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Environmental Consultants



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Te Kowhai East- Industrial Development Mangaheka Stream Enhancement Plan

Prepared for:
Te Kowhai East Limited Partnership



water



fauna



flora



land

Quality Assurance

This report has been prepared and reviewed by the following:

Prepared by: Chad Croft
Senior Ecologist



Reviewed by: Nick Carter
Director/
Senior Freshwater Ecologist



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ecoLogical solutions

tauranga office
115 the strand, tauranga 3110.
p: 021 806 933

auckland office
building 4/195 main highway,
ellerslie, Auckland, 1051
p: 021 578 726

northland office
30 leigh street, kāeo
po box 180, kāeo 0448
p: 021 403 386

nelson office
58 factory road, brightwater
p: 021 172 2091

www.ecoLogicalsolutions.co.nz

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1.0 Introduction

1.1 Background

This report prepared by Ecological Solutions Ltd presents a Stream Enhancement Plan for the Mangaheka Stream (MSEP). This MSEP has been prepared as part of the Te Kowhai East Limited Partnership's substantive application for approvals under the Fast-track Approvals Act 2024 (FTAA) to develop the Te Kowhai East Industrial Development (the Project). The Project covers 187.5 ha and is commonly referred to by the primary addresses of 270 Te Kowhai Road and 28 Mathers Road (the Project Area), as shown in Figure 1.

This MSEP sets out the implementation, monitoring and maintenance measures for the reconstruction and restoration of the Mangaheka Stream within and immediately downstream of the Project Area.

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

1.2 Purpose

The MSEP draws on information from the Ecological Impact Assessment (EclA) prepared by Ecological Solutions (2026a), engineering plans prepared by Maven Associates (2026a) and the urban design statement prepared by Adapt Studio (2026).

The purpose of the MSEP is to provide for the implementation of stream enhancement, habitat creation, fish passage, riparian restoration and ecological management measures necessary to achieve the ecological outcomes anticipated for the Project, including the restoration and enhancement of the Mangaheka Stream and the ecological offset associated with reclamation of Watercourse M13.

The MSEP applies to approximately 1,870 m of Mangaheka Stream within the Project Area and approximately 450 m immediately downstream of the Project Area.

1.3 Objectives

The specific objectives of the MSEP are:

- The creation of a self-sustaining stream ecosystem with the resilience to adapt to the changing surrounding land use and an SEV score 0.57 or better in 5 years.
- The creation of a minimum of c. 212 m of additional stream length and c. 434 m² of streambed area over the c. 1,870 m long reach of the Mangaheka Stream within the Project Area as an offset for the reclamation of the modified watercourse M13.
- Improved instream habitat diversity and complexity through the creation of diverse habitat features.
- Restoration of a self-sustaining native riparian zone along the length of the new Mangaheka Stream channel and stormwater reserve covering c. 84,430 m² (Maven Associates 2026a), that once established, requires minimal management to persist in perpetuity.

1.4 Related Documentation

This MSEP should be read alongside the following related documents (Table 1).

Table 1: Related Documents

Plan code	Plan name	Interface with this MSEP
TKE-FMP-001	Fish Management Plan (Ecological Solutions 2026b)	Fish salvage, capture, and relocation methods.
TKE-STMP-001	Stream Works Management Plan (Maven Associates 2026b)	Stream works methodology, staging, temporary diversions, erosion and sediment control and construction hold points relevant to implementation of the stream enhancement works.
TKE-EcIA-001	Ecological Impact Assessment (Ecological Solutions 2026a)	Source for baseline habitat assessment, effects characterisation and application of effects management hierarchy.
TKE-EWMP-001	Earthworks Management Plan (Maven Associates 2026c)	Bulk earthworks programme that determines drain works timing within each stage.
TKE-BMHCP-001	Black Mudfish Habitat Creation Plan (Ecological Solutions 2026c)	Provides for creation, establishment, monitoring and adaptive management of replacement black mudfish habitat. The BMHCP operates separately from, but alongside, the Mangaheka Stream restoration and enhancement measures in this MSEP.
TKE-CMP-001	Construction Management Plan (Maven Associates 2026d)	Overall construction management, incident reporting, and pre-commencement notification.
TKE-BMP-001	Bat Management Plan (Ecological Solutions 2026d)	Provides protocols for clearance of existing potential bat roost trees during the widening of the Mangaheka.
TKE-LMP-001	Lizard Management Plan (Ecological Solutions 2026e)	Drain margins potentially support lizards. Pre-works lizard survey and salvage capture per TKE-LMP-001 applies before drain works in lizard habitat areas.
TKE-LCP-001	Landscape Concept Plans	Identify the spatial extent and layout of riparian, stormwater reserve and wider landscape planting associated with the Mangaheka Stream corridor. The planting shown on the landscape plans is to be implemented consistently with the ecological species selection, planting zones, densities, establishment, monitoring and maintenance requirements of this MSEP.

