Waikanae North Development

Fast Track Application:

Ecological Restoration Management Plan

Report prepared for

Waikanae North Developments Limited

Prepared by

RMA Ecology Limited

Report number and date

Job 2144

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BETTER ECOLOGICAL OUTCOMES

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Executive Summary

Waikanae North Developments Limited (WNDL) is applying for a resource consent under the Fast-track Approvals Act for a subdivision of approximately 1,200 lots.

The development proposal includes a commercial centre, recreational open space, a network of supporting infrastructure including roading, shared walkways and cycleways, stormwater and flood management, and enhancement and connection of existing ecological features.

The site lies on the coastal plains of the Kāpiti District, within the Foxton Ecological District (ED). The landform is characteristic of the ED, with a high stable dune ridge, extensive flats to the west and east, with a scattering of low rolling stable dunes.

The site is an active farm and has been farmed for over a century, with the eastern flats extensively drained. Vegetation onsite is mainly exotic pasture, with exotic shrubland and rank grass covering most of the high dunes.

Detailed assessment of ecological communities, habitats and species was undertaken using desktop assessment and best practice field survey methods during 2024 and 2025.

This Ecological Restoration Management Plan (ERMP) has been developed to address the outcome of the mitigation package detailed in the AEE. This ERMP includes ecological restoration details and requirements for stream modification, wetland creation, revegetation, animal and weed control, monitoring, and reporting.

Contents

1.0 Introduction

1.1 Background

Waikanae North Developments Ltd (WNDL) is progressing a Fast Track Approvals Act (FTAA) application (resource consent and wildlife authority) for a residential and commercial development at Peka Peka Road, Peka Peka, Kapiti (the site; Figure 1). This site is located between the Kapiti Expressway and the Kapiti Coast, and covers approximately 141 ha, excluding a leased block for stormwater management and an accessway to Paetawa Road.

The area supports mainly pastoral grazing within a lowland dune landscape. It is characterised by a central ridge of tall dunes, separating the large Te Harakeke Swamp in the west from extensive historic wetlands and poorly drained land in the east. The site is drained by a network of drains feeding into Ngarara Stream.

Figure 1. The site investigations area (white outline).

RMA Ecology Ltd designed the mitigation, offset and compensation package for the site regarding the loss, removal, enhancement, and re-creation of ecological values associated with the FTAA application for the residential project development.

RMA Ecology Ltd has been engaged by WNDL to develop the draft ecological restoration management plan which outlines and details the practical application and ongoing maintenance of the effects management.

1.2 Scope

WNDL has commissioned RMA Ecology Limited to prepare this ERMP for the FTAA application to manage and restore the relevant ecological effects.

This plan excludes in depth details regarding values and effects assessments. Those assessments were completed in the Assessment of Ecological Effects, also for the FTAA application.

This plan excludes management of direct effects on lizard and freshwater wildlife. Those values are managed in the Lizard Management Plan and the Freshwater Fauna Salvage and Relocation plan, also for the FTAA application.

However, some information of values and effects is summarised in the site description below and in the values and effects summary of this report.

This ERMP contains:

1. A summary of the site and its contemporary and historic environmental context;
2. A summary of the values assessment and baseline surveys;
3. A summary of the effects assessment;
4. Stream modification management;
5. Wetland modification and creation management;
6. A revegetation plan for wetland, riparian, and dune habitats;
7. Planting maintenance protocols;
8. Weed and animal control and monitoring;
9. Monitoring and reporting of the plans;
10. Roles and responsibilities; and
11. Timeframes for implementing the ERMP.

1.3 Credentials and Code of Conduct

Dr Ussher, Dr Nicol, and Mr Lurling (variously, the authors, co-authors or technical reviewers to the ecology reports and plans) are qualified and experienced ecologists.

Dr Ussher holds the qualifications of BSc, MSc (1st class honours) and PhD in conservation ecology. He has 34 years experience as an ecologist in New Zealand, with speciality expertise in herpetology, and effects assessment and management, including offset accounting and modelling.

Dr Nicol holds the qualifications of BSc, MSc, and PhD in ecology and botany. He has 9 years experience as an ecologist in New Zealand, with speciality expertise in conservation, restoration, and taxonomy with strengths in botany, biostatistical analysis, and GIS bio-analysis.

Mr Lurling holds the qualifications of BSc, Postgraduate Diploma in Wildlife Management (Distinction), and GradDip (Geography), specialising in Aquatic Ecology & Water Quality (Distinction). He has 28 years experience as an ecologist and specialises in the fields of bat ecology, wetland ecology (botany, plant communities, wetland classification and functions), avifauna, and botany.

Dr Ussher, Dr Nicole, and Mr Lurling have extensive experience in ecological site assessments, significance assessments, impact assessment, and impact management, including extensive experience on the ground designing, constructing, implementing, monitoring and reporting on interventions to restore, enhance, salvage, and protect ecology values at sites across New Zealand. They are considered to be sufficiently qualified to undertake an assessment of this kind.

Although this document has not been written as a statement of expert evidence, we confirm that at all times we have complied with the Environment Court's Code of Conduct for Expert Witnesses contained in its Practice Note 2023 as well as the UDIA Code of Ethics. No part of this report has been authored by an AI or other software.

We declare that in relation to our role in providing expert ecological assessment and advice for this project we are not, to the best of our knowledge, subject to any real or perceived conflicts of interest.

1.4 Site description

The site is located within the Foxton Ecological District (ED). The Foxton ED is characterised by an extensive dune system. These dunes are now primarily stabilised from agriculture, pine forestry, and extensive lifestyle block development.

The approximately 141 ha site is typical of the Ecological District and the Kapiti Coast, in that the original vegetation has been cleared, and agriculture is the main land use (Plate 1), with recently cleared forestry over much of the prominent dune ridge (Plate 2).

The site has operated as a working farm for many decades, and the landform has been modified to some extent through the construction of farm tracks, farm drains, and a drainage network with associated culvert crossings. The national Threatened Environment Classification (TEC) lists the site as being located within a highly modified environment, with less than 10 % indigenous vegetation remaining.

The site contains a tall stabilised back-dune ridge, surrounded by a mosaic of low dunes, wetlands, and farmed historic wetlands. Although a natural landform, the dunes are stabilised by exotic vegetation. East of this dune ridge, a primarily flat low-lying area is drained by the Ngarara Stream and a network of artificial drains. The site lies within the floodplain of the Ngarara Stream and parts experience floodwater inundation during moderate to heavy rainfall events. West of the dune ridge, Te Harakeke Swamp lies in a broad depression draining to the south.

Peat deposits have been identified within the eastern and southern portions of the site, associated with low-lying wetland terrain and historic wetland features (Geotechnical Report, CGW Ltd).

1.5 Project works

The project is an urban subdivision that will provide approximately 1,200 residential allotments, 11 commercial lots, and 4 jointly-owned access lots. Land use consent is sought for the subsequent residential development of the subdivision. The proposal will also provide for a commercial centre and an associated community space. The proposal will be supported by the provision of requisite infrastructure, including roading, open space reserves, and stormwater areas.

Aspects of the project relevant to potential and actual ecological effects stem from the following activities:

- Bulk earthworks involving peat soil removal, sand fill, and hard fill;
- Earthworks that will disturb or infill wetland areas, sections of Ngarara stream, a network of artificial farm drains and a small part of one SNA;
- Earthworks that will clear indigenous dune vegetation;
- Installing and developing a comprehensive suite of stormwater management measures;
- Flood hazard mitigation works: a bund and a twin culvert will be constructed on Ngarara Stream at the southern end of the stormwater easement for flood management purposes;
- Creating open space areas;
- Providing shared pedestrian and cycle facilities;
- Providing a connected and integrated internal roading network;
- Stream re-meandering, water-level raising, bank recontouring, and riparian restoration of a reach of Ngarara Stream;
- Realigning two major farm drains; and
- Removing existing culverts and installing new culverts.

Plate 1. Agricultural grazing onsite, east of main dune ridge.

Plate 2. Dune forestry post-clearance.

2.0 Summary of values, effects, and management plans

2.1 Values assessment and baseline surveys

The values on site have been identified over six site investigations between October 2023 and October 2025. The purpose of the investigations was to identify and assess the extent (mapping) and general condition (values assessment) of ecological features, including wetlands, watercourses, vegetation, lizards, birds, freshwater fish, bats, and indigenous wildlife habitat.

A range of methods were used to assess the ecological features. These methods included NPS-FM wetland delineation and valuation, watercourse identification, vegetation mapping, freshwater fish netting and trapping, stream and wetland eDNA sampling, and lizard, bird, and bat surveys.

2.1.1 Streams

Watercourses were mapped and classified onsite according to the definitions within the Wellington Regional Policy Statement. The GWRC guidance document on watercourse types[1] was used for guidance. The condition and ecological value of each watercourse was assessed, including artificial watercourses (drains).

One watercourse onsite meets the criteria for a highly modified stream; Ngarara Stream. It is mapped as a 'highly modified river or stream' in GWRC maps online, and it is classified as such because it is a modified form of a historic stream. Onsite, Ngarara Stream has been modified into a straight eastern section of stream approximately 850 m long, entering the site from a culvert structure beneath the Kapiti Expressway. It then turns to the southwest and has a straight reach approximately 750 m long to the southern boundary of the application site.

Ngarara Stream is of moderate ecological condition and low-moderate representativeness. Substrate in Ngarara Stream consists of fine mud and silt, with minimal woody debris, and minimal flow heterogeneity or habitat diversity, scoring low for diversity and pattern. Riparian shelterbelts of poplar and willow provide moderate shading in summer, and abundant leaf fall seasonally. In-stream macrophytes are common where the stream is not well shaded. Fish abundance and diversity is low-moderate, but includes two At Risk – Declining species, īnanga and longfin eel, scoring high for rarity.

A network of 20 artificial watercourses (farm drains) feeds into Ngarara Stream. The ecological condition of these drains ranged from poor to poor-moderate (Table 8). Common characteristics include a high loading of fine sediment, no natural sinuosity, steep banks, no flow heterogeneity (standing water only, mostly stagnant), little to no habitat diversity or pattern (apart from seasonal drying), and poor to moderate shading and riparian vegetation.

2.1.2 Wetlands

The site was assessed for wetlands based on the definition in the Resource Management Act 1991 (RMA). The site was also assessed for 'natural inland wetlands' based on the definition within the National Policy Statement for Freshwater Management 2020 (NPS-FM) and associated technical

[1] Watercourse Types: How to determine whether a watercourse is a river, ephemeral watercourse, highly modified river or stream, or artificial watercourse. Greater Wellington Regional Council, May 2021 (updated 2022).

guidance documents. The boundaries of potential wetland areas were delineated by carrying out assessments of the various vegetation communities and through professional judgement.

There are 18 NPS-FM natural inland wetlands identified onsite. Total wetland area is 251,836 m^2 (25.18 ha). Seven of the wetland areas were larger than 1 ha.

Wetlands onsite are largely groundwater influenced, with surface water inputs and significant fluctuations in water table. Wetlands were grouped based on comparable species, wetland condition, wetland type, and ecological value. Although common in many respects, there was sufficient variation to categorise the 18 wetlands into six (6) clusters:

Cluster 1: Te Harakeke Swamp Cluster is of very high ecological value.

Cluster 2: Ngarara Stream Wetland Cluster is of moderate ecological value.

Cluster 3: Lower Ngarara Stream Wetland Cluster is of moderate ecological value.

Cluster 4: Dune edge Wetland Cluster is of upper-moderate ecological value.

Cluster 5: Eastern Wetland Cluster is of moderate ecological value.

Cluster 6: Peka Peka Road Swamp Cluster is of high ecological value.

Te Harakeke Swamp (Cluster 1) and Peka Peka Road Swamp (Cluster 6) have the highest wetland values, primarily due to a high level of intactness and prevalence of indigenous species, as well as the provision of high quality habitat for Threatened and At Risk bird species and At Risk fish species.

2.1.3 Vegetation

Vegetation was mapped and described in terms of its composition and values. Vegetation was also assessed to determine if it was otherwise protected by the Kāpiti Coast District Plan for specifically listed species, such as 'trees of note'. Individual species were recorded and their threat status checked against the national threatened species classification list for vascular plants[2].

The existing vegetation on the site consists largely of cultivated exotic grassland on the flats and gentle slopes. The taller dunes have been cleared of exotic forestry and the current vegetation consists of mixed exotic shrubland, rank grassland, and scattered exotic trees. Remaining indigenous vegetation includes small pockets of indigenous scrub and trees in the dunes, as well as extensive indigenous vegetation communities within wetlands. Vegetation was categorised into five vegetation communities:

1. managed exotic pasture;
2. wetland;
3. exotic shrubland and rank pasture;
4. exotic trees; and
5. indigenous dryland.

One At Risk – Declining species was detected. The eastern margins of Te Harakeke Swamp are bordered by several mature sand dune kānuka (*Kunzea amathicola*) trees, with seedlings emerging elsewhere along the wetland margins.

[2] de Lange, Peter J., Jeremy R. Rolfe, John W. Barkla, Shannel P. Courtney, Paul D. Champion, Leon R. Perrie, Sarah M. Beadel, Kerry A. Ford, Ilse Breitwieser, Ines Schönberger, Rowan Hindmarsh-Walls, Peter B. Heenan and Kate Ladley (2017). Conservation status of New Zealand indigenous vascular plants. New Zealand Threat Classification Series 22. 82p.

2.1.4 Freshwater fauna

2.1.4.1 Ngarara Stream

A targeted fish survey was undertaken, focusing on the Ngarara Stream catchment in the east of the site where development is focused. The survey employed multiple techniques, including netting, trapping, and eDNA sampling.

Five native fish species and kōura were detected onsite within the Ngarara Stream and its tributaries. The detections included two At Risk – Declining species: īnanga (*Galaxias maculatus*) and long-fin eel (*Anguilla dieffenbachia*).

Gee's minnow trapping and fyke netting in Ngarara Stream and the network of drains in the east of the site detected three native fish species and no exotic species. Longfin eel (*Anguilla dieffenbachii,* At Risk – Declining) is common in Ngarara Stream, and 13 individuals up to 1,300 mm in length were captured. Īnanga is common in Ngarara Stream, and common bully (*Gobiomorphus cotidianus*) and kōura are occasional in Ngarara Stream.

2.1.4.2 Harakeke Swamp

A desktop assessment indicated the presence of two At Risk species within the wider Te Harakeke Swamp (beyond this site): īnanga (*Galaxias maculatus*) and brown mudfish (*Neochanna apoda*). It is reasonable to expect mudfish are likely to be present on the site within Te Harakeke Swamp, despite the lack of detection in eDNA samples in 2025. Limited water flow tends to restrict DNA dispersal and detectability within wetlands.

2.1.5 Avifauna

Greater Wellington Regional Council surveys in 2022 and 2023 detected spotless crake throughout Te Harakeke Swamp, including onsite, with at least three individuals present.

RMA Ecology avifauna monitoring included five-minute bird counts (5MBCs), targeted wetland bird playback surveys, a bittern survey, and eDNA sampling of streams and wetlands. During the field surveys, 18 native and 15 exotic bird species were detected at the site, including four species listed as At Risk.

At Risk - Declining species detections included North Island fernbird and an unidentified crake, both in Te Harakeke Swamp. One black shag (At Risk – Relict) was observed flying over the site. No bitterns were detected during call triangulation surveys. New Zealand dabchick (Threatened – Vulnerable) and brown teal (Threatened – Nationally Increasing) were not detected.

Large numbers of pūkeko and paradise shelduck, as well as moderate numbers of spur winged plover were recorded on the flats east of the dunes. All three of these species are native and Not Threatened.

2.1.6 Lizards

The combined lizard survey method included a desktop survey, habitat assessment, debris inspections, artificial cover object (ACO) layouts, and pitfall trapping.

The field survey detected one species of indigenous lizard, the northern grass skink (*Oligosoma polychroma*), which has a threat status of Not Threatened, but it is protected under the Wildlife Act. A total of 31 northern grass skinks were detected onsite. Most were located within an area of indigenous dune scrub pōhuehue (*Muehlenbeckia complexa*) in the central part of the main dune ridge, which forms a dense tangle, providing protection from predators.

Suitable lizard habitat was mapped across the site and then classified as low, moderate, or high quality (Figure 18).

2.1.7 Bats

No bats have been recorded at or near the site in recent times, as per the Department of Conservation bat database. Over 100 bat survey points completed within 25 km of the site in the last 10 years have detected no bats (except the Kapiti Island population).

A bat presence-absence survey was undertaken over 24 nights, from 6–30 October 2025. This falls within the monitoring season for bats in New Zealand, when they are most active. Ten (10) Songmeter Min Bat 2 full-spectrum automatic bat monitors (ABMs) were deployed at key locations providing either feeding areas (focusing on wetlands and watercourses), flyways (especially treelines and corridors), or likely roost trees, primarily large macrocarpas.

The bat presence-absence field survey in October 2025 detected no bats after 24 survey nights. No recording sequences met diagnostic criteria for New Zealand long-tailed or short-tailed bats.

2.2 Effects assessment summary

The following sections summarise the outcomes of the Ecological Impact Assessment (EcIA), undertaken in accordance with the Environment Institute of Australia and New Zealand (EIANZ) EcIA guidelines (Roper-Lindsay et al. 2018). The EcIA provides the basis for management actions as part of this Ecological Restoration Management Plan (ERMP).

2.2.1 ERMP relevant effects

Summary of development activities, their adverse effects, and corresponding management, as well as additional benefits:

- Infilling and excavating wetlands.
    - Extensive wetland creation and enhancement as part of this ERMP.
    - Extensive wetland buffer planting as part of this ERMP.
    - Shallow swale excavations and construction of log weirs in drains as part of this ERMP.
    - Development of a Native Freshwater Fauna Salvage and Relocation Plan.
- Clearing exotic SNA vegetation.
    - Wetland buffer planting around SNA areas as part of this ERMP.
- Infilling and excavating streams; installing four (4) culverts.
    - Stream realignment and remediation as part of this ERMP.
    - Stream buffer planting as part of this ERMP.
    - Stream culvert removal.
    - Development of a Native Freshwater Fauna Salvage and Relocation Plan.
- Clearing dune shrubland, rushland, and treeland.

  - Dune shrubland and rushland node planting at 1:1.5 area ratio as part of this ERMP.
  - Dune treeland planting at 1:5 area ratio as part of this ERMP.
  - Pest plant control.
- Clearing high quality, moderate quality, and low quality lizard habitat.
  - Dune shrubland and rushland node planting at 1:2 high quality area ratio as part of this ERMP.
  - Establishment of a dune reserve area for lizard habitat and release.
  - Development of a Lizard Management Plan, including salvage and relocation.
  - Animal pest control.
- Clearing dune vegetation, wetland vegetation, and riparian vegetation constituting bird habitat.
  - Providing replacement habitat through restoration plantings as part of this ERMP.
  - Delimiting earthworks buffers around high value habitats during the breeding season as part of this ERMP.
  - Construction methodology is to clear trees outside of the key breeding period for native forest birds (breeding period is from September to January). In cases where tree clearance cannot avoid the bird breeding period, assessment for breeding or nesting will be undertaken by a suitably qualified and experienced ecologist prior to clearance.
- Domestic pet ownership and pest control.
  - Dog and cat management measures as part of this ERMP.
  - Pest animal control within SNA wetland areas, and within the dunelands restoration and lizard release areas.
- Additional ecological benefits:
  - Wetland creation to achieve a net gain in wetland area as part of this ERMP.
  - Wetland enhancement planting to achieve a net gain in wetland values as part of this ERMP.
  - Wetland buffer planting as part of this ERMP.
  - Wetland enhancement through hydrological improvements.

3.0 Ecological restoration – stream and drain modification

3.1 Stream restoration purpose and outcomes

3.1.1 Purpose

The purpose of the stream and drain restoration is to address adverse effects on the Ngarara Stream from the project, so that there is no net loss of ecological value. Moreover, if restoration works are undertaken in accordance with this plan, there will considerable improvement in ecological condition and habitat value, providing a large positive ecological benefit.

In general, the restoration plan aims to address the loss of stream from realigning Ngarara Stream, the loss of groundwater storage from extracting peat at site, and the loss of surface water storage from raising the ground level.

3.1.2 Objectives

The hydraulic capacity of the existing Ngarara Stream is limited in places, and this leads to surface water ponding on some areas of the site in large rainfall events. It is proposed to realign the central reach of this channel into a more natural stream channel, with curves and variable cross section to achieve better hydraulic control, a more natural character and improved habitat outcomes. Remaining reaches will have bank profile recontouring, but no bed disturbance.

Stream restoration objectives include

- improving channel form and hydraulic complexity;
- improving instream habitat;
- enhancing sediment processes;
- restoring riparian function and connectivity;
- improving floodplain capability and connectivity; and
- improving ecological resilience of the stream ecosystem.

Many of the stream restoration objectives are incorporated in the flood management strategy which includes:

- improving the hydraulic capacity of the Ngarara Stream within the site to manage stream flows within the site;
- re-aligning a section of the Ngarara Stream within the site to achieve a more naturalised stream alignment and improved variability in hydraulic gradient;
- raising the invert level of sections of the Ngarara Stream within the site to enhance wetland soil moisture and raise groundwater levels in parts of the site;
- constructing a flow control structure (weir) at the downstream extent of the Ngarara Stream within the site so that flood levels within the site are raised to off-set loss of ponding volume from earthworks fill placed in parts of the existing flood storage area; and

- setting the downstream flood flow control system (twin box culvert with high level overflow weir) at the correct level to prevent increased flood ponding upstream and downstream of the site.

3.1.3 Successful performance

Success of this stream restoration will be assessed based on the extent to which the actual restoration activities achieve the conditions in this plan and the extent to which the future state of the Ngarara Stream on the site meets the outcomes of this plan.

The performance targets include the following:

- The restored channel maintains a sinuous planform with discernible variation in depth, width, and flow velocity, and has no persistent scouring or bed incision.
- The instream habitat offers a range of hydraulic conditions and the embedded woody and rocky structures remain stable, providing flow disruption and shelter.
- Sediment infilling is infrequent and sediment particle size remains variable across stretch.
- Riparian plantings establish and persist, progressively increasing in cover and shade.
- The floodplain connection remains and riparian banks avoid excessive erosion.
- Maintenance requirements remain consistent with regional expectations.

Restoration outcomes develop over time. Monitoring of the restoration will capture whether these outcomes are being met and is detailed in Section 7.0.

3.2 Context

3.2.1 Existing stream

There are large areas of existing low-lying land within the eastern part of the site and several existing artificial drainage channels cross this area. This area is prone to flooding in large rainfall events. The Ngarara Stream that runs through the site has a large upstream catchment of approximately 350 ha on the eastern side of the Kāpiti Expressway.

The Ngarara Stream was modified many decades ago to form a relatively straight channel running east to west for approximately 400 m into the site and then turning to the south and running for approximately 700 m as a straight channel to the southern boundary.

The land is very flat with a change of invert level of approximately 2 m over a length of approximately 1,600 m. There are several unnamed farm drains connected to the Ngarara Stream within the site, and these have relatively small catchment areas of approximately 50 ha combined.

3.2.2 Hydrology and flow regime

A notable factor influencing the hydrology of the low-lying central and low-lying eastern portions of the site is the frequency of flooding of this land when the Ngarara Stream overflows its banks. The site is very flat, and the Ngarara Stream has historically been formed with a very limited cross-sectional area and a channel depth of approximately 2 m. It overflows in small to modest rainfall events.

The hydraulic capacity of the existing Ngarara Stream is limited in places, and this leads to surface water ponding on some areas of the site in large rainfall events. It is proposed to reconstruct this channel into a more natural stream channel, with curves and variable cross sections to achieve better hydraulic control, a more natural character, and improved habitat outcomes.

3.2.3 Riparian and floodplain

Riparian shelterbelts of poplar and willow provide moderate shading in summer, and abundant leaf fall seasonally. In-stream macrophytes are common where the stream is unshaded. Floodplains and surface ponding occur over much of eastern flats and include the identified and mapped wetlands as well as large areas of the surrounding pastures.

3.2.4 Instream ecology

Details are provided in the RMA Ecology 'Assessment of Ecological Effects' and in Section 2 of this report.

3.3 Concept design and layout

3.3.1 Design principles

A set of five (5) design principles were used to inform the stream modification and restoration plan.

1. Channel form and cross-section will have intentional variability and gradients that meet geomorphic constraints.
2. Channel form should encourage and facilitate natural redistribution and sorting of sediment.
3. Channel form should provide controlled connection to floodplains and should dissipate energy during high flow.
4. Habitat will be improved with physical heterogeneity, woody emplacements, and low-flow connectivity.
5. Riparian function should provide channel shade, bank stability, and organic impacts, while specific plantings should be structured in ecologically viable zones.

3.3.2 Planform concept

A 979 m reach (including culverts) of the highly modified and straightened Ngarara Stream (W1) will be realigned to form a meandering 974 m reach (including culverts) beneath the power transmission lines (Figure 2). The un-culverted stream bed area within the realigned reach will be increased by $[x]^2$ (tbc in detailed design), to ensure that there will be a net gain in terms of overall stream extent, value and function.

The realigned stream bed will be designed to have the same average width as the present Ngarara Stream – averaging 4 m.

