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Environmental Consultants





August 2026

Te Kowhai East - Industrial Development Ecological Impact Assessment (EcIA)

Prepared for:

Te Kowhai East Limited Partnership

water fauna flora land

Quality Assurance

This report has been prepared and reviewed by the following:

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Qualifications, Experience and Code of Conduct

The qualifications and experience of the author and technical director/reviewer of this report are summarised below. We confirm that we have read the Code of Conduct for Expert Witnesses contained in the Environment Court of New Zealand Practice Note 2023 and we agree to comply with it. We confirm that the issues addressed in this report are within our area of expertise, except where we state that we are relying on the evidence or advice of another person. We have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this report.

Report Authors

Steven Gorinski (Steve) is an ecologist with seven years of consulting experience. He is skilled in vegetation, botanical, freshwater, and wetland surveys, GIS mapping, restoration management plans, and preparing ecological effects assessments and significance criteria across various industries throughout New Zealand. Steve has a BSc from Waikato University and a Diploma in Environmental Management from Toi Ohomai Institute of Technology. Steve has extensive ecological experience in the land development, mining and quarrying industries.

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Chad Croft is a terrestrial and freshwater ecologist with 20+ years' experience delivering on a wide range of ecology projects from small scale land development to large scale infrastructure, public and private land management and landscape scale restoration. He has extensive experience in planning, managing and implementing both terrestrial and freshwater impact assessments, ecological surveys, ecosystem restoration, mitigation strategies and residual effects management through offset and compensation design.

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Executive Summary

This ecological impact assessment (EcIA) has been prepared as part of the Te Kowhai East Limited Partnership's substantive application for approvals under the Fast-track Approvals Act 2024 (FTAA). The Project is a large-scale industrial development located on the north-western edge of Hamilton, adjacent to the established Te Rapa industrial area. The application provides for the creation of an integrated industrial precinct, including approximately 210 industrial lots, land for neighbourhood centre activities, reserves for recreation, stormwater management and ecological mitigation, and associated roading and infrastructure services.

The Project Area has been subject to a long history of modification, including grazing, cropping, historic wetland alterations and drainage works. As a result, the landscape is dominated by exotic vegetation with poor connectivity with surrounding habitats.

The Project Area is largely high-producing exotic grassland with a small area of native fernland, scattered exotic trees, shelterbelts/hedgerows and scrub of 'negligible' to 'low' ecological value. Although vegetation removal will have 'very low' initial impact on the vegetation, restoration measures such as native planting, stream enhancement, and constructed wetlands are expected to improve biodiversity and as a result provide a net ecological gain over the short to medium-term (5–15 years).

The development will remove some 'low-quality' habitat for native birds, lizards and potentially bats. Mitigation measures, including bird nest checks, a lizard capture and relocation plan, and implementation of bat roost protocols will ensure minimal impacts on wildlife.

The proposed terrestrial mitigation for the Project Area has been designed to enhance ecological values and deliver net-gain biodiversity outcomes. The restoration package will comprise:

- Restoration of the Mangaheka Stream via native riparian planting and enhancement (c. 84,430 m^2), pest animal and weed control.
- Creation of constructed wetlands (c. 3,600 m^2) suitable for black mudfish to provide enhanced habitat values and greater functional connectivity for native wildlife and fauna across the landscape.
- Habitat enhancement will provide opportunity to plant forest trees such as kahikatea (*Dacrycarpus dacrydioides*), pukatea (*Laurelia novae-zelandiae*) and swamp maire (*Syzygium maire*) with an understory of native sedges, providing suitable habitat for ferns to naturally colonise. Floristic enhancement could include the introduction of restiads; greater wire rush (*Emporia robustum*) and giant cane rush (*Sporadanthus ferrugineus*).

Freshwater values within the Project Area were assessed as 'low' to 'moderate' based on the highly modified state of aquatic habitat and the presence or potential presence of fish species with an 'At Risk – Declining' status in artificial drains (e.g., black mudfish) and Mangaheka Stream (e.g., longfin eel, banded kōkopu, giant kōkopu).

Ecological effects have been identified which involve the reclamation of potential black mudfish habitat in artificial drains, reclamation of 212 m of Watercourse M13, potential construction and post development effects associated with stormwater and earthworks on Mangaheka Stream, and the creation and enhancement of habitat in Mangaheka Stream.

Mitigation of stormwater and earthworks related effects will be managed by implementing the following management plans:

- Earthworks Management Plan (Maven Associates 2026a).
- Stormwater Management Plan (Maven Associates 2026c).
- Fish Management Plan (Ecological Solutions 2026c).
- Mangaheka Stream Enhancement Plan (Ecological Solutions 2026d).
- Black Mudfish Habitat Creation Plan (Ecological Solutions 2026e).

The removal of artificial drains will result in the loss of potential black mudfish habitat within the Project Area. The pre-mitigation level of effect will be high. Compensation will be achieved by creating black mudfish habitat within the Project Area in advance of the development that will ensure there is no overall loss of black mudfish habitat extent. Constructing habitat in advance will also ensure there is habitat within the Project Area where black mudfish can be relocated to prior to and during construction. Details of the design and specifications of the habitat creation are in the Black Mudfish Habitat Creation Plan (Ecological Solutions 2026e). The long-term outcome of black mudfish habitat creation is expected to be positive and will be assessed and monitored through a comprehensive monitoring programme.

The reclamation of 212 m of highly modified Watercourse M13 will be offset by creating an additional 409 m length of Mangaheka Stream by introducing meanders to the existing straight aligned stream and planting the entire length of Mangaheka Stream within the Project Area (i.e., 2,279 m). An additional 450 m section downstream of the Project Area will be enhanced via riparian planting. The overall effect of proposed stream works on stream ecology will be positive and result in an overall 'net gain' in extent and values.

Implementation of the effects management hierarchy and residual effect management measures, as outlined, are expected to result in an overall low level of adverse effect and even a net-gain for many of the ecological values identified as being adversely impacted.

Table of Contents

Index to Tables

Index to Figures

Appendices

1.0 Introduction

1.1 Background

The report has been prepared as part of the Te Kowhai East Limited Partnership's substantive application for approvals under the Fast-track Approvals Act 2024 (FTAA).

'The Project' is a large-scale industrial development located on the north-western edge of Hamilton, adjacent to the established Te Rapa industrial area. The application provides for the creation of an integrated industrial precinct, including approximately 210 industrial lots, land for neighbourhood centre activities, reserves for recreation, stormwater management and ecological mitigation, and associated roading and infrastructure services.

The application also seeks approval for the ultimate land use outcomes anticipated across the site, being predominantly industrial activities, along with a limited range of compatible non-industrial activities suited to an industrial environment.

The development will form a logical extension of Hamilton's primary industrial node within the Upper North Island economic corridor and responds to projected growth and demand. A comprehensive description of the Project is provided in the Substantive Application Report (SAR).

The Project Area comprises a large, contiguous landholding located on the north-western edge of Hamilton. It is generally bounded by Te Kowhai Road to the south, Koura Drive and State Highway 1C to the east, and Onion Road to the north ('the Site'). The site is made up of multiple land titles, legal descriptions, and associated physical addresses.

For identification purposes, the site is commonly referred to by the primary addresses of 270 Te Kowhai Road and 28 Mathers Road. Full details of the landholdings are provided in the SAR. The Project Area is shown in Figure 1.

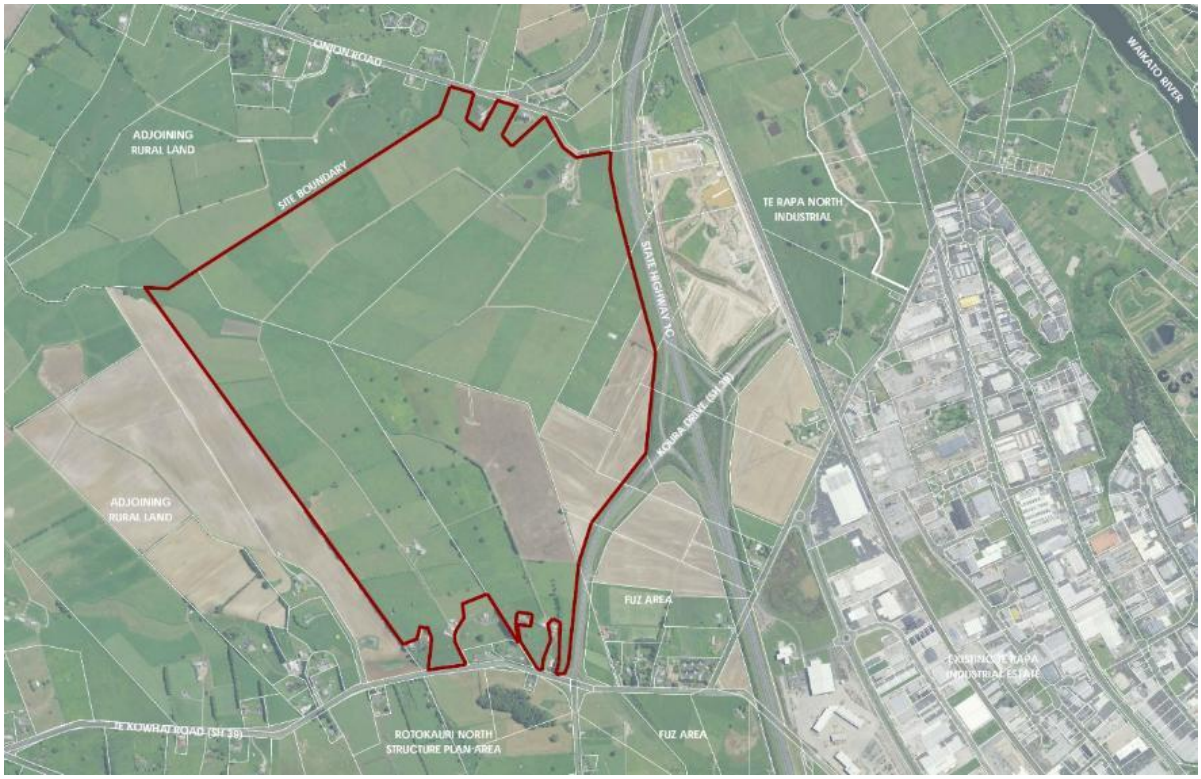

Figure 1: Location of the Project Area.

1.2 Scope of Report

The following Ecological Impact Assessment (EcIA) identifies the actual and potential ecological effects attributable to the proposed industrial development and provides recommendations for the management of adverse effects in accordance with the effects management hierarchy. The following EcIA considers both the New Zealand National Policy Statement for Freshwater Management 2020 amended December 2025 (NPS-FM; MfE 2025a) and The National Policy Statement for Indigenous Biodiversity 2023 amended December 2025 (NPS-IB; MfE 2025b). This report has been prepared based on the proposed Masterplan (Figure 2) to support the substantive application that will be lodged with the Environmental Protection Agency (EPA) for consideration by an expert panel.

This report is structured as follows:

- Section 1 – Introduction.
- Section 2 – Ecological setting.
- Section 3 – Description of the methods used in this assessment.
- Sections 4, 5 and 6 – Assessment of terrestrial, wetland and freshwater values.
- Section 7 – Assessment of significance (WRPS).
- Section 8 – Assessment of terrestrial, wetland and freshwater effects.
- Section 9 – Residual effects.
- Section 10 – Summary.
- Appendices A–C – Supporting information.

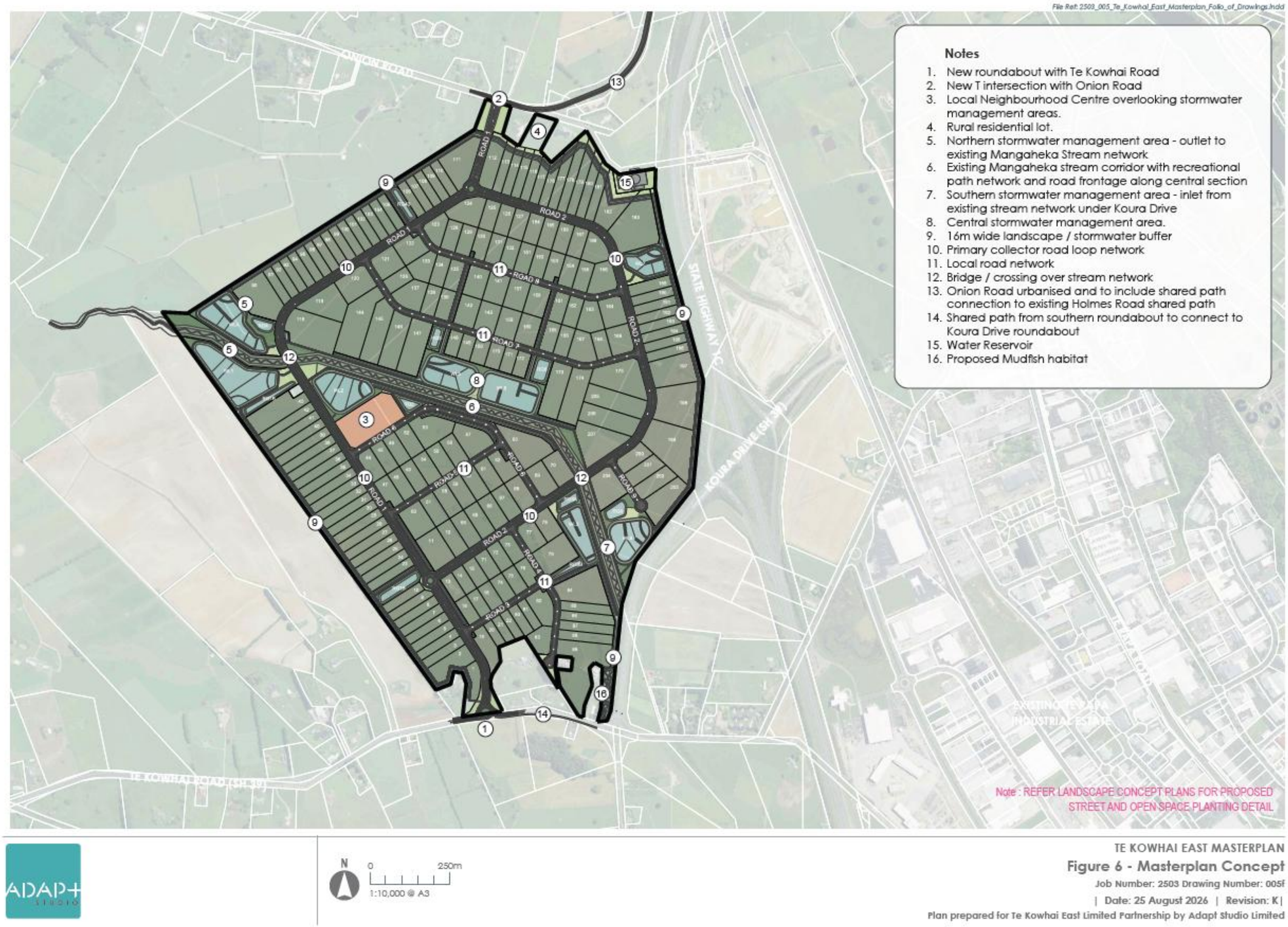

Figure 2: Proposed Masterplan for the Project Area (Adapt Studio Limited).

2.0 Ecological Setting

The Project Area is located within the Hamilton Basin, a warm, sub-humid bioclimatic zone of the Hamilton Ecological District (ED). The Hamilton ED is one of the most modified districts in New Zealand with only 1.6% of the original indigenous vegetation remaining (Leathwick et al. 1995). At least 20% of the district's indigenous flora is threatened or extinct and more than one half of its indigenous bird species have gone. Hamilton City, in the centre of this transformed landscape, has only a few tiny remnants of the former indigenous forest cover, perhaps less than 20 ha in total of high-quality indigenous habitat (Clarkson and McQueen 2004), but recent efforts have been made to restore gully systems and city-wide ecological connectivity via gully restoration projects.

Former vegetation and habitats across the alluvium and peat basin included freshwater swamps, fens and bogs (wetland complexes), secondary vegetation, shrubland and fernland types (McEwen 1987). Historic habitat and vegetation types expected for the Project Area and surrounds is thought to have comprised a mosaic of peat bog communities, such as mānuka (*Leptospermum scoparium* agg.), greater wire rush (*Empodisma robustum*), restiad (*Sporadanthus ferrugineus*) rushland; bounded by secondary vegetation on alluvium, and podocarp/broadleaved forest on low rolling hills to the north, including rimu (*Dacrydium cupressinum*), kahikatea, mīro (*Prumnopitys ferruginea*), matai (*P. taxifolia*), and tawa (*Beilschmiedia tawa*), mangeao (*Litsea calicaris*), kāmahi (*Weinmannia racemosa*) forest (Singers 2015, Singers and Rogers 2014). A sketch map of the Waikato District from the 1870s[1], appears to show an area of 'swampy' ground, surrounded by 'open scrub country' in the vicinity of the Project Area.

Much of the original extent of putative wetlands, such as those present in the 1840-1870s (cf. Nicholas 2002, McCraw 2011), and secondary fragments still visible in the northwestern portion of the Project Area in 1946 and 1952, had already been extensively cleared and drained for agricultural development. As a result, the Project Area has been effectively managed for over the past 80 years primarily for pasture, and cropping. There are no SNAs, notable trees or natural environment value overlays within the Project Area.

2.1 Land Environment

The Threatened Environment Classification (TEC) combines data from three national databases: Land Environments of New Zealand (LENZ), the Land Cover Database (LCDB), and the National Protected Areas Network (Cieraad et al. 2015, Walker et al. 2015). The TEC is designed as a regional-national scale tool for assessing the threat status of land environments based on the loss of original natural vegetation cover and the extent to which the remaining indigenous vegetation is protected. The Project Area consists entirely of Land Environment A5.3a which comprises a flat terrace landform at low elevation (c. 40-60 m above sea level) within the Hamilton Basin which includes poorly drained alluvium, along with peat soils and some older sands, of low to moderate natural fertility. Land Environment A5.3a is assigned to Threat Category 2 which contains 10–20% remaining indigenous cover. In these environments, indigenous biodiversity values have been severely reduced with only fragmented indigenous habitats remaining, sparsely distributed across the landscape (Cieraad et al. 2015).

Current vegetation of the Project Area according to the LCDB (v6.0) primary comprises 'high producing exotic grassland', with areas of 'short-rotation cropland' (e.g., maize), and 'deciduous hardwoods' (e.g., exotic shelterbelts).

[1] *Historical Maps of the Waikato Region*. University of Waikato, https://onehera.waikato.ac.nz/nodes/view/4799 accessed 19/05/2026.

2.2 Freshwater Environment

The Mangaheka Stream flows through the Project Area, entering from Koura Drive on the eastern boundary and exits on the western boundary, flowing into the Waipa River (Figure 3). The Mangaheka Integrated Catchment Management Plan (ICMP) describes the catchment as approximately 2,080 ha with the majority of the catchment (86%) being within the Waikato District Council boundaries and the upper catchment being within the Hamilton City Council boundaries (HCC 2019). Land use is predominately rural (dairy and grazing) in the lower catchment and vegetation throughout the catchment is dominated by exotic pasture, shelter belts and shade trees associated with rural residential properties.

The Mangaheka Stream catchment is typical of similar rural watercourses, with moderate to poor water quality and low benthic invertebrate health indices (MCI) (HCC 2019). Habitat modification, removal and influences from earthworks and development have led to the catchment wide deterioration of freshwater habitat quality. Despite this, the Mangaheka Stream catchment provides habitat for longfin eel ('At Risk – Declining') and shortfin eel, banded kōkopu ('At Risk – Naturally Uncommon') and black mudfish ('At Risk – Declining'), placing ecological significance on the catchment based on the matters specified in the operative Regional Policy Statement (WRPS 2016).

The Te Otamanui Stream crosses the site at the southern boundary, which is the head waters of the Te Otamanui Stream catchment, and was connected via a small stream feeding from the Mangaheka Catchment but is now disconnected (HCC 2019) (Figure 3).

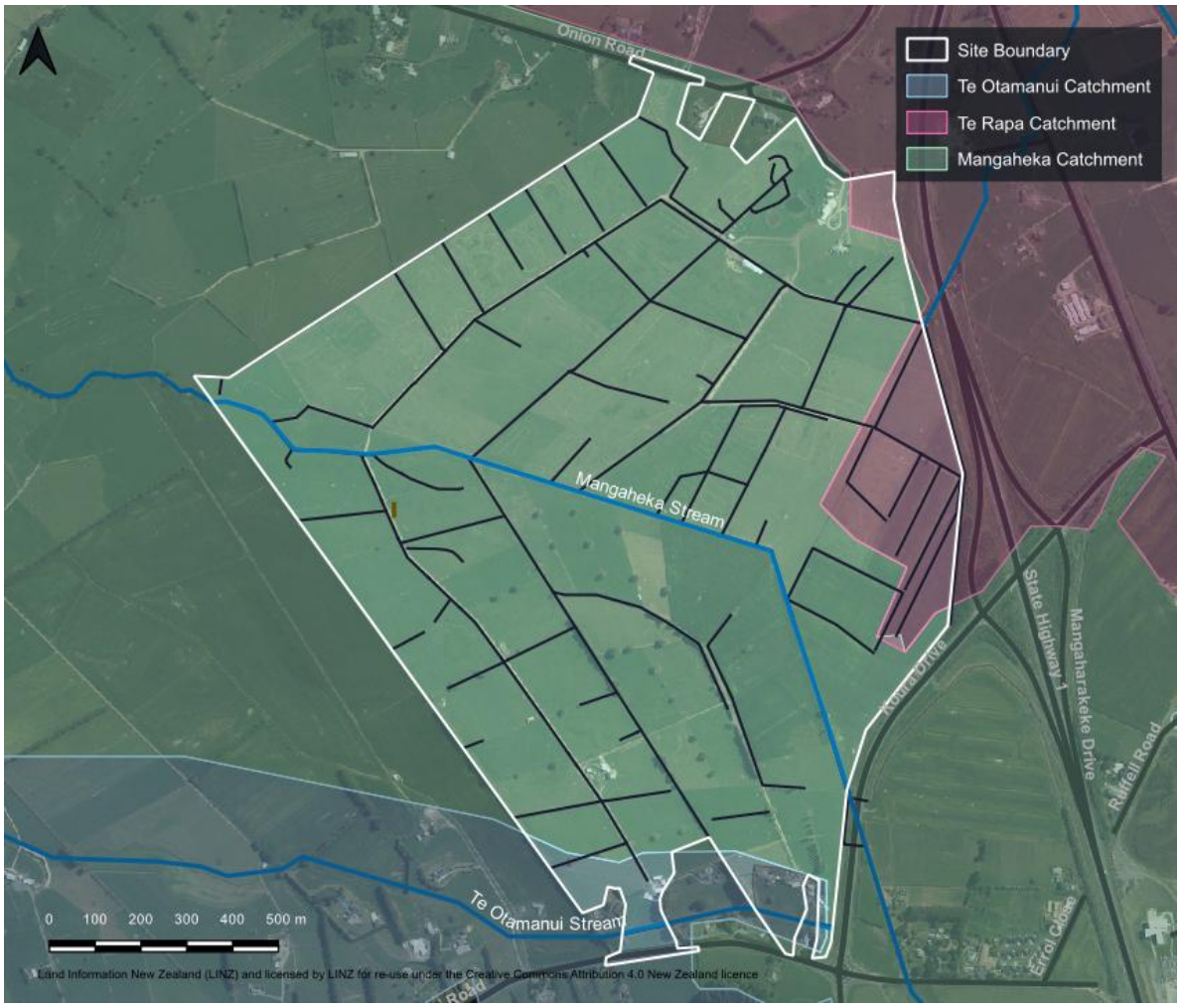

Figure 3: Location of watercourses and catchment boundaries.

3.0 Methodology

3.1 Desktop Assessment

A desktop review of existing literature and databases for the Project Area was undertaken and included the following:

- Waikato Regional Council (WRC) plans, policies and maps to determine if any significant freshwater or terrestrial features have been identified within the Project Area or the surrounding area.
- Significant Natural Area's (SNAs) and Protected Natural Area Programme (PNAP) reports.
- Database records held in the New Zealand Freshwater Fish Database (NZFFD), herpetofauna records (Department of Conservation database), bat records (Department of Conservation database), Waikato Region Bat Distribution and bird records (New Zealand eBird database).
- Current and historical aerial images from Google Earth, LINZ and Retrolens to assist with identifying historical stream alignments and potential wetland habitat.

3.2 Ecological Surveys

The Project Area has been surveyed on eight occasions to assess terrestrial and freshwater ecological values, including areas of potential wetland, and the identification of key habitat for native flora and fauna (fish, birds, bats, lizards) (Table 1). Details of survey outcomes are presented in Sections 4.0, 5.0 and 6.0.

Table 1: Summary of ecological surveys undertaken across the Project.

Date	Survey effort	Notes
March 2021	eDNA Survey. Terrestrial and wetland habitat survey.	Initial due diligence assessment.
November 2021	eDNA Survey.	Follow up survey to March 2021.
November 2023	eDNA Survey, Gee's minnow Trapping, wetland assessment, watercourse classifications and vegetation description and SEVs.	Freshwater assessment.
September 2025	Gee's minnow survey, revisit watercourse classification. Wetland survey.	Extend trapping area.
October 2025	Gee's minnow survey. Vegetation assessment. Lizard habitat assessment.	Extend trapping area.
November 2025	Gee's minnow survey.	Follow up survey to October 2025
December 2025	Deploy ABMs.	Bat survey.
January 2026	Collect ABMs.	End of bat survey.
May 2026	SEV data collection and terrestrial, wetland and fauna assessment.	

3.3 Terrestrial Flora and Fauna

3.3.1 Vegetation and habitat

Terrestrial ecology surveys within the Project Area were undertaken on several occasions as summarised in Table 1.

Terrestrial surveys involved walking over the entire site to characterise and describe terrestrial vegetation and habitat and ground truth desktop information. Vegetation and habitats were identified, mapped, photographed and described.

Factors used to assess the likelihood of occupancy for key fauna of interest included:

- Size and connectivity of habitat to other sites.
- Current and previous land use.
- Structure and intactness of vegetation.
- Depth of leaf litter and humus layers.
- Provision of microhabitats for foraging, shelter and breeding.

Specific fauna surveys were also undertaken for birds, lizards, bats (refer to methods described in Sections 3.3.2, 3.3.3, 3.3.4, respectively).

3.3.2 Birds

Birds seen or heard during sites visits were recorded. Bird records within 5 km of the site were obtained from the New Zealand eBird database and used to indicate which species may be present based on available habitat within the Project Area.

3.3.3 Lizards

Areas of potential lizard habitat on site were identified, photographed and location mapped during the site surveys. Manual habitat searches were undertaken within suitable lizard habitat areas. A two-person hour manual habitat search effort of potential lizard habitat including turning over organic (e.g., logs, woody debris, mulch) and inorganic debris (e.g., sheet metal), and searching through rank vegetation (e.g., grass along fencelines, and under shelterbelts/hedgerows) was undertaken to confirm lizard presence.

3.3.4 Bats

Twenty-one automatic bat monitors (ABMs) were deployed across the Project Area (as shown in Figure 4) from 17 December 2025 to 14 January 2026 for a survey period of 28 nights. This survey period aligns with the parturition and lactation period when bats exhibit some of their highest and most complex nocturnal activity of the year (O'Donnell 2002).

All ABM data was analysed using BatSearch Version 3.23. The number of valid survey nights was determined using the requirements outlined in the Bat Roost Protocols (Department of Conservation 2024). Weather data was provided by EnviroNZ from their onsite weather monitoring station (-37.808425, 175.258896).

Potential bat roost trees and features, (i.e. trees with a >15 cm dbh with cavities, crevices, loose bark etc), observed during the Site surveys were noted and photographed.

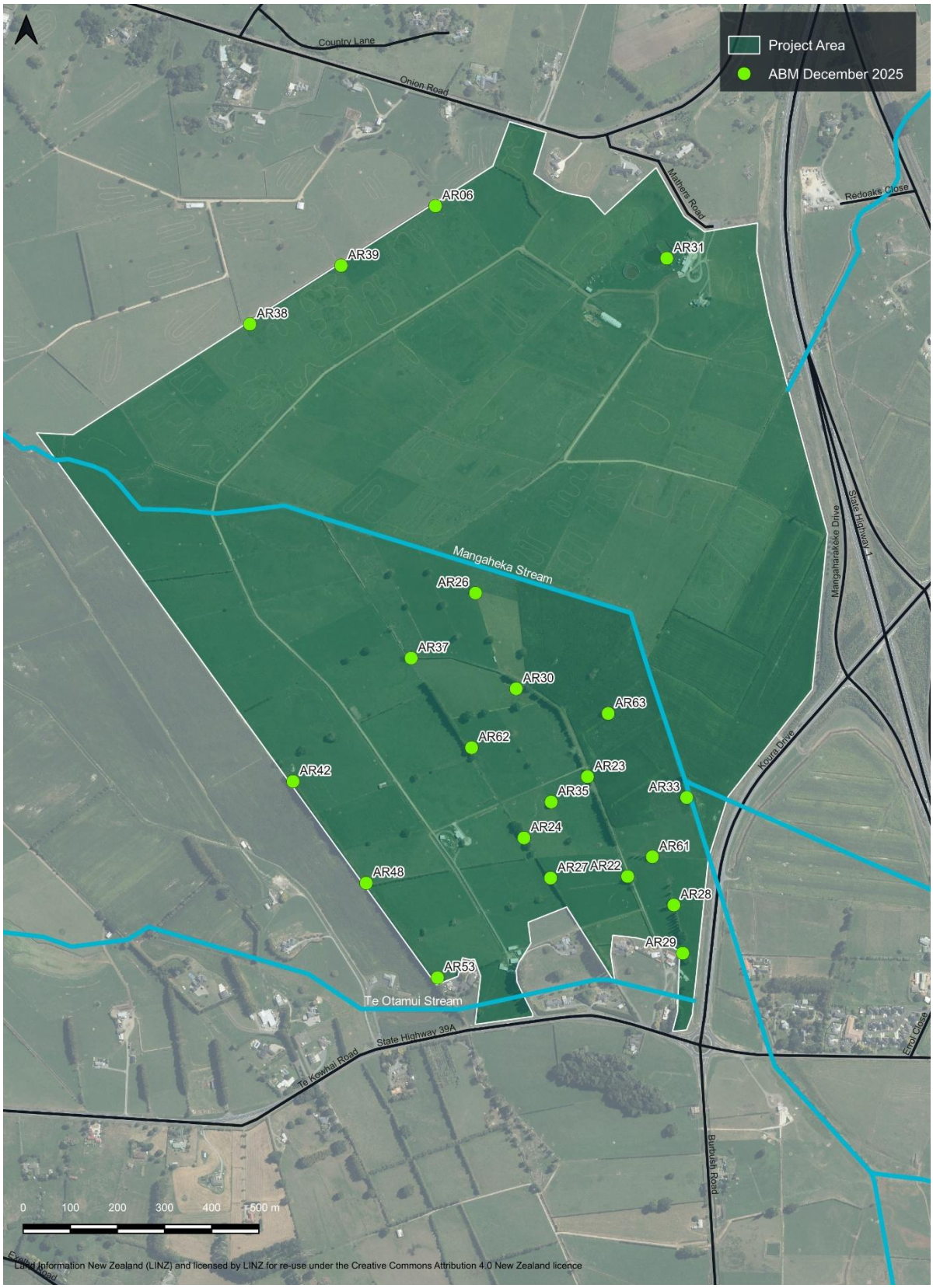

Figure 4: Location ABMs deployed December 2025 – January 2026.

3.4 Freshwater Environment

3.4.1 Watercourse classification

Watercourses within the Project Area were classified in accordance with the definitions outlined in the Waikato Regional Plan (WRP) for the Waikato Region (i.e., artificial, farm drainage canal, modified, ephemeral or perennial). The WRP definitions are set out in Table 2. The classification of watercourses within the Project Area was based on surveys in April and May 2023 and October 2025. Current and historical aerial photographs were also reviewed to provide an indication of historical alignments.

Table 2: Watercourse definitions in the Waikato Regional Plan.

Watercourse classification	Description
Artificial	A watercourse that contains no natural portions from its confluence with a river or stream to its headwaters and includes irrigation canals, water supply races, canals for the supply of water for electricity power generation and farm drainage canals.
Farm drainage canal	An artificial watercourse on a farm that contains no natural portions from its confluence with a river or stream to its headwaters, and includes a farm drain or a farm canal.
Modified watercourse	An artificial or modified channel that may or may not be on the original watercourse alignment and which has a natural channel at its headwaters.
Ephemeral	Streams that flow continuously for at least three months between March and September but do not flow all year.
Perennial	Streams that flow year-round assuming average rainfall.

3.4.2 Habitat characteristics

Aquatic and riparian habitat characteristics recorded included measurements or visual estimates of wetted width, water depth, habitat type, streambed substrate, shade, erosion, flow velocity, aquatic plant cover and periphyton cover.

3.4.3 Macroinvertebrates

Macroinvertebrates were sampled from selected watercourses (i.e., Mangaheka Stream, M1, M4, M6) using a kick-net (mesh size 500 µm) and inspected on the bank to provide an indication of the dominant taxonomic groups and taxa present.

3.4.4 Fish fauna

A search of the New Zealand Freshwater Fish Database (NZFFD) within the Catchment was carried out to check for fish records within the Project Area and the wider area. Environmental DNA (eDNA) samples were collected within the Project Area during the 2021 and 2023 surveys. Samples were sent to Wilderlab for basic multispecies analysis.

Black mudfish surveys were undertaken using Gee's minnow traps which were set on four occasions (see Figure 29; Section 6.6.3) in watercourses where there was sufficient surface water. Fine mesh (3 mm) Gee's minnow traps were set at 10 m intervals overnight. Each survey was conducted over one night.

The first step during the black mudfish survey involved identifying drains within the Project Area that provided suitable habitat based on our experience. Ten un-baited fine wire mesh (3 mm) Gee's minnow traps per 100 m were set overnight in areas of shallow water within the drains identified as providing suitable habitat. There have been five black mudfish surveys within the Project Area since 2021 (Table 1).

In November 2021, Ecological Solutions established the presence of black mudfish in drains within the Project Area based on environmental DNA (eDNA) samples. A comprehensive trapping survey was undertaken over one night on 12–13 October 2023. A further survey was undertaken in September 2025 using 110 Gee's minnow traps set overnight. In October 2025, 85 Gee's minnow traps were set overnight in previously unfished drains. In November 2025, 75 Gee's minnow traps were set in drain in the central eastern portion of the Project Area and in an 850 m long section of drain within the NZTA road reserve (off-site).

3.4.5 Stream Ecological Valuation

Stream Ecological Valuation (SEV) surveys were carried out on Mangaheka Stream along the upper, upper-middle, middle-lower and lower reaches, watercourse M13 and the section of Te Otamanui Stream that flows through the Project Area. SEV surveys were carried out following the method in Storey et al. (2011). SEV results provide an indication of the ecological function and values of the Mangaheka Stream. SEV scores calculated from the habitat, biological and physical characteristics can range between 0 (poor) and 1 (excellent).

3.5 Wetlands

An initial desktop assessment was carried out using aerial imagery (e.g. Google Earth, Retrolens), topographic maps and GIS datasets (e.g., LCDB V5.0, Waikato Regional Council, Hamilton City Council). These were used to assist in assessing historic hydrological conditions and identify possible wetland locations and extents within the Site and within 100 m of the Site for subsequent field survey.

Wetland field assessments within the Project Area were undertaken on several occasions including on 21 March 2021, 1 September 2025, 8 October 2025, and 22 May 2026. The assessments focused on identification of areas within and immediately surrounding the Project Area that would meet the RMA (1991) definition of a wetland (i.e., an area that can "*support a natural ecosystem of plants and animals that are adapted to wet conditions*") and the definition of any natural inland wetlands in accordance with the National Policy Statement for Freshwater Management (NPS-FM) (MfE 2025a).

The NPS-FM defines natural inland wetlands as a wetland (as defined in the Resource Management Act 1991) that is not:

(a) in the coastal marine area; or

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

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

(d) a geothermal wetland; or

(e) a wetland that:

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

(ii) has vegetation cover comprising more than 50% exotic pasture species (as identified in the National List of Exotic Pasture Species (Cosgrove et al. 2022) using the Pasture Exclusion Assessment Methodology (see clause 1.8)); unless;

(iii) the wetland is a location of a habitat of a threatened species identified under clause 3.8 of this National Policy Statement, in which case the exclusion in (e) does not apply.

Any RMA wetlands within the Project Area were assessed following the delineation protocols in relevant guidelines at the time and subsequent tools (Clarkson 2014, Fraser et al. 2018, Clarkson et al. 2021, MfE 2021, 2022a, 2022b, Cosgrove et al. 2022).

3.6 Assessment of Ecological Values

Ecological values were assigned following the approach outlined in the Environment Institute of Australia and New Zealand's (EIANZ) Ecological Impact Assessment guidelines (EcIAG) (Roper-Lindsay et al. 2018). The EcIAG outline a standardised approach for defining ecological values. The approach involves assessing four matters including representativeness, rarity/distinctiveness, diversity/pattern and ecological context with consideration of the attributes outlined in Tables 5 and 7 of the EcIAG. The overall ecological values within the site and vicinity were assigned based on the four matters outlined above and using the scoring system outlined in Table 6 of the EcIAG.

3.7 Assessment of Effects

The level of effects was assessed using the method recommended by the EcIAG (Roper-Lindsay et al. 2018). This method involves assigning ecological values as above and determining the magnitude of effects based on criteria outlined in Table 3 below and assigning the overall level of effect using the matrix in Table 4 below. The magnitude of the effects was considered at the site and ecological district scale, with consideration to factors relevant at a regional and national scale.

Table 3: Criteria for describing magnitude of effect.

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

Table 4: Criteria for describing level of effects.

Effect level	Ecological value				
	Very high	**High**	**Moderate**	**Low**	**Negligible**
Very high	Very high	Very high	High	Moderate	Low
High	Very high	Very high	Moderate	Low	Very low
Moderate	High	High	Moderate	Low	Very low
Low	Moderate	Low	Low	Very low	Very low
Negligible	Low	Very low	Very low	Very low	Very low
Positive	Net gain	Net gain	Net gain	Net gain	Net gain

4.0 Terrestrial Ecology Features and Values

4.1 Vegetation

The Project Area was characterised by predominately high producing exotic grassland, with scattered individual or grouped paddock trees (Figure 5), areas of cropping, and shelterbelts/hedgerows running generally northwest-southwest from the southern boundary along Te Kowhai Rd (Figure 6).

Five terrestrial vegetation types were characterised within the Project Area, including a small regenerating native fernland, and various exotic vegetation/scrub types (Figure 6). A list of vascular plant species within the Project Area is provided in Appendix A. Historic habitat and vegetation types expected within the Project Area such as mānuka/ restiad rushland, or podocarp/broadleaved forest were entirely absent.

In total, 50 terrestrial vascular plant species were recorded across the Project Area of which approximately 14% were native, and 86% exotic. This composition indicates a highly modified environment. No plant species of botanical or conservation interest (following de Lange et al. 2024) were observed within the Project Area during past and recent surveys.

Figure 5: Typical terrestrial vegetation and habitat within the Project Area.

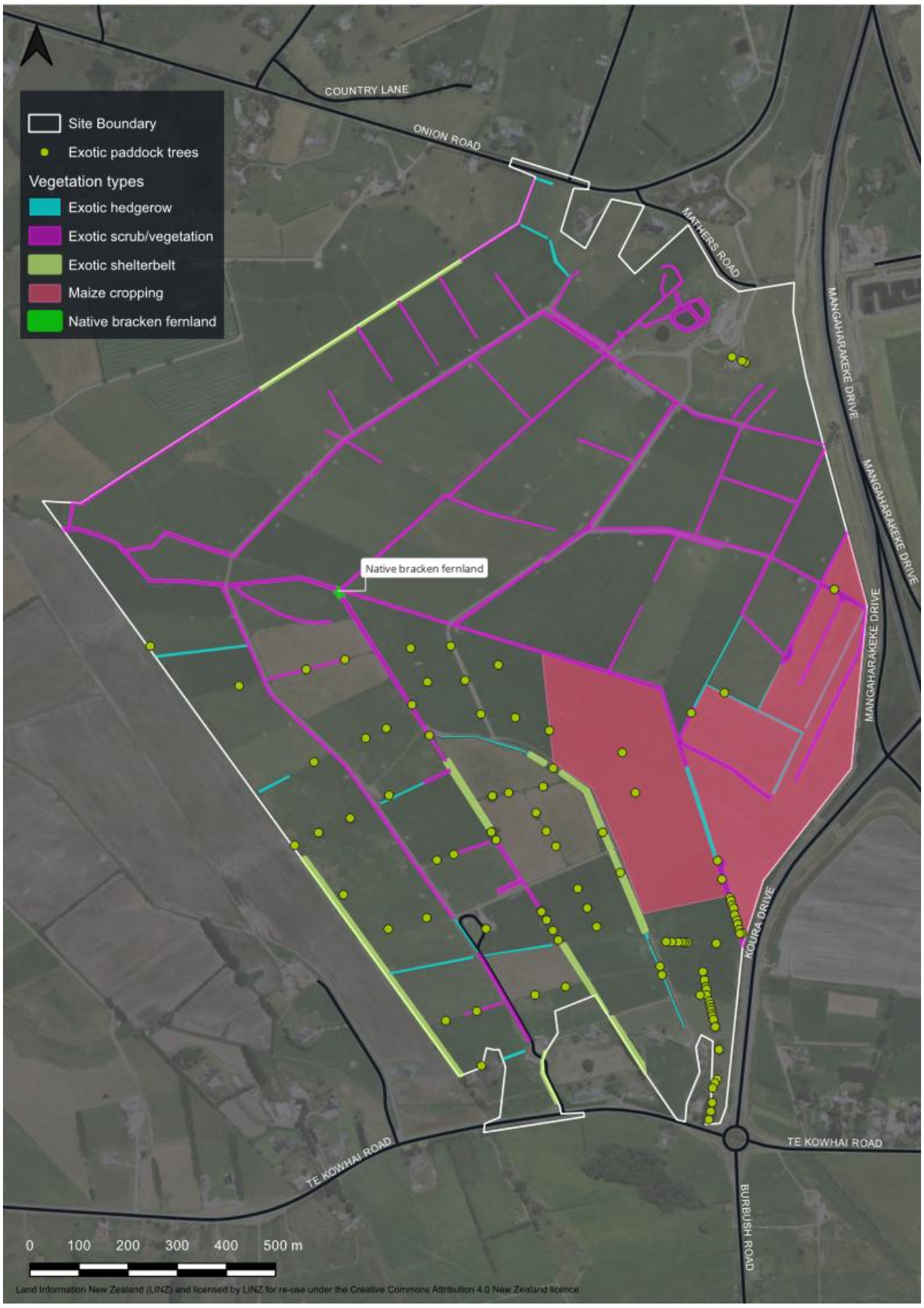

Figure 6: Terrestrial vegetation and habitat within the Project Area.

4.1.1 Native bracken fernland

A small regenerating bracken (*Pteridium esculentum*) fernland (c. 232 m^2) confined to an artificial drain margin, comprised scattered and stunted ponga (*Cyathea dealbata*) and whekī (*Dicksonia squarrosa*), with common rank cocksfoot (*Dactylis glomerata*) and occasional blackberry (*Rubus fruticosus* agg.) as shown in Figure 7.

Figure 7: Small area of regenerating native bracken fernland within the Project Area.

4.1.2 Exotic pasture

Pasture typically comprised of rye/ clover (*Lolium perenne*/ *Trifolium repens*) grassland (c. 155 ha), with occasional cocksfoot, daisy (*Bellis perennis*), hawksbeard (*Crepis capillaris*), Italian rye (*Lolium multiflorum*), plantain (*Plantago lanceolata, P. major*), red clover (*T. pratense*), dandelion (*Taraxacum officinale*) (Figure 8), and uncommon pennyroyal (*Mentha pulegium*) and smooth witchgrass (*Panicum dichotomiflorum*). Pastural weeds included willow weed (*Persicaria hydropiper*), creeping buttercup (*Ranunculus repens*), broad-leaved dock (*Rumex obtusifolius*) and various thistles.

Figure 8: Example of exotic grazed rye/clover pasture within the Project Area.

4.1.3 Exotic cropping

Several paddocks (c. 23 ha) were utilised for maize (*Zea mays*) cropping (Figure 9).

Figure 9: Example of exotic maize crop within the Project Area.

4.1.4 Exotic shelterbelts, hedgerows and paddock trees

A variety of exotic conifer and hardwood shelterbelts, hedgerows (c. 4,945 m) and paddock trees were positioned around the Project Area, with a typical example shown in Figure 10. Common shelterbelt species included she-oak (*Casuarina* sp.), cedar (*Cryptomeria japonica*), radiata pine (*Pinus radiata*), poplar (*Populus* sp.); hedgerows, primarily barberry (*Berberis glaucocarpa*); and paddock trees such as, macrocarpa (*Cupressus macrocarpa*), gum (*Eucalyptus* sp.), honey locust (*Gleditsia triacanthos*), oak (*Quercus robur*), red dawn (*Metasequoia glyptostroboides*), plane (*Platanus ×hispanica*) and popular (*Populus nigra* f. italica). Native tī kōuka/cabbage tree (*Cordyline australis*) were sparse.

Figure 10: Example of exotic shelterbelts, hedgerows and paddock trees within the Project Area.

4.1.5 Exotic scrub/vegetation

Mixed herbaceous and woody weeds and rank grass communities (c. 5.2 ha) were widespread along the riparian margins of artificial drains, farm ponds, and Mangaheka Stream, a typical example is shown in Figure 11. Common species included pampas grass (*Cortaderia selloana*), barberry, blackberry, cocksfoot, creeping buttercup, Yorkshire fog (*Holcus lanatus*), occasional wīwī (*Juncus edgariae*), soft rush (*J. effusus*), summer grass (*Paspalum dilatatum*), wild radish (*Raphanus raphanistrum*), woolly nightshade (*Solanum mauritianum*), gorse (*Ulex europaeus*), local barnyard grass (*Echinochloa crus-galli*), tree privet (*Ligustrum lucidum*) and bamboo (*Pseudosasa japonica*). Regenerating native ferns were scattered throughout but varied in density (i.e., sparse to local) such as, ponga, mātātā (*Paesia scaberula*), bracken, whekī, and kiokio (*Parablechnum novae-zelandiae*).

Figure 11: Example of exotic scrub/vegetation within the Project Area.

4.2 Avifauna

Bird species observed during surveys were common species of rural landscapes including the native pūkeko (*Porphyrio melanotus*), spur-winged plover (*Vanellus miles novaehollandiae*), swamp harrier (*Circus approximans*) and welcome swallow (*Hirundo neoxena*), all considered 'Not Threatened' (Roberston et al. 2021). Exotic species (introduced and naturalised) recorded included mallard duck (*Anas platyrhynchos*) and house sparrow (*Passer domesticus*).

Avifauna recorded during the survey, and potentially using habitat within the Project Area, included common native and exotic species, and lacks the diversity expected in unmodified environments. There was potential nesting habitat for common native and exotic birds (e.g., trees/shrubs, shelterbelts, hedgerows).

Mobile species such as pūkeko and spur-winged plover are expected to visit the Project Area periodically for opportunistic roosting and/or foraging. However, in the context of the Project Area, the site offers limited habitat opportunity to support birds of conservation interest and was not considered core breeding habitat.

4.3 Lizards

Potential lizard habitat was identified within the Project Area associated with areas of scrub/vegetation, particularly around fencelines, existing farm buildings and sheds, organic/inorganic debris piles, shelterbelts and hedgerows scattered throughout the Project Area, as shown in Figure 12.

The Project Area contained no habitat suitable for native geckos due to historic vegetation clearance and the absence of suitable habitat connectivity with known gecko habitats.

It is anticipated that copper skink (*Oligosoma aeneum*, 'At Risk – Declining') (Hitchmough et al. 2025) are present in low numbers. Copper skink are ground dwelling lizards commonly found in the aforementioned habitats across the Waikato lowlands.

Suitable lizard habitat areas were manually searched during the assessment of the Project Area. No indigenous lizards were found during two person-hours of search effort.

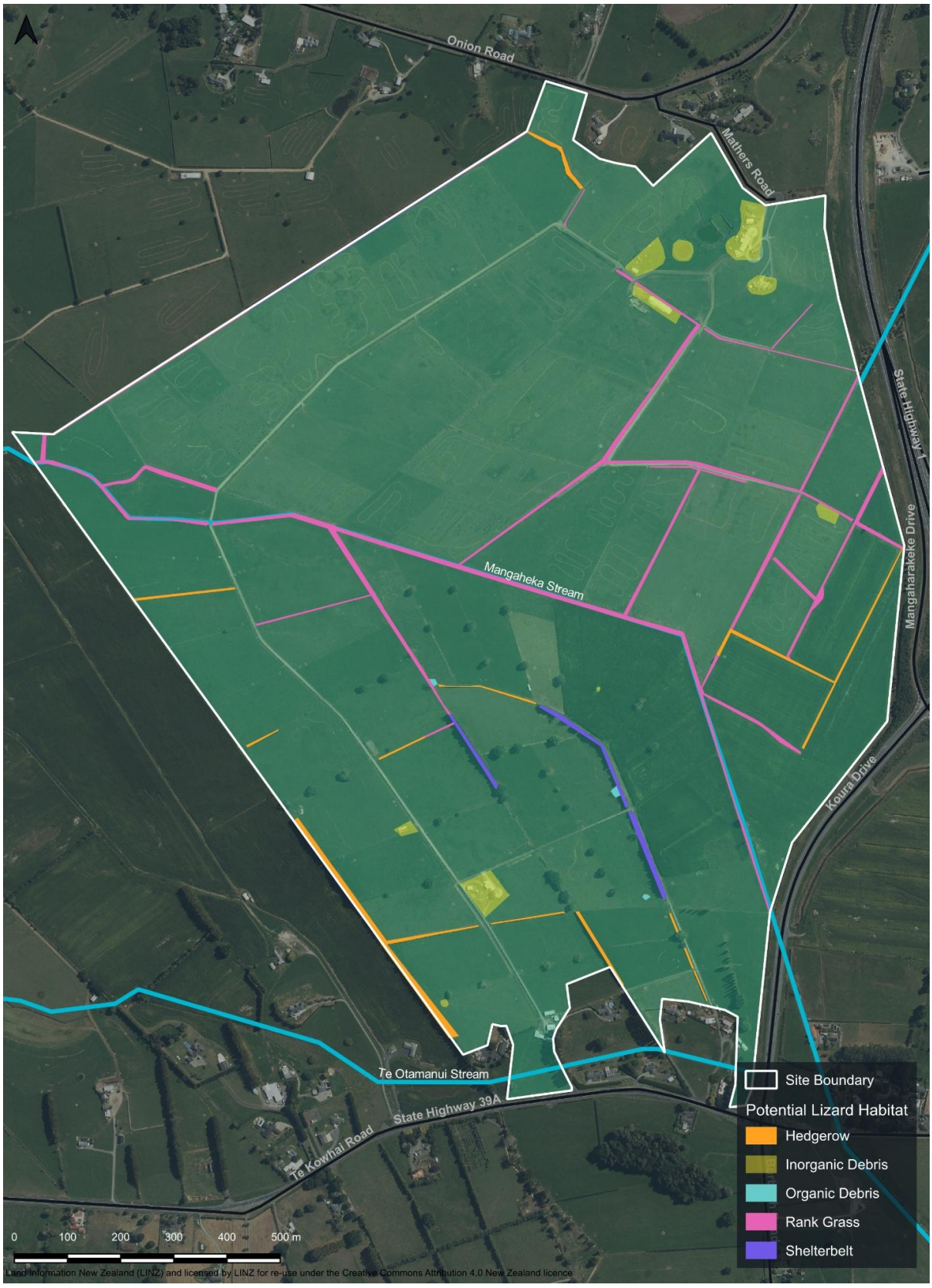

Figure 12: Potential lizard habitat within the Project Area.

4.4 Bats

Long-tailed bats are considered 'Threatened – Nationally Critical' (O'Donnell et al. 2023). The Waikato Region Bat Distribution and Department of Conservation National Bat Database records show long-tailed bat activity has been previously recorded within c. 3 km of the Project Area in 2018 and 2020. This bat activity was strongly correlated with Waikato River gully systems to the east and west of the Project Area and remnant forest fragments to the south.

Vegetation cover to the north of Hamilton where the Project Area is located is highly fragmented with large areas of high-producing exotic grassland dominating the landcover. While the Hamilton long-tailed bat population is known to use open exotic pasture areas (Davidson-Watts Ecology 2019) these grassland areas have been found to have lower bat activity (Crewther and Parsons 2017).

A predictive model of habitats likely to contain bats, based on acoustic survey results and environmental variables that influence bat presence across the Hamilton area found a strong correlation between bat presence and vegetation, land cover types and gully systems (Crewther and Parsons 2017). Correlations between bat presence and vegetation types is unsurprising given the importance of vegetation to bats for navigating, roosting, shelter from predators and edge habitat for foraging.

Figure 13 below is an excerpt from the predictive model which shows a low probability of long-tailed bat activity in proximity to the Project Area based on previous acoustic survey results, the scarcity of suitably sized forest fragments and the dominance of high producing exotic grassland cover. The red dots represent no bat presence; the green equals bat presence and the pink numbers indicate predicted bat habitat suitability of proximal forest vegetation fragments and gullies (Crewther and Parsons 2017).

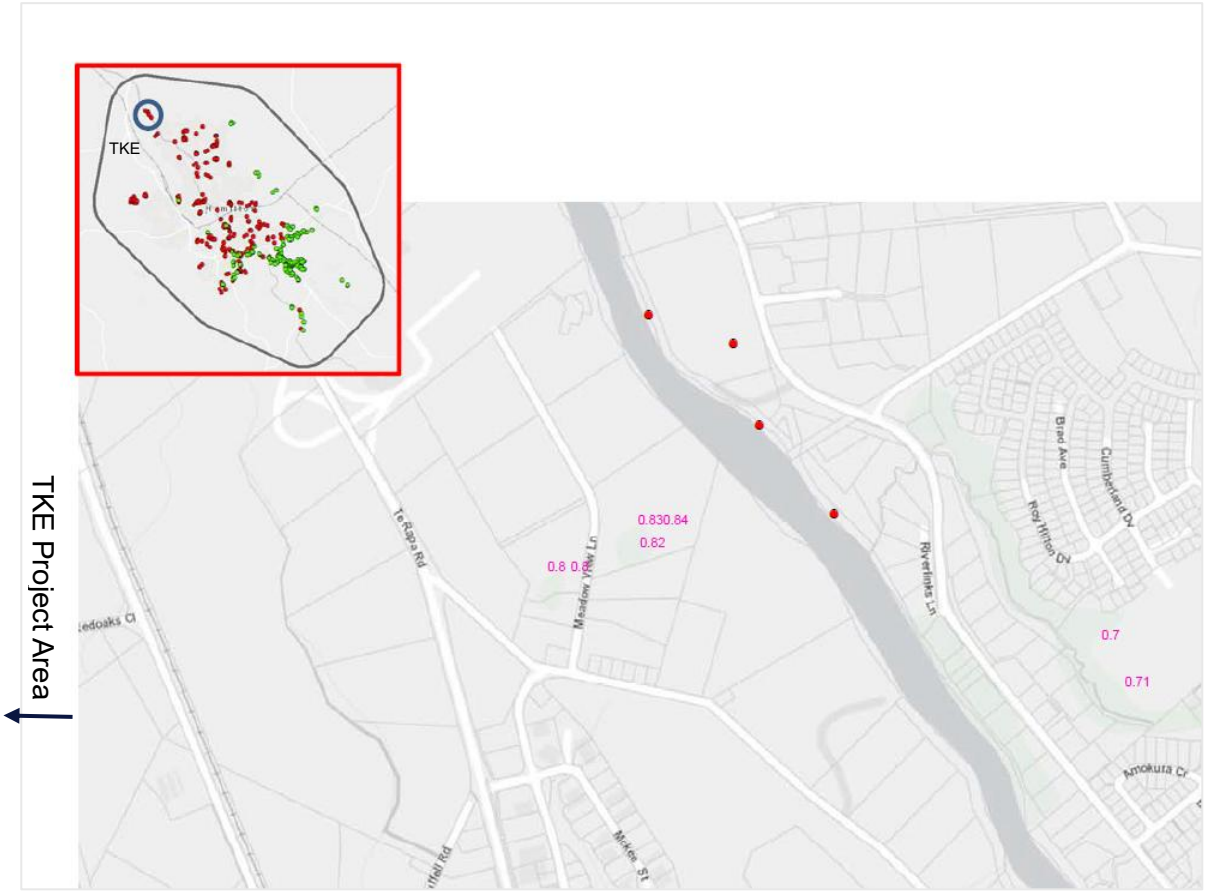

Figure 13: Excerpt from predictive bat presence model (Crewther and Parsons 2017) in relation to the Project Area (circled in blue).

4.4.1 Habitat features

The Project Area was characterised by c. 155 ha of predominately high producing exotic grassland with scattered individual pasture trees and c. 4,945 m of shelterbelts/hedgerows running generally northwest-southwest from the southern boundary of the Project Area along Te Kowhai Road (Figure 14). Some isolated pasture trees were noted as having a diameter at breast height (DBH) greater than 15 cm and containing suitable bat roost features (Figure 15).

4.4.2 Acoustic bat survey

A total of 21 ABMs were deployed across the Project Area from 17 December 2025 to 14 January 2026 (see Figure 4 in Section 3.3.4 for locations) for a total survey period of 28 nights. During this period 19 ABMs recorded as anticipated with two ABMs failing to record (AR26 and AR38). One appeared to have a battery failure and the other fell to the ground and appeared to be trampled by stock.

Analysis of acoustic data found no confirmed bat calls/activity on any of the ABMs deployed over the survey period. There were four instances of 'possible' long-tailed bat calls on one ABM (AR31) near the northeastern corner of the site. The four 'possible' calls were noted on a precautionary basis and were verified as only 'possible' during our third-party quality assurance and quality control process. The nearest previously recorded bat activity was recorded c. 3 km from the Project Area in 2018 and 2020 (DOC Database 2025).

Figure 14: Example of linear habitat feature (exotic shelterbelt) within Project Area.

Figure 15: Example of suitably sized gum tree with potential bat roost features within the Project Area.

4.5 Summary of Terrestrial Ecology Values

4.5.1 Vegetation

Exotic vegetation communities within the Project Area were typical of an intensive agricultural landscape with 'negligible' ecological value. Indigenous vegetation within the Project Area was of 'low' ecological value and isolated. Indigenous species recorded were all common, widespread and typical pioneer communities within rural, lowland farms. Overall, vegetation within the Project Area had 'negligible' to 'low' ecological value (Table 5).

4.5.2 Birds

Bird species recorded within the Project Area and most of the historic records in the local area comprised predominantly exotic and common native species typical of rural areas across Waikato lowlands. Habitats within the Project Area are considered unlikely to provide critical breeding or nesting opportunities for bird species of conservation concern. The overall ecological value for birds and bird habitat within the Project Area was considered 'low' (Table 6).

4.5.3 Lizards

The Project Area contains low-quality habitat for native skinks and no habitat suitable for native geckos due to historic vegetation clearance, lack of connectivity, and current intensive farm practices.

The low-quality skink habitat present was fragmented and surrounded by intensively managed pasture. No indigenous lizards were detected during manual habitat searches of identified habitat areas. If present, the indigenous lizard species most likely to occur within the Project Area are copper skink ('At Risk – Declining'). It is expected that any lizards present will be at low numbers with low detectability. The overall ecological value for lizards within the Project Area was considered to be 'moderate' due to the conservation status of copper skink (Table 6).

4.5.4 Bats

While long-tailed bats themselves are of 'very high' ecological value because of their conservation status ('Threatened – Nationally Critical'), no bat activity was detected within the Project Area during a valid acoustic survey, and limited bat activity has been previously recorded in proximity to the Project Area. Potential bat habitat features within the Project Area were not representative of high bat activity areas and were of low quality due to their isolated and exposed nature. Therefore, the Project Area was not considered to be important bat habitat. Consequently, the ecological value for bats within the Project Area was considered 'moderate' (Table 6) due to the conservation status of long-tailed bats.

4.5.5 Summary of Terrestrial Ecological Values

Table 5: Terrestrial (botanical) ecological values assessed using the EcIAG framework (Roper-Lindsay et al. 2018).

Feature	Representativeness	Rarity/distinctiveness	Diversity and pattern	Ecological context	Overall
Native fernland	**Low.** Represents a pioneer native vegetation type.	**Moderate.** Small, isolated natural pioneer community	**Low.** Typical low diversity for pioneer community. Poorly connected to indigenous habitats.	**Low.** Only native vegetation community within the Project Area surrounded by intensively managed as pasture.	**Low**
Exotic pasture and cropping	**Very low.** Does not represent any native vegetation type.	**Very low.** Intensively managed pasture. No natural ecosystem remnants.	**Very low.** Intensively managed pasture with low diversity. Poorly connected to indigenous habitats.	**Very low.** Exotic vegetation community, intensively managed as pasture/maize	**Negligible**
Exotic Trees (shelterbelts, hedgerows and paddock trees)	**Very Low.** Does not represent any native vegetation type.	**Very Low.** Vegetation is exotic.	**Very Low.** Planted vegetation of low level of diversity.	**Low.** Scattered exotic trees, isolated and not contributing to any botanical significance or ecosystem services such as shading some small drains.	**Negligible**
Exotic scrub/ vegetation	**Low.** Although some native species are scattered throughout (e.g., ferns), they do not represent any former vegetation type.	**Low.** Some native species present, although are common. The exotic vegetation community is not rare or distinctive in structure or composition.	**Low.** Includes weeds/pest plants, with low native biodiversity. Does not demonstrate ecological gradients.	**Low.** Vegetation provides minimal ecosystem services such as watercourse shading, bank stability and adds native species to a predominantly exotic landscape.	**Low**

Table 6: Ecological values of terrestrial fauna and fauna habitat using the EcIAG framework (Roper-Lindsay et al. 2018).

Fauna	Representativeness	Rarity/distinctiveness	Diversity and pattern	Ecological context	Overall
Birds/ bird habitat	**Low.** Avifaunal assemblage not representative of indigenous ecosystems.	**Low.** No 'At Risk' or 'Threatened' or locally important bird species were observed within the Project Area, or would be expected to utilise habitat on site.	**Low.** Avifaunal assemblage included common species and lacked diversity present in native ecosystems. No habitats are large enough to sustain more than a very small number of birds for part of the year.	**Low.** The habitat provides for foraging, some roosting, and potential breeding for common native and exotic species. With the majority of the low-lying areas cleared for agriculture, these modified habitats are not unique within the wider landscape.	**Low**
Lizards/ lizard habitat	**Low.** The habitat value for lizards within the Project Area (excluding grazed pasture, which is not considered habitat), while lacking diversity and complexity, is representative of habitat for copper skinks within the Waikato lowlands.	**High.** Copper skink are considered 'At Risk – Declining'. If this species is present within the Project Area, it is likely to be in low numbers due to historic vegetation clearance, habitat modification and current farming practices.	**Low.** Low species diversity and limited suitable habitat (i.e., rank pasture with organic/inorganic debris, shelterbelts/hedgerows, exotic scrub, and fernland). These habitats are small and sparsely distributed. Given the Project Area's isolation from suitable habitats nearby, and abundance of predators, it is unlikely that skinks are present in large numbers.	**Moderate.** Copper skink are potentially sparsely distributed at low density across much of the Waikato lowlands. Given the likely low population levels, any individuals that can contribute to sustaining the population are important.	**Moderate**
Bats/ bat habitat	**Low.** Farm landscape characteristic of intensive agriculture was not representative of (high quality) bat habitat.	**Very high.** Long-tailed bat are considered 'Threatened – Nationally Critical' which is the highest possible threat ranking. There are records of long-tailed bat within 10km of the Project Area.	**Low.** No long-tailed bats recorded across the Project Area.	**Low.** Although the vegetation and habitat within the Project Area could provide linkages/stepping stones between bat populations and also provide foraging opportunities, no bats were detected across the Project Area.	**Moderate**

5.0 Wetland Ecology Values

The Project Area was characterised as a flat, low-lying area under intensive agricultural management. Pasture areas were dominated by exotic rye/ clover grassland, with small, discrete and widely scattered damp areas and areas where livestock pugging was localised during certain times of the year (as shown in Figure 16 and Figure 17). In these areas pastural wet-tolerant exotic grass species such as annual poa (*Poa annua*), sweet grass (*Glyceria declinata*), Italian rye and Yorkshire fog, as well as wet-tolerant exotic weeds such as creeping buttercup (*Ranunculus repens*), willow weed (*Persicaria hydropiper*), broad-leaved dock (*Rumex obtusifolius*), lotus (*Lotus pendunculatus*), and soft rush (*Juncus effusus*) were noted. These wetter areas had no surface connectivity with each other or to other freshwater features. Remnants of historic peat bog habitat communities (e.g., mānuka/ restiad rushland) expected within the Project Area were entirely absent.

There were no areas within the Project Area identified as wetlands in accordance with the RMA definition or natural inland wetlands as defined by the NPS-FM. That is, there were no areas deemed to be supporting a natural ecosystem of plants and animals. The Department of Conservation (2012) defined natural habitats and ecosystems as:

> "*Habitats and ecosystems with a dominant or significant indigenous natural character. They do not include modified areas, such as farm or forestry land, where the indigenous vegetation has largely been replaced, although these areas may still provide important habitats for indigenous species*".

While there is no known definition of "*indigenous natural character*" in any of the national policy documents, in the case of the Project area, the explicit exclusion of "*modified areas, such as farm or forestry land, where the indigenous vegetation has largely been replaced*" appears to provide some clarity.

This can be interpreted to mean that highly modified areas dominated by exotic species do not possess "*dominant or significant indigenous natural character*".

The lack of guidance on defining these terms within New Zealand legislation or national policy documents leads to the inference that professional judgement must be used to define what is a 'natural ecosystem' and the above definition and rational were deemed appropriate.

Figure 16: Damp exotic pasture within the Project Area.

Figure 17: Pugged exotic pasture within the Project Area.

6.0 Freshwater Ecology Features and Values

6.1 Stream Classifications

Watercourses within the Project Area include the Mangaheka Stream (c. 1,900 m within the Project Area), 220 m of the Te Otamanui Stream and a highly modified unnamed

watercourse (M13) (212 m), and an extensive network of artificial farm drains. Both the Mangaheka Stream and Te Otamanui Stream are highly modified aquatic environments that have been straightened and deepened for drainage management.

The large network of artificial farm drains within the Project Area are man-made farm drainage canals that have no natural portions to their headwaters so were classified as 'Artificial' in accordance with WRP definitions. The classification status of watercourses within the Project Area in accordance with definitions in the WRP are shown on Figure 27.

6.2 Habitat Characteristics

6.2.1 Modified streams

Instream habitat within Mangaheka Stream (Figure 18), Te Otamanui Stream (Figure 19) and Watercourse M13 (Figure 20) was characterised by deep silt deposits, artificially incised channels with steep banks, poorly vegetated riparian margins and provided uniform aquatic habitat. The mean width of Mangaheka Stream was c. 1.5 m (range: 1.20–2.4 5 m) and mean depth was c. 0.16 m (range: 0.07–0.26 m). The mean width of Te Otamanui Stream was c. 1.6 m whilst the mean depth was 0.22 m. Culverts (single or double pipe) were common along the length of Te Otamanui Stream.

There are two culverts on the Mangaheka Stream that may impeded fish passage. The farm drain culvert located the north western Site boundary, has intermittent flow, which acts as a partial barrier to fish passage. There is also a culvert located at Horotiu Road which is perched and is barrier to non-climbing fish species (Boffa Miskell 2019).

Many of the culverts were perched during the surveys but may be submerged during wet periods when water depths are greater. There was no effective shading along most of the stream length. Occasional blackberry and exotic shrubs providing negligible shading along some reaches where present.

The streambed substrate was mainly fine hypoxic silt that provided low diversity and very poor-quality habitat for invertebrate and fish species. Macrophytes were prolific and some drains were choked with various exotic macrophyte species and types (Figure 18). The most common macrophytes were: *Persicaria hydropiper* and *P. decepiens, Potamogeton crispus* (curly pondweed), *Callitriche stagnalis* (starwort) and *Lemna disperma* (duckweed). Also present were *Egeria densa, Glyceria maxima* and *Nasturtium* sp. (watercress).

6.2.2 Artificial drains

Artificial drains within the Project Area provided poor quality habitat conditions due to straight channel alignments, lack of aquatic habitat diversity (e.g., uniform depths, widths), lack of vegetated riparian margins, low channel gradient, poor channel shade and ephemeral nature. Stagnant surface water was covered in filamentous green and brown algae and was stained orange-brown due to ferrous iron in some areas that reflected the low velocity environment, absence of shading and probable high nutrient concentrations. Despite their degraded state and ephemeral nature, some drains supported black mudfish and therefore have higher ecological value. Habitat characteristics of selected artificial drains within the Project Area are shown in Figure 21 to Figure 26.

Figure 18: View of Mangaheka Stream.

Figure 19: View of Te Otamanui Stream.

Figure 20: View of Watercourse M13.

Figure 21: View of Drain M1.

Figure 22: View of Drain M2.

Figure 23: View of Drain M4.

Figure 24: View of Drain M5.

Figure 25: View of Drain M6.

Figure 26: View of Drain M12.

Figure 27: Watercourse classifications.

6.3 Water Quality

6.3.1 Mangaheka Stream

Water quality sampling within Mangaheka Stream was undertaken to inform the Mangaheka ICMP (HCC 2019). Data collected is more than ten years old, but water samples collected from Mangaheka Stream at the boundary of the Project Area (Site 3 - The Farm Culvert), provides a snapshot of metals, nutrients and biological parameters (Table 7).

Total copper and zinc at sites within the Project Area exceeded the ANZECC (2018) guidelines. Elevated metal concentrations have the potential to effect ecological values in the stream, but the bioavailable dissolved fractions were below the guidelines. Although zinc and copper concentrations were elevated, Boffa Miskell (2018) concluded that it was no different from other disturbed catchments in the Hamilton City area. Dissolved reactive phosphorus was below the guideline but total nitrogen, TKN, nitrate-N + nitrite-N and total phosphorus were above guidelines.

Elevated nutrient concentrations in watercourses within the Project Area and in the other streams sampled was noted as being typical of waterways around Hamilton, but the Mangaheka Catchment had lowest phosphorus concentrations in the region (HCC 2019).

Table 7: Summary of water quality data from the Mangaheka Stream (modified from HCC 2019).

Parameter	Unit	Mangaheka Stream		Guideline value
		Site 2 Te kowhai Road	Site 3 Farm Culvert	
Temperature	°C	11.4	11.4	-
pH	pH units	6.4	6.4	6-9
Conductivity	µs/cm	-	-	-
Dissolved oxygen	Mg/L	-	-	-
Turbidity	NTU	30.5	63.1	-
Total suspended solids	g/m^3	18	23	-
Carbonaceous Biochemical oxygen demand	G O^2/M^3	<2	<2	-
Faecal coliforms	CFU /100 mL	700	900	100
Dissolved copper	g/m^3	-	-	0.0018
Total copper	g/m^3	0.0028	0.0026	0.0018
Dissolved lead	g/m^3	-	-	0.0056
Total lead	g/m^3	<0.0001	0.00019	0.0056
Dissolved zinc	g/m^3	-	-	0.015
Total zinc	g/m^3	0.023	0.033	0.015
Total nitrogen	g/m^3	2.5	4.6	0.04—0.10
Total Kjeldahl Nitrogen	g/m^3	1.12	1.21	0.04—0.10
Total ammoniacal N	g/m^3	-	-	1.43
Nitrite-N	g/m^3	-	-	0.04—0.10
Nitrate-N	g/m^3	-	-	0.04—0.10
Nitrate-N = Nitrite-N	g/m^3	1.39	3.4	0.04—0.10
Dissolved reactive phosphorus	g/m^3	0.012	0.007	0.015-0.03
Total phosphorus	g/m^3	0.106	0.077	0.015-0.03
PAH	g/m^3	-	-	-
TPH C7-C36	g/m^3	<1.4	<1.4	-

6.3.2 Water physicochemistry

Water physicochemistry was recorded at seven locations within the Project Area by Ecological Solutions in May 2026. Results in Table 8 show stream temperatures ranged between 10.1 and 14.9ºC and reflected the time of year. All watercourses had near-neutral or slightly acidic water (6.2– 6.7). Dissolved oxygen concentrations (1.4–5.2 g/m^3) and saturations (12–52%) were low in artificial drains and Te Otamanui Stream and may have limited aquatic fauna at the time of the survey. Dissolved oxygen was higher in Mangaheka Stream (9.8 g/m^3, 91%). Electrical conductivity was moderate-high and variable in watercourses within the Project Area (179–505 µS/cm).

Table 8: Water physicochemistry results during the May 2026 survey.

Watercourse	Time	Temp. (°C)	Dissolved oxygen		pH	Conductivity (µS/cm)
			(g/m^3)	(%)		
Mangaheka Stream	1.20 p.m.	12.0	9.8	91	6.6	179
Te Otamanui Stream	2.40 p.m.	14.9	5.2	52	6.4	230
Drain M1	3.05 p.m.	11.2	1.9	17	6.6	294
Drain M2	2.55 p.m.	11.1	3.8	35	6.7	505
Drain M6	12.25 p.m.	12.3	6.2	58	6.6	383
Drain M12	1.05 p.m.	11.8	2.3	21	6.4	416
Drain T2	11.35 a.m.	10.1	1.4	12	6.2	284

6.4 Macroinvertebrates

Macroinvertebrate communities recorded from the section of Mangaheka Stream and artificial watercourses (drains) within the Project Area were dominated by taxonomic groups that tolerate modified or degraded habitats, slow water velocities and poor water quality. The most abundant taxa recorded were Diptera (e.g., Chironomidae, *Chironomus*, Culicidae), Hemiptera (e.g., *Sigara*), Platyhelminthes (flatworms), Oligochaeta (worms) and Molluscs (*Potamopyrgus*). No water quality and habitat sensitive EPT (mayflies, stoneflies, caddisflies) were recorded from any watercourse within the Project Area during sampling.

6.5 Stream Ecological Valuation

Results from Stream Ecological Valuation (SEV) surveys carried out at three sites on Mangaheka Stream, Te Otamanui Stream and Watercourse M13 in May 2026 are presented in Table 9. SEV scores ranged between 0.246 and 0.345 out of a maximum possible score of 1 (Table 9). Detailed SEV results are presented in Appendix B.

SEV scores for all watercourses assessed were low and indicate they had poor ecological function and value. Low scores were given to the ‘natural flow regime’, ‘floodplain effectiveness’ and ‘fish spawning habitat’ due to the channelised and incised nature of the channels and lack of effective floodplain.

Low SEV scores were given to the 'water temperature control', 'organic matter input', 'instream particle retention' and 'riparian vegetation intact' functions due to the general lack of vegetated riparian margins.

Low SEV scores were given to 'habitat for aquatic fauna' function due to the uniform habitat conditions and unshaded upstream catchment.

Table 9: Stream Ecological Valuation (SEV) data for four sites surveyed on the Te Kowai East Property.

Function	Mangaheka Stream	Te Otamanui Stream	M13
Natural flow regime	0.098	0.098	0.098
Floodplain effectiveness	0.051	0.036	0.104
Connectivity for natural species migrations	0.300	0.300	1.000
Natural connectivity to groundwater	0.587	0.587	0.587
Mean	***0.259***	***0.255***	***0.447***
Water temperature control	0.040	0.020	0.440
Dissolved oxygen levels maintained	0.400	0.400	0.400
Organic matter input	0.195	0.100	0.098
Instream particle retention	0.130	0.200	0.130
Decontamination of pollutants	0.306	0.285	0.295
Mean	***0.214***	***0.201***	***0.272***
Fish spawning habitat	0.500	0.500	0.500
Habitat for aquatic fauna	0.369	0.351	0.416
Mean	***0.435***	***0.425***	***0.458***
Riparian vegetation intact	0.086	0.078	0.078
Mean	***0.086***	***0.078***	***0.078***
Overall SEV score	**0.255**	**0.246**	**0.345**

6.6 Fish Fauna

6.6.1 New Zealand Freshwater Fish Database and existing data

The New Zealand Freshwater Fish database (NZFFD) holds 14 records within the Mangaheka Stream catchment between 1984 and 2026 (Figure 28). Species recorded from the catchment include shortfin eel (*Anguilla australis*), longfin eel (*Anguilla dieffenbachii*), banded kōkopu (*Galaxias fasciatus*), and black mudfish (*Neochanna diversus*). Black mudfish and longfin eels are considered to have an 'At Risk – Declining' conservation status whilst banded kōkopu have an 'At Risk – Naturally Uncommon' status (Dunn et al. 2025).

The Mangaheka Catchment ICMP (Boffa Miskell 2018) stated the following:

> *"The drains (in the catchment) provide habitat for shortfin eels, and threatened longfin eels and black mudfish. The stream provides habitat for shortfin eels and banded kokopu, and threatened giant kokopu and longfin eels. The presence of threatened species confers ecological significance on the catchment".*

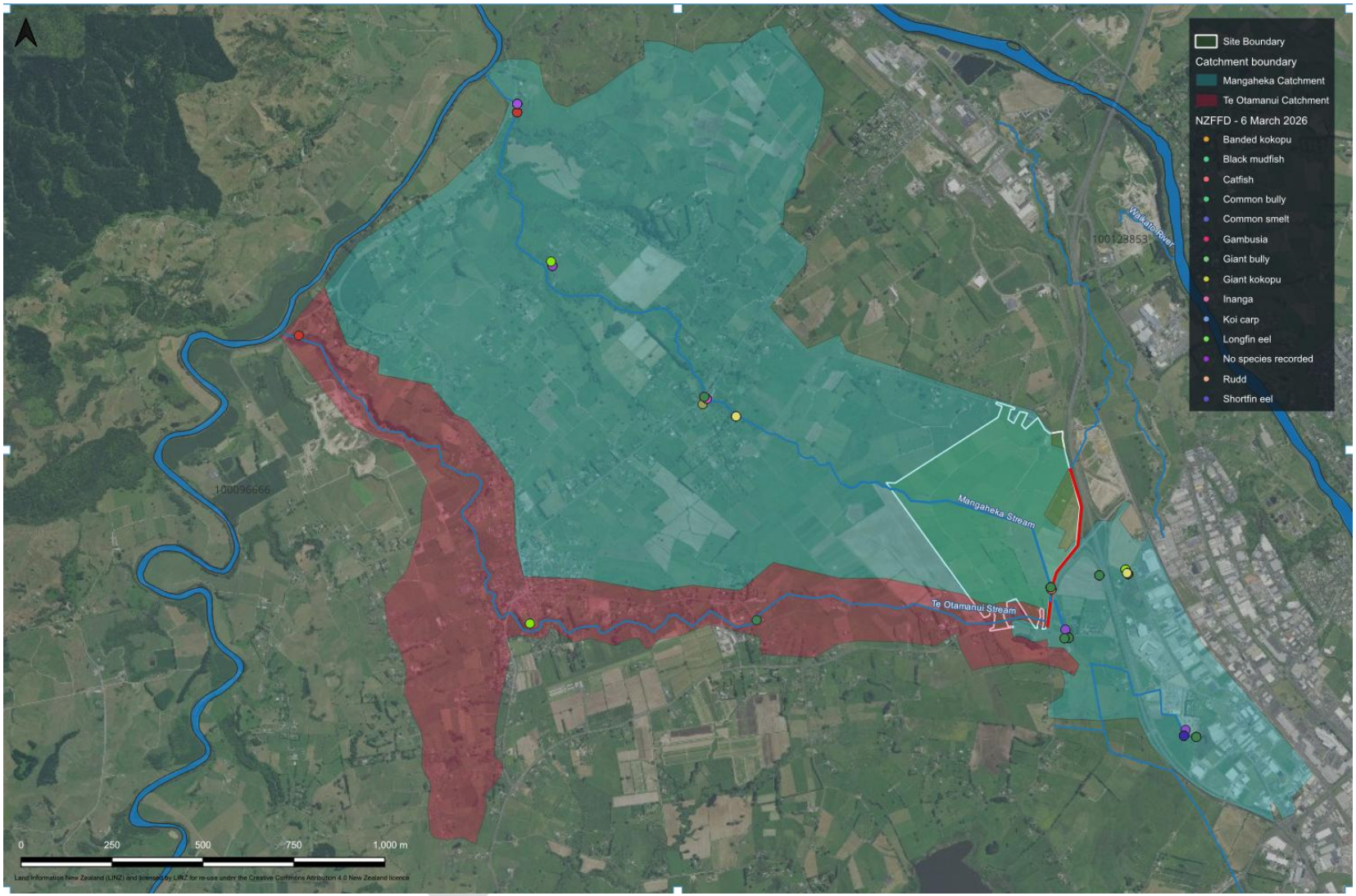

Figure 28: NZFFD records (Accessed March 2026).

6.6.2 Gee's minnow trap surveys

Gee's minnow surveys on artificial drains have been carried out within the Project Area on four occasions (Table 10). The extent and results of trapping is shown on Figure 29

The Gee's minnow surveys involved trapping 6,271 m of drain. A total of 111 black mudfish have been captured from drains within the Project Area with fish ranging in length between 23–135 mm (Table 10). The total length of drain where black mudfish were captured within the Project Area was 1,770 m. Black mudfish were not captured in 4,500 m of surveyed drain within the Project Area. Results indicate drains in the eastern central portion of the Project Area (i.e., drains T3, T2, T5, T7, T4) supported highest numbers of black mudfish (i.e., 6–51 individuals). Other drains within the Project Area supported low numbers of black mudfish (i.e., none or 1–5 captured) in the Gee's minnow traps set.

A Gee's minnow trap survey was carried out in November 2025 in a drain within the NZTA road reserve to the east and outside of the Project Area. A total of 117 black mudfish ranging in length between 29–139 mm were captured in Gee's minnow traps set in the NZTA drain. The NZTA drain to the east of the Project Area was connected to the drain network within the Project Area.

Table 10: Summary of black mudfish surveys within the Project Area.

Survey	Method	Result	Location
March 2021	eDNA	Negative	Drain M4 and
November 2021	eDNA	Positive detection	Drain M4 and Drain M6
November 2023	Gee's minnow	11 black mudfish	Drains M4, M7, M5 and M1
September 2025	Gee's minnow	No fish captured	M1, M4, M11
October 2025	Gee's minnow	2 black mudfish	Drains M11 and M12
November 2025*	Gee's minnow	98 black mudfish	Drains T2–T7 (98 black mudfish)*

Note: *An additional 117 black mudfish were captured in the NZTA drain outside of the Project Area.

6.6.3 Environmental DNA

Environmental DNA results indicate the presence of black mudfish (*Neochanna diversus*) in two drains (M4 and M6) and also the presence of longfin eel (*Anguilla dieffenbachii*) in Te Otamanui Stream. Four introduced and naturalised species considered pest species in the Waikato Region were also detected in eDNA samples (Table 11). Giant kōkopu (*Galaxias argenteus*) were detected in the Mangaheka Stream and drains M3, M4, M5 and M6. Shortfin eel (*Anguilla australis*) was detected in all samples expect drain M4. Environmental DNA results are presented in Appendix B.

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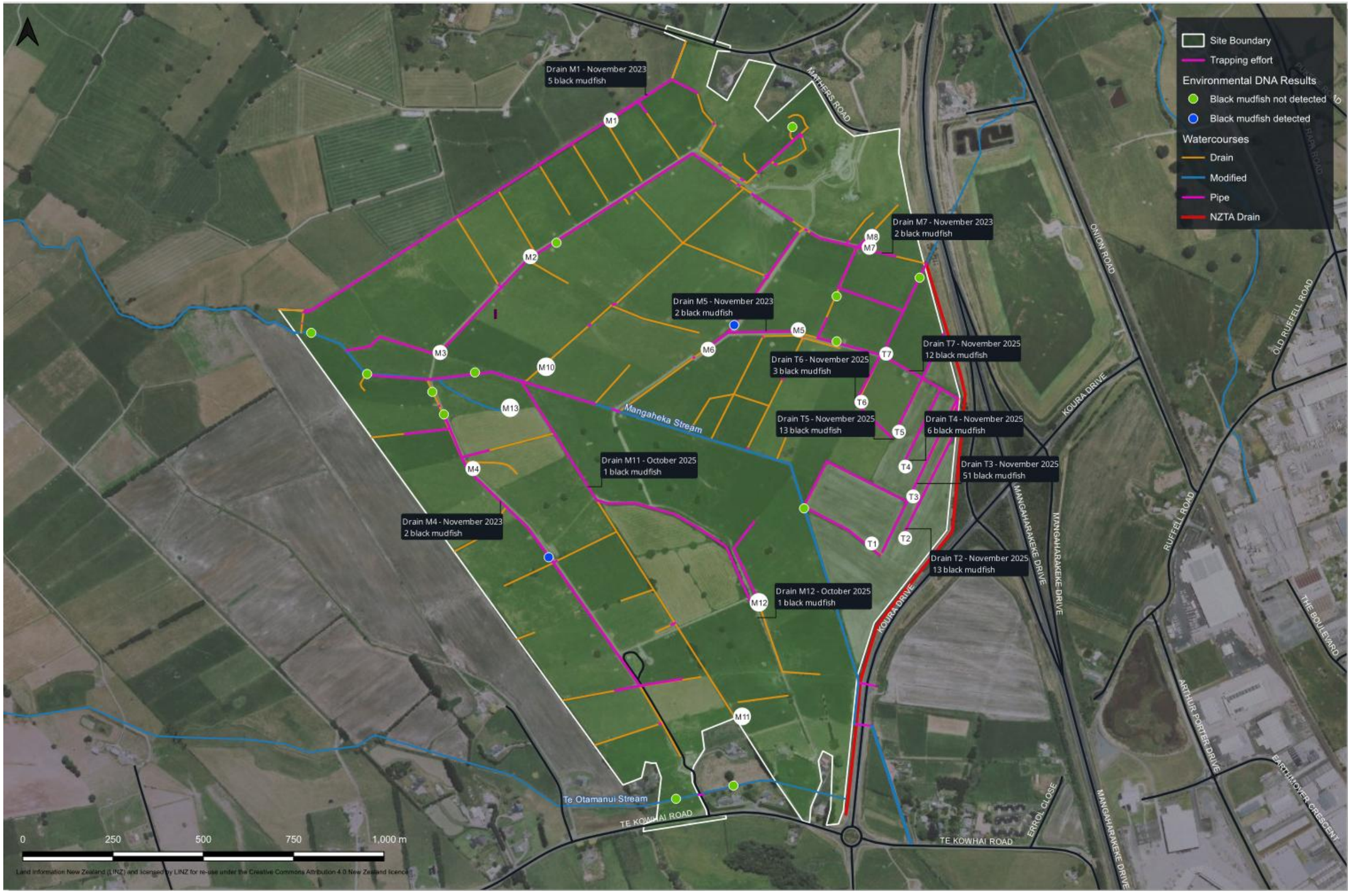

Figure 29: Gee's minnow trapping effort eDNA survey location and results.

Table 11: Fish detected from eDNA sampling in March and November 2021.

Common name	Scientific name	Threat status	Pest	Watercourse						
				Mangaheka	Te Otamanui	M2	M3	M4	M5	M6
Shortfin eel	*Anguilla australis*	Not Threatened	-	✓	✓	✓	✓	-	✓	✓
Longfin eel	*Anguilla dieffenbachii*	At Risk – Declining	-	-	✓	-	-	-	-	-
Giant kōkopu	*Galaxias argenteus*	At Risk – Declining	-	✓	-	-	✓	✓	✓	✓
Black mudfish	*Neochanna diversus*	At Risk – Declining	-	-	-	-	-	✓	-	✓
Catfish	*Ameiurus nebulosus*	Introduced and naturalised	Yes	✓	✓	-	-	-	-	-
Koi carp	*Cyprinus rubrofuscus*	Introduced and naturalised	Yes	✓	✓	-	-	-	-	-
Goldfish	*Carassius auratus*	Introduced and naturalised	Yes	✓	✓	-	✓	-	-	-
Gambusia	*Gambusia affinis*	Introduced and naturalised	Yes	✓	✓	-	✓	✓	✓	✓

Note: Listed as pests in the Waikato Regional Pest Management Plan 2014–2024 (Waikato Regional Council 2014)

6.6.4 Black mudfish

Mangaheka Stream Catchment has been subject to less extensive mudfish survey effort when compared to the nearby Rotokauri catchment. Surveys have been conducted over the years to inform the ICMP (Boffa Miskell 2016) and through surveys conducted by DOC and Waikato Regional Council. Surveys undertaken by Ecological Solutions in the neighbouring Te Rapa Stream catchment confirmed the presence of a black mudfish population on the eastern side of the highway.

