VIRIDIS
Environmental Consultants

Ecological Impact Assessment

Milldale - Stages 10-13

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Cover photo: Isolated exotic trees in pasture in the Stage 13 area proposed to be developed at Milldale, Auckland (photo source: Viridis 2024).

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STATEMENT OF QUALIFICATIONS AND EXPERIENCE

Mark Delaney (Co-author)

I am a Director and Lead Ecologist at Viridis Limited (Viridis). Viridis is a small consultancy specialising in ecology and environmental science. I have been employed at Viridis since December 2022.

I hold the qualification of a Master of Science in Ecology and Conservation from Massey University, which I completed in 2007. I am a full member of the Environmental Institute of Australia and New Zealand and the New Zealand Freshwater Sciences Society.

I have 15 years of professional experience in the field of ecology, including roles such as Senior Ecologist at Bioresearches Group Limited and Ecology Research Technician at Massey University. My experience includes conducting freshwater and terrestrial ecological impact assessments for both urban and rural developments, as well as ecological restoration and monitoring. I have provided ecological input—such as fieldwork, reporting, and reviewing—for various stages of the Milldale urban development, including the Milldale North and Wainui West Plan Changes, as well as Stages 7, 8, and 9. Additionally, I have served as the lead project ecologist for several approved projects under the COVID-19 Recovery (Fast-track Consenting) Act 2020, including the Auckland Surf Park Community, Beachlands housing development, Botanic Riverhead development, Brickfields Scott Road development, Melia Place development, Unitec Residential Development – Wairaka Stage 1, and the Te Whenua Haa Ora, Wellsford North and Verran Mews development.

I confirm that, in my capacity as a co-author of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

Brittany Pearce (Co-author)

I am an Ecologist at Viridis. Viridis is a small consultancy specialising in ecology and environmental science. I have been employed at Viridis since February 2023.

I hold the qualifications of a Bachelor of Science in Biological Sciences from the University of Auckland, which I completed in 2017. I am a full member of the Environmental Institute of Australia and New Zealand.

I have more than five years of professional experience in the ecological consulting field, including ecologist roles at Bioresearches Group Limited and Cato Bolam Consultants Limited. My experience includes freshwater and terrestrial ecological impact assessments for urban and rural developments, ecological restoration, and ecological monitoring. I have provided ecological input—such as field work, reporting and reviewing—for other stages of the Milldale urban development, including the field work and reporting for the Milldale North and Wainui West Plan Changes, and quarterly wetland vegetation monitoring for Stage 7. Additionally, I have been involved with field work and reporting for approved projects under the COVID-19 Recovery (Fast-track Consenting) Act 2020, including the Auckland Surf Park Community and Beachlands housing development.

I confirm that, in my capacity as a co-author of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

Annabelle Coates (Reviewer)

I am a Senior Ecologist at Viridis. Viridis is a small consultancy specialising in ecology and environmental science. I have been employed at Viridis since February 2023.

I hold the qualifications of Bachelor of Science, which I completed in 2007 and a Master of Science in Environmental Science from the University of Canterbury, which I completed in 2013. I am a full member of the Environmental Institute of Australia and New Zealand and am a Certified Environmental Practitioner (CEnvP).

I have more than 11 years of professional experience in the ecological consulting field, including roles such as ecologist roles at Bioresearches Group Limited and Opus International Consultants Limited (now WSP New Zealand Limited). My experience includes conducting freshwater, terrestrial and coastal ecological impact assessments for both urban and rural developments, as well as ecological restoration and monitoring. I have provided ecological input—such as reporting and reviewing—for stages 7-9 of the Milldale urban development. Additionally, I have been involved with reporting and reviewing for approved projects under the COVID-19 Recovery (Fast-track Consenting) Act 2020, including the Botanic Riverhead development and Wellsford North.

I confirm that, in my capacity as a reviewer of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

1 INTRODUCTION

This report has been prepared in support of the application by Fulton Hogan Land Development (FHLD) for a resource consent to the Environmental Protection Authority (EPA) under the Fast-Track Approvals Act 2024 (FTAA).

Resource consent is required for bulk earthworks, subdivision, streamworks, water permits and discharge consents for the development of 623 residential lots, 27 residential super lots, jointly owned access lots (JOALS) and roads to vest, reserves to vest, and all associated works, landscaping and infrastructure.

The site subject to this application is located within the Milldale development and is referred to as the Milldale Stages 10 – 13 subdivision areas ('the site'; Figure 1). The site consists of land covered by Lot 9006 DP 602895; Lot 9007 DP 602895; Lot 3 DP 151229; Lot 1 DP 147739; Lot 1 DP 488814; Lot 2 DP 488814; Lot 3 DP 488814; and Lot 2 DP 147739. Stages 10 – 13 are located within the northern and western extents of the Milldale development and comprise the remaining undeveloped greenfield stages of Milldale.

Overall, the site covers a total area of approximately 71 ha. The site is bordered by Wainui Road to the north, Lysnar Road to the north-east, and undeveloped land to the west. Previously consented Milldale stages are located to the south of the site including Stages 5 – 8 and the Milldale Town Centre.

A full description of the site and surrounds is provided in the application AEE.

Figure 1. Map showing the boundaries of Milldale Stages 10-13 proposed for urban development under the FTAA.

1.1 Assessment Scope

Viridis Limited (Viridis) was engaged by FHDL to undertake an Ecological Impact Assessment (EcIA) to accompany and inform the application under the FTAA.

The EcIA identifies and discusses the existing terrestrial and freshwater ecological values present within the site and surrounding environment, and determines the impact of the proposed development and associated activities on those values. Recommended measures to avoid, remedy, or mitigate adverse effects on terrestrial and freshwater ecology are provided as necessary. Recommendations for addressing anticipated residual adverse effects on the ecological values of the site through enhancement are also made where applicable.

The assessment has been informed by relevant regulations, including the Auckland Unitary Plan – Operative in Part (AUP-OP), the National Policy Statement for Freshwater Management 2020 (NPS-FM), the National Environmental Standards for Freshwater 2020 (NES-F) and the National Policy Statement for Indigenous Biodiversity 2023 (NPS-IB).

2 METHODOLOGY

2.1 Overview

The assessment included a desktop review and site visit, undertaken by a suitably qualified freshwater ecologist. The desktop review involved an examination of current and historical aerial imagery of the site, during which factors such as changes in vegetation and surface water were noted. A review of data on Auckland Council's Geomaps (such as current biodiversity layers, predicted watercourses and site topography) was also undertaken.

Project site assessments were undertaken during August 2023, and November and December 2024. The presence and extent of freshwater and terrestrial features within the property and surrounding area were recorded and the quality of any associated habitat was visually assessed, in accordance with the methodology detailed in Sections 2.2 through 2.3, below.

Watercourse classifications and wetland mapping for the offset site (173 Upper Ōrewa Road, Wainui) were undertaken by Bioresearches Group Limited during 2022. These classifications and extents have been utilised for this assessment and for preparation of the offset/compensation package (Section 6.3).

In preparation for on-site assessments, recent and historical aerial imagery was reviewed, alongside available information regarding hydrology, topography, and mapped ecosystem types. Previous ecological reporting undertaken by consultants for the Milldale area have been drawn upon where applicable.

2.2 Terrestrial Ecology

The vegetation within the property was assessed during the site visit. The botanical value of both exotic and native vegetation was recorded, and the quality, extent and connectivity of vegetation was considered. Terrestrial vegetation coverage was mapped to a high level via aerial imagery and based on site observations.

Terrestrial fauna habitat was assessed qualitatively, in conjunction with database reviews (e.g., Department of Conservation's (DOC) ARDs, Bioweb, eBird and iNaturalist) and considered indigenous lizards, birds, and bats[1]. A desktop review of local bat and herpetofauna records from specific databases was undertaken. Previous fauna survey results undertaken by other consultancies was reviewed where available. Opportunistic sightings of avifauna were recorded, and the conservation status of the species, as defined in Robertson et. al. (2021), was noted.

The ecological value of terrestrial features were determined in accordance with the methodology prescribed in the Environment Institute of Australia and New Zealand (EIANZ) guidelines (refer Section 2.4).

2.3 Freshwater Ecology

2.3.1 Watercourses

During the site assessment, the presence and extent of streams within the site were noted and the quality of freshwater habitat was visually assessed. Watercourses were classified in accordance with the AUP-OP definitions to determine ephemeral, intermittent, or permanent status. Ecological factors such

[1] The authors have been certified by the Department of Conservation Bat Recovery Group to assess high risk roost trees (competency 3.3).

as hydrological regime, aquatic habitat and riparian environment were assessed. Modifications to natural flow paths or the presence of artificial drainage channels were also noted. Riparian and catchment information was also reviewed alongside the NIWA New Zealand Freshwater Fish Database (NZFFD) for species potentially present within the site.

Stream Ecological Valuation

The Stream Ecological Valuation (SEV) methodology (Storey et al., 2011) enables the overall function of the streams to be assessed and compared to the quality of other streams in the Auckland region. It considers 16 different stream functions that are grouped into four categories: hydraulic, biogeochemical, habitat provision and biodiversity. Each function is scored and the SEV score is an average of all function scores. The SEV procedure involves the collection of habitat data in the field (e.g., stream depth, substrate type and riparian cover), and sampling of fish communities and macroinvertebrates (e.g., insect larvae and snails) can be incorporated where appropriate as indicators of habitat quality. Desktop information is also utilised (e.g. for assessing the percentage of riparian vegetation and impervious surfaces).

Seven SEV assessments were undertaken across representative reaches within each Milldale stage (10-13). SEV assessments were undertaken on 26th November and 2nd December 2024. In January 2025, three additional SEVs were also undertaken in the offset site (173 Upper Orewa Road, Wainui).

Data was entered into a SEV calculator to provide a value between 0 (severely degraded with negligible ecological value) and 1 (a pristine stream with very high ecological value).

Macroinvertebrates

Macroinvertebrate samples were collected within the SEV reaches where sufficient aquatic habitat persisted. Samples were collected using a D-net and followed the protocol 'C2: soft-bottomed, semi-quantitative' for macroinvertebrate sampling (NEMS 2022). All samples were preserved in 70% ethanol for later identification and enumeration.

Benthic macroinvertebrates were identified and counted to a level suitable for calculating taxa richness, abundance, EPT[2] taxa richness and % EPT, macroinvertebrate community index (MCI) and quantitative MCI (QMCI) following protocols outlined in NEMS (2022) and Stark et al. (2001). Due to their sensitivity to poor water quality and habitat, an increased proportion of EPT taxa within the overall community can indicate higher stream health and water quality. MCI and QMCI indicate better habitat and water quality. Scores were compared to the attribute bands and national bottom line (NBL) defined in the NPS-FM. The relevant NPS-FM attribute bands and NBLs are reproduced in Table 1.

[2] Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) taxonomic groups that are typically sensitive to poor quality water and habitat.

Table 1. Estimates of stream health using MCI and QMCI indices as per the NPS-FM (2020).

Attribute band	Description	Numeric attribute states	
		MCI	QMCI
A	Pristine conditions	>130	≥6.5
B	Mild pollution	≥110 and <130	≥5.5 and <6.5
C	Moderate pollution	≥90 and <110	≥4.5 and <5.5
National bottom line		90	4.5
D	Severe pollution	<90	<4.5

2.3.2 Wetlands

The Ministry for the Environment (MfE) wetland delineation protocols (MfE 2022) were used to determine whether an area met the definition of a 'natural inland wetland' under the NPS-FM. Assessments were carried out within the 'growing season' for the Auckland region (MfE, 2021). As per the Clarkson (2014) vegetation tool methods, plant species within putative wetlands were identified, and each species was assigned one of the below wetland indicator status ratings (Clarkson et al., 2021):

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

Based on the dominance and prevalence of hydrophytic (wetland) species, natural inland wetland presence/absence was determined. Where results of the vegetation assessment remained uncertain or conditions were modified or atypical, hydric soils and hydrological assessments were undertaken.

Value assessments included identifying native and exotic vegetation species, examining the structural tiers within wetland areas, and assessing the quality and abundance of aquatic habitats. Signs of wetland degradation such as pugging and grazing from stock access, structures such as culverts impeding hydrological function, and weed infestation were also noted.

2.4 Ecological Impact Assessment

The ecological value of the site, relating to species, communities and systems, were determined as per the EIANZ Ecological Impact Assessment guidelines (EcIAG) for use in New Zealand (Roper-Lindsay et. al. 2018). This report also identifies statutory guidelines and regulation with respect to ecology (such as watercourses, wetlands, high value vegetation and habitats) where relevant to the proposed development. Using this framework, the EcIAG describes a simple ranking system to assign value to species as well as other matters of ecological importance such as species assemblages and levels of organisation. The overall ecological value is then determined on a scale from '*Negligible*' to '*Very High*'.

Criteria for describing the magnitude of effects are given in Chapter 6 of the EcIAG. The level of effect can then be determined through combining the value of the ecological feature/attribute with the score or rating for magnitude of effect to create a criterion for describing level of effects (Table 1). A moderate level of effect requires careful assessment and analysis of the individual case. For moderate levels of effects or above, measures need to be introduced to avoid through design, or appropriate mitigation needs to be addressed (Roper-Lindsay et al. 2018).

Table 2. Criteria for describing the level of effects (from Roper-Lindsay et al. 2018).

Magnitude of Effect	**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

Notes: Where text is italicised, it indicates 'significant effects' where mitigation is required.

3 SITE DESCRIPTION

3.1 Site Context

3.1.1 Ecological district

The site is in the Rodney Ecological District. The district is characterised by hill country, ranging from steep to rolling, indented on the eastern coastline by sand dunes in the northeast. Parts of the district remain relatively unmodified and retain some extensive areas of bush. However, many of these areas are fragmented and isolated, with bush, wetlands, dunes, coastal environments and scrub no longer directly connected to each other. The rest of the district has been heavily modified, with large amounts of vegetation cleared to accommodate pasture. The district also contains several urban and semiurban areas, including Warkworth, Wellsford, and the Ōrewa-Silverdale-Whangaparāoa area.

The Rodney Ecological District would have historically been heavily forested. Vegetated remnants within the district included mixed podocarp-hardwood forest with tānekaha (*Phyllocladus trichomanoides*) and some areas of kauri (*Agathis australis*). Regenerating areas generally consist of conifers, including kauri, rimu (*Dacrydium cupressinum*), tānekaha, tōtara (*Podocarpus totara*) and kahikatea (*Dacrycarpus dacrydiodies*), with kānuka (*Kunzea ericoides*), mānuka (*Leptospermum scoparium*) and tree ferns interspersing. Coastal forest contains pōhutukawa (*Metrosideros excelsa*) and broadleaved species such as pūriri (*Vitex lucens*), with wetland areas of mangroves (*Avicennia marina*) and saltmarsh where habitat is suitable. Wetland habitat has been greatly reduced.

Fauna habitat would have degraded and reduced over time as vegetation clearance and conversion to farmland occurred. Currently, the district contains a number of important breeding areas for birds, generally concentrated around the coast. Existing wetlands are known to support pāteke (*Anas chlorotis*) and banded rails (*Gallirallus philippensis*), however fernbird (*Poodytes punctatus*) habitat has been significantly reduced through land modification. Kākāriki (*Cyanoramphus novaezelandiae*) and North Island kāka (*Nestor meridionalis*) are known to occur in areas of remnant forest, however they are generally present in low numbers.

3.1.2 Local context

The site is in one of the most heavily modified parts of the district. The local area has been highly modified for farming, and more recently for urban development. The site is in the wider Ōrewa River catchment which flows in a generally easterly direction to the coast. The topography of the land varies from gently to moderately sloping, most of which remains in agricultural use at present with a dominant cover of managed pasture. Some of the land has been used for crops (e.g., turnips, kūmara) in recent years. Low density rural-residential dwellings and associated farm ancillary buildings are present. Natural wetlands and watercourses are present, along with artificial drains and ponds. The surrounding land uses include rural residential living and agricultural farming to the north and west; however, the site is immediately adjacent to the medium-high density suburbia of the Milldale community to the south and east (Figure 2).

Historically (pre-human era), much of the site is expected to have contained kauri, podocarp, broadleaved forest (WF11; Singers et al. 2017). This ecosystem type would have supported a diverse range of invertebrates, amphibians, reptiles, birds and bats (Singers et. al. 2017). However, a review of historical aerial imagery indicates that the site, and much of the surrounding landscape, was cleared more than 80 years ago for agricultural purposes (Figure 3).

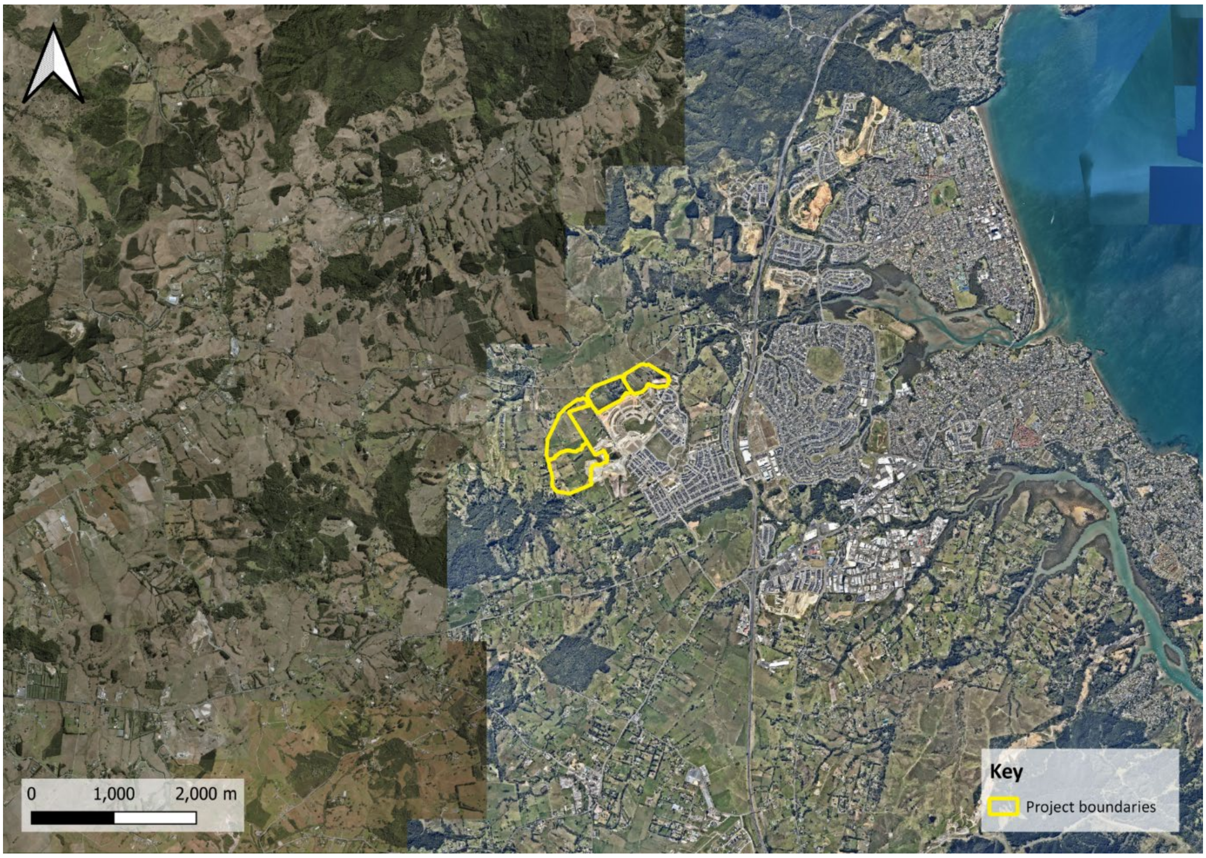

Figure 2. Map showing the site in relation to the surrounding environment (Aerial source: Google Earth).

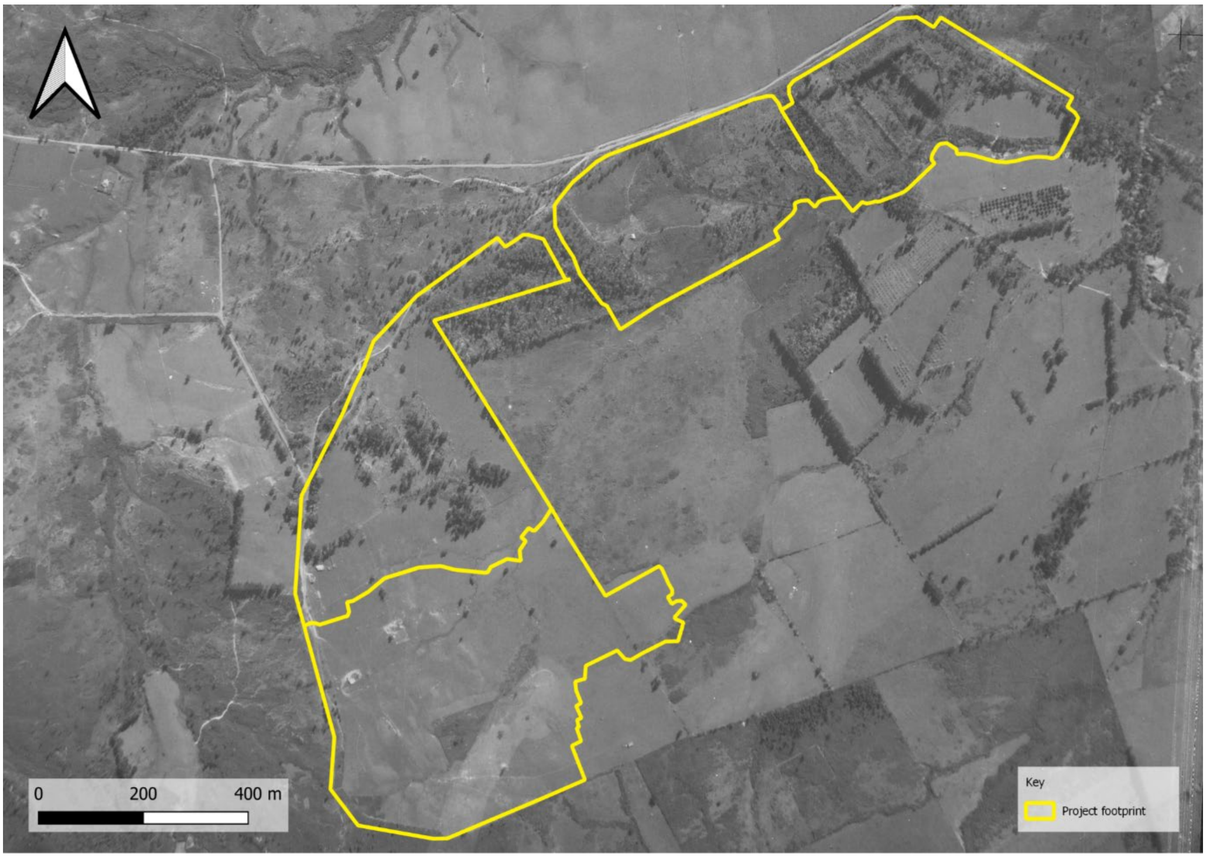

Figure 3. Map of historic aerial imagery of the site from 1940, showing agricultural land use (Aerial source: Retrolens).

4 TERRESTRIAL ECOLOGY

4.1 Terrestrial Vegetation

4.1.1 Vegetation overview

Vegetation within the site was classified and mapped using observations from site visits and aerial imagery (Appendix A). Overall, tree and shrub vegetation was sparse across the site, and native vegetation was present in only small amounts. The AUP-OP does not identify any areas of Significant Ecological Area (SEA) within the site. The nearest SEA is approximately 70 meters west of the Stage 13 boundary.

Most of the site was dominated by managed pasture used for agricultural and horticultural purposes. Vegetative cover was limited, except for the eastern part of Stage 11, which featured a significantly higher density of trees compared to the rest of the site. Elsewhere, tree vegetation was largely confined to scattered exotic trees along riparian areas, isolated shelterbelts, and individual trees in paddocks.

Riparian vegetation was generally sparse. A relatively small riparian area along Watercourse 21 (Appendix B), located in Stage 11, contained denser vegetation comprising mixed native and exotic trees. Outside of these areas, riparian vegetation consisted only of sporadic exotic trees and occasional natives.

Overall, the vegetation within the site was assessed as being of **low** ecological value. The botanical composition was dominated by exotic and common native species, alongside pest plants, offering limited ecological significance. The tree vegetation provided poor ecological connectivity and lacked sufficient corridors to support the movement of indigenous fauna.

4.1.2 Exotic vegetation

The vegetation within the site was dominated by exotic species (Figure 4-Figure 6, Appendix A). Exotic trees constituted most of the canopy cover, including a wide variety of species identified by Viridis and Arborlab Limited (2025). The most observed tree species within the site were poplar (*Populus nigra*), pine (*Pinus radiata* & *P. pinaster*), crack willow (*Salix* x *fragilis*), redwood (*Sequoia sempervirens*), sheoak (*Casuarina cunninghamiana*), swamp cypress (*Taxodium distichum*), gum tree (*Eucalyptus* sp.) and English oak (*Querus robur*).

Other exotic tree species included sweetgum (*Liquidambar styraciflua*), Japanese cedar (*Cryptomeria japonica*), camphor tree (*Cinnamomum camphora*), silky oak (*Grevillea robusta*), coral tree (*Erythrina* x *sykesii*), macrocarpa (*Cupressus macrocarpa*), queen palm (*Syagrus romanzoffiana*), Mexican fan palm (*Washingtonia robusta*), Norway maple (*Acer platanoides*), silver wattle (*Acacia dealbata*), ginkgo (*Ginkgo biloba*), magnolia (*Magnolia campbellii*), port wine magnolia (*Michelia figo*), and juniper (*Juniperus communis*).

Garden/amenity species observed included fig tree (*Ficus carica*), olive (*Olea europaea*), feijoa (*Feijoa sellowiana*), pear (*Pyrus communis*), lemon (*Citrus* x *limon*), Japanese camellia (*Camellia japonica*), tulepo (*Nyssa sylvatica*), canna lily (*Canna indica*) bottlebrush (*Callistemon viminalis*), fir tree (*Albies* sp.), and brush cherry (*Syzygium australe*).

In the pasture areas, isolated trees and shelterbelts consisted mainly of pine, poplar, crack willow, sheoak, and redwood (Figure 6). Small stands of treeland and amenity plantings, often featuring mixed exotic and native species, were more prevalent around rural residential dwellings.

The eastern part of Stage 11 was characterized by mixed exotic-dominant vegetation, including a stand of pine and areas of planted mixed exotic and native trees and shrubs. Some of this vegetation was within the riparian margins of watercourses 21, 35 and 37 (Appendix A). Around the constructed pond in Stage 11, mature exotic trees such as swamp cypress were present. One stand of mature gum trees (*Eucalyptus* sp.) was present within the eastern part of Stage 10, however this area lacked understorey vegetation entirely.