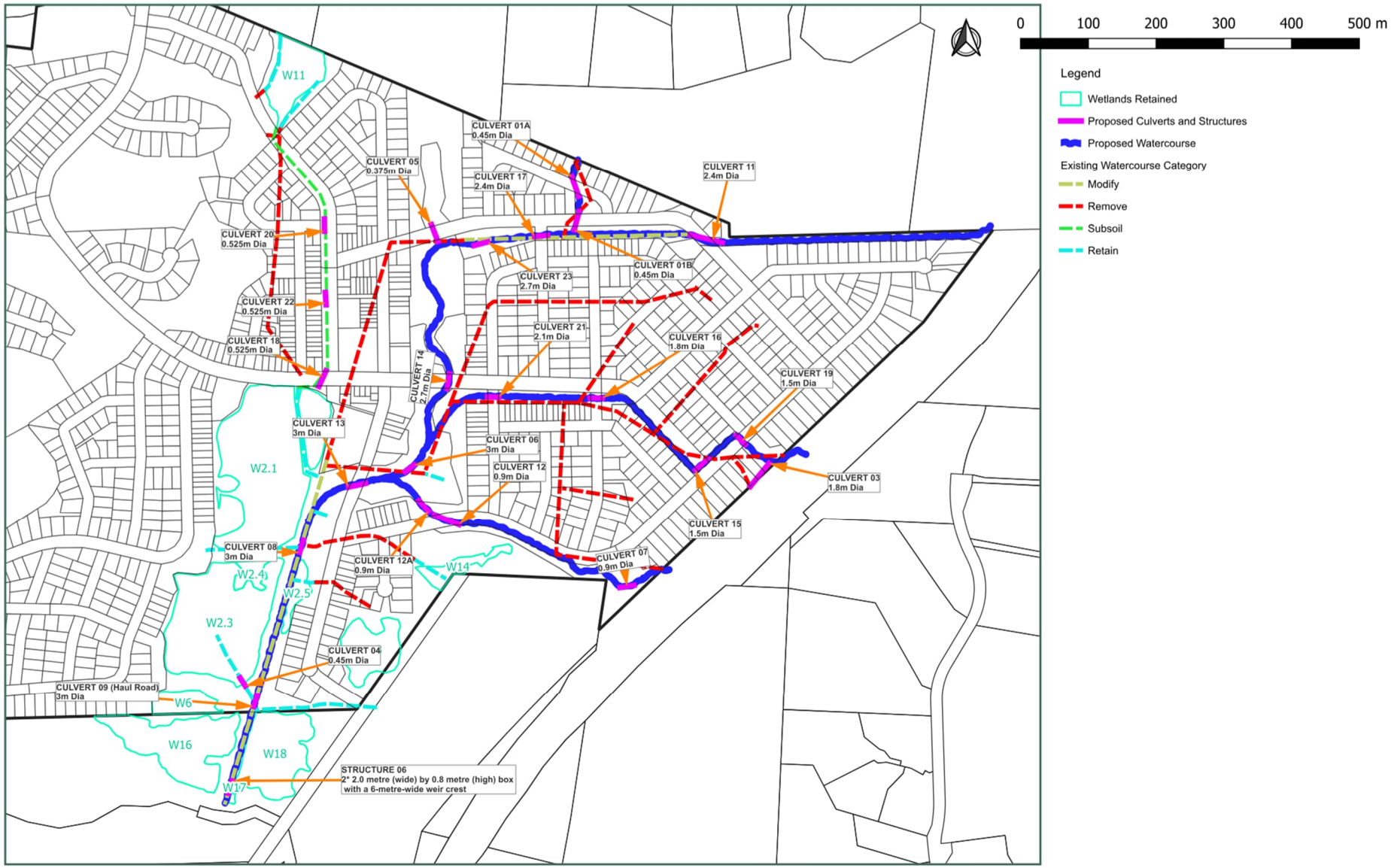

Figure 2. Overall realignment and culvert plan. Proposed Ngarara Stream, central drain, and southeastern drain (dark blue lines). Proposed culverts (pink boxes with labels). Wetlands (cyan polygons with labels). Removed watercourses (red dashed lines). (Provided by Landlink).

3.3.3 Flow control and longitudinal profile

The Ngarara Stream realignment, recontouring, and construction of the downstream flow control system will result in an increase in the normal dry weather flow water level within the stream by up to 0.4 m through most of the site.

The length of the diversion is approximately 979 m with minimal elevation change. Variable velocity will be achieved through installation of varying features over the diversion length. For example, four (4) pool sections approximately 50 m long and six (6) sections approximately 30 m long at an average 0.05 % gradient could be constructed, and the remainder of the realigned portion could be formed with riffles, runs, and embedded features at a grade of approximately 0.14 % gradient (Figure 3, Figure 4). These details remain in development and will be addressed during detailed design for each construction phase. See Section 3.4.3.

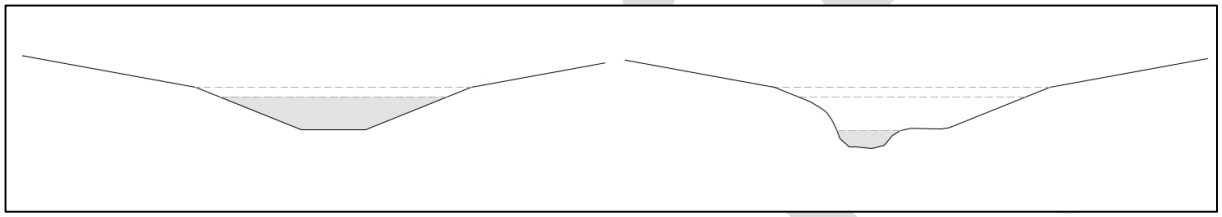

Figure 3. Cross-section of pool (left), and run (right).

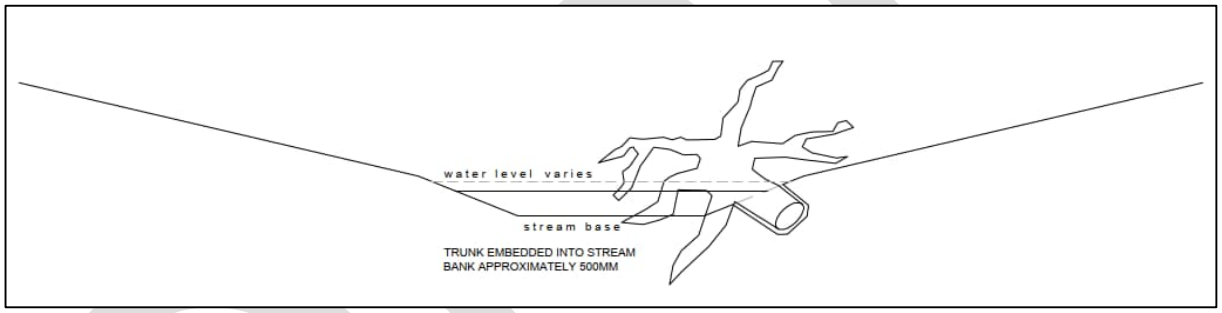

Figure 4. Cross-section of imbedded woody debris.

The groundwater system is inter-connected to the water level in Ngarara Stream. The increased water level in the Ngarara Stream after it is realigned and remediated will raise the localised groundwater level over a wide area when the groundwater system is below ground level. The increased water storage will contribute to offsetting the loss of groundwater within the removed peat zones and adjacent areas.

The water level in the retained southern part of farm drain W1.2, between wetlands W2.1 and W2.2, will also be raised above existing levels. Additionally, buried log weirs and rocks will be emplaced to raise water tables, to promote infiltration, and to enhance soil moisture for the wetlands in this zone.

The hydraulic proposals include the construction of a downstream flow control structure to increase flood water ponding depth and extent within the site, compensating for the loss of flood ponding area resulting from mass earthworks fill used to create development areas. The Awa modelling included this downstream flow control structure in the model.

Floodplain connection, ponding retention and expansion, and flow volume will all be controlled with the downstream flow control system at the downstream Ngarara Stream exit. The flow control system consists of a twin box culvert (each culvert 2 m wide x 1.2 m high, of which 0.3 0.4 m is embedded in the substrate) and a high-level overflow weir that will operate in the extreme flood events. This system can detain flood water on site, utilising the available large ponding volume (209,000 m^3) to manage flood flows and reduce risk for both onsite properties and neighbouring properties.

3.3.4 Typical cross-sections

Bank recontouring is proposed along the remaining downstream and upstream sections of Ngarara Stream. Recontouring and realignment will improve hydraulic control, flood management, and ecological enhancement.

Two artificial watercourses (drains 1.1 and 1.1.6) will be realigned along most of their course over the site, but will retain steep bank profiles like the existing drains.

Indicative designs for ideal cross sections along Ngarara Stream vary across the recontoured and realigned areas (Figure 6, Figure 7, Figure 8, Figure 9). Chainage (CH) refers to distance downstream from the site boundary at the state highway.

The first 800 m from the site boundary will be recontoured and will incorporate two cross section designs across the stretch with examples at 200 m (Figure 6) and at 645 m (Figure 7).

The mid-section of the Ngarara Stream onsite will be recontoured and realigned. Parts of the meandering will be constructed beneath the power lines (Figure 8). The realigned channel will also be shallower than pre-development channel depth, providing greater connection to the floodplains and wetlands.

3.4 Construction methodology

3.4.1 Sequencing and staging

The proposed development involves earthworks to address liquefaction risks, earthworks to raise parts of the site to be above flood storage levels, and earthworks to reconstruct parts of the existing Ngarara Stream that runs through the site.

In Phase 2 (see Infrastructure Report) earthworks, the re-alignment of the central section of the Ngarara Stream will be undertaken to infill the eastern side of the Phase 2 low-lying area within the existing Ngarara Stream corridor. The downstream control twin box culvert and overflow weir will also be constructed at this time so that flood storage can be increased on the site to off-set loss of existing flood storage volume resulting from filling in the low-lying central and eastern areas. After completion, the available flood storage will be 209,000 m^3 (noting that a 2130 100-year flood volume is approximately 151,000 m^3).

In Phase 3 earthworks, the section of Ngarara Stream between the downstream end of the re-aligned section to the new control system at the downstream end of the Stream within the project works will be modified to provide the required stream hydraulics. Farms drains flowing into Ngarara Stream from the east will also be remediated during this phase.

In Phase 6 earthworks, the section of Ngarara Stream from the top of the re-aligned section to the site boundary where the Ngarara Stream enters the neighbouring property will be constructed.

In Phase 8 earthworks, all stream realignments, reshaping, and recontouring will be completed. Phase 8 includes the formation of the secondary flow path for the Ngarara Stream at the eastern corner of the site where it enters the site.

3.4.2 Erosion and sediment control

The construction of the Ngarara Stream realignment section can be carried out "in the dry" for most of the works. This will be achieved by staging the works (above) and creating temporary diversions.

Project earthworks intend to undertake most of the realignment and recontouring of Ngarara Stream in isolation from existing stream flows, and so the risk of sediment release from this activity is relatively low. Regarding the stream diversion, the focus of the Erosion and Sediment Control Plan (ESCP) will be on controlling erosion and sediment runoff from the reconstructed and reinitiated stream channel and stream banks and surrounding earthworked area before full vegetative cover is achieved. There is high risk of potential scour from low–moderate flood flows prior to vegetation stabilisation. Temporary silt fences are expected to provide an effective solution. They will be installed perpendicular to the stream at 15–20 m spacings and maintained for 1–2 years to control flood-flow velocities.

Each proposed culvert construction site will be incorporated into the ESCP for the relevant phase of the construction, which will set out culvert construction methodology and associated ESC measures.

The realigned section of Ngarara Stream will cut into the existing peat layer to reach the design invert levels. When peat is exposed to oxygenated water, decomposition can occur, with potential discharge of nutrients (which can reduce stream oxygen levels), heavy metals, and sulphur, which can acidify the water. Realignment of Ngarara Stream bed will be undertaken in the 'dry' during flow diversion, and the bed will be lined with a gravel mix. Both procedures will reduce the risk of peat decomposition and associated adverse effects.

The new invert levels of the Ngarara Stream realignment will cut into the existing peat layer. To improve bed substrate, 0.15–0.2 m of material below the invert will be removed and replaced with an uncompacted graded river metal backfill which will prevent scour at the 0.25–0.5 m/s flow velocities expected in 2-year and 5-year flood events. This capping will separate the stream flow from the underlying peat material. As the underlying peat material will remain within the groundwater system, exposure to stream flow oxygenated water is expected to be minimal.

For further details, see the Construction Management Plan and the Erosion and Sediment Control Plan.

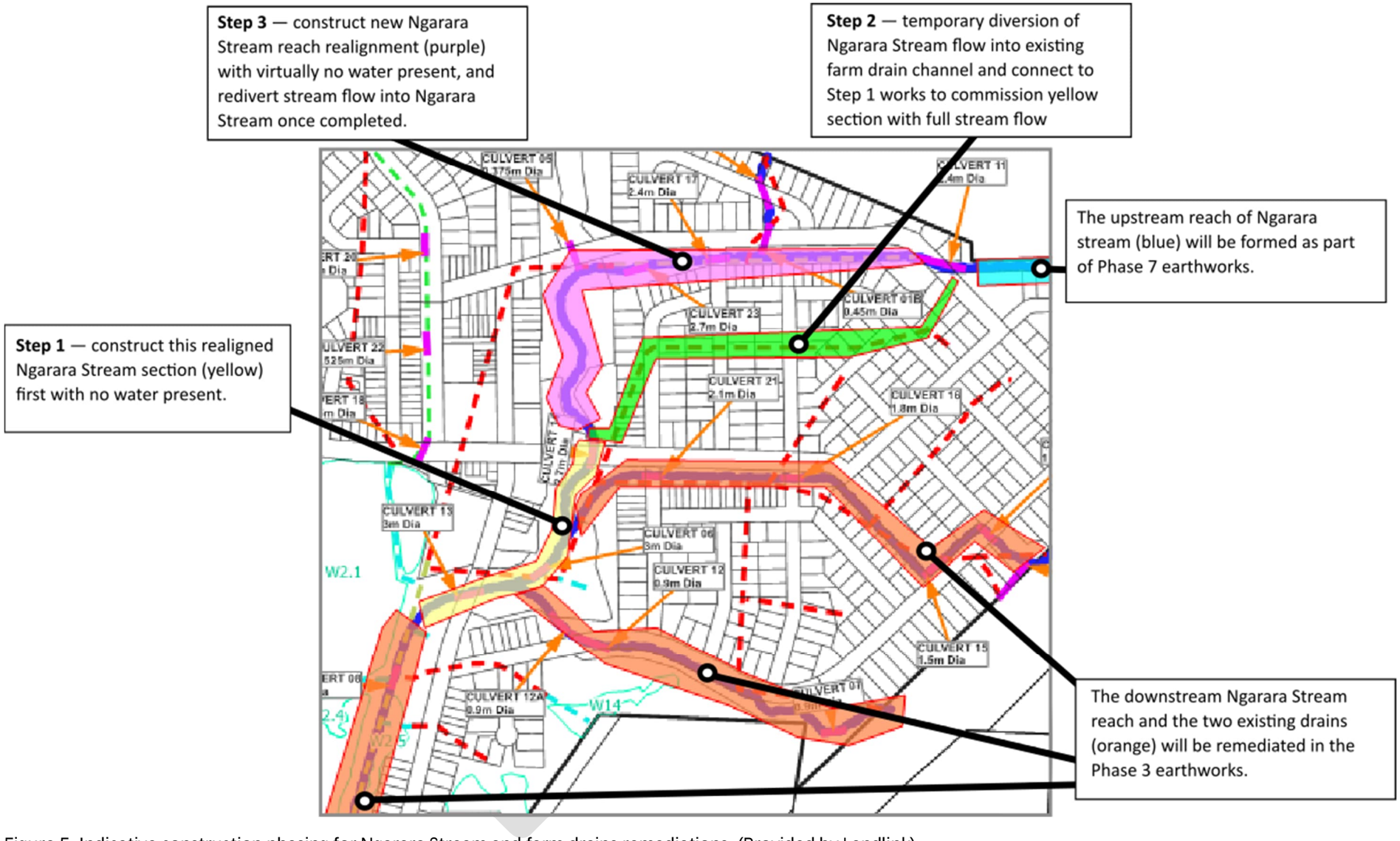

Figure 5. Indicative construction phasing for Ngarara Stream and farm drains remediations. (Provided by Landlink).

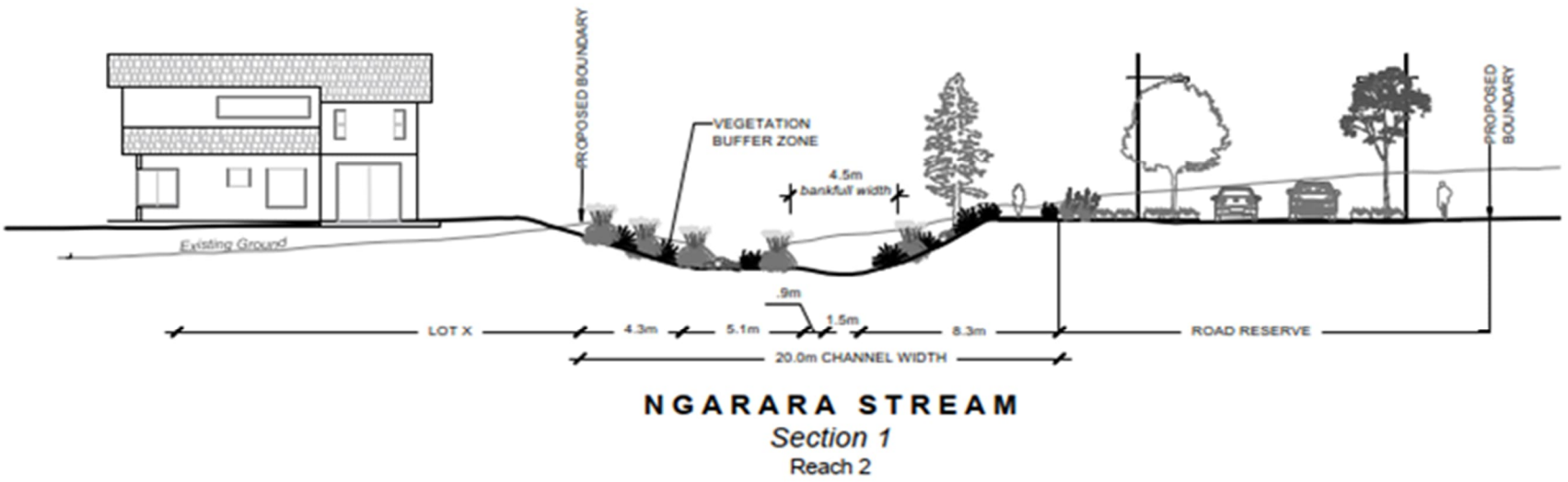

Figure 6. Design cross section of recontoured Ngarara Stream at CH 200 (metre distance along the stream from the eastern site boundary). Existing ground (light grey) compared against design surface (bold black line). (Provided by Landlink).

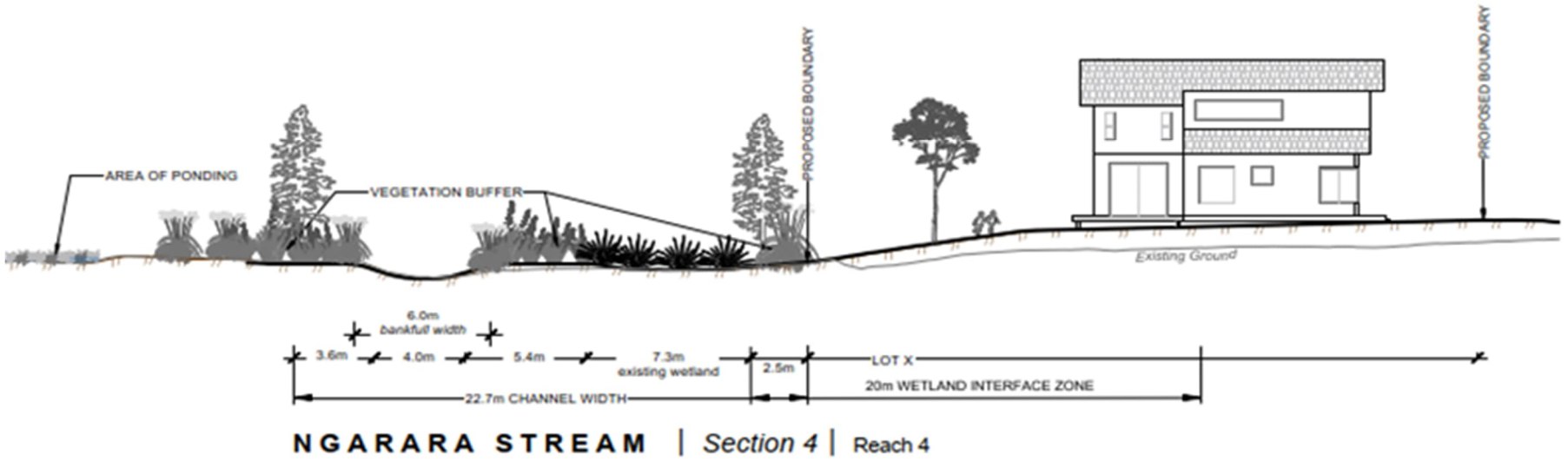

Figure 7. Design cross section of recontoured Ngarara Stream at CH 645 (metre distance from eastern site boundary). Existing ground (light grey) compared against design surface (bold black line). (Provided by Landlink).

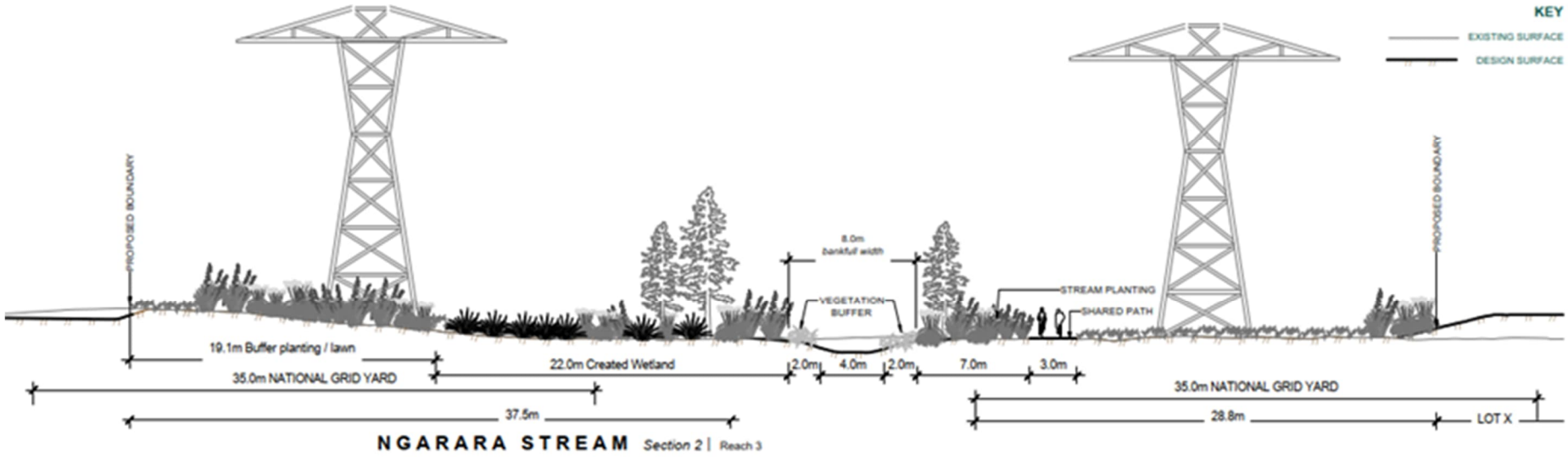

Figure 8. Design cross section of realigned and recontoured Ngarara Stream at CH 910 (above) and CH 1345 (below) (CH is the metre distance from eastern site boundary). A 12 m setback area for the National Grid is also indicated (above). Existing ground (light grey) compared against design surface (bold black line). (Provided by Landlink).

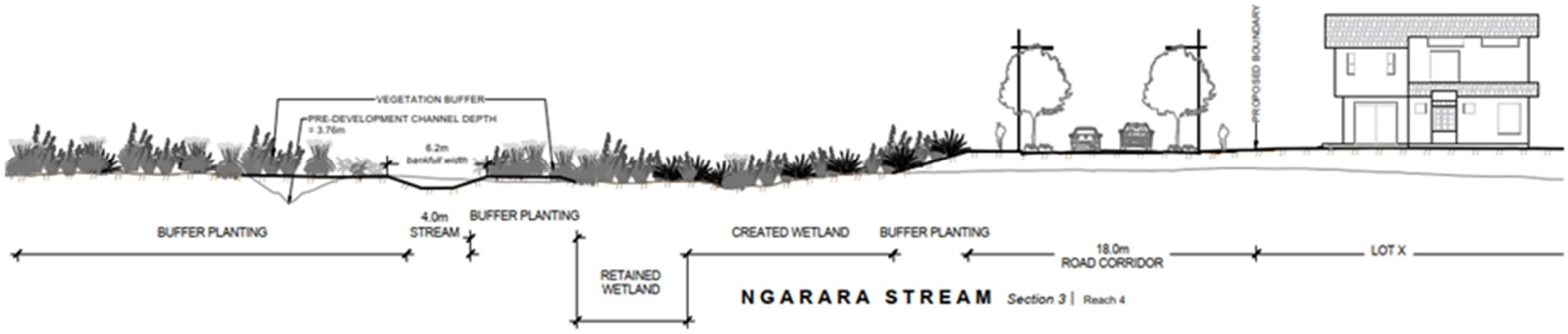

Figure 9. Design cross section of recontoured reach of Ngarara Stream, downstream of the realigned reach, at CH 1510 (metre distance from eastern site boundary). Existing ground (light grey) compared against design surface (bold black line). (Provided by Landlink).

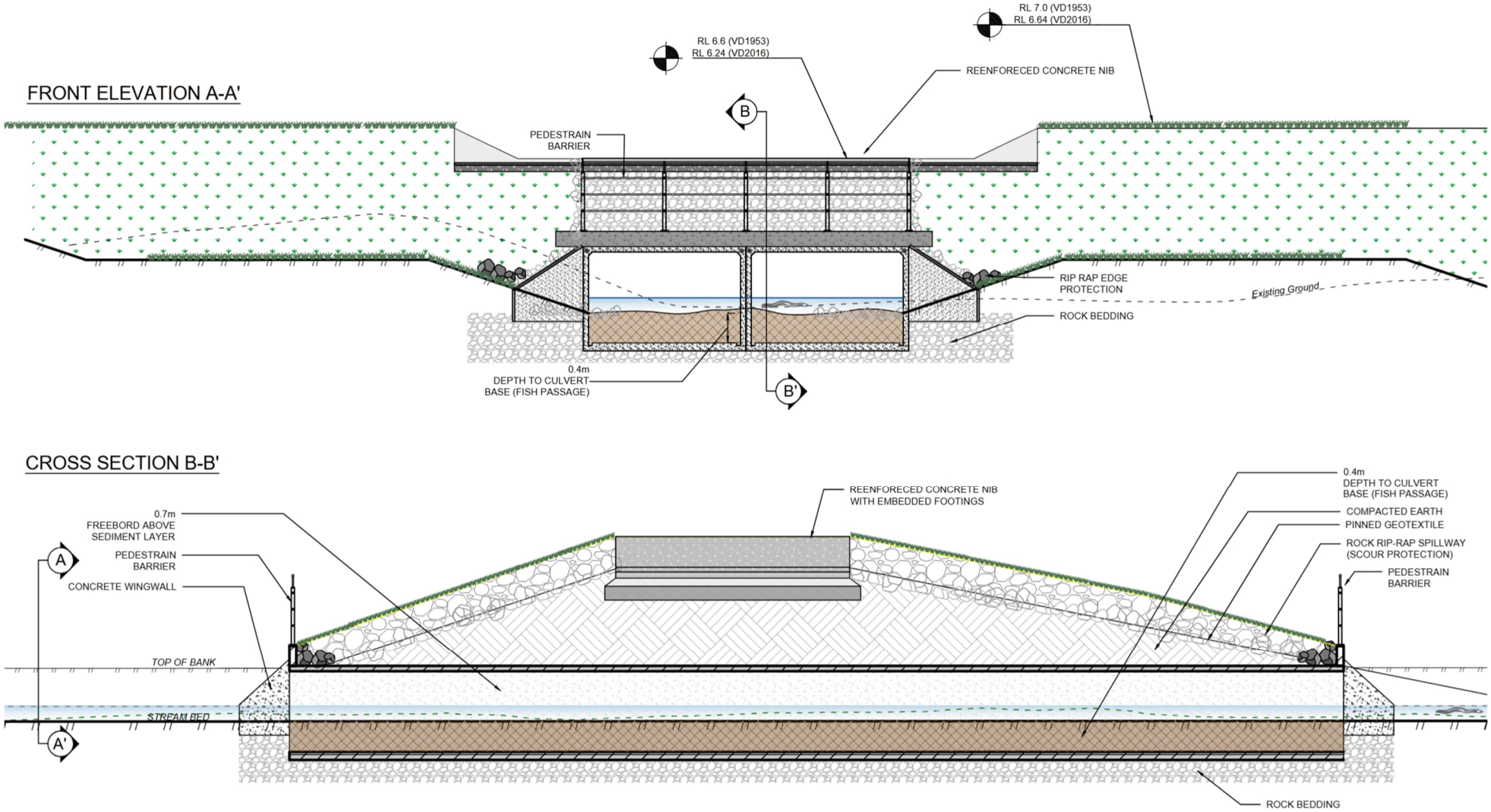

Figure 10. Proposed weir structure to be constructed at the downstream site of Ngarara Stream near the southern property boundary. Front face of the structure (above). Side on cross section of the structure (below). (Provided by Landlink).

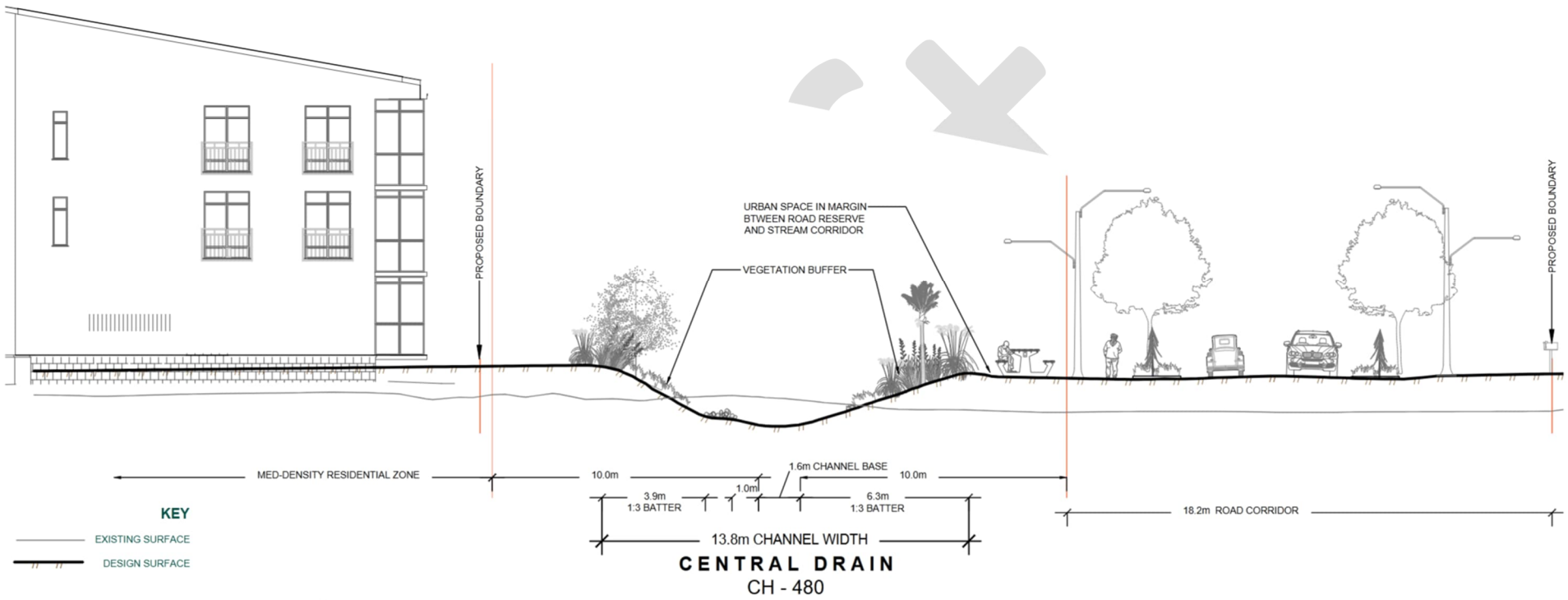

Figure 11. Design cross section of recontoured central drain at CH 480 (metre distance from eastern site boundary). Existing ground (light grey) compared against design surface (bold black line). (Provided by Landlink).

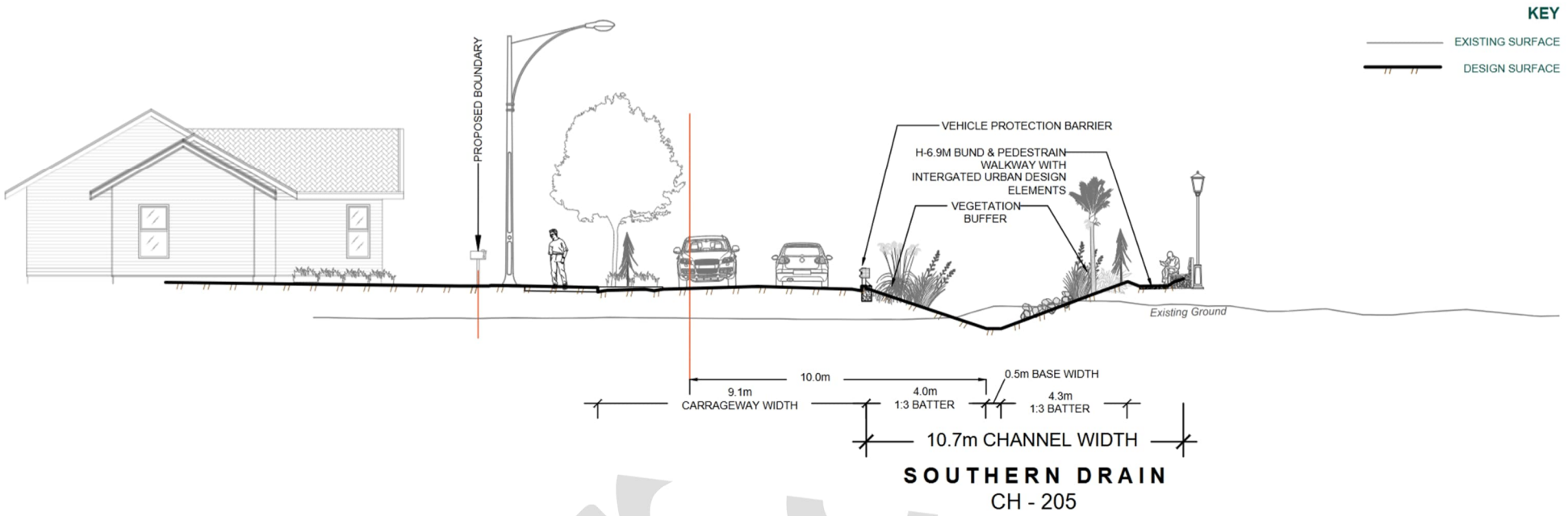

Figure 12. Design cross section of recontoured southern drain at CH 480 (metre distance from eastern site boundary). Existing ground (light grey) compared against design surface (bold black line). (Provided by Landlink).

3.4.3 Materials and substrate

The remediation works in the Ngarara Stream include the placement of gravel in the bed and the creation of vertical gradient variation to provide habitat variability. To improve the bed substrate in the reconstructed Ngarara Stream, 0.15–0.2 m of bed material below the design invert will be excavated and replaced with uncompacted, graded river metal backfill. The velocities in the reconstructed Ngarara Stream will be generally lower than 0.5 m/s. The backfill material will be graded from 50 mm down to sand; with a relatively low percentage of sand, because finer material will be mobilized without shielding from the larger pebble and gravel material.

Woody material for stream habitat enrichment will be sourced from site where practicable (Figure 4). Species capable of vegetative regeneration in aquatic or riparian environments (such as *Salix* spp. (willow), *Populus* spp. (poplar), *Alnus* spp. (alder), and *Acer* spp. (maple)) will be avoided. Suggested woody material if accessible, include already downed native trees, as well as *Cupressus macrocarpa* (macrocarpa), *Fagus* spp. (beech), *Quercus* spp. (oak), *Ulmus* spp. (elm), *Fraxinus* spp. (ash), and *Platanus* spp. (plane). Slash and leaf litter will not be added to the stream.

The Geotechnical Assessment has also considered the risk of lateral spreading and associated soil instability adjacent to the Ngarara Stream, and potential instability adjacent to slope crests. The design solutions have responded to the assessment and ensure site stability is achieved, in accordance with the recommendations of the Geotechnical Assessment.

3.5 Riparian planting

The intended goal of the riparian margin revegetation is to provide multi-tiered, dense native plantings for bank stabilisation, stream shading, habitat corridors, habitat provision, water temperature regulation, and organic input regulation. See Section 5.0.

3.6 Fish passage

3.6.1 Fish passage requirements

The NPS-FM requires that fish passage be maintained, or improved, by instream structures.

The NES-F Subpart 3 (p66–p76), clause 70, provides details on the permitted and discretionary activities surrounding culvert and weir infrastructure.

Installation of 50.9 m of new culverts within the Ngarara Stream will result in a reduction in stream habitat quality. This will be partly mitigated using appropriately sized culverts that are partially buried to allow the retention and development of a natural streambed substrate. This design will maintain more natural hydraulic and ecological conditions, supporting fish passage and benthic habitat continuity. The proposed culvert design therefore represents a substantial improvement over the existing structures, which currently provide little natural substrate within the culvert bed. All culverts will comply with NES-FM Subpart 3, clause 70, to provide fish passage.

The downstream weir will not present a barrier to fish passage. The culverts that comprise the weir will be embedded in the stream bed by 0.3 – 0.4 m deep. Modelled flow velocity through the culverts is 90 L/s at standard flows, with an average of 0.46 m/s. These average flows are sufficient for most fish that use this catchment to pass through, apart from īnanga (require flow velocities under 0.3 - 0.35 m/s as they are poor swimmers); therefore, cobble/boulder substrate will be added to the culverts top provide

a roughened/embedded substrate and to break up flow and provide a continuous line of low velocity refuges for īnanga passage.

3.6.2 Passage during construction

Just as water flow will be managed sequentially in sections (Figure 5), fish passage will also be considered during construction phasing so that freshwater fauna passage is unobstructed. More information is available as part of the Native Freshwater Fauna Salvage and Relocation Plan.

Watercourses within Wetland Cluster 2 will be partially obstructed with a series of low log weirs to improve wetland hydrology while maintaining fish passage. Log weirs will be placed 10–30 m apart along the drain or stream, resulting in a maximum of 0.1–0.2 m of fall, with gentle backwater pools in between, allowing for passage of poor swimmers such as īnanga. A notched low-flow channel approximately 0.1 m deep will encourage surface flows during dry spells if bed substrates are porous, to allow for fish passage. A rock and cobble apron below each weir will manage scour. Log weirs will be installed in watercourses 1.2, 1.11, 1.12 (farm drains), within Ngarara Wetland Cluster, and adjacent parts of Ngarara Stream.

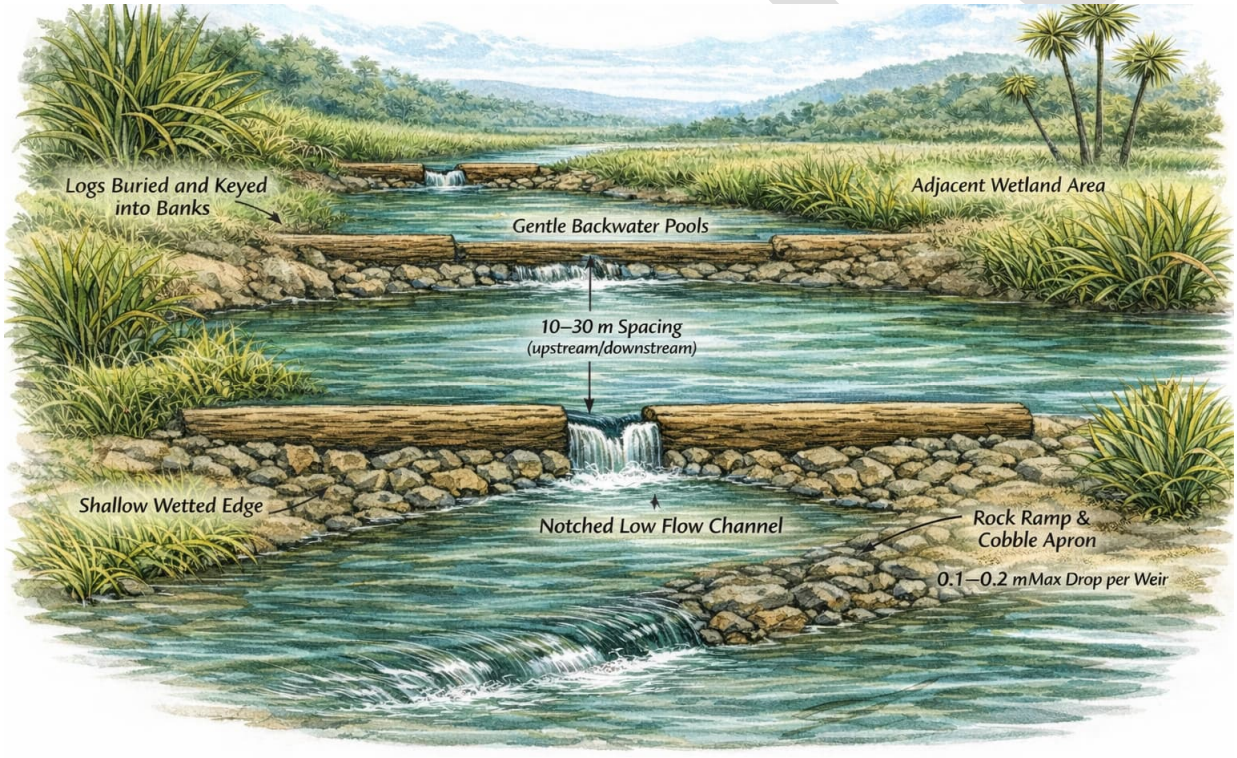

Figure 13. Representative diagram indicating key design features of stepped fish-friendly log weirs across selected drains and Ngarara Stream to raise water tables in the Ngarara wetland complex. (AI illustration).

4.0 Ecological restoration – wetland creation and enhancement

4.1 Purpose and outcomes

4.1.1 Purpose

The purpose of wetland creation and wetland enhancement is to address the adverse effects of the consented development and bring about a net-gain in wetland values.

4.1.2 Objectives

1. Hydrological — Establish and maintain hydrological conditions and connectivity to support the various wetland types within the restoration plan, and avoid unintended drainage, drawdown, or inundation inconsistent with design intent.
2. Biogeochemical — Facilitate wetland soil conditions, support wetland nutrient retention and transformation.
3. Biological — Establish appropriate vegetation communities that support wetland dependent flora and fauna.
4. Landscape and resilience — Integrate wetlands into the site design to persist through weather variability, withstand extreme weather events, and provide ecological connectivity onsite and offsite.

4.1.3 Performance expectations

1. Structural — Wetland basins, swales, buffer margins, and extent remain stable and intact.
2. Functional — Wetland hydrology behaves according to design intent, including saturation, ponding, and discharge treatment.
3. Biological — Established vegetation persists and provides a variety of habitats for fauna.
4. Management — Wetland value and function increase while management and maintenance de-escalate.

4.2 Context

4.2.1 Peat extent and depth

There is a layer of peat soil across most of the low-lying eastern area. This peat layer varies in thickness from 0.5–1.5 m with the top of the peat typically 0.5 – 1m below the surface. This peat material will be removed within the development footprint so that suitable foundation conditions for houses and roads can be created. This will require the excavation and disposal of approximately 475,000 m^3 of peat material and replacement with suitable material cut from other parts of the site.

4.2.2 Groundwater regime

The peat extraction process will occur in small stages, excavating peat in the development footprint in small scale patches and replacing the excavations with compacted sand prior to excavating the next patch. This will limit hydrological impacts on wetlands spatially and temporally to a low level.

The low-lying central eastern portion of the site is very large and very flat. There are no widely dispersed drainage systems across these areas. Rainfall onto these areas has a very low runoff coefficient, particularly due to the influence of the vegetation trapping most of the rainfall in localized tiny sub-catchments.

Groundwater fluctuations of approximately 0.5 m between summer and winter are indicated by the monitoring and observations onsite. The increase in groundwater levels over winter months is influenced by the recharging from rainfall on the low-lying areas and from surface flooding from the Ngarara Stream.

Shallow groundwater in the low-lying eastern areas is hydraulically connected to adjacent Ngarara Stream and surrounding drains. Assessments indicate a direct interconnection of groundwater levels and stream levels during the summer months.

4.2.3 Current wetland status

Wetlands identified onsite were grouped into six (6) clusters (WC1 to WC6): see Section 2.1 and RMA Ecology 'Assessment of Ecological Effects'.

4.3 Effect management strategy

4.3.1 Wetlands lost, retained, and created

Four (4) wetlands (W3, W5, W9 and W10) and parts of Wetland Clusters 2 and 3 will be removed by infilling, resulting in a total wetland removal of 1.67 ha.

Retained wetlands total 6.52 ha. Enhancement node planting will be undertaken across approximately 1.1 ha of these wetlands, distributed as either 125 m^2 or 100 m^2 nodes.

Based on WEV–ECR modelling, 1.74 ha of wetland will be created, offsetting loss of wetland value and extent. (see RMA Ecology 'Assessment of Ecological Effects' for detailed calculations).

4.4 Concept design and layout

4.4.1 Layout and connectivity

All road runoff and direct-discharge sub-catchments receive water-quality treatment via bioretention basins, bioretention swales, and bioretention basins with soakage.

Overall, with direct discharges to natural wetlands being avoided, and treatment, attenuation, and secondary flow routing implemented in accordance with best practice, the proposed system will avoid or at least mitigate adverse water quality effects on wetland ecosystems to an acceptable level.

The two shared cycle-walkway crossings of Ngarara floodplain wetland (WC2) and Te Harakeke Swamp (WC1) will be constructed as raised boardwalks. Boardwalks maintain hydrological connection and avoid

channelisation and associated scour and drainage. The existing raised farm track across WC2 will be partly removed and replaced with board walk to restore surface flows south across WC2.

4.4.2 Water level controls

The Hydrology Report includes a stormwater network plan designed to achieve catchment neutrality or in some cases a slight net increase in flow to wetlands. Treated stormwater flows will be fed into wetlands via diffuse outlets, rather than through direct discharge to streams or drains, to maximise water level recharge during rain events (Error! Reference source not found.).

Hydrological enhancement is planned for the Ngarara Stream floodplain Wetland Clusters 2 and 3. Proposed enhancement measures are expected to elevate water tables above existing levels, as well as slowing water flows, enhancing surface and subsurface retention and mitigating the effect of increased floods and droughts predicted under a warming climate. This will provide ecological benefits (beyond mitigation requirements) by partly restoring these severely hydrologically degraded wetlands. The enhancements will be achieved by:

- Installing a double box culvert with a high flow weir within the stormwater easement at the south of the site. This infrastructure will throttle flood flows at the downstream end of the site, resulting in deeper and more frequent inundation of Wetland Clusters 2 and 3 within the Ngarara Stream floodplain. This will increase the frequency and extent of hydrological recharge of peat soils across these wetland clusters and support more obligate and facultative wetland plant species. The weir culvert invert will also be raised above the existing bridge invert by up to 0.4 m, to raise stream water levels. As the stream and groundwater are closely interconnected, this also is expected to raise the water table within the adjacent restoration Wetland Clusters 2 and 3 by an equivalent amount.
- Raising the water level in drains W1.2, W1.11 and W1.12, and Ngarara Stream reaches adjacent to Wetlands Cluster 2, to maximise soil moisture for the enhanced wetlands in this zone. Low, weir type structures, created with buried logs and tree stumps will be installed to raise the water level Figure 13). Appropriate placement of embedded objects will also reduce downstream scour.
- The retained dune wetland (W4) will be hydrologically enhanced. Treated stormwater will be dispersed into it, increasing the catchment area from the pre-development catchment area of 2 ha to be 2.87 ha of which 1.56 ha will be open space and some of the balance will be on-lot previous surfaces. This increase in catchment is expected to help mitigate the impact of more extreme dry periods due to climate warming. Periodic inundation is a key component of dune wetlands, resetting succession to characteristic pioneering species when inundation duration is sufficient. For example, during the ecological survey period from 2024 to 2025, an extended dry spell resulted in mid-succession rushes replacing ephemeral wetland herbs.
- A series of shallow swales will be excavated within the northern and western parts of WC2, to increase retention of surface water flows from treated stormwater discharges, allowing water to soak into the peat layer which sustains this wetland system. These swales are expected to be ephemerally ponded, providing seasonal habitat for waterfowl, wetland birds, and potential habitat for brown mudfish and ephemeral wetland plants.
- Partial restoration planting of the wetland with sedges, rushes and shrubs will enhance wetland hydrology by slowing flood water movement, reducing surface evaporation by shading the ground, and building organic soil in the long term, including peat in wetter areas.

The operation of the downstream outlet control structure, in conjunction with the raised bed level of the realigned section of Ngarara Stream and the two side drains will result in an increase in the water surface level of flood ponding within the site during rainfall events. The invert of the Ngarara Stream adjacent to the floodplain wetlands will also be higher than the existing invert. This is to increase the natural water levels through the wetland areas adjacent to the Ngarara Stream.

4.4.3 Creation of offset wetlands

Offset wetland creation is required for 11 specific areas (labelled OW1 to OW11).

Wetlands will be constructed by excavation to groundwater where appropriate (Table 1), with basin elevations and planting zones designed to support wetland hydrology through seasonal fluctuations. The wetland form will be based on the summer (lowest) groundwater level to ensure saturated soils and wetland conditions persist through the driest period, while allowing expanded inundation during winter when groundwater levels are higher (approximately 0.5 m).

Wetland basins will incorporate a range of depths and microtopography, including shallow benches and deeper refuge pools, to support diverse wetland habitats and vegetation communities.

Where adjacent to existing wetlands, created wetlands will be excavated to the same level, or to a slightly lower level if the adjacent wetland is hydrologically degraded.

The wetland hydrological characteristics assessed in the Hydrology Report were used to estimate the required ground level, groundwater depth, and estimated difference between them (Table 1).

Table 1. Created offset wetland areas and their required ground level based on the estimated (est.) groundwater level and measured difference in adjacent and nearby wetlands.

Created Wetland	Est. required ground level (RL)	Est. groundwater level (RL)	Recommended RL difference	Reference Wetland
OW1	5.4	4.7	0.7	W2.1, W14
OW2	5.4	4.7	0.7	W2.1, W14
OW3	5.1	4.6	0.6	W2.3, W2.4
OW4	5.4	4.7	0.7	W10, W14
OW5	5.7	5.3	0.4	W14
OW6	5.7	5.3	0.4	W14
OW7	6.5	4.8	1.7	W13
OW8	5.1	4.6	0.5	W2.3, W6
OW9	5.1	4.3	0.8	W2.1, W2.4
OW10	5.1	4.0	1.0	W2.1, W2.2
OW11	5.1	4.0	1.0	W2.1, W2.2

4.4.4 Swale design intent and function

Constructed swales within WC2 will be ephemeral, and will create habitat for brown mudfish, waterfowl and Regionally Threatened wetland birds such as spotless crake, marsh crake, and bittern. Swale depth will be guided by topsoil and peat depth, aiming to remove topsoil and avoid or minimise peat removal, particularly where shallow. Ephemeral inundation is expected. These swales will provide hydrological improvements and ecological benefits in the form of improved habitat diversity, community and species diversity.

The proposed stormwater management system incorporates bioretention swales and basins which will mitigate both water quality effects (contaminants) and water quantity (increased flow caused by catchment hardening). Each treatment device consists of:

1. a detention pond with treatment wetland;
2. a piped low flow dispersed outflow, designed to simulate existing diffuse flows; and
3. a piped high flow outlet for rainfall events exceeding a 10-year AEP, with riprap scour protection and native planting. (Figure 14).

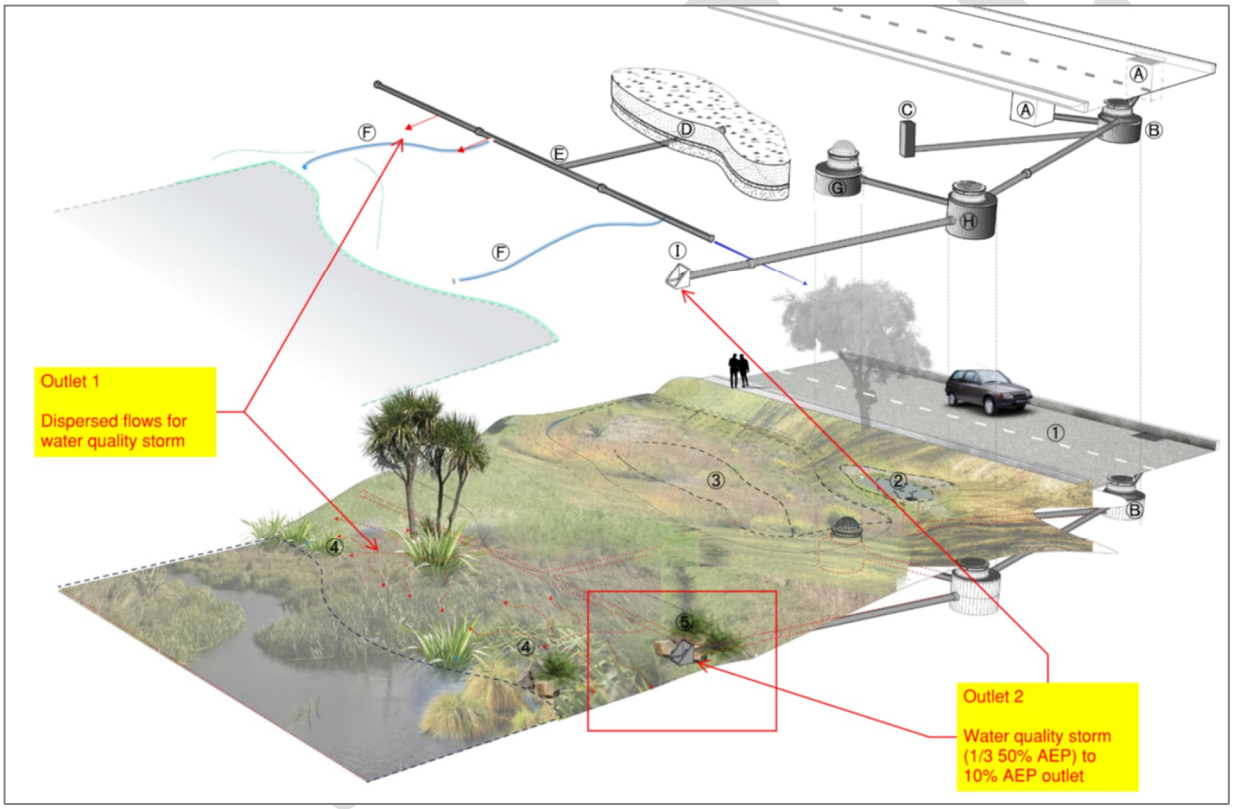

Figure 14. Graphic of stormwater treatment device installation and outflow, as well as a wetland swale (to left) constructed for water retention and habitat enhancement (Provided by Landlink).

Treatment wetlands and outflows are proposed to be located outside of a 10 m buffer around wetlands, except for two outflows on the western side of WC2, where this impractical (Figure 34).

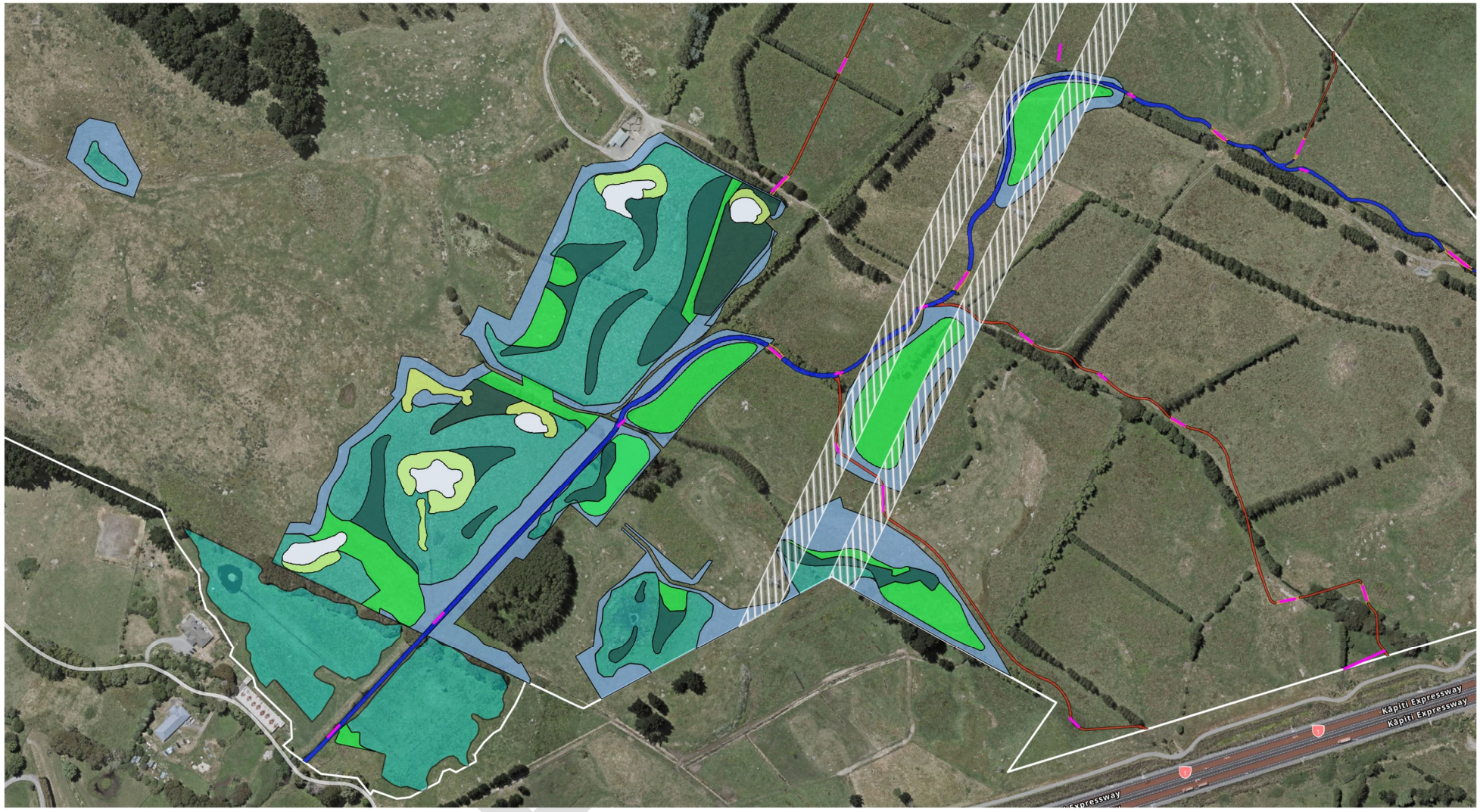

Figure 15. Indicative created wetland swales (white polygons) and created wetlands (bright green polygons). Wetland buffer plantings (blue polygons); retained wetlands (cyan polygons); Ngarara Stream (blue line); realigned drains (red lines), culverts and bridges (pink lines).

4.4.5 Vegetation communities

Vegetation communities are divided into four (4) planting schemes (see Section 5.0).

4.5 Construction methodology

Extensive earthworks including significant cut, fill and land recontouring will occur within 100 m of wetlands and streams. Compliance with the Construction Management Plan and the associated Erosion and Sediment Control Plan will minimise sediment discharge downstream to acceptable standards. The Infrastructure report details further measures to manage the potential sediment discharge impacts on wetlands and streams, including:

- Staged earthworks. Earthworks will be staged and areas of disturbance will be minimised at any one time. Each development stage will involve certification of a separate detailed ESCP, prior to works commencing for that stage.
- Targeted controls by soil type, recognising the differing behaviour of dune sands and peat soils, considering expected earthworks methodology, equipment, surface water controls etc.
- Sensitive-edge protection using super silt fence and bund systems adjacent to wetlands, drains and watercourses, in conjunction with associated separation.
- Batters will be stabilised primarily through revegetation, but also using dried peat on several sandy dune batters.
- Adaptive management linked to flood-storage monitoring and expected changes in flood storage patterns resulting from progressive filling in low-lying areas, watercourse realignments and the construction of the Ngarara Stream outlet culvert and overflow weir infrastructure.
- Risk-based monitoring, will be undertaken to ensure their effectiveness, including temporary telemetry at key outlets during higher-risk phases.
- A requirement for certification of each construction stage prior to commencement, supported by inspection, maintenance, and monitoring programmes.

During construction: To avoid or minimise indirect disturbance effects on high-value wetland birds, seasonal earthworks buffers, where no earthworks will taker place, will be set 100 m around wetlands with moderate and high value bird habitat (e.g., the SNA wetlands). Where practicable, earthworks will be scheduled outside the breeding season of Threatened and At Risk wetland bird species (September to February).

Prior to any earthworks and vegetation clearance within the breeding season, a suitably qualified and experienced ecologist will carry out a presence-absence survey of At Risk and Threatened wetland birds.

Nest surveys for these species in dense wetland vegetation are not practicable, and nesting can be reasonably presumed to occur if these species are present. If At Risk or Threatened bird species are detected, a minimum buffer distance of 200 m from the wetland margin is recommended for earthworks during the breeding season.

After construction: potential disturbance effects on indigenous wetland birds arising from the proximity of residential development, human activity, and domestic pets will be minimised through a combination of physical barriers, buffer planting, and access management:

- Restoration planting along wetland margins and development boundaries will establish dense native vegetation buffers that provide visual screening between residential areas and wetlands, reducing bird responses to movement, noise, and lighting. Tall shrubs and trees will provide effective visual screening, particularly at SNA wetlands with high bird values, swales in Wetland Clusters 2 and 3, and along walkways and residential areas.
- Defined access paths and viewing areas will direct pedestrian activity away from the most sensitive wetland zones, maintaining opportunities for residents to experience the natural environment without causing disturbance.
- Walking and cycling accessways through wetlands are avoided where practicable. Both walking and cycling paths through Ngarara Wetland Cluster (WC2) and Te Harakeke Swamp will be visually screened by vegetation or fencing.

4.5.1 Wetland swale excavation approach

Swale delineation will be confirmed and marked on site, ensuring positions are well-placed for discharge interception. Excavation will be undertaken in accordance with earthworks phases and erosion and sediment control plans.

Excavators will avoid traversing wetland extents where practicable to reduce unnecessary compaction and ruts which can act as minor drainage channels.

Actual swale excavations will be shallow (up to 0.5 m), broad depressions with gradual gradients at the margins. This will avoid unintended drainage channels and prevent scour. Drainage pathways will be filled in and graded.

Replanting of the excavated area will occur within the same week as excavation, to reduce erosion risk.

4.5.2 Water management during works

In Phase 3, there will be a hydraulic connection between W14 and culvert 12A to allow a small flow into and out of wetland W14. However, the Awa hydrological model developed for the site works has not gone into this level of detail for the hydraulic connection and has assumed the water level in wetland 14 (and the adjacent land over the boundary, will be the same as the water level in the drain.

At detailed design for this part of the site (Phase 3) a small culvert with a backflow prevention device working in conjunction with a low flow supply from the drain into the wetland, will connect W14 to the drain to allow the wetland to discharge into the drain when the hydraulic condition in the drain allows (Figure 14).

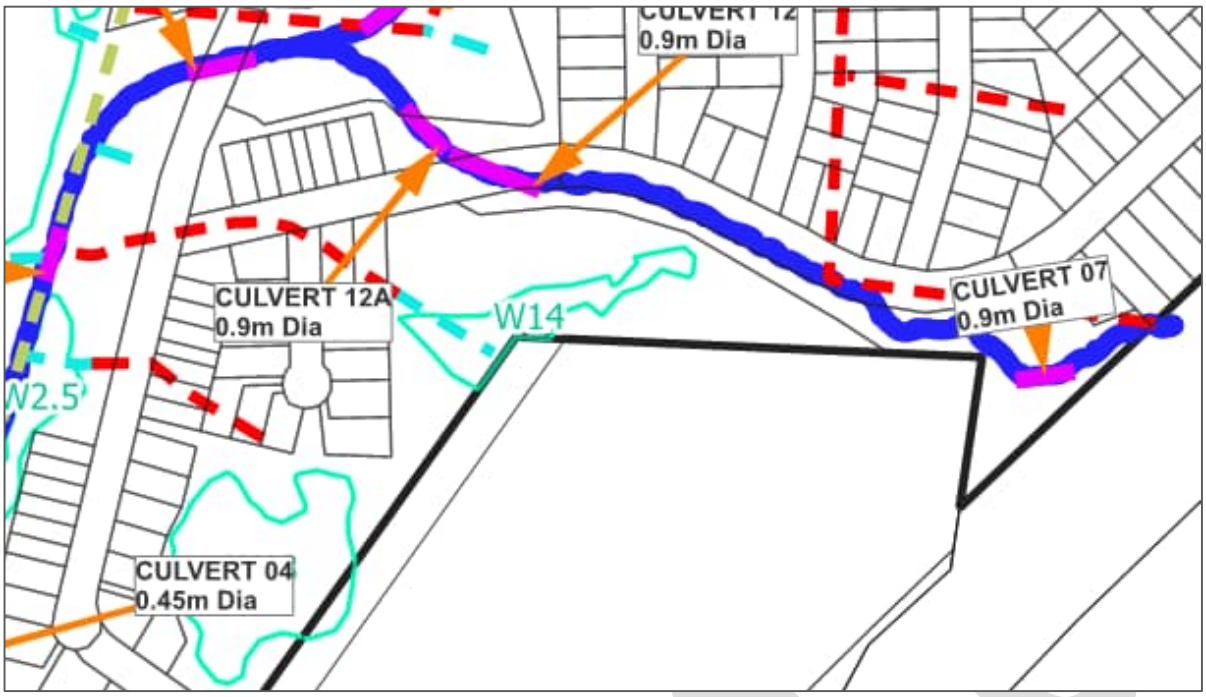

Figure 16. Area showing where a small outflow is designed to hydrologically accommodate wetland W14 from the realigned drain at proposed culvert 12A.

4.6 Vegetation establishment and enhancement

The total area (1.79 ha) of constructed offset wetlands will be planted at high density to achieve 80 % canopy cover.

Enrichment planting of indigenous species will take place in the degraded wetlands in Wetland Clusters 2, 4, and 5 to enhance diversity and cover of native vegetation and to create or improve habitats of indigenous fauna, such as wetland birds (particularly fernbird, marsh crake, spotless crake and bittern) and fish (including mudfish).

Planting buffers will restore natural ecological gradients and provide multiple ecological benefits to protect the wetlands and mitigate subdivision effects. Dense indigenous plantings proposed (rush–sedge margins grading to shrub and canopy species) will improve wetland health by intercepting and retaining sediment, nutrients, and contaminants from overland flow, providing a final polishing after stormwater treatment during high flow events, improving water quality, and protecting wetland and stream biota.

Root systems stabilise soils and reduce bank erosion. The vegetated setback buffer will shade margins, moderate temperatures, and dampen wind and light penetration, reducing edge effects (desiccation, weed exploitation, algal growth) while keeping earthworks, mowing, and structures out of the wetland.

Banks will be planted with dense riparian vegetation to further reduce erosion. Temporary silt fences will be placed at about 15–20 m spacing along the corridor shoulders to control velocity and erosion, and to protect plantings until they have established.

The buffer will add habitat complexity and food resources, supporting invertebrates, lizards, and terrestrial and wetland birds, and will function as a movement corridor linking terrestrial and aquatic habitats, providing broader landscape connectivity. The buffer will also provide a visual and physical barrier to reduce human disturbance of wetland birds. In combination with ongoing pest-plant and predator control, the proposed native buffer will measurably improve ecological integrity and resilience of the wetland and will mitigate the magnitude of subdivision-related effects.

In several locations, a full width 10 m buffer is not practicable, due to engineering requirements that encroach into an ideal 10 m wide buffer. To balance these encroachments, buffer widths will be increased elsewhere, resulting in a buffer width of approximately 10 m average around all wetlands, and 20 m around Te Harakeke Swamp (wetland).

Dense planting of voluminous species such as flax can reduce flood detention capacity due to displacement. The proposed plantings will be in nodes, covering less than 15 % of the retained wetland areas, and consists mainly of low bulk sedges and rushes, displacement will be under 15 %; the displacement also will be partly offset by increases in storage volume by excavating swales and constructed wetlands.

5.0 Ecological restoration – revegetation

5.1 Summary of revegetation activities

The planned area for revegetation is approximately 13.9 ha and is categorised into the following three treatments (

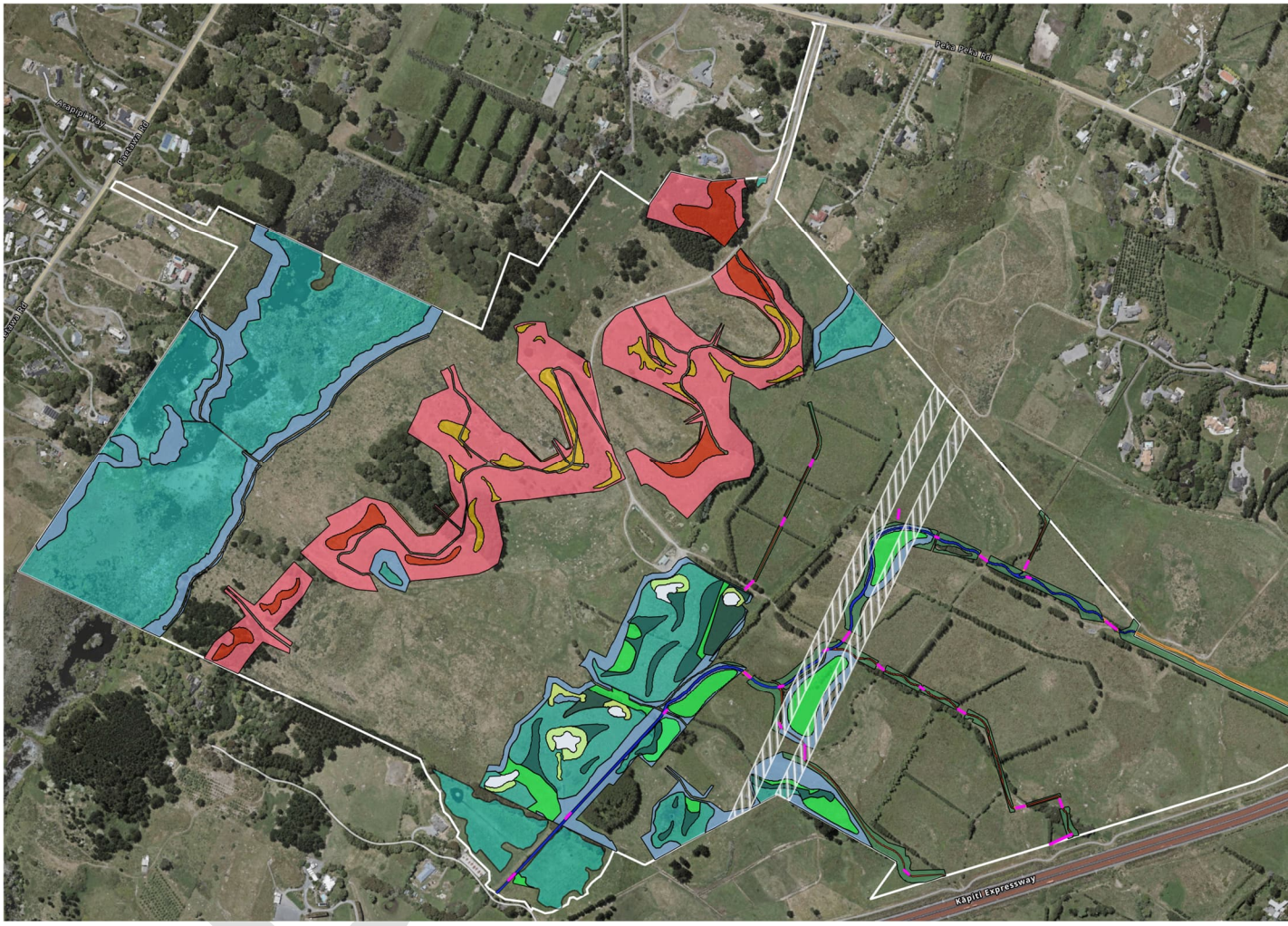

Figure and 18):

1. Riparian revegetation– riparian margin planting of 1.59 ha of stream buffer area. This is a planting treatment following best practice guidelines for stream margins and floodplains. The intended goal of the riparian margin revegetation is to provide multi-tiered, dense native plantings for bank stabilisation, stream shading, habitat corridors, habitat provision, water temperature regulation, and organic input regulation.
2. Wetland revegetation – enhancement of 0.6 ha of retained wetlands, creation of approximately 1.74 ha of offset wetlands, establishment of approximately 9.1 ha of buffer areas, enhancement of 0.09 ha of excavated swales, and revegetation of approximately 0.48 ha of stormwater discharge buffer planting. This is a planting treatment following best practice guidelines for wetlands. The intended goal of the wetland revegetation is to provide multi-tiered gradients of dense native

plantings to improve integrity by increasing diversity and creating habitat for indigenous fauna and flora.

3. Dune revegetation– planting 30 nodes of approximately 62.5 m^2 each for shrubland, rushland, and herbfield; and planting 22 nodes of approximately 55 m^2 each for treeland. The intended goal of the restoration is to enrich dune diversity and provide high quality terrestrial bird and lizard habitat.

The restoration and revegetation will result in a considerable ecological-benefit for indigenous dunes, streams, wetlands and associated indigenous wildlife at the property.

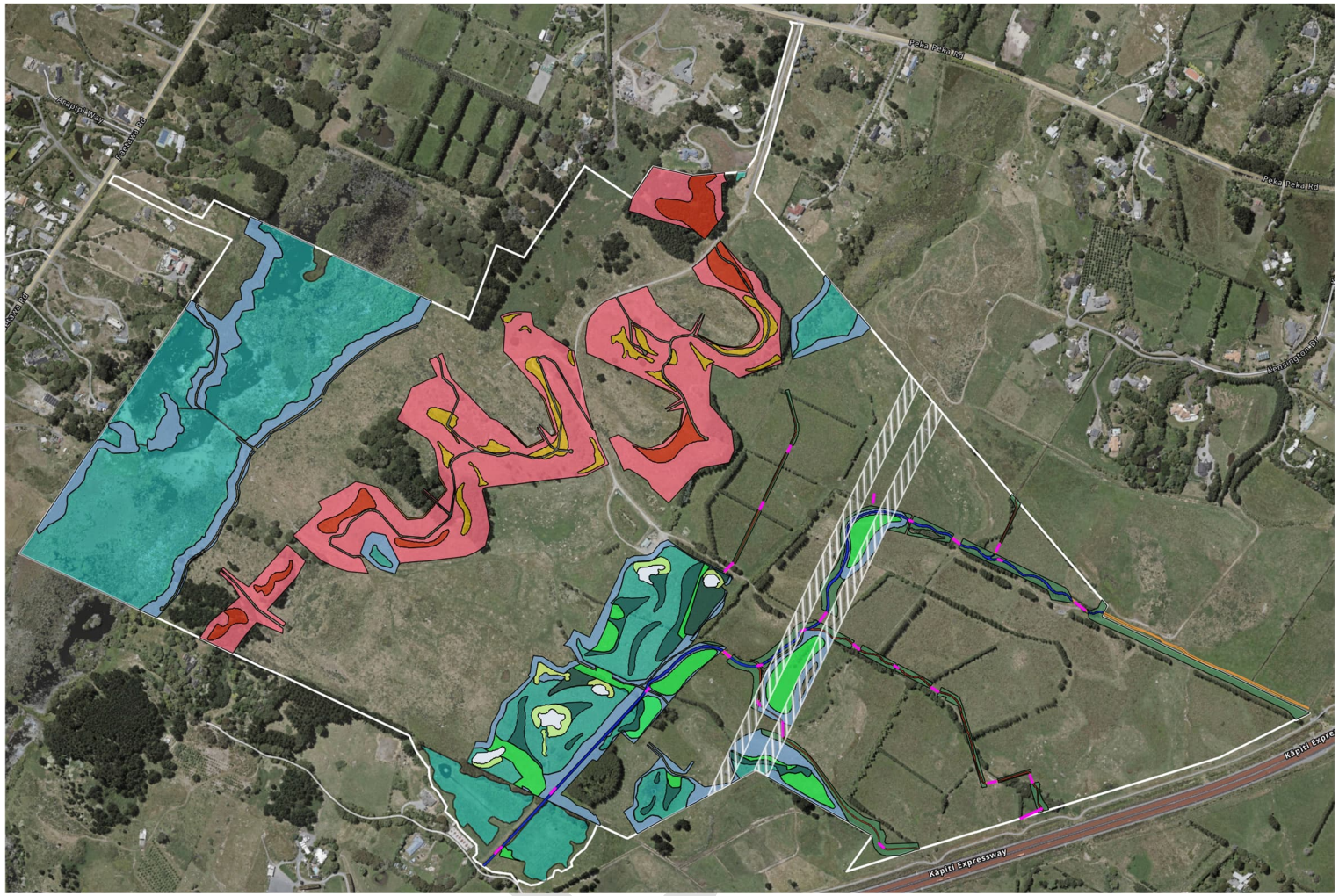

Figure 17. Sitewide restoration planting plan. Site boundary (white perimeter). Open space dune reserve and lizard release site (peach polygon), with dune shrub node planting (amber polygons) and dune treeland node planting (red polygons). Wetland buffer planting (light blue), wetland creation and planting (bright green), retention and pest control (cyan), and enhancement planting, including constructed swales and planting (white polygons), wetland discharge planting (lime polygons) and wetland enhancement planting nodes (dark green polygons). Riparian buffer planting (mid green).