The following presents an assessment of the predicted length of drain within the Project Area that provides habitat for black mudfish. The assessment was based on the approach outlined in the Mudfish Management Plan prepared for Hamilton City Council for the Rotokauri Greenway Project (Beca and Tonkin & Taylor 2022).

The length of artificial drain providing potential black mudfish habitat within the Project Area was of drain where black mudfish were captured relative to the total length of drain fished. All drains within the Project Area considered to provide suitable black mudfish habitat were fished. Habitat suitability was determined based on known habitat preferences (e.g., presence of surface water, good cover, organic material, suitable bed substrate).

There was 16,192 m of artificial drain within the Project Area, of which 9,398 m provided suitable habitat for black mudfish, and was trapped. The length of drain within the Project Area that did not provide suitable habitat for black mudfish (e.g., no water, no cover, no organic material, firm bed) was therefore 6,794 m. Black mudfish were captured from 3,582.5 m of the 9,398 m of drain trapped (i.e., 'hit rate' = 38.12%). Because all drains considered to provide suitable habitat for black mudfish were trapped, the length of drain providing potential habitat for black mudfish was 3,582.5 m based on the 'hit rate' of 38.12%.

The following outlines the assumptions and specific steps applied to determine this length:

1. There is 16,192 m of drain within the Project Area and excludes overland flow paths, modified watercourses and piped sections.
2. A total of 9,398 m of drain was considered to be potential habitat for black mudfish based on habitat characteristics and known black mudfish habitat preferences (e.g., presence of surface water, good cover, organic material, suitable bed substrate).
3. All of the 9,398 m of potential black mudfish habitat was trapped.
4. The length of drain within the Project Area that did not provide potential black mudfish habitat was 6,794 m (i.e., 16,192 m - 9,398 m).
5. Where black mudfish were captured within a 100 m survey reach (even if only one trap over 100 m had one black mudfish), the entire reach was considered to be black mudfish habitat. This approach added a level of conservatism.
6. Black mudfish were recorded from 3,582.5 m of drain within the Project Area. The entire length of drain (i.e., drain node to drain node) counted towards the total if one or more black mudfish were recorded in traps within a reach.
7. A total of 38.1% of drains trapped had black mudfish (3,582.5 m / 9,398 m) x 100 = 38.12%). Given the large trapping effort within the Project Area, 38.12% is considered a reliable but conservative estimate of the total length of drain that may support black mudfish.
8. Drains within the Project Area had an average channel width of 1 m.
9. Applying the 'hit rate' of 38.12% and average channel width of 1 m, the estimated area of black mudfish habitat within the Project Area was 3,582.5 m^2 (i.e., 9,398 m x 0.3812 x 1 m).

6.7 Summary of Freshwater Ecological Values

6.7.1 Mangaheka Stream

The section of Mangaheka Stream within the Project Area (i.e., 1,900 m length) was a highly modified stream in the upper catchment that has been historically straightened, realigned and excavated for irrigation and drainage purposes. The section of Mangaheka Stream within the Project Area provided uniform poor quality habitat due to its highly modified state, had a low SEV score indicating low ecological value and function (refer Section 6.4), so scores low for the representativeness and diversity/pattern matters.

The Project Area is in the upper Mangaheka Stream catchment so does not represent an important migratory pathway for diadromous native fish. There was very limited suitable spawning habitat for native fish that migrate into headwater catchments (e.g., banded kōkopu). The section of Mangaheka Stream within the Project Area therefore scored low for the ecological context matter. The Mangaheka Stream does however support native fish species of conservation interest (e.g., longfin eel, banded kōkopu, giant kōkopu) so scored high for rarity/ distinctiveness. The overall ecological value of Mangaheka Stream within the Project Area was assessed as 'moderate' based on the matters assessed (Table 12).

Table 12: Ecological values of the Mangaheka Stream within the Project Area.

Criteria for assessment	Description for the Project Area	Rating
Representativeness	Mangaheka Stream within the Project Area is straightened and channelised and has limited habitat heterogeneity.	Low
Rarity/ distinctiveness	Mangaheka Stream within the Project Area provides habitat and supports at least one 'At Risk – Declining' native fish species (e.g., giant kōkopu) and may also support longfin eel (At Risk – Declining).	High
Diversity and pattern	Mangaheka Stream within the Project Area is a straight, aligned drain with limited natural features and limited habitat complexity for native fish and invertebrates. The drain is mostly unvegetated.	Low
Ecological context	Mangaheka Stream within the Project Area does not represent an important migratory pathway due to its location in the upper catchment and the lack of suitable spawning habitat for species that migrate into headwater portions of catchments.	Low
Overall value		**Moderate**

6.7.2 Te Otamanui Stream

The Te Otamanui Stream sub-catchment occurs along the southwestern border of the Mangaheka Stream catchment, discharges to Waipa River and has an approximate area of 500 ha that comprises mainly rural land (HCC 2019). The headwater section of Te Otamanui Stream drains through the southern portion of the Project Area and has been heavily modified via straightening and deepening and lacks vegetated riparian margins resulting in no effective shading.

The short and highly modified section of Te Otamanui Stream that flows through the Project Area is not representative of a naturally meandering stream and provides uniform aquatic habitat so scores low for the representativeness and diversity and pattern matters. The headwater section of Te Otamanui Stream within the Project Area does not provide an important migratory pathway for native diadromous dish as there is limited upstream habitat so scores low for ecological context.

Environmental DNA sampling indicates the presence of longfin eel (At Risk – Declining) and four species of pest fish within the Project Area. Longfin eel is relatively abundant in the Waikato Region, but due to its 'At Risk – Declining' status, the section of stream within the Project Area scores high for the rarity/ distinctiveness matter. The overall ecological value of Te Otamanui Stream within the Project Area was assessed as 'moderate' based on the matters assessed (Table 13).

Table 13: Ecological values of the Te Otamanui Stream within the Project Area.

Criteria for assessment	Description for the Project Area	Rating
Representativeness	The Te Otamanui stream has been straightened and channelised and has limited habitat heterogeneity.	Low
Rarity/ distinctiveness	The Te Otamanui stream provides habitat and supports at least one 'At Risk – Declining' native fish species (longfin eel).	High
Diversity and pattern	The Te Otamanui Stream is a straight, aligned drain with limited natural features and limited habitat complexity for native fish and invertebrates. The stream is mostly unvegetated within the Project Area.	Low
Ecological context	The Te Otamanui provides connectivity between the Waipa River and Te Kowhai Road, and represents what remains of a large peat wetland between these two areas.	Low
Overall value		**Moderate**

6.7.3 Watercourse M13

Watercourse M13 is a highly modified intermittent stream, which exists within a paleo-channel. The short tributary of the Mangaheka Stream is highly modified, through straightening and deepening.

The stream has no effective shading with only pasture grasses and weeds dominating the banks on either side of the channel. There is a culvert at the confluence to the Mangaheka Stream which is perched and likely a complete barrier to fish passage.

On each of the Site visits, the watercourse has either been dry or too shallow to effectively survey. There are no database records of fish for Watercourse M13, and currently serves negligible ecological function or value within the Mangaheka Stream catchment. The overall ecological value of Watercourse M13 was assessed as 'low' based on the matters assessed (Table 14).

Table 14: Ecological values of Watercourse M13 within the Project Area.

Criteria for assessment	Description for the Project Area	Rating
Representativeness	Watercourse M13 has been straightened and channelised and has limited habitat heterogeneity.	Low
Rarity/ distinctiveness	No fish have been recorded with M13.	Low
Diversity and pattern	Watercourse M13 is a straight highly modified watercourse with limited natural features and limited habitat complexity for native fish and invertebrates.	Low
Ecological context	Watercourse M13 has limited ecological function within the catchment which is demonstrated through the low SEV score for the watercourse. The riparian zone is limited to pasture grasses and weed species and lies within an active farming area.	Low
Overall value		**Low**

6.7.4 Artificial drains

Farm drains within the Project Area were typical of artificial watercourses across the region (HCC 2019). The drains were devoid of riparian vegetation so were poorly shaded, subject to elevated temperatures, lacked filtration of fine sediment/nutrients and had higher risk of

bank erosion. Artificial drains are man-made features and are common throughout lowland Waikato rural areas.

Artificial drains within the Project Area provided very poor-quality habitat and score low for representativeness, rarity/ distinctiveness and diversity and pattern. Although artificial drains have no status under Waikato Regional Plan (WRP 2024), drains that support black mudfish have ecological value as they provide important habitat. Therefore, drains that support black mudfish score high for rarity/ distinctiveness (as opposed to low). Artificial drains within the Project Area do not represent important migratory pathways for native diadromous fish so score low for ecological context. Artificial drains within the Project Area that support black mudfish were assessed as having 'moderate' ecological value (Table 15). Drains that do not or are unlikely to support black mudfish were considered to have 'negligible' ecological values (Table 15).

Table 15: Ecological values of artificial drains within the Project Area.

Criteria for assessment	Description for the Project Area	Rating
Representativeness	Artificial drains are man-made habitats that comprise straight channels and have limited habitat heterogeneity and no riparian shading.	Very low
Rarity/ distinctiveness	Some artificial drains contain habitat for 'At Risk – Declining' species (Black mudfish). Not all drains contain suitable habitat for this species.	Low – drains without black mudfish High – drains known to have black mudfish
Diversity and pattern	Artificial drains have very low diversity and complexity of habitat, and support limited native species.	Very low
Ecological context	Artificial drains	Low
Overall value		**Negligible – drains without black mudfish** **Moderate – drains with black mudfish**

7.0 Assessment of Significance (WRPS)

The Waikato Regional Policy Statement (WRPS) sets out the criteria in APP5 for assessing significance of indigenous vegetation and habitats of indigenous fauna in the Waikato Region (WRPS 2026). Table 16 below summarises the assessment of indigenous vegetation and habitats of indigenous fauna recorded across the Project Area against these criteria, and updated guidelines by Wildland Consultants Ltd (2023). If any one criterion is met, the site is deemed significant under the WRPS (WRC 2016).

In summary the site is deemed significant under the WRPS criteria with respect to indigenous fauna due to the presence of black mudfish ('At Risk – Declining'). We consider that the Project Area does constitute important aquatic habitat for black mudfish.

It is anticipated that copper skink ('At Risk – Declining') are present within the Project Area in low or undetectable numbers. However, copper skink are commonly found in these habitats and are widespread across the wider landscape of the Waikato lowlands, and district. We do not consider the Project Area constitutes important habitat for copper skink.

Table 16: Assessing significance of indigenous biodiversity in the Waikato Regional Policy Statement (WRPS).

Criteria	Matters	Description	Response / Assessment
APP5 – Criteria for determining significance of indigenous biodiversity	Previously assessed site	1. It is indigenous vegetation or habitat for indigenous fauna that is currently, or is recommended to be, set aside by statute or covenant or by the Nature Heritage Fund, or Ngā Whenua Rāhui committees, or the Queen Elizabeth the Second National Trust Board of Directors, specifically for the protection of biodiversity, and meets at least one of criteria 3-11.	No.
	Ecological values	2. In the Coastal Marine Area, it is indigenous vegetation or habitat for indigenous fauna that has reduced in extent or degraded due to historic or present anthropogenic activity to a level where the ecological sustainability of the ecosystem is threatened.	No.
		3. It is vegetation or habitat that is currently habitat for indigenous species or associations of indigenous species that are: • classed as threatened or at risk, or • endemic to the Waikato region, or • at the limit of their natural range.	Yes.
		4. It is indigenous vegetation, habitat or ecosystem type that is under-represented (20% or less of its known or likely original extent remaining) in an Ecological District, or Ecological Region, or nationally.	No.
		5. It is indigenous vegetation or habitat that is, and prior to human settlement was, nationally uncommon such as geothermal, chenier plain, or karst ecosystems, hydrothermal vents or cold seeps.	No.
		6. It is wetland habitat for indigenous plant communities and/or indigenous fauna communities (excluding exotic rush/pasture communities) that has not been created and subsequently maintained for or in connection with: • waste treatment; • wastewater renovation; • hydroelectric power lakes (excluding Lake Taupō); • water storage for irrigation; or • water supply storage; unless in those instances they meet the criteria in Whaley et al. (1995).	No.
		7. It is an area of indigenous vegetation or naturally occurring habitat that is large relative to other examples in the Waikato region of similar habitat types, and which contains all or almost all indigenous species typical of that habitat type. Note this criterion is not intended to select the largest example only in the Waikato region of any habitat type.	No.
		8. It is aquatic habitat (excluding artificial water bodies, except for those created for the maintenance and enhancement of biodiversity or as mitigation as part of a consented activity) that is within a stream, river, lake, groundwater system, wetland, intertidal mudflat or estuary, or any other part of the coastal marine area and their margins, that is critical to the self-sustainability of an indigenous species within a catchment of the Waikato region, or within the coastal marine area. In this context "critical" means essential for a specific component of the life cycle and includes breeding and spawning grounds, juvenile nursery areas, important feeding areas and migratory and dispersal pathways of an indigenous species. This includes areas that maintain connectivity between habitats.	Yes.
		9. It is an area of indigenous vegetation or habitat that is a healthy and representative example of its type because: • its structure, composition, and ecological processes are largely intact; and • if protected from the adverse effects of plant and animal pests and of adjacent land and water use (e.g., stock, discharges, erosion, sediment disturbance), can maintain its ecological sustainability over time.	No.
		10. It is an area of indigenous vegetation or habitat that forms part of an ecological sequence, that is either not common in the Waikato region or an ecological district, or is an exceptional, representative example of its type.	No.
	Role in protecting ecologically significant area	11. It is an area of indigenous vegetation or habitat for indigenous species (which habitat is either naturally occurring or has been established as a mitigation measure) that forms, either on its own or in combination with other similar areas, an ecological buffer, linkage or corridor and which is necessary to protect any site identified as significant under criteria 1-10 from external adverse effects.	No.

8.0 Assessment of Effects

8.1 Introduction

This section assesses the actual and potential, positive and adverse ecological effects associated with developing the Project as described in Section 1.0 and shown on the Concept Plan (Figure 2). The extent of earthworks and staging is shown on Figure 30. Earthworks is outlined in the Earthworks Management Plan (EWMP) (Maven Associates 2026a) and drawings C200 to C245 (prepared by Maven Associates). Stormwater management is summarised in the Civil Infrastructure Report (Maven Associates 2026b), Stormwater Management Plan (SMP) (Maven Associates 2026c) and drawings C400-0 to C490-3 (prepared by Maven Associates). Proposed stream works methodology is outlined in the Stream Works Management Plan (STMP) (Maven Associates 2026d).

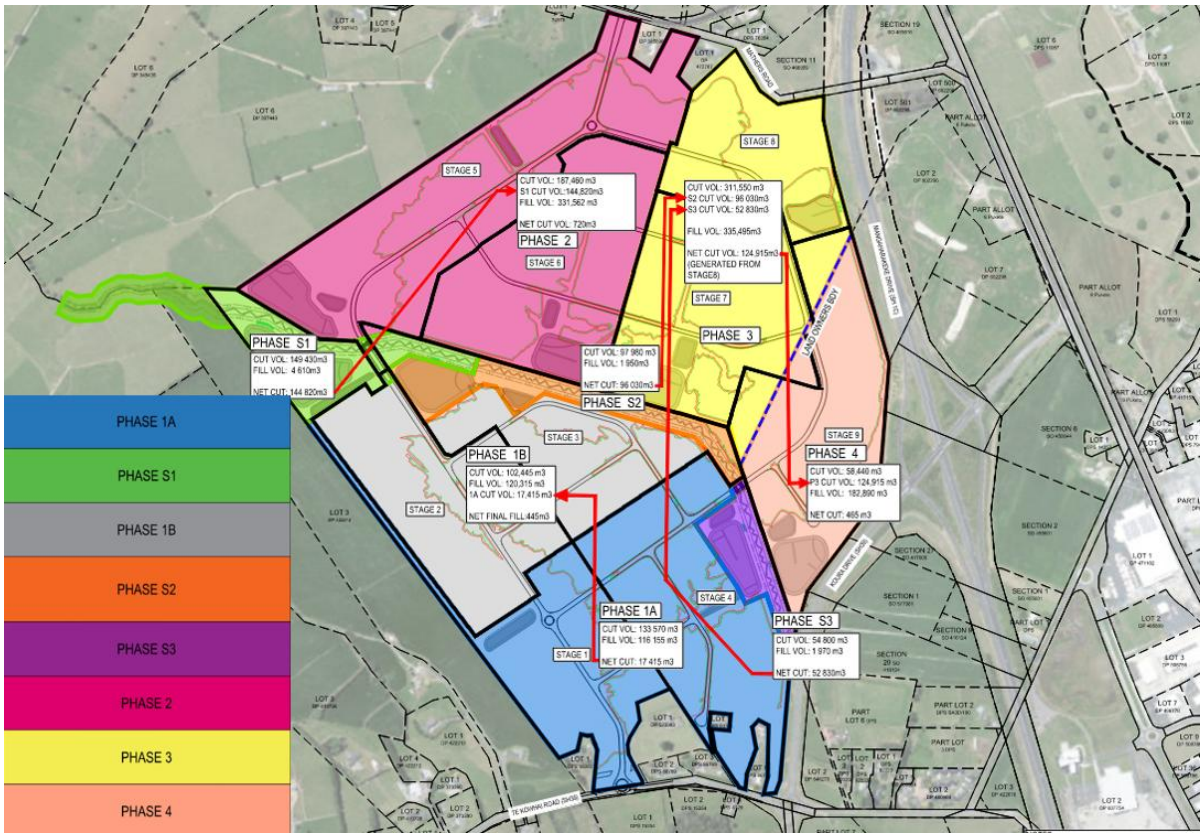

Figure 30: Earthworks Staging Plan (Maven Associates drawing C221).

The positive and adverse effects attributable to the proposed development on terrestrial, and freshwater ecological values within the Project Area are summarised below and outlined in Table 17 and Table 18.

Terrestrial Effects

Positive

- The proposed restoration package for the Project Area has been designed to enhance ecological values and deliver net-gain biodiversity outcomes:
- Native riparian planting and enhancement (c. 84,430 m^2 (Maven Associates 2026)), pest animal and weed control.

- Overall improved ecological habitats and connectivity for native wildlife and flora.

Adverse

- Removal of 'low-quality' habitat for native birds, lizards and potentially bats.
- Potential mortality or injury to native wildlife.
- Short to medium-term (5–15 years) lag period for vegetation/habitat establishment.

Freshwater Effects

Positive

- Removal of intensive livestock management and associated effluents discharging to watercourses.
- Restoration of riparian vegetation function in terms of filtration, bank stabilisation and shading.
- Improved fish passage in Mangaheka Stream by upgrading existing perched culvert.
- Creation of wetland habitat for black mudfish and increased structural habitat and biodiversity.
- Creation of 409 m / 613.5 m² of new, enhanced stream extent.

Adverse

- Potential sedimentation and erosion during earthworks
- Reclamation of 16,192 m of artificial watercourse (farm drains).
- Stormwater discharges.
- Potential mortality or injury to native fish during construction.
- Loss of 212 m of highly modified watercourse (Watercourse M13).
- Construction of culverts on Mangaheka Stream and Te Otamanui Stream.

8.2 Effects on Terrestrial Ecology

8.2.1 Introduction

The nature and level of actual or potential adverse ecological effects attributable to the proposal are addressed below with recommendations for the management of adverse effects in accordance with the effects management hierarchy (summarised in Table 17).

8.2.2 Vegetation removal

It is anticipated that the entirety of the 'negligible' to 'low' ecological value exotic vegetation and 'low' ecological value native fern land across the Project Area will be removed. The pre-effects management magnitude of effect on vegetation is expected to be 'high', resulting in a pre-effects management level of effect of 'very low' to 'low' as set out in Table 17. Effects management measures include native revegetation and restoration of the Mangaheka Stream, constructed wetlands and riparian and wetland vegetation associated with the black mudfish habitat creation. This restoration of indigenous vegetation cover will increase biodiversity and contribute to the target of at least 10% indigenous vegetation cover for urban/non-urban environments that have <10% cover of indigenous vegetation in accordance with the NPS-IB condition 3.22(3). As a result, the post-effects management level of effect will be a 'net gain' (Table 17).

8.2.3 Birds and bird habitat

Almost all native birds are protected under the Wildlife Act 1953, except those listed in Schedule 5 of the Act. The proposed development activities will result in the removal of low-quality potential bird nesting habitat including native fernland, and exotic paddock trees, shelterbelts/hedgerows, pasture, and scrub/vegetation. The pre-effects management magnitude of effect on avifauna is expected to be 'moderate', resulting in a pre-effects management level of effect of 'low' as set out in Table 17.

Effects management measures include the avoidance of vegetation clearance within the bird breeding season (September and February inclusive). If the above is not possible, vegetation that may provide breeding habitat for birds should be checked by an ecologist or other suitably trained professional for nests prior to removal. If native bird nests are present, vegetation should be left in situ (with an appropriate buffer of vegetation 20 m) until chicks have fledged and nests have been declared empty by the ecologist.

The overall level of effect during vegetation clearance on birds after implementing proposed mitigation is assessed as 'very low' with the long-term effect of vegetation removal and proposed enhancement planting assessed as a 'net gain' (Table 17).

8.2.4 Lizards and lizard habitat

All indigenous lizards are protected under the Wildlife Act 1953. There are small and widespread areas of potential lizard habitat (e.g., rank grass, fernland, organic and inorganic debris, scrub/vegetation) along watercourses, hedgerows/shelterbelts, sheds and within paddocks (Figure 12). The presence of indigenous lizards within the Project Area has not been confirmed; however, it is likely that copper skinks ('At Risk – Declining') are present in low/undetectable numbers. Consequently, vegetation clearance within the identified habitat areas has the potential to cause injury or death to native lizards, leading to a pre-effects management magnitude of effect of 'high' and a pre-effects management level of effect of 'moderate'.

A Lizard Management Plan (LMP) (Ecological Solutions 2026a) outlining capture and relocation protocols has been prepared and will be implemented within mapped lizard habitat areas to mitigate the potential effects prior to vegetation clearance and earthworks. The lizard management framework follows Department of Conservation's key principles for lizard salvage and transfer in New Zealand (DOC 2019). Implementation of the LMP will ensure the overall level of effect on lizards will be 'low', as set out in Table 17.