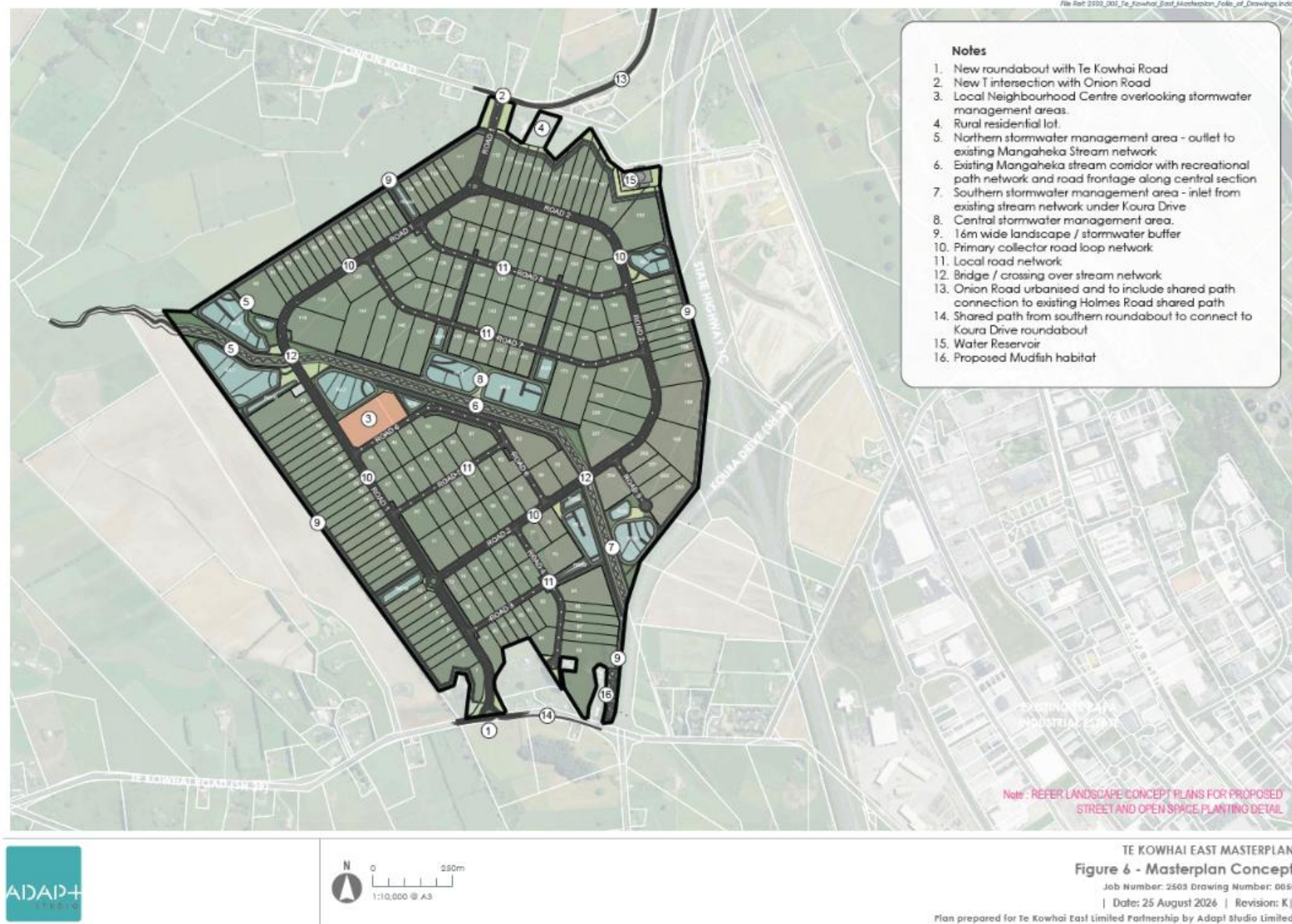


Figure 1: Masterplan Concept (Adapt Studio).

2.0 Responsibilities

Table 2: Summary of roles and responsibilities

Role	Party	Responsibilities
Consent Holder	Te Kowhai East Ltd Partnership	Responsible for overall implementation of the certified MSEP, engagement of suitably qualified specialists, provision of reports to WRC, implementation of any required remedial actions and ensuring long-term protection and maintenance arrangements are established.
Freshwater Ecologist	Ecological Solutions Ltd	Responsible for ecological input to detailed stream design, supervision of ecological enhancement measures, establishment and monitoring of riparian and instream habitat, interpretation of ecological monitoring results and recommendations for remedial or adaptive management.
Civil/Stream Design Engineer	Maven Associates	Responsible for detailed stream geometry, grades, hydraulic performance, streambank stability, culverts, erosion protection, construction supervision, and as-built information.
Hydrogeologist	WGA	Responsible for hydrological and groundwater input where required to confirm stream flow and water-level performance.
Principal Contractor	[To be appointed: independent of contractor; per TKE-CMP-001 Section A7.1]	Responsible for construction of the stream enhancement works in accordance with the certified MSEP, STMP, engineering drawings and applicable consent conditions.
Waikato Regional Council	WRC	Consent authority responsible for technical certification and compliance monitoring in accordance with the resource consent conditions.
Waikato District Council/ Hamilton City Council	HCC	Proposed future asset owner for relevant stormwater reserve and stream corridor assets, subject to final vesting and infrastructure ownership arrangements.
Tanagata Whenua Working Group (TWWG)	TWWG	Mātauranga input into ecological restoration and enhancement outcomes.

3.0 Waikato-Tainui Environmental Plan

This MSEP is aligned with the objectives of the Waikato-Tainui Environmental Plan (WTEP) Tai Tumu Tai Pari Tai Ao. The WTEP plan was developed out of the Whakatupuranga 2050 long-term development approach with the key strategic objective ‘to grow our tribal estate and manage natural resources’ with Waikato-Tainui aspiring to restore the environment to the state that Kiingi Taawhiao observed when he composed his maimai aroha.

Sections 7 and 8 of the WTEP specifically address environmental enhancement and managing effects. An enhancement approach requires a holistic approach to the whole environment, which aims for positive ecological and social outcomes.

Effects management in relation to the project have been previously considered as part of the Ecological Impact Assessment (EclA) (Ecological Solutions 2026a). The MSEP specifically addresses the biodiversity offset component and aims to enhance the existing environment through the creation of additional stream length, establishment of a native riparian vegetation community as well as supporting and ideally increasing native freshwater fish populations within the catchment.

The realigned stream will be created in a way that results in a higher quality aquatic environment. Restoration activities will benefit other flora and fauna that are adapted to stream environments and increase habitat connectivity at a landscape scale.

The vision and strategy for the Waikato River (Te Ture Whaimana o te Awa o Waikato) recognises the significance of the Waikato River to Waikato-Tainui, with the vision, objectives and strategies applicable to Waikato River tributaries and overall catchment. The project aims to enhance the amount and quality of stream habitat within the Waikato River catchment and aligns with the objectives of the vision and strategy for the Waikato River.

The protection of Natural Heritage and Biosecurity is covered in Section 15 of the WTEP, which identifies that post 1840, three quarters of indigenous vegetation has been removed with the greatest loss occurring in lowland areas. Habitat for threatened and At-Risk native freshwater fish populations would have been more common prior to historical land clearance and channelisation activities, which have reduced, fragmented, and modified stream habitats. Habitat loss and modification is recognised as one of the major threats to native fish populations. Continued development which potentially result in habitat modifications, continue to threaten native fish populations. The project, and this MSEP aims to increase the amount and quality of native fish habitat within the Mangaheka Stream.

4.0 Ecological Setting

4.1 Ecological Context

The Mangaheka Stream is in the Hamilton Ecological District. The Hamilton Ecological District is one of the most modified districts in New Zealand with only 1.6% of indigenous vegetation remaining (Leathwick et al. 1995). Vegetation was formerly largely bogs, scrub and fernland with small areas of swamp forest (McEwen 1987). At least 20% of indigenous flora within the Hamilton Ecological District is threatened or extinct and >50% of the indigenous bird species have gone. Hamilton City has only a few small remnants of the former indigenous forest cover, perhaps <20 ha in total of high-quality indigenous habitat (Clarkson and McQueen 2004).

The Hamilton Ecological District experiences warm, humid summers and heavy frosts in winter with an annual rainfall of approximately 1,100–1,400 mm (McEwen 1987). The Hamilton landscape is made up of three elements: the low 'Hamilton Hills'; an alluvial plain formed by coalescing fans deposited by the Waikato River; and low terraces of pumice alluvium deposited by the most recent Taupo eruption (McCraw 1997).

4.2 Modified Watercourse M13

The highly modified watercourse, M13, originates parallel to the Mangaheka Stream on the western side of the Project Area following a historic paleo-channel (Figure 2). M13 is an intermittent Stream, which was assessed as having 'low' ecological values based on the absence of shading, poor riparian vegetation and poor-quality substrate and surface water (Ecological Solutions 2026a).

The watercourse has been incised and realigned for farming practices. No fish have been recorded in M13. Watercourse M13 (212 m) will be reclaimed during earthworks. Offsetting the loss of water course M13 will be accomplished through the realignment and

enhancement of the Mangaheka Stream. Details of the SEV, ECR and extent of the required enhancement is provided in the EclA (Ecological Solutions 2026a).



Figure 2: View of Watercourse M13.

4.3 Mangaheka Stream

The Mangaheka Stream flows through the Project Area, entering from Koura Drive on the eastern boundary of the Project Area and exits on the western boundary, discharging into the Waipa River (Figure 3).

The Mangaheka Integrated Catchment Management Plan (ICMP) describes the catchment as approximately 2,080 ha. with the majority of the catchment (86%) being within the Waikato District Council boundaries and the upper catchment being within the Hamilton City Council boundaries (HCC 2019). Land use is predominantly rural (dairy and grazing) in the lower catchment and vegetation throughout the catchment is dominated by exotic pasture, shelter belts and shade trees associated with rural residential properties.