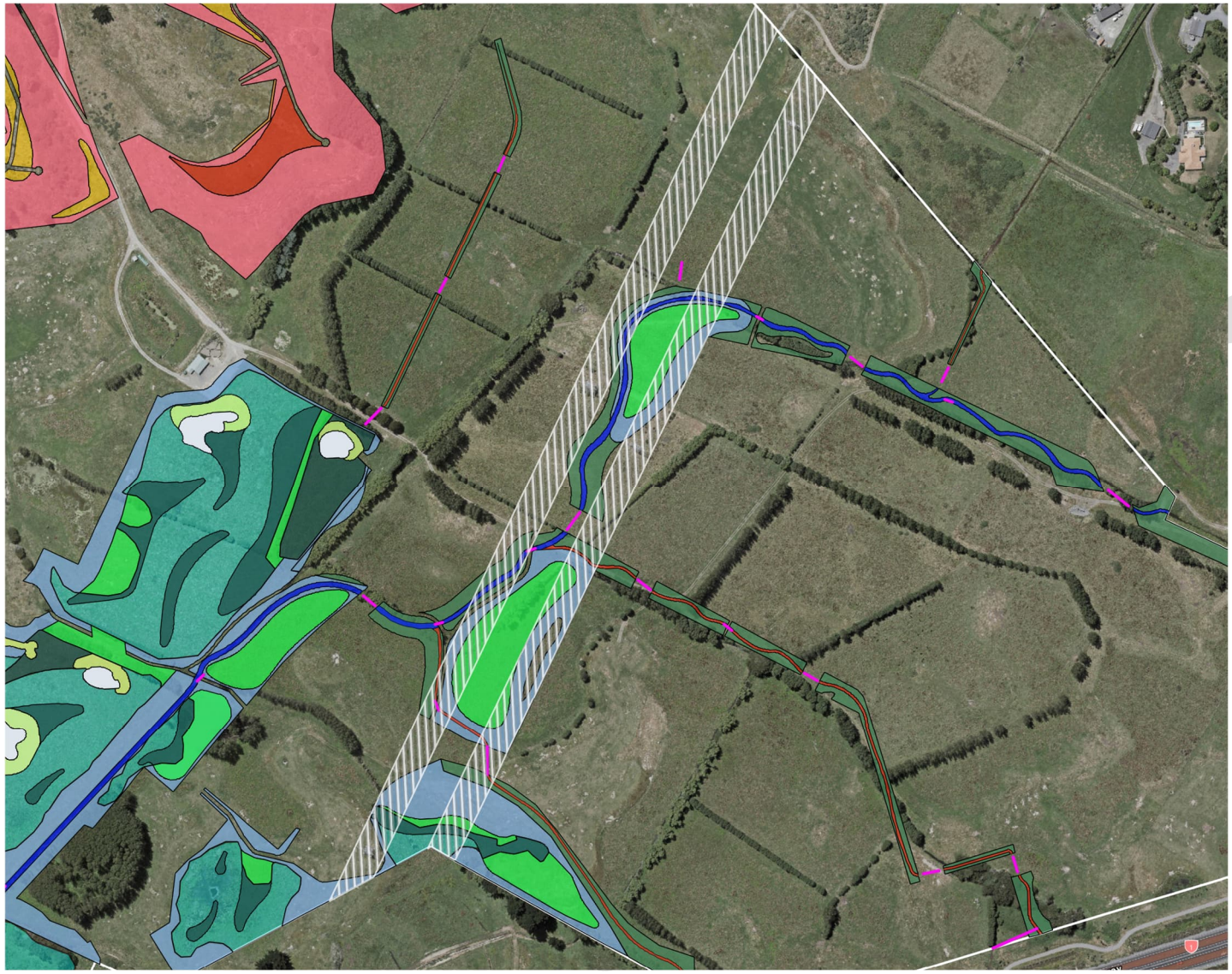

Figure 18 Boundary of the 12 m National Grid Yard setback (white parallel blocks with hatched lines). Plantings within the yard setback area are height restricted.

5.2 Restoration species selection

Multiple sources were used to design and select the planting suites in this plan.

1. Vegetation was recorded from wetland plots and site investigations in 2023 and 2025.
2. Ecological reference documents were used to build a species list for the region, including:
   a. Greater Wellington Regional Council (GWRC) native plant guide (2010);
   b. New Zealand Plant Conservation Network (nzpcn.org.nz); and
   c. Inaturalist records (inaturalist.nz).
3. The species were then categorised according to suitability for the restoration planting zones based on the wetland plant status indicator ratings (Clarkson et al. 2021), the GWRC planting guide recommendations, and relevant information from the New Zealand Plant Conservation Network (https://nzpcn.org.nz). The planting zones include:

   Riparian 1 (R1) — damp stream edges and floodplains;

   Riparian 2 (R2) — well-drained banks;

   Wetland 1 (W1) — permanent or ephemeral wetland;

   Wetland 2 (W2) — seasonally saturated wetland;

   Wetland 3 (W3) — drier wetland margins;

   Wetland 4 (W4) — stormwater discharge buffer;

   Dune 1 (D1) — dune shrubland, rushland, and herbfield; and

   Dune 2 (D2) — dune treeland.
4. The planting suites focus on establishing a diverse mix of ground cover, shrub and tree pioneer species, as well as key long-lived tree species. This encourages bird seed disperses to use the planting sites, naturally bringing seed from surrounding long-lived canopy trees. When shade and ground conditions are suitable after several years, the desirable tree species will germinate and establish successfully.
5. Three (3) standard planting centres were selected and assigned to each species based on their habit. Small-stature plants, including most herbs, grasses, sedges, rushes, and reeds, are assigned 0.5 m planting centres. Shrubs and small trees are assigned 1.4 m planting centres. Large trees and canopy trees are assigned 5 m planting centres.
6. The proportion of each species (percentage mix) is divided relatively evenly to maximise chances of long-term diverse communities. However, several are selected at higher proportions for specific objectives, including *Muehlenbeckia complexa* (46 % of shrubland planting for lizard habitat enhancement) and *Kunzea amathicola* (20 % of treeland planting for At Risk – Declining population enhancement). Finally, the number of plants required for each species is calculated based on a geometric formula which accounts for areas, planting centres, and proportions of each species.

5.3 Riparian restoration and enhancement

Table 2. Riparian revegetation plan.

Planting overview	27,600 m^2 (approx. 2.76 ha) to be planted with 39,464 eco-sourced individuals from a diverse assemblage of native species.
Revegetation objective	Restoration of both retained, and realigned stream reaches and stream buffer areas with suitable plant species to provide shading and habitat corridors.
Existing vegetation	Mosaic of exotic grasses, weeds, and trees.
Site Preparation	Remove ecological weeds (e.g., boxthorn, pampas, inkweed). Exclude stock from site.
Planting	Plant diverse communities suited for ecological enhancement at a range of planting centres and with a range of plant habits (Table 3, Table 4).
Monitoring	Assess planted areas until 80 % canopy closure. Monitor plant loss, ecological weeds, and animal pest damage.
Maintenance	Ecological weed control for 15 years (details in Section 5.9). Control animal pests as needed. Infill plants to ensure vegetation closure target. Provide post-flood response.

5.3.1 Planting rationale

The riparian planting lists accommodate two habitat communities. One community consists of plants usually occurring along damp stream edges and floodplains. The other community consists of plants usually occurring along well drained banks. Both communities have the potential to stabilise banks and provide shade for instream habitat.

The planting locations for either vegetation community R1 or R2 will depend on the final cross-sectional design of Ngarara Stream and models for floodplain inundation. The current restoration plan estimates that approximately 70 % of buffer planting will contain damp stream edges and connection to floodplains (Table 3), and approximately 30 % will contain well-drained banks (Table 4).

Two 220 kV National Grid electricity transmission lines cross the site. The National Grid Yard (NGY) is a defined buffer area around the centreline of National Grid transmission lines and transmission line support structures (Figure 19). Planting will be limited to low-growing wetland and shrub species that will not encroach into the safe clearance envelope required under NZECP 34:2001 and the Electricity (Hazards from Trees) Regulations 2003. Species within the NGY will generally be restricted to:

- sedges and rushes (e.g., *Carex*, *Juncus*, *Schoenoplectus*)
- low wetland shrubs where appropriate
- groundcover and marginal wetland vegetation compatible with saturated conditions

Canopy-forming indigenous trees (e.g., kahikatea, tōtara) will be planted outside the NGY, to avoid potential future conflicts with transmission line clearance requirements. Planting areas within the NGY will be subject to periodic inspection and maintenance to ensure vegetation remains within acceptable height limits and does not interfere with Transpower access or asset integrity.

Table 3. R1. Riparian buffer revegetation planting treatment of damp stream edges and adjacent floodplains. Estimated planting area 19,320 m^2 (70 % of buffer area; approximately 1.1 ha).

Species	Common Name	Planting size	Percentage mix (%)	Planting centres (m)	Total plant numbers
Apodasmia similis	Oioi	RT	10	0.5	8,856
Austroderia toetoe	Toetoe	0.5L or PB3	10	1.4	1,130
Carex secta	Pūrei	RT	10	0.5	8,856
Carex virgata	Swamp sedge	RT	5	0.5	4,428
Dacrycarpus dacrydioides	Kahikatea	PB3 or PB5	10	5.0	89
Gahnia xanthocarpa	Māpere	0.5L or PB3	10	1.4	1,130
Machaerina sinclairii	Machaerina	RT	10	0.5	8,856
Myrsine australis	Māpou	0.5L or PB3	5	1.4	565
Phormium tenax	Harakeke	0.5L or PB3	10	1.4	1,130
Plagianthus divaricatus	Marsh ribbonwood	0.5L or PB3	10	1.4	1,130
Plagianthus regius	Mānatu	0.5L or PB3	10	1.4	1,130
					Total: 37,300

Table 4. R2. Riparian buffer revegetation planting treatment of well-drained banks. Estimated planting area 8,280 m^2 (30 % of buffer area; approximately 0.83 ha;

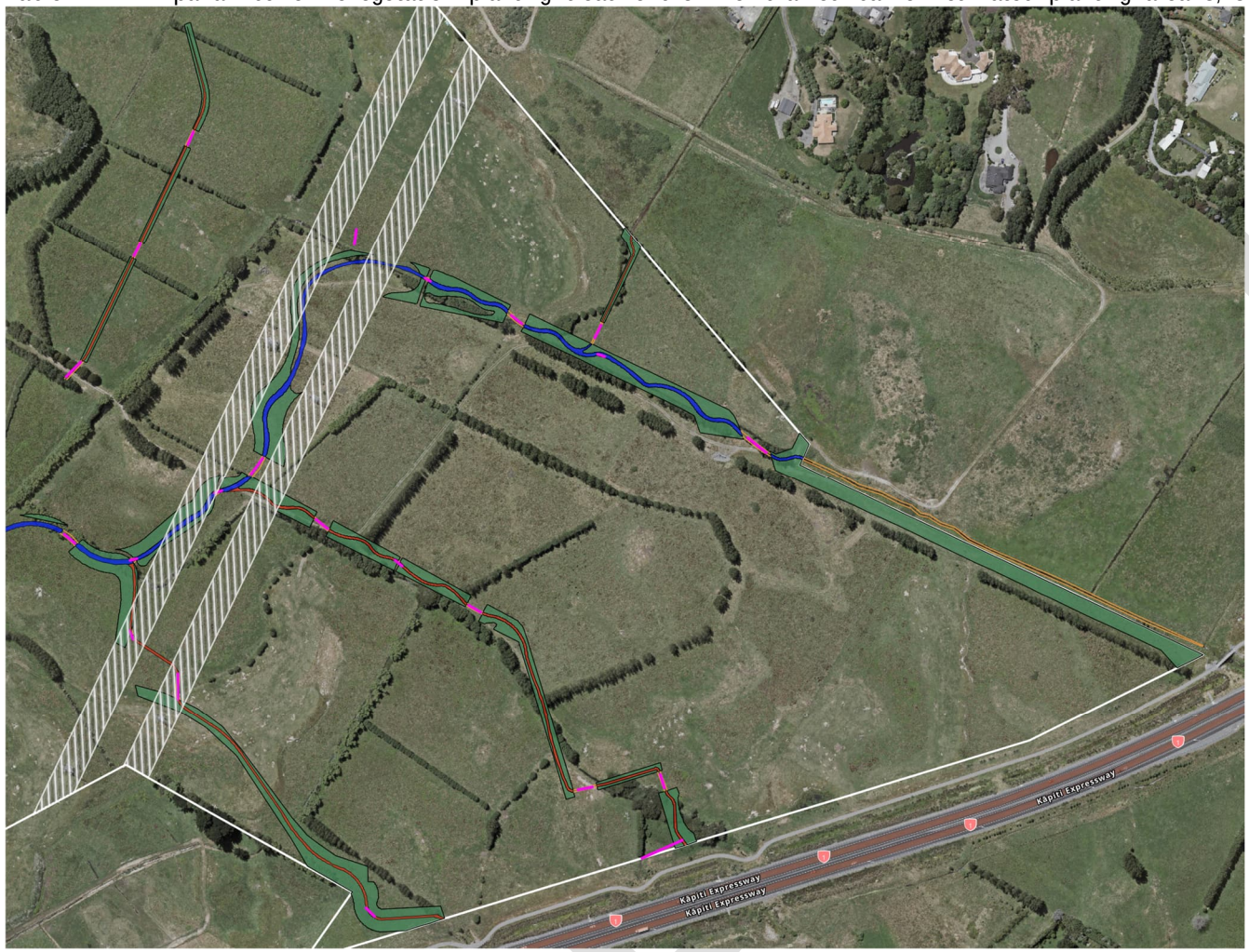

Figure 14).

Species	Common Name	Planting size	Percentage mix (%)	Planting centres (m)	Numbers

Dacrycarpus dacrydioides	Kahikatea	PB3 or PB5	15	5.0	57
Elaeocarpus hookerianus	Pōkākā	0.5L or PB3	10	1.4	484
Gahnia xanthocarpa	Māpere	0.5L or PB3	15	1.4	726
Hoheria sexstylosa	Houhere	PB3 or PB5	15	5.0	57
Notelaea neolanceolata	White maire	PB3 or PB6	15	5.0	57
Podocarpus totara	Tōtara	PB3 or PB7	15	5.0	57
Sophora microphylla	Small-leaved kōwhai	0.5L or PB3	15	1.4	726
				Total:	2,164

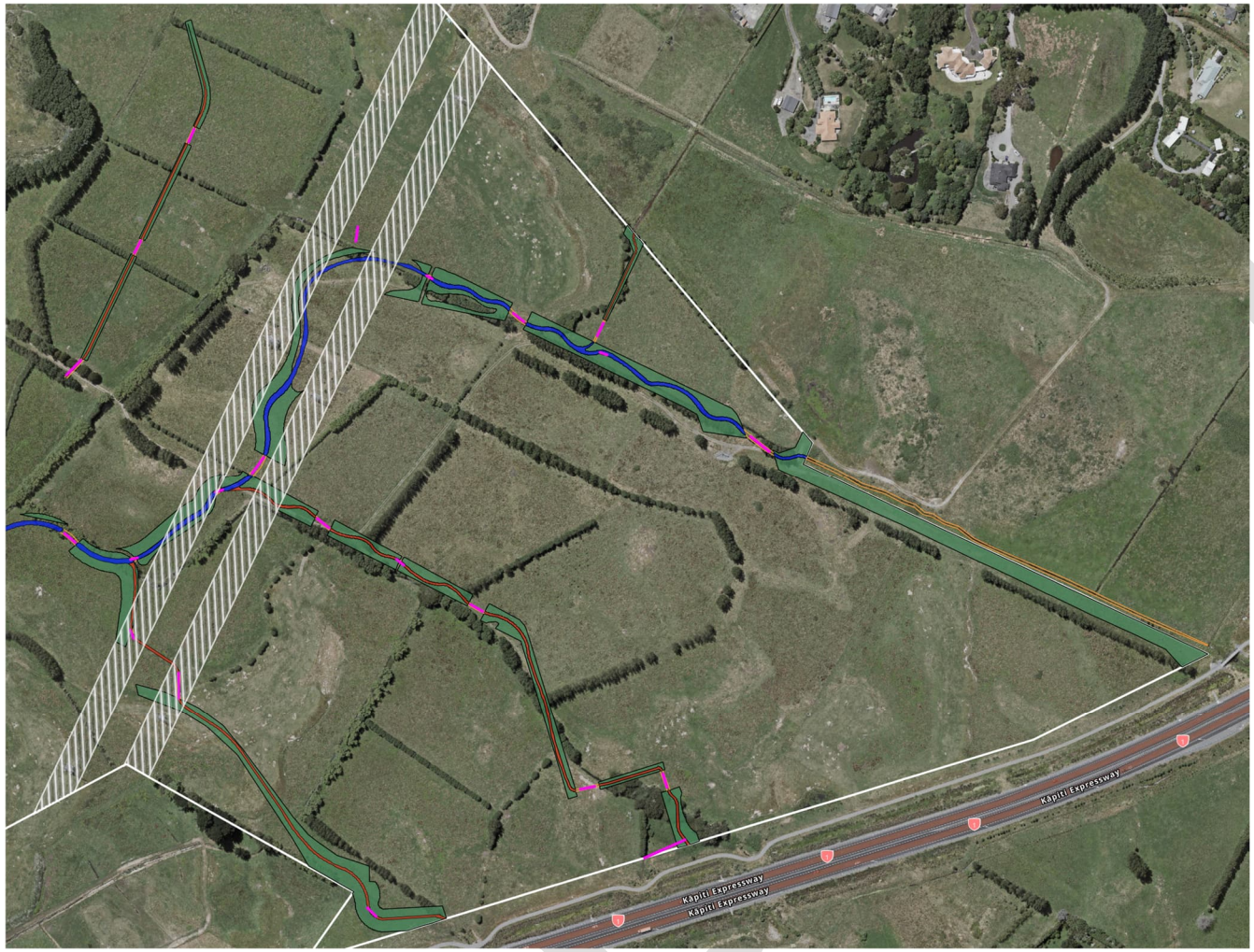

Figure 14. Planting areas for riparian planting treatment. Green polygons include both damp stream edge plantings (R1) and drier bank plantings (R2). Ngarara Stream (light-blue line). Retained and remediated drains (red lines). National Grid Yard (white polygons with hatch lines).

5.4 Wetland restoration and enhancement

Table 5. Wetland restoration plan.

Planting overview	Approximately 12 ha of wetland area to be planted with eco-sourced individuals from a diverse assemblage of native species.
Revegetation objective	Creation and enhancement of wetland areas with four wetland communities, providing habitat to waterfowl, wetland birds, and fish, as well as filtering stormwater and high flow events (in addition to stormwater management requirements).
Existing vegetation	The SNA wetlands are dominated by native sedges, rushes, reeds and shrubs. All other wetlands are a mosaic of exotic herbs, grasses, sedges and rushes, with few native species.
Site preparation	Removal of ecological weeds. Exclusion of stock from site. Swales are planned to be constructed across approximately 0.38 ha of retained degraded wetland area.
Planting	Planting of diverse communities suited for ecological wetland enhancement and creation at a range of planting centres (Table 6, Table 7,Table 8, Table 9). No machinery is required, and measures to control erosion and sediment are unnecessary because of manual planting.
Monitoring	Assessment of planted areas until 80 % canopy closure. Monitoring plant loss, ecological weeds, animal pest damage, fence integrity.
Maintenance	Ecological weed control for 15 years (details in Section 5.9). Browsing animal pest control as required. Fencing as required. Infill plants to ensure vegetation closure target. Provide post-flood response.

5.4.1 Planting rationale

The wetland planting plan has been structured into four vegetation communities (W1–W4) to reflect the expected hydrological gradients and functional requirements onsite:

- W1 (Table 6) planting focuses on hydrophytic species tolerant of ponding and low-oxygen substrates, with inundation of up to 1 m for several days at a time after heavy rainfall events.
- W2 (Table 7) planting focuses on species suitable for fluctuating hydrological regimes.
- W3 (Table 8) planting focuses on species that can stabilise the margins and provide ecological connectivity to surrounding habitats.
- W4 (Table 9) planting focuses on species tolerant of variable flow, sediment input, and disturbance, capable of filtration and protection of habitat from discharge outflows.

Wetland revegetation zones include[3]:

- W1: Planting 125 m^2 nodes to enhance 875 m^2 of seven (7) constructed swales; each of the seven (7) nodes includes 477 individual plants, for a total of 3,339 plants.
- W1: Dense total-area planting for an estimated 70 % of created wetland area, constituting 17,637 m^2 with 66,735 plants (the remainder to be planted in W2).

[3] Note that plant numbers cited here are indicative and will be confirmed at certification.

- W2: Planting 100 m^2 nodes to enhance 6,000 m^2 of retained wetlands (approximately 20% of the 6.4 ha retained wetland area); each of the 60 nodes includes 215 individuals, for a total of 12,900 plants.
- W2: Dense total-area planting for an estimated 30 % of created wetlands, across a 7,556 m^2 with 16,098 plants.
- W3: Planting 81,172 m^2 of wetland buffer margins with 50,568 individuals.
- W4: Planting 4,775 m^2 of discharge buffers, primarily between stormwater discharges and created wetland swales, with 16,168 individuals.

No enhancement planting is proposed within Te Harakeke wetland as most of this wetland is already native dominated, and taller vegetation within the wetland is likely to reduce the suitability of waterfowl and wetland bird habitat. Buffer planting of margins, and pest plant control throughout the wetland is most critical to restoration here.

To mitigate disturbance of wetland birds, particularly by dogs, buffer planting around wetlands will provide a dense, continuous and visually impermeable barrier at least 3 m in height around wetlands, particularly where walkways are within 100 m of constructed swales and existing open water bodies, or within 20 m of SNA wetlands. Exceptions include height-restricted planting under the National Grid yard, and an allowance for visual amenity around the town centre development.

Table 6. W1. Revegetation treatment for permanently saturated and ephemerally inundated depressions (up to 1 m depth for ≤3 days). Swales 875 m^2. Dense plantings 17,637 m^2.

Species	Common Name	Planting size	Mix (%)	Planting space (m)	Plants per swale node	Total plants in swales	Plant numbers in created wetlands
Carex secta	Pūrei	RT	10%	0.5	58	406	8,084
Carex virgata	Swamp sedge	RT	10%	0.5	58	406	8,084
Eleocharis acuta	Spike rush	RT	10%	0.5	58	406	8,084
Machaerina rubiginosa	Machaerina	RT	10%	0.5	58	406	8,084
Phormium tenax	Harakeke	0.5L or PB3	20%	1.4	15	105	2,062
Typha orientalis	Raupō	RT	40%	0.5	230	1610	32,337
						Totals: 3,339	66,735

Table 7. W2. Revegetation treatment for seasonally saturated and shallowly inundated wetland areas (typically ≤0.3 m flood inundation). Swales 6,000 m^2;Dense plantings 7,556 m^2.

Species	Common Name	Planting size	Mix (%)	Planting space (m)	Plants per enhancement node	Total plants in enhancements	Plant numbers in created wetlands
Apodasmia similis	Oioi	RT	10%	0.5	46	2760	3,463
Austroderia toetoe	Toetoe	0.5L or PB3	10%	1.4	6	360	442
Carex secta	Pūrei	RT	5%	0.5	23	1380	1,732
Carex virgata	Swamp sedge	RT	5%	0.5	23	1380	1,732
Coprosma tenuicaulis	Swamp coprosma	0.5L or PB3	10%	1.4	6	360	442
Cordyline australis	Tī kōuka	0.5L or PB3	10%	1.4	6	360	442
Dacrycarpus dacrydioides	Kahikatea	PB3 or PB5	10%	5.0	1	60	35
Machaerina tenax	Machaerina	RT	10%	0.5	46	2760	3,463
Phormium tenax	Harakeke	0.5L or PB3	10%	1.4	6	360	442
Plagianthus divaricatus	Marsh ribbonwood	0.5L or PB3	10%	1.4	6	360	442
Schoenus maschalinus	Bog rush	RT	10%	0.5	46	2760	3,463
						Totals: 12,900	16,098

Table 8. W3. Revegetation treatment of drier wetland margins and buffers. 81,172 m^2.

Species	Common Name	Planting size	Mix (%)	Planting space (m)	Total plant numbers
Carex flagellifera	Trip me up	RT	5%	0.5	18,603
Coprosma propinqua	Mingimingi	0.5L or PB3	15%	1.4	7,119
Coprosma robusta	Karamū	0.5L or PB3	5%	1.4	2,373
Dacrycarpus dacrydioides	Kahikatea	PB3 or PB5	15%	5.0	558
Dracophyllum longifolium	Inanga	0.5L or PB3	5%	1.4	2,373
Elaeocarpus hookerianus	Pōkākā	PB3 or PB5	5%	5.0	186
Kunzea amathicola	Sand dune kānuka	0.5L or PB3	15%	1.4	7,119
Leptospermum scoparium	Mānuka	0.5L or PB3	5%	1.4	2,373
Myrsine australis	Māpou	0.5L or PB3	5%	1.4	2,373
Pittosporum tenuifolium	Kōhūhū	0.5L or PB3	5%	1.4	2,373
Plagianthus regius	Mānatu	0.5L or PB3	5%	1.4	2,373
Shawia virgata	Twiggy tree daisy	0.5L or PB3	5%	1.4	2,373
Syzygium maire	Swamp maire	PB3 or PB5	10%	5.0	372
				Total:	50,568

Table 9. W4. Revegetation treatment for buffer planting of wetlands between constructed swales and stormwater discharges. 4,775 m^2.

Species	Common Name	Planting size	Mix (%)	Planting space (m)	Total plant numbers
Apodasmia similis	Oioi	RT	10%	0.5	2190
Austroderia toetoe	Toetoe	0.5L or PB3	10%	1.4	280
Carex geminata	Cutty grass	RT	20%	0.5	4379
Coprosma tenuicaulis	Swamp coprosma	0.5L or PB3	10%	1.4	280
Eleocharis acuta	Spike rush	RT	20%	0.5	4379
Juncus edgariae	Wīwī	RT	10%	0.5	2190
Juncus sarophorus	Soft rush	RT	10%	0.5	2190
Phormium tenax	Harakeke	0.5L or PB3	10%	1.4	280
				Total:	16,168

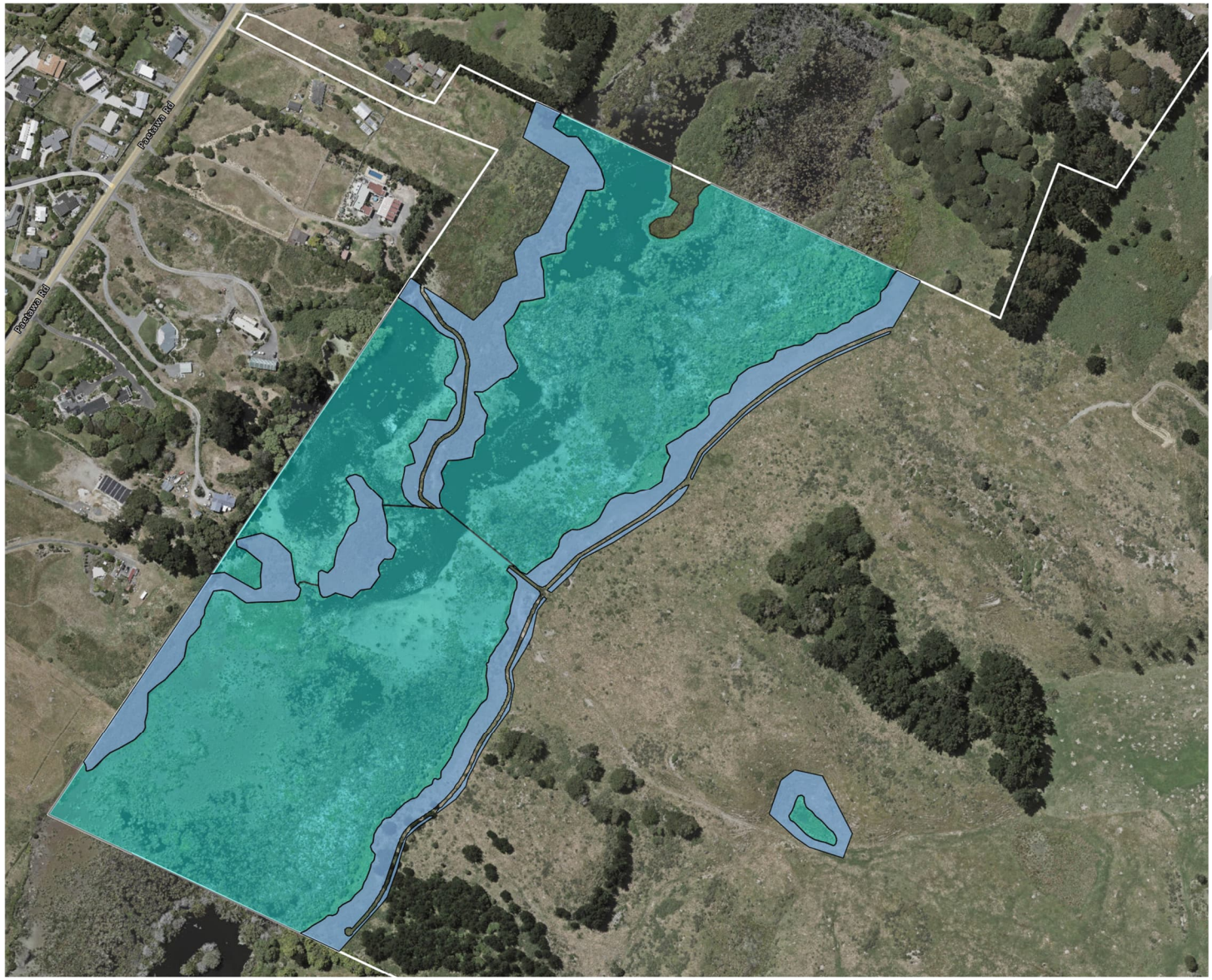

Figure 15. Wetland planting areas. Retained wetland, no planting (cyan). W3 Buffer margin planting (blue).

Figure 16. Wetland planting areas. Retained wetland, no planting (cyan). W3 Buffer margin planting (blue).

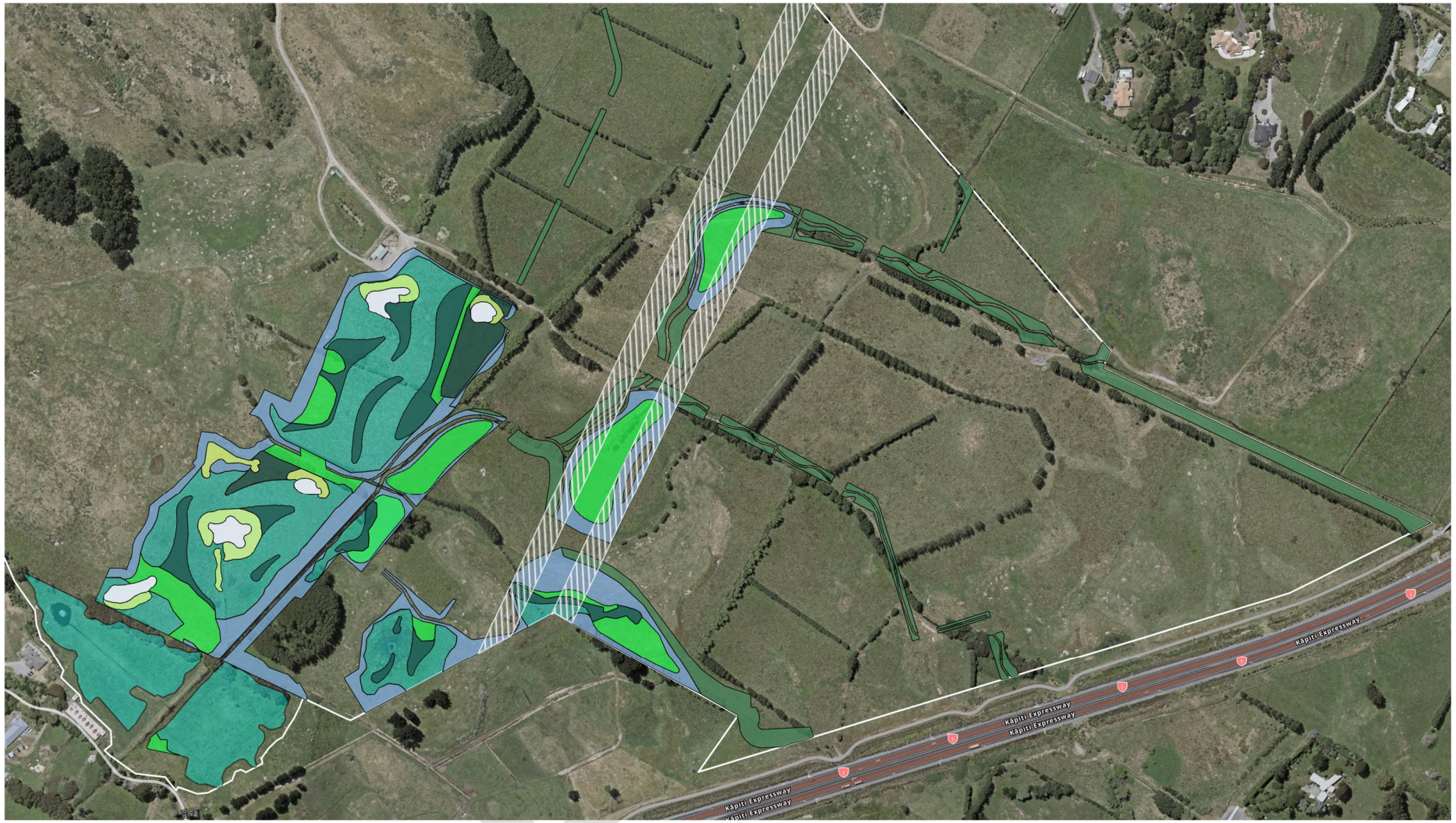

Figure 17. Wetland planting in the lowland eastern flats. Constructed swales (white polygons) with W1 planting, and surrounding W4 discharge buffers (lime polygons). Created offset wetland extent with W1 and W2 communities depending on inundation levels (bright green). W2 enhancement node planting zones (dark green polygons). W3 Buffer margin planting (blue). Retained wetlands (cyan). Riparian buffer planting (mid green; see previous section).

5.5 Dune revegetation

Table 10. Dune revegetation plan.

Planting overview	3,085 m² (approx. 0.3 ha) of node planting with 6,550 eco-sourced individuals from a diverse assemblage of native species, covering 1.8 % of the dune lizard release site.
Revegetation objective	Restoration of dune vegetation to provide bird and lizard habitat and mitigate vegetation loss.
Existing vegetation	Exotic weeds and rank grass.
Site Preparation	Remove ecological weeds. Exclude stock from site.
Planting	Node-based planting diverse communities suited for dune habitats at a range of planting centres and with a range of plant habits (Table 11, Table 12).
Monitoring	Assess planted areas until 80 % canopy closure. Monitor plant loss, ecological weeds, and animal pest damage.
Maintenance	Ecological weed control for 15 years (details in Section 5.9). Control animal pests as needed. Infill plants to ensure vegetation closure target. Provide post-flood response.

5.5.1 Planting rationale

Placement of nodes within the open reserve was determined based on topography (sunlight and slope), nearby retained vegetation (especially existing shrubland), and habitat suitability and connectivity (especially for skinks).

Table 11. D1. Dune shrubland, rushland, and herbfield node planting treatment. Planting 30 nodes of 200 plants and 62.5 m^2 each, across a total of 1,875 m^2 with 6,000 plants (covering a spatial area of around 1.14 ha).

Species	Common Name	Planting size	Mix (%)	Planting space (m)	Plant numbers per node	Total plant numbers
Apodasmia similis	Oioi	RT	3%	0.5	9	270
Clematis afoliata	Leafless clematis	0.5L or PB3	2%	0.5	6	180
Clematis paniculata	White clematis	0.5L or PB3	2%	0.5	6	180
Coprosma acerosa	Sand coprosma	0.5L or PB3	3%	1.4	2	60
Coprosma areolata	Thin-leaved coprosma	0.5L or PB4	3%	1.4	2	60
Coprosma propinqua	Mingimingi	0.5L or PB5	5%	1.4	2	60
Coprosma rhamnoides	Twiggy coprosma	0.5L or PB6	3%	1.4	2	60
Disphyma australe	New Zealand ice plant	RT	3%	0.5	9	270
Euphorbia glauca	Shore spurge	0.5L or PB3	5%	1.4	2	60
Ficinia nodosa	Knobby club rush	RT	3%	0.5	9	270
Muehlenbeckia complexa	Pōhuehue	RT	46%	0.5	132	3,960
Ozothamnus leptophyllus	Tauhinu	0.5L or PB3	3%	1.4	2	60
Pimelea prostrata (subsp. *prostrata* or *seismica*)	Sand daphne	0.5L or PB3	5%	1.4	2	60
Pimelea villosa	Sand daphne	0.5L or PB3	3%	1.4	2	60
Plagianthus divaricatus	Marsh ribbonwood	0.5L or PB3	5%	1.4	2	60
Rubus squarrosus	Leafless lawyer	RT	3%	0.5	9	270
Shawia paniculata	Akiraho	0.5L or PB3	3%	1.4	2	60
					200	Total: 6,000

Table 12. D2. Dune treeland node planting treatment. Planting 22 nodes of 25 plants with 550 trees.

Species	Common Name	Planting size	Mix (%)	Planting space (m)	Plant numbers per node	Total plant numbers
Coprosma repens	Taupata	0.5L or PB3	10%	1.4	4	76
Corynocarpus laevigatus	Karaka	PB3 or PB5	10%	5.0	1	19
Dodonaea viscosa	Akeake	0.5L or PB3	5%	1.4	2	38
Kunzea amathicola	Sand dune kānuka	PB3 or PB5	20%	5.0	1	19
Melicytus ramiflorus	Māhoe	0.5L or PB3	10%	1.4	4	76
Myoporum laetum	Ngaio	PB3 or PB5	20%	1.4	8	151
Pseudopanax crassifolius	Lancewood	0.5L or PB3	5%	1.4	2	38
Shawia paniculata	Akiraho	PB3 or PB5	5%	5.0	1	19
Shawia solandri	Coastal tree daisy	0.5L or PB3	15%	1.4	6	114
					29	Total: 550

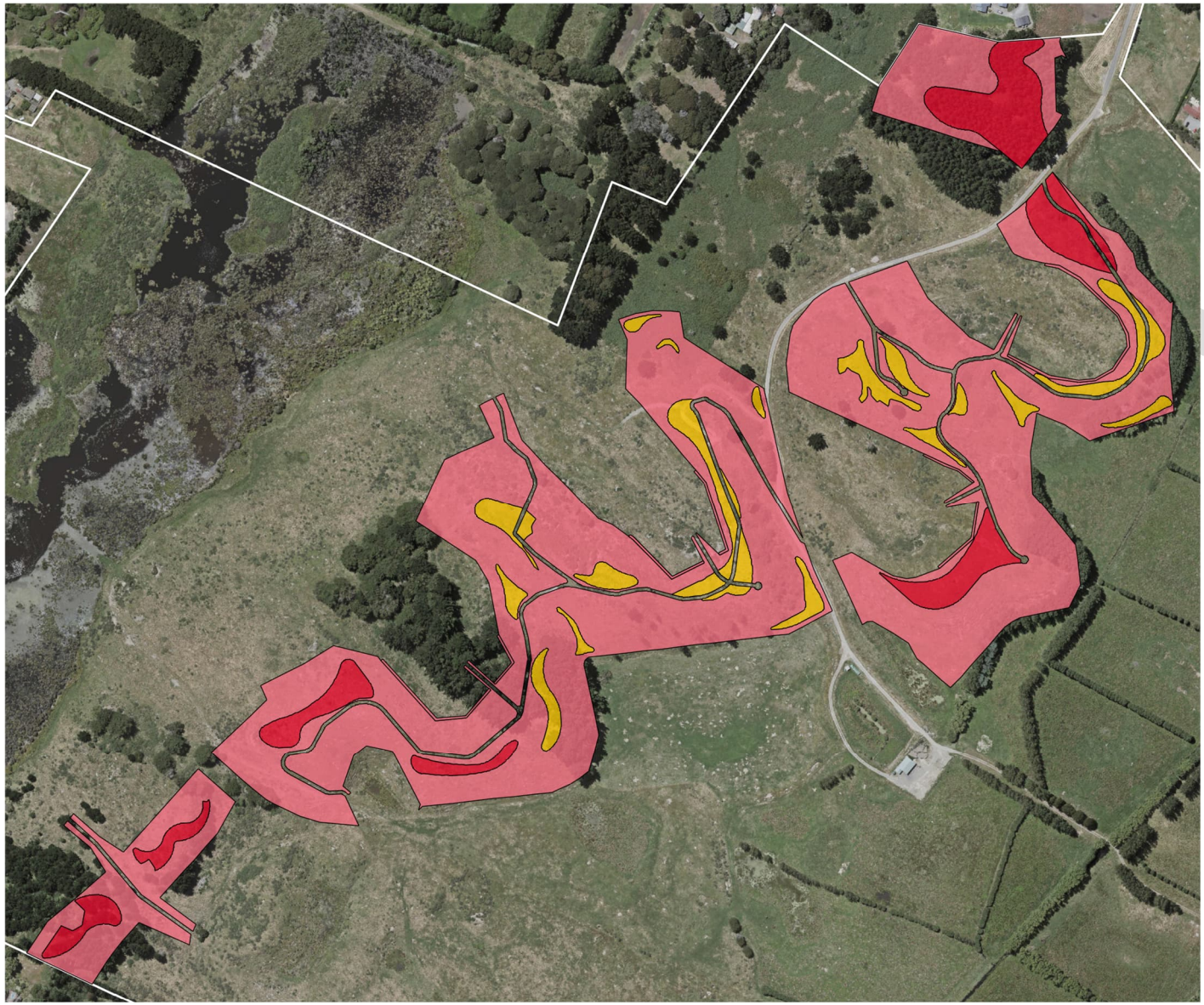

Figure 18. Zones for dune node revegetation planting. D1 dune shrubland and rushland planting (amber polygons). D2 Treeland planting (red polygons).

5.6 Planting approach

Good practice principles for this planting follows preferred methodologies and standards advocated by DOC and councils elsewhere in New Zealand. The key ecological principles and goals of the planting strategy include:

- Creating a self-sustaining native plant community;
- Using indigenous species that are representative of natural-historical local plant communities and which provide appropriate community structure;
- Sourcing seed and plants locally to maintain the integrity of local genetic stocks;
- Increasing the diversity of native species and creating habitats that benefit native fauna;
- Providing greater function and services for streams, wetlands, shrubland, and treeland; and
- Reducing or eliminating potential threats to the restored system; in New Zealand these threats are largely from introduced weeds and animal pests. This also includes safe myrtle rust protocols for Myrtaceae species.

The general approach to planting will involve five steps:

1. Source species that are ecologically appropriate to this site at the size and number in the planting treatments, which include root trainers (RT), 0.5L, or PB3, or PB5 grade plant sizes.
2. Before planting, exclude stock, and, if needed, use an appropriate herbicide to kill and clear rank grass to avoid suppression of planted seedlings and saplings.
3. Plant in late winter to early spring to avoid winter frosts, but provide time for root systems to develop before summer dry periods occur, using combi-guards (or similar).
4. Undertake release weeding to clear encroaching exotic grasses and herbs after planting. Once root systems have developed (over the first three growing seasons, or as appropriate based on monitoring of survival and growth), plants should readily survive grass and herb interference.
5. Aftercare maintenance for ecologically important weeds (e.g. climbing vines and woody weeds) will be undertaken over a 15-year period at various times (see Section 5.9).

5.7 Site preparation

5.7.1 Stock exclusion

Stock will be removed from the site prior to development activities. If stock remain in some areas during staged works, any planting within stocked fields will be fenced to effectively exclude stock.

5.7.2 Plant pest control

Pest plants can have costly adverse effects on revegetation objectives, and there is value in removing these infestations to reduce the risk of further spread within and outside of the site.

The existing vegetation in the restoration areas is occupied by rank grass and exotic herbs and shrubs.

Te Harakeke Swamp and Peka Peka Road Swamp have scattered grey willow (*Salix cinerea*) and crack willow (*Salix fragilis*) at a pre-explosion phase, with margin planting of willows at Peka Peka Road Swamp. Te Harakeke Swamp also has low densities of pampas grass (*Cortaderia selloana*) along its eastern margin, and both wetlands have blackberry (*Rubus fruticosus* agg.) along their margins. These pest weeds have the potential to exploit these high value SNA wetlands, proliferate, and exclude the present native species.

The approach that will be implemented at this site is to undertake intensive pre-planting control of ecological weeds to achieve near-total clearance and to plant at a moderate to high plant density (generally one (1) stem per 0.5–1.4 m planting centres in open areas) to achieve higher plant survival, facilitate greater natural plant spread, and to create a dense canopy cover within a short timeframe. Larger trees and canopy trees take longer to reach full potential and cover a greater area so are given 5 m planting centres to avoid overcrowding in the long-term.

Weed control will be part of site preparation and ongoing monitoring and control (see Section 5.9). Weed control will be undertaken by a certified and experienced contractor, such that the objectives within this plan are achieved. Weed control will follow accepted industry practice and will form part of ecological restoration preparation, including:

- Knock-down of weeds using methods and herbicides as part of site preparation prior to planting. For most weeds this will involve cutting or spot spraying herbicide within 14 days of planting;
- If weeds persist, repeat herbicide use will be required.
- Every effort will be taken to ensure non-target species are avoided,
- All operations should comply with the Agrichemical Users Code of Practice (NZ Agrichemical Education Trust);
- Herbicide application will adhere to the New Zealand Standard 8409 Code of Practice for the Management of Agrichemicals, commonly known as GROWSAFE®; and
- A programme of follow-up monitoring of plantings to ensure that weeds are suppressed or removed as part of revegetation objectives, described further below.

Further weed control will be required if weeds establish prior to planting, because earthworks and topsoiling occurred with a long enough time gap. To avoid the need for additional control, topsoil should be spread in the planting area fewer than six (6) weeks prior to planting. If this timing is not met, then blanket coverage herbicide application or spot-spraying (at least 600 mm diameter) of anticipated plant locations will be required.

5.8 Planting

5.8.1 Planting layout

Planting under the high voltage power lines (will be restricted in height to align with the 'Electricity (Hazards from Trees) Regulations 2003, Schedule 2 Growth limit zones'. The area of height restriction will be influenced by line conductor span (varying between 200 m and 400 m onsite) and line sag height at each location; however, a 12 m

indicative guide has been developed in the cross sections and the planting plan (Figure 8,

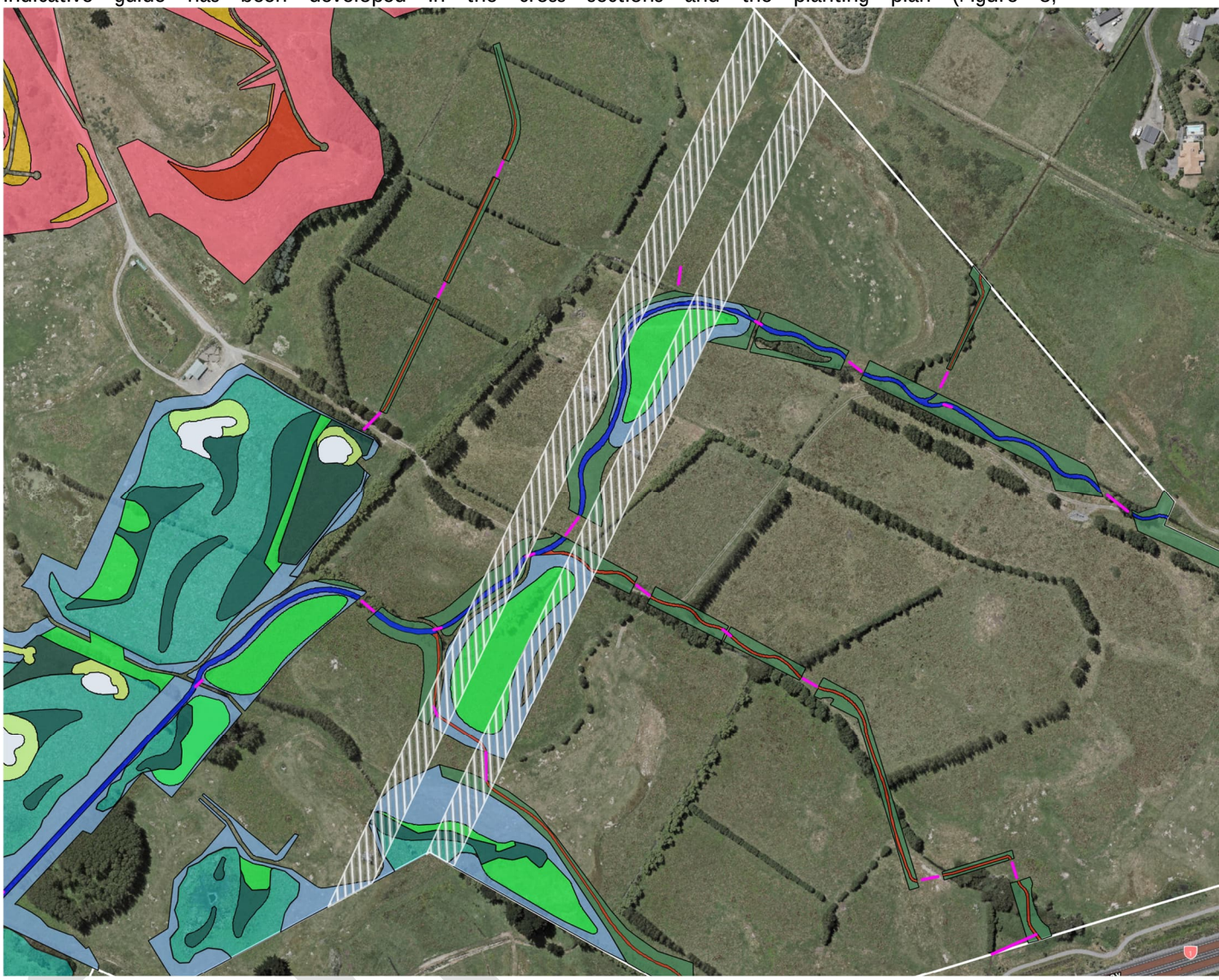

Figure). Areas may be restricted to shrub and groundcover planting.

Plantings will be set out in accordance with the planting plans. The various plant species will be distributed within the mix at specified centres. Generally (excluding pōhuehue plantings), no more than three (3) individuals of the same species will be planted together in a single cluster. Unless shown otherwise, trees within these mixes will be distributed randomly and in small clusters, as they would occur naturally, in accordance with the average spacing specified. Groundcover plants (grasses, rushes, reeds, etc.) will be clustered at a maximum of three (3) plants together.

Care will be taken to plant in a natural pattern, maintaining appropriate spacing but avoiding planting in rows, particularly for canopy species (those with 5 m spacings), which will remain for over a century.

5.8.2 Planting holes

The planting holes for individual plants will be well cultivated and large enough to contain the plant roots without distortion. Cultivated planting holes shall be at least twice the diameter of the plant rootball and 1.5 times the depth of the rootball (Figure 9). All holes for plants will be hand dug with the sides and the bottom of the hole well loosened to remove glazing and to allow root penetration.

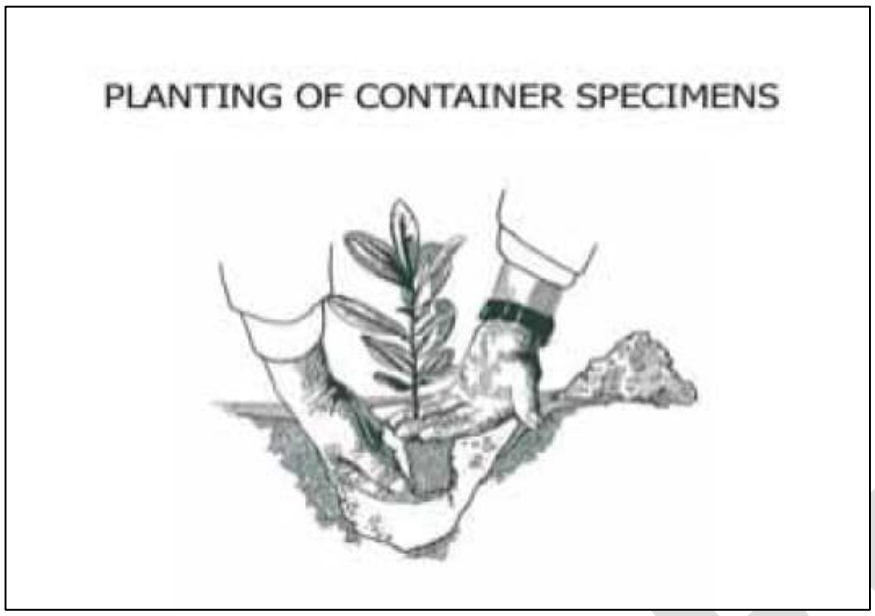

Figure 19. Illustration showing cultivated planting hole and depth of plant.

Prior to planting, all plant root balls will be soaked. Backfill material will consist of the material from the planting hole. If roots have formed in a tight mass, they will be gently freed prior to planting. All care will be taken to keep the root ball of the plant intact during placement. Root bound plants will be discarded and replaced with suitable alternatives.

The base of the planting hole will be filled and firmed with backfilling material to a level where the top of the plant rootball is level with surrounding ground. On sloping sites this level will relate to the bottom edge of the hole.

A bamboo stake (or similar) will be positioned next to each plant to aid relocation during maintenance visits. This is particularly important for releasing plants from rank grass.

With the dune node planting in particular, the number of individuals for each species planted will be recorded. The centre (point) of each node or the perimeter (polygon) of each node will be recorded. These records will be kept in digital formats that can be sent easily among maintenance and reporting staff.

5.8.3 Timing and staging

Planting will occur in the planting season: May–September for forest, riparian, and wetland buffer areas and late summer–autumn for wetlands. The aim for this period is to benefit from peak soil moisture, but planting will be undertaken when the weather is suitable with mild, dull, and moist conditions. All plant material will be hardened off to cope with the climatic conditions at site.

Planting will not be undertaken all in one year - it will be staged in accordance with the staged earthworks plans. Figure 26a shows the earthworks programem indicative staging plan. Figure 26b shows the corresponding staged planting plan for duneland areas, wetland, streams and buffers.

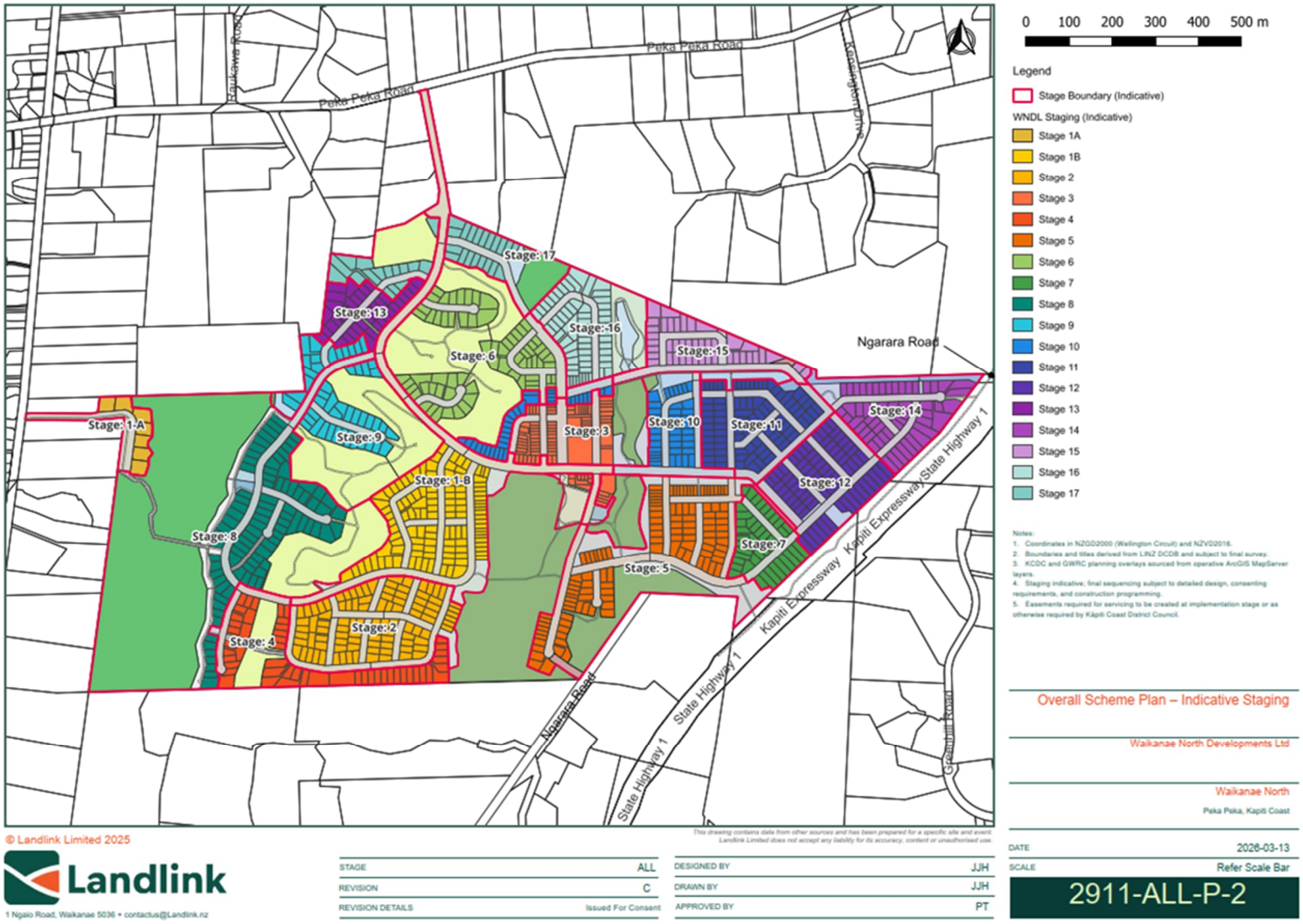

Figure 26a. Indicative earthworks staging plan.

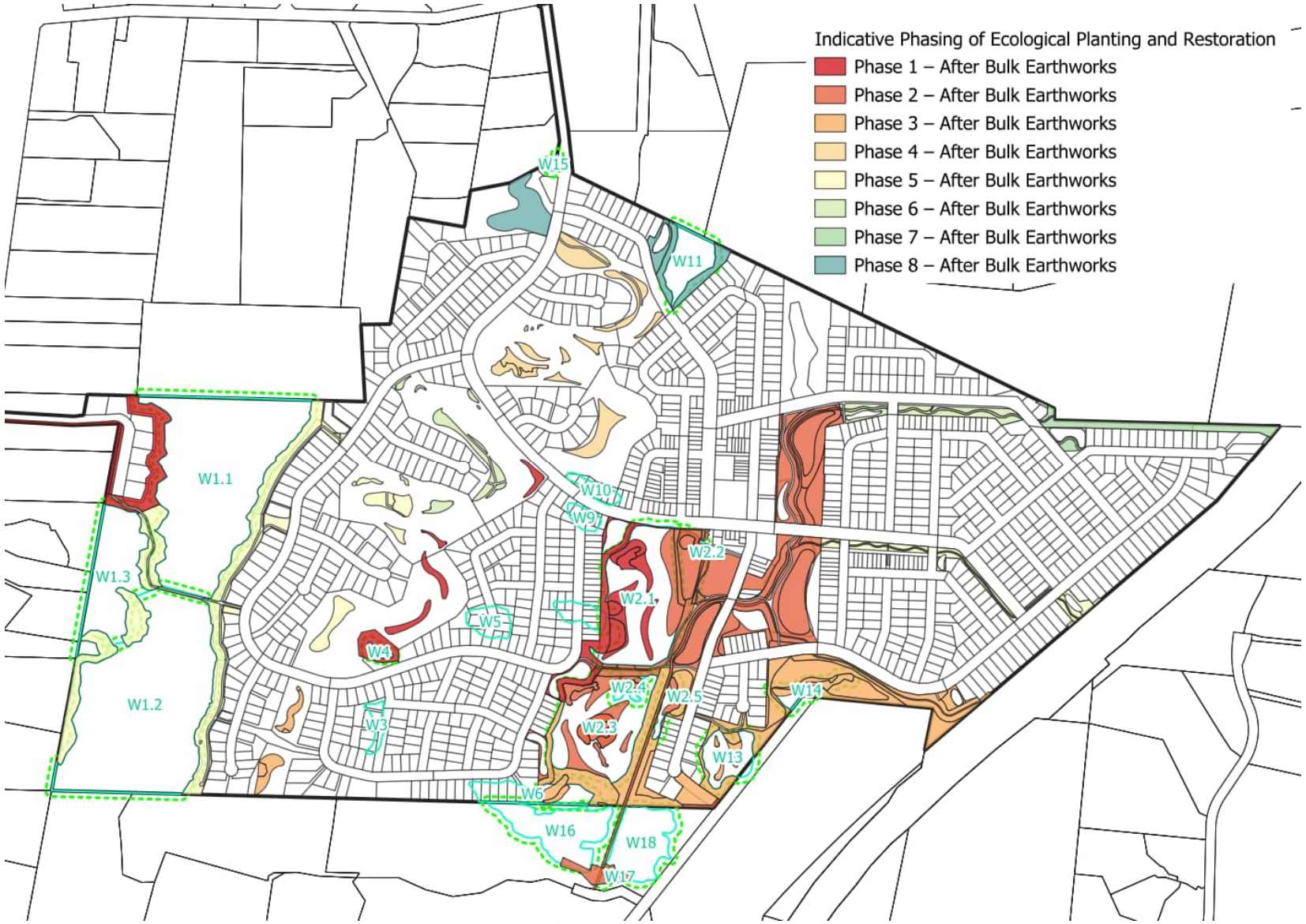

Figure 26b. Indicative planting staging plan.

5.9 Maintenance

To ensure ecological restoration and enhancement is successful, planting areas will have a suite of maintenance, including weed control, infill planting, and pest animal control, and flooding maintenance.

5.9.1 Weed control

Ongoing control of pest plants will be required to facilitate the successful establishment of the planted natives. The key objectives of weed control in the plantings are to:

- Control, reduce, and eradicate pest plants within the planting areas, including willow (*Salix* spp.), blackberry, pampas, and any pest plants listed in the Regional Pest Management Plan (RPMP) or National Pest Plant Accord (NPPA);
- Control and contain outbreaks of infestations of pest plant species; and
- Ensure minimal damage to native plants and avoid adverse effects on streams and wetlands.

To achieve these objectives, weed control may be best achieved by using a combination of manual control and herbicide application using the manufacturer's recommended application rate. Glyphosate- and Triclopyr-based herbicides would be appropriate for the weeds currently present at this site, however, should other weeds exploit the site, then other herbicides or control techniques may need to be used.

Releasing will be required where rank grass is overgrowing plantings.

Control will be undertaken three (3) times per year (spring, summer, autumn) for five (5) years following planting, and then two (2) times per year (spring, autumn) for an additional ten (10) years, a combined total of 15 years of weed control following planting. Weed control will be undertaken by experienced and qualified contractors in the field of ecological restoration.

If using herbicide, weather conditions will be dry (and forecast to be dry for at least 12 hours to ensure adequate herbicide efficacy) and not windy (to avoid spray drift into streams and wetlands or non-target species). No herbicide will be applied directly onto native plants, streams or wetlands – instead, these areas will be controlled without the use of herbicide.

Good weed hygiene will be adopted when working on site. Clothing, boots and equipment will be free of any weed material and seeds before arriving or leaving the site. This will reduce the risk of spreading weed species.

5.9.2 Infill planting

Infill planting will be undertaken in month three (3), year one (1), and year two (2) following planting to achieve 80 % native canopy cover by year five (5). Infill requirements will be informed by observations during weed control and monitoring assessments (see Section 7.3). If 80 % native canopy cover is unsuccessful by year (5), infill planting will be reconsidered. The composition of infill plants does not need to be the same as the initial planting; instead, species growing well should be ordered and planted.

5.9.3 Post-flood maintenance

Flood events may affect the planted natives by physically removing plants, or smothering them in sediment or other debris. Riparian plantings may be vulnerable to flood events while they are growing,

because it takes time for stabilisation. Some in-stream sediment disposition and streambank erosion are to be expected as part of any naturally functioning stream system, especially as this new created system finds balance. However, a response will be needed to, at the minimum, inspect the plantings following heavy rainfall events.

5.9.4 Stock fencing

If stock are retained on any part of the property during staging, fencing installed for stock exclusion will be inspected and maintained, or until stock are removed. Inspections will occur in the same years as wetland and stream monitoring (years 1, 2, 5, 10, and 15 (wetlands only) after works). If stock are detected within the fencing, then fencing will be immediately inspected and repaired promptly.

6.0 Exotic animal management

Exotic animal management includes a combination of options including ownership recommendations and rules, structural exclusion, and ongoing control of browsing pests. Cat and dog controls will be implemented; boundary fencing around restoration areas will exclude stock; and browsing pests, such as rabbits, hares and possums will require suppression to revegetate palatable species. Control of animal predators including hedgehogs and rats will be undertaken within the lizard release area.

6.1 Animal management for planting areas

Animal control will be needed in places to facilitate revegetation across planting zones, to protect lizard populations in release sites, and to protect native fauna in wetlands and riparian margins. The key animal pest species that threaten the planting areas are possums, hares, and rabbits, as well as larger browsing animals such as deer and goats. Stock will be excluded by fencing prior to planting (see above). Rabbits, hares, and possums are present throughout the district. Animal pests will be controlled to a low level, and pest control will be undertaken by an experienced pest management contractor, to be engaged by the consent holder.

A pest animal control plan for each planting treatment will be prepared by an appropriately qualified and certified pest control contractor. The programme will focus on protecting planted vegetation to encourage the 80 % canopy cover target.

Animal pest control has been in place at varying levels over the previous several years. Based on the data of the previous control programme, the pest control contractor will prepare an appropriate programme for rabbits, hares, and possums as required.

The animal pest control contractor will consider and, if appropriate, incorporate the following factors as per their professional judgement:

1. For hares and rabbits, assess the level of rabbit presence prior to the start of the planting programme and use rabbit-proof plant guards, poison, or other approved control methods to reduce numbers until planted trees are resistant to rabbit browse;
2. For possums, undertake a knock-down control operation using encapsulated cyanide, tamper-proof traps, bait stations or some other method, and maintain ongoing control on a regular basis;
3. If obvious signs of geese-caused or pūkeko-caused plant mortality are apparent, consider localised control (shooting) or protection of plants (plant guards/ pinning plants);
4. Deer or goats straying onto site (an unlikely occurrence) will be controlled because individuals can cause considerable damage to planting areas.

Animal pest management and maintenance measures will be implemented for 10 years post-planting.

The types of baits, trap maintenance (e.g. bait replenishment) and specific locations will be determined onsite by the pest management contractor.

Monitoring sheets will be completed and retained as a record of animal pest control.

Post monitoring will be advised by the pest control operator, as will targets for a subsequent control programme. The purpose of the control programme will be to reduce pest animals to very low levels such that the likelihood of environmental damage being caused is low.

Where possible, the programme will coordinate with broader control programmes being managed by Council or others to leverage landscape-level benefits.

For possums the focus will be on assessing the levels of trap kills or bait take (as appropriate), and where at all feasible, work in with monitoring being undertaken by Council to provide a more robust picture of pest animal populations over these and adjoining sub-catchments.

Rabbit, hare and possum management and maintenance measures will be implemented for an adequate period from the commencement of bulk earthworks in each stage. Maintenance of control will be considered as the development progresses and will consider Council's district-wide programmes, local community support for ongoing pest control, and the advantages (if any) of continuing the programme.

6.2 Lizard release area

Pest animal control operations will be undertaken across the 5.8 ha lizard release area as outlined in the Lizard Management Plan (see LMP for full details).

This includes:

- Control of rats and hedgehogs through a trapping grid.
- Control for 10 years from the commencement of earthworks
- The pest animal control will be undertaken in conjunction with improvements to habitat for lizards through installing log refuges and node plantings, both of which will provide long-term protection of native lizards from predation after the pest animal control programme ceases.

6.3 Cat management

The following measures for cats will reduce ecological pressure on indigenous wildlife onsite.

Several options are proposed, at the discretion of the consent holder:

Option A.

- Pet control fencing around sensitive wetlands (being the Te Harakeke Swamp wetland, and the Pekapeka Wetland SNA sites); and
- Pest animal control (primarily trapping) in all ecological areas for a period of 10 years. This is part of the general pest control measures proposed for the project.
- Educational material to be provided to landowners.
-

Option B.

- No pet control fence.
- KCDC requirements of cat on properties (cat runs)

- Pest animal control in all ecological areas for a period of 35 years.
- Educational material to be provided to landowners.

Option C.

- Placement of a covenant precluding the ownership of cats on Paetawa Road lots to the east of Te Harakeke Swamp.
- Pest animal control (primarily trapping) in all ecological areas for a period of 10 years. This is part of the general pest control measures proposed for the project.
- Educational material to be provided to landowners.

6.3.1 Domestic cats

Kāpiti Coast District Council permitted activity rule GRUZ-R7, Standard 8, specifies that the keeping of domestic cats within a 500 m buffer of SNAs or protected ecological sites is not permitted unless the cats are kept in a cat run. As this buffer encompasses more than half of the properties within the site (Figure 27), and given that extensive wetland and stream restoration is proposed across the development area, including outside the 500 m buffer, WNDL proposes that for Option B, all domestic cats be required to be contained within the property of their owner throughout the entire development. This requirement would be secured by way of a covenant registered on the property titles.

In line with many New Zealand Territorial Authorities, all cats over four (4) months old and all re-homed stray cats, must be microchipped, desexed, and registered to the New Zealand Companion Animals Register (NZCAR). Owners must update any registration changes.

Domestic cats are defined here as cats that are both microchipped and registered. Where domestic cats are captured in live traps within the ecological management areas and are found to be non-compliant with District Council bylaws.

Cats roaming in these areas present a significant predation risk to avifauna and lizards. Research indicates that some cats previously captured in traps may become trap-averse and less likely to enter traps in the future, while individual cats can have disproportionate impacts on wildlife, including repeated predation on birds or targeting nests. For this reason, effective predator management requires that trapped cats are removed to avoid ongoing impacts on sensitive fauna.

Cat traps will be installed and managed by the experienced pest control contractor and checked every 1-3 days.

6.3.2 Feral and stray cats

Feral and stray cats include any cats which are not microchipped and registered. Any feral and stray cats caught in the live traps will be humanely euthanised.

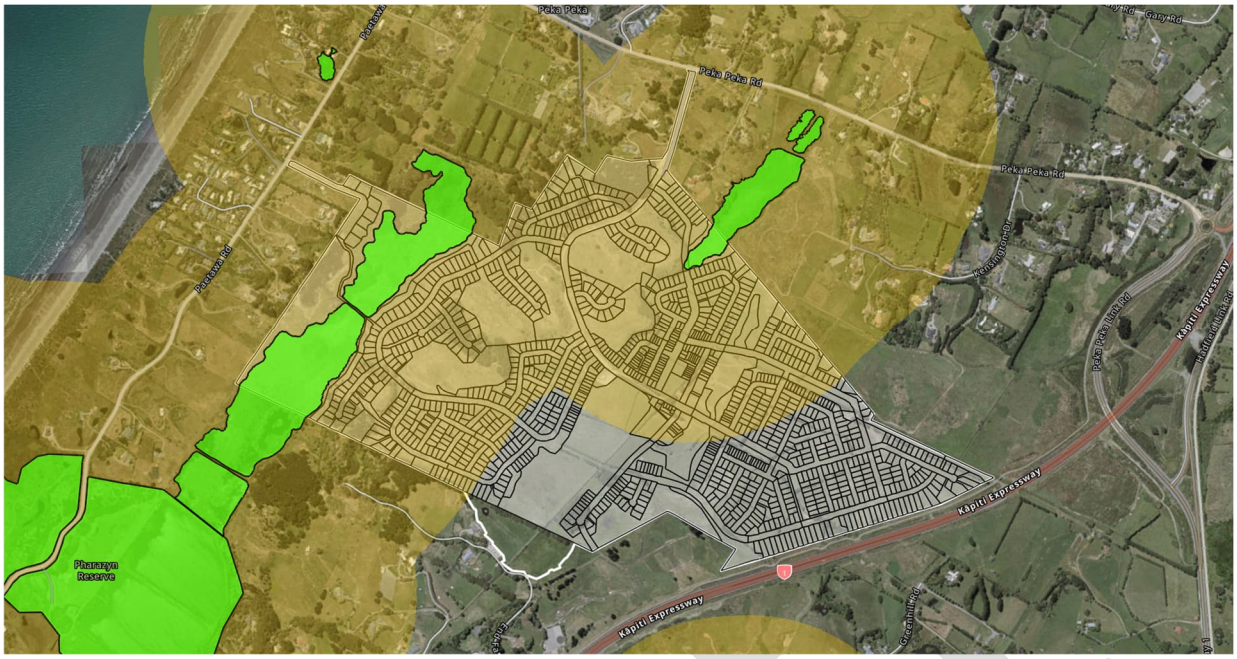

Figure 20. Significant Natural Areas (SNAs; green areas) around the site (white boundary) with the extent of 500 m buffer (yellow shading). Property lots outlined within the site (black outlines).

6.4 Wetland pet control fencing

To reduce predation pressure on wetland fauna, a pet control boundary fence is proposed as an option along the subdivision–wetland interface. Fencing is proposed at Te Harakeke Wetland and Pekapeka Road wetland, which are both SNA wetlands with high wetland bird values.

The fence is intended to substantially reduce cat access from the residential side while recognising that the wetland remains open on other sides and therefore cannot function as a full predator-exclusion enclosure. Installation of fencing within the wetland itself is not practicable due to the potential construction impacts on the SNA wetland and the increased likelihood of fence degradation within an aquatic environment.

Accordingly, the fence is located along the wetland margin where it can provide effective deterrence while avoiding disturbance to wetland habitats (Figure 28). Key design features, demonstrated to deter cat access, will be incorporated, including:

- Fence height: approximately 1.8 m vertical welded-mesh fence, excluding roller hood; and
- Mesh specification: small-aperture welded mesh (<50 mm) to reduce climbability; and
- Top barrier: a roller hood installed above the fence line to discourage climbing and jumping attempts by cats. The roller will be 300–400 mm in height and may comprise either smooth sheet metal or mesh. If a mesh roller is used, an electric deterrent wire will be installed as a mandatory component to prevent animals gaining purchase on the mesh surface. Electric deterrent: single electric outrigger wire installed near the top of the fence (~100–150 mm below the top) to discourage climbing attempts by cats; and
- Vegetation management: a minimum 3 m clearance corridor on the subdivision side of the fence will maintain vegetation to remove potential launch or climbing aids. Vegetation within this corridor will be maintained at low height (below 0.3 m). Along the eastern side of Te Harakeke wetland, planting of low dune herb and rush groundcovers within the dune

vegetation planting list will achieve maintain a 20 m wetland planted buffer as well as maintaining the clearance zone (Figure 29); and

- Subsurface barrier: installation of an underground mesh skirt may be incorporated (subject to detailed design) to discourage burrowing beneath the fence by dogs or rabbits, unless these species are otherwise effectively controlled; and
- Fence extensions: the fence will extend approximately 400 m along the subdivision's southern boundary to reduce the likelihood of cats bypassing the barrier at the ends and entering Te Harakeke Wetland on this property or adjoining properties; and
- Large-diameter end spirals (e.g. 5 m) are proposed at fence terminations where feasible, such as within open space areas. The spiral extends the fence into a continuous curved barrier, removing a direct "walk-around" path and requiring animals to enter a long, enclosed route (Plate 3). This configuration creates a behavioural barrier to cats, which are unlikely to traverse such features due to limited visibility and escape options, and tendency to follow along the fenceline and be directed back along the same fence. When well-constructed and maintained, end spirals can be highly effective at reducing cat ingress, although they do not guarantee complete exclusion. Smaller diameter fence spirals or curls of 2 - 3 m are proposed where lot layout precludes large diameter spirals.

The pet control fence is intended to prevent most cat incursions to SNA wetlands thereby reducing predation pressure on wetland birds and other fauna, rather than providing complete predator exclusion, which is not possible due to boundaries with neighbouring properties being un-fenced.

Fence sections (Figure 28) include:

1. The main fence will run along the eastern boundary of Te Harakeke Swamp, with extensions along the property boundary to the north and west, mitigating predation pressure from the main residential development to the west. The total length of fence is approximately 1,650 m.
2. At the western margin of Te Harakeke Swamp, the requirement for approximately 385 m of pet control fencing depends on whether the adjoining Paetawa Road lots are subject to covenants prohibiting the ownership of cats and dogs.
3. Pekapeka Road Wetland will also be protected by a pet control fence of the same design. Included are fence extensions 100 -175 m along the northern property boundary to reduce the likelihood of cats bypassing the barrier at the ends and entering the wetland on this property or the adjoining property, adding up to approximately 590 m total length.

Figure 28. Indicative pet control fencing layout (red lines), around SNA wetlands, Te Harakeke and Pekapeka Road wetlands.

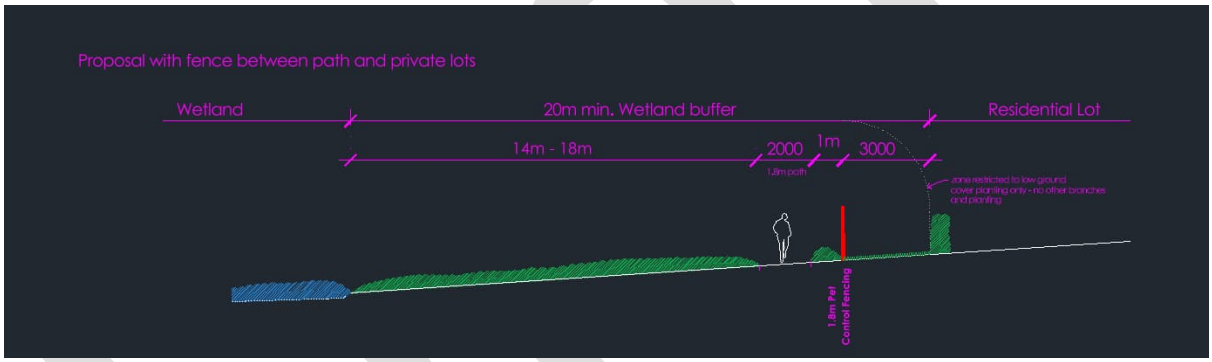

Figure 29. Profile view of fencing layout along eastern margin of Te Harakeke Swamp, relative to pedestrian walkway and wetland planted buffer.

Plate 3. Indicative design of predator exclusion fence with top cap, and end spiral to reduce incursions around fence edges. (photo shows Tawharanui Sanctuary fence).

Any fencing installed for cat control will be inspected and maintained by the consent holder for 35 years. At a minimum, the fence will be inspected 6-monthly, and after any particularly heavy rains or high winds. For the first month after installation, inspection will occur weekly. It is envisaged inspections will be conducted by the pest control operator (likely during trap checks).

The entirety of the fence will be inspected for damage or significant gaps to the mesh, cap and base skirting, any holes under the fence, tree fall, and vegetation or structures over 0.5 m height within the fence clearance zone, including overhanging trees from residential lots. In addition, residents will be encouraged to report any issues with the fence, through supplied cat management information packs. Damage to the fence will be repaired promptly by the applicant, on the same day where feasible.

Vegetation within the fence clearance zone (3 m from the fence towards the residential side of the fence) will be maintained to under 0.5 m height at all times, with a target of less than 0.3 m.

6.5 Educational material relating to domestic cats

WNDL will include cat education material with Sale and Purchase Agreements and Contracts. This will include the rules above and brief explanation around ecological impacts of cats.

The following information will be provided:

- The development contains natural areas that are being restored;
- Restoration includes the control of introduced pest animals;
- Pest animals include feral cats;

- Council bylaws and property covenants prohibit cat ownership, unless cats are contained within a cat run.
- There are live capture cat traps throughout the natural areas at Waikanae North Development;
- The contractor is obligated to check the trap within 24 hours of it being set;
- Feral cats are those cats that do not have a collar or microchip. Domestic cats are those cats that do have a collar and/or microchip;
- Feral cats will be humanely killed;
- Domestic cats caught within SNA wetlands will be returned to their owner, who will also be reminded of their obligation to keep the cat under control. Individual domestic cats caught more than twice within ecological areas, including SNA wetlands, will be treated as feral cats (i.e., humanely killed);
- It is therefore strongly recommended that the owners of domestic cats constrain their cat(s) to their private property to eliminate the risk of their domestic cat being treated as a feral cat.

6.6 Dog ownership management

Domestic dog ownership will be managed in accordance with the Kāpiti Coast District Council Dog Control Bylaw.

In addition, all dogs must be leashed outside of private residences and the fenced dog park.

7.0 Monitoring and reporting

Monitoring will be undertaken to track progress towards targets and to identify management issues so that corrective actions can be taken. Where necessary, adaptive management approaches will be taken.

Ecological monitoring of each value will be undertaken by a suitably qualified and experience ecologist who will be engaged and provided with this plan prior to implementation.

Hydrological monitoring and reporting will be undertaken by a suitably qualified and experienced hydrologist.

7.1 Stream restoration monitoring and reporting

Monitoring of realigned and recontoured streams include the following process.

1. Establish and monitor cross-sections at variable sites to assess habitat and sediment particulates.
2. Establish photo points showing variation in depth, width, and flow paths.
3. Assess whether scour is within expected parameters, and assess the degree of incision and evulsion (if any).
4. Assess woody structure stability and effectiveness.
5. Assess whether flow diversity remains.
6. Observations of overbank inundation and floodplain connection.
7. (Riparian vegetation is assessed in planting monitoring below).
8. Conduct baseline SEV surveys (Wellington version) at three representative 100 m reaches along the realigned section of Ngarara Stream (one in the upper reach, one in the middle reach, and one in the lower reach). SEV scores must match or exceed the baseline SEV score of 0.422 (excluding biotic indices) within 10 years after works.

Monitoring years will be years 1, 2, 5, and 10 after completion of the Ngarara Stream works.

7.2 Wetland restoration monitoring and reporting

7.2.1 Monitoring created wetlands

Wetland Ecological Valuation (WEV) scoring (created wetlands)

The WEV–ECR model used future potential states of wetland clusters to calculate offset requirements. The future states were potential restored states after 15 years of management, and these states will calibrate the targets for monitoring and compliance.

Monitoring will be completed at years 1, 2, 5, 10, and 15 after works. Monitoring will reassess WEV scores of the offsetting wetlands. The target will be the WEV values used in the WEV–ECR model in the RMA Ecology "Ecological Impact Assessment" report.

Attributes in the WEV assessment relating to neighbouring property activities, or attributes of catchment wide processes will be excluded from the assessment if they have deteriorated. Instead, attributes related to neighbouring properties will be incorporated at baseline values used for the ECR modelling in this report.

NPS-FM delineation protocols.

At least one full and representative wetland delineation NPS-FM protocol plot will be measured (including soils and hydrology components) in each discrete wetland (see Table 13 and Figure 30).

Hydrological monitoring.

Water level monitoring instruments will be installed in created wetlands, to monitor hydrological regimes for a minimum of 10 years post-development.

Success will be achieved if there is no deterioration in value or extent of wetlands. There may be fluctuations in condition and extent in the first 2 years. These will be reported and managed. By year 5 increases in value are expected relative to baseline conditions. If increases are not achieved, management actions will be discussed between council, ecologists, and WNDL to develop and implement solutions.

7.2.2 Monitoring retained wetlands

Retained wetland areas are potentially at risk of being affected by the development (i.e., those wetlands that may have their extent or catchment impacted by the development) and will therefore be subject to ecological monitoring.

Three or four control (reference) wetlands (i.e., those wetlands where it is certain that there will be no adverse effect on extent or catchment from the development) will also be monitored. The three control wetlands will be selected to be broadly representative of the wetland diversity that is being monitored. The catchments of the control wetlands will be outside of the earthworks footprint.

These reference wetlands will represent the best available examples on public land nearby (e.g. at the nearby Pharazyn Reserve duneland/ wetland restoration area), including part of Te Harakeke Wetland, and two smaller dune wetlands.

Ecological monitoring will be undertaken by a suitably qualified and experienced ecologist.

The framework for monitoring the subject wetlands is partially based on relevant aspects of the Handbook for Wetland Condition Monitoring[4]. The assessed aspects are dryland plant invasion, erosion and sedimentation (including dust), wetland area loss, and exotic species invasion.

An assessment of these aspects will be undertaken and a numerical percentage recorded (as well as a categorical score). The scoring is based on the percentage falling into broad categories but the exact percentage will enable a semi-quantitative commentary.

[4] Clarkson, B. R., Sorrell, B. K., Reeves, P. N., Champion, P. D., Partridge, T. R., and Clarkson, B. D. (2004). Handbook for monitoring wetland condition.

For each wetland, monitoring will be undertaken using the following methods:

1. Vegetation monitoring plots (retained wetlands):

   Two vegetation monitoring plots will be established and physically marked in each retained wetland that may be affected by the development (wetlands listed in Table 13; plot locations shown on Figure 30). Plots will be placed with consideration given to the following factors:

   - Representative habitat;
   - Reasonable proximity to the water table;
   - Locations where sedimentation may occur such as confluences, overland flow paths, or in proximity to proposed earthworks; and
   - Change sensitive areas of the wetland.

   Each plot will be marked with a wooden stake or waratah or similar. Plot sizes will be 2 x 2 m for groundcover stratum, a 5 m radius circle for scrub and sapling stratum, and a 10 m radius circle for trees (these dimensions will be adapted if necessary for smaller wetlands). If and where necessary, the shape of plots will be revised to ensure they do not extend outside of the wetland and into dryland vegetation communities.

   Each plot will be photographed.

   Data will be collected in accordance with the vegetation tool for wetland delineation[5]. Data recorded from these plots will be analysed to assess dryland plant invasion (criteria D1) and introduced plant canopy cover (criteria H3). The percentage for each indicator will be compared to the baseline measurements.

   In addition, each monitoring plot will be assessed according to the prevalence and dominance tests described in Clarkson (2013)[6].

Table 13. Wetlands at which retained wetland monitoring plots will be located.

Wetland	Number of monitoring plots
Retained wetlands – W1.1, W1.2, W1.3, W2.1, W2.2, W2.3, W2.5, W4, W5, W11, W13, W14, W16, W18	2 plots within each wetland – 28 plots in total
Created wetlands	13 (one within each of 13 discrete created wetlands)

[5] Clarkson, B. (2013). A vegetation tool for wetland delineation in New Zealand.

[6] Clarkson, B. (2013). A vegetation tool for wetland delineation in New Zealand.

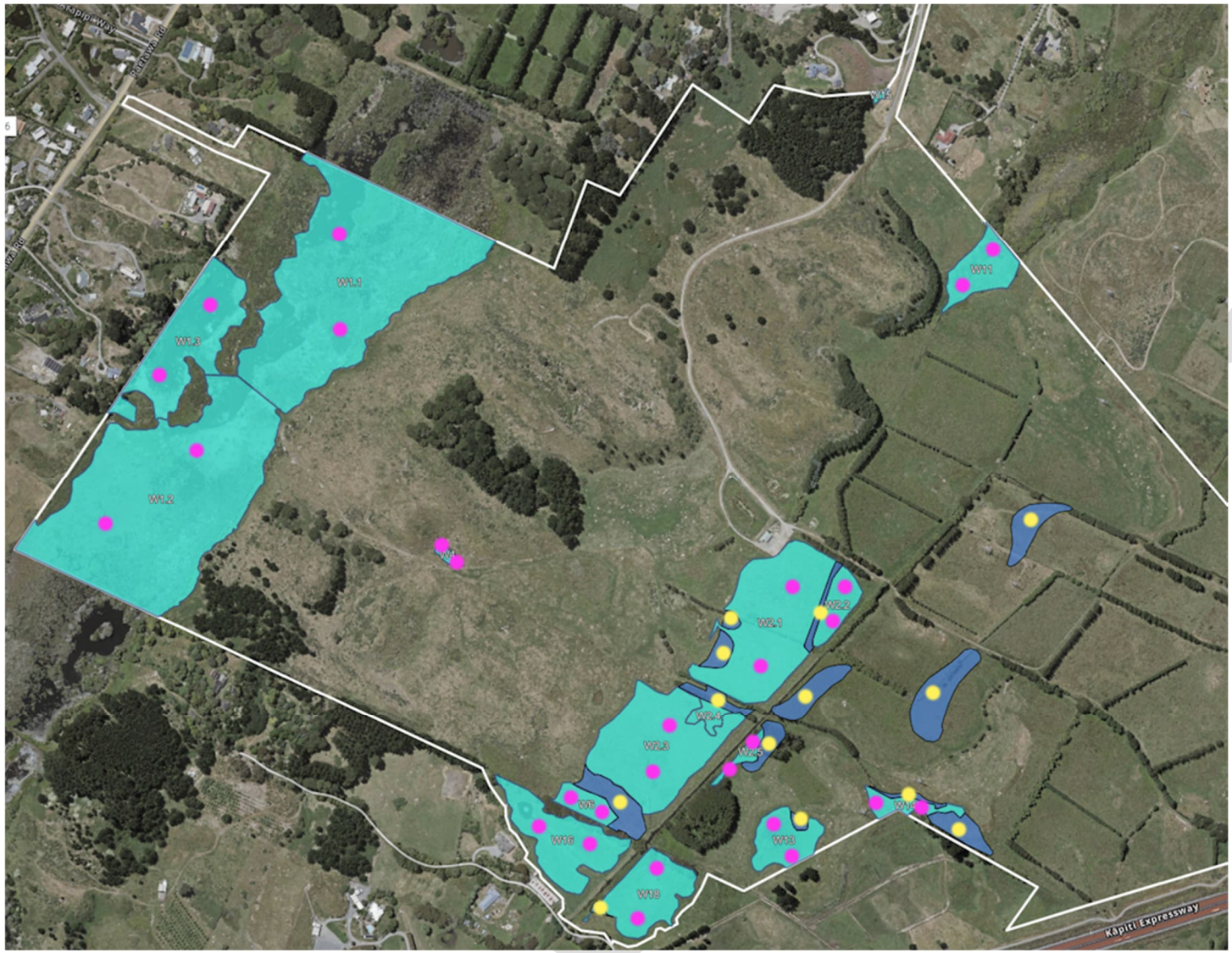

Figure 30. Locations of wetland monitoring plots within retained wetlands (turquoise polygons are retained wetlands; purple dots are indicative locations of monitoring plots, and created wetlands (dark blue polygons, with yellow dots as indicative plot locations).

2. Assessment of changes to wetland extent:

   Each wetland will be visually assessed for changes to wetland extent. If the wetland is visually assessed as being approximately the same as previous monitoring visits (i.e., +/- <5 % in size and likely as a result of seasonal fluctuations) then no further assessment is required. If the wetland extent is visually assessed as being markedly different to previous monitoring visits (i.e., +/- >5 %), then the extent of the wetland will be delineated by applying the wetland delineation protocols[7] and recorded using a GIS enabled device.

   Application of the wetland delineation protocols will likely require wetland plots additional to the vegetation monitoring plots described in Method 1 above, and will include the full range of wetland delineation methods (vegetation, soils, hydrology), if necessary, according to the wetland delineation protocols. The wetland boundary will be assessed according to factors described in Clarkson (2013), including visual clues such as vegetation or soils, and/or establishing paired wetland plots (wetland/upland) located close enough to either side of the wetland boundary to substantiate boundary location.

   Recorded data will be analysed to assess loss in area of original wetland (criteria E1).

3. General visual assessment:

   A general visual assessment of each wetland will be carried out to assess wetland condition (e.g., stock or vehicle damage, wetland plant dieback).

   At least four photo points will be established and retaken at each monitoring visit. The photo points will be easily re-taken (e.g., they have a fence post or notable tree within the frame) and will provide a meaningful comparison over time.

4. Sedimentation assessment:

   Each wetland will be assessed for the percentage cover of sediment and erosion across the wetland (criteria P2). If sedimentation, dust deposition, or erosion is detected, then photographs will be taken. If sedimentation is detected, then a soil profile will be excavated using a spade or hand auger to determine sediment depth.

   The percentage cover of sediment and erosion will relate to scoring detailed in Table 14.

Each of the four criteria will be recorded as a percentage (Table 14). The result for dryland plant invasion (indicator H3) or introduced plant canopy (indicator D1) from each of the two plots in a wetland will be averaged to obtain an overall percentage for each wetland. The percentage change compared to the baseline, relative to the matched control wetland, and matched to the same season (i.e., winter-winter or summer-summer) will be assessed at each monitoring visit after the baseline monitoring visits, as per the following equation which can be applied to each of the indicators described in Table 14:

$$\frac{Impact\ wetland\ baseline\ indicator\ \%\ -\ impact\ wetland\ during\ earthworks\ \%}{Control\ wetland\ baseline\ indicator\ \%\ -\ control\ wetland\ during\ earthworks\ \%} = \Delta\ indicator$$

For example, if the proportion of dryland species in a wetland (indicator H3) increases from 30 % in the baseline monitoring to 50 % one year later (20 % increase), and the matched wetland exhibited an increase from 20 % to 25 % over the same time period (5 % increase), then the effective change for the impact wetland will be 15 %.

[7] Ministry for the Environment. 2022. Wetland delineation protocols. Wellington: Ministry for the Environment.

An effective change for any indicator of > 7.5 % will serve as a trigger for further investigation by the ecologist and/or hydrologist to gather evidence for the causation of the degradation.

An effective change (i.e., relative to the matched control wetland) in prevalence score of > 0.5, averaged across the two wetland plots in each wetland will also serve as a trigger for further investigation by the ecologist and/or hydrologist to gather evidence for the causation of the degradation.

Note that the impact wetlands will be paired to control wetlands of the same or similar wetland type – eg. Te Harakeke wetland will be paired with Te Harakeke in Pharazyn Reserve, and eastern and dune edge wetland clusters will be paired with dune wetlands in Pharazyn Reserve. The Ngarara floodplain wetlands lack a comparable and nearby control which is publicly accessible and outside of the area potentially affected by the development. Several options at QEII park, 12 km to the south, will be assessed.

If it is determined that the degradation is at least potentially as a result of the earthworks and water diversions and discharges, then this will serve as an adverse effect trigger for intervention, including an adaptive management response, increased monitoring to assess success, and reporting of the adverse effect as described in Section 3.1.

7.2.3 Timing

In terms of timing, monitoring will be undertaken:

1. As a baseline, once within the 3 months preceding the commencement of earthworks in the wetland's catchment. If possible, the timing of baseline monitoring will be in summer or winter so that subsequent monitoring visits are comparable. And, if possible, a second baseline monitoring visit will be undertaken in the opposing season (i.e., in winter if the first baseline monitoring visit was in summer) so that there is comparable data for both summer and winter ongoing monitoring;
2. Biannual monitoring (summer and winter) throughout the duration of the earthworks in the wetland's catchment; and
3. Once between three and nine months following the completion of earthworks in the catchment of that specific wetland. Where feasible, this will be timed to coincide with the month or the season of the baseline monitoring.

Because the development will be staged, only some wetlands will be subject to monitoring at any one time.

Table 14. Wetland monitoring criteria.

Indicator and component/s	Explanation	Example
Δ Hydrological integrity H3: Dryland plant invasion	Percentage of wetland that has dryland plant species present (indicator ratings of FACU/UPL).	No dryland plants = 0 % All dryland plants = 100 %
Δ Physicochemical factors P2: Degree of sedimentation/ erosion	Percentage of wetland that has visible sediment deposits or erosion.	No sediment deposits or erosion = 0 % Completely covered in sediment or completely eroded = 100 %
Δ Ecosystem intactness E1: Loss in area of original wetland	Percentage of wetland area lost compared to baseline extent.	Wetland same size or larger = 0 % Wetland completely lost = 100 %
Δ Dominance of Native plants D1: Introduced plant canopy cover	Percentage of wetland that has introduced plants in the canopy	No introduced plants = 0 % All introduced plants = 100 %

7.2.4 Hydrological monitoring

Wetland Monitoring will be paired with on-going groundwater monitoring and informal stream flood flow behaviour to link wetland performance to the hydrological assessment set out in the Hydrological Report as the two are intrinsically linked. Hydrological monitoring will continue for a minimum of 10 years post development.

7.3 Planting monitoring

The target of the planting programme is to reach 80 % canopy cover by year 5 post-planting, or to maintain at least 550 trees (+10 %) for duneland treeland revegetation.

Monitoring will be undertaken at multiple intervals post-planting until 80 % canopy cover is achieved: at 3 months, at 1 and 2 years, and then every two years from year 5 onward to Year 9 (i.e, years 5, 7, and 9).

Monitoring will target all planting areas and schemes as described in Section 5.0. Monitoring referred to here excludes landscape and amenity plantings.

Table 15. Number of 3 m × 3 m monitoring plots for different planting areas.

Planting area	Area (ha)	Number of plots
Damp stream edges (R1)	1.11	10
Well-drained stream banks (R2)	0.48	10
Created wetlands (W1, W2)	1.79	20
Excavated swale nodes (W1)	0.09	7
Retained wetland enhancements nodes (W2)	0.60	20
Wetland margin buffers (W3)	9.08	45
Stormwater discharge buffer (W4)	0.48	10
Dune shrubland nodes (D1)	0.19	8
Dune treeland nodes (D2)	0.12	8
Total	13.94	138

Pest plant assessments in the planting areas, as well as revegetation reports, will be submitted to WNDL by the contractor. Plot sampling by an experienced ecologist will include:

- The percentage canopy cover of each planting area (Table 15) will be calculated by taking the average cover of sampled plots. A monitoring sampling plot is a 3 m × 3 m plot, in which the absolute native canopy cover of the area is estimated as a percentage by the ecologist.
- Revegetation planting will be sampled with 138 plots across all sampled areas, providing one plot per 1,000 m^2 (0.1 ha) of planting area.
- The condition of native plantings at each 3 m × 3 m plot, including:
    - General health and damage;

- Encroachment of pest plants in planting areas.

Recommendations will be provided for any infill planting required. Replanting stock must be eco-sourced from Foxton Ecological District or from nearby districts, including Kapiti Coast District, Porirua City District, and Horowhenua District.

7.4 Dwarf mistletoe presence-absence

A dwarf mistletoe presence-absence survey will be undertaken during clearance of the two *Kunzea amathicola* trees on the eastern flats, to be undertaken by a suitably qualified botanist.

7.5 Pest animal monitoring

Monitoring for pest animals will be undertaken in two phases:

1. Baseline monitoring prior to establishing the control network to determine the presence, abundance, and distribution of the target species; and
2. Ongoing monitoring to track the progress of pest animal control efforts.

Pest animal monitoring methods are described in Table 16 and will follow industry best practice[8,9].

Table 16. Target pest animals and monitoring methods.

Common name	Monitoring method/ target	Network dimensions	Bait type	Monitoring frequency
Possum	Less than a 10% Chew Card Index	2x transects at least 200 m apart; each transect consists of 10 chew cards set at 20 m spacing	Peanut butter	3 nights twice annually in May and September
Rabbit and hare	No mortality of planted plants Decline in night shooting returns per hunting effort (e.g. person hunting hours)	Planted areas monitored for plant mortality	N/A	1-, 3-, 6-, and 12-months following planting
Rats	Less than a 10% Tracking Tunnel Index	3x transects at least 200 m apart[10]; each transect consists of 10 tunnels set at 20 m spacing	Peanut butter	3 nights twice annually in May and September
Hedgehogs	Less than a 10% Tracking Tunnel Index	3x transects at least 200 m apart; each transect consists of 10 tunnels set at 20 m spacing	Eraze rabbit	3 nights twice annually in May and September

[8] Williams, D. 2013: DOC tracking tunnel guide v2.5.2: Using tracking tunnels to monitor rodents and mustelids. Department of Conservation, Science & Capability Group, Hamilton, New Zealand.

[9] National Pest Control Agencies (2015). A1 Possum population monitoring: Using the trap-catch, waxtag and chewcard methods.

Mustelids (ferret, stoat, weasel)	Less than a 10% Tracking Tunnel Index Catch per unit effort with evidence of a declining catch rate that stabilises at a very low level	3x transects at least 200 m apart; each transect consists of 10 tunnels set at 20 m spacing	Eraze rabbit	3 nights twice annually in May and September
Feral cat	Catch per unit effort with evidence of a declining catch rate that stabilises at a very low level.	Live capture traps; number and location to be determined by a qualified pest control contractor.	N/A	2 weeks, twice annually in May and September, or if other monitoring shows sign of cats in ecological areas.

7.6 Reporting

Written confirmation will be provided to GWRC, within 30 days following final completion of the restoration works of this ERMP.

A combined report for stream monitoring and wetland monitoring will be completed after each round of monitoring (years 1, 2, 5, 9, and 15). Stream and wetland monitoring reports will detail the following:

- The date of the inspection;
- The person carrying out the inspection and their qualifications;
- The results of the monitoring; and
- Recommended changes to the management regime.

The baseline monitoring report will be completed prior to the commencement of earthworks.

Should any monitoring of wetlands identify adverse effects as a result of the earthworks and water diversions and discharges, GWRC will be notified immediately and a report will be provided to GWRC within fifteen working days of the identification of the adverse effect, outlining (in addition to the above information):

- The adverse effect;
- The likely cause of the adverse effect;
- Measures that will be undertaken to prevent is from occurring again; and
- Measures that will be undertaken to remedy the effect.

In instances where there are no or negligible adverse effects identified from the monitoring, then the report will be provided to GWRC within three months of the monitoring being completed.

Revegetation monitoring reports will be completed and submitted to GWRC after each round of monitoring. Monitoring of revegetation areas will continue until all planting areas achieve 80 % canopy cover. Individual planting areas which achieve 80 % canopy cover will be excluded from the following round of monitoring. Monitoring will be undertaken at multiple intervals post-planting until 80 % canopy cover is achieved: at 3 months, at 1 and 2 years, and then every two years from year 5 to year 9.

The revegetation monitoring assessments will include:

- The date of the inspection;
- The person carrying out the inspection and their qualifications;
- Comparison of repeatable photopoints;
- Survival estimates and the number of infill plantings of each species.
- Notes on areas or species struggling;
- The percentage canopy cover estimated;
- The condition and survival of native plantings, including any considerable gaps in planted areas;
- A map showing the general locations of weeds found and controlled during that year;
- General indication of wetland and riparian margin health;
- Observations of any damage to native trees and plants (whether caused by people, pest animals, or natural events) that may increase the susceptibility of planted areas to weed interference;
- Pest animal control applied during that year together with an estimate of the number of pest animals removed or the effectiveness of control techniques at reducing pest densities; and
- Corrective actions undertaken to reduce threats to planted areas and levels of pest animals, as appropriate.

At the completion of the 80 % canopy cover across the entire revegetation area, a final report will be submitted to the GWRC by a suitably qualified ecologist summarising the outcomes of the planting and maintenance in accordance with this plan. At this point a decision will be made by the WNDL and GWRC as to the ongoing scope and duration of the monitoring and maintenance programme.

7.7 Remediation works

If the monitoring assessments find that the stream restoration, wetland restoration, or planting revegetation have been unsuccessful, then corrective actions will be recommended and managed in the monitoring reports.

If remediation work is recommended to streams, wetland, or revegetation, the consent holder will:

- Undertake the remediation work within six months from the date it was recognised as being necessary; and
- Provide GWRC with a report confirming the remediation work has been undertaken. This report will be submitted to WRC within 6 months after the remediation work has been undertaken.

If the reassessments of WEV calculations (which will use baseline scores for attributes outside of WNDL control) are below the set targets at 9 and 15 years, then a Wetland Remediation Works Plan must be prepared within six (6) months following the WEV assessment. The Wetland Remediation Works Plan will identify the reasons for falling short of targets, and it will propose repairs or improvements for meeting target WEV scores.

7.8 Mechanisms for protection

All planting areas will be protected in perpetuity by covenant or similar.

7.9 Pest monitoring

The certified and experienced pest control contractor will provide annual reports to WNDL and GWRC.

8.0 Roles and responsibilities

Registration of Covenants for Significant Natural Areas and wetlands on site with Greater Wellington Regional Council (GWRC) will be completed, and a copy of the updated record of title will be provided to GWRC.

Project implementation, project management and performance monitoring will be managed internally by WNDL with fieldwork delivered mainly by contractors. Details of roles and responsibilities associated with this management plan are provided in Table 17.

Table 17. Roles and responsibilities associated with this Management Plan.

Position	Accountable Task
Waikanae North Developments Limited (WNDL)	Provide adequate resources for the implementation of this Plan and ensure it is implemented in accordance with any approved requirements; Report the results of the works to GWRC in accordance with the monitoring and reporting requirements of this Plan; Organise the annual work programme as described in the relevant parts of this Plan; Facilitate any monitoring required as part of this Plan; Ensure the instruction of workers, and ensure the implementation of the requirements of this Plan, including monitoring the effectiveness of the methods set out in this Plan; and Ensure monitoring is conducted, recorded, and communicated as per the requirements of this Plan.
Suitably qualified ecologist – (staff or contractor)	Provide technical advice, including on-site assistance (e.g. planting audits, monitoring, and technical reporting) as may be required by this Plan and by WNDL;
Contractors	Undertake works associated with stream modification, wetland creation, planting, planting maintenance, weed control, animal pest control; Ensure all personnel are fully trained and aware of relevant requirements under this Plan; and Undertake work practices that comply with this Plan.

9.0 Planting timeframe

This ERMP will be submitted to Greater Wellington Regional Council.

Monitoring and reporting are to be completed annually with specified information outlined in Section 7 of this ERMP (Table 18).

See Figures 26a and 26b for indicative earthworks and planting staging across the site.

The table below provides a generic timeline of for each area planted in term of maintenance, monitoring and reporting for individual areas (irrespective of calendar year planted).

Table 18. Yearly timeline for monitoring and reporting, including quantity of tasks required.

Task	Year: 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Site preparation	× 1															
Eco-sourcing plant stocks	× 1															
Planting		× 1														
Weed control	× 1	× 2	× 3	× 3	× 3	× 3	× 2	× 2	× 2	× 2	× 2	× 2	× 2	× 2	× 2	× 2
Infill planting		× 2	× 1			× 1										
Planting monitoring (until 80 %)		× 1	× 1	× 1	× 1	× 1										
Retained wetland monitoring	× 1	× 2	× 2	× 1												
Created wetland monitoring		× 1	× 1			× 1					× 1					× 1
Stream restoration monitoring		× 1	× 1			× 1					× 1					
Fencing assessments		× 1	× 1			× 1					× 1					× 1
Animal pest control as required																
Reporting		× 2	× 2			× 2		× 1		× 2						× 2

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30-Mar-26

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Appendix 1. ERMP consent conditions

[to be completed once consent is granted]