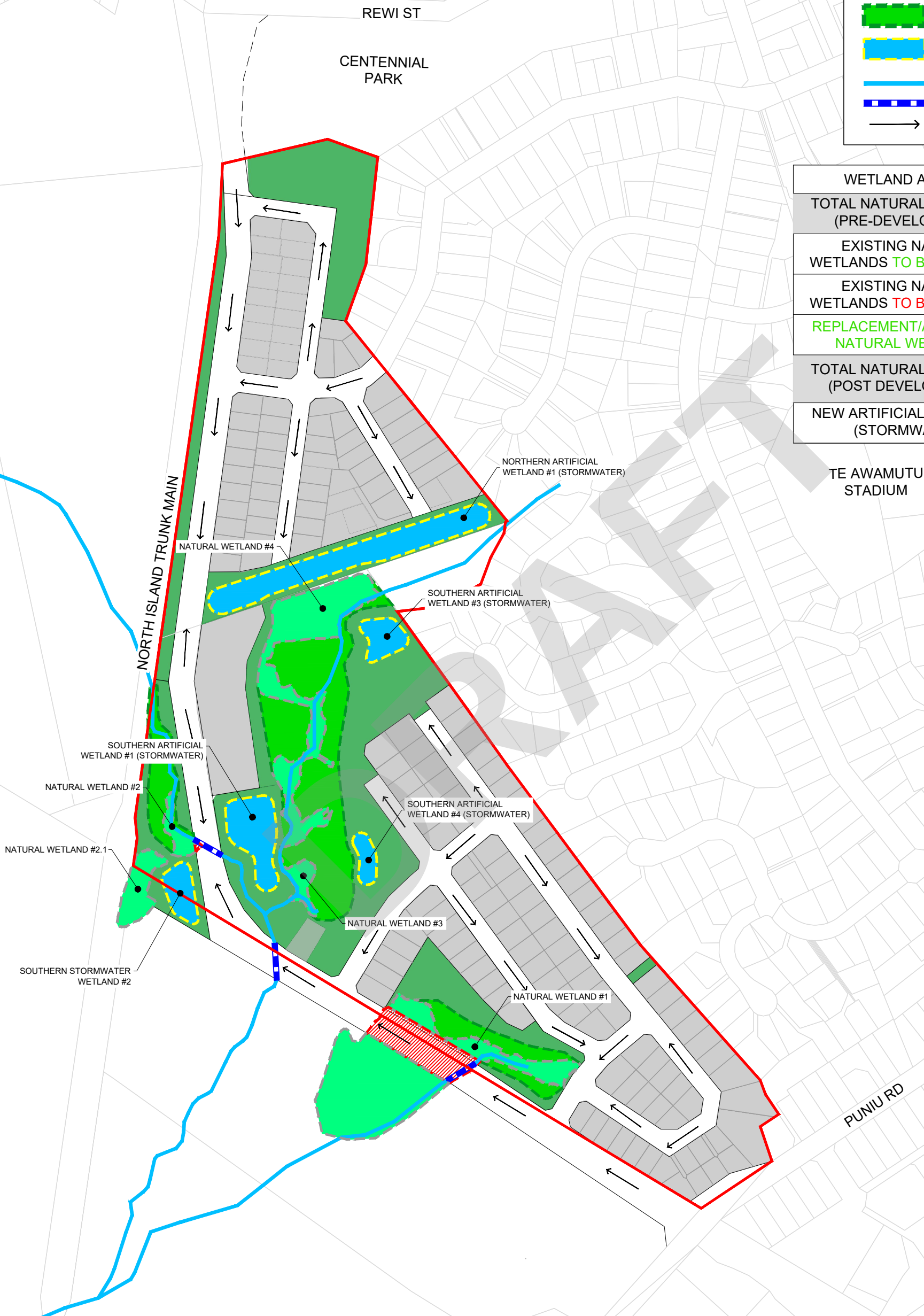


LEGEND

- OTHER ZONING (i.e. RESIDENTIAL)
- OPEN SPACE
- EXISTING NATURAL WETLANDS (TO BE RETAINED)
- EXISTING NATURAL WETLANDS (TO BE REMOVED)
- NEW NATURAL WETLANDS (INDICATIVE ONLY)
- NEW ARTIFICIAL STORMWATER WETLAND (INDICATIVE ONLY)
- EXISTING STREAM
- NEW CULVERT
- OVERLAND FLOW PATH (INDICATIVE)

WETLAND AREA ASSESSMENT

TOTAL NATURAL WETLANDS (PRE-DEVELOPMENT)	1.73 Ha
EXISTING NATURAL WETLANDS TO BE RETAINED	1.38 Ha
EXISTING NATURAL WETLANDS TO BE REMOVED	0.35 Ha
REPLACEMENT/ADDITIONAL NATURAL WETLANDS	2.12 Ha
TOTAL NATURAL WETLANDS (POST DEVELOPMENT)	3.50 Ha (+102%)
NEW ARTIFICIAL WETLANDS (STORMWATER)	1.36 Ha



PROPOSED PLAN CHANGE
T4 GROWTH CELL
TE AWAMUTU

STORMWATER

Appendix 8 Biodiversity Compensation Model

Model Inputs					
Input descriptors		Input data			
Project/reference name		T4 Private Plan Change			
Biodiversity type		Modified Wetland			
Technical expert(s) input		MC and JS			
Benchmark		5			
How many habitat types OR sites are impacted		2			
Number of proposed compensation actions		3			
Net gain target		10%			
Habitat/Site Impact(s)		High value wetland loss wetland 1	Low value wetland loss wetlands 2 - 4		
Impact risk contingency:		3	2		
Impact uncertainty contingency:		3	2		
Areal extent of impact (ha):		0.35	0.01		
Value score prior to impact:		4	3.5		
Value score after impact:		0.001	0.001		
Compensation Action(s)		Restore high value wetland	Restore low value wetland	Create new 'low value' wetland	
Discount rate:		3.0%	3.0%	3.0%	
Finite end point (years):		15	15	15	
Compensation confidence contingency:		2	2	2	
Areal extent (ha) of compensation type:		0.29	1.08	1.61	
Value score prior to compensation:		3.5	2	0.001	
Value score after compensation:		4	3.5	3	
Model outputs					
		Total impact score	High value wetland loss wetland 1	Low value wetland loss wetlands 2 - 4	
Impact score		-0.37759	-0.36951	-0.00808	
		Total compensation score	Restore high value wetland	Restore low value wetland	Create new 'low value' wetland
Compensation score		0.69829	0.01536	0.17157	0.51136
Net gain outcome		84.9%			

Table 29: Explanation and reasoning for BCM scoring: Impact Scenario.

Impact Model Values	Definition	High Value Wetland Loss	Low Value Wetland Loss
Impact Risk Contingency	The likelihood that adverse effects will result in the permanent and irreplaceable loss of significant biodiversity values when impacting on habitats or species that are of higher ecological value.	3 – Potential for irreversible and irreplaceable loss of wetland habitat. Potential loss of black mudfish.	2 – Potential for irreversible and irreplaceable loss of wetland habitat.
Impact Uncertainty Contingency	By providing for a greater margin of error, the impact uncertainty contingency addresses the increased risk of permanent or irreplaceable biodiversity loss when impacting on more complex habitats, or on species for which there is less information regarding species-specific impacts associated with an effect.	3 – Accounts for uncertainty of effects on wetland habitat and black mudfish.	2 – Accounts for uncertainty of effects on wetland habitat.
Value Score Prior to Impact	The assigned value score in all instances must relate explicitly to the biodiversity type and ecological value that the model relates to.	4 – High value wetland restored to its potential value.	3.5 – Moderate to high potential value for wetland habitat restored to its potential value.
Value Score after Impact	The model does not accept a value score of 0 as the formula will not work, but it does allow for a score of 0.001 (virtually zero).	0.001 – Total loss of area (note cannot be 0)	0.001 – Total loss of area (note cannot be 0)

Table 30: Explanation and reasoning for BCM scoring: Compensation Scenario.

Impact Model Values	Definition	Restoration of High Value Wetland	Restoration of Low Value Wetland	Create New 'Low Value' Wetland
Discount rate	The discount rate addresses the temporal time lag between the impact occurring and the biodiversity gains being generated by the conservation action(s). A discount rate of 3% is recommended.	3%	3%	3%
Finite end point (years)	The finite end-point is the time period (years) over which to calculate NPBV. This equates to the time between the commencement of proposed compensation action(s) and an assessment of the associated benefits for the affected biodiversity value	15 Years for planting to be established and self-sustaining.	15 Years	15 Years

Impact Model Values	Definition	Restoration of High Value Wetland	Restoration of Low Value Wetland	Create New 'Low Value' Wetland
Compensation confidence contingency	The compensation confidence contingency relates to the level of confidence in the likely success of the proposed compensation measures and methodology	2 – High confidence in success of planting	2 – High confidence in success of planting	2 – High confidence in success of planting
Value Score prior to Compensation	The assigned value score in all instances must relate explicitly to the biodiversity type and ecological value that the model relates to.	3.5 – High value wetland (note considers current ecological value).	2 – Low value for wetland habitat (note considers current ecological value).	0.001 – Wetland to be create where does not currently exist (cannot be 0).
Value Score after Compensation	Adequate detail must be provided to justify the assigned ecological value score after implementation of compensation actions based on desktop and field investigations and assessed using EciAG	4 – High value wetland with restoration planting and persistence of black mudfish within habitat.	3.5 – Moderate to high value wetland as a result of restoration of habitat with native vegetation reflective of the natural pre-modified state.	3.5 – Moderate to high value wetland, created to the same criteria as existing low value wetlands.



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