Given the low value of the lizard habitat on site, the pre-effects management magnitude of effect on lizard habitat is considered 'moderate' and the pre-effects management level of effect on habitat is 'low', as set out in Table 17. Proposed native revegetation and restoration planting will increase biodiversity and indigenous vegetation cover within the Project Area with the overall post-development level of effect on lizard habitat assessed as 'very low' or 'net gain' (Table 17).

A Wildlife Act approval for lizard management is being sought as part of the substantive application. Specific Wildlife Act approval requirements under Section 42(4)(h) of the FTAA and how the substantive application complies with these requirements are outlined in Volume C of the Substantive Application Report (BBO 2026).

8.2.5 Bats and bat habitat

Bats are protected under the Wildlife Act 1953. No bats were detected utilising the Project Area. The Project Area was determined to not be important bat habitat based on the absence of bat activity and the low value of the habitat features present. However, suitable roosting features may be utilised in future, and as such, clearance of trees with a diameter

at breast height (dbh) greater than 15 cm and containing at least one bat roost feature (e.g., Figure 15), has the potential to cause injury or death to native bats should they be present at the time of clearance.

Consequently, the clearance of suitably sized trees with identified bat roost features was considered to have a pre-effects management magnitude of effect of ‘moderate’ and a pre-effects management level of effect of ‘moderate’, as set out in Table 17.

Effects management measures include the implementation of the Bat Roost Tree Protocols (DOC 2024) to ensure no injury or mortality to long-tailed bats during potential roost tree removal if bats are present at the time and will result in an overall ‘low’ level of effect (Table 17). Bat Roost Tree Protocols are detailed in the Bat Management Plan (BMP) (Ecological Solutions 2026b).

Should bats be present, native revegetation and restoration planting and maintenance of the Mangaheka Stream and constructed wetlands will retain and enhance habitat for potential long-tailed bat foraging and commuting in the short- to medium-term (up to 5–15 years) so the overall level of effect on bat foraging and commuting habitat and features is assessed as ‘low’ (Table 17).

Table 17: Magnitude and level of terrestrial effects for the proposed Te Kowhai East development pre and post effects management.

Activity	Ecological feature	Effect	Ecological value	Magnitude of effect	Level of effect (pre-effects Management)	Effects Management Measures	Level of effect (post-effects management)
Vegetation removal	Native fern land, and exotic vegetation: pasture, cropping, shelterbelts, hedgerows, paddock trees, scrub/vegetation.	Loss of botanical value.	Negligible-Low	High	Low to Very Low	Low and Very Low effects should not normally be of concern. Native revegetation and restoration planting of the Mangaheka Stream, constructed wetlands and BMF habitat will increase biodiversity and indigenous vegetation cover and contribute to NPS-IB condition 3.22(3).	**Net Gain**
		Birds: Risk of disturbance, injury or death during vegetation clearance and earthworks.	Low	Moderate	Low	Avoid vegetation clearance between September and February inclusive. If the above is not possible, vegetation that may provide breeding habitat for birds should be checked by an ecologist or other suitably trained professional, for nests prior to removal. If native nests are present, trees should be left in situ (with an appropriate buffer of vegetation 20-50 m, subject to species present) until chicks have fledged and nests have been declared empty by the ecologist. Revegetation and restoration planting will provide an increase of habitat availability in the short- to medium-term (up to 5-15 years).	**Very Low – Net gain**
		Lizards: Risk of disturbance, injury or death during vegetation clearance and earthworks.	Moderate	High	Moderate	Implementation of a Lizard Management Plan (LMP) prior to vegetation removal to capture and relocate indigenous lizards. A Wildlife Act approval will be required.	**Low**
		Loss of lizard habitat.	Low	Moderate	Low	Low effects should not normally be of concern. Native revegetation and restoration planting and maintenance of the Mangaheka Stream and constructed wetlands will increase biodiversity and indigenous vegetation cover in the short-term (up to 5 years).	**Very Low – Net gain**
		Long-tailed bats: Risk of disturbance, injury or death during vegetation clearance and earthworks.	Moderate	Moderate	Moderate	Implement Bat Roost Tree Protocols (DOC 2024), detailed in a Bat Management Plan (BMP), to ensure no injury or mortality to long-tailed bats during potential roost tree removal if bats present at the time.	**Low**
		Loss of suitable foraging and commuting features for long-tailed bats.	Low	Moderate	Low	Low effects should not normally be of concern. Native revegetation and restoration planting and maintenance of the Mangaheka Stream and constructed wetlands will retain and enhance habitat for potential long-tailed bat foraging, in the short- to medium-term (up to 5-15 years), should bats be present.	**Low – Net gain**

8.3 Effects on Freshwater Ecology

8.3.1 Earthworks effects on water and habitat quality

Proposed earthworks have the potential to result in fine sediment discharging to the Mangaheka Stream and Te Otamanui Stream. The addition of fine sediment to receiving watercourses has the potential to increase turbidity and decrease light penetration that can then affect primary production and feeding for some fish species. The deposition of sediment can also smother instream surfaces, decrease interstitial spaces and decrease the amount of suitable habitat available for benthic invertebrates.

The receiving environment for treated stormwater is highly modified streams with poor water quality due to catchment land use pressures. As a result, the ecological sensitivity to the discharge of well-treated stormwater is low. Without sediment and erosion control, earthworks have potential to result in a 'moderate' magnitude of effect and 'moderate' overall level of effect on water and habitat quality.

All works will be carried out in accordance with the Earthworks Management Plan (EWMP) prepared by Maven Associates (2026a). The EWMP documents the management of stockpiling and provides an Erosion and Sediment Control Plan (ESCP).

Stockpile management will involve the following practices:

- Stockpiles will not be placed on steep or unstable slopes, within 10 m of the Mangaheka Stream, adjacent to stormwater basin excavations.
- There must be a silt fence perimeter around all stockpiles.
- Stockpiles have a maximum height of 3 m.

Erosion and sediment control measures will be designed and implemented in accordance with Waikato Regional Council best practice erosion and sediment control measures (WRC TR2009/02).

Control measures will be installed in a staged approach following the earthworks staging approach set out in Figure 30. Once earthworks levels are achieved, the ground will be stabilised with top soil and seeded. Details of the mitigations are provided in Maven Associates (2026a), which also outlines a comprehensive monitoring and reporting plan including protocols to ensure silt fences, diversions and bunds are maintained, particularly during rainfall events.

With the implementation of appropriate silt controls and treatment of stormwater during earthworks, the potential effects of earthworks on water and habitat quality during construction will be minimised, reducing the magnitude of effect to 'low' and resulting in an overall level of effect of 'low' (Table 18).

8.3.2 Earthworks effects on groundwater

The Project has the potential to effect groundwater during construction earthworks for the stormwater wetlands and wastewater infrastructure (WGA 2026). The drawdown of groundwater has the potential to reduce baseflows, affect the flow regime (i.e. perennial streams may convert to intermittent) and there may be indirect effects on water quality, which may affect the success to the Mangaheka Stream restoration, black mudfish habitat creation and potentially affect the hydrology and black mudfish habitat in the NZTA drain which is located to the east of the site boundary.

WGA (2026) assessed groundwater effects within the Project Area based on piezometer data, bore holes and modelling. The results from this assessment related to ecology are summarised below.

Mangaheka Stream

Shallow groundwater of depths between 0.5 m and 2 m below ground level (bgl) occurs across the project area. Groundwater predominantly flows to the northwest toward the Mangaheka Stream, which varies seasonally and is primarily recharged by local rainfall (WGA 2026).

The development of stormwater infrastructure will involve deepening the Mangaheka Stream as well as the creation of conveyance channels and treatment wetlands. The deepened Mangaheka Stream channel will be restored through riparian planting and instream habitat creation and enhancement.

WGA (2026) indicate that the development of the stormwater treatment infrastructure may intercept groundwater, that would otherwise flow into the Mangaheka and Te Rapa Streams. If groundwater is intercepted during construction activities, WGA (2026) recommend that this water is pumped back upstream to the receiving drainage network to mitigate any effects associated with a potential reduction in stream water levels.

WGA (2026) concluded:

"Groundwater drawdown effects are not expected to impact the availability of water at nearby groundwater abstraction bores. The long-term groundwater diversion to the stormwater wetlands, deepened stream, and swales represents a redistribution of groundwater discharge within the site catchment rather than a net loss."

Implementing the measures recommended by WGA (2026) (i.e., pumping) intercepted groundwater upstream during construction, it is expected that there will be no long-term effects on groundwater or loss of surface water, with the overall level of effect assessed as 'low' (Table 18).

Created Mudfish Habitat

Black mudfish wetland habitat will be created at the southern end of the site near Koura Drive. The design and hydrogeological components of the proposed black mudfish wetland habitat was undertaken by WGA (2026) with ecological input from Ecological Solutions. To be successful, the created habitat must maintain seasonal connectivity with groundwater and provide a range of habitat depths, vegetation types and cover/shade. Groundwater levels in the vicinity of the proposed wetland creation area are shallow (0.8–2.1 m bgl) and consistent with the wider site.

WGA (2026) provided a concept design that shows a seasonal groundwater range between 27.5 m to 28.5 m RL that will maintain groundwater inflow year-round but will allow the outer edges of the wetland to dry out and be intermittently flooded. The design has incorporated expected drawdown effects from earthworks that were assessed as 'low' (Table 18). Ongoing groundwater level monitoring is recommended to confirm the seasonal ranges are consistent with those modelled for the habitat design.

Off-site NZTA Drain

The NZTA drain over the eastern boundary of the site supports black mudfish. Black mudfish have specific habitat requirements. Changes to hydrology has potential to adversely affect groundwater levels and the existing black mudfish in the NZTA drain.

Based on the WGA (2026) assessment of effects, the projected summer drawdown effect in the vicinity of the NZTA drain is approximately 0.35 m. Existing groundwater levels indicate that it naturally drops below the base of the drain in summer, and means the existing drain becomes disconnected from groundwater during the summer, with groundwater levels approximately 1.3 m below the NZTA drain. WGA (2026) conclude:

"*Further drawdown below existing summer levels associated with the east swale is therefore considered to not influence the seasonal water balance for the mudfish habitat".*

Based on this assessment, and with the implementation of ongoing monitoring of surface and groundwater levels, the expected effects on the NZTA drain through localised groundwater drawdowns is assessed as 'low' (Table 18).

8.3.3 Stormwater effects

The Project will result in an increase in impervious area and stormwater runoff from stormwater sub-catchments (Maven Associates 2026b). Stormwater has the potential to affect physical aspects of the stream from erosion caused by regular, high velocity run off events. Erosion leads to channel bed smothering and therefore can affect instream habitat loss for fish and invertebrates and elevated turbidity can result in a decrease or loss of primary production. Increased sedimentation can lead to changes in the channels width and depth leading to the increased frequency of bank top floods and further stream bank degradation.

The Civil Infrastructure Report prepared by Maven Associates (2026b) outlines the stormwater management framework that includes mitigation measures to manage stormwater quantity, quality, stream protection and conveyance design.

Maven Associates (2026b) applied the following key design criteria:

- Water quality treatment objectives defined in the SMP and BoD.
- Peak flow management for 2-year, 10-year, and 100-year ARI events.
- Stream erosion control based on 2-year ARI extended detention (EDV) requirements.
- Climate change allowances in accordance with NIWA HIRDS guidance.
- Maintenance of downstream hydrological performance where practicable.
- Maintenance of Waikato Regional Council Land Drainage Management Plan (LDMP) performance in downstream systems.

The stormwater strategy for the Project adopts an integrated catchment-wide treatment train approach incorporating source control, conveyance, attenuation and discharge management (Maven Associates 2026b). The system is structured around hydraulic sub-catchments aligned with development staging, enabling staged implementation while maintaining overall catchment functionality (Maven Associates 2026b).

Key principles adopted by Maven Associates (2026b) include:

- Integrated treatment of runoff through multiple system components.
- Combination of piped reticulation and open channel conveyance systems.
- Use of wetland and basin systems for attenuation and treatment.
- Progressive implementation aligned with staged development.
- Integration with ICMP and LDMP constraints.

The principal stormwater infrastructure, including constructed wetlands, stormwater reserves, major conveyance channels, principal overland flow paths, culverts, outlet structures and nominated discharge locations, forms the fixed or controlled stormwater framework for the development (Maven Associates 2026).

The stormwater conveyance system comprises a hierarchical network of piped reticulation, open channels, and overland flow pathways designed to convey runoff efficiently through the development. The stormwater conveyance system includes:

- Primary conveyance systems (trunk pipes and major channels)
- Secondary piped reticulation within road corridors.
- Local lot-level connections and drainage pathways.
- Open channel systems where hydraulically efficient (conveyance channels).

The channels are proposed where a piped network becomes impractical given the flat gradients across the Project Area. The channels provide conveyance for both the primary network and also to safely contain flood waters within the secondary network (Maven Associates 2026c). Typical cross-sections of conveyance channels are shown on Figure 31 with the locations shown on Figure 31 (light blue areas). Conveyance channels will be planted and are not designed to provide fish passage as they are part of stormwater management infrastructure and do not replace natural watercourses.

Stormwater quantity will be managed through a combination of flow control, attenuation, and storage systems designed to manage peak flows and runoff volumes (Maven Associates 2026b). Key components of the design will include flow attenuation for 2-year, 10-year, and 100-year ARI events, wetland and basin storage to provide detention capacity, flow control devices regulating discharge rates, restricted culverts and overflow spillways to safely convey exceedance flows during extreme events (Maven Associates 2026b). In addition, Mangaheka Stream will be lowered and reconstructed to have a meandering base flow channel within a wider floodplain that will be enhanced via planting and will improve flood conveyance and reduce flood risk (Maven Associates 2026b).

Stormwater quality treatment is provided through a treatment train approach consistent with SMP and BoD requirements, with the treatment system including:

- Lot-scale source control measures where appropriate;
- Road corridor treatment integrated with amalgamated raingardens; and
- End-of-line treatment via constructed wetlands.

The proposed stormwater management strategy and design for the Project will effectively manage stormwater quantity and quality, with the overall level of effect on the receiving environment assessed as ‘low’ (Table 18).

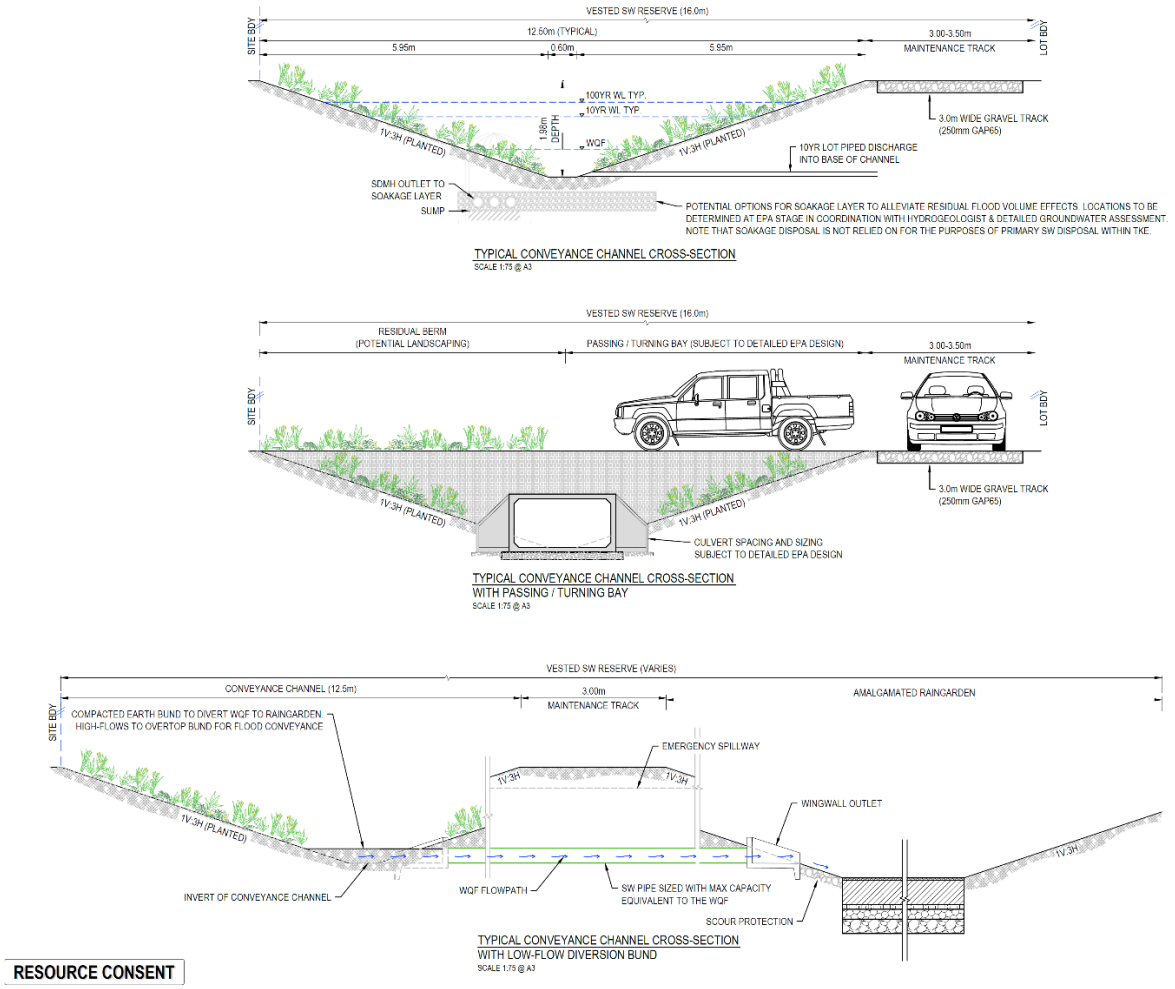

Figure 31: Typical conveyance channel design (Maven Associates drawing C460-3).

8.3.4 Stream-works and enhancement of Mangaheka Stream

Mangaheka Stream will be integrated into the open space network, providing stormwater management and opportunity for ecological enhancement. The section of Mangaheka Stream within the Project is a highly modified watercourse with 'moderate' ecological value. The current values of the stream are restricted by poor water and habitat quality due to channelisation but may support giant kōkopu (At Risk – Declining) based on eDNA results.

The proposal will involve deepening and widening the existing channel primarily for stormwater management. Stormwater design drawings prepared by Maven Associates indicate the stream will be lowered from 0.8 m to 1.5 m, but will maintain the existing slope along the channel. A low flow channel will be constructed to meander within a wider floodplain between the batter slopes (Figure 32 and Figure 33). Batter slopes and floodplains will be planted with native wetland and riparian vegetation species. Treatment wetlands will be constructed along the streambanks and receive stormwater from conveyance channels throughout the Project Area.

Stream works will be carried out in accordance with best practice and the proposed methodology outlined in the STMP (Maven Associates 2026d). Stream works will occur over short discrete sections (<100 m) and stabilised before going 'on line', will ensure continuous flow is maintained at all times, have sufficient capacity to pass the 5-yr ARI flow without causing upstream flooding, and maintain fish passage (Maven Associates 2026d). Stream

works will involve diverting flow into temporary geotextile lined diversion channels, isolating work reaches with bunds.

Stream works will be carried out in accordance with the ESCP (Maven Associates 2026a). Implementing the ESCP and following the methodology outlined in the STMP will minimise the potential for sediment mobilisation and deposition in Mangaheka Stream, with the overall level of effect assessed as 'low' (Table 18).

Stream works will require the temporary loss of aquatic habitat along discrete sections (<100 m) of Mangaheka Stream that are being worked on at any given time during reconstruction. The diversion will result in dewatering, temporary loss of habitat, and potential for fish to be stranded. The magnitude of the effect on native fish is considered 'high' if not managed. Potential effects on native fish during stream works will be minimised by implementing the Fish Management Plan (FMP) prepared by Ecological Solutions (2026d) to capture and relocate fish prior to, and during, dewatering. Implementing the FMP during stream works will result in an overall 'low' level of effect on native fish (Table 18).

Details and design of proposed enhancements to Mangaheka Stream are outlined in the Mangaheka Stream Enhancement Plan (MSEP) (Ecological Solutions 2026d). After the reconstructed Mangaheka Stream has been completed, stabilised, woody debris installed and floodplains and batter slopes planted with indigenous vegetation covering c. 84,430 m^2, the stream will provide higher quality habitat for aquatic fauna than what currently exists and have higher ecological value. The increase in the amount, diversity and quality of habitat will have a positive ecological effect and result in a long-term 'net gain' outcome (Table 18).

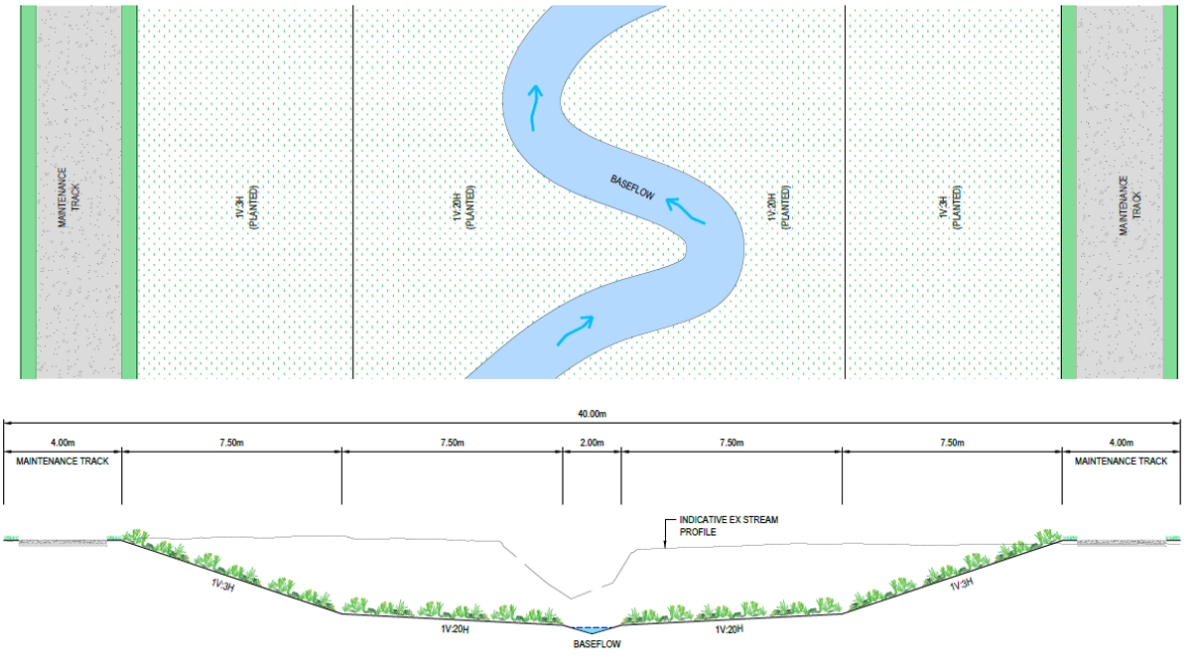

Figure 32: Indicative detail showing meandering low flow channel and cross-section of reconstructed Mangaheka Stream (Maven Associates drawing C460-5).