While pest plant presence was generally low across the site, the eastern portion of Stage 11 had higher infestations. Listed[3] pest species observed included crack willow, hawthorn (*Crataegus monogyna*), Sydney golden wattle (*Acacia longifolia*), coastal banksia (*Banksia integrifolia*), English ivy (*Hedera helix*), monstera (*Monstera deliciosa*), watsonia (*Watsonia meriana*), Spanish heath (*Erica lusitanica*), palm grass (*Setaria palmifolia*), gorse (*Ulex europaeus*), tuber ladder fern (*Nephrolepis cordifolia*) and Chinese fan palm (*Trachycarpus fortunei*).

a)

b)

Figure 4. Examples of Stage 10 vegetation, showing a) an isolated pine tree within the riparian margin of watercourse 42, and b) poplars and a stand of gum trees.

a)

b)

[3] As per the Auckland Regional Pest Management Plan 2020-2030.

c) d)

Figure 5. Vegetation within Stage 11, showing a-b) examples of exotic and native tree vegetation, and c-d) showing prevalent ivy under pine tree stand, and a high weed abundance around exotic tree and amenity plantings.

a) b) c) d)

Figure 6. Isolated exotic trees such as crack willow, poplars and pines within a & b) Stage 12, and c & d) Stage 13 of the site.

4.1.3 Indigenous vegetation

There were no native-dominant areas of vegetation within the site. Where present, indigenous tree vegetation was largely restricted to planted specimens, primarily located in the eastern area of Stage 11 amongst exotic species, and along the riparian margin of Watercourse 21. A small number of well-established cabbage trees (*Cordyline australis*) were present within the riparian margin of Watercourse 37 (Figure 7). Small trees such as *Pittosporum* sp. were occasionally observed planted in rows along fences in paddock areas.

In addition, some young planted native vegetation was observed along the roadside at Lysnar Road (eastern boundary of Stage 10) and persisted in the presence of pest plant species.

Indigenous species identified within the site included kānuka, kahikatea, tōtara, cabbage tree, lemonwood (*Pittosporum eugenioides*), kawaka (*Libocedrus plumosa*), flax (*Phormium tenax*), karo (*Pittosporum crassifolium*), māpou (*Myrsine australis*), kōhūhū (*Pittosporum tenuifolium*), mānuka (*Leptospermum scoparium*), and karamū (*Coprosma robusta*).

a) **b)** **c)** **d)**

Figure 7. Examples of indigenous vegetation within the site, showing a) exotics and scattered natives (e.g., cabbage trees, tōtara) within the east of Stage 11, b) karamū amongst garden vegetation within Stage 11, c) cabbage trees within the riparian margin of watercourse 36, and d) planted natives such as mānuka and flax along Lysnar Road in the east of Stage 10.

4.1.4 Terrestrial connectivity and ecological function

As the terrestrial vegetation was largely limited, and confined mostly to exotic tree stands, exotic-dominant areas with scattered natives and pest plants, and isolated trees and shelterbelts, edge effects were considered to be high throughout the site. Edge communities increase with fragmentation of vegetation within a landscape, and are heavily influenced by increased exposure to sunlight, wind and competition from pest plants. These factors restrict establishment of some native flora and fauna to forest interiors. Connectivity between areas of vegetation is important to facilitate ecological function, and loss of connectivity can impair reproductive function for both flora and fauna communities.

There was little habitat available within the site for highly mobile fauna such as birds and bats, that move between habitats while foraging, nesting and roosting. There was significantly higher quality habitat in the surrounding environment, including the SEA within the Ōrewa River Stewardship Area to the east which provides a corridor to the Ōrewa Estuary, the extensive Nukumea Scenic Reserve approximately 1.5 km to the north, and areas further afield including Okura Bush, Riverhead Forest and forested areas north of Ōrewa. The vegetation across the site provides very little linkage or stepping stones for species moving between these habitats and others in the wider Auckland area.

The connectivity and ecological function of the vegetation to the surrounding area was of **low** ecological value.

4.2 Terrestrial Fauna Habitat

4.2.1 Avifauna (Birds)

No formal avifauna surveys were undertaken, however birds seen/heard were opportunistically recorded during multiple site visits. Table 3 provides a list of species that are expected to be present within the site, at least periodically. Records were retrieved from eBird.org for nearby sites (accessed December 2024), and observations made during site visits in the general Milldale area by Viridis ecologists and various other ecologists in recent years were drawn upon (e.g., RMA Ecology Ltd, 2020).

The avifauna community within the Milldale area is relatively diverse, albeit consisting largely of a combination of common exotic and native species that are abundant in the wider Auckland region including urban, urban fringe, and rural areas. Although not observed, occasional visits from New Zealand pipit (*Anthus novaeseelandiae* – At Risk, Naturally Uncommon) to pasturelands may occur, but pipit numbers are expected to be very low if present, as they naturally occur in limited numbers.

Avifauna habitat throughout much of the site was fairly limited to isolated exotic trees and shelterbelts and managed pasture. The exotic-dominant treeland and mixed exotic-dominant tree habitat in the east of Stage 11 provided the best quality habitat within the site for feeding, roosting and nesting indigenous species. However, this habitat was patchy and isolated from larger areas of dense indigenous forest habitat that would provide significantly hight quality habitat. Artificial ponds provide some limited surface water habitat for waterfowl. Overall, the avifauna ecological values of the site were considered to be **low.**

Table 3. Birds known to be present in the site and wider Milldale area.

Common name	Species name	Conservation status	Observed on site
Australian magpie	*Gymnorhina tibicen*	Introduced and Naturalised	✓
Australasian harrier	*Circus approximans*	Not Threatened	✓
Blackbird	*Turdus merula*	Introduced and Naturalised	
Black backed gull	*Larus dominicanus dominicanus*	Not Threatened	
Canada goose	*Branta canadensis*	Introduced and Naturalised	✓
Fantail	*Rhipidura fuliginosa placabilis*	Not Threatened	✓
Goldfinch	*Carduelis carduelis*	Introduced and Naturalised	
Grey warbler	*Gerygone igata*	Not Threatened	
Kererū	*Hemiphaga novaeseelandiae*	Not Threatened	
Kingfisher	*Todiramphus sanctus vagans*	Not Threatened	✓
Mallard	*Anas platyrhynchos*	Introduced and Naturalised	✓
Myna	*Acridotheres tristis*	Introduced and Naturalised	✓
Paradise shelduck	*Tadorna variegata*	Not Threatened	✓
Pheasant	*Phasianus colchicus*	Introduced and Naturalised	✓
Pied stilt	*Himantopus himantopus*	Not Threatened	
Pūkeko	*Porphyrio melanotus melanotus*	Not Threatened	✓
Silvereye	*Zosterops lateralis lateralis*	Not Threatened	
Shining cuckoo	*Chrysococcyx lucidus*	Not Threatened	
Skylark	*Alauda arvensis*	Introduced and Naturalised	
Song thrush	*Turdus philomelos*	Introduced and Naturalised	
Sparrow	*Passer domesticus*	Introduced and Naturalised	
Spurwinged plover	*Vanellus miles novaehollandiae*	Not Threatened	✓
Tūī	*Prosthemadera novaeseelandiae novaeseelandiae*	Not Threatened	✓
Welcome swallow	*Hirundo neoxena neoxena*	Not Threatened	✓
White faced heron	*Egretta novaehollandiae*	Not Threatened	✓
Yellowhammer	*Emberiza citrinella*	Introduced and Naturalised	

4.2.2 Herpetofauna (Lizards)

Herpetofauna (reptiles and amphibians) comprise a significant component of New Zealand's terrestrial fauna. There are currently at least 135 endemic herpetofauna taxa recognised in New Zealand (Hitchmough et al., 2021), 85.9% of which are considered 'Threatened' or 'At-Risk'. All indigenous reptiles and amphibians are legally protected under the Wildlife Act 1953, and vegetation and landscape features that provide significant habitat for native herpetofauna are protected by the Resource

Management Act 1991 (RMA). Statutory obligations require management of resident reptile and amphibian populations if they are threatened by a disturbance i.e., land development.

A review of the Department of Conservation's Herpetofauna database identified six lizard species recorded within 10 km of the sites (accessed November 2024). These included copper skink (*Oligosoma aeneum* – At-Risk, declining), ornate skink (*Oligosoma ornatum* – At-Risk, declining), forest gecko (*Mokopirirakau granulatus* – At-Risk, declining), elegant gecko (*Naultinus elegans* – At-Risk, declining), Pacific gecko (*Dactylocnemis pacificus* – not threatened), and moko skink (*Oligosoma moco* – At-Risk, relict) (Hitchmough et al., 2021).

During the site visits, opportunistic observations of potential lizard habitat were made. Potential skink habitat was present in the form of dense, rank grasses throughout many areas on site. Stage 11 contained areas of unmaintained garden/weed species such as English ivy (*Hedera helix*), tuber ladder fern and agapanthus (*Agapanthus praecox*), that formed dense groundcover/shrubby areas suitable for skinks. Copper skink are the most likely species to be present on the site, though would only be expected in low numbers. They would be confined to isolated areas of suitable habitat (thick rank grass, log/rock/vegetation debris) due to frequent disturbance generated by ongoing farm activities. Several invasive plague skinks (*Lampropholis delicata* – introduced/naturalised) were the only lizards observed on the site and this species is expected to be abundant.

Ornate skinks are generally found in forested areas and shrubland, amongst dense leaf litter, low foliage, thick rank grass and under rocks or logs, and thus are unlikely to be present. The lack of mature native vegetation and understorey also make it highly unlikely that arboreal gecko species persist anywhere on the site.

The areas of suitable habitat for skinks within the site had poor connectivity, reducing their ecological value significantly. However, the ecological values of the herpetofauna habitat were conservatively assessed to be **moderate** due to the potential for 'At-Risk' copper skink to be present within the site.

4.2.3 Chiroptera (Bats)

New Zealand has two species of endemic bats on the mainland. The most widespread is the long-tailed bat (*Chalinolobus tuberculatus*, Threatened – nationally critical), although colonies are assumed to be small and their health is largely unknown (O'Donnell et al., 2023).

The lesser short-tailed bat has three described subspecies; the northern lesser short-tailed bat (*Mystacina tuberculata aupourica,* Threatened – nationally vulnerable), the central lesser short-tailed bat (*Mystacina tuberculata rhyacobia,* At-risk – declining) and the southern lesser short-tailed bat (*Mystacina tuberculata tuberculata,* Threatened – nationally increasing) (O'Donnell et al., 2023). There are no known populations of the short-tailed bat on the mainland in the Auckland region, with the closest known population being the northern lesser short-tailed bat population on Te Hauturu-o-Toi/Little Barrier Island.

Bats roost in tree features such as hollows, under split/flaking bark, in dense epiphytes, and also in rocky overhangs. Over the warmer breeding season, large communal roosts occur in similar habitat. Long-tailed bats in particular are known to be highly mobile, with large home ranges and can travel large distances each night during foraging. They have large home ranges (>5,000 ha) and can travel large distances (~25 km) each night during foraging. Long-tailed bats are known to utilise forest edge habitats and will also utilise linear features in the landscape, including vegetation edges, cullies, waterways, and road corridors as they transit between roosts and foraging sites.

No formal bat surveys have been undertaken within the site as a part of this assessment, however, surveys using automatic bat monitors (ABMs) undertaken in 2015 and 2020 within the Milldale area did not detect any bat activity (Opus Limited 2015; RMA Ecology Ltd 2020). These surveys focused on suitable habitat features including old trees, mature exotic shelterbelts and other features that bats utilise for foraging such as streams and open areas next to vegetation. Since those surveys were undertaken, extensive earthworks and residential development have occurred adjacent to the site. The introduction of urban influences to the area, including lighting, noise and disturbance has likely reduced the favourability of the area for bats further.

The closest long-tailed bat records have been recorded within 3.7 km to the northeast of the site in 2015, and within 6 km to the southeast of the site on and adjacent to the Whangaparāoa peninsula in SEA vegetation in 2022/2023 (DOC database accessed May 2024). Due to the low detection rates in the wider area, the Milldale area is not considered to be a high bat use area.

Mature trees within the site such as shelterbelts and single isolated trees (e.g., pines, sheoaks, crack willows) provide potential roosting habitat for bats due to the presence of desirable features such as cavities. However, this vegetation is expected to be of low value due to its exposed and isolated nature. High-quality SEA native bush fragments are in close proximity to the south and southwest of the site; these are expected to provide suitable feeding and roosting habitat for long-tailed bats of significantly higher value compared to the habitat within the site.

It is unlikely that long-tailed bats utilise the low-quality habitat within the site given the higher quality vegetation nearby. Nevertheless, the ecological value of the site for bats was conservatively considered to be **moderate**, as habitat was present and bat presence cannot be ruled out despite reasonable survey effort in recent years.

5 FRESHWATER ECOLOGY

5.1 Watercourses

All watercourses within the site were classified and mapped according to definitions within the AUP-OP as either permanent, intermittent, ephemeral, or artificial (Appendix B). Watercourses that have been modified for farm drainage, but were once natural upon review of historic aerials, have been conservatively mapped as natural streams.

Watercourse classifications were undertaken during August 2023 and re-assessed in November 2024. Where there was uncertainty regarding classification, the conservative approach has been taken for all watercourses.

The watercourses are described in this section. Maps with labelled watercourses and a table showing the criteria met for each watercourse is provided in Appendices B and C, respectively.

5.1.1 Permanent streams

One permanent stream was identified within the site, watercourse 21, which began downstream of Stage 12 and flowed through the site along the southern boundary of Stages 10 and 11 in an easterly direction (Figure 8 & Figure 9, Appendix B). The stream was classified as permanent based on the clear presence of permanent flowing water, stream width and catchment sizes. The stream is a tributary to the Waterloo Creek in the east.

Watercourse 21 had been historically modified for farm drainage, with evidence of straightening, deepening and widening observed. The eastern end of the stream within Stage 10 (approximately 200 m reach) had been diverted and realigned over the past year under an existing consent for the wider Milldale development (Figure 9b). Additional meanders had been created during these works, and riparian revegetation planting undertaken in 2024.

The stream was highly degraded due to the modified agricultural land use, with limited riparian vegetation minimising organic matter inputs, filtration, and shading functions. The substrate was soft-bottomed, and contained high sediment input due to the agricultural land use within the wider catchment.

A review of the NZFFD for the wider Waterloo Creek and Ōrewa River catchment showed shortfin eel (*Anguilla australis* – not threatened) and the pest fish gambusia (*Gambusia affinis* – listed unwanted organism) have been recorded previously. Other indigenous fish species recorded downstream within the wider Ōrewa River catchment included banded kōkopu (*Galaxias fasciatus* – not threatened), longfin eel (*Anguilla dieffenbachii* – At-Risk, declining), īnanga (*Galaxias maculatus* – At-Risk, declining), kōura (*Paranephrops planifrons* – not threatened), freshwater shrimp (*Paratya curvirostris* – not threatened), and giant bully (*Gobiomorphus gobioides* – At-Risk, naturally uncommon) (Dunn et al. 2018).

Previous fish surveys within the permanent stream (the reconstructed area) and within some parts of the now-developed Milldale area have found a small number of shortfin eels only (Opus Limited 2015, RMA Ecology Limited 2020). Poor water quality and potential fish barriers downstream of the site/within Waterloo Creek are likely reasons for low indigenous fish diversity.

Due to its degraded and modified nature, poor water quality and likely presence of only common pollutant-tolerant fish, watercourse 21 was assessed to have a **low** ecological value.

a) **b)**

Figure 8. Photos of watercourse 21 from August 2023, showing a) the western end of Stage 11 downstream of the culvert under Argent Lane, and b) immediately downstream of the riparian vegetation within Stage 11.

a) **b)**

Figure 9. a) Photo of watercourse 21 looking upstream within the west of Stage 11, and b) example of reach that has been recently realigned and the riparian margin planted within Stage 10.

5.1.2 Intermittent streams

Several watercourses within the site have been identified as intermittent streams (Appendix B). The intermittent criteria met by each of the streams is provided in the table in Appendix C. All the intermittent streams identified within the site flow to the permanent stream and are a part of the Waterloo Creek catchment.

Watercourses 12, 35 and 36 had some scattered shading provided by exotic trees such as willows, however, most of the intermittent stream reaches within the site had little riparian vegetation present. In most areas, the riparian margin consisted of pasture that is regularly managed, which provided very limited shading, organic matter input and filtration functions.

All intermittent streams had been modified through works such as artificial deepening, straightening, realignment and channel clearance for farm drainage (Figure 10). This was particularly evident in areas where there was a very incised channel but only a small catchment (e.g., watercourses 35, 36, 42, 43).

The flow within the intermittent streams was very low during all site visits. The substrates were almost entirely silt/soft-bottomed, with very occasional cobbles that had likely been washed down from gravel farm tracks. The streams had low hydrological heterogeneity; run habitat was dominant and an occasional pool had been induced immediately downstream of culverts. Stock had access to the streams in most areas. Instream habitat was limited to slow flowing or stagnant water that would not be expected to provide good quality habitat (Figure 11). It is possible these areas may intermittently support the common and pollution-tolerant shortfin eel, however poor water and habitat quality, and the intermittent nature of the streams, means other species are not expected to be present.

The intermittent streams were considered to be of **low** ecological value across the site, due to their highly modified nature, general lack of riparian vegetation to provide filtration and shading functions, and lack of suitable aquatic habitat.

a) **b)**

Figure 10. a) Watercourse 2 showing narrow and artificially incised channel, and b) watercourse 43 showing straightened and deepened channel.

a) **b)**

Figure 11. a) Lower reach of watercourse 27, and b) watercourse 20.

5.1.3 SEV results

Seven representative SEVs were undertaken within watercourses 2, 20, 26, 35, 36, 42 and 43 (Appendix B & Figure 12). SEV results are summarised in Table 4 and presented in full in Appendix D. The SEV labels within Figure 12 correspond to the columns in Table 4.

The main focus of the SEV assessments within the project site was to provide relative scores for comparison with the offset SEV sites. While there is no prescribed season for SEV assessments, it is acknowledged that conducting these during the drier, warmer months poses some limitations. For instance, some sections of the intermittent streams were dry during the assessments, primarily affecting the 'Vdepth' and 'Vvelocity' functions. These dry sections are assumed to be representative of typical intermittent environments. Where channels were dry, water depths and velocities were estimated based on channel characteristics and observations of similar watercourses in the catchment.

The seven SEVs within the project site scored between 0.25 and 0.36 (out of a maximum of 1), indicating **low** ecological and functional values. Low SEV function scores generally reflect the poor-quality habitat for aquatic fauna and the poor macroinvertebrate diversity (Section 5.1.4), and the highly modified and degraded nature of the channels and riparian margins.

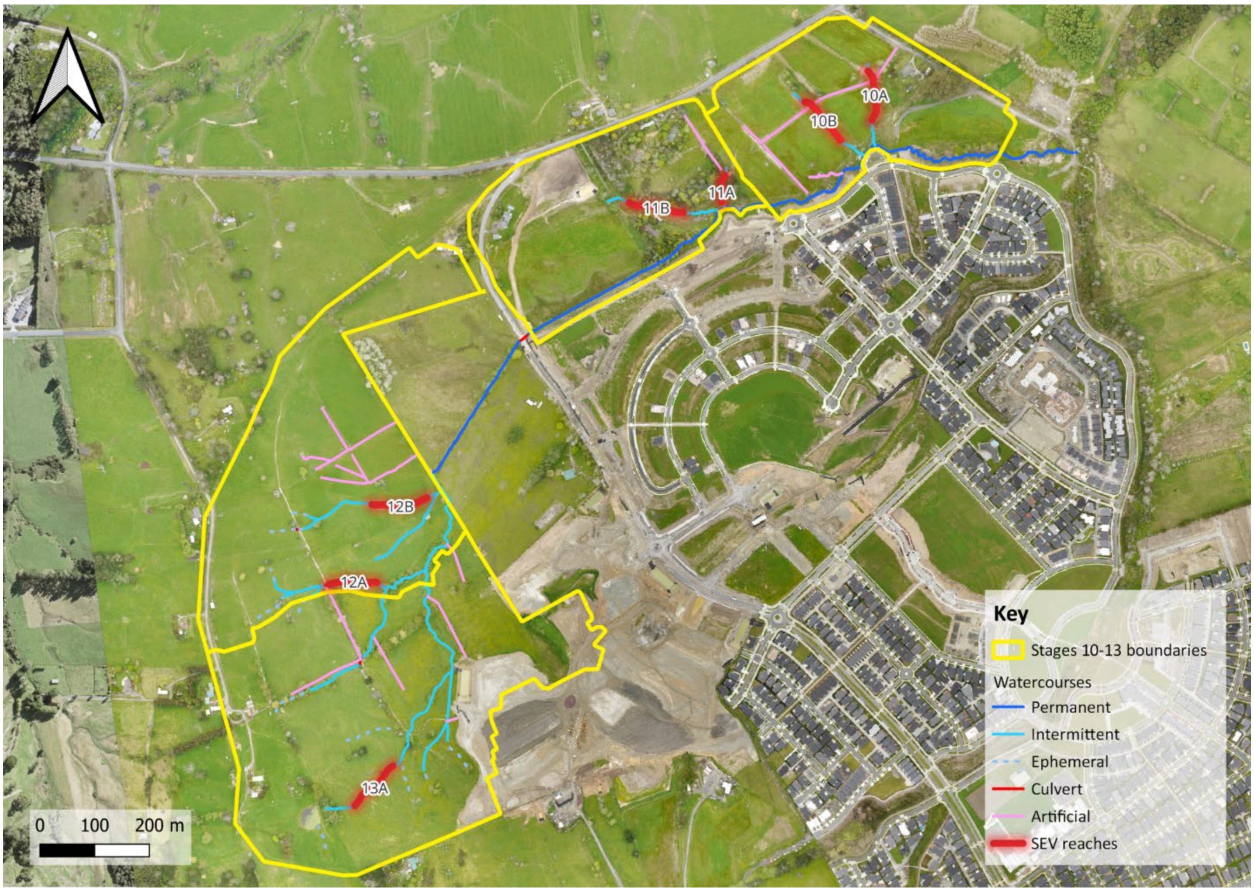

Figure 12. Map of the project site showing locations of SEV assessments undertaken by Viridis.

Previous SEV assessments were undertaken by RMA Ecology Limited and Tonkin & Taylor Limited in October 2017 and 2018 within some of the same watercourses or the same catchments (RMA Ecology Ltd 2020). These assessments returned scores between 0.36 and 0.40, similarly indicating poor stream health, consistent with Viridis' recent findings. While Viridis' SEVs were conducted during summer, the results align closely with those from mid-spring. Some variation in SEV results is to be expected due to factors such as differences in assessment reach locations, agricultural modifications, and the subjective nature of the SEV methodology, which can lead to variability between ecologists.

Results of the SEVs undertaken within the offset site are discussed in Section 7.3.5.

Fish communities

A fish survey was not undertaken within the assessment reaches due to poor habitat availability at the time of assessment. Based on the information known about the streams, general quality, habitat, topography, NZFFD records available for the catchment, and previous fishing efforts undertaken in recent years within the site and wider catchment, fish species assumed to be present were used to calculate the Fish IBI. Due to the poor habitat quality and intermittent aquatic habitat availability of the assessed reaches, only shortfin eel was assumed to be present. This species is tolerant to poorer water quality and is highly mobile compared to other indigenous fish species. This resulted in a Fish IBI score of 20 for all assessed reaches, falling within NPS-FM category C and indicating low integrity of the fish community and habitat and/or migratory access is considerably impairing and stressing the community.

Table 4. Summary of SEV data for the assessed intermittent reaches at Milldale Stages 10-13.

Function Category	Function	10-A	10-B	11-A	11-B	12-A	12-B	13-A
Hydraulic	Natural flow regime	0.33	0.33	0.33	0.33	0.33	0.33	0.35
	Floodplain effectiveness	0.10	0.08	0.20	0.19	0.06	0.12	0.26
	Connectivity for species migrations	0.30	0.30	0.00	1.00	1.00	1.00	1.00
	Natural connectivity to groundwater	0.62	0.60	0.62	0.60	0.61	0.61	0.64
	Hydraulic function mean score	0.34	0.33	0.29	0.53	0.50	0.52	0.56
Biogeographical	Water temperature control	0.18	0.04	0.38	0.22	0.20	0.04	0.18
	Dissolved oxygen levels maintained	0.45	0.45	0.75	0.45	0.45	0.40	0.68
	Organic matter input	0.03	0.01	0.20	0.08	0.00	0.03	0.00
	In-stream particle retention	0.20	0.20	0.20	0.20	0.20	0.20	0.20
	Decontamination of pollutants	0.24	0.25	0.36	0.45	0.18	0.38	0.32
	Biogeochemical function mean score	0.22	0.19	0.38	0.28	0.21	0.21	0.27
Habitat Provision	Fish spawning habitat	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	Habitat for aquatic fauna	0.38	0.30	0.44	0.40	0.32	0.34	0.38
	Habitat provision function mean score	0.22	0.18	0.24	0.23	0.18	0.19	0.21
Biodiversity	Fish fauna intact	0.33	0.33	0.33	0.33	0.33	0.33	0.33
	Invertebrate fauna intact	0.45	0.45	0.42	0.42	0.32	0.21	0.20
	Riparian vegetation intact	0.16	0.11	0.36	0.28	0.09	0.20	0.20
	Biodiversity function mean score	0.31	0.30	0.37	0.34	0.25	0.25	0.24
SEV Score		**0.273**	**0.251**	**0.332**	**0.358**	**0.296**	**0.303**	**0.341**

5.1.4 Macroinvertebrate communities

The results of the representative macroinvertebrates samples collected from the assessment reaches are summarised in Table 5 and provided in full in Appendix E. Watercourses 10-A and 11-A were not sampled as there was insufficient habitat available during November/December 2024 when the SEVs were undertaken. However, the streams were all considered to be of a similar nature and thus macroinvertebrate samples taken were considered to be representative of all SEV reaches.

An MCI/MCI-sb value of below 80 and QMCI/QMCI-sb value of <4.00 is indicative of 'probable severe pollution' (Stark & Maxted 2007). The NBL is 90 for MCI and 4.5 for QMCI. The macroinvertebrate results for all assessed reaches were within Attribute D, i.e., below the NBL.

Notably, 24 *Polyplectropus* sp. caddisflies (an EPT taxa) were present in the stage 10 (10-B) sample. This was somewhat unexpected given this species is sensitive to pollution and has an MCI-sb score of 8.1, however this genus is known to tolerate soft-bottomed freshwater environments well (pers. comm. Brett Stansfield, EIA Limited, December 2024). Aside from this outlier, the community generally consisted of species found in poor quality freshwater environments (Appendix E).

Overall, the macroinvertebrate community was dominated by common, pollutant-tolerant taxa. The community showed habitat and water quality within the representative assessment reaches were likely highly compromised. The results are considered representative of the general stream ecological health and water quality within the site's catchments. These results, in conjunction with low SEV scores, indicate that the water/habitat quality was **low** within the assessed watercourses.

Table 5. Summary of macroinvertebrate data for each intermittent reach sampled.

SEV number	10-B	11-B	12-A	12-B	13-A
Number of taxa	19	15	20	13	12
Number of EPT taxa	2	2	1	0	0
% EPT	14.04	0.50	0.36	0.00	0.00
% EPT of all taxa	10.53	6.67	5.00	0.00	0.00
MCI value	84.21	82.67	80.00	67.69	81.67
QMCI value	4.67	3.84	3.44	3.42	3.25
SBMCI value	78.38	78.77	78.00	61.23	85.17
QMCI-sb value	3.94	1.94	2.37	2.60	2.24

5.1.5 Ephemeral flow paths

Natural ephemeral channels identified have been mapped and labelled as per Appendix B. Ephemeral channels had very small catchments, typically contained rooted terrestrial vegetation across their channel width, showed no evidence of substrate sorting and did not contain natural pools or easily identifiable channels/banks (Figure 13). They contained no significant riparian vegetation and no instream freshwater habitat. Some appeared to have been modified for farm drainage, however, these have been considered natural where they aligned with the site's topography.

The ecological value of the ephemeral watercourses within the site was considered to be **negligible**.

a)

b)

Figure 13. Examples of ephemeral flow paths showing a) watercourse 4, and b) watercourse 24.

5.1.6 Artificial watercourses (drains)

Multiple artificial watercourses were present within the site (Appendix B). These features were constructed for farm drainage purposes. Drains were identified based on attributes including alignment with natural topography, presence/absence of a historic natural channel, catchment size, and artificial characteristics such as deepening and straightening. Figure 14 shows examples of drainage channels within the site. Artificial drainage channels are excluded from the relevant stream protection rules under the AUP-OP and the NPS-FM.

The ecological value of the artificial watercourses within the site were considered to be **negligible**.

a)

b)

Figure 14. Examples of artificial drains showing a) watercourses 31-34, and b) watercourse 13.

5.2 Natural Inland Wetlands

Natural inland wetlands have been mapped as per Appendix B. All wetlands within the site were considered 'natural inland wetlands' in line with the NPS-FM definition. Wetland extent was delineated based on contours and/or a clear change in vegetation community from OBL/FACW dominant to FACU/UPL dominant. Additional vegetation plots were taken outside of putative wetland areas to determine their extent where the change of vegetation type was less clear. Wetland vegetation plot data is provided in Appendix F.

Areas showing evidence of wetland vegetation identified on neighbouring land at 147 Argent Lane (to the south/east of Stage 12) via aerial imagery and during a visual assessment from the site's boundary have been mapped as 'potential wetlands' (Appendix B). The wetland delineation protocols were not able to be applied in these areas due to access restrictions, however, the areas appeared to contain a dominance of *Juncus* rushes (FACW) amongst pasture grasses and saturation was evident in recent 2024 aerial imagery. For the purposes of this assessment, these potential wetlands have been conservatively considered to meet the definition of natural inland wetlands.

5.2.1 Rapid vegetation assessments

Wetlands A, C-H, J, K, M, N, P and Q each met the rapid test for dominance of FACW/OBL species and exhibited primary hydrological indicators such as saturated ground and/or surface water (Appendix F). No vegetation plots were required to be undertaken in these areas to confirm wetland presence.

Vegetation communities were similar across each of these wetlands, consisting primarily of exotic herb tier vegetation with occasional natives. Species recorded in these areas included soft rush (*Juncus effusus* – FACW), mercer grass (*Paspalum distichum* – FACW), sharp spike sedge (*Eleocharis acuta* – OBL), *Isolepis prolifera* (OBL), *Isolepis reticularis* (FACW), creeping buttercup (*Ranunculus repens* – FAC), curled dock (*Rumex crispus* – FAC), toad rush (*Juncus bufonius* – FACW), hairy buttercup (*Ranunculus sardous* – FAC), creeping bent (*Agrostis stolonifera* – FACW), Yorkshire fog (*Holcus lanatus* – FAC), wiwi (*Juncus edgariae* – FACW), lotus (*Lotus pedunculatus* – FAC) and sweet vernal (*Anthoxanthum odoratum* – FACU). The species composition observed across these areas was typical of degraded wetlands on rural land with a history of grazing. Examples of the degraded wetlands are shown in Figure 15 and Figure 16.

There was no evidence of Wetland Q (Stage 10) on recent or historical aerial imagery, however, the paddock was tilled and used for growing kumara in 2024. Ground disturbance in this area, including the formation of a drainage channel, likely led to uneven ground, soil compaction and the rapid colonisation of exotic hydrophytic species. Despite its recent establishment, the area has been conservatively included as a wetland.

Each of these wetland areas were located within paddocks used and maintained for agricultural purposes. All were either seepage fed and/or associated with intermittent or permanent stream margins.

The ecological value of Wetlands A, C-H, J, K, M, N, P and Q was considered to be **low**, due to their degraded nature, relatively small size, lack of indigenous flora biodiversity, general lack of structural tiers which limited habitat availability, and negligible aquatic habitat.

a) **b)**

Figure 15. a) View looking across at Wetlands C and D from the south, and b) Wetland G showing pooling shallow water backing up against the fence upstream of a farm culvert.

Figure 16. Wetland vegetation present within Wetland N that was limited to an exotic herb tier and contained vegetation such as Juncus spp., Isolepis spp. and creeping bent.

5.2.2 Vegetation plots assessments

Where wetland vegetation was present but was not visually dominant amongst FAC/FACU species, vegetation plots were undertaken to determine the dominance and prevalence values. Wetlands B, I, L, and O were subject to vegetation plots (P1, P8, P9, P13, Appendix F). Wetland O (P13) contained some sparse common alder (*Alnus glutinosa* – FACW) trees (Figure 17a), but all other wetland plots contained a single herbaceous vegetation tier only (Figure 17b). The species composition within these areas was generally similar to the other wetlands within the site described above, however, there was a higher coverage of FAC and FACU which added uncertainty. Primary wetland hydrology such as saturated soils and/or surface water were present in all these areas. All wetlands were unfenced and accessible to grazing stock, apart from Wetland O within Stage 11 which had not been recently grazed.

Each of these areas had a dominance value of more than 50% (between 66%-100%) and a prevalence index of less than 3 (range of 2.4-2.87). Thus, they were considered natural inland wetlands under the NPS-FM. The full vegetation plot results are provided in Appendix F.

The ecological value of Wetlands B, I, L, and O was considered to be **low**, due to their degraded nature, small sizes, lack of indigenous flora biodiversity, general lack of structural tiers which limited habitat availability, and negligible aquatic habitat.

Figure 17. a) Wetland O, with sparse common alder trees and exotic species such as rushes, Yorkshire fog and sweet vernal, and b) Wetland I, showing scattered rushes amongst pasture grasses.

5.3 Non-wetlands

5.3.1 Putative wetland areas

All other vegetation plots undertaken within the site failed the dominance test and prevalence indices and were not considered to be natural inland wetland areas. Some plots were undertaken within putative wetland areas, and others were undertaken to inform the extent of the identified wetlands as above (Appendix B).

Vegetation plots were undertaken adjacent to Wetlands B and L to assist with delineation of the confirmed wetland extents (P2 & P9, Appendix F). As per the wetland delineation protocols (MfE 2022), the areas were non-wetlands (i.e., uplands) as they contained less than a 50% cover of wetland vegetation and had a prevalence index of more than 3.

Two vegetation plots (P5 & P6) were undertaken within Stage 13 to the south of Wetland I due to the presence of sparse rushes, creeping bent and FAC species such as Yorkshire fog and buttercup amongst FACU species (Figure 18a). Common FACU species in this area included dallis grass (*Paspalum dilatatum*) and perennial rye grass (*Lolium perenne* – FACU). The dominance values for plots P5 and P6 were 50% and 0%, and the prevalence indices were 3.1 and 3.42, respectively (Appendix F).

Four vegetation plots were also undertaken within Stage 11 within the riparian margins of watercourse 35. In this area, there were FACW/FAC species such as soft rush and Yorkshire fog amongst FACU pasture grasses such as sweet vernal and kikuyu (*Cenchrus clandestinus*) and FAC species such as creeping buttercup, lotus and Yorkshire fog (Figure 18b). There was also a small area containing large swamp cypress (*Taxodium distichum* – FACW, presumably planted) with FACU grasses such as rough-meadow grass (*Poa trivialis* – FACU) and cocksfoot (*Dactylis glomerata* – FACU) in the understorey (Figure 19).

Each plot contained 50% or less cover of wetland vegetation and had a prevalence index of greater than 3 (Appendix F). As such these areas were classified as non-wetlands (i.e., were not natural inland wetlands under the NPS-FM). The species observed in these areas are characteristic of poorly managed pasture in the Auckland region, particularly where damp soils/poor drainage are present. The problematic soils within the site are discussed further below.

a) **b)**

Figure 18. a) Putative wetland within Stage 13 where plots P5 and P6 were undertaken, and b) putative wetland area within Stage 11 near P15 was undertaken.

Figure 19. Location of plot P11 showing FACU grass dominance under swamp cypress trees.

5.3.2 Problematic pasture and soils

Complex vegetation and hydrology

Although hydrology is the primary factor influencing whether an area is wetland or not, vegetation plots are the primary means for determining potential wetland presence as per the wetland delineation protocols (Clarkson 2014; MfE 2022). This is on the assumption that the vegetation community directly reflects the underlying hydrological conditions.

Large areas of managed pasture across the site were dominated by FACW species, namely creeping bent and/or toad rush. It was common to observe creeping bent growing amongst FACU pasture species such as kikuyu. Creeping bent is a common grass found in pasture throughout the Auckland region and beyond. It was deliberately introduced to New Zealand in the late 1800s, for the purpose of supporting livestock grazing (New Zealand Plant Conservation Network, n.d.). Although no longer commercially available, farmers have not typically removed this species but left it to persist in areas of paddocks in which it thrives i.e., poor soils, and where it provides important stock feed.

The land across the site has been disturbed for decades through ongoing farming practices. Further, paddocks in Stages 10 and 11 have been recently utilised for growing kumara and turnips. Following harvest in 2024, the open soils were reseeded with pasture species such as rye grass and white clover (*Trifolium repens* – FACU). Toad rush (FACW) colonised the temporarily exposed soils over large areas (Figure 21). Toad rush is an exotic weed that favours disturbed environments, is a prolific seeder, and can become dominant in cultivated soils, lawns and bowling greens. Areas dominated by toad rush within the site were not considered to be good indicators of wetland presence.

Outside of the mapped wetland areas (Sections 5.2.1 & 5.2.2), there were other areas of FACW species dominance in pasture that contained no primary hydrological indicators. Such areas were patchy and formed a mosaic across the site, thus were near impossible to map/delineate. These areas were not aligned with topographical features that would typically support hydrology, such as seepages, gullies or depressions. However, despite wetland hydrology not being present in these areas, they contained >50% FACW species coverage and therefore met the rapid test for wetland presence (MfE 2022).

To provide an example of the site's patchy FACW species coverage, three plots were undertaken in Stage 13 on an elevated area where creeping bent occurred amongst FACU vegetation (Figure 20). The results of the plots are summarised in Table 6 below, and the plot locations map and data shown in Appendix F. The plots were taken approximately 3 m apart; however, the results came out different in each plot for wetland/non-wetland vegetation. It should be noted the area where the plots were undertaken showed no evidence of soil saturation or wetland hydrology during the site visits, or on recent or historic aerial imagery.

a)

b)

Figure 20. a) Areas on the hillside in Stage 13 showing creeping bent mixed in with pasture species such as kikuyu and dallis grass.

Table 6. Summary of dominance and prevalence value test results for plots P3-P5 in Stage 13.

Plot number	Dominance test result (%)	Pass/fail	Prevalence index result (0-5)	Pass/fail	Wetland vegetation?
P3	100	Pass	2.52	Pass	**Yes**
P4	50	Fail	2.41	Pass	**Uncertain**
P5	50	Fail	3.20	Fail	**No**

Williamson Land & Water Advisory Limited (WWLA 2025a) undertook hydrological assessments and hydric soils assessments across the site. The results within their hydrology report show that even in areas that Viridis have mapped as wetlands based on the rapid test and topographical features, there were several areas tested by WWLA that did not pass hydrology test or hydric soils, or only passed one of these (WWLA 2025a). WWLA stated that due to a historic cover of kauri and podocarp forest followed by agricultural land uses, the soils within the site are highly leached, acidic and have low permeability, meaning that the moisture content of the soils fluctuates significantly between summer and winter. This demonstrates the versatility of some of the FACW listed plants to adapt to both wet and dry conditions and highlights the complexities of the site's problematic ground conditions.

The results of the plots discussed above and the presence of toad rush in recently disturbed areas highlight that due to the difficulty of the soils and agricultural nature of the site, hydrophytic vegetation presence (namely areas containing high proportions of creeping bent or toad rush) within many parts of the site is not solely indicative of wetland status.

Figure 21. Examples of toad rush that has colonised large patches within Stages 10 and 11 following recent disturbance of soils for crops.

Difficult soils

To provide further specialist input on the soils, Dr Scott Fraser, pedologist at Soils Pirongia and Manaaki Whenua, visited the Stage 13 in December 2023. Dr Fraser highlighted that the soils within the site were difficult and inconclusive. Dr Fraser concluded that the soils within Stage 13 "are highly leached, acid, low nutrient, poor structure and in particular are structurally vulnerable due to the presence of an E horizon. Stocking with cattle has probably resulted in considerable structural damage, and low productivity means high producing pastures won't survive and there would be little funds available for pasture renewal due to poor productivity." Dr Fraser also commented that the hydric soils guide (Fraser et al. 2018, which he co-authored) isn't definitive on these difficult soil types. He considered the soils to have induced hydric conditions from farming practices. The soils contained a deep topsoil with an A/E horizon (a composite of both topsoil and E horizon), therefore the colours observed were not definitive of hydric soils. However, these areas likely have poor drainage due to structural damage (pers. comm. Dr Scott Fraser, Soils Pirongia, 2023).

Conclusions

There were paddock areas within the site that were dominated by the FACW species, creeping bent and toad rush, and interspersed with FACU pasture species. These particular FACW species are poor indicators of wetland presence on a site such as this where the soils are damaged and low permeability, resulting in the hydric status of the soils to be largely inconclusive, even to an industry-leading pedologist. Based on a lack of underlying wetland hydrology within these problematic areas (WWLA 2025a), they were not considered to be natural inland wetlands under the NPS-FM.

The intent of the NES-F regulations is not to capture problematic areas such as these. These pasture areas in question would not restore as natural inland wetlands due to their lack of persistent hydrology. They provide negligible ecological values, aside from very low levels of filtration provided by the managed pasture grasses.

5.4 Constructed ponds

Several constructed ponds were present across the site in Stages 11-13 (Appendix B, Figure 22). The ponds were all isolated with no freshwater connectivity, and thus were only expected to contain pollutant-tolerant fish species such as the shortfin eel.

Man-made ponds are excluded from the definition of 'natural inland wetlands', as they meet the definition of a constructed wetland under the NPS-FM definitions. Therefore, these features are not subject to the NES-F. These waterbodies may develop associated wetland habitat as a direct or unintentional result of being built and maintained, and the exclusion of a constructed wetland also extends to 'incidental wetlands' such as these.

Due to the poor water quality, isolated and artificial nature, poor habitat quality (e.g., lack of flow and hydrological heterogeneity), and likelihood of only a single common native fish species presence, the constructed ponds within the site were considered to be of a **low** ecological value.

a) **b)**

Figure 22. Examples of constructed ponds within the site, within a) Stage 12 and b) Stage 13.

6 SUMMARY OF ECOLOGICAL VALUES

The values of the site are summarised in Table 7. The terrestrial ecological value of the site was generally low. Exotic trees included planted stands, shelterbelts, scattered riparian vegetation and exotic treeland and garden species within the site were considered to provide low ecological values. Very little native vegetation was present across the site to provide any significant habitat for indigenous fauna, aside from some scattered trees amongst exotic vegetation and planted roadsides. Rank terrestrial grasses and dense areas of weedy/shrub vegetation within the site (mainly within Stage 11) may provide suitable habitat for 'At-Risk' indigenous herpetofauna, however, terrestrial connectivity was poor.

The freshwater features within the site consisted of one permanent stream, several intermittent streams, and constructed ponds. These features were of low ecological value, due to their degraded natures because of agricultural practices, and lack of suitable habitat for most indigenous fish species.

Table 7. Summary of the terrestrial and freshwater ecological values within the site.

Ecological Feature	Ecological Value
Terrestrial tree/shrub vegetation	Low
Avifauna (Birds)	Low
Herpetofauna (Lizards)	Moderate
Chiroptera (Bats)	Moderate
Permanent streams	Low
Intermittent streams	Low
Freshwater fish	Low
Macroinvertebrates	Low
Ephemeral flow paths	Negligible
Artificial channels	Negligible
Natural inland wetlands	Moderate
Constructed ponds	Low

7 ASSESSMENT OF ECOLOGICAL EFFECTS

7.1 Project Overview

FHLD are proposing the subdivision and development of the site into a medium density residential development. The proposal will result in the development of the site into 623 residential lots, 27 residential super lots, JOALS and roads to vest, reserves to vest, and all associated works, landscaping and infrastructure. A full description of the project is provided in the application AEE.

The development will require land modification works to facilitate Stages 10-13 of the Milldale Fast Track application. This includes bulk earthworks across the site to refine the site to the required finished levels.

Activities proposed that relate to ecology include bulk earthworks, vegetation removal, works within riparian yards, stream diversion and reclamation, wetland reclamation, and proposed revegetation planting. The magnitude and level of effect that these activities have been assessed in the remainder of this section.

7.2 Impacts on Terrestrial Ecology

7.2.1 Vegetation removal and revegetation

The magnitude of effect of the removal of vegetation within the site is considered to be high, mitigated to **positive** in conjunction with the proposed revegetation planting.

All tree and shrub vegetation within the site, outside of riparian and wetland setbacks (discussed in Section 7.3.1), will be removed. Tree and shrub vegetation across the 71 ha site currently includes scattered exotic shelterbelts, exotic tree stands, residential garden and amenity planting, and areas of mixed native-exotic and pest plant scrub amongst large areas of pasture (Appendix A). Very little native vegetation is present within the site (Appendix A). All vegetation within the site is considered to be of low ecological value (Section 4.1).

Proposed revegetation planting
A revegetation planting package has been prepared for the project, proposing a total of 6.95 ha of planting across the site (drawing series 4672100-AL, Beca Limited, February 2025). This includes 4.44 ha of enhancement and restoration planting within all retained riparian margins. Planting zones for riparian areas include stream edge, lower embankment, and upper embankment, with plant schedules incorporating species suited to each zone. These species are selected to support natural succession over time and include erosion-minimising plants, understorey and early successional shrubs, and canopy trees. A total of 44,461 riparian plants will be planted across the site at an average spacing of one plant per square metre.

Additional planting will be integrated into the site’s open spaces, including suburban reserves with large native and exotic specimen trees, street trees along all roads, JOALS, public walkways, planted private earth batters, and stormwater dry ponds. Along with private residential gardens, these plantings will significantly enhance the site's biodiversity.

Stormwater dry basins will also be planted with wetland species such as oioi (*Apodasmia similis*) and native *Juncus* and *Carex* species. While primarily designed for stormwater management, these plantings will provide additional ecological benefits, including habitat creation, increased biodiversity, and improved water filtration.

The existing vegetation on-site is predominantly exotic and sparse, offering minimal ecological value. In contrast, the proposed planting will substantially enhance both terrestrial and freshwater ecological values. It will increase native and riparian vegetation cover, improve habitat diversity and connectivity, and support freshwater ecosystems through shading, filtration, and the creation of improved aquatic habitats.

7.2.2 Indigenous fauna

A draft Fauna Management Plan (FMP) has been prepared to provide an overview of the management of indigenous birds, lizards and bats for this project (Appendix G). This FMP will be refined and finalised as a condition of consent once the full details of the project are confirmed.

Birds (avifauna)
The magnitude of effect of the proposed works on birds is considered to be temporary and low, mitigated to **very low**.

Avifauna habitat throughout much of the site was limited to isolated exotic trees and shelterbelts and managed pasture. Stage 11 contained the most valuable habitat within the site for avifauna, with mixed exotic-dominant treeland vegetation present that included occasional native trees.

Birds are highly mobile, unless they are nesting, or have eggs or chicks in the nest. They can move over relatively large distances, depending on the species, to find suitable habitat as required. Clearance of trees during the bird breeding season has the potential to result in direct mortality of birds, eggs and chicks. It is recommended that removal of any vegetation, other than pasture, occurs outside of the bird nesting season (October to February, inclusive). If clearance is unable to occur outside of breeding season, it is recommended that a condition of consent requires an ecologist to inspect the affected vegetation within 24 hours of clearance. If active native bird nests are identified, a minimum 10 m buffer must be maintained around the nesting site until an ecologist deems it to be inactive (Appendix G).

The loss of, and disturbance to, habitat within the site is not expected to permanently displace the bird community. There is significant unaffected similar habitat, as well as higher quality habitat, in the immediate surrounds and wider landscape. It is expected any birds present within the site will move away from the disturbed habitat while works are occurring and will recolonise the site once works have been completed.

The proposed riparian revegetation and amenity planting within the site is anticipated to significantly enhance its value for native birds by providing increased resources such as food, nesting opportunities, and shelter as the vegetation becomes established.

Lizards (herpetofauna)
The magnitude of effect on lizards is considered to be moderate and temporary, mitigated to **low**.

The majority of the site did not present habitat for native lizards due to the dominance of regularly grazed/maintained pasture and horticultural land. However, there were areas of habitat suitable for At Risk – Declining copper skink, despite the site's low terrestrial connectivity. Potential habitat consisted of rank grasses and dense ground cover vegetation and garden planting, particularly within the Stage 11 area.

Works within the site have the potential to result in direct mortality and/or injury of any lizards present, through activities such as earthworks and the movement of machinery. The proposed bulk earthworks within the site will require the removal of all potential lizard habitat. As lizards are not considered to be highly mobile, they have limited ability to move quickly to safety. Indirect effects on lizards include the loss of habitat as a result of vegetation clearance and associated construction activities. However, once established, the 4.44 ha of proposed native riparian revegetation planting is expected to provide good quality habitat for native skinks. Therefore, the effect on habitat is considered to be temporary.

As works in their habitat cannot be avoided during construction, it is recommended a lizard management plan (LMP) is prepared outlining how lizards will be managed during works. The LMP should include measures to capture native lizards from any suitable habitat within the site, and locations where they will be released. A draft LMP has been prepared in Appendix G. Additional information such as habitat enhancement at the release site and any ongoing monitoring should be provided as necessary.

Bats (chiroptera)
The magnitude of effects on bats is considered to be conservatively moderate, mitigated to **low**.

Tree felling when bats are utilising them for roosts or refugia has the potential to result in mortality and/or injury to any bats present. It is recommended that pre-clearance monitoring of potential roost trees as per DOC's Bat Roost Protocols (DOC 2024) is undertaken. This could be required through the preparation of a Bat Management Plan (BMP), or a resource consent condition requiring application of the DOC standards to be undertaken by a competent bat worker[4]. A draft BMP has been prepared, refer to Appendix G. In summary, prior to felling, a suitably qualified and experienced ecologist should assess any tree greater than 15 cm diameter at breast height for potential bat roost habitat, and if there is potential roost habitat then further assessment (e.g., using ABMs) can be undertaken following the protocols to ensure that there are no bats roosting in the tree.

Clearance of trees is not expected to result in any significant habitat loss or population displacement of a potential bat population. The wider area is not known to be a high use area for bats, which has been reflected in previous ABM survey data. The habitat available in the site is of low quality with poor connectivity, and is heavily influenced by human activities, including increased light levels and noise disturbance. There is unaffected habitat in the immediate vicinity, and significant higher quality habitat in the wider area which will be unimpacted by the proposed works.

7.3 Impacts on Freshwater Ecology

7.3.1 Riparian and wetland buffer vegetation removal

The magnitude of effect of vegetation removal from the riparian yard and wetland buffer areas is considered to be moderate, mitigated to **positive** through revegetation planting.

To facilitate bulk earthworks across the site, removal of exotic and native vegetation from all 10 m riparian margins, and within 20 m of all natural wetlands is proposed. Currently, riparian and wetland buffer vegetation is very sparse across the site and is dominated by exotic and pest plant species. The existing scattered riparian vegetation offers low shading overall, and otherwise little ecological function (i.e., with respect to filtration or organic matter input) and, as such, the ecological value of the existing riparian vegetation and wetland buffer areas was low.

[4]A 'competent bat worker' is a suitably qualified expert who holds the relevant DOC competencies required to undertake an activity relating to bat management.

Arborlab has identified 485 trees that are proposed for removal within 10 m riparian margins and/or 20 m wetland buffer zones within the site (Arborlab 2025). Of these, 223 are listed pest trees as per the Auckland Regional Pest Management Plan 2020-2030. Pest species to be removed include crack willow, coast banksia and tree privet. Of the remaining 262 non-pest trees to be removed, 40 are native, and 122 are exotic. Only common native species are to be removed, limited to cabbage tree, mānuka, kānuka, tōtara and *Pittosporum* spp.

Extensive riparian planting along the streams to be retained will provide significantly more, and higher quality, riparian vegetation than is currently present (Section 7.2.1). Once established, the planned planting is expected to provide high levels of shade, organic matter inputs, bank stability, filtration of overland flow, and provide habitat for native fauna. Overall, the project is expected to have a positive effect on riparian functioning and water quality of the streams to be retained.

Further, as part of the offsetting package for the proposed wetland reclamation, buffer planting will occur around a newly created wetland, as well as significant riparian planting around existing stream/wetland systems (Section 7.3.9).

7.3.2 Earthworks

Bulk earthworks are proposed across most of the site to facilitate urban development. Stages 10 and 11 will involve 248,982 m^3 of cut and 186,150 m^3 of fill over an area of approximately 23.1 hectares. Stages 12 and 13 include approximately 498,124 m^3 of cut and 860,627 m^3 of fill over an area of 45 hectares (SouthernSkies Environmental Limited 2024). As stream diversion and reclamation and wetland reclamation are proposed, earthworks will occur within all riparian margins and within natural inland wetlands on site. Woods & Partners Consultants Limited (Woods) have specified that bulk earthworks will occur over three seasons commencing in October 2025 (Woods 2025a).

The stormwater design for the project has considered the hydrological effects on freshwater features and this is addressed in Section 7.3.10.

Erosion and sedimentation

The magnitude of effect of fine sediment release on freshwater environments is considered to be high, mitigated to **low** providing control measures are implemented.

Elevated levels of suspended sediment can have detrimental effects on freshwater environments including reducing light penetration, smothering food and interstitial spaces, and clogging fish and invertebrate gills. However, aquatic organisms are adapted to periods of elevated sediment in the water, as they intermittently experience this during times of high river/stream flow.

It is expected earthworks and vegetation removal will generate the release of sediment. If not carefully managed, this could enter and detrimentally effect the freshwater environment. Woods (2025b) have prepared a plan detailing erosion and sediment control (ESC) measures for the development in line with Auckland Council's GD05 guidelines. Primary ESC controls for the site will utilise sediment retention ponds, with decanting earth bunds as a secondary measure. Other control measures may also be utilised, such as silt fences and super silt fences, clean water diversion drains, contour drains, stabilised access roads and hay bales.

A maximum of 30 ha of active earthworks area will occur at any given time, and progressive stabilisation will occur across the site as areas are completed. Woods (2025a) specifies weekly site walkovers to inspect the quality of ESCs, and these will also be inspected before and after rain events.

7.3.3 Streamworks

One permanent stream (watercourse 21) was identified within the site. Watercourse 21 transitions into an intermittent stream within its upper reaches. An additional 15 intermittent streams were identified within the site (Appendix B & C). Approximately 3,300 m of intermittent and permanent stream length is located within the site.

No stream diversion or reclamation is proposed for within the permanent section of watercourse 21. The remaining 15 intermittent streams are proposed to be diverted, reclaimed, or a combination of both (Table 8).

Table 8. Proposed streamworks across Stages 10-13.

	Streamworks (m)			
Stream number	**Existing Stream Length***	**Stream Length Retained & Enhanced†**	**Stream Length Diverted‡**	**Stream Length Reclaimed***
2	372.7	72.6	297.1	3
6	193.6	0	0	193.6
8	32.7	0	0	32.7
9	219.5	185.4	0	34.1
12	115.1	0	0	115.1
15	147	0	0	147
20	334.6	0	282.7	51.9
21 (P)	592.1	592.1	0	0
21 (I)	195.8	143.4	10.6	41.8
26	290.9	121.4	137	32.5
27	168.7	0	0	168.7
35	201.5	0	145.8	55.7
36	76	0	0	76
42	174.4	0	109	65.4
43	162.8	0	151.8	11
Totals	**3277.4**	**1114.9**	**1134**	**1028.5**

Notes: *Includes existing culverts. † Includes daylighted culverts. ‡Does not include proposed culverts. P = permanent stream. I = intermittent stream.

Seven representative SEVs were undertaken within the site (Figure 12). SEV results are summarised in Table 4 and presented in full in Appendix D. All seven SEV reaches scored low SEV scores, ranging from 0.251 to 0.358, indicating that these streams are of current low ecological value and have been heavily impacted through human modification. Due to the similar nature of the streams (e.g., intermittent, soft bottomed, lacked riparian vegetation and impacted through modifications), some of the SEVs were used to represent the current value of the other streams impacted.

7.3.4 Stream diversion

A total of 1,134 m of intermittent stream length is proposed to be diverted (Table 8). Stream diversion lengths do not include new culverts. The location and extents of these diversions are shown on the drawing series P24-128-00-1400-EW prepared by Woods (dated February 2025). All intermittent streams proposed for diversion were assessed as having low ecological values.

The potential aquatic ecological effects of the diversion include:

- Loss of stream hydrological function
- Temporary reduction of low value aquatic habitat
- Potential release for fine sediment effects
- Potential native fish injury or mortality

The magnitude of effect of the intermittent stream diversion on freshwater values is expected to be moderate-high without mitigation (e.g., sediment controls, stream enhancement). Based on the current ecological value and the magnitude of effect, the overall level of effect of the proposed intermittent stream diversion without mitigation is low-moderate.

Stream hydrological function and recharge

While all intermittent stream reaches proposed for diversion will be realigned horizontally, some will also require vertical realignment. This vertical realignment increases the risk of altering natural baseflows.

WWLA (2025b) undertook a groundwater assessment to determine if there would be any significant changes to stream baseflows following the proposed stream diversions. Their findings indicate that while some changes to groundwater contributions will occur, the overall variance between the natural and developed state will be less than minor. Additionally, WWLA's analysis did not account for any proposed underfill drainage, which would further reduce the level of variance.

Stream recharge will be achieved by diverting an appropriate amount of the proposed stormwater network and underfill drainage into the uppermost reaches of these diverted streams. The stormwater network has been designed to replicate pre-development flows as closely as possible (Woods 2025a).

Underfill drainage will also discharge groundwater to the heads of the retained streams, supplementing base flows alongside flow contributions from the stormwater network. This network of underfill drainage is defined in the Geotechnical Investigation Report (CMW 2024).

By integrating underfill drainage with the mitigated post-development stormwater flows, the diverted and retained stream reaches will receive sufficient flow to support an intermittent stream environment.

Stream value

Currently, the intermittent stream reaches proposed for diversion have been highly modified through land use practices (e.g., deepening, straightening, stock access and removal of riparian vegetation) and have very low levels of habitat diversity and abundance, as well as very low levels of hydrologic heterogeneity. The diversion of the streams allows for the ability to restore and enhance aquatic habitat and hydrologic heterogeneity.

It is expected that the new channels will comprise of a main low-flow channel within a wider high-flow channel that meanders through a varied floodplain. The channel has been designed to enhance hydrological variation and habitat diversity with features such as pools, logs, root wads, and meanders. These features will create eddies, velocity changes, and interstitial spaces and pools at intervals which providing diverse habitat for aquatic fauna. To prevent any net loss of streambed area, the channels will be as wide as or wider than the existing channels. The proposed stream design is shown on drawing P24-128-00-1405-EW, prepared by Woods (dated December 2024).

Additionally, restorative riparian planting is proposed along the margins of the diverted intermittent streams. The planting aims to achieve a minimum width of 10 m on both banks, with some areas extending to 20 m. This riparian restoration will enhance ecological value and improve the integrity of both retained and realigned streams by increasing connectivity, shade, ground filtration, bank stability, and organic matter input. The proposed riparian plantings are detailed in drawing series 4672100-AL (Beca Limited, February 2025). As a result of the diversion existing culverts will be removed and the stream naturalised in these areas, providing additional ecological gains.

Full current, potential, and diversion SEV results are provided in Appendix D as a quantitative assessment of stream ecological values. The predicted potential SEV score has been estimated to reflect typical conditions 5+ years after implementing 'best-practice' stream management/restoration in Auckland, including a minimum 10 m riparian buffer on both banks, appropriate fencing, and no in-stream enhancements. The diversion SEV score represents conditions 5+ years after stream realignment, incorporating both in-stream habitat enhancements and riparian planting.

Table 9 presents the current, potential, and predicted diversion SEV scores for each diverted stream. These scores indicate no significant residual adverse effects will occur as a result of the diversion and demonstrates that a net gain in biodiversity and ecological value is achievable.

Overall, the proposed diversion activities are expected to have a positive effect on the site's freshwater ecological values, provided the stream realignment is implemented effectively.

Table 9. Current, potential and theoretical diverted SEV scores for the diverted streams.

Stream number	Length Diverted (m)	SEV Reach	Current SEV Score	Potential SEV Score	Diversion SEV Score
2	297.1	13A	0.341	0.419	0.537
20	282.7	12A	0.296	0.383	0.512
21	10.6	12A	0.296	0.383	0.512
26	137	12B	0.303	0.379	0.496
35	145.8	11B	0.358	0.402	0.519
42	109	10B	0.251	0.352	0.525
43	151.8	10A	0.273	0.354	0.524

Native fauna

Due to the poor habitat quality and intermittent habitat availability of the assessed reaches, only shortfin eel were assumed to be present. However, the preparation of a Native Fish Capture and Relocation Plan (NFCRP) is recommended as a condition of consent which should be carried out prior to the stream diversion to mitigate potential mortality and harm to indigenous fish (Section 7.3.6).

Erosion and sedimentation

Potential erosion and sedimentation as a result of the proposed earthworks will be appropriately mitigated through an approved sedimentation and erosion controls (Section 7.3.2).

Streamworks methodology

The diverted channel will be created, and flows redirected prior to the original stream being removed.

Mitigation Hierarchy

- **Avoidance** – Avoidance of partial stream reclamation through the diversion of stream reaches. Diversion cannot be avoided as they are required to integrate retained streams into the proposed development layout.
- **Minimisation** – Adverse effects on in-stream fauna will be minimised by salvaging and relocating native fish and implementing appropriate sediment and erosion controls to prevent sediment discharge to the downstream receiving environment.
- **Remedy** – Restoration of the current degraded streams though enhancement actions, including naturalisation of stream channel.
- **Offset & Compensation** – No offset or compensation is considered necessary as there will be no loss of stream extent or streambed area as a result of the diversion, and there will be no significant residual effects. However, additional enhancement of the streams is proposed though the provision of aquatic habitat features (e.g. rootwads) and riparian planting.

7.3.5 Stream reclamation

Where stream works are proposed, some reaches cannot be diverted and are therefore classified as reclamation. As a result, even after stream diversions, there will be a residual loss of intermittent stream extent and ecological value.

A total of 1,028.5 m of intermittent stream length is proposed for reclamation (Table 8), equating to 402.3 m^2 of streambed area, based on measured widths from the SEV assessments. Existing culverts within these reaches are included in the total reclamation calculations. The location and extent of these reclamations are shown in drawing series P24-128-00-1400-EW by Woods (dated February 2025). All intermittent streams identified for reclamation have been assessed as having low ecological value.

Without mitigation, offsetting, or compensation measures, the magnitude of effect on freshwater values would be very high. Given the low ecological value of the affected intermittent streams, the overall level of effect from the proposed stream diversions, in the absence of mitigation, is moderate.

While the hydrological function of the lost streams (e.g., water conveyance) will be mitigated through stormwater management, there will still be a loss of intermittent stream extent and ecological value, which is considered a significant residual effect.

Stream Value

To appropriately offset for the significant residual impact of losing 402.3 m^2 of potential intermittent stream value, an Environmental Compensation Ratio (ECR) was calculated following the methodology outlined in Storey et al. (2011).

The ECR calculation = [(SEVi-P – SEVi-I)/(SEVm-P – SEVm-C)] x 1.5, where:

- SEVi-P = Impact stream potential SEV Score;
- SEVi-I = Impact Stream impact SEV Score;
- SEVm-P = Offset Stream potential SEV Score;
- SEVm-C = Offset Stream current SEV Score; and

- The x '1.5' is the multiplier to account for delay and uncertainty.

The offset site is located within the same wider catchment as the impact site— the Ōrewa River catchment, north of the project area at 173 Upper Orewa Road, Wainui (Figure 23). Three SEV assessments were undertaken in representative reaches within the offset catchment (Figure 24). While the impact site has been heavily modified through channel deepening and straightening, the offset site has similar characteristics, including intermittent flow, a soft-bottomed substrate, and modification through agricultural practices such as stock access and riparian vegetation removal. The offset site also has a low diversity of aquatic habitat and hydrologic heterogeneity, with low current SEV scores (Figure 25 & Figure 26, Table 10).

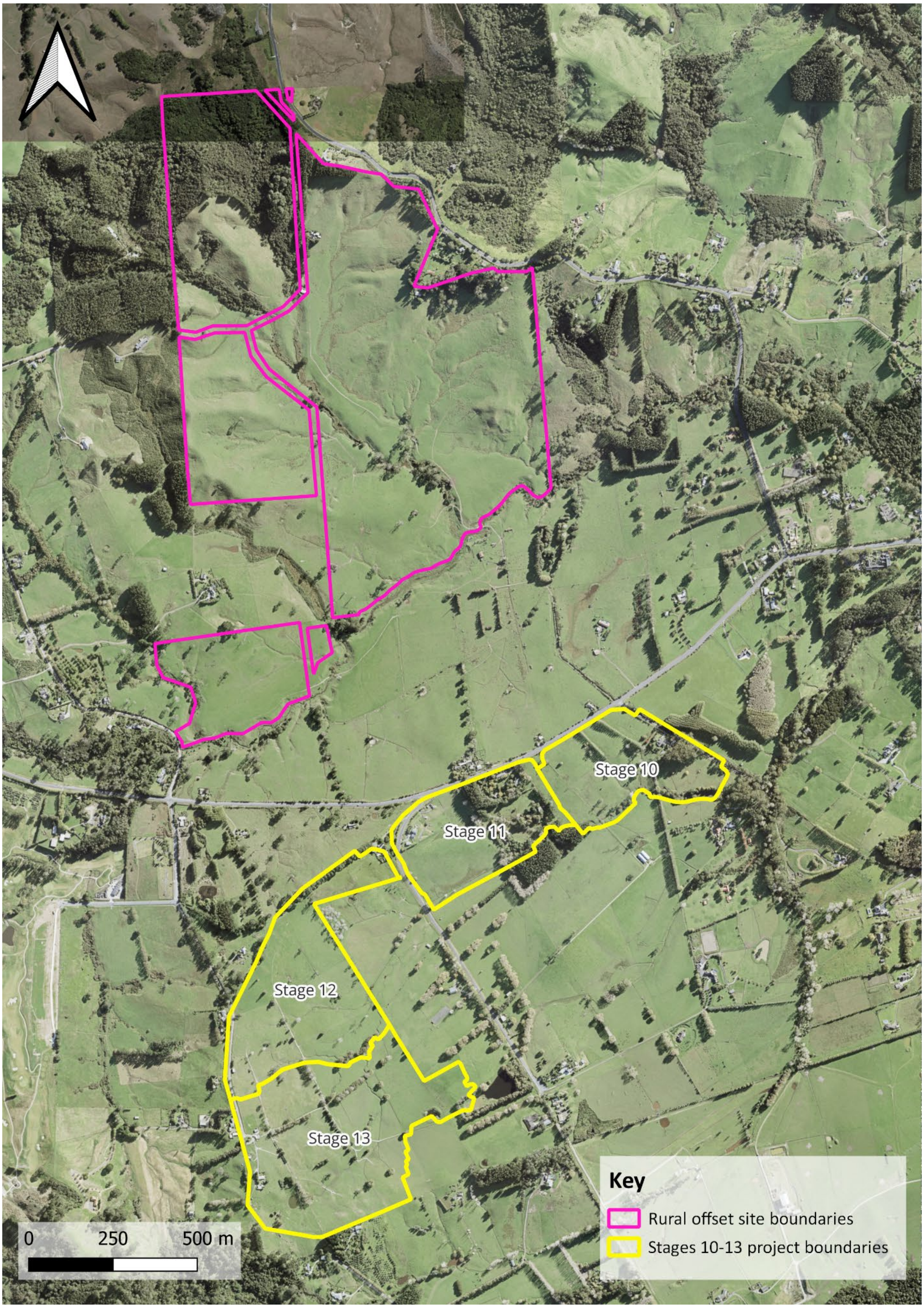

Figure 23. Map showing the rural offset site location in relation to the project site.

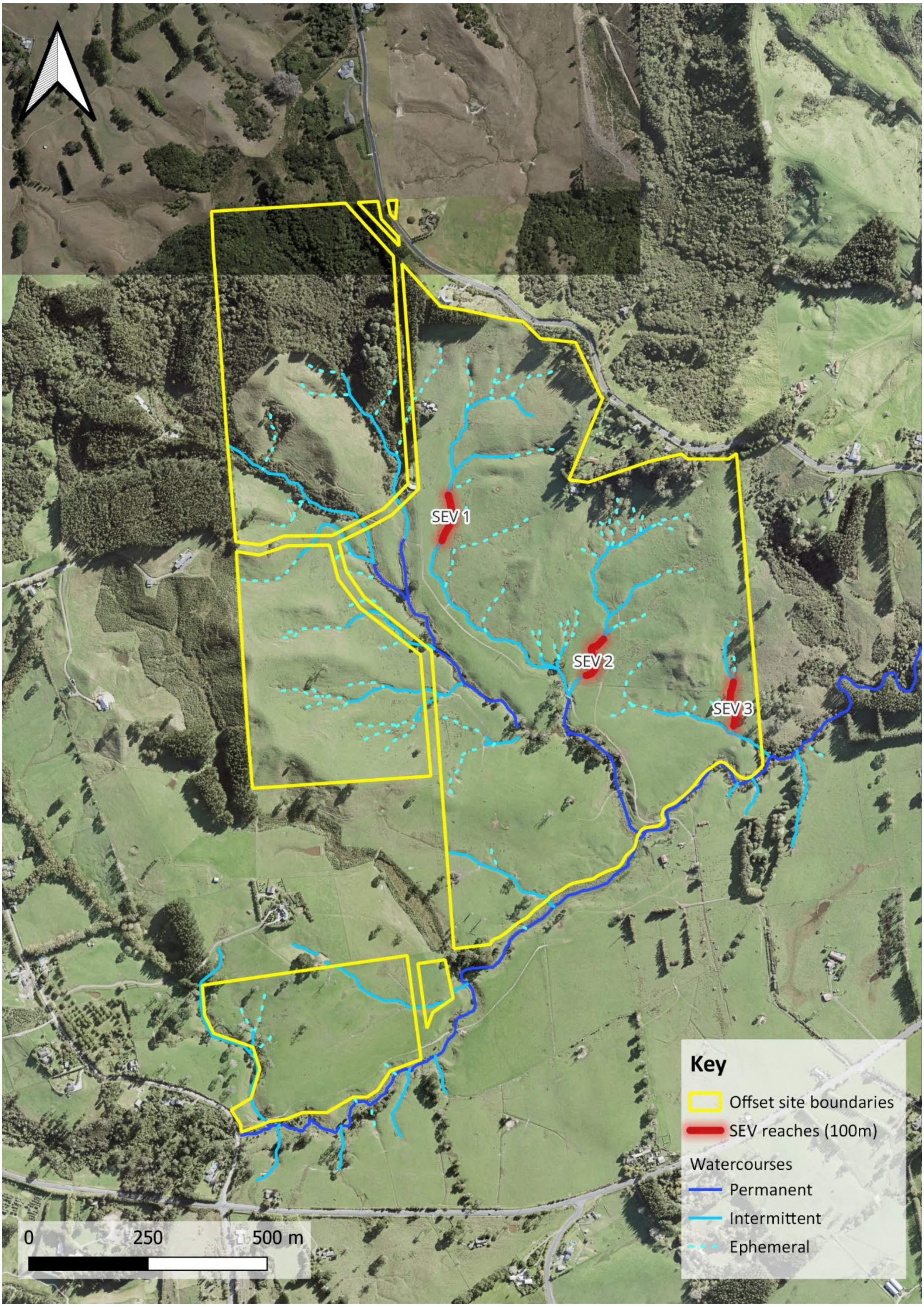

Figure 24. Map showing the locations of the SEV reaches within the offset site.

a)

b)

Figure 25. Photos of SEV 1 reach showing a) the reach looking upstream, and b) the intermittent stream channel.

a)

b)

Figure 26. a) SEV 2 reach facing upstream, and b) an example of the SEV 3 intermittent stream channel.

This offset location was chosen because it is within the same catchment as the impact site, contributes to a broader catchment-scale enhancement plan, and provides comparable stream habitat and functions to those being lost. Enhancement measures at the offset site will include 10 m of riparian planting along both banks, stock fencing to exclude livestock, weed and pest control, connection to other restored watercourses within the catchment, and legal protection (e.g., covenant).

Riparian planting will follow a similar methodology to that used at the impact site, as shown in drawing series 4672100-AL (Beca Limited, February 2025). However, finalised enhancement planting plans should be required as a condition of consent.

Current and potential SEV scores for the offset site are provided in Table 10 and the full SEV results provided in Appendix H. The potential SEV scores were calculated assuming full implementation of the proposed enhancement measures. All three SEV reaches recorded low baseline scores (0.347 to 0.362), confirming that the streams are currently of low ecological value due to agricultural impacts. Given the similar characteristics of other stream reaches within the same sub-catchment, these SEV scores are considered representative of the current condition of all reaches to be enhanced under the offset plan.

Table 10. Current and potential SEV scores for the offset site.

Catchment	Stream length (m)	SEV Reach	Current SEV Score	Potential SEV Score
1	983	SEV 1	0.347	0.496
2	655	SEV 2	0.362	0.515
3	350	SEV 3	0.361	0.519

Current, potential and impact SEV scores for the impact SEV reaches are provided in Table 11. As above, the predicted potential SEV score has been estimated to reflect typical conditions 5+ years after implementing ‘best-practice’ stream management/restoration in Auckland, including a minimum 10 m riparian buffer on both banks, appropriate fencing, and no in-stream enhancements. The diversion SEV score represents conditions 5+ years after stream realignment, incorporating both in-stream habitat enhancements and riparian planting.

Table 11. Current, potential and impacted SEV scores for the impacted SEV reaches.

SEV Reach	Current SEV Score	Potential SEV Score	Impact SEV Score
10A	0.273	0.354	0.0
10B	0.251	0.352	0.0
11A	0.332	0.355	0.0
11B	0.358	0.402	0.0
12A	0.296	0.383	0.0
12B	0.303	0.379	0.0
13A	0.341	0.419	0.0

Table 12 presents the ECR calculations used to determine the required amount of offsetting. Note that, in accordance with Storey et al. (2011), biotic functions (IFI and FFI) are not included in the SEV scores when applying to the ECR calculations. To appropriately offset the loss of 402.3 m^2 of stream value within the impact site, 1,364.5 m^2 of streambed (1,554.8 m stream length) will be enhanced within the Ōrewa catchment to the north of the site at 173 Upper Orewa Road, Wainui (‘offset site’). Based on the amount required to offset, only catchments 1 and 2 will be needed to be enhanced (Figure 27).

Table 12. Environmental Compensation Ratio (ECR) calculations.

Impact Stream	Impact Length (m)	Impact Stream Width (m)	Impacted Streambed (m2)	Impact SEV Reach	Offset SEV Reach	ECR	ECR Area (m2)	Offset Stream Width (m)	Offset Length Required (m)	Remaining Offset Stream Length (m)
2	3	0.37	1.1	13A	1	3.83	4.3	0.87	4.9	978.1
6	193.6	0.37	71.6	13A	1	3.83	274.4	0.87	315.3	662.8
8	32.7	0.37	12.1	13A	1	3.83	46.3	0.87	53.3	609.5
9	34.1	0.37	12.6	13A	1	3.83	48.3	0.87	55.5	554.0
12	115.1	0.35	40.3	12A	1	3.37	135.8	0.87	156.0	397.9
15	147	0.35	51.5	12A	1	3.37	173.4	0.87	199.3	198.6
20	51.9	0.35	18.2	12A	1	3.37	61.2	0.87	70.4	128.3
21	41.8	0.35	14.6	12A	1	3.37	49.3	0.87	56.7	71.6
26	32.5	0.39	12.7	12B	1	3.42	43.3	0.87	49.8	21.8
27	168.7	0.39	65.8	12B	2	3.33	219.1	0.89	246.2	408.8
35	55.7	0.44	24.5	11B	2	3.4	83.3	0.89	93.6	315.2
36	76	0.4	30.4	11A	2	2.95	89.7	0.89	100.8	214.4
42	65.4	0.64	41.9	10B	2	2.9	121.4	0.89	136.4	78.1
43	11	0.46	5.1	10A	2	2.92	14.8	0.89	16.6	61.5

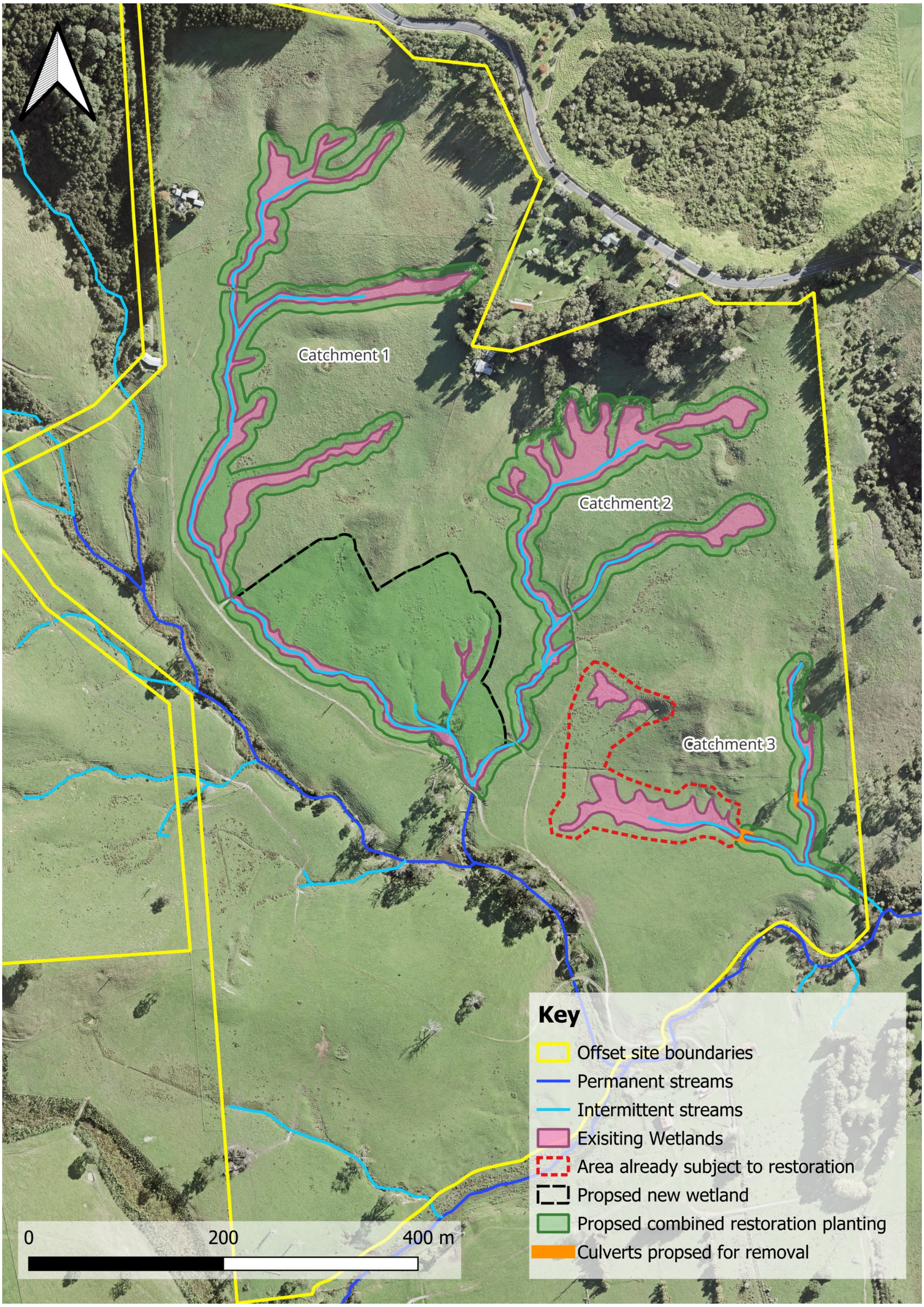

Figure 27. Map showing the proposed offsetting and compensation measures within the offset site.

Stream Extent

A total of 402.3 m² (1,028.5 m lineal length) of intermittent stream extent will be permanently lost as a result of the proposed reclamation.

To effectively offset stream extent, one would need to either construct an entirely new stream or daylight existing streams that have been piped or culverted. However, the hydrological challenges of creating a new stream make this an unfeasible option, as it would require sourcing water from another catchment, potentially causing negative impacts on an existing watercourse. Additionally, within the site, the broader Milldale area, and the offset site, there is not enough piped or culverted stream available to adequately offset the lost stream extent.

Given these challenges, offsetting was deemed impractical, and environmental compensation was considered the most suitable alternative.

To appropriately compensate for the loss of stream extent, the following measures are proposed:

- Restoration of the remaining streams within the Stage 10-13 site.
  - This equates to 785.3 m^2 of stream extent (1,114.9 m lineal length), of which approximately 600 m^2 is permanent stream extent.
  - Restoration will entail a minimum 10 m of riparian planting along both banks as shown in drawing series 4672100-AL (Beca Limited, February 2025).
- Removal of three existing culverts within the Stage 10-13 site to improve connectivity and fish passage.
  - The culverts proposed for daylighting are located within streams 9, 21 and 26 as shown on the drawing series P24-128-00-1400-EW prepared by Woods (dated February 2025).
- Restoration of the remaining streams within catchments 1 and 2 of the offset site and all the streams within catchment 3 (Figure 27).
  - This equates to 598.8 m^2 of stream extent (433.2 m lineal length).
  - Restoration measures include 10 m of riparian planting along both banks, stock fencing to exclude livestock, weed and pest control, connection to other restored watercourses within the catchment, and legal protection (e.g., covenant).
- Restoration of the degraded wetlands associated with the offset streams.
  - This equates to 2.7 ha of wetland restoration.
  - Restoration measures include 10 m of buffer planting around wetland perimeters, stock fencing to exclude livestock, weed and pest control, connection to other restored watercourses within the catchment, and legal protection (e.g., covenant).
- Removal of two existing farm culverts within the offset site to improve connectivity and fish passage.

To maximise the effectiveness of restoration efforts, a catchment-wide approach was intentionally adopted for the compensation measures within the offset site, including the created wetland discussed in Section 7.4.6 of this report. This approach provides significantly greater benefits than isolated, scattered efforts, leading to more effective and sustainable environmental improvements. Many freshwater issues originate upstream, such as erosion, pollution, and altered flow regimes. By addressing these underlying causes rather than just treating localised symptoms, catchment-wide restoration enhances water availability, reduces flood risks, and improves overall ecosystem health. Additionally, it minimises edge effects, fosters the development of ecotones, and strengthens connectivity between terrestrial and freshwater habitats, ultimately supporting greater biodiversity.

The offset site for the compensation measure was chosen due to its proximity to the impact site and the fact that it is located within the same wider catchment of the Ōrewa River.

To summarise, to compensate for the loss of 402.3 m² of intermittent stream extent, a total of 1,384.1 m² of stream extent and 2.7 ha of wetland will be restored or enhanced, and five culverts will be daylighted.

Although there will be an overall net loss of intermittent stream extent, the proposed compensation proffered would restore or enhance ecosystem processes equivalent to or greater than those lost. This includes improvements in water quality, habitat diversity, biodiversity support, and hydrological stability.

Native fauna

Due to the poor habitat quality and intermittent habitat availability of the reaches proposed to be reclaimed, only shortfin eel were assumed to be present. However, the preparation of a NFCRP is recommended as a condition of consent which should be carried out prior to stream reclamation to mitigate potential mortality and harm to indigenous fish (Section 7.4.3).

Regarding the key biodiversity offsetting principles, the following comments are provided:

- **Mitigation Hierarchy** –
  - Avoidance – As a result of the proposed scheme plan and bulk earthworks proposal, there are unavoidable impacts on the existing low value intermittent streams. Reclamation has been avoided where stream diversion is appropriate.
  - Minimisation – Adverse effects on in-stream fauna will be minimised by salvaging and relocating native fish and implementing appropriate sediment and erosion controls to prevent sediment discharge to the downstream receiving environment. The loss of the reclaimed streams functional roles of water conveyance has been mitigated through stormwater design. Retained reaches will be enhanced.
  - Offset – Offsetting options, such as daylighting and creation of new streams were considered unfeasible.
  - Compensation – Since other effects management options, such as minimisation and offsetting, have been sequentially explored and exhausted, environmental compensation was considered as a last alternative. Compensation has been used to address the significant residual effects of the stream reclamations.
  - Compensation – No offset or compensation is considered necessary as there will be no loss of stream extent or streambed area as a result of the diversion, and there will be no significant residual effects. However, additional enhancement of the streams is proposed though the provision of aquatic habitat features (e.g. rootwads) and riparian planting.
- **Additionality** – Apart from this application, there are no requirements or other plans relating to the compensation measures proposed.

- **Landscape Context (Proximity)** – All retained stream reaches within the site are proposed to be enhanced and as such additional sites were required to create a viable compensation package. A suitable offset site within the Milldale rural block was located, approximately 1.5 km to the north. Both the impact and offset sites are located within the wider Ōrewa River catchment.
- **"Like for Like"** – Since compensation rather than offsetting is being sought, the "like for like" principle is not always applicable. However, the streams located at the offset site have similar characteristics to the impact site, including intermittent flow, a soft-bottomed substrate, and modification through agricultural practices such as stock access and riparian vegetation removal. Additional, while the wetlands proposed for enhancement are not intermittent streams, they are a form of freshwater habitat, within the same wider catchment and are interconnected to the intermittent stream network.
- **No net loss and preferably a net gain** – For the loss of 402.3 m² of intermittent stream extent, a total of 1,384.1 m^2 of stream extent and 2.7 ha of wetland will be restored or enhanced, in addition five culverts will be daylighted. Although there will be an overall net loss of intermittent stream extent, the compensation package offers restore ecosystem processes equivalent to or greater than those lost. Overall, it is considered that there will be at least a no-net loss in biodiversity values, and likely a net gain.
- **"Like for Like"** – Since compensation rather than offsetting is being sought, the "like for like" principle is not always applicable. However, the streams located at the offset site have similar characteristics to the impact site, including intermittent flow, a soft-bottomed substrate, and modification through agricultural practices such as stock access and riparian vegetation removal. Additional, while the wetlands proposed for enhancement are not intermittent streams they are a form of freshwater habitat, within the same wider catchment and are connected to the intermittent stream network.
- **No net loss and preferably a net gain** – For the loss of 402.3 m² of intermittent stream extent, a total of 1,384.1 m^2 of stream extent and 2.7 ha of wetland will be restored or enhanced, in addition five culverts will be daylighted. Although there will be an overall net loss of intermittent stream extent, the compensation package would restore ecosystem processes equivalent to or greater than those lost. Overall, it is considered that there will be at least a not-net loss in biodiversity values and likely a net gain.

7.3.6 Freshwater fish

The magnitude of effect of the proposed works on indigenous freshwater fish is considered moderate, reducing to **low** with mitigation.

Aquatic features providing suitable habitat for indigenous freshwater fish are limited to some intermittent streams, the permanent stream, and offline constructed ponds. Shortfin eels, a highly mobile species, have been recorded on-site and are expected to be present in all available aquatic habitats.

Without mitigation, stream diversion, reclamation, and pond removal could result in native fish injury or mortality. To address this, a NFCRP is recommended as a consent condition. This plan should ensure the rescue and relocation of indigenous fish from disturbed aquatic habitats. Fish management should occur before works commence in any affected freshwater feature, including constructed ponds, artificial drains, and channels, where aquatic habitat is present.

7.3.7 Culvert removal and installation

The magnitude of effect on the streams as a result of removal of existing farm culverts, and installation of new culverts is considered to be low, mitigated to **very low** through appropriate design and the implementation of fish management.

Within the retained streams (i.e., streams that are not proposed to be diverted or reclaimed), a total of 64.8 m of existing farm culverts across the site will be removed. Many of these restrict hydrological connectivity and inhibit fish passage. Their removal is expected to improve stream hydrology and reduce localised flow disruptions.

The proposed works will include installation of 304.7 m of new culverts to support roading connections across retained and realigned watercourses (Woods 2025a). These culverts will cross intermittent watercourses and will be simple circular designs, suitable for the scale and hydrology of the streams. All new culverts will be designed to NPS-FM and AUP-OP permitted standards. Each culvert will be less than 30 m in length, countersunk 25% into the streambed, and be at least 1.3x the width of the streambed to maintain the natural alignment and substrate of the stream, ensuring minimal ecological disturbance. They will also be equipped with flexible baffles to facilitate the movement of aquatic species.

Two additional culverts have been consented as a part of Stage 6 of the Milldale development; an upgrade of an undersized culvert under Argent Lane to the southwest of Stage 11, and a “U” culvert directly to the east of Stage 10.

To minimise adverse effects during installation, works should be timed to occur in the warm season when most streams are likely to have low flow or be dry. Should aquatic habitat be present at the time of works, fish salvage will be undertaken by an experienced freshwater ecologist in accordance with the NFCRP (as above). It is recommended streambeds at culvert inlets and outlets are stabilised with natural materials as required to prevent scouring and erosion.

7.3.8 Wetland reclamation

Sixteen wetlands (Wetlands A-K and M-Q) within the site are proposed for removal, equating to a combined loss of 1.59 ha of wetland extent (Appendix B). There is an existing consent to remove Wetland L under resource consent BUN60393113, and thus effects on this wetland are not considered in this assessment.

The loss of the wetlands’ functional roles of flood attenuation and nutrient capture will be appropriately mitigated through stormwater management. However, there will still be a loss of wetland extent and value, which is considered a significant residual effect.

Furthermore, six ‘potential wetlands’ have been conservatively mapped on the neighbouring site at 147 Argent Lane (Appendix B). These wetlands have been mapped as ‘potential wetlands’ on the basis that they could not be fully assessed and delineated due to site ownership restrictions. However, these wetlands were observed to be within 100 m of the proposed development.

A hydrological assessment undertaken by Williamson Water & Land Advisory (WWLA 2025b) determined that, with the exception of the north-western potential wetland, these wetlands are primarily supported by groundwater. As a result, their extents are not anticipated to be significantly altered post-development (WWLA 2025b).

The north-western wetland, however, is predominantly surface water-fed in its upper portion (59%), while the remainder (41%) is groundwater-supported. The development will result in the redirection of stormwater runoff away from this wetland, removing 66% of its surface water inputs. Additionally, groundwater drawdown is expected to lower the water table below 0.5 m from the surface, reducing the groundwater-supported portion by 70%.

As a result, the wetland extent is expected to reduce from 6,300 m² to approximately 2,025 m², representing a 68% loss in extent. This significant reduction is likely to impact wetland function, including potential losses in habitat availability, hydrological connectivity, and ecological services.

When including the reduction of the north-western wetland within 147 Argent Lane, there will be a total loss of 2.02 ha of wetland habitat.

The wetlands proposed for removal or reduction ranged in size from 73 m^2 (Wetland G) to 6,892 m^2 (Wetland N). All of these wetlands were assessed as having low ecological value. The magnitude of effect (prior to any mitigation or offsetting actions) on the wetlands is very high from a localised site context, and moderate from a wider environment context. Based on the current ecological value and the magnitude of effect, the overall level of effect of the proposed wetland reclamation is **low-moderate**.

To appropriately offset the significant residual effect of the loss of 2.02 ha wetland extent and potential wetland value, 2.81 ha of new wetland is proposed to be created within the Ōrewa catchment to the north of the site at 173 Upper Orewa Road, Wainui.

7.3.9 Wetland offsetting

Impact site

All wetlands proposed to be reclaimed were of a very similar nature, having a similar plant species composition of common exotic rushes, sedges and grass species (Section 5.2). All wetlands were either seepage fed and/or associated with intermittent or permanent stream margins. The wetlands also had similar habitat features, generally lacking indigenous flora biodiversity, structural tiers, and aquatic habitat, and all were in the same contributing catchment of the Waterloo Creek. All wetlands were assessed as having a low ecological value.

Due to their similar nature, and for offsetting purposes, all wetlands were treated as a whole and hereafter referred to as the 'impact wetland', with a total area of 2.02 ha ('impact area').

There is currently no standard, accepted approach for assessing an appropriate multiplier for the loss of wetland values. An equivalent – albeit simplified – version of the SEV offsetting tool, a Wetland Ecological Valuation (WEV) method, has been developed by RMA Ecology in conjunction with Auckland Council.

The WEV methodology is a method for quantifying the value of wetland ecosystems, enabling the overall value of a wetland to be assessed and compared to the quality of other wetlands in a similar region. It considers 29 different components over 20 different wetland attributes that are ultimately grouped into three categories: catchment, wetland, and buffer. The data is manipulated using a series of formulae to produce an WEV score of between 0 (severely degraded with no ecological value) and 1 (a pristine wetland with very high ecological value).

This WEV method was applied on a project in Drury West which reclaimed wetland areas of similar scale and degradation, and was recently applied to and accepted by Auckland Council for two other Milldale stages during 2021 (BUN60366520) and 2024 (BUN60427756). As such, it was considered that the WEV method was applicable to this project.

The impacted wetland had a current WEV score of 0.5 and a potential score of 0.688. The potential score was also calculated, assuming current wetland enhancement and protection best practice measures which includes a 10 m planted riparian buffer, stock fencing (if applicable) and pest plant control. The development proposes to reclaim the wetland areas, therefore the impact WEV score for the impacted wetlands is 0. Summarised WEV scores for the impacted wetlands are provided as Appendix I of this report.

Offset site (Milldale rural block)

The offset site is located in the same wider catchment as the impact site; the Ōrewa river catchment. The proposed offset wetland will be created within a series of ephemeral overland flow paths and adjacent to existing degraded wetlands and a stream network. Similar to the impact wetland, the adjacent wetlands have been highly modified through agricultural practices, there is a lack of structural tiers, a very high dominance of exotic species and lack of aquatic habitat. Historical agricultural practices have severely impacted these wetlands through pugging and grazing.

This location was selected because it lies within the same catchment as the impact site, avoids streamworks, and utilises the natural overland flow paths as a collection point for surface runoff. Additionally, it will contribute to a broader catchment-focused enhancement plan and offer wetland habitat and functions comparable to those of the impact site.

The proposed offset wetland will be formed to create 2.81 ha of new wetland. There are no natural wetlands in this area at present, and the plant community is dominated by upland pasture species (Figure 28). As such, the current WEV score for this area was 0 (i.e., no wetland values currently present).

WWLA (2025c) has proposed a construction method to induce a hydrological regime that would support hydrophytic plant species, connecting the adjacent wetlands and streams without having a detrimental effect on their hydrology, essentially creating one larger and enhanced wetland feature.

The new offset wetland has a potential WEV score of 0.755. The potential score was also calculated, assuming the proposed enhancement actions are undertaken. These enhancement actions include extending/joining the adjacent wetlands, planting of the wetlands with appropriate native species, planting a 10 m buffer with appropriate native species, weed and pest control, stock fencing and legal protection (e.g., covenant). It is recommended that a wetland planting and management plan is required as a condition of consent to ensure successful establishment of a native wetland ecosystem.


Figure 28. a - d) Photos showing the proposed wetland offset site where 2.81 ha of new wetland will be created.

Extent Offset

A total of 2.02 ha of wetland is proposed to be reclaimed at the impact site. A total of 2.81 ha of new wetland is proposed to be created at the offset site (Figure 29). With hydrological input from WWLA (2025c), the created offset wetland has been designed to induce a wetland hydrological regime to support native hydrophytic plants.

The newly created wetland will offset for the loss of wetland area at the impact site, ensuring at least no net loss of wetland extent. Moreover, it will result in a net gain of 0.05 ha of wetland habitat.

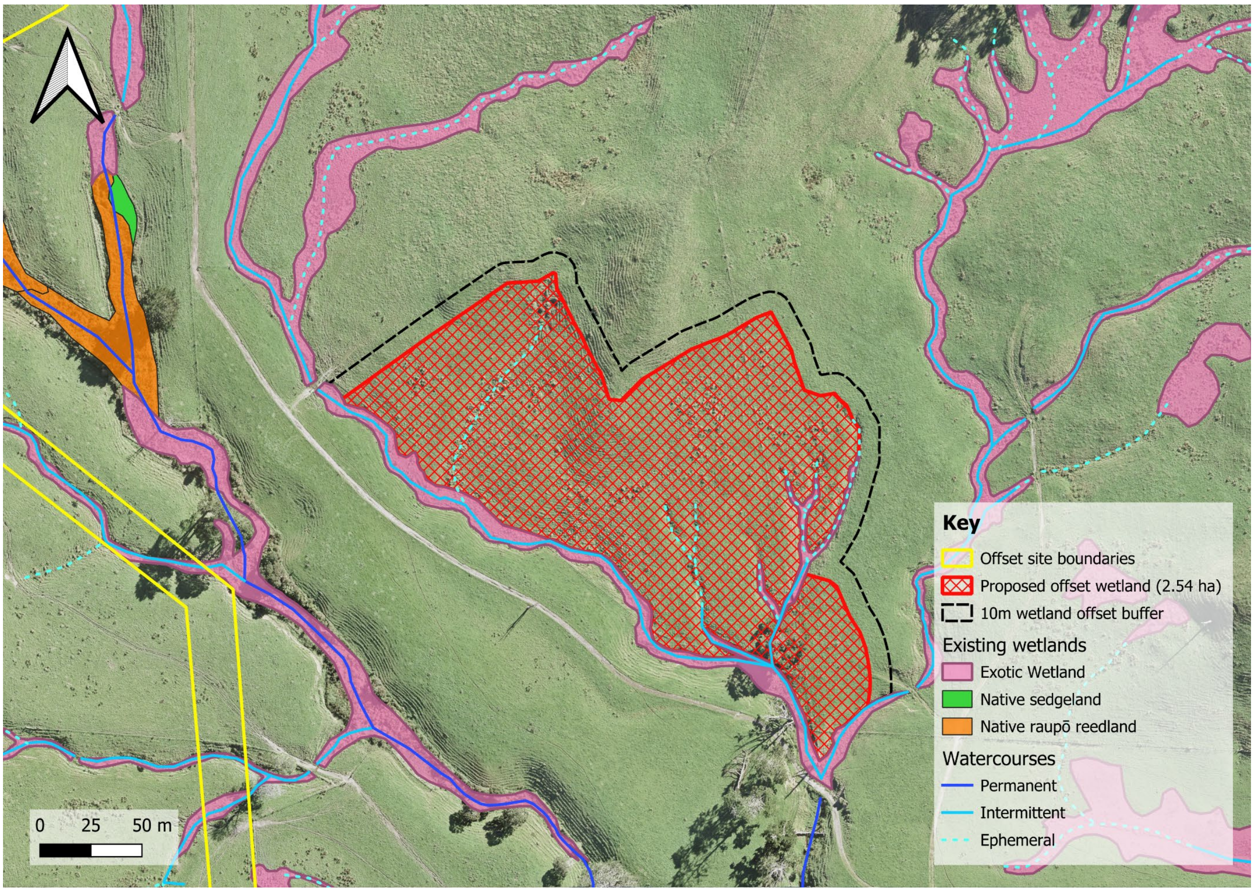

Figure 29. Map showing proposed offset wetland and surrounding existing freshwater features.

Value Offset

As part of the WEV method, the Auckland Council's technical report TR009 guidelines for calculating an Environmental Compensation Ratio (ECR) were incorporated. This ensures that adverse effects are mitigated, achieving a 'no-net-loss' of biodiversity values.

The ECR calculation = [(WEVi-P – WEVi-I)/(WEVm-P – WEVm-C)] x 1.5, where:

- WEVi-P = Impact wetland potential WEV Score (0.688);
- WEVi-I = Impact wetland impact WEV Score (0);
- WEVm-P = Offset wetland potential WEV Score (0.755);
- WEVm-C = Offset wetland current WEV Score (0); and
- The x '1.5' is the multiplier to account for delay and uncertainty.

The creation and planting of the new wetland at the offset site will offset the loss in ecological value at the impact site. The WEV/ECR calculations regarding the impact site and the created offset wetlands are provided below in Table 13.

Table 13. WEV/ECR calculations for the impact wetland and the created offset wetland.

Variable/calculation	Impact wetland	Offset wetland
Wetland area (m^2)	20,134	28,100
Wetland perimeter (m)	3,379	1,172
Existing WEV state	0.5	0
Potential WEV state	0.688	0.755
State after impact	0	N/A
WEV ECR (multiplier)	1.37	
Wetland area required (m^2)	**27,592**	

Based on the ECR calculations, 2.76 ha of new wetland habitat would be required to be created to appropriately offset the ecological values lost at the impact site, ensuring at least no net loss of wetland value. Since a total of 0.81 ha of new wetland habitat is proposed, a net gain of 0.05 ha of wetland habitat will be achieved regarding ecological value. Further, once established, the native wetland vegetation will provide higher ecological value to native fauna than the exotic-dominant wetlands being lost.

Regarding the key biodiversity offsetting principles, the following comments are provided:

- **Mitigation Hierarchy** – As a result of the proposed scheme plan and bulk earthworks proposal, there are unavoidable impacts on the existing low value wetlands. Adverse effects have been mitigated in part by mitigating the loss of the wetlands' functional roles of flood attenuation and nutrient capture through stormwater design. However, there will still be a significant residual loss of wetland extent and ecological value as a result of the reclamation, which the proposed offset addresses to a minimum no-net loss level.

- **Additionality** – Outside of this proposal to create a new wetland for offsetting, there are no requirements or other plans to create new wetland within the offset site. Therefore, the proposed offset site and the work within it to provide the necessary enhancements, satisfy the additionality test.
- **Landscape Context (Proximity)** – There are no other wetlands or suitable areas within the development site to enhance or create wetlands. As such, the offset was required to be off-site. A suitable offset site within the Milldale rural block was located, approximately 1.5 km to the north. Both the impact and offset sites are located within the wider Ōrewa River catchment.
- **"Like for Like"** – Once the offset wetland is established, both the impact and offset wetlands will be of a similar nature. Both wetland areas will be within the Ōrewa River catchment, will have similar structural tiers, will be associated with stream habitat and have a comparable hydrological regime.
- **No net loss and preferably a net gain** – Through the creation of new wetland habitat there will be a no net loss in wetland extent, in fact there will be marginal net gain (0.05 ha). The previously accepted WEV/ECR methodology was applied as part of the calculation process to offset lost ecological value. The WEV/ECR includes consideration of the current and future states of the impact and offset site, including accounting for risk, uncertainty and time lag (i.e., through a 1.5 x multiplier). The overall result will be at a minimum a no-net-loss to redress the potential ecological values lost at the impact site. In fact, the additional creation of 0.05 ha (above the required 2.76 ha) will provide for a net biodiversity gain.

Wetland monitoring

It is recommended as a condition of consent that a wetland monitoring plan is developed to ensure the successful establishment of wetland vegetation and buffer plants. It is recommended that the wetland monitoring is implemented for a minimum of five years following the completion of the initial planting.

7.3.10 Stormwater management

If not appropriately designed and managed, changes to a site's stormwater regime could result in adverse effects on the freshwater environment, such as reduced baseflows to streams, altered flow regimes, erosion and sedimentation, and contaminant loading.

The stormwater management design has been developed to meet Stormwater Management Area Flow (SMAF) hydrology mitigation requirements, including retention and detention measures, and aligns with Water Sensitive Design (WSD) principles (Woods 2025a).

Stormwater treatment will be achieved through a treatment train approach incorporating swales, raingardens, private tanks, and drainage basins. Most road runoff will be treated via basins, while some minor road catchments will discharge directly to watercourses. Additional storage within basins and raingardens will offset direct discharges to streams.

Key features of the stormwater management have been incorporated to minimise adverse effects on the streams to be retained, including:

- Stormwater outlets – Designed according to TP10 standards to minimise scouring and erosion while managing up to the 10% AEP flow. Scruffy dome outlets and wingwalls will direct flows to watercourses.

- Stream recharge – Stormwater discharge and underfill drainage will support six retained and realigned watercourses by providing base flows at their headwaters. Post-development flows will replicate or exceed pre-development contributions to ensure stream recharge and sustain intermittent stream environments.
- Groundwater diversion – Underfill drainage systems to manage sensitive soils and stability issues, while also directing groundwater to the retained streams to enhance base flows.

Riparian revegetation planting will be included to further stabilise stream channels and enhance ecological outcomes. These measures aim to maintain hydrological and ecological functionality within the development area.

7.4 Summary of Ecological Effects

The overall level of effect for the proposed works is generated using Table 2, taking the ecological value and expected magnitude of the effect on that value. Expected levels of effect for the proposal are given in Table 14. Generally, mitigation is only required when the level of effect is expected to be moderate or higher. However, in line with best practice, a number of mitigation measures are recommended to ensure the level of effect of the proposal remains low.

Table 14. Overall level of effect of the project on ecological values.

Effect	Ecological value	Magnitude of effect before mitigation/offset	Magnitude of effect after mitigation/offset	Level of effect
Effect on botanical and habitat values	Low	High	Low	Positive – following extensive riparian planting
Effect on birds	Low	Moderate	Low	Low – due to avifauna management
Effect on lizards	Moderate	Moderate	Low	Low
Effect on bats	Moderate	Moderate	Low	Low
Effects of erosion and sedimentation on freshwater environments	Low	High	Low	Low
Effects on stream value	Low	Very High	Low	Positive – net gain based on stream offset package
Effects on stream extent	Low	Very High	Low	Positive – residual loss of stream extent to be compensated for through stream enhancement
Effects of culvert removal	Low	Moderate	Low	Positive
Effects of culvert installation	Low	Moderate	Low	Low
Effects on wetlands	Low	High	Low	Positive – offset package provides net gain
Effects on freshwater fish	Low	Moderate	Low	Low – due to fish management

8 SUMMARY AND RECOMMENDATIONS

Viridis was engaged by FHLD to undertake an EcIA within the 71 ha site at Milldale Stages 10-13, which is proposed for development under the FTAA. The terrestrial ecological values of the site were largely limited to exotic pasture, scattered exotic and pest plants amongst the agricultural setting, small exotic tree stands, and garden/amenity plantings associated with rural residential dwellings. The botanical values of the site were low, however the vegetation may provide suitable habitat for 'At Risk' copper skinks and 'Threatened' long-tailed bats.

One permanent stream and several intermittent streams, several natural inland wetlands, and constructed ponds and drainage channels were also present within the site. All freshwater features were assessed as having a low ecological value due to the sites history of agricultural and horticultural land uses which has resulted in modification and degradation of freshwater systems.