The Mangaheka Stream catchment is typical of similar rural watercourses, with moderate to poor water quality and low benthic invertebrate health indices (MCI) (HCC 2019). Habitat modification, removal and influences from earthworks and development have led to the catchment wide deterioration of freshwater habitat quality. Despite this, the Mangaheka Stream catchment provides habitat for longfin eel (*Anguilla dieffenbachia*, 'At Risk – Declining'), shortfin eel (*Anguilla australis*, 'Not Threatened'), banded kōkopu (*Galaxias fasciatus*, 'At Risk – Naturally Uncommon'), Giant kokopu (*Galaxias argenteus*, 'At Risk – Declining') and black mudfish (*Neochanna diversus*, 'At Risk – Declining'), placing ecological significance on the catchment based on the matters specified in the operative Regional Policy Statement (WRPS 2016).

Habitat and water quality in Mangaheka Stream is poor and reflects a long history of intensive land use and modification. The Mangaheka Stream is a perennial soft-bottomed stream that has been channelised. The channel has a mean wetted width of c. 1.5–2.0 m, is

generally shallow (0.3–0.5 m deep), has limited flow, high emergent macrophyte cover and provides poor quality for invertebrates and native fish species (Figure 4).

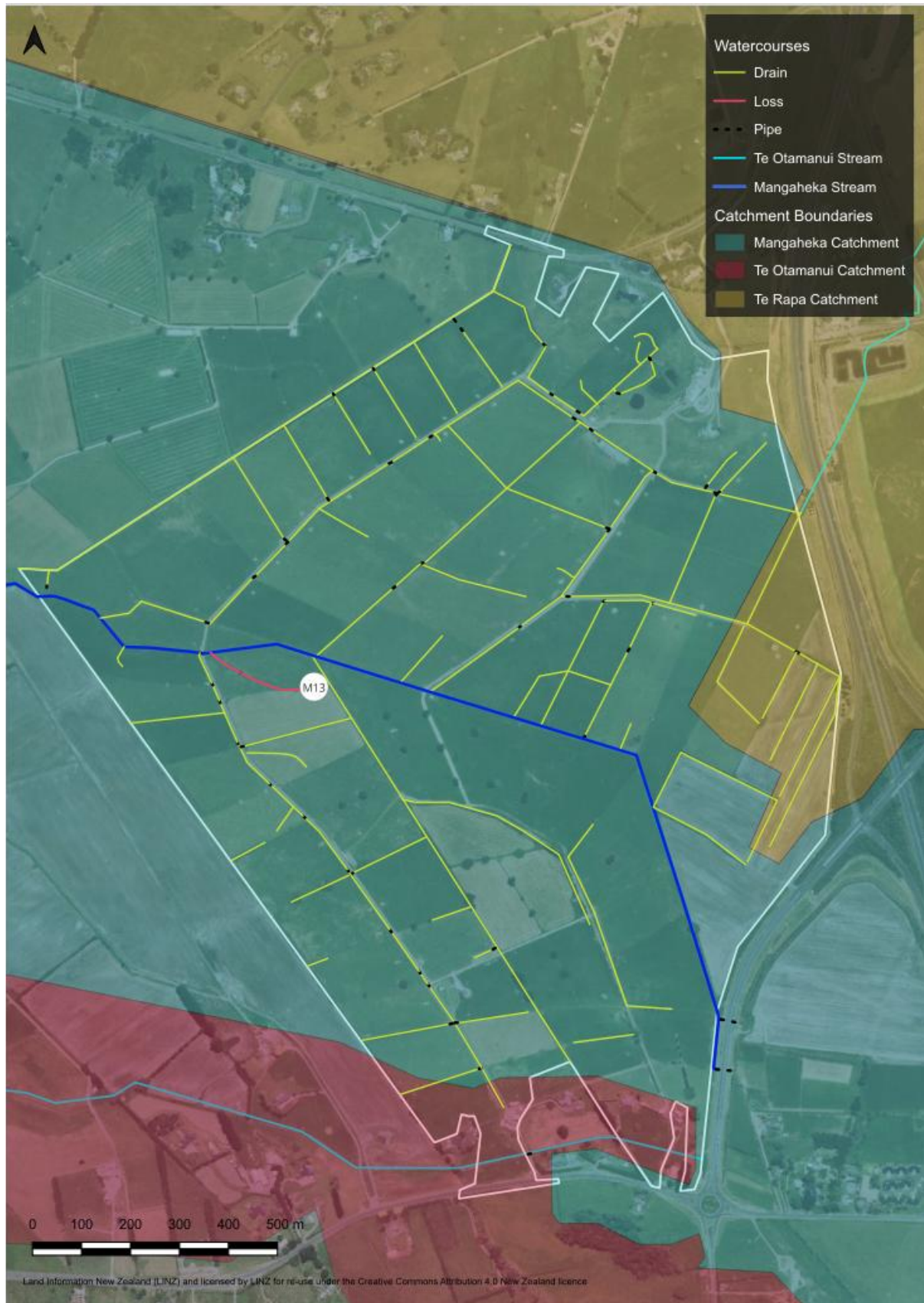


Figure 3: Mangaheka catchment and alignment through the Project Area.



Figure 4: Mangaheka Stream in eastern portion of Project Area.



Figure 5: Mangaheka Stream in western portion of Project Area.

5.0 Ecological Restoration and Enhancement Measures

The proposed restoration and enhancement measures will include:

- The creation of a minimum c. 2,082 m of total stream length (existing c. 1,870 m + additional 212 m = 2,082 m) within the Mangaheka Stream low flow channel and c. 4,164 m² of streambed area (2,082 m x 2 m width) through the establishment of a meandering channel.
- The creation of structural habitat heterogeneity through establishment of shallow and deep zones, woody debris and suitable plantings in and around the Mangaheka Stream margins to maximise habitat diversity and complexity for indigenous fish species including banded and giant kōkopu that are known to occur within the catchment.
- Plant and maintain an indigenous riparian vegetation community covering c. 84,430 m² (Maven Associates 2026a) along the banks of the Mangaheka Stream and stormwater reserve.
- Implement pest plant and animal control, monitoring, and maintenance within the newly planted riparian areas.

6.0 Stream Enhancement Design

6.1 Introduction

The stormwater reserve and Mangaheka Stream design was prepared by Maven Associates with input from Ecological Solutions to create a minimum of 2,082 m of stream length and 4,164 m² of streambed habitat within the Project Area.

Stormwater reserve and low flow stream channel dimensions, invert level, streambed and streambank gradients were determined using site topographical information, hydrological information and stormwater design requirements. The design aims to maximise the stormwater and ecological capacity/productivity of the Mangaheka Stream.

The proposed concept design for the enhancement of Mangaheka Stream is shown below in Figure 6 and Figure 7.

6.2 Stream Alignment and Habitat Creation

The enhanced low flow channel of the Mangaheka Stream was designed to increase the overall stream length and increase habitat heterogeneity through a meandering flow path with variable water depths reflective of a naturally occurring soft-bottomed Waikato low-land stream.

The conceptual low flow channel alignment is shown in Figure 6 and in cross section (Figure 7). The wetted width of the low flow stream channel during base flow conditions will range between 1.5–2.0 m wide and have water depths ranging between 0.2–0.8 m deep. The low flow channel will flow within a wider floodplain that has battered sides (i.e., ~30°) extending away from the channel and which allows higher flows to spill out onto during specific rainfall events.

The indicative locations of runs, pools and coarse woody debris are shown on Figure 6. Pools will be deeper and located on bends of the stream. Runs will occur between pools and at shallower water depths. Coarse woody debris will be anchored in to the low flow channel at different intervals to provide organic structural habitat suitable for indigenous fish and macroinvertebrate refuge. Installing woody debris will create areas with variable flow and natural erosion and increase instream habitat diversity over time. Wood used should be

moderate diameter (i.e. >150 mm) and complex (i.e., a range of sizes). Woody debris will be secured to the streambed or streambank. Half of the woody debris will be installed in runs and half in deeper pools.

A cross-section showing the indicative channel profile and proposed planting is shown in Figure 7. The wetted stream channel will be constructed with a more natural profile.

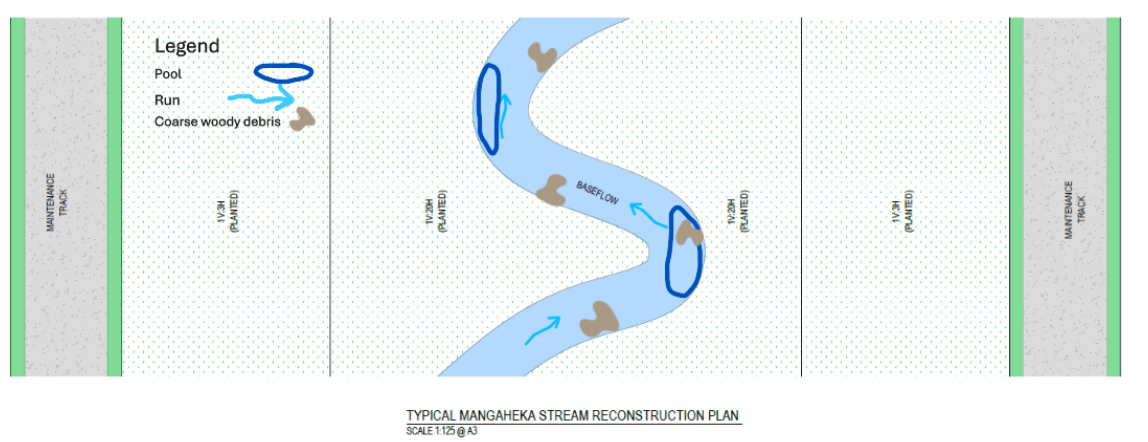


Figure 6: Mangaheka Stream channel concept design.

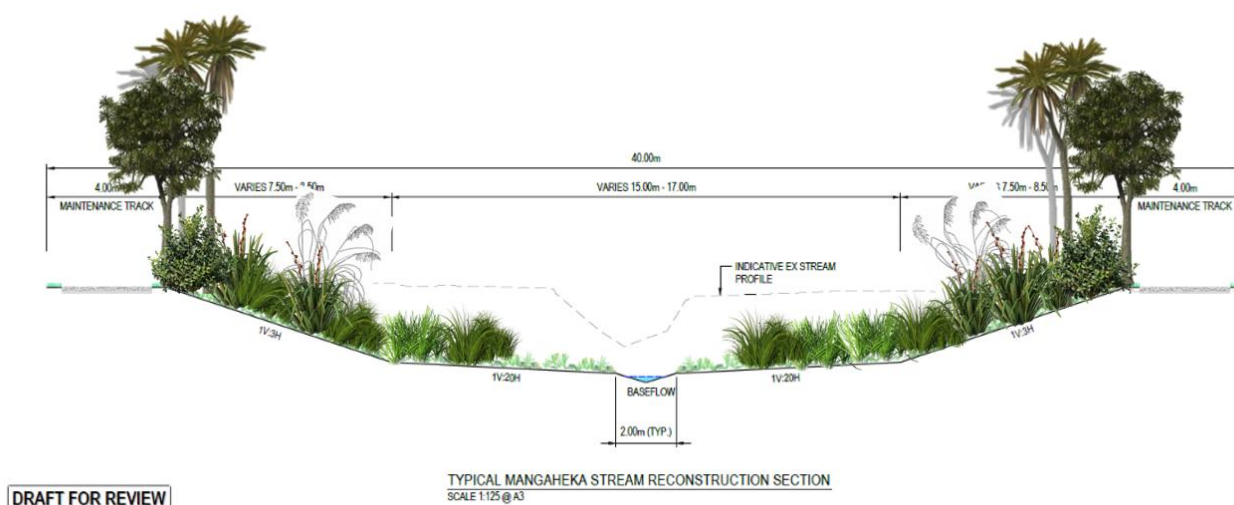


Figure 7: Indicative Mangaheka Stream enhancement concept cross section.

Extent of stream riparian planting

Riparian planting will be undertaken along the new widened reach of the Mangaheka Stream. The full extent of riparian planting is shown on Figure 6. A detailed description of riparian planting is covered in Section 7.0. Riparian planting will be carried out across the full width of the widened channel and along both streambanks (i.e. entire stormwater reserve).

The total planting area (i.e., includes both banks) will cover c. 84,430 m², with c. 74,122 m² within the Project Area and an additional 10,304 m² along the c. 450 m long reach downstream of the western boundary of the Project Area. Planted riparian areas will be fenced, protected, and maintained in perpetuity.



Note: REFER LANDSCAPE PLANS FOR
LANDSCAPE DESIGN CONCEPTS

Figure 8: Extent of riparian planting along the Mangaheka Stream (Adapt Studio, Drawing Number 005e).

Culvert and fish passage

Two culvert crossings are proposed along the Mangaheka Stream within the Project Area (Figure 9). The proposed culvert designs will meet Regulation 70 of the National Environmental Standards for Freshwater (NES-F) regarding fish passage and will have the following:

- Provide for the same passage of fish upstream and downstream as would exist without the culvert.
- Laid parallel to the slope of the bed.
- Mean cross-sectional water velocity within the culvert being no greater than that immediately upstream and downstream.
- A minimum of 25% of the culvert diameter will be embedded into the streambed.
- Bed substrate will be present over the full length of the culvert over time.
- Provide for continuity of geomorphic process (e.g., movement of sediment, debris).

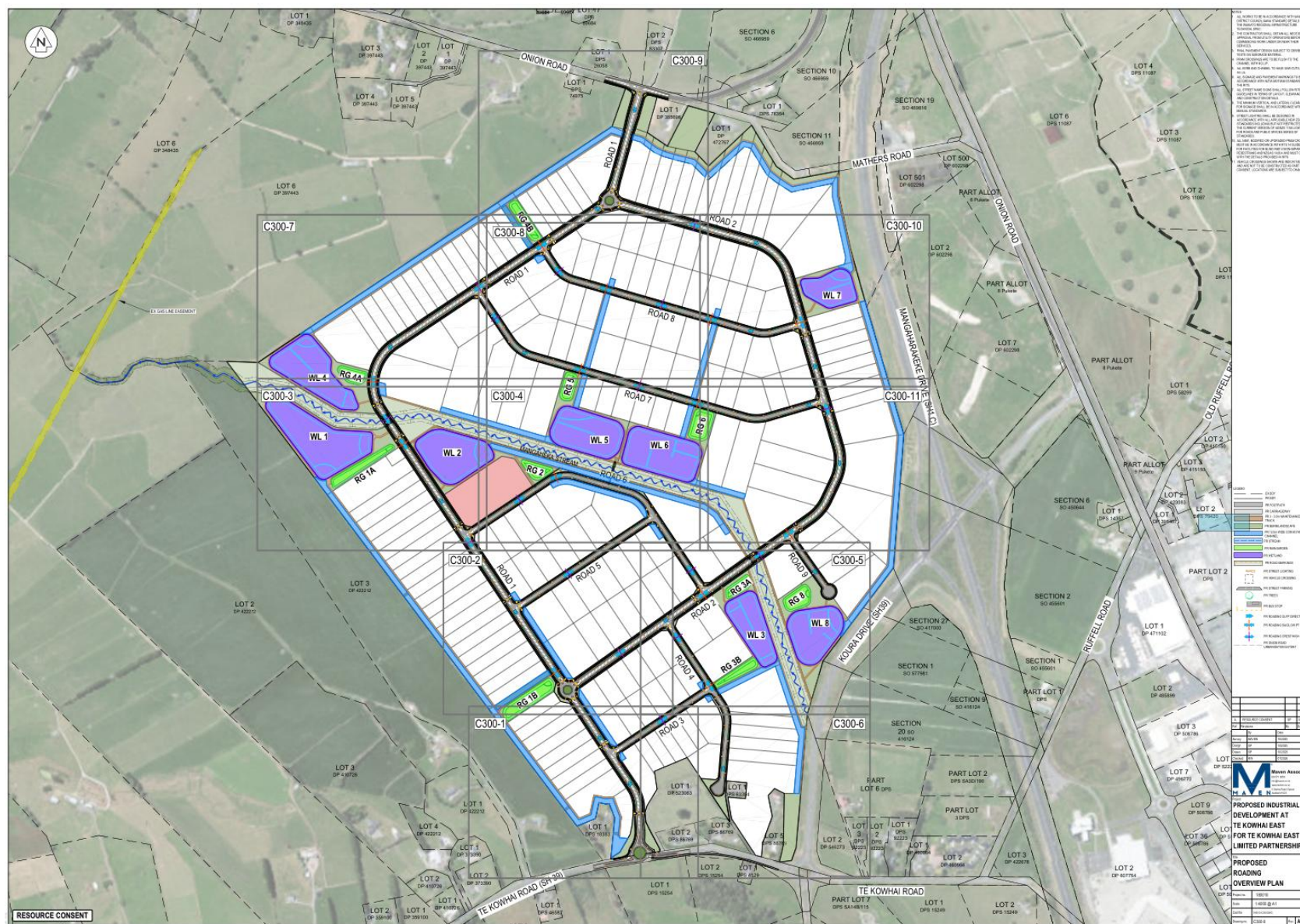


Figure 9: Road culvert crossings

6.3 Earthworks and Staging

Earthworks for the realignment and enhancement of the Mangaheka Stream will be carried out in accordance with engineering drawings, Stream Works Management Plan (STMP) (Maven Associates 2026b) and Erosion and Sediment Control Plan (ESCP) presented in the Earthworks Management Plan (Maven Associates 2026c).

Stream-works will not commence until the Fish Management Plan (FMP) prepared by Ecological Solutions (2026b) has been implemented and an ecologist has provided appropriate clearance.

Stream realignment and enhancement works will be carried out offline and under the supervision of a suitably qualified and experienced engineer, hydrogeologist, and freshwater ecologist.

6.4 As-built Certification Statements

Signed As-built certification statements will be prepared by suitably qualified and experienced practitioners (engineer, hydrogeologist, freshwater ecologist) to certify the stream realignment and enhancement works have been established in accordance with the MSEP and submitted to WRC within two months of completion of the stream works, for each stage.

7.0 Riparian Planting

7.1 Introduction

The spatial extent and layout of planting is shown on the Project landscape plans. Where there is any inconsistency between the landscape plans and this MSEP in relation to ecological planting requirements, species selection, planting zones, establishment, monitoring or maintenance, the requirements of the certified MSEP shall prevail unless otherwise agreed through the applicable certification process.

7.2 Restoration Aims

Revegetation restoration projects are based on the natural successional processes and incorporate ecological concepts such as colonisation, connectivity/fragmentation and ecological function. Riparian margins along both streambanks of the Mangaheka Stream will be enhanced via planting, weed and pest animal control, plant maintenance, fencing and monitoring for 5 years to achieve a positive ecological outcome. Riparian planting in association with realigning and enhancing the low flow stream channel will increase floodplain and ecological corridor connectivity and improve functional habitat and water quality.

The ecological aims of the proposed plantings are to:

- Restore indigenous vegetation along riparian margins.
- Improve the ecological health and functionality of riparian vegetation communities.
- Encourage natural ecosystem processes including the regeneration and dispersal of indigenous flora and fauna.
- Establish a self-sustaining native riparian community that once established, requires minimal further management to persist in perpetuity.

These aims will be achieved through implementation of the following:

- Remove unwanted weeds and pest animals within the restoration site.
- Revegetate specified areas with eco-sourced pioneer plants in order to establish a nurse crop into which light and moisture sensitive species will spread and establish via natural means of dispersal.
- Enrich the specified areas with a selection of eco-sourced specimen tree species to establish suitable canopy cover.
- Plant floodplains and potential riverine wetland habitats with wet-adapted species that can tolerate water inundation and provide overhanging cover along streambanks and within and around floodplain/wetland habitats.

7.3 Restoration Concept

A typical focus of riparian restoration plans is to fast-track canopy closure within 2–5 years by planting a high proportion of pioneer species to create suitable growing conditions for taller native broadleaf and conifer trees.

Canopy closure is also important as it reduces weed seed germination, provides sheltered conditions for other species to either establish naturally or be planted at a later stage, and provides stream/floodplain/wetland shade and bank stabilisation. Another focus will be to stabilise the realigned stream by planting low stature emergent wetland and wet tolerant vegetation to enhance potential habitats suitable for indigenous freshwater fish species.

7.4 Site Preparation

To aid the overall restoration outcome, ecosystem function, general aesthetics and health and safety of the site, any refuse within areas to be planted should be removed and disposed of appropriately at a transfer station at the contractor's discretion. Prior to planting, the site shall be prepared to be weed free (no mature, flowering and/or fruiting plants) to promote successful establishment of native plants.

7.5 Eco-sourcing

Eco-sourcing is a practice fundamental to the long-term success of a revegetation programme. Each ecological region has been defined by the underlying geology, landforms and soils which affect the plant species found within an area. The benefits of eco-sourcing include: the maintenance of local biodiversity/genetic variability, the plants are adapted to growing in local conditions and subsequently the threat of disease is lessened. All plants selected for the site will be sourced from the Hamilton Ecological District or failing that, the wider Waikato Ecological Region.

7.6 Plant Substitutions

Due to nursery stock availability, it may be that some species prescribed may not be available. Any substitutions to the plant list should be discussed with Ecological Solutions to ensure they fit within the ecological context.

7.7 Biosecurity

A NZPPI Biosecurity Declaration for myrtle rust must be presented by the nursery upon collection of plants and kept on record by the contractor to ensure all Myrtaceae species (e.g., mānuka/kānuka) have been treated according prior to planting.

7.8 Plant Pest Control

Site approach

Weed species occur in the catchment and surroundings and have potential to invade when native plantings are establishing. Ongoing maintenance weed control is to take place quarterly for three years following planting, and then twice-yearly in spring and late summer for another two years, and for effectiveness and efficiency be aligned with the proposed planting maintenance programme. This frequency is intended to be enough to control existing pest plants effectively, whilst preventing any remaining plants, growth from the seed bank or re-invasions of pest plants reaching maturity and setting further seed, which will maximise the opportunity for the success of the new plantings.

Best practice herbicide use

Any control efforts requiring agrichemical application will be completed by a GrowSafe certified contractor and wearing appropriate PPE. Appropriate precautions will be undertaken to protect non-target plants and bees.

All agrichemical use including (but not limited to) transport, storage, disposal, training, notification of use, use near waterways and application shall comply with the industry standard NZS 8409:2004 and relevant standards included in the WRP.

Herbicides will be applied during periods of active growth. Weather conditions at the time of application will be suitable for herbicide application (i.e., little to no wind in order to minimise spray drift). If weather conditions are not suitable, spraying will be completed at an alternative time. Spray marker dye will be added to all spray solutions to ensure full coverage of all weed infestations.

Foliar spray

This method is an efficient way to target larger areas of pest plants, and is well suited to dense shrubs, grasses and vines <6 m. It is usually applied from a backpack sprayer, or in larger infestations a vehicle such as a tractor or mower. The pressure used and nozzle shape (fan or cone) should be chosen appropriately for effective delivery of herbicide to minimise off-target damage. In some cases, such as climbing vines, it is appropriate to cut the all vines at shoulder or waist height with secateurs and then foliar spray the remaining stems and foliage to avoid damage to the canopy or through overspray.

Hand pull

Seedlings and some species can be easily pulled from the ground and left to rot on site (provided their entire root system can be dug out). This method reduces herbicide use and minimises potentially detrimental effects to non-targets. It is only an appropriate method for species where broken root fragments will not regrow (e.g., *Tradescantia*) and is generally not suitable for species with tubers or bulbs. Consideration should also be given to the time of year when plants such as pampas or gorse are seeding as it is not appropriate to leave seed heads/ pods onsite to rot down.

Timeline

Table 3 presents the proposed timing of weed control and planting for the site. This timeline is flexible, however weed control should be completed within the appropriate season.

Table 3: Timing of Weed Control.

	Summer		Autumn			Winter			Spring			Summer
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Year 0	Site preparation					Revegetation Planting						
Year 1												
Year 2												
Year 3												
Year 4												
Year 5												

Note: Blue shade cells = plant pest control and planting maintenance.

7.9 Animal Pest Control

Goodnature pest animal control stations (A24) have been selected to provide effective pest management for rodent species across the restoration site. Self-resetting devices provide low maintenance management. The purpose of control stations is to reduce pest animal populations to low densities to minimise the adverse effects upon native flora and fauna (e.g., plant browsing, bird predation). Pest control stations will be installed as per manufacturer's instructions and the location of installation marked with flagging tape and/or GPS coordinates to facilitate quick and effective servicing. The Goodnature A24 kill traps have been developed for relatively safe use and to exclude non-target species.

Animal pest control details are outlined below:

Goodnature A24 Kill Traps

- Install Goodnature A24 kill traps on the outer margins of planting area on fence posts, 0.3 m from the ground and at 50 m spacings.
- Goodnature A24 kill traps are safe for use around pets and native birds and are toxin free. Pests brush past an internal trigger when attempting to reach the lure, which fires a piston killing them instantly. The trap is set with a CO² canister that and resets itself automatically killing 24 times before the gas canister requires replacing. Because this trap resets automatically, it can be activated year-round.
- Goodnature A24 kill traps are to be baited with appropriate Goodnature lure.
- Goodnature lure and CO² canister replaced every 6 months as per manufacturer's instructions.

Philproof Bait Stations

- Philproof Bait Stations for possums. Bait stations filled with an effective poison (e.g., brodifacoum) will provide a control against possum browse to newly planted palatable species. Bait stations will be deployed and baited three months prior to planting and spaced approximately 100 m apart and attached to tree stakes or fence posts. Poison will be re-applied every three months.

7.10 Planting Zones

For the purposes of the MSEP, the planting areas along the reach of the Mangaheka Stream both within the Project Area and downstream has been divided into two planting sub-zones reflective of the planting microsites and ecological conditions available (e.g., aspect, shelter, contour, hydrology).

The two planting zones are as follows:

- **Zone 1: Streambank slopes** – batter slopes/upland terrestrial species.
- **Zone 2: Floodplain/wetland** – wet adapted terrestrial species that tolerate water inundation.

Proposed plantings have been planned to accommodate a transition in ecological communities from floodplain/wetland to stream riparian buffer. Plant species known to occur within the Hamilton Ecological District and that which would have historically occurred within the Project Area have been selected in accordance with specified guidelines (i.e., Planting guide for lower Waikato River - Ngāruawāhia to Tamahere, Department of Conservation; Indigenous vegetation types of Hamilton Ecological District (Clarkson 2007)). Sufficient diversity is present in the mix of species selected to allow the planting contractor to use their knowledge and experience to locate plants in their preferred 'micro-sites' within each planting unit. Guidance for each 'micro-suite' area is included in the species list tables presented in Section 7.11.

Plants have been considered for each area based on:

- Their ability to establish quickly and provide a suitable nursery crop to allow natural revegetation.
- Their ability to grow in a high or low light situation.
- Their likely tolerance of the water regime proposed.
- Their reliability in establishing in revegetation plantings elsewhere.
- Their ability to add aesthetic value and their contribution to natural ecological processes such as bird dispersal.

Plants will be nursery-raised seedlings raised from seed collected from the Hamilton Ecological District. All plants selected are to be true to their name and species, healthy and free of disease and injury at the time of planting and grown from seed (rather than cuttings). Plant numbers indicated may vary depending on availability.

Plants are to be equivalent to those specified in Landscape Plan (Adrian Morton 2026) (i.e., 20–60 cm tall at the time of planting) with no visible weed contamination. Plants of this size have been selected as they can typically recover more rapidly from the stress of planting than larger plants and are easier to source in high quantities from nurseries due to their ease of propagation and transport. Species favoured by browsing birds such as pūkeko (e.g., cabbage tree, flax, *Carex* spp.) will be planted in larger sizes to prevent them from being browsed or pulled out.

7.11 Plant Lists

Full plant lists can be found in the Landscape Plan (Adrian Morton 2026). Restoration plant lists incorporate both riparian and upper slope pioneer and climatic species that represent the former vegetation cover (i.e., Kahikatea Alluvial terrace/ floodplain ecosystem) (Clarkson 2007). Flowering/fruiting broadleaf and podocarp species have been selected to aid sustenance for kererū and tūī (keystone species).

7.12 Planting Guidelines

Plants will be planted in accordance with the following guidelines (refer to Figure 10).

- The roots of kānuka and mānuka are sensitive to root disturbance so care will be taken to keep this to a minimum.
- All plants within Zone 1 (streambank/batter slopes) are to be planted with a slow-release fertiliser tablet and care will be taken to ensure this does not directly touch the plants root mass.
- Plant holes are to be made three times the diameter of the plants root mass and at least one and a half times the depth of the root mass. Care will be taken to ensure no additional top soil is added around the base of the plants stem.
- Any rocks, rubble or undesirable debris is to be removed from the plant hole and once the plant is in, the hole will be backfilled with a mix of 100% topsoil sourced from the site.
- All plants will be soaked thoroughly before planting, and shall not be removed from their container until planted.
- Large tree species will be planted in small groups of 3–5 trees with mānuka between them to mimic a natural pattern and allow them to spread as they grow.
- The use of mulch in buffer areas is not required for the site initially; however, its application later in the project has been left to the discretion of the developer and property owner.
- If it is to be used it would be confined to dry slope areas only, where there is no risk of it ending up in the wetland. Only organic mulches are recommended. Grass clippings, sawdust and bark chip will not be used. The ground will be thoroughly wet/sodden before mulch is applied.
- The use of staking or ties is optional.

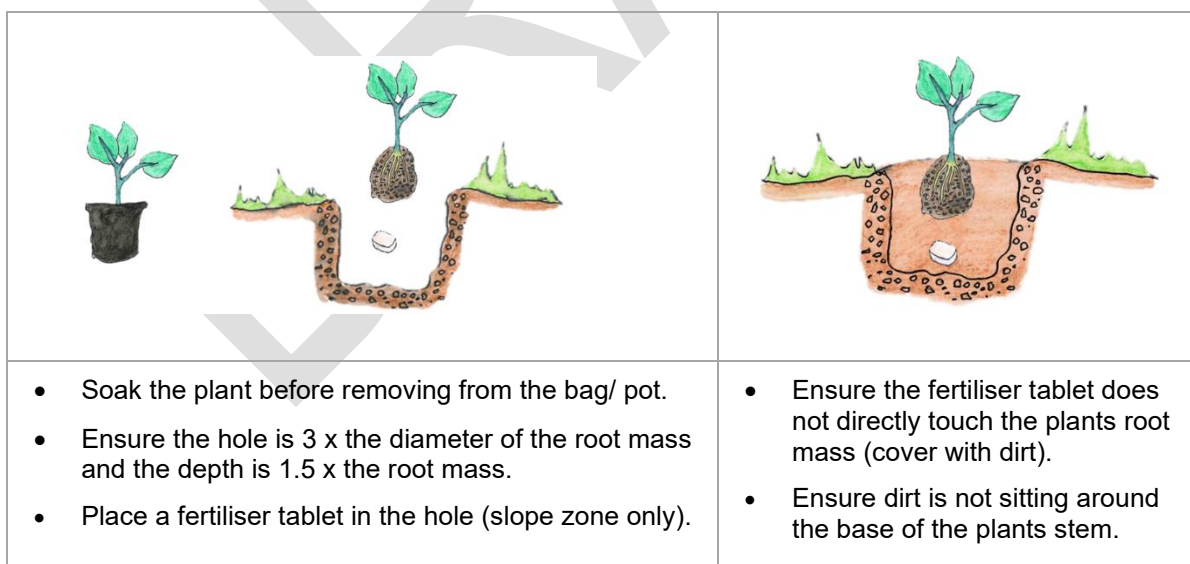


Figure 10: Plant planting guideline.

8.0 Monitoring and Maintenance

8.1 Monitoring Forms and Record Keeping

Inspection checklists (monitoring forms) for all aspects and elements of the stream realignment and enhancement features are presented in the following appendices:

- Appendix A – Planting Monitoring Form.
- Appendix B – Stream Monitoring Form.

8.2 Record Keeping

Data from completed monitoring forms is to be entered into a Microsoft Excel spreadsheet and field forms scanned to provide an electronic copy.

8.3 Plant Monitoring

Monitoring of plant survival and presence of plant pest species by a suitably qualified and experienced operator will occur approximately three months after planting has concluded to record survival and successful establishment. Once plantings have established (after three months), monitoring will be undertaken at least once annually for five years (during spring or autumn). The planting monitoring form is provided in Appendix A. Monitoring shall include, but not be limited to the following:

- Record success rates, including establishment, survival rates and number of plants lost and the distribution of losses.
- Record canopy closure, including notes on natural ecological processes such as the use of the area by birds and presence of natural native seedling establishment.
- Record plant health, noting any indicators of insect or disease damage.
- Include a running record of fertilisation and weed pest control.
- Include a running record on the replacement of dead plants.
- Comments on the condition of fencing.

8.4 Plant Maintenance

General plant maintenance

General plant maintenance will involve the following:

- Hand watering of all new plants at the frequency and amount required to sustain healthy development (expected to be once a week during the first summer post planting unless there is sufficient rainfall).
- Control of insects and disease by treatment with an appropriate chemical.
- Removal of any damaged or diseased plant material (to prevent further spread).
- Fill of any soil compaction and sinkage around plants (common post planting once the soil has settled).

Plant releasing

Plant releasing is the process of releasing young plants primarily from grass growth until they can either compete effectively, or have 'over topped' less desirable species. Extensive plant releasing is not foreseen for the site as a canopy of mature exotic vegetation will remain mostly in place particularly in buffer areas which has shaded out most terrestrial

grasses. However, should plant releasing be required, it will be completed using the following methods:

- Hand/manual releasing, which can involve the use of a scrub bar or hand tools to cut back grass and weed growth around plants which have or are at risk of becoming suppressed. This method is labour intensive but low risk to plant health.
- Spray releasing with herbicide, this method depends on the herbicide to be used and the skill of the contractor. Typically, selective herbicides such as Galant are able to be applied safely around/over most native species (excluding monocots such as cabbage tree, flax, *Carex* and *Cyperus*). In the instance where spray releasing can reduce labour, incompatible species can be manually cleared as per manual release above.
- Non-selective herbicides (such as glyphosate) will not be used due to the high risk of spray drift and associated non-target mortality.

If spray releasing with herbicide is the method selected, the methodology in Section 7.8 will be applied.

Plant replacement (blanking)

A 5–10% mortality rate can be expected in revegetation plantings due to natural causes such as insect damage, frosts and drought along with mortality from animal pest damage and spray drift. Plant mortality of 5% is expected in the first-year post planting, followed by 3% in the second year, and a further 2% after the third year.

Where monitoring identifies plant mortality exceeding the above rates replacement planting shall be undertaken during the next appropriate planting season. Replacement planting shall use species appropriate to the relevant planting zone and shall continue as necessary during the five-year establishment period to achieve the required outcomes.

8.5 Plant Pest Monitoring

Plant pest control will be completed throughout the enhancement project over a duration of five years with a particular emphasis on keeping the pest species present in the site at low densities. Recommended weed control methods are discussed in Section 7.8.

To measure the effectiveness of the control programme it is important that good quality records be maintained to track weed control efforts and site outcomes. The following information should be kept as a record and be supplied as part of the regular monitoring:

- Date of weed control.
- Control methods used.
- Herbicides used.
- Areas targeted.

8.6 Stream and Wetland Ecology Monitoring

Post-construction monitoring will be carried out for five years along the widened and realigned reach of the Mangaheka Stream and riparian habitats.

Installation of permanent staff gauge to measure water levels

The following stream water level monitoring will be implemented to assess pre- and post-development stormwater effects of the development on Mangaheka Stream flow:

- *Baseline monitoring* – qualified hydrologist to install a staff gauge at the lower end of the stream reach proposed to be widened/realigned prior to any works commencing to collect pre-diversion baseline flow data.
- *Post-diversion monitoring* – qualified hydrologist to move the staff gauge to the lower end of the widened/ realigned stream reach after construction.

Stream monitoring

Bi-monthly monitoring (every two months)

- Monitoring of water levels on the permanent staff gauge installed in the lower reaches of the widened and realigned Mangaheka Stream every two months for the first year, post construction.

Annual monitoring

- Annual stream survey during summer (between 1 December – 31 March).
- Fill out stream monitoring form presented in Appendix B.
- Measure Stream Ecological Valuation (SEV) along the upper, upper-middle, middle-lower and lower reaches of the realigned Mangaheka Stream to assess performance progress towards the predicted SEV score 0.57 at year 5 (Ecological Solutions 2026a). SEV surveys are to be carried out following the method in Storey et al. (2011).
- Assess stream riparian planting (e.g., mortality, shade, structure, streambank stability).
- Biological monitoring to include macroinvertebrate sample collection to determine stream health and demonstrate that there is a sustainable food source for native fish species.
- Annual fish survey to assess fish diversity and abundance. Surveys will be carried out in the realigned and enhanced sections of the Mangaheka Stream using baited fyke nets (where possible), g-minnow traps and electric fishing.

Timeline

Table 4 presents the proposed timing of Mangaheka Stream and riparian monitoring for the site. Monitoring includes measurement of water levels in Mangaheka Stream at permanent staff gauge installed at the downstream end of the realigned reach for the first year.

Other stream and riparian monitoring would occur annually for five years.

Table 4: Timing of Mangaheka Stream and riparian monitoring.

Year	Summer		Autumn			Winter			Spring			Summer
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Annual stream / riparian survey (once in summer)											Annual stream / wetland survey (once in summer)
		Stream water level (staff gauge)		Stream water level (staff gauge)		Stream water level (staff gauge)		Stream water level (staff gauge)		Stream water level (staff gauge)		Stream water level (staff gauge)
2	Annual stream / riparian survey (once in summer)											Annual stream / riparian survey (once in summer)
3	Annual stream / riparian survey (once in summer)											Annual stream / riparian survey (once in summer)

4	Annual stream / riparian survey (once in summer)										Annual stream / riparian survey (once in summer)
5	Annual stream / riparian survey (once in summer)										Annual stream / riparian survey (once in summer)

8.7 Operation and Maintenance

Operation and maintenance of the widened and realigned reach of Mangaheka Stream will be carried out. The key aspects of operation and maintenance will be to:

- Ensure hydrological connectivity along the stream.
- Ensure fish passage is provided upstream and downstream.
- Avoid adverse effects of flooding on the stream, habitat structures, land and property.
- Avoid streambed and streambank scour and erosion.
- Ensure the stream is clear of debris, accumulated sediment and obstructions.

If any of the above matters are encountered, WRC will be notified and the matter remedied without delay with input from appropriate experts.

Any evidence of adverse effects resulting from the above matters will be outlined in the annual monitoring report and recommendations made to remedy effects.

8.8 Reporting and Closure

Bi-monthly reporting

Water level monitoring results collected every two months for one year using the permanent staff gauge installed on the lower reaches of the diverted section of Mangaheka Stream will be submitted to WRC.

Annual reporting

An annual monitoring report will be submitted to Waikato Regional Council in conjunction with the 'post stream realignment and enhancement monitoring' results by 31 October each year for five years.

The monitoring report will include the completed inspection checklist for plant monitoring and maintenance, stream data (i.e., water level, channel width data), SEV scores and riparian data (i.e., mortality, shade, structure, streambank stability).

Monitoring reports will make recommendations on any follow-up maintenance required (e.g., weed control, animal pest control, plant replacement (blanking), plant disease control and fence maintenance) and if stream and riparian habitats require additional enhancement.

The report will include the following specific information:

Planting monitoring

- Success rates, including growth rate and number of plants lost and analysis of the distribution of losses.
- Canopy closure, including notes on natural ecological processes such as the use of the area by birds and presence of natural native seedling establishment.
- Plant health, noting any indicators of insect or disease damage.
- Fertilisation and weed pest control.

- Replacement planting.
- Comments on the conditions of fencing.

Stream monitoring

- Water level and wetted channel width data.
- Assessment of habitat enhancement features (e.g., anchored coarse woody debris, pools).
- SEV scores
- Assessment of riparian vegetation establishment and whether it provides shade, streambank stability and organic matter inputs to stream.

Closure

Restoration and enhancement of the realigned Mangaheke Stream is to be considered successfully accomplished when the riparian vegetation communities have achieved an average of 75% indigenous canopy closure, a 90% survival rate, less than 10% pest plant cover and an average SEV score of 0.57 or better.

9.0 Certification

This MSEP is to be submitted to Waikato Regional Council for technical certification at least 20 working days prior to commencement of works under the relevant resource consents, in accordance with the consent conditions issued. The Consent Holder shall undertake the stream enhancement works, planting, maintenance, monitoring and replacement planting in accordance with the certified MSEP.

Any material amendments to the certified MSEP shall be submitted to Waikato Regional Council for technical certification where required by the resource consent conditions.

10.0 References

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- Ecological Solutions., 2026d. Te Kowhai East Development Bat Management Plan (BMP). Report to Te Kowhai East Limited Partnership
- Ecological Solutions., 2026e. Te Kowhai East Development Lizard Management Plan (LMP). Report to Te Kowhai East Limited Partnership
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- Maven Associates. 2026b. Stream Works Management Plan. Te Kowhai East Limited Partnership. Prepared for Fast Track Approvals Act 2024 Consent Application.
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- McCraw, J. 1997. Soils and topography of the Hamilton Basin In Te Hononga Ki Te Whenua Belonging to the Land: People and Places in the Waikato Region. Stokes, E. and Begg, M. (eds). Waikato Branch, New Zealand Geographical Society, Department of Geography, University of Waikato, Hamilton, New Zealand.

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APPENDIX A

Planting Monitoring Form

Enhancement Planting Monitoring Form

Date (d/m/y):	
Monitored by:	

Fencing

Condition:	
Previous works undertaken:	
Additional comments:	

Survival rate

Percentage survival:	
Growth estimate (cm/year):	
Percent ground cover:	
Requirement for blanking (yes/no):	
Distribution of plant losses:	
Signs of disease or insect damage:	
Additional comments:	

Fertilisation

Date applied:	
What used:	
Areas applied:	
Quantity used:	
Additional comments:	

Weed control

Date undertaken:	
Sprays used:	
Weeds targeted:	
Areas targeted:	
Additional comments:	

Replacement planting

Date undertaken:	
Species being replaced:	
Species planted:	
Number of plants replaced:	
Additional comments:	

Assessment of problems

(e.g., certain weeds difficult to control and detrimental to planting? Animal pests causing significant problems?)

Nature of problem:	
Recommended solutions:	
Analysis of plant losses: (Are losses greater than expected, are there any obvious reasons, are losses in certain areas, are certain species showing high losses, what are possible solutions?)	

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APPENDIX B

Stream Monitoring Form

Stream Monitoring Form

Date (d/m/y):	
Monitored by:	

Stream water level

Water level (m) (Measured off staff gauge installed on stream):	
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Stream water depths

Transect	Location (upper, mid, lower)	Section (Eastern / Western)	Habitat (run, riffle, pool)	Width (m)	Depth (m)				
					D1	D2	D3	D4	D5
Transect 1:									
Transect 2:									
Transect 3:									
Transect 4:									
Transect 5:									

Riparian vegetation condition

Transect	Shade (%)	Structure (good/mod/poor)	Streambank stability (good/mod/poor)	Overhanging vegetation (y/n)	Organic inputs (leaf litter, woody debris)
Transect 1:					
Transect 2:					
Transect 3:					
Transect 4:					
Transect 5:					

Comments (e.g., observations, issues, recommendations)

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