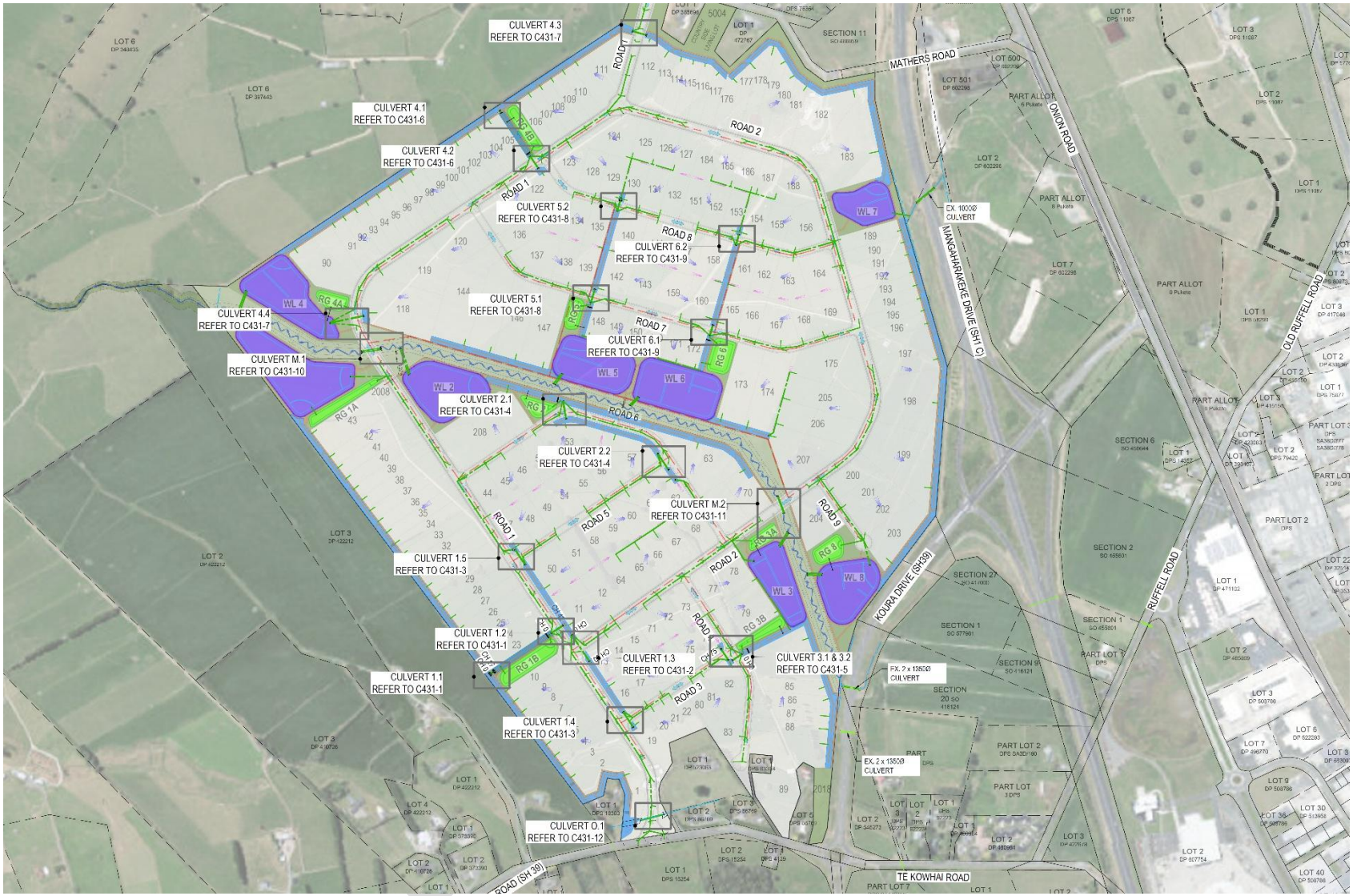

Figure 33: Indicative alignment of reconstructed and enhanced Mangaheka Stream (Maven Associates drawing C430).

8.3.5 Reclamation of Watercourse M13

Development of the Project will result in the loss of 212 m of highly modified stream habitat along Watercourse M13. This loss cannot be remediated or mitigated at the point of impact and is therefore a residual effect. The overall ecological values of Watercourse M13 were assessed as 'low', but the residual effect is proposed to be offset, as it has the status of a stream under the Waikato Regional Council watercourse definitions. An assessment of the offset needed based on the Stream Ecological Valuation (SEV) and Environmental Compensation Ratio (ECR) approach is provided in Section 9.0 (Residual Effects). The FMP (Ecological Solutions 2026c) will be implemented prior to, and during, the reclamation of Watercourse M13 to minimise the potential for harm or mortality of native fish.

8.3.6 Loss of black mudfish habitat in artificial drains

Development of the Project will result in the loss of all artificial drains within the Project Area (i.e., total length = 16,192 m). Of this length, a conservative estimate of the area of artificial drain (mean wetted width = 1 m) within the Project Area that has potential to support black mudfish based on habitat suitability and 'hit rate' (i.e., 38.12%) of black mudfish in the 9,398 m of drains trapped is 3,582.5 m² (i.e., 9,398 m x 0.3812 x 1 m) (refer to Section 6.6.4).

The overall ecological value of the drains with the potential to support black mudfish were assessed as 'moderate'. The loss of 3,582.5 m² of potential black mudfish habitat cannot be remediated or mitigated at the point of impact and is therefore a residual effect. This residual effect is proposed to be offset through the creation of at least an equivalent area of higher quality, more secure black mudfish habitat within the Project Area. The primary response will be 'on-site' habitat creation integrated with the ecological design for the development. Off-site habitat creation or enhancement will only be used if detailed design or monitoring confirms that a residual effect remains after the on-site habitat solution has been finalised. Any need for an off-site location or the identification of a suitable off-site location will be undertaken in consultation with WRC.

This is an appropriate approach to managing effects on black mudfish for the Project because the habitat being lost is highly modified, hydrologically vulnerable, and there are opportunities to create higher quality, more secure habitat within the Project Area using 'set aside' areas where habitat can be designed and created specifically for black mudfish in advance of the loss of any habitat values.

The indicative design of the proposed black mudfish habitat is shown on Figure 36 (see Section 9.3). Replacement habitat will be designed for black mudfish and will draw on recent successful black mudfish habitat creation at Lake Waiwhakareke. Created black mudfish habitat will ensure suitable hydrological conditions, planted with indigenous vegetation, incorporate woody debris for cover and refuge habitat and result in higher quality black mudfish habitat than what currently exists. Habitat will be protected in perpetuity within the completed development and managed to provide more reliable long-term hydrological and ecological conditions. Details of the black mudfish habitat compensation are in the Black Mudfish Habitat Creation Plan (Ecological Solutions 2026e). The overall level of effect of the Project on black mudfish and habitat will be positive and result in a 'net gain' outcome.

8.3.7 Construction of culverts

Two new box culvert road crossings with an approximate length of 24 m each are proposed to be installed on the reconstructed section of Mangaheka Stream within the Project Area. The location of proposed box culverts are shown on Figure 33 (culverts M.1 and M.2). An additional box culvert is proposed on Te Otamanui Stream (culvert O.1).

The installation of the box culverts has potential to affect fish passage. All box culverts on Mangaheka Stream and Te Otamanui Stream will be designed and installed in accordance with relevant regulations in the National Environmental Standards for Freshwater (NES-F) to ensure fish passage is provided. An indicative design of proposed box culverts is presented in Figure 34. Final culvert design including associated bed protection will be completed during detailed design.

Existing culverts on Mangaheka Stream (total length = ~24 m), including one that is perched and is a fish barrier, will be removed during the reconstruction and enhancement of Mangaheka Stream. The removal of an existing perched culvert on Mangaheka Stream and construction of two box culverts that provide fish passage will mean that fish passage within the Project Area will be improved.

The construction of box culverts on watercourses has potential to modify aquatic habitat. Because the box culverts on Mangaheka Stream will be located on a section that will be reconstructed and enhanced, there will be no additional disturbance or loss of existing stream habitat. Enhancement of the reconstructed ~2.3 km section of Mangaheka Stream (i.e., via planting installation of woody debris) will more than adequately compensate the reduction in ecological values at the location of the culverts (i.e., combined total length = ~50 m). Similarly, the proposed box culvert on Te Otamanui Stream will also be adequately compensated via enhancement of the reconstructed Mangaheka Stream.

Culverts will be installed in accordance with the STMP and EWMP (Maven Associates (2026a, 2026d) (see Section 8.3.1) to minimise the potential for sediment mobilisation and deposition in watercourses. The FMP (Ecological Solutions 2026c) will be implemented prior to and during construction to minimise potential harm or mortality of native fish. The design and construction of the proposed box culverts in accordance with NES-F regulations and management plans will ensure fish passage is provided and will minimise construction related effects, with the overall level of effect assessed as ‘low’ or ‘net gain’ (Table 18).

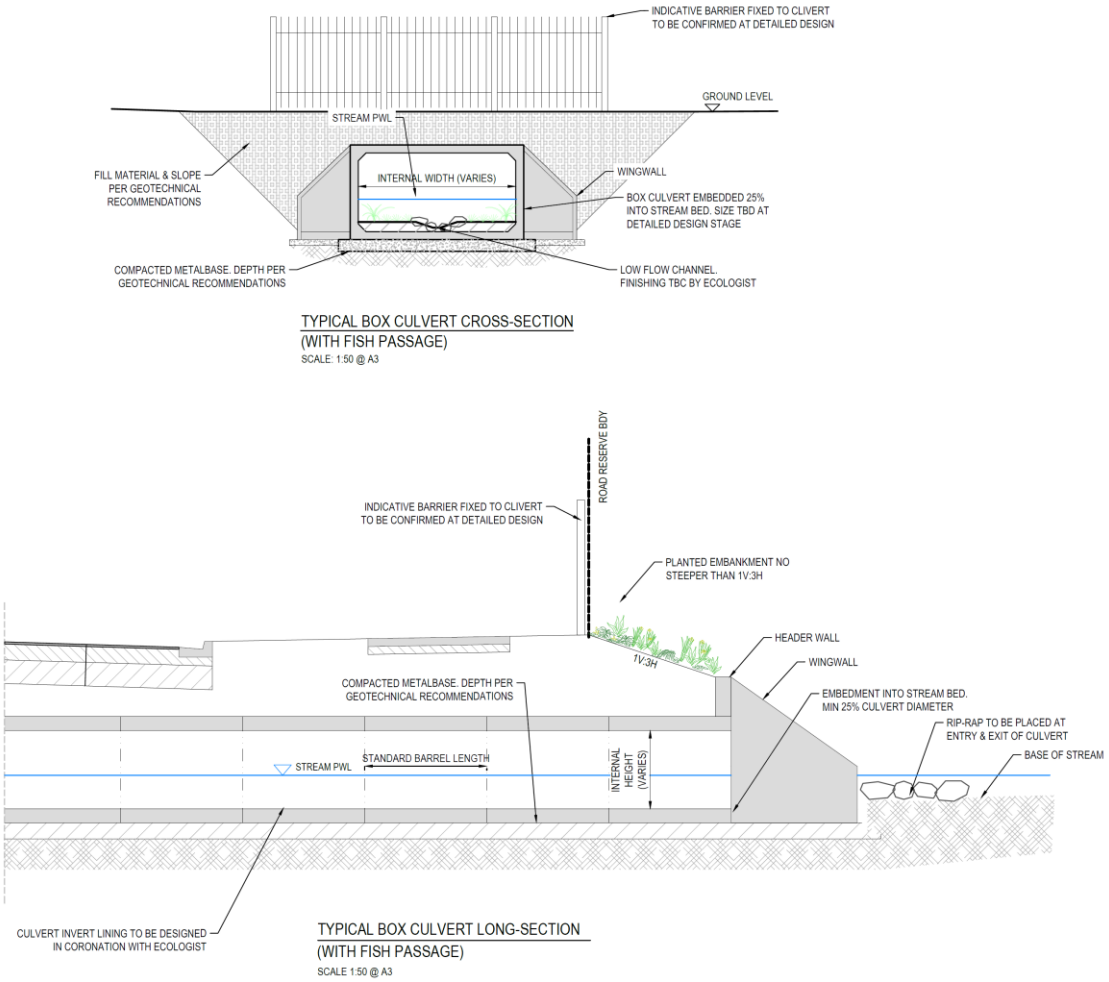

Figure 34: Indicative box culvert design (Maven Associates drawing C460-7).

Table 18: Magnitude and level of freshwater effects for the proposed Te Kowai East development before and after mitigation.

Activity	Ecological feature	Effect	Ecological value	Magnitude of effect	Level of effect (pre-effects Management)	Effects Management Measures	Level of effect (post-effects management)
Earthworks	Te Otamanui Stream, Mangaheka Stream	Release sediment into the downstream freshwater environment that could affect water and habitat quality	Moderate	Moderate	Moderate	Implement sediment and erosion controls in accordance with plans prepared by Maven Associates.	**Low**
Earthworks	Mangaheka Stream, Te Otamanui Stream, created wetland (black mudfish habitat)	Groundwater drawdown effects	Moderate	Low	Low	Pumping intercepted groundwater during construction upstream.	**Low**
	NZTA drain (black mudfish habitat)		Moderate	Low	Low	Continue to monitor groundwater levels to determine modelling accuracy.	**Low**
Stormwater discharges	Mangaheka Stream, Te Otamanui Stream	Water and habitat quality effects	Moderate	Moderate	Moderate	Stormwater management in accordance with SMP and Infrastructure Report (Maven Associates).	**Low**
Reconstruct / enhance Mangaheka Stream	Mangaheka Stream	Temporary loss of habitat, Harm / mortality of native fish during works. Restore and enhance stream habitat.	Moderate	High	Moderate	Implement EWMP and SWMP (Maven Associates 2026a, 2026d) and FMP (Ecological Solutions 2026c) during construction. Riparian planting along reconstructed Mangaheka Stream with meanders, floodplain, woody debris, diverse bed. Treatment wetlands along stream banks	**Low (during works)** **Net gain (post works)**
Reclamation of modified watercourse	Watercourse M13	Loss of habitat	Low	Very high	Moderate	Can not be mitigated so offsetting required for creation of stream values and extent. Refer to Section 9.0.	**Net gain**
Earthworks	Drains without black mudfish	Loss of habitat	Negligible	Very High	Low	Can not be mitigated so offsetting required for creation of black mudfish habitat. Refer to Section 9.0.	**Net gain**
	Drains with black mudfish	Loss of habitat	Moderate		High		
Culvert removal and replacement	Mangaheka Stream, Te Otamanui Stream	Fish passage and harm/mortality during construction	Moderate	Moderate	Moderate	Construct new culverts in accordance with New Zealand Fish Passage Guidelines and NES-F regulations. Remove existing perched culvert that is an existing fish barrier. Implement FMP during construction.	**Net gain**
	Mangaheka Stream, Te Otamanui Stream	Habitat modification	Moderate	Moderate	Moderate	Enhance reconstructed Mangaheka Stream via riparian planting along a ~2.3 km reach.	**Net gain**

9.0 Residual Effects

9.1 Defining Biodiversity Offsets

A biodiversity offset is a 'measurable conservation outcome' that meets certain principles and balances adverse residual effects, to a demonstrable No Net Loss (NNL) or preferably Net Gain (NG) standard (Maseyk et al. 2018; Baber et al. 2021). Key biodiversity offsetting principles for wetlands, streams and indigenous biodiversity are set out in the relevant National Policy Statements for example NPS-FM (Appendix 6), which include the principles:

- Adherence to the effects management hierarchy. Offsets should only be contemplated after steps to avoid, remedy, or mitigate adverse effects have sequentially been exhausted, and thus applies only to residual biodiversity impacts. Compensation, as the least certain and most risky management of effects, should be considered as a last resort.
- No net loss or preferably net gain outcomes.
- Ecological equivalence, meaning the degree to which the biodiversity gain attributable to an offset is balanced with the biodiversity losses and therefore whether the exchange achieves NNL.
- Additionality, meaning the gains in biodiversity must be above and beyond gains that would have occurred anyway in the absence of the offset or compensation.
- Long-term outcomes (preferably in perpetuity).
- Landscape context, whereby the biodiversity offset or compensations considers the landscape context of both the impact site and the offset site.
- Transparency, the design and implementation of an aquatic offset and communication of the results to the public are undertaken in a transparency and timely manner.

The NPS-FM also discusses the following principles:

- When aquatic offsetting is not appropriate, this occurs in situations where in terms of conservation outcomes, the extent or values cannot be offset to achieve no net loss and preferably a net gain in the extent and values.

The NPS-FM also takes into account cultural inputs within the offset such as:

- Science and mātauranga Māori, meaning the design and implementation of the offset is a documented process informed by science and mātauranga Māori at place.
- Tangata whenua or stakeholder participation, participation of tangata whenua or stakeholders is demonstrated when planning aquatic offsets, including their evaluation, selection, design, implementation, and monitoring.

Following the release of the NPS-FM there has been a greater emphasis placed on offsetting both extent and values. It is generally accepted that for an offset to be an offset, both values and extent must be accounted for (whereas previous offsetting exercises prior to release of the NPS-FM, have focused more so on trading extent for values and not necessarily covered both). The overall 'low' effects determined above are not significant adverse residual effects, therefore offsetting is only proposed to manage the residual effects attributable to the reclamation of Watercourse M13 and the loss of black mudfish habitat within the artificial drains. The restoration of Mangaheka Stream will improve the extent and

ecological values of Mangaheka Stream (i.e., currently highly modified and degraded) and result in a 'net gain' outcome so is not considered to be a residual effect.

9.2 Reclamation of Watercourse M13

9.2.1 NPS-FM

Reclamation or modification of modified watercourses has been avoided where possible; however, the proposed development will result in the unavoidable reclamation of 212 m of Watercourse M13. Policy 7 of the NPS-FM refers to both extent and values of stream loss and Section 3.24 (1) states that:

> *"The loss of river extent and values is avoided, unless the council is satisfied that:*
>
> *(a) there is a functional need for the activity in that location and,*
>
> *(b) the effects of the activity are managed by applying the effects management hierarchy."*

The following presents an offset assessment for the unavoidable loss of 212 m of Watercourse M13 to ensure there is 'no loss of extent and values' in order to satisfy Policy 7 of the NPS-FM. When considering no loss of stream extent, it refers to both no loss of stream length and no loss of streambed area (i.e., length (212 m) x channel width (1.4 m) = streambed area (296.8 m^2)). The proposed loss of 212 m of Watercourse M13 means that at least 212 m of stream length with a streambed area of at least 296.8 m^2 will need to be created to ensure no loss of extent.

The Environmental Compensation Ratio (ECR) approach outlined in Storey et al. (2011) was used to quantify the amount of stream that would need to be created and enhanced to ensure no loss of extent and ecological values. The ECR approach is based on Stream Ecological Valuation (SEV) scores and should adhere to best practice restoration guidelines (e.g., appropriate riparian widths, provide fish passage, etc.).

9.2.2 Environmental Compensation Ratio Approach

SEV surveys were carried out on Watercourse M13 (impact reach) and Mangaheka Stream (restoration reach) following the methodology in Storey et al. (2011) (described in Section 3.4.5). ECR values are calculated using SEV scores and Equation 1 below and requires predicting the 'after impact' value (SEVi-I) and 'potential' value (SEVi-P) of the impacted stream and current value (SEVm-C) and 'post restoration' value (SEVm-P) of the restoration reach (i.e., stream to be created). The ECR value is then used to calculate the amount of stream habitat required to be created and enhanced using Equation 2 below.

Equation 1: Calculation of Environmental Compensation Ratio (ECR)

ECR = [(SEVi-P – SEVi-I) / (SEVm-P – SEVm-C)] x 1.5

Where: SEVi-P is the potential SEV value for the site to be impacted.
SEVm-C is the current SEV value for the site where environmental compensation is applied.
SEVm-P is the potential SEV value for the site where environmental compensation is applied.
SEVi-I is the predicted SEV value of the stream to be impacted after impact.

Equation 2: Calculation of length of stream to restore

Restoration stream length = ('Impact Area' x ECR) / 'Restoration Stream Channel Width'.

9.2.3 Assumptions used to calculate Environmental Compensation Ratio values

The following outlines the assumptions applied in the watercourse offset assessment:

- The impact section of Watercourse M13 is 212 m long, has a mean wetted channel width of 1.4 m and streambed area of 296.8 m^2 (212 m x 1.4 m).
- The predicted after-impact value (SEVi-I) of Watercourse M13 was assessed as zero as the section of this watercourse within the site will no longer exist.
- The predicted potential value (SEVi-P) of Watercourse M13 was based on riparian planting out to a width of 20 m on each bank but does not assume that the stream would need to be realigned (i.e., introducing meanders).
- Mangaheka Stream within the Project Area is proposed to be realigned to have a meandering pattern to increase instream habitat variability (i.e., widths and depths) and enhance ecological values. The existing length of Mangaheka Stream is c. 1,870 m and will be c. 2,279 m long when realigned to have a meandering pattern. The average width of the realigned Mangaheka Stream will be 1.5 m.
- The addition of meanders will increase the total length and streambed area of Mangaheka Stream within the Project Area by 409 m and 613.5 m² (channel width = 1.5 m), respectively (Figure 32 in Section 8.3.4 and Figure 35).
- The entire c. 2,279 m length of Mangaheka Stream (excluding road crossings) will be planted out to an average width of 15 m on each bank with indigenous plant species covering c. 84,430 m^2. Riparian planting will be carried out on floodplains and batters and comprise wet-adapted native species in floodplain areas and trees/shrubs on batters to introduce canopy and sub-canopy tiers. An additional 450 m length of Mangaheka Stream downstream of the Project Area (i.e., off-site) will also be planted and contributes to the overall ecological package.

9.2.4 Calculation of Environmental Compensation Ratio values

A summary of SEV data used to calculate ECR values for the loss of 212 m of Watercourse M13 (impact) and using the additional 409 m of Mangaheka Stream created by introducing meanders (offset) to ensure 'no loss of extent and values' is presented in Table 19 and Appendix C. The ECR value calculated for reclaiming 212 m of Watercourse M13 was 1.54.

Table 19: Predicted and current SEV scores used to calculate ECR values.

Impact reach	Impact scores		Offset reach	Offset scores		ECR
	SEVi-P	SEVi-I		SEVm-P	SEVm-C	
Watercourse M13	0.587	0.000	Mangaheka Stream	0.571	0.000	1.54

9.2.5 Offset Calculations using Environmental Compensation Ratio values

Channel dimensions, ECR values and the length of Mangaheka Stream required to be created and enhanced to offset the reclamation of 212 m of Watercourse M13 to ensure no loss of extent and values is summarised in Table 20.

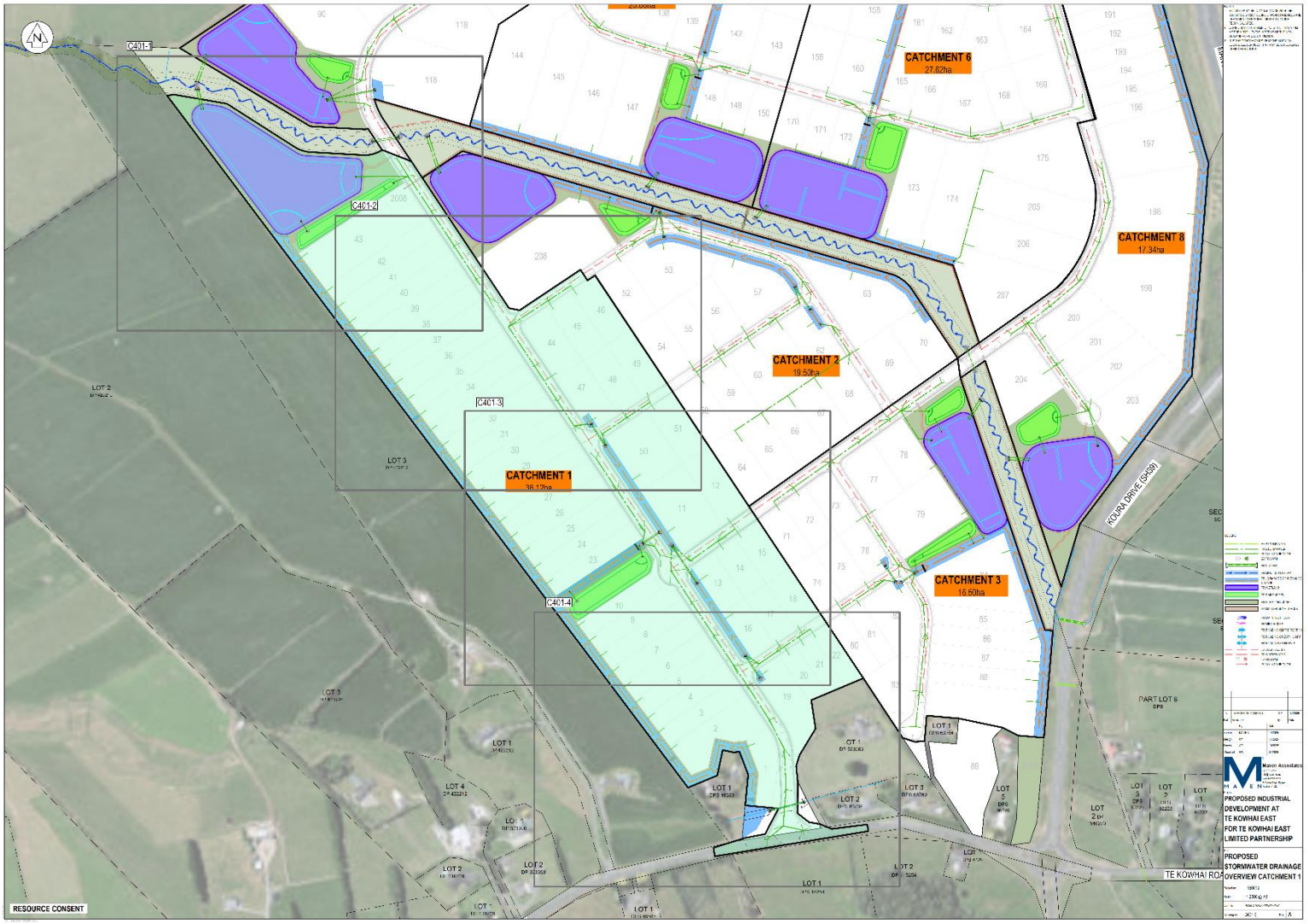

Figure 35: Proposed stormwater drainage (Maven Associates, drawing number:C401-0 REV A).

Table 20: Watercourse offset calculations for loss of 212 m of Watercourse M13.

Impact reach				ECR		Offset / restoration reach					(b)	(c)	(d)
Stream	Length (m)	Width (m)	(a) Area (m^2)	ECR	ECR x Area	Stream	Length available (m)	Width (m)	Area available (m^2)	Calculated restoration length required (m)	Length to restore (m)	Restoration length still available (m)	Outstanding area not offset (m^2)
Watercourse M13	212.0	1.4	296.8	1.54	457.4	Mangaheka Stream	409.0	1.5	613.5	304.9	304.9	104.1	-
											304.9		

Notes: (a) = Streambed area impacted based on channel widths at 10 SEV cross sections;

(b) = Length of restoration stream to create calculated by ('ECR x Area' / 'Restoration Width'), restoration length defaults to 1:1 length if shorter than that impacted (* indicates restoration reach defaulted to 1:1 the length impacted);

(c) = Restoration stream length available after being used in assessment and calculated by (('Area available' – 'ECR x Area') / restoration reach 'Width') with amount transferred to 'Restoration reach Length available' in the next row if applicable;

(d) = Amount of streambed area that has not been offset/compensated and is transferred to 'Impact reach Area' on the next row if applicable for additional compensation calculation using next available restoration reach. The outstanding amount is determined by ('Restoration reach Area available' – 'ECR x Area') / ECR value.

The ECR assessment determined that 304.9 m of additional stream length would need to be created and enhanced along the realigned section of Mangaheka Stream within the Project Area to ensure no loss of extent and values (Table 20).

Because 409 m of additional stream length is proposed to be created by introducing meanders on Mangaheka Stream, an additional 104.1 m of stream length will be created over and above that required (i.e., 409 m – 304.9 m = 104.1 m) (Table 20).

The creation of more stream length than required (i.e., 104.1 m), enhancement of the entire length of Mangaheka Stream within the Project Area (i.e., total length = 2,279 m) and enhancing an additional 450 m of Mangaheka Stream downstream of the Project Area, will mean there will be an increase in stream extent. This significant enhancement of ecological values within Mangaheka Stream will result in an overall 'net gain' outcome.

9.3 Loss of Black Mudfish Habitat

The following offset approach for black mudfish was deemed appropriate for managing effects on black mudfish for the Project because the habitat being lost is highly modified, hydrologically vulnerable, and there are opportunities to create higher quality, more secure habitat within the Project Area using 'set aside' areas where habitat can be designed and created specifically for black mudfish in advance of the loss of any habitat values.

The indicative design of the proposed black mudfish habitat is shown on Figure 36. Replacement habitat will be designed for black mudfish and will draw on recent successful black mudfish habitat creation at Lake Waiwhakareke consented under Resource Consent AUTH141384.02.02 and CPT-608524-1-325-V2 Record of Decision of the Expert Consenting Panel under Clause 37 Schedule 6 of the COVID-19 Recovery (Fast-track Consenting) Act 2020.

Created black mudfish habitat will ensure suitable hydrological conditions, planted with indigenous vegetation, incorporate woody debris for cover and refuge habitat and result in higher quality black mudfish habitat than what currently exists. Habitat will be protected in perpetuity within the completed development and managed to provide more reliable long-term hydrological and ecological conditions. Details of the black mudfish habitat offset are in the Black Mudfish Habitat Creation Plan (Ecological Solutions 2026e). The overall level of effect of the Project on black mudfish and habitat will be positive and result in a 'net gain' outcome.

Figure 36: Indicative design of proposed black mudfish habitat creation (prepared by WGA).

10.0 Summary

Terrestrial and Wetland Ecology

The Project Area is largely high-producing exotic grassland with a small area of native fernland, scattered exotic trees, shelterbelts/hedgerows and scrub of 'negligible' to 'low' ecological value. Although vegetation removal will have 'very low' initial impact on the vegetation, restoration measures such as native planting, stream enhancement, and constructed wetlands are expected to improve biodiversity and as a result provide a net ecological gain over the short to medium-term (5–15 years).

The development will remove some 'low-quality' habitat for native birds, lizards and potentially bats. Mitigation measures, including nest checks, a lizard capture and relocation plan, and implementation of bat roost protocols will ensure minimal impacts on wildlife.

The Project Area has been subject to a long history of modification, including grazing, cropping, historic wetland alterations and drainage works. As a result, the landscape is dominated by exotic vegetation with poor connectivity with surrounding habitats.

The proposed restoration package for the Project Area has been designed to enhance ecological values and deliver net-gain biodiversity outcomes. The restoration package will comprise:

- Restoration of the Mangaheka Stream via native riparian planting and enhancement (c. 84,430 m^2), pest animal and weed control.
- Creation of constructed wetlands (c. 3,600 m^2) suitable for black mudfish to provide enhanced habitat values and greater functional connectivity for native wildlife and fauna across the landscape.
- Habitat enhancement provides opportunity to plant forest trees such as kahikatea (*Dacrycarpus dacrydioides*), pukatea (*Laurelia novae-zelandiae*) and swamp maire (*Syzygium maire*) with an understory of native sedges, providing suitable habitat for ferns to naturally colonise. Floristic enhancement could include the introduction of restiads; greater wire rush (*Emporia robustum*) and giant cane rush (*Sporadanthus ferrugineus*).

Freshwater Ecology

Freshwater values within the Project Area were assessed as 'low' to 'moderate' based on the highly modified state of aquatic habitat and the presence or potential presence of fish species with an 'At Risk – Declining' status in artificial drains (e.g., black mudfish) and Mangaheka Stream (e.g., longfin eel, banded kōkopu, giant kōkopu).

Ecological effects have been identified which involve the reclamation of potential black mudfish habitat in artificial drains, reclamation of 212 m of Watercourse M13, potential construction and post development effects associated with stormwater and earthworks on Mangaheka Stream, and the creation and enhancement of habitat in Mangaheka Stream.

Mitigation of stormwater and earthworks related effects will be managed by implementing the following management plans:

- Earthworks Management Plan (Maven Associates 2026a).
- Stormwater Management Plan (Maven Associates 2026c).
- Fish Management Plan (Ecological Solutions 2026c).

- Mangaheka Stream Enhancement Plan (Ecological Solutions 2026d).

The reclamation of 212 m of highly modified Watercourse M13 will be offset by creating an additional 409 m length of Mangaheka Stream by introducing meanders to the existing straight aligned stream and planting the entire length of Mangaheka Stream within the Project Area (i.e., 2,279 m). An additional 450 m section downstream of the Project Area will be enhanced via riparian planting. The overall effect of proposed stream works on stream ecology will be positive and result in an overall 'net gain' in extent and values.

The removal of artificial drains will result in the loss of potential black mudfish habitat within the Project Area. The pre-mitigation level of effect will be high. A commensurate offset will be achieved by creating black mudfish habitat within the Project Area in advance of the development that will ensure there is no overall loss of black mudfish habitat extent. Constructing habitat in advance will also ensure there is habitat within the Project Area where black mudfish can be relocated to prior to and during construction. Details of the design and specifications of the habitat creation are in the Black Mudfish Habitat Creation Plan (Ecological Solutions 2026e). The long-term outcome of black mudfish habitat creation is expected to be positive and will be assessed and monitored through a comprehensive monitoring programme.

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Appendix A Plant Species List

Common Name	Scientific Name
Conifer / Gymnosperm - Trees	
Cedar	*Cryptomeria japonica**
Macrocarpa	*Cupressus macrocarpa**
Red dawn	*Metasequoia glyptostroboides**
Radiata pine	*Pinus radiata**
Ferns	
Ponga	*Cyathea dealbata*
Whekī	*Dicksonia squarrosa*
Mātātā	*Paesia scaberula*
Kiokio	*Parablechnum novae-zelandiae*
Bracken	*Pteridum esculentum*
Dicot - Trees and Shrubs	
She-oak	*Casuarina* sp.*
Honey locust	*Gleditsia triacanthos**
Tree privet	*Ligustrum lucidum**
Poplar	*Populus nigra* f. *italica**
Poplar	*Populus* sp.*
Oak	*Quercus robur**
Barberry	*Berberis glaucocarpa**
Plane	*Platanus ×hispanica**
Woolly nightshade	*Solanum mauritianum**
Gorse	*Ulex europaeus**
Monocot - Trees and Shrubs	
Tī kōuka/cabbage tree	*Cordyline australis*
Dicot - Herbs	
Daisy	*Bellis perennis**
Starwort	*Callitriche stagnalis**
Hawksbeard	*Crepis capillaris**
Lotus	*Lotus pedunculatus**
Pennyroyal	*Mentha pulegium**
Smooth witchgrass	*Panicum dichotomiflorum**
Willow weed	*Persicaria hydropiper**
Narrow-leaved plantain	*Plantago lanceolata**
Broad-leaved plantain	*Plantago major**
Creeping buttercup	*Ranunculus repens**
Wild radish	*Raphanus raphanistrum**
Curly dock	*Rumex crispus**
Broad-leaved dock	*Rumex obtusifolius**
Dandelion	*Taraxacum officinale**
Red clover	*Trifolium pratense**
White clover	*Trifolium repens**
Rushes	
Wīwī	*Juncus edgariae*
Soft rush	*Juncus effusus**
Grasses	

Pampas grass	*Cortaderia selloana**
Cocksfoot	*Dactylis glomerata**
Barnyard grass	*Echinochloa crus-galli**
Sweet grass	*Glyceria declinata**
Yorkshire fog	*Holcus lanatus**
Bamboo	*Pseudosasa japonica**
Italian rye	*Lolium multiflorum**
Perennial rye	*Lolium perenne**
Summer grass	*Paspalum dilatatum**
Annual poa	*Poa annua**
Maize	*Zea mays**
Lianes and Climbers	
Blackberry	*Rubus fruticosus* agg.*

An asterisk (*) next to a species denotes 'introduced/exotic' status.

Appendix B eDNA Data

Sampling Round 1: 8 March 2021

Common name	Scientific name	Rank	TaxID	Mangaheka Stream					
				1	2	3	4	5	6
Shortfin eel	*Anguilla australis*	Species	7940	720	574	787	1147	1430	951
Mosquitofish	*Gambusia affinis*	Species	33528	964	618	1932	472	922	680
Brown bullhead catfish	*Ameiurus nebulosus*	Species	27778	561	0	771	1376	66	487
Goldfish	*Carassius auratus*	Species	7957	361	409	196	686	249	360
Koi carp	*Cyprinus carpio*	Species	7962	260	182	313	212	195	171
Longfin eel	*Anguilla dieffenbachii*	Species	61127	0	0	128	0	14	21
Catfish	*Ameiurus*	Genus	50384	245	0	140	250	0	266

Sampling Round 2: 31 March 2021

Common name	Scientific name	Rank	TaxID	Watercourse				
				Mangaheka Stream	Te Otamanui Stream (1)	Te Otamanui Stream (2)	M4	M5
Mosquitofish	*Gambusia affinis*	Species	33528	374	15	0	0	611
Goldfish	*Carassius auratus*	Species	7957	305	0	0	0	0
Koi carp	*Cyprinus carpio*	Species	7962	161	0	0	0	0
Shortfin eel	*Anguilla australis*	Species	7940	93	0	0	0	47
Brown bullhead catfish	*Ameiurus nebulosus*	Species	27778	128	0	0	0	0

Sampling Round 3: 19 November 2021

Common name	Scientific name	Rank	TaxID	Watercourse					
				Mangaheka Stream	M3	M4	M5 (1)	M5 (2)	M6
Black mudfish	*Neochanna diversus*	Species	66455	0	0	400	0	0	203
Giant kōkopu	*Galaxias argenteus*	Species	89553	9	179	13	129	0	13
Giant or shortjaw kōkopu	*Galaxias argenteus/ postvectis*	Species	10000020	0	8	0	26	0	0
Goldfish	*Carassius auratus*	Species	7957	0	35	0	0	0	0
Mosquitofish	*Gambusia affinis*	Species	33528	136	71	77	95	0	83
Rainbow trout	*Oncorhynchus mykiss*	Species	8022	0	4	0	0	0	0
Shortfin eel	*Anguilla australis*	Species	7940	38	49	5	9	69	110 9
Snapper	*Pagrus auratus*	Species	75562	0	926	0	0	0	0
Snoek/Snake Mackerel	*Thyrsites atun*	Species	499858	0	17	0	0	0	0
Jacks	*Carangidae*	Family	8157	0	101	0	0	0	0
Breams	*Pagrus*	Genus	8172	0	147	0	0	0	0
Galaxiids	*Galaxias*	Genus	51242	0	0	0	19	0	0
Trevally	*Pseudocaranx*	Genus	349645	0	11	0	0	0	0
Skipjack tuna	*Thunnini*	Tribe	186749	0	7	0	0	0	0

Appendix C SEV Data

Current SEV Sores

Function category	Function	Variable	Te Otamanui Stream	Mangaheka Stream	Watercourse M13
		Vchann	0.100	0.100	0.100
		Vlining	0.780	0.780	0.780
		Vpipe	0.300	0.300	0.300
	NFR	=	0.098	0.098	0.098
		Vbank	0.140	0.160	0.400
		Vrough	0.260	0.320	0.260
Hydraulic	FLE	=	0.036	0.051	0.104
		Vbarr	0.300	0.300	1.000
	CSM	=	0.300	0.300	1.000
		Vchanshape	0.200	0.200	0.200
		Vlining	0.780	0.780	0.780
	CGW	=	0.587	0.587	0.587
Hydraulic function mean score			0.255	0.259	0.447
		Vshade	0.020	0.040	0.440
	WTC	=	0.020	0.040	0.440
		Vdod	0.400	0.400	0.400
	DOM	=	0.400	0.400	0.400
		Vripar	0.100	0.200	0.100
		Vdecid	1.000	0.950	0.950
biogeochemical	OMI	=	0.100	0.195	0.098
		Vmacro	0.440	0.130	0.130
		Vretain	0.200	0.200	0.200
	IPR	=	0.200	0.130	0.130
		Vsurf	0.289	0.352	0.269
		Vripfilt	0.280	0.260	0.320
	DOP	=	0.285	0.306	0.295
Biogeochemical function mean score			0.201	0.214	0.272
		Vgalspwn	1.000	1.000	1.000
		Vgalqual	0.000	0.000	0.000
		Vgobspwn	1.000	1.000	1.000
habitat provision	FSH	=	0.500	0.500	0.500
		Vphyshab	0.329	0.365	0.268
		Vwatqual	0.044	0.048	0.128
		Vimperv	0.700	0.700	1.000
	HAF	=	0.351	0.369	0.416
Habitat provision function mean score			0.425	0.435	0.458
		Vfish			
	FFI	=			
		Vmci			
		Vept			
Biodiversity		Vinvert			
	IFI	=			
		Vripcond	0.120	0.140	0.120
		Vripconn	0.650	0.618	0.650
	RVI	=	0.078	0.086	0.078
Biodiversity function mean score			0.078	0.086	0.078
SEV score			**0.246**	**0.255**	**0.345**

SEV Sores used in ECR Assessment

Function category	Function	Variable	Impact		Restoration	
			Watercourse M13		Mangaheka Stream	
			SEVi-P	SEVi-I	SEVm-C	SEVm-P
Hydraulic		Vchann	0.000	0.100	0.000	0.220
		Vlining	0.000	0.880	0.000	0.840
		Vpipe	0.000	0.300	0.000	0.300
	NFR	=	0.000	0.108	0.000	0.128
		Vbank	0.000	0.400	0.000	0.700
		Vrough	0.000	0.940	0.000	0.800
	FLE	=	0.000	0.376	0.000	0.560
		Vbarr	0.000	1.000	0.000	1.000
	CSM	=	0.000	1.000	0.000	1.000
		Vchanshape	0.000	0.200	0.000	0.480
		Vlining	0.000	0.880	0.000	0.840
	CGW	=	0.000	0.653	0.000	0.720
Hydraulic function mean score			0.000	0.534	0.000	0.602
biogeochemical		Vshade	0.000	0.860	0.000	0.580
	WTC	=	0.000	0.860	0.000	0.580
		Vdod	0.000	0.600	0.000	0.675
	DOM	=	0.000	0.600	0.000	0.675
		Vripar	0.000	1.000	0.000	0.600
		Vdecid	0.000	1.000	0.000	1.000
	OMI	=	0.000	1.000	0.000	0.600
		Vmacro	0.000	0.910	0.000	0.880
		Vretain	0.000	0.200	0.000	0.200
	IPR	=	0.000	0.200	0.000	0.200
		Vsurf	0.000	0.269	0.000	0.591
		Vripfilt	0.000	0.620	0.000	0.550
	DOP	=	0.000	0.445	0.000	0.570
Biogeochemical function mean score			0.000	0.621	0.000	0.525
habitat provision		Vgalspwn	0.000	1.000	0.000	1.000
		Vgalqual	0.000	0.250	0.000	0.750
		Vgobspwn	0.000	1.000	0.000	1.000
	FSH	=	0.000	0.625	0.000	0.875
		Vphyshab	0.000	0.653	0.000	0.812
		Vwatqual	0.000	0.318	0.000	0.263
		Vimperv	0.000	1.000	0.000	0.300
	HAF	=	0.000	0.656	0.000	0.547
Habitat provision function mean score			0.000	0.641	0.000	0.711
Biodiversity		Vfish				
	FFI	=				
		Vmci				
		Vept				
		Vinvert				
	IFI	=				
		Vripcond	0.000	0.800	0.000	0.685
		Vripconn	0.000	0.650	0.000	0.585
	RVI	=	0.000	0.520	0.000	0.401
Biodiversity function mean score			0.000	0.520	0.000	0.401
SEV score			**0.000**	**0.587**	**0.000**	**0.571**