The project will involve bulk earthworks, the installation of infrastructure, vegetation removal, the reclamation and diversion of intermittent streams, culvert installation, and the reclamation of natural inland wetlands. Works proposed to offset/compensate for residual effects on freshwater values include extensive riparian enhancement, stream enhancement and naturalisation, and the creation of new wetland that is anticipated to achieve higher ecological values than the existing features to be affected.

The following recommendations are provided to avoid and minimise any potential adverse effects to the ecological value of the terrestrial and freshwater environments during the undertaking of earthworks, and development activities, on the site:

- Site management should include ensuring that no rubbish, fuel, solvents, concrete wash-down material or other related materials enter the freshwater environment;
- If tree clearance occurs during bird breeding season, it is recommended that a condition of consent requires an ecologist to inspect the affected vegetation within 24 hours of clearance. If active native bird nests are identified, a minimum 10 m buffer must be maintained around the nesting site until an ecologist deems it to be inactive (Appendix G);
- A consent condition to minimise adverse effects on bats that requires the preparation of a BMP, or a resource consent condition requiring application of the DOC standards to be undertaken by a competent bat worker (Appendix G);
- A LMP is required as a condition of consent and is prepared and implemented by a suitably qualified and experienced herpetologist to minimise adverse effects on indigenous lizards (Appendix G);
- ESC measures are implemented according to Auckland Council's GD05 guidelines and strictly adhered to;
- Prior to commencement of streamwork activities on the subject site, an NFCRP, produced by a suitably qualified and experienced freshwater ecologist, should be prepared and submitted to Auckland Council for approval to minimise adverse effects on indigenous freshwater fish;
- A stream and wetland planting and management plan for the offset site is prepared as a condition of consent that provides full planting schedules for the stream riparian zones, wetland, and wetland buffer zone, as well as ongoing replacement planting, pest plant and animal control, and stock-proof fencing as required; and
- A wetland monitoring plan is prepared and implemented as a condition of consent to ensure the successful establishment of the proposed offset wetland. This plan should include recommendations for vegetation and hydrological monitoring (Appendix J).

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Appendix A
Terrestrial Vegetation Maps

VIRIDIS
Environmental Consultants

Terrestrial vegetation - Milldale Stages 10-13

Fulton Hogan Land Development Limited

Legend

- Stage boundaries

Vegetation

- Exotic trees
- Native trees/scrub
- Exotic weeds
- Mixed native-exotic trees/scrub

SOURCES
Milldale Drone Aerial 20241015

DISCLAIMER:
This map/plan is not an engineering draft.
This map/plan is illustrative only and all information should be independently verified on site before taking any action.

SCALE
1:5,400 @ A3

PROJECT NO. 10015
DRAWN BY: B. P
DATE: 23 January 2025

VIRIDIS
Environmental Consultants

Terrestrial vegetation - Milldale Stage 10

Fulton Hogan Land Development Limited

Legend

Stage boundaries

Vegetation

Exotic trees

Native trees/scrub

Mixed native-exotic trees/scrub

SOURCES
Milldale Drone Aerial 20241015

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SCALE
1:1,700 @ A3

PROJECT NO. 10015

DRAWN BY: B. P

DATE: 23 January 2025

VIRIDIS
Environmental Consultants

Terrestrial vegetation - Milldale Stage 11

Fulton Hogan Land Development Limited

Legend

Stage boundaries

Vegetation

Exotic trees

Native trees/scrub

Exotic weeds

Mixed native-exotic trees/scrub

SOURCES
Milldale Drone Aerial 20241015

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SCALE
1:1,700 @ A3

PROJECT NO. 10015

DRAWN BY: B. P

DATE: 23 January 2025

VIRIDIS
Environmental Consultants

Terrestrial vegetation - Milldale Stage 12

Fulton Hogan Land Development Limited

Legend

Stage boundaries

Vegetation

- Exotic trees
- Native trees/scrub
- Exotic weeds

SOURCES
Milldale Drone Aerial 20241015

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SCALE
1:2,600 @ A3

PROJECT NO.	10015
DRAWN BY:	B. P
DATE:	23 January 2025

VIRIDIS
Environmental Consultants

Terrestrial vegetation - Milldale Stage 13

Fulton Hogan Land Development Limited

Legend

Stage boundaries

Vegetation

Exotic trees

Native trees/scrub

Exotic weeds

SOURCES
Milldale Drone Aerial 20241015

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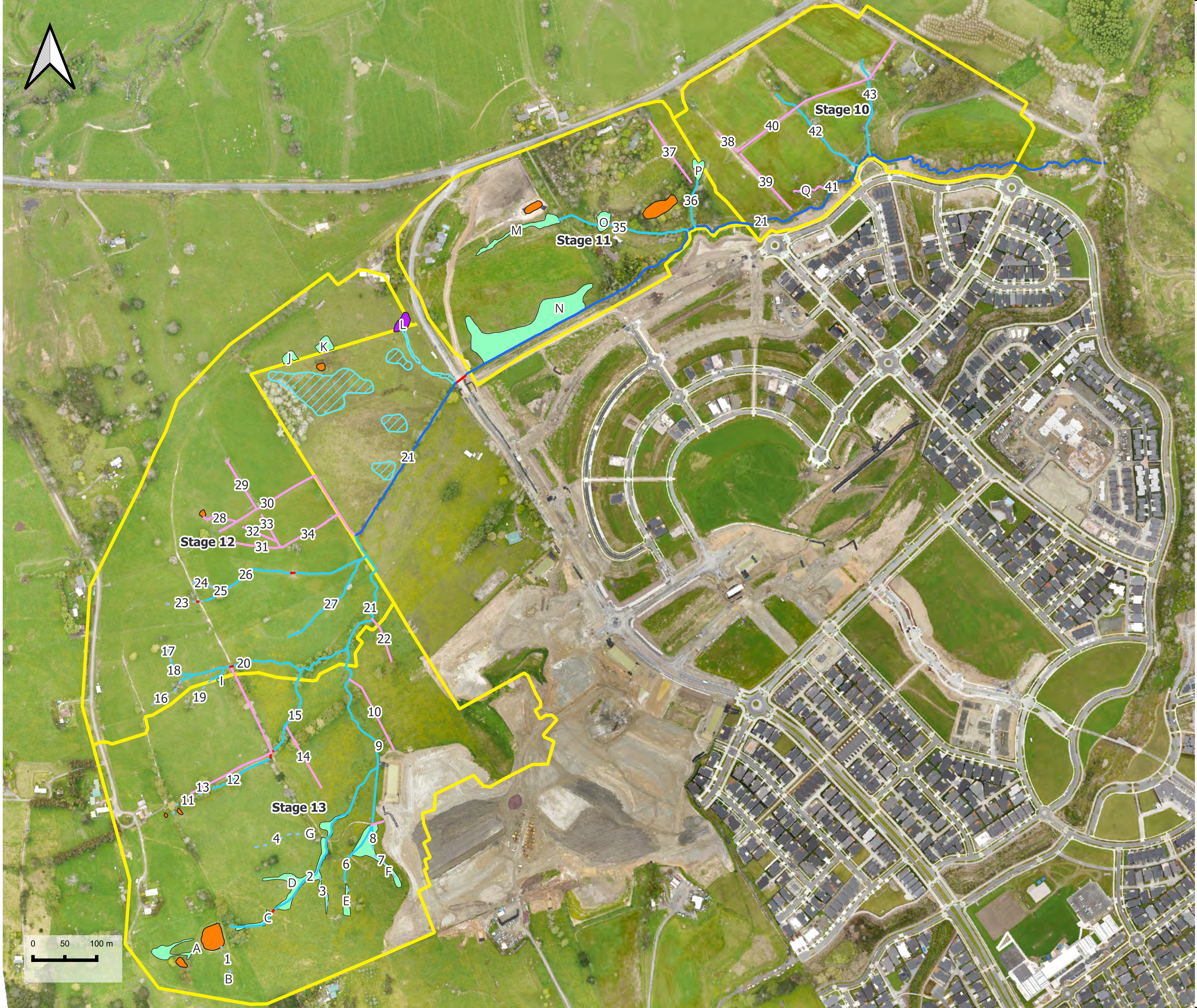
SCALE
1:2,180 @ A3

PROJECT NO. 10015

DRAWN BY: B. P

DATE: 23 January 2025

Appendix B
Freshwater Features Maps



VIRIDIS
Environmental Consultants

Freshwater features - Milldale Stages 10-13

Fulton Hogan Land Development Limited

Legend

- Stage boundaries

Watercourses
- Permanent
- Intermittent
- Ephemeral
- Culvert
- Artificial

Wetlands
- Natural wetland
- Natural wetland - Consented to remove
- Constructed pond
- Potential wetland

SOURCES
Milldale Drone Aerial 20241015

DISCLAIMER:
This map/plan is not an engineering draft.
This map/plan is illustrative only and all information should be independently verified on site before taking any action.

SCALE
1:5,400 @ A3

PROJECT NO.	10015
DRAWN BY:	B. P
DATE:	26 February 2025

VIRIDIS
Environmental Consultants

Freshwater features - Milldale Stage 10

Fulton Hogan Land Development Limited

Legend

Stage boundaries

Watercourses
- Permanent
- Intermittent
- Artificial

Wetlands
- Natural
- Pond

SOURCES
Milldale Drone Aerial 20241015

DISCLAIMER:
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This map/plan is illustrative only and all information should be independently verified on site before taking any action.

SCALE
1:1,700 @ A3

PROJECT NO. 10015
DRAWN BY: B. P
DATE: 23 January 2025

VIRIDIS
Environmental Consultants

Freshwater features - Milldale Stage 11

Fulton Hogan Land Development Limited

Legend

Stage boundaries

Watercourses
- Permanent
- Intermittent
- Culvert
- Artificial

Wetlands
- Natural
- Pond
- Potential

SOURCES
Milldale Drone Aerial 20241015

DISCLAIMER:
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This map/plan is illustrative only and all information should be independently verified on site before taking any action.

SCALE
1:1,700 @ A3

PROJECT NO.	10015
DRAWN BY:	B. P
DATE:	23 January 2025

VIRIDIS
Environmental Consultants

Freshwater features - Milldale Stage 12

Fulton Hogan Land Development Limited

Legend

- Stage boundaries

Watercourses

- Permanent
- Intermittent
- Ephemeral
- Culvert
- Artificial

Wetlands

- Natural wetland
- Natural wetland - Consented to remove
- Constructed pond
- Potential wetland

SOURCES
Milldale Drone Aerial 20241015

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SCALE
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PROJECT NO.	10015
DRAWN BY:	B. P
DATE:	26 February 2025

VIRIDIS
Environmental Consultants

Freshwater features - Milldale Stage 13

Fulton Hogan Land Development Limited

Legend

Stage boundaries

Watercourses

- Intermittent
- Ephemeral
- Culvert
- Artificial

Wetlands

- Natural
- Pond

SOURCES

Milldale Drone Aerial 20241015

DISCLAIMER:
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This map/plan is illustrative only and all information should be independently verified on site before taking any action.

SCALE

1:2,180 @ A3

PROJECT NO.	10015
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DATE:	23 January 2025

Appendix C
Watercourse Classifications – Project Site

Table C1. Watercourse classification table for project site.

Watercourse number	Classification	Natural pools	Well-defined channel, such that the bed and banks can be distinguished	Contains surface water more than 48 hours after rain	Rooted terrestrial vegetation is NOT established across the entire cross-sectional width	Organic debris resulting from flooding can be seen on the floodplain	Evidence of substrate sorting, including scour and deposition	Comments
1	Ephemeral	✗	✗	✗	✗	N/A	✗	Overland flow path in pasture, flows to artificial pond
2	Intermittent	✓	✓	✓	✓	N/A	✓	Modified stream within degraded exotic wetland, perched culverts present, negligible riparian tree vegetation
3	Ephemeral	✗	✗	✗	✗	N/A	✗	Overland flow path in pasture, wetland vegetation present
4	Ephemeral	✗	✗	✗	✗	N/A	✗	Overland flow path in pasture
5	Ephemeral	✗	✗	✗	✗	N/A	✗	Overland flow path in pasture
6	Intermittent	✓	✓	✓	✓	N/A	✓	Modified stream within pasture/exotic wetland
7	Ephemeral	✗	✗	✗	✗	N/A	✗	Overland flow path in wetland vegetation
8	Intermittent	✓	✓	✓	✓	N/A	✓	Modified stream within pasture, negligible riparian tree vegetation
9	Intermittent	✓	✓	✓	✓	N/A	✓	Modified stream within pasture, negligible riparian tree vegetation
10	Artificial drain	N/A	N/A	N/A	N/A	N/A	N/A	Shallow constructed drain – bed above water table
11	Ephemeral	✗	✗	✗	✓	N/A	✗	Overland flow path along farm track
12	Intermittent	✓	✓	✓	✓	N/A	✓	Modified stream parallel to farm track, scattered exotic tree vegetation
13	Artificial drain	N/A	N/A	N/A	N/A	N/A	N/A	Shallow drain – bed above water table

Watercourse number	Classification	Natural pools	Well-defined channel, such that the bed and banks can be distinguished	Contains surface water more than 48 hours after rain	Rooted terrestrial vegetation is NOT established across the entire cross-sectional width	Organic debris resulting from flooding can be seen on the floodplain	Evidence of substrate sorting, including scour and deposition	Comments
14	Artificial drain	N/A	N/A	N/A	N/A	N/A	N/A	Shallow constructed drain, unnatural alignment, bed above water table
15	Intermittent	✓	✓	✓	✓	N/A	✓	Modified stream within pasture, negligible riparian tree vegetation
16	Ephemeral	✗	✗	✗	✗	N/A	✗	Overland flow path in pasture
17	Ephemeral	✗	✓	✗	✗	N/A	✗	Overland flow path in pasture
18	Intermittent	✓	✓	✓	✓	N/A	✓	Modified stream within pasture, negligible riparian tree vegetation
19	Ephemeral	✗	✗	✗	✗	N/A	✗	Overland flow path in pasture
20	Intermittent	✓	✓	✓	✓	N/A	✓	Modified stream within pasture, negligible riparian tree vegetation
21	Intermittent/Permanent	✓	✓	✓	✓	✓	✓	Tributary to Waterloo Creek in the east. Upper reach intermittent within Stage 12 before owing offsite and re-entering into Stage 11 as a permanent stream with a bed below the water table. Highly modified straightened deepened channel, riparian vegetation largely absent with some small patches. Consented streamworks have incorporated meanders and recent riparian revegetation (in Stage 10 portion of reach)
22	Artificial drain	N/A	N/A	N/A	N/A	N/A	N/A	Shallow constructed drain, unnatural alignment, bed above water table
23	Ephemeral	✗	✓	✗	✗	N/A	✗	Overland flow path in pasture, upstream of culvert under farm track

Watercourse number	Classification	Natural pools	Well-defined channel, such that the bed and banks can be distinguished	Contains surface water more than 48 hours after rain	Rooted terrestrial vegetation is NOT established across the entire cross-sectional width	Organic debris resulting from flooding can be seen on the floodplain	Evidence of substrate sorting, including scour and deposition	Comments
24	Ephemeral	✗	✗	✗	✗	N/A	✗	Overland flow path in pasture
25	Intermittent	✓	✓	✓	✓	N/A	✓	Modified stream within pasture, negligible riparian tree vegetation short reach which adjoins watercourse 26
26	Intermittent	✓	✓	✓	✓	N/A	✓	Modified stream within pasture, negligible riparian tree vegetation, culvert present
27	Intermittent	✓	✓	✓	✓	N/A	✓	Modified stream within pasture, negligible riparian tree vegetation
28	Artificial drain	N/A	N/A	N/A	N/A	N/A	N/A	Shallow constructed drain which conveys overflow from constructed pond, bed above water table
29	Artificial drain	N/A	N/A	N/A	N/A	N/A	N/A	Shallow constructed drain, unnatural alignment, bed above water table
30	Artificial drain	N/A	N/A	N/A	N/A	N/A	N/A	Shallow constructed drain, unnatural alignment, bed above water table
31	Artificial drain	N/A	N/A	N/A	N/A	N/A	N/A	Shallow constructed drain, bed above water table
32	Artificial drain	N/A	N/A	N/A	N/A	N/A	N/A	Shallow constructed drain, bed above water table
33	Artificial drain	N/A	N/A	N/A	N/A	N/A	N/A	Shallow constructed drain, unnatural alignment, bed above water table
34	Artificial drain	N/A	N/A	N/A	N/A	N/A	N/A	Shallow constructed drain, bed above water table, no evidence of natural watercourse on historic aerials
35	Intermittent	✓	✓	✓	✓	N/A	✓	Modified stream within pasture, occasional exotic riparian tree vegetation

Watercourse number	Classification	Natural pools	Well-defined channel, such that the bed and banks can be distinguished	Contains surface water more than 48 hours after rain	Rooted terrestrial vegetation is NOT established across the entire cross-sectional width	Organic debris resulting from flooding can be seen on the floodplain	Evidence of substrate sorting, including scour and deposition	Comments
36	Intermittent	✓	✓	✓	✓	N/A	✓	Modified stream within pasture, low-moderate exotic and native riparian tree vegetation
37	Artificial drain	N/A	N/A	N/A	N/A	N/A	N/A	Shallow constructed drain, unnatural alignment following fenceline, bed above water table
38	Artificial drain	N/A	N/A	N/A	N/A	N/A	N/A	Shallow constructed drain, unnatural alignment, bed above water table
39	Artificial drain	N/A	N/A	N/A	N/A	N/A	N/A	Shallow constructed drain, unnatural alignment, bed above water table
40	Artificial drain	N/A	N/A	N/A	N/A	N/A	N/A	Shallow constructed drain, unnatural alignment, bed above water table
41	Artificial drain	N/A	N/A	N/A	N/A	N/A	N/A	Shallow constructed drain, bed above water table, no evidence of feature on historic aerials
42	Intermittent	✓	✓	✓	✓	N/A	✓	Modified stream within pasture, negligible exotic riparian tree vegetation
43	Intermittent	✓	✓	✓	✓	N/A	✓	Modified stream within pasture, negligible exotic riparian tree vegetation

Appendix D
Current, Potential & Diversion Stream Ecological Valuation Results – Project Site

Table D1. Current Stream Ecological Valuation (SEV) data for each assessment reach within the Stages 10-13 project site.

Function category	Function	Variable	Assessed SEV reach						
			10-A	10-B	11-A	11-B	12-A	12-B	13-A
Hydraulic		Vchann	0.10	0.10	0.10	0.10	0.10	0.10	0.13
		Vlining	0.80	0.80	0.80	0.80	0.80	0.80	0.80
		Vpipe	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	NFR	=	0.33	0.33	0.33	0.33	0.33	0.33	0.35
		Vbank	0.36	0.36	0.36	0.36	0.24	0.24	0.52
		Vrough	0.27	0.22	0.57	0.52	0.23	0.51	0.50
	FLE	=	0.10	0.08	0.20	0.19	0.06	0.12	0.26
		Vbarr	0.30	0.30	0.00	1.00	1.00	1.00	1.00
	CSM	=	0.30	0.30	0.00	1.00	1.00	1.00	1.00
		Vchanshape	0.27	0.21	0.27	0.20	0.24	0.24	0.31
		Vlining	0.80	0.80	0.80	0.80	0.80	0.80	0.80
	CGW	=	0.62	0.60	0.62	0.60	0.61	0.61	0.64
Hydraulic function mean score			0.34	0.33	0.29	0.53	0.50	0.52	0.56
Biogeochemical		Vshade	0.18	0.04	0.38	0.22	0.20	0.04	0.18
	WTC	=	0.18	0.04	0.38	0.22	0.20	0.04	0.18
		Vdod	0.45	0.45	0.75	0.45	0.45	0.40	0.68
	DOM	=	0.45	0.45	0.75	0.45	0.45	0.40	0.68
		Vripar	0.05	0.02	0.30	0.15	0.00	0.05	0.00
		Vdecid	0.10	0.10	0.36	0.10	0.00	0.00	0.00
	OMI	=	0.03	0.01	0.20	0.08	0.00	0.03	0.00
		Vmacro	0.97	0.97	0.92	0.75	0.99	0.90	0.90
		Vretain	0.20	0.20	0.20	0.20	0.20	0.20	0.20
	IPR	=	0.20	0.20	0.20	0.20	0.20	0.20	0.20
		Vsurf	0.28	0.31	0.32	0.33	0.17	0.36	0.23
		Vripfilt	0.20	0.20	0.40	0.58	0.20	0.40	0.40
	DOP	=	0.24	0.25	0.36	0.45	0.18	0.38	0.32
Biogeochemical function mean score			0.22	0.19	0.38	0.28	0.21	0.21	0.27
Habitat Provision		Vgalspwn	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Vgalqual	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Vgobspwn	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	FSH	=	0.05	0.05	0.05	0.05	0.05	0.05	0.05
		Vphyshab	0.24	0.09	0.28	0.27	0.11	0.16	0.19
		Vwatqual	0.06	0.03	0.18	0.07	0.07	0.03	0.13
		Vimperv	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Function category	Function	Variable	Assessed SEV reach						
			10-A	10-B	11-A	11-B	12-A	12-B	13-A
	HAF	=	0.38	0.30	0.44	0.40	0.32	0.34	0.38
Habitat provision function mean score			0.22	0.18	0.24	0.23	0.18	0.19	0.21
Biodiversity		Vfish	0.33	0.33	0.33	0.33	0.33	0.33	0.33
	FFI	=	0.33	0.33	0.33	0.33	0.33	0.33	0.33
		Vmci	0.42	0.42	0.52	0.52	0.44	0.28	0.36
		Vept	0.33	0.33	0.17	0.17	0.17	0.00	0.00
		Vinvert	0.58	0.58	0.58	0.58	0.35	0.35	0.23
	IFI	=	0.45	0.45	0.42	0.42	0.32	0.21	0.20
		Vripcond	0.17	0.11	0.38	0.28	0.11	0.23	0.20
		Vripconn	0.95	0.96	0.95	1.00	0.85	0.90	1.00
	RVI	=	0.16	0.11	0.36	0.28	0.09	0.20	0.20
Biodiversity function mean score			0.31	0.30	0.37	0.34	0.25	0.25	0.24
Overall mean SEV score (maximum value 1)			**0.273**	**0.251**	**0.332**	**0.358**	**0.296**	**0.303**	**0.341**

Notes: NFR is natural flow regime; FLE is floodplain effectiveness; CSM is connectivity for species migration; CGW is natural connectivity to groundwater; WTC is water temperature control; DOM is dissolved oxygen levels maintained; OMI is organic matter input; IPR is in-stream particle retention; DOP is decontamination of pollutants; FSH is fish spawning habitat; HAF is habitat or aquatic fauna; FFI is fish fauna intact; IFI is invertebrate fauna intact; RVI is riparian vegetation intact.

Table D2. Potential Stream Ecological Valuation (SEV) data for each assessment reach within the Stages 10-13 project site.

Function category	Function	Variable	Assessed SEV reach						
			10-A	10-B	11-A	11-B	12-A	12-B	13-A
Hydraulic		Vchann	0.10	0.10	0.10	0.10	0.10	0.10	0.13
		Vlining	0.90	0.90	0.90	0.90	0.90	0.90	0.90
		Vpipe	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	NFR	=	0.37	0.37	0.37	0.37	0.37	0.37	0.39
		Vbank	0.36	0.36	0.36	0.36	0.24	0.24	0.52
		Vrough	0.42	0.42	0.42	0.42	0.42	0.42	0.42
	FLE	=	0.15	0.15	0.15	0.15	0.10	0.10	0.22
		Vbarr	0.30	0.30	0.00	1.00	1.00	1.00	1.00
	CSM	=	0.30	0.30	0.00	1.00	1.00	1.00	1.00
		Vchanshape	0.27	0.21	0.27	0.20	0.24	0.24	0.31
		Vlining	0.90	0.90	0.90	0.90	0.90	0.90	0.90
	CGW	=	0.69	0.67	0.69	0.67	0.68	0.68	0.70
Hydraulic function mean score			0.38	0.37	0.30	0.55	0.54	0.54	0.58
Biogeochemical		Vshade	0.52	0.52	0.52	0.52	0.52	0.52	0.52
	WTC	=	0.52	0.52	0.52	0.52	0.52	0.52	0.52
		Vdod	0.68	0.68	1.00	0.68	0.68	0.60	1.00

Function category	Function	Variable	Assessed SEV reach						
			10-A	10-B	11-A	11-B	12-A	12-B	13-A
	DOM	=	0.68	0.68	1.00	0.68	0.68	0.60	1.00
		Vripar	0.50	0.50	0.50	0.50	0.50	0.50	0.50
		Vdecid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	OMI	=	0.25	0.25	0.25	0.25	0.25	0.25	0.25
		Vmacro	0.98	0.98	0.94	0.83	1.00	0.93	0.97
		Vretain	0.20	0.20	0.20	0.20	0.20	0.20	0.20
	IPR	=	0.20	0.20	0.20	0.20	0.20	0.20	0.20
		Vsurf	0.33	0.36	0.32	0.33	0.22	0.41	0.28
		Vripfilt	0.40	0.40	0.40	0.40	0.40	0.40	0.40
	DOP	=	0.37	0.38	0.36	0.36	0.31	0.40	0.34
Biogeochemical function mean score			0.40	0.40	0.47	0.40	0.39	0.39	0.46
Habitat Provision		Vgalspwn	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Vgalqual	0.25	0.25	0.25	0.25	0.25	0.25	0.25
		Vgobspwn	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	FSH	=	0.05	0.05	0.05	0.05	0.05	0.05	0.05
		Vphyshab	0.44	0.38	0.42	0.44	0.38	0.45	0.45
		Vwatqual	0.21	0.21	0.31	0.21	0.21	0.19	0.36
		Vimperv	0.30	0.30	0.30	0.30	0.30	0.30	0.30
	HAF	=	0.34	0.32	0.36	0.34	0.32	0.35	0.39
Habitat provision function mean score			0.20	0.18	0.21	0.20	0.18	0.20	0.22
Biodiversity		Vfish	0.33	0.33	0.33	0.33	0.33	0.33	0.33
	FFI	=	0.33	0.33	0.33	0.33	0.33	0.33	0.33
		Vmci	0.42	0.42	0.52	0.52	0.44	0.28	0.36
		Vept	0.33	0.33	0.17	0.17	0.17	0.00	0.00
		Vinvert	0.58	0.58	0.58	0.58	0.35	0.35	0.23
	IFI	=	0.45	0.45	0.42	0.42	0.32	0.21	0.20
		Vripcond	0.28	0.28	0.28	0.28	0.28	0.28	0.28
		Vripconn	0.95	0.96	0.95	1.00	0.85	0.90	1.00
	RVI	=	0.27	0.27	0.27	0.28	0.24	0.25	0.28
Biodiversity function mean score			0.35	0.35	0.34	0.35	0.30	0.26	0.27
Overall mean SEV score (maximum value 1)			**0.354**	**0.352**	**0.355**	**0.402**	**0.383**	**0.379**	**0.419**

Notes: NFR is natural flow regime; FLE is floodplain effectiveness; CSM is connectivity for species migration; CGW is natural connectivity to groundwater; WTC is water temperature control; DOM is dissolved oxygen levels maintained; OMI is organic matter input; IPR is in-stream particle retention; DOP is decontamination of pollutants; FSH is fish spawning habitat; HAF is habitat or aquatic fauna; FFI is fish fauna intact; IFI is invertebrate fauna intact; RVI is riparian vegetation intact.

Table D3. Diversion Stream Ecological Valuation (SEV) data for each assessment reach within Stages 10-13 site.

Function category	Function	Variable	Assessed SEV reach*					
			10-A	10-B	11-B	12-A	12-B	13-A
Hydraulic		Vchann	0.75	0.75	0.75	0.75	0.75	0.75
		Vlining	0.94	0.94	0.94	0.94	0.94	0.94
		Vpipe	1.00	1.00	1.00	1.00	1.00	1.00
	NFR	=	0.81	0.81	0.81	0.81	0.81	0.81
		Vbank	0.68	0.68	0.68	0.68	0.68	0.68
		Vrough	0.48	0.51	0.48	0.51	0.48	0.54
	FLE	=	0.33	0.35	0.33	0.35	0.33	0.37
		Vbarr	1.00	1.00	1.00	1.00	1.00	1.00
	CSM	=	1.00	1.00	1.00	1.00	1.00	1.00
		Vchanshape	0.80	0.80	0.80	0.80	0.80	0.80
		Vlining	0.94	0.94	0.94	0.94	0.94	0.94
	CGW	=	0.89	0.89	0.89	0.89	0.89	0.89
Hydraulic function mean score			0.76	0.76	0.76	0.76	0.76	0.77
Biogeochemical		Vshade	0.52	0.52	0.52	0.52	0.52	0.52
	WTC	=	0.52	0.52	0.52	0.52	0.52	0.52
		Vdod	0.68	0.68	0.68	0.68	0.60	1.00
	DOM	=	0.68	0.68	0.68	0.68	0.60	1.00
		Vripar	0.60	0.65	0.60	0.65	0.60	0.70
		Vdecid	0.00	0.00	0.00	0.00	0.00	0.00
	OMI	=	0.30	0.33	0.30	0.33	0.30	0.35
		Vmacro	0.98	0.98	0.91	0.97	0.96	0.98
		Vretain	0.80	0.80	0.80	0.80	0.80	0.80
	IPR	=	0.80	0.80	0.80	0.80	0.80	0.80
		Vsurf	0.24	0.23	0.23	0.21	0.22	0.23
		Vripfilt	0.42	0.43	0.42	0.43	0.42	0.44
	DOP	=	0.33	0.33	0.33	0.32	0.32	0.34
Biogeochemical function mean score			0.53	0.53	0.52	0.53	0.51	0.60
Habitat Provision		Vgalspwn	0.63	0.63	0.63	0.63	0.63	0.63
		Vgalqual	0.25	0.25	0.25	0.25	0.25	0.25
		Vgobspwn	0.20	0.10	0.10	0.10	0.10	0.10
	FSH	=	0.18	0.13	0.13	0.13	0.13	0.13
		Vphyshab	0.59	0.59	0.59	0.59	0.59	0.59
		Vwatqual	0.21	0.21	0.21	0.21	0.19	0.31
		Vimperv	0.30	0.30	0.30	0.30	0.30	0.30

Function category	Function	Variable	Assessed SEV reach*					
			10-A	10-B	11-B	12-A	12-B	13-A
	HAF	=	0.42	0.42	0.42	0.42	0.42	0.45
Habitat provision function mean score			0.30	0.27	0.27	0.27	0.27	0.29
Biodiversity		Vfish	0.33	0.33	0.33	0.33	0.33	0.33
	FFI	=	0.33	0.33	0.33	0.33	0.33	0.33
		Vmci	0.42	0.42	0.52	0.44	0.28	0.36
		Vept	0.33	0.33	0.17	0.17	0.00	0.00
		Vinvert	0.58	0.58	0.58	0.35	0.35	0.23
	IFI	=	0.45	0.45	0.42	0.32	0.21	0.20
		Vripcond	0.31	0.33	0.31	0.33	0.31	0.34
		Vripconn	0.95	0.96	1.00	0.85	0.90	1.00
	RVI	=	0.29	0.31	0.31	0.28	0.28	0.34
Biodiversity function mean score			0.36	0.36	0.36	0.31	0.27	0.29
Overall mean SEV score (maximum value 1)			**0.524**	**0.525**	**0.519**	**0.512**	**0.496**	**0.537**

*Diversion SEV data is not available for assessment reach 11-A because this watercourse is not being diverted as a part of the proposal.

Notes: NFR is natural flow regime; FLE is floodplain effectiveness; CSM is connectivity for species migration; CGW is natural connectivity to groundwater; WTC is water temperature control; DOM is dissolved oxygen levels maintained; OMI is organic matter input; IPR is in-stream particle retention; DOP is decontamination of pollutants; FSH is fish spawning habitat; HAF is habitat or aquatic fauna; FFI is fish fauna intact; IFI is invertebrate fauna intact; RVI is riparian vegetation intact.

Appendix E
Macroinvertebrate Sampling Results – Project Site

Table E1. Macroinvertebrate data collected from the SEV assessment reaches within the project site.

Taxa	MCI score	MCI-sb score	10-B	11-B	12-A	12-B	13-A
Caddisfly Hydrobiosis	5	6.7		1	1		
Caddisfly Oxyethira*	2	1.2		1			
Caddisfly Polyplectropus	8	8.1	24				
Caddisfly Pycnocentrodes	5	3.8	1				
Bug Anisops	5	2.2		1			
Bug Diaprepocoris	5	4.7		1			
Bug Microvelia	5	4.6	2		6		
Bug Sigara	5	2.4			1		
Beetle Dytiscidae	5	0.4			1		
Beetle Hydrophilidae	5	8.0			4		1
Beetle Liodessus	5	4.9			8	5	6
Beetle Onychohydrus	5	0.0	1				
Beetle Rhantus	5	1.0				2	
True Fly Culicidae	3	1.2	10	61	14	24	
True Fly Hexatomini	5	6.7					1
True Fly Orthocladiinae	2	3.2	12	1	1	9	
True Fly Paradixa	4	8.5	2	4	2	17	1
True Fly Paralimnophila	6	7.4			1		
True Fly Tanypodinae	5	6.5		1	1	6	
True Fly Tanytarsini	3	4.5	1	1	11	3	
True Fly Zelandotipula	6	3.6					1
Collembola	6	5.3	4	1			
Crustacea Isopoda	5	4.5	5		2		15
Crustacea Ostracoda	3	1.9	3		6	5	165
Crustacea Paracalliope	5	0.0	8	6			
Crustacea Paraleptamphopus	5	0.0	57	29			
Crustacea Talitridae	5	5.0	4	1			2
MITES (Acari)	5	5.2	1		18		
Mollusc Physella (Physa)	3	0.1	4	9	66	30	
Mollusc Potamopyrgus	4	2.1	29	83	97	81	1
OLIGOCHAETES	1	3.8	6		31	15	1
HIRUDINEA (Leeches)	3	1.2			4	3	1
PLATYHELMINTHES (Flatworms)	3	0.9			3	2	13
Rhabdocoel Flatworms	3	0.9	4				
Number of Taxa			19	15	20	13	12
EPT Value			2	1	1	0	0
Number of Individuals			178	201	278	202	208
% EPT			14.04	0.50	0.36	0.00	0.00
% EPT Taxa			10.53	6.67	5.00	0.00	0.00
MCI Value			84.21	82.67	80.00	67.69	81.67
QMCI Value			4.67	3.84	3.44	3.42	3.25
SBMCI Value			78.38	78.77	78.00	61.23	85.17
QMCI-sb Value			3.94	1.94	2.37	2.60	2.24

*not included as an EPT taxa, very pollutant tolerant caddisfly species.

Appendix F
Vegetation Plot Map & Results

VIRIDIS
Environmental Consultants

Vegetation plots - Milldale Stage 11 & 12

Fulton Hogan Land Development Limited

Legend
- Stage boundaries

Watercourses
- Permanent
- Intermittent

Wetlands
- Natural wetland
- Natural wetland - Consented to remove
- Potential wetland

Vege plots
- Non-wetland vegetation
- Wetland vegetation

SOURCES
Milldale Drone Aerial 20241015

DISCLAIMER:
This map/plan is not an engineering draft.
This map/plan is illustrative only and all information should be independently verified on site before taking any action.

SCALE
1:1,100 @ A3

PROJECT NO. 10015
DRAWN BY: B. P
DATE: 23 January 2025

VIRIDIS
Environmental Consultants

Vegetation plots - Milldale Stage 13

Fulton Hogan Land Development Limited

Legend

Stage boundaries

Watercourses
- Intermittent
- Ephemeral
- Culvert
- Artificial

Wetlands
- Natural
- Pond

Vege plots
- Non-wetland vegetation
- Wetland vegetation
- Uncertain

SOURCES
Milldale Drone Aerial 20241015

SCALE
1:1,800 @ A3

PROJECT NO.	10015
DRAWN BY:	B. P
DATE:	23 January 2025

Table F1. Plot P1 vegetation assessment results.

Binomial name	Common name	Rating	Biostatus	Cover (%)	Dominant
Juncus effusus	Soft rush	FACW	Exotic	15	Y
Holcus lanatus	Yorkshire Fog	FAC	Exotic	10	
Paspalum dilatatum	Paspalum	FACU	Exotic	15	Y
Lotus pedunculatus	Lotus	FAC	Exotic	8	
Ranunculus repens	Buttercup	FAC	Exotic	5	
Rumex crispus	Curled Doc	FAC	Exotic	2	
Leontodon saxatilis	Hawkbit	FAC	Exotic	1	
Anthoxanthum odoratum	Sweet Vernal	FACU	Exotic	10	
Paspalum distichum	Mercer Grass	FACW	Exotic	2	
Agrostis stolonifera	Creeping Bent	FACW	Exotic	30	Y
Trifolium repens	White Clover	FACU	Exotic	2	
Ulex europaeus	Gorse	FACU	Exotic	3	
Total cover				103	
% of dominant species that are FAC/FACW/OBL					**66.6**
Prevalence value					**2.83**

Table F2. Plot P2 vegetation assessment results.

Binomial name	Common name	Rating	Biostatus	Cover (%)	Dominant
Juncus effusus	Soft rush	FACW	Exotic	0.5	
Holcus lanatus	Yorkshire Fog	FAC	Exotic	3	
Paspalum dilatatum	Paspalum	FACU	Exotic	5	
Lotus pedunculatus	Lotus	FAC	Exotic	7	
Ranunculus repens	Buttercup	FAC	Exotic	0.5	
Rumex crispus	Curled Doc	FAC	Exotic	0.5	
Agrostis stolonifera	Creeping Bent	FACW	Exotic	30	Y
Trifolium repens	White Clover	FACU	Exotic	5	
Ulex europaeus	Gorse	FACU	Exotic		
Ranunculus sardous	Hairy Buttercup	FAC	Exotic	1	
Plantago lanceolata	Narrow-leaved plantain	FACU	Exotic	8	
Lolium perenne	Perennial ryegrass	FACU	Exotic	40	Y
Cenchrus clandestinus	Kikuyu	FACU	Exotic	5	
Persicaria hydropiper	Water pepper	FACW	Exotic	0.5	
Total cover				106	
% of dominant species that are FAC/FACW/OBL					**50**
Prevalence value					**3.3**

Table F3. Plot P3 vegetation assessment results.

Binomial name	Common name	Rating	Biostatus	Cover (%)	Dominant
Lotus pedunculatus	Lotus	FAC	Exotic	5	
Ranunculus repens	Buttercup	FAC	Exotic	8	
Rumex crispus	Curled Doc	FAC	Exotic	3	
Agrostis stolonifera	Creeping Bent	FACW	Exotic	70	Y
Cenchrus clandestinus	Kikuyu	FACU	Exotic	20	
Total cover				106	
% of dominant species that are FAC/FACW/OBL					**100**
Prevalence value					**2.53**

Table F4. Plot P4 vegetation assessment results.

Binomial name	Common name	Rating	Biostatus	Cover (%)	Dominant
Ranunculus repens	Buttercup	FAC	Exotic	1	
Rumex crispus	Curled Doc	FAC	Exotic	1	
Agrostis stolonifera	Creeping Bent	FACW	Exotic	68	Y
Cenchrus clandestinus	Kikuyu	FACU	Exotic	30	Y
Total cover				100	
% of dominant species that are FAC/FACW/OBL					**50**
Prevalence value					**2.4**

Table F5. Plot P5 vegetation assessment results.

Binomial name	Common name	Rating	Biostatus	Cover (%)	Dominant
Lotus pedunculatus	Lotus	FAC	Exotic	1	
Ranunculus repens	Buttercup	FAC	Exotic	1	
Rumex crispus	Curled Doc	FAC	Exotic	1	
Agrostis stolonifera	Creeping Bent	FACW	Exotic	40	Y
Trifolium repens	White Clover	FACU	Exotic	1	
Cenchrus clandestinus	Kikuyu	FACU	Exotic	60	Y
Total cover				100	
% of dominant species that are FAC/FACW/OBL					**50**
Prevalence value					**3.2**

Table F6. Plot P6 vegetation assessment results.

Binomial name	Common name	Rating	Biostatus	Cover (%)	Dominant
Juncus effusus	Soft rush	FACW	Exotic	7	
Holcus lanatus	Yorkshire Fog	FAC	Exotic	2	
Paspalum dilatatum	Paspalum	FACU	Exotic	15	
Lotus pedunculatus	Lotus	FAC	Exotic	1	
Ranunculus repens	Buttercup	FAC	Exotic	5	
Rumex crispus	Curled Doc	FAC	Exotic	1	
Agrostis stolonifera	Creeping Bent	FACW	Exotic	30	Y
Trifolium repens	White Clover	FACU	Exotic	1	
Ranunculus sardous	Hairy Buttercup	FAC	Exotic	5	
Lolium perenne	Perennial ryegrass	FACU	Exotic	35	Y
Total cover				102	
% of dominant species that are FAC/FACW/OBL					**50**
Prevalence value					**3.13**

Table F7. Plot P7 vegetation assessment results.

Binomial name	Common name	Rating	Biostatus	Cover (%)	Dominant
Holcus lanatus	Yorkshire Fog	FAC	Exotic	10	
Paspalum dilatatum	Paspalum	FACU	Exotic	5	
Lotus pedunculatus	Lotus	FAC	Exotic	3	
Ranunculus repens	Buttercup	FAC	Exotic	10	
Agrostis stolonifera	Creeping Bent	FACW	Exotic	15	Y
Trifolium repens	White Clover	FACU	Exotic	1	
Ranunculus sardous	Hairy Buttercup	FAC	Exotic	5	
Lolium perenne	Perennial ryegrass	FACU	Exotic	50	Y
Bellis perennis	Daisy	FACU	Exotic	1	
Plantago major	Broad-leaved plantain	FACU	Exotic	1	
Total cover				101	
% of dominant species that are FAC/FACW/OBL					**100**
Prevalence value					**3.42**

Table F8. Plot P8 vegetation assessment results.

Binomial name	Common name	Rating	Biostatus	Cover (%)	Dominant
Juncus effusus	Soft rush	FACW	Exotic	15	
Holcus lanatus	Yorkshire Fog	FAC	Exotic	25	Y
Paspalum dilatatum	Paspalum	FACU	Exotic	3	
Lotus pedunculatus	Lotus	FAC	Exotic	8	
Ranunculus repens	Buttercup	FAC	Exotic	10	
Agrostis stolonifera	Creeping Bent	FACW	Exotic	30	Y
Lolium perenne	Perennial ryegrass	FACU	Exotic	5	
Isolepis reticularis		FACW	Endemic	7	
Bare ground				5	
Total cover				108	
% of dominant species that are FAC/FACW/OBL					**100**
Prevalence value					**2.57**

Table F9. Plot P9 vegetation assessment results.

Binomial name	Common name	Rating	Biostatus	Cover (%)	Dominant
Holcus lanatus	Yorkshire Fog	FAC	Exotic	10	
Paspalum dilatatum	Paspalum	FACU	Exotic	5	
Lotus pedunculatus	Lotus	FAC	Exotic	10	
Ranunculus repens	Buttercup	FAC	Exotic	8	
Anthoxanthum odoratum	Sweet Vernal	FACU	Exotic	15	
Agrostis stolonifera	Creeping Bent	FACW	Exotic	30	Y
Trifolium repens	White Clover	FACU	Exotic	1	
Galium palustre	Marsh bedstraw	OBL	Exotic	2	
Lythrum hyssopifolia	Loosestrife	FACW	Exotic	1	
Eleocharis acuta	Sharp spike sedge	OBL	Non-Endemic	25	Y
Total cover				107	
% of dominant species that are FAC/FACW/OBL					**100**
Prevalence value					**2.4**

Table F10. Plot P10 vegetation assessment results.

Binomial name	Common name	Rating	Biostatus	Cover (%)	Dominant
Holcus lanatus	Yorkshire Fog	FAC	Exotic	2	
Paspalum dilatatum	Paspalum	FACU	Exotic	10	
Lotus pedunculatus	Lotus	FAC	Exotic	10	
Ranunculus repens	Buttercup	FAC	Exotic	10	
Anthoxanthum odoratum	Sweet Vernal	FACU	Exotic	30	Y
Agrostis stolonifera	Creeping Bent	FACW	Exotic	30	Y
Trifolium repens	White Clover	FACU	Exotic	2	
Plantago lanceolata	Narrow-leaved plantain	FACU	Exotic	3	
Lolium perenne	Perennial ryegrass	FACU	Exotic	10	
Total cover				107	
% of dominant species that are FAC/FACW/OBL					**50**
Prevalence value					**3.23**

Table F11. Plot P11 vegetation assessment results.

Binomial name	Common name	Rating	Biostatus	Cover (%)	Dominant
Juncus effusus	Soft rush	FACW	Exotic	7	
Holcus lanatus	Yorkshire Fog	FAC	Exotic	55	Y
Paspalum dilatatum	Paspalum	FACU	Exotic	2	
Lotus pedunculatus	Lotus	FAC	Exotic	3	
Ranunculus repens	Buttercup	FAC	Exotic	10	
Anthoxanthum odoratum	Sweet Vernal	FACU	Exotic	25	Y
Plantago lanceolata	Narrow-leaved plantain	FACU	Exotic	3	
Total cover				105	
% of dominant species that are FAC/FACW/OBL					**50**
Prevalence value					**3.21**

Table F12. Plot P12 vegetation assessment results.

Binomial name	Common name	Rating	Biostatus	Cover (%)	Dominant
Herb					
Poa trivialis	Meadow grass	FACU	Exotic	85	Y
Dactylis glomerata	Cocksfoot	FACU	Exotic	15	
Myosotis sylvatica	Forget-Me-Not	UPL	Exotic	0.5	
Daucus carota	Wild carrot	UPL	Exotic	0.5	
Ranunculus repens	Buttercup	FAC	Exotic	0.5	
Rumex crispus	Curled Doc	FAC	Exotic	0.5	
Tree					
Taxodium distichum	Cypress	FACW	Exotic	60	Y
Magnolia grandiflora	Magnolia	Exotic	FAC	15	
Alnus glutinosa	Alder	Exotic	FACW	7.5	
Tristaniopsis laurina	Water Gum	Exotic	FAC	7.5	
Quercus robur	Oak	Exotic	FACU	5	
Total cover				102	
% of dominant species that are FAC/FACW/OBL					**50**
Prevalence value					**3.24**

Table F13. Plot P13 vegetation assessment results.

Binomial name	Common name	Rating	Biostatus	Cover (%)	Dominant
Herb					
Ranunculus repens	Buttercup	FAC	Exotic	10	
Holcus lanatus	Yorkshire fog	FAC	Exotic	50	Y
Anthoxanthum odoratum	Sweet vernal	FACU	Exotic	20	Y
Lotus pedunculatus	Lotus	FAC	Exotic	2	
Machaerina teretifolia	Sedge	FACW	Native	2	
Juncus effusus	Soft rush	FACW	Exotic	20	Y
Prunella vulgaris	Self-heal	FACU	Exotic	1	
Tree					
Alnus glutinosa	Alder	FACW	Exotic	15	Y
Total cover				105	
% of dominant species that are FAC/FACW/OBL					**75**
Prevalence value					**2.87**

Table F14. Plot P14 vegetation assessment results.

Binomial name	Common name	Rating	Biostatus	Cover (%)	Dominant
Juncus effusus	Soft rush	FACW	Exotic	7	
Holcus lanatus	Yorkshire Fog	FAC	Exotic	15	Y
Paspalum dilatatum	Paspalum	FACU	Exotic	10	
Lotus pedunculatus	Lotus	FAC	Exotic	2	
Ranunculus repens	Buttercup	FAC	Exotic	3	
Leontodon saxatilis	Hawkbit	FAC	Exotic	1	
Anthoxanthum odoratum	Sweet Vernal	FACU	Exotic	45	Y
Agrostis stolonifera	Creeping Bent	FACW	Exotic	12	
Plantago lanceolata	Narrow-leaved plantain	FACU	Exotic	5	
Total cover				100	
% of dominant species that are FAC/FACW/OBL					**50**
Prevalence value					**3.41**

Table F15. Plot P15 vegetation assessment results.

Binomial name	Common name	Rating	Biostatus	Cover (%)	Dominant
Juncus effusus	Soft rush	FACW	Exotic	15	
Holcus lanatus	Yorkshire Fog	FAC	Exotic	3	
Paspalum dilatatum	Paspalum	FACU	Exotic	5	
Lotus pedunculatus	Lotus	FAC	Exotic	2	
Ranunculus repens	Buttercup	FAC	Exotic	3	
Anthoxanthum odoratum	Sweet Vernal	FACU	Exotic	55	Y
Agrostis stolonifera	Creeping Bent	FACW	Exotic	10	
Cenchrus clandestinus	Kikuyu	FACU	Exotic	10	
Total cover				103	
% of dominant species that are FAC/FACW/OBL					**0**
Prevalence value					**3.44**

Appendix G
DRAFT Fauna Management Plan

1 AVIFAUNA MANAGEMENT

Clearing of vegetation has the potential to negatively impact on birds, particularly if birds are nesting in vegetation at the time it is cleared. Native avifauna are legally protected by the Wildlife Act 1953 (WA) and significant habitats for indigenous fauna are protected under the Resource Management Act 1991 (RMA).

Wildlife Act (1953) Authority

Most indigenous birds are legally protected under the Wildlife Act (and subsequent amendments). A Wildlife Act Authority (WAA) is required to capture, handle, and relocate native wildlife.

Resource Management Act 1991

Landscape features that provide significant habitat for indigenous species, including birds, are protected under the RMA (Section 6(c)). This includes ostensibly low value exotic vegetation that can support populations of native birds.

1.1 Potential Adverse Effects on Birds

The project requires earthworks and vegetation clearance. If indigenous birds are present within the affected area, potential adverse effects on birds may include:

Direct effects:

- Adult and chick mortality during physical clearance/construction works
- Injury during physical clearance/construction works

Indirect effects:

- Temporary loss of habitat
- Temporary noise and dust disturbance
- Disruption to nesting and breeding behaviour

Site development cannot be achieved without vegetation removal, and therefore potential adverse effects on native birds cannot be avoided. Adult birds are highly mobile and expected to move to nearby unaffected habitat once disturbance commences. Nesting birds and chicks that have not fledged are unable to move away. Therefore, managing effects on birds requires mitigation through monitoring for signs of nesting activity and displays of breeding behaviour.

To mitigate the effects of direct mortality and indirect disturbance on breeding and nesting birds, the following protocol will be followed for all vegetation that will be cleared.

1.2 Bird Survey and Management

1.2.1 Timing

In the first instance, vegetation clearance between 1 September and 28 (29) February should be avoided where practicable.

If vegetation clearance must occur within this time frame, the nesting bird survey protocols will be adopted, as detailed below.

1.2.2 Nesting bird survey

- A survey will be undertaken to identify if and/or where native bird nesting behaviour (including courtship, nest building, and active nesting) is occurring.
- The survey will be completed by an appropriately qualified ecologist.
- The survey will include inspections for tree cavities, tree nests and ground nesting species such as pūkeko.
- Where no nesting behaviour or activity is observed, the vegetation may be cleared within 24 hours of the survey being completed. If clearance does not occur within 24 hours, the area must be surveyed again to verify the absence of nesting behaviour prior to clearance.
- If nesting behaviour, or an active nest is located, an exclusion area with a diameter of 10 m will be demarcated around the tree (or nest if it is a ground nest) and works shall not occur within this cordon until it has been confirmed by the appropriately qualified ecologist that all nestlings have fledged. Once the appropriately qualified ecologist has confirmed this, the vegetation may be cleared.

1.3 Inadvertent Bird Injury or Death

If a native bird is found injured or dead during vegetation clearance, the following steps will be taken:

- Injured native birds will be placed in an appropriate carrying box/cloth bag and immediately transported to a veterinarian for assessment.
- If the species has a conservation status of At Risk or Threatened (Robertson et al. 2017), the local Department of Conservation (DoC) office will be contacted as soon as practicable, but within 24 hours.
- All deceased birds (including those found dead on site, or any that are ultimately euthanised by a veterinarian) will be transported to the local DoC office as soon as practicable.
- All injuries or mortalities will be accurately recorded and reported to DoC on request.

Native bird management is required in all areas where vegetation clearance will occur, including the grassed paddocks on the flat portion of the site.

1.4 Management of Dotterels

The site does not currently provide habitat for NZ dotterels (*Charadrius obscurus aquilonius*; Threatened – Nationally Increasing). In Auckland they tend to favour open areas and bare ground. They are known from the wider Milldale and Silverdale area, with eBird.org records showing them in various urban areas, though mostly around the fringe. As works progress, it is expected the open areas will be generated by earthworks and clearance of the pasture within the site. It is possible that they may utilise these open areas as they become available. Dotterels are known to establish nests on construction sites where habitat conditions are suitable.

1.4.1 Deterrence

From July onwards, dotterels begin looking for breeding territory. Weekly inspections of the works area should occur to determine if dotterels are present. Breeding dotterels are territorial and will show defensive behaviour to anything that they think is a threat (including people). Defensive behaviour includes alarm calls, running in front of potential threats to distract and lure them away (‘rat run’), and pretending to be injured ('broken wing'). It is this behaviour that should be looked for during weekly site inspections.

The easiest method to manage dotterels on a site is to deter them from establishing nests in the first place. From early July onwards, one or more of the methods in Table 2 should be employed to discourage dotterel presence within the site.

Table 1. Deterrence options (adapted from NZTA, 2012[1]).

Method	Description	Likelihood of success	Comments
Long grass	Allow grass to grow long so not considered by dotterels to be a good place to lay eggs.	High	Leave grass to grow from at least April to ensure it is long
Machinery*	Park large machinery close to where dotterels are showing an interest. Start the engine from time to time.	Moderate	Machinery cannot be left for long periods or the birds may get used to it.
Silt fences	Erect shade cloth at knee height. Place in rows. Space at 5– 10 m.	High	These fences obscure dotterel vision from nesting sites as they actively seek areas with good sight lines
Metallic or reflective tape	Streamers attached to posts that flutter when there is wind	Moderate	Works for a short time (up to three weeks) and then birds habituate

* to be used in early to mid-July only. If nests establish, movement of machinery increases the risk of nest damage.

The likelihood of success column used in Table 2 has been developed based on known dotterel behaviours. However, they are known to become used to activities, such as machinery, if it is left stationary for any period of time, and reflective tape can become ineffective within a few weeks. Actions that alter the site to make it less attractive for nesting are considered to be the most effective options over a long period of time.

1.4.2 Eggs found within the construction zone

If, despite deterrence options being in place, eggs are still found within the construction zone, the following measures should be followed.

- If eggs are found on the ground within the construction zone activities within 50 metres of the nest are to stop immediately and people are to leave the area.
- Contact the project ecologist.
- If the nest needs to be marked in order for the project ecologist, or others, to find it the markers should be at least 10 m away from the nest. Use two on either side of the nest if necessary as long as they are at least 10 m away.
- The project ecologist will monitor the nest on a weekly basis to confirm when chicks have fledged (usually 6-7 weeks after hatching). Once this has occurred, the ecologist will confirm when works in the area can re-commence.

[1] NZTA. 2012. Guidance in Relation to New Zealand Dotterels on NZTA Land. NZ Transport Agency, Wellington.

2 HERPETOFAUNA MANAGEMENT

2.1 Management of Potential Adverse Effects on Lizards

2.1.1 Statutory protections and management of lizards

Wildlife Act (1953) Authority

All indigenous lizards are legally protected under the Wildlife Act (and subsequent amendments). A WAA is required to capture, handle, and relocate native wildlife.

Resource Management Act 1991

Landscape features that provide significant habitat for indigenous species are protected under the RMA (Section 6(c)). This includes ostensibly low value exotic vegetation that can support populations of native lizards.

2.1.2 Potential adverse effects on lizards

The project requires earthworks and vegetation clearance. If indigenous lizards are present within the affected area, potential adverse effects on lizards may include:

Direct effects:

- Lizard mortality during physical clearance/construction works
- Injury during physical clearance/construction works

Indirect effects:

- Temporary loss of habitat
- Temporary noise and dust disturbance

Site development cannot be achieved without vegetation removal, and therefore potential adverse effects on indigenous herpetofauna cannot be avoided. Managing the effects on lizards requires mitigation through a salvage and relocation programme and potential release site habitat enhancement.

2.1.3 Project herpetologist

A suitably qualified herpetologist or ecologist ('project herpetologist') is required to implement all herpetofauna management, and a WAA to capture and relocate indigenous lizards is required.

2.2 Lizard Search and Capture Methodology

Lizard capture and relocation will be associated with consented vegetation clearance activities through the methods outlined in this section.

2.2.1 Timing of activities

Vegetation clearance should occur between October and April (inclusive); lizard salvage activities are confined to warmer months when lizards are the most active and likely to be detected if present.

All lizard management activities are required to be undertaken during fine, calm, and dry weather.

2.2.2 Destructive searches

Destructive searches will be undertaken by the project herpetologist prior to vegetation removal, in coordination with the appropriate contractor undertaking the clearance works. This will involve systematic manual searches of suitable habitat (e.g. log piles, tree bark) and destruction of habitat where practicable. Leaf litter, ground cover vegetation and small debris may be hand-raked, and larger debris overturned to search for refuging lizards.

2.2.3 Felled trees searches

Destructive searches involve searching through branches and foliage of felled vegetation. The crowns of large trees shall be felled intact as far as practicable. All branches and foliage of felled vegetation will be thoroughly searched. Where practicable, the crowns of any larger trees that cannot be fully searched after felling should be left in any areas of vegetation to remain on site, to allow any undetected lizards to disperse naturally.

2.2.4 Construction (machinery) assisted searches

Suitable ground cover will be searched during machine-assisted clearance. The machine will be fitted with a toothed scraping bucket (or similar) during vegetation clearance to lift habitat such as non-woody vegetation, logs, and debris piles.

Machine-assisted searches will continue until all habitat for lizards has been removed and there is no suitable habitat for native lizards remaining within the affected area, as assessed by the project herpetologist.

2.2.5 Post-clearance search

At the conclusion of the machine-assisted searches and vegetation clearance, the suitably qualified ecologist would undertake a final site walk over to detect any remaining lizards.

2.2.6 Lizard handling and containment

All indigenous lizards found during the destructive searches, machine-assisted searches and post-clearance search, will only be captured and handled by, or under supervision of, the DoC-authorised suitably qualified ecologist. Hands should be sterilised before and after handling lizards, along with all field equipment that indigenous lizards may encounter.

All captured lizards would be placed in a holding container(s) with adequate ventilation and kept at ambient temperature. Vegetation, soil and leaf litter from the capture site will be placed in the box to provide shelter and protection during containment/transport. Lizards would only be held temporarily for the period of the active searches or trap inspections, before being released at the approved relocation site (refer Section 4.4).

It is not anticipated that lizard taxa with conservation statuses higher than ‘At Risk’ would be encountered on-site. However, if ‘Threatened’ lizard species were encountered, the individual(s) would be captured and temporarily contained, and the local DoC office contacted for further instruction.

2.3 Inadvertent Lizard Injury or Death

The following steps will be implemented should any injured or dead indigenous lizards be found during the vegetation clearance activities:

- The project herpetologist would notify DoC at soon as possible (within 24 hours);
- Any lizard death of ‘Threatened’, ‘At Risk’ or ‘Data Deficient’ species shall be sent to Massey University Wildlife post-mortem service for necropsy. The body should be chilled if it can be delivered within 24 hours, or frozen if delivery will take longer than 24 hours;

- Where appropriate, measures shall be undertaken to minimise further lizard deaths;
- Injured lizards found during salvage will be taken to a suitably qualified vet as soon as possible for assessment and treatment. Injured lizards will be kept in an appropriate portable enclosure (i.e., a clean, well-ventilated (plastic container) under the direction of the project herpetologist to ensure the lizard is handled appropriately until it can be treated;
- Lizards assessed by the vet or alternative specialist as uninjured, or otherwise in suitable condition for release, would be transported to the relocation site in the portable enclosure and released; and
- Euthanasia of an injured lizard is only to be undertaken under direction from DOC.

2.4 Release Site

All salvaged indigenous lizards are required to be released into an approved release site. Factors that should be considered when selecting a release site include ecological appropriateness, long-term security, habitat suitability, and protection from predators and future human disturbance (DOC Lizard Technical Advisory Group, 2019). Key considerations include, but are not limited to, the following:

- It is important that the release site is an appropriate distance from the project footprint to prevent the lizards from re-entering the works area. However, the release site should be located as close as possible to the salvage site to help retain similar microhabitats and environmental conditions.
- The habitat within the release site should be representative to, or of higher ecological value than the salvage site.
- Areas with long-term protection should be favoured, such as reserves managed by DoC or Council, vegetation covenants or areas protected by Auckland Unitary Plan provisions (e.g., SEA overlay, riparian habitat).
- Potential existing species composition and density at the release site should be considered as far as practicable, to limit potential adverse effects of intra- and inter-species competition at the release site.

2.4.1 Proposed release site

It is generally preferred that lizards are relocated within or adjacent to the project footprint as far as practicable, to maintain local biodiversity and reduce the risk of adverse effects that may occur with longer distance relocations. A key consideration of relocation is ensuring the habitat suitability (quantity and quality) is present to support relocated lizards.

[Details within this section will be included in the final Fauna Management Plan, and will recommend release sites within the site, and/or within the surrounding environment. Figure showing potential release sites will be included.]

2.4.2 Habitat enhancement

Refuge structures (e.g., felled logs, rocks, branches) should be recovered prior to vegetation clearance by the project herpetologist and relocated into the release sites. In addition, if five or more indigenous lizards are captured for relocation, the implementation of supplementary refugia is also recommended prior to lizard release. The provision of permanent refuges, including but not limited to log piles, natural debris (e.g. decaying vegetation), artificial cover objects (i.e., Onduline sheets) and rock piles should be installed to supplement the natural refuges already present. Salvaged skinks would be released beneath these refuge structures to provide immediate protection.

2.5 Capture Trigger

If more than 20 native lizards are captured, then contact should be made with DoC immediately to discuss the next steps. These may include continuation with the current programme, additional habitat enhancement and/or protection, or the requirement of additional permits.

2.6 Completion Reporting

A completion report or Amphibian/Reptile Distribution Scheme (ARDS) Card will be prepared by the project herpetologist and submitted to Auckland Council within 30 days of the completion of all vegetation removal. The information provided should detail the number of lizards captured and the locations they were captured from, and whether any post-release monitoring (and timing) is recommended based on the number of lizards salvaged.

3 BAT MANAGEMENT

All vegetation removal should occur under the following protocols. The protocols are required to minimise the likelihood of adverse effects on potentially occupied bat roosts as vegetation is cleared. They have been adopted from the *Protocols for minimising the risk of felling bat roosts* prepared by the New Zealand Bat Recovery Group[2]. If no bats were detected during the pre-vegetation clearance survey, felling can occur without implementation of the protocols.

3.1 Identification of Potential Roost Habitat

All trees to be removed within the site should be visually assessed prior to vegetation clearance by an appropriately qualified ecologist with Competency 3.3[3]. Each tree should be classified as either high risk, or low risk, with regard to bat roost habitat.

Low risk trees have a diameter at breast height (DBH) of ≤ 150 mm.

High risk trees have a DBH of ≥ 150mm and have one or more of the following features:

- Holes, cavities, crevices, cracks and/or fractured limbs that could potentially support roosting bat/s
- Hollow trunks and/or branches
- Loose, flaking bark, or deep incised bark crevices that could potentially support bat/s
- Deadwood (including debris caught in tree forks) or epiphyte communities in the canopy or in the trunk that could potentially support bat roosts
- Evidence of bat droppings, grease marks and/or urine staining around cavities

All low-risk trees can be felled at any time, subject to requirements of other management measures (e.g. for birds). The only exception is where low risk trees have evidence of bat droppings, grease marks and/or urine staining around cavities, in which case they will be treated as high-risk trees.

High risk trees, including adjacent groupings of high-risk trees will be subject to a pre-felling assessment. Pre-felling assessments will be undertaken by an appropriately qualified ecologist.

3.2 Pre-felling Procedures

High risk vegetation should only be cleared between 1 October and 30 April to align with the season when bats are active. A Competent Bat Worker[3] (CBW) will be present to supervise the clearance of all high-risk vegetation and they must be available at all times during the vegetation removal stages in order to respond immediately to any incidental discoveries of bats within the site.

The following procedure must be adhered to:

- All high-risk vegetation will be clearly identified by a CBW prior to clearance commencing.
- All high-risk vegetation will be acoustically monitored using ABMs for two consecutive nights (with optimal weather conditions[2]; Table 3) immediately prior to vegetation removal. Results will be

[2] DoC 2024. Protocols for minimising the risk of felling occupied bat roosts (Bat Roost Protocols). Dated October 2024.

[3] A person who has been certified as ‘Competent’ in a particular skill by the NZ Bat Recovery Group.

analysed the following morning, as early as possible. If vegetation removal does not take place the day after monitoring, monitoring will continue until it does.

- Where a night does not meet optimum conditions[2] (Table 3), monitoring must continue to take place until a total of two consecutive nights of optimum conditions have been monitored.
- If no bats are recorded:
  - The ecologist will notify the site manager immediately after data is reviewed, and permission will be given to clear the monitored vegetation within 24 hours.
- If bats are recorded:
  - If bat activity recorded on the ABM/s suggest bats may be roosting in the vicinity of the ABM, or if a bat roost is observed, the site manager shall be notified immediately after reviewing the data and the affected vegetation cannot be cleared until additional investigations have been completed.
  - The ABM survey must continue until no bat activity has been recorded for two consecutive nights; OR
  - If safe to do so, the suspected roost/s will be visually assessed by an arborist trained to identify bat roosts. The arborist will take photos of any roosts or roost evidence found. If necessary, an endoscope and handheld bet detector will be used to examine potential features.
- If bat roosts are confirmed:
  - The tree/s will not be removed until further acoustic monitoring (for seven nights) confirms the bats have abandoned the roost.
  - The tree/s will be clearly marked and a 10 m radius exclusion zone established around the site. The zone will be identified with fencing or other appropriate materials. All relevant people (e.g. site manager, vegetation contractors) will be notified the area must be left as is.
  - Representatives from DoC and Auckland Council will be informed via email, of the relevant information, including photos if available. The CBW, DoC and Council will agree on options for next steps in the event roosting continues after seven nights.
  - If bats are still roosting in the tree/s after seven nights, a meeting will be held between the CBW, site manager, DoC and Council to determine an appropriate way forward. The meeting must occur within three days of the end of the seven day monitoring period.
  - Immediately following clearance of high-risk vegetation, trees will be inspected for bats and evidence of bat roosts by the CBW.

Table 2. Optimal weather conditions required for bat surveys[2] (derived from DoC 2024).

Component	Conditions
Timing	Begin one hour before sunset and end one hour after official sunrise
Temperature	Temperatures of 8°C or higher for the first four hours after official sunset
Wind	Little to no wind of ≤ 20 km/hour for the first four hours after official sunset
Precipitation	Little to no precipitation (≤ 2.5mm) in the first four hours after official sunset

3.3 Managing and Reporting Injury or Mortality

If any living bat/s are found during or after vegetation clearance that are not able to fly away, they will be taken immediately to a veterinarian for assessment. Bats will be placed in a clean, dark, cotton bag by the CBW, and then in a carrier to ensure safe transportation. The site manager, and relevant representatives from DoC and Council will be notified as soon as practicable, but within 24 hours of the bat being found. Any bat found dead or subsequently euthanised by a veterinarian will be returned to DoC.

Bats assessed by the veterinarian as uninjured will be transported back to site in the cotton bag and placed in an open, temporary artificial roost box suspended within a tree outside of the site but as close as possible to the site the animal was found. The roost box will be open to allow the animal to come and go as it chooses and will be placed within the tree prior to dusk on the same day the bat is found.

3.4 Bat Mitigation

If bats are detected on site during the pre-vegetation clearance survey, mitigation in the form of habitat enhancement will be required if vegetation to be cleared is identified as suitable for bat nesting/roosting.

To replace roosting habitat following vegetation clearance, artificial bat roost boxes will be installed in area suitable for roosting, as directed by the CBW. Emphasis should be placed on the established riparian bush areas or SEAs in the immediate surrounding environment, as they will be largely protected from future vegetation clearance.

The number of roost boxes will be installed at a rate of one per every 10 high risk bat roost tree/s removed. The boxes should be installed at a minimum height of four metres from the ground, with no clutter within 2 m of the box opening. 'Possum bands' will be wrapped around each tree where a box is installed to deter mammalian predators. Any bat box installed must be checked annually to remove any nesting materials that have been brought in by birds.

In recent years, several bat box designs have been installed at sites in New Zealand:

- A timber 'Kent' bat box design (Auckland Council);
- A timber 'Microbat box' design (Auckland Council);
- A bespoke timber design similar to the 'Kent' (Waikato Regional Council); and
- Four Schwegler 'woodcrete' designs (models 2F, 2FN, 1FF and 1FD; DoC, South Canterbury).

Any of these designs are considered suitable for use within the site, as needed.

Appendix H
Current and Potential Stream Ecological Valuation Results – Offset Site

Table G1. Current and Potential Stream Ecological Valuation (SEV) data for each assessment reach within the Offset Site.

Function category	Function	Variable	Assessed SEV reach					
			Current			Potential		
			1	2	3	1	2	3
Hydraulic		Vchann	0.40	0.52	0.52	0.40	0.52	0.52
		Vlining	0.80	0.80	0.80	0.90	0.90	0.90
		Vpipe	1.00	1.00	1.00	1.00	1.00	1.00
	NFR	=	0.53	0.61	0.61	0.57	0.65	0.65
		Vbank	1.00	1.00	1.00	1.00	1.00	1.00
		Vrough	0.20	0.20	0.20	0.52	0.52	0.52
	FLE	=	0.20	0.20	0.20	0.52	0.52	0.52
		Vbarr	1.00	1.00	1.00	1.00	1.00	1.00
	CSM	=	1.00	1.00	1.00	1.00	1.00	1.00
		Vchanshape	0.90	0.92	0.92	0.90	0.92	0.92
		Vlining	0.80	0.80	0.80	0.90	0.90	0.90
	CGW	=	0.83	0.84	0.84	0.90	0.91	0.91
Hydraulic function mean score			0.64	0.66	0.66	0.75	0.77	0.77
Biogeochemical		Vshade	0.00	0.00	0.00	0.52	0.52	0.52
	WTC	=	0.00	0.00	0.00	0.52	0.52	0.52
		Vdod	0.45	0.45	0.45	0.68	0.68	0.68
	DOM	=	0.45	0.45	0.45	0.68	0.68	0.68
		Vripar	0.00	0.00	0.00	0.50	0.50	0.50
		Vdecid	1.00	1.00	1.00	1.00	1.00	1.00
	OMI	=	0.00	0.00	0.00	0.50	0.50	0.50
		Vmacro	0.20	0.28	0.30	0.62	0.65	0.57
		Vretain	0.20	0.36	0.36	0.20	0.36	0.36
	IPR	=	0.20	0.28	0.30	0.20	0.36	0.36
		Vsurf	0.51	0.57	0.57	0.34	0.37	0.37
		Vripfilt	0.20	0.20	0.20	0.40	0.40	0.40
	DOP	=	0.35	0.38	0.38	0.37	0.39	0.38
Biogeochemical function mean score			0.20	0.22	0.23	0.45	0.49	0.49
Habitat Provision		Vgalspwn	0.00	0.00	0.33	0.00	0.00	0.33
		Vgalqual	0.00	0.00	0.00	0.25	0.25	0.25
		Vgobspwn	0.10	0.10	0.10	0.10	0.10	0.10
	FSH	=	0.05	0.05	0.05	0.05	0.05	0.09
		Vphyshab	0.16	0.21	0.16	0.40	0.44	0.44
		Vwatqual	0.05	0.05	0.05	0.34	0.34	0.34

Function category	Function	Variable	Assessed SEV reach					
			Current			Potential		
			1	2	3	1	2	3
		Vimperv	1.00	1.00	1.00	1.00	1.00	1.00
	HAF	=	0.34	0.37	0.34	0.54	0.55	0.55
Habitat provision function mean score			0.20	0.21	0.20	0.29	0.30	0.32
Biodiversity		Vfish	0.33	0.33	0.33	0.33	0.33	0.33
	FFI	=	0.33	0.33	0.33	0.33	0.33	0.33
		Vmci	0.42	0.42	0.42	0.42	0.42	0.42
		Vept	0.33	0.33	0.33	0.33	0.33	0.33
		Vinvert	0.58	0.58	0.58	0.58	0.58	0.58
	IFI	=	0.45	0.45	0.45	0.45	0.45	0.45
		Vripcond	0.12	0.11	0.11	0.33	0.33	0.33
		Vripconn	1.00	0.95	1.00	1.00	0.95	1.00
	RVI	=	0.12	0.10	0.11	0.33	0.31	0.33
Biodiversity function mean score			0.30	0.29	0.29	0.37	0.36	0.37
Overall mean SEV score (maximum value 1)			**0.347**	**0.362**	**0.361**	**0.496**	**0.515**	**0.519**

Notes: NFR is natural flow regime; FLE is floodplain effectiveness; CSM is connectivity for species migration; CGW is natural connectivity to groundwater; WTC is water temperature control; DOM is dissolved oxygen levels maintained; OMI is organic matter input; IPR is in-stream particle retention; DOP is decontamination of pollutants; FSH is fish spawning habitat; HAF is habitat or aquatic fauna; FFI is fish fauna intact; IFI is invertebrate fauna intact; RVI is riparian vegetation intact.

Appendix I
Wetland Ecological Valuation Results – Project Site

Table H1. Wetland Ecological Valuation summary data for project site.

Component	Attribute	WEVi-C Average Score	WEVi-P Average Score	WEVi-I Average Score	WEVm-C Average Score	WEVm-P Average Score
Catchment	Land use affecting catchment hydrology	0.99	0.95	0.00	0.00	1.20
Catchment	Diversion of flows	5.00	5.00	0.00	0.00	5.00
Catchment	Water quality in catchment	2.00	4.00	0.00	0.00	4.00
Catchment	Mammalian predators in catchment	2.00	2.00	0.00	0.00	2.00
Catchment	Key undesirable plants in catchment	2.00	4.00	0.00	0.00	3.00
Catchment	% impervious surfaces in catchment	4.00	1.00	0.00	0.00	5.00
Catchment	% catchment in vegetation of any sort	5.00	2.00	0.00	0.00	5.00
Catchment	Degree of runoff control – flood and first flush	0.00	5.00	0.00	0.00	0.00
Catchment	Wetland connections	3.00	3.00	0.00	0.00	4.00
Wetland	Size and shape	2.00	2.00	0.00	0.00	3.50
Wetland	Change in hydrology	4.00	4.00	0.00	0.00	4.00
Wetland	Change in water/ soil quality or state (physico chemical parameters)	3.00	4.00	0.00	0.00	4.00
Wetland	Change in ecosystem intactness	4.67	4.67	0.00	0.00	4.67
Wetland	Change in amount of animal damage and harvest by humans	2.33	3.67	0.00	0.00	3.67
Buffer	Change in dominance of native plants	0.00	1.00	0.00	0.00	4.00
Buffer	Animal damage	0.00	5.00	0.00	0.00	5.00
Buffer	Weeds	0.00	5.00	0.00	0.00	5.00
Buffer	Canopy dieback	5.00	5.00	0.00	0.00	5.00
Buffer	Buffer	0.00	2.50	0.00	0.00	2.50
Overall Mean Score		2.50	3.44	0.00	0.00	3.78
Maximum attainable Score		5.00	5.00	5.00	5.00	5.00
Wetland Condition (WEV score)		**0.500**	**0.688**	**0.000**	**0.000**	**0.755**

Appendix J
DRAFT Wetland Monitoring Plan

1 OFFSET WETLAND MONITORING PLAN

1.1 Overview

The monitoring plan for wetland vegetation and ecological value follows the methodologies outlined in Clarkson et al. (2004)[1] and Clarkson (2013)[2]. All sampling must be conducted by qualified ecologists with expertise in wetland botany.

Long-term vegetation plots will be established within the wetland for the purposes of monitoring vegetation cover and composition, which will be used to indicate the successful establishment of wetland conditions. [The number of 2 x 2-metre vegetation plots to be established will be specified, and a map will be included which shows approximate plot locations]. While buffer planting is integral to the wetland system, specific monitoring is not proposed. Instead, plant cover, survival, and health within buffer areas will be monitored during the maintenance period, with any non-thriving plants replaced.

1.2 Monitoring Timeframes and Frequency

As the wetland is yet to be constructed, baseline monitoring will not be conducted. The monitoring shall begin [XXX] years following initial planting efforts. During the first monitoring round, the corners of each plot will be permanently staked and will remain in place until the final monitoring round, after which they will be removed. [Recommended monitoring frequency and timeframes will be detailed].

The location of each of the plots will be marked using a handheld GPS unit. A reference photo at an established photo point will be taken showing the vegetation within each plot. In addition, reference photos of the entire wetland area will be taken during each monitoring round to visually track environmental changes over time.

1.3 Monitoring Methodologies

Clarkson et al. (2014) Wetland Condition Monitoring

Monitoring at each plot will follow the methods outlined in Clarkson et al. (2004). All plant species will be identified for each structural tier (canopy, subcanopy, and groundcover) where applicable for each monitoring plot. The percentage cover of each species and height of tallest individual of each species based on foliage (not seed or flower heads) will be recorded. Plot indicator scores and condition indices will be calculated based on the vegetation present.

The Clarkson et al. (2004) monitoring methods are designed for intact (but potentially impacted), existing wetlands, thus are not designed to monitor whether constructed wetlands establish effectively and continue to persist. Some variables used in this methodology are less applicable to constructed wetlands. For example, Indicator H1 assesses the impact of manmade structures, but this is less relevant as the wetland itself is a constructed restoration feature. To maintain consistency in indicator scoring, the same individual or company should conduct all monitoring where feasible. If this is not possible, previous monitoring records, including raw data, should be provided to the ecologist conducting the assessment.

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[1] Clarkson, B. R., Sorrell, B. K., Reeves, P. N, Champion, P. D, Partridge, T. R.. Clarkson, B. D. 2004. Handbook for monitoring wetland condition. Ministry for the Environment, Wellington.

[2] Clarkson B.R. (2013). A vegetation tool for wetland delineation in New Zealand. Prepared for Meridian Energy Limited. Dated December 2013. Landcare Research Contract Report: LC1793. 62 pp.

Clarkson (2013) Vegetation Monitoring
Due to the limited applicability of the Clarkson et al. (2004) methodology, application of the wetland delineation protocols will also be undertaken, namely the Vegetation Tool (Clarkson 2013). Calculating the dominance test and prevalence index for each plot will assess the proportion of hydrophytic species, and therefore determine if they are persisting within the wetland. Changes in species composition over time will also detect if any species is struggling, determine levels of weed or upland plant invasion, and determine if new wetland species (i.e. ones not included in the original planting schedule) have naturally colonised the wetland.

1.4 Analysis and Reporting

Following each monitoring round, results will be compiled, analysed, and presented in a report. The purpose of the monitoring is to determine if wetland conditions establish and persist over time, allowing wetland vegetation to also persist over time.

If monitoring indicates a decline in the Wetland Condition Score (Clarkson et al. 2004) between rounds, or if the dominance test or prevalence index (score >3.0) suggests marginal wetland conditions, the ecologist will assess wetland health, identify potential issues, and discuss factors affecting vegetation persistence.

It should be noted that prevalence indices are more informative than dominance values when it comes to monitoring change over time. A slight change in the species composition within the assessment/plot areas can have a disproportionate effect on the dominance values. Small changes are unlikely to trigger a ‘declining state’ without continually declining scores, which would require evaluation on a case-by-case basis.

The report will include recommendations for additional investigations, adjustments to weed/pest control measures, or modifications to monitoring frequency to address any identified decline and enhance ecological function.

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