Milldale Argent Lane Extension
Ecological Assessment of Effects

Report prepared for:
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Epoch Ref: 1-MM001

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1 Introduction

Epoch Ecology has been engaged by Mott MacDonald on behalf of Fulton Hogan Development Limited to undertake an ecological assessment for a proposed road extension and realignment as part of the Milldale Development, north of Auckland (the Project) (Figure 1).

The purpose of this ecological assessment is to identify the actual and potential effects of the Project on the ecological values of the site, during both construction and operation. Where potential adverse effects are identified, this report proposes appropriate measures to avoid, remedy or mitigate those effects.

This report has been prepared to support the notice of requirement (NOR) and resource consent application(s) for the proposed road extension.

2 Methodology

This assessment was based on the following:

- A desktop information review of maps and databases in table 1:

Table 1: Databases used for desktop review.

Database	Source
Auckland Council GIS- catchments and hydrology layer; historic aerial photograph layer	http://maps.aucklandcouncil.govt.nz/aucklandcouncilviewer/
New Zealand Land Cover Database (LCDB) version 4.1, Mainland New Zealand	https://lris.scinfo.org.nz/layer/423-lcdb-v41-land-cover-database-version-41-mainland-new-zealand/
DOC Herpetofauna Database	Natural heritage information project (herpetofauna), DOC Wellington
New Zealand Freshwater Fish Database	https://www.niwa.co.nz/our-services/online-services/freshwater-fish-database
Auckland Unitary Plan (AUP: OP) Operative in part, updated May 2020- Natural Resources and Natural Heritage Overlays	http://acmaps.aucklandcouncil.govt.nz/unitaryplan/FlexViewer/index.html

A site visit was conducted in September 2019 to provide a qualitative terrestrial, and semi-quantitative aquatic ecological assessment, consisting of:

- Compilation of an indicative vegetation list of canopy trees, sub-canopy and groundcover tier species, exotic species and general vegetation habitat quality;
- Assessment of lizard and bat habitat quality, including presence of suitable substrate for lizards and foraging/roosting trees for bats;
- Observation of all bird species present at the site during the visit, either flying overhead (where applicable) or within the Project area;
- Deployment of two fkye and two G-minnow traps within an artificial pond that is connected to an overland flowpath within the Project area;
- Classification of all overland flowpaths within the Project area as ephemeral, intermittent, or permanent using Auckland Council guidelines;

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Figure 1. Site location within the Auckland Region.

0 1 2 km

Projection: NZDG 2000
Source: LINZ Topo 50 maps

- Classification of all wetland areas using the definition of a wetland under the RMA definition of a wetland;

- Measurement of 10 cross-sectional widths of an overland flowpath within the proposed road corridor for Stream Ecological Valuation (SEV) compensation purposes;

- Assessment of potential ecological values after implementation of practical ecological restoration methods.

The New Zealand Threat Classification System (Hitchmough et al. 2007) has been developed to determine the importance of any indigenous plant or animal species present at a site. The New Zealand Threat Classification System and updates of this classification system for freshwater fish (Dunn et al. 2017), birds (Robertson et al. 2016), bats (O'Donnell et al. 2017), plants (de Lange et al. 2017) and reptiles (Hitchmough et al. 2015) have been referred to where applicable to the Project.

Reference was also made to the relevant schedules in the Appendices of the Auckland Unitary Plan: Operative in Part (May 2020) (AUP: OP), in particular the Schedule of Notable Trees and the Schedule of Significant Ecological Areas (version updated 8 May 2020).

The status of pest plant species was determined with reference to the Auckland Regional Pest Management Strategy (2007-2014) and the National Pest Plant Accord.

2.1 Watercourse Classification

2.1.1 Streams

An initial desktop review was conducted using Auckland Council GIS Viewer (catchments and hydrology layer), to determine the likely location of the ephemeral/intermittent boundary for each watercourse. To improve the accuracy of stream classifications, Auckland Council have used the results of research by Storey and Wadhwa (2009) together with the catchments and hydrology layer of the Auckland Council GIS Viewer to predict the boundary of ephemeral and intermittent stream types. That research found that a catchment greater than 1.8 ha (averaged over catchment geology) indicates the predicted boundary point between an intermittent and ephemeral stream. Ground-truth studies from Auckland Council have found that in general the boundary can be anywhere between 1.3-1.8 ha across the Auckland region, depending on catchment geology.

The definitions of stream types within the AUP:OP are listed below.

Permanent River or Stream

The continually flowing reaches of any river or stream.

Intermittent Stream

Stream reaches that cease to flow for periods of the year because the bed is periodically above the water table. This category is defined by those stream reaches that do not meet the definition of permanent river or stream and meet at least three of the following criteria:

a) It has natural pools;
b) It has a well-defined channel, such that the bed and banks can be distinguished;
c) It contains surface water more than 48 hours after a rain event which results in stream flow;
d) Rooted terrestrial vegetation is not established across the entire cross-sectional width of the channel;
e) Organic debris resulting from flood can be seen on the floodplain; or
f) There is evidence of substrate sorting process, including scour and deposition.

Ephemeral Stream

Stream reaches with a bed above the water table at all times, with water only flowing during and shortly after rain events. This category is defined as those stream reaches that do not meet the definition of permanent river or stream or intermittent stream.

2.1.2 Wetlands

In the absence of a wetland definition in the AUP the RMA definition was used to classify wetlands as intermittent or permanent-

Wetland includes permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that area adapted to wet conditions.

3 Description of Site and Works

3.1 Site Description

The existing environment of the Project area consists of pasture grass, a stand of poplar (*Poplus* spp), and planted native trees within the road corridor of Pine Valley Road. Young native vegetation and large exotic trees are present within the road corridor of Dairy Flat Highway.

Various overland flow paths are present within the pasture area that flow in an approximate south-west to north-east direction, adjacent to and across the footprint of the proposed road (Figure 2).

3.2 Proposed Works

A new interim two lane road section will be constructed (within two years) between Old Pine Valley Road connecting to the existing Pine Valley Road with pedestrian footpaths and cycleways and the NOR/ designation will future proof widening to four lanes at a later date (~2036).

Dairy Flat Highway is proposed to be widened by the addition of a second eastbound lane with an upgrade to the Dairy Flat Highway/Pine Valley Road intersection in the interim stage (within two years).

An approximately 270 m^2 artificial pond is located within the alignment of the proposed new road (Figure 2). The pond will be filled and flow will run through a 1500 mm wide by 750 mm high 43 m long box culvert underneath the road to join the downstream channel. The invert level of the culvert will be 250 mm below the stream bed, meaning the stream bed will form over the culvert floor over time, and allow fish passage. An approximately 40 m new channel, with the purpose of mimicking the natural stream channel, will be created adjacent to the proposed road to connect the culvert outlet with the existing downstream stream channel (Appendix 1).

All stormwater from the new road and the upgraded existing roads will be treated through a series of raingardens, with a super raingarden constructed in a pasture area adjacent to Pine Valley Road. A new outlet will be constructed adjacent to the northern end of the constructed channel, south of Old Pine Valley Road. Another outlet will be constructed to discharge stormwater into an ephemeral stream that flows into the true left bank of the permanent stream near the existing bridge of Pine Valley Road. Two new outlets will be constructed to discharge stormwater into the true right bank of the permanent stream, and one outlet will be constructed to discharge flow from the southern side of Dairy Flat Road into the John Creek catchment to the south of the Project Area (Appendix 1).

A series of batters will be constructed either side of Dairy Flat Highway and Pine Valley Road. A combination of cuts and batters will be used to construct the new road to link Old Pine Valley Road to Pine Valley Road. Indicative earthworks for the Project are cut volume of 10,600 m^3 (maximum depth of cut 4 m), fill volume of 28,600 m^3 (maximum height of fill 5 m), giving a balance of 18,000 m^3 (fill).

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Legend

Overland FlowPaths | Artificial Pond | Extent of Construction

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Figure 2. Site Layout

0 100 200 m

DATE: 26 May 2020

Projection: NZGD 2000
Source: Auckland Council Geomaps

4 Desktop Information Review

4.1 Local Planning Documents

The Auckland Unitary Plan Operative in Part November 2016 (updated May 2020) shows no Significant Ecological Areas (SEA) or notable trees within the Project area.

4.2 Ecological/Environmental Information Sources

The terrestrial databases, reports, documents and photos described in section 2 were reviewed for relevant ecological information at the site. The results are described below:

- Auckland Council GIS: Multiple overland flow paths originate within the farmland adjacent to and across the Project area. The largest modelled catchment of the flow path within the alignment at the artificial pond is approximately 1.5 ha, indicating the ephemeral/intermittent boundary is near that location. The largest modelled catchment size of the flow path that crosses underneath Pine Valley Road is approximately 130 ha. Based on the catchment size of 130 ha, the flow path is permanent (Auckland Council, 2014. Guidance for the classification of drainage systems based on the Proposed Auckland Unitary Plan definition). These drainage classifications were considered during the site visit.

- Historical aerial photos on the Auckland Council GIS website from 1999 show the vegetation of the Project area as similar to current aerial photos. Photos earlier than 1999 are unavailable on the Council GIS website.

- New Zealand Land Cover Database (LCDB) version 4.1, Mainland New Zealand: The LCDB classifies the Project area as 'high producing exotic grassland'.

- DOC herpetofauna database: A search of the database shows no records of any species at the site. The database shows records of native copper skink (*Oligosoma aeneum*) (Not Threatened), and ornate skink (*Oligosoma ornatum*) (At Risk-Declining) from 2011 less than 2 km from the site. Records of forest gecko (*Mokopirirakau granulatus*) and elegant gecko (*Naultinus elegans*) (both At Risk-Declining) are present from 2009 within 10 km of the Project area.

- New Zealand freshwater fish database: The NZ Freshwater Fish Database was accessed in March 2019 searching for records that within the same catchment as the Project site and within the past 10 years. No records were found within the onsite waterways, or within the parameters that were searched. Multiple records from 2007 of banded kokopu (*Galaxias fasciatus*) (Not Threatened), inanga (*Galaxias maculatus*) (At Risk-Declining), and eel (*Anguilla* spp) are from a location approximately 2.5 km downstream from the Project area.

5 Site Visit

A site visit was conducted in September 2019 during fine weather after an extended period of rain.

5.1 Vegetation

The area where the proposed road will be constructed consists mainly of pasture grass. A small stand of mature poplar trees south of Old Pine Road is located within the Project area (Figure 3). Weed species are present mostly along the southern edge of the poplar stand, consisting of blackberry (*Rubus fruticosis*), arum lily (*Zantedeschia aethiopica*), and pampas (*Cortederia* spp).

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Legend

- Poplar plantation
- Native Plantings
- Pine Macrocarpa Totara
- Extent of Construction

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Figure 3. Vegetation communities within the road alignment

0 100 200 m

DATE: 26 May 2020

Projection: NZGD 2000
Source: Auckland Council Geomaps

Native plantings are located within the road corridor of Pine Valley road, near the existing culvert of the permanent stream. Tree species consist of approximately 2-3 m kahikatea (*Dacrycarpus dacrydioides*), tanekaha (*Phyloclladus trichomanioides*), and rimu (*Dacrydium cupressenum*). A row of flax (*Phormium tenax*) and ti kouka (*Cordyline australis*) is located either side of the road (Figure 3). Scattered wiwi (*Juncus edgariae*) is also present.

Juncus species are scattered throughout wet areas within the Project area either side of Pine Valley Road up to Dairy Flat Highway. Species are likely to be native *J. edgariae* and exotic *J. effusus*, however the level of livestock grazing makes it difficult to determine.

The vegetation surrounding Dairy Flat Highway consists mainly large pine (*Pinus radiata*) and macrocarpa (*Cupressus macrocarpa*). Scattered native totara (*Podocarpus totara*) and ti kouka are also present.

5.2 Avifauna

A variety of common introduced and native birds were noted within the Project area during the site visit (Table 2). These were generally typical of riparian and forest margin habitat.

Table 2. Bird species found in the Project area during the site visit.

Endemic	Native	Introduced
• Fantail (*Rhipidura fuliginosa*)	• Swamp harrier (*Circus approximans*) • Pukeko (*Porphyrio melanotus*) • Spur winged plover (*Vanellus miles*) • White faced heron (*Egretta novaehollandiae*)	• Eurasian blackbird (*Turdus merula*) • House sparrow (*Passer domesticus*) • Song thrush (*Turdus philomelos*)

5.3 Herpetofauna

Minimal habitat for native lizards is present within the Project area. A small amount of woody debris is present underneath the mature poplar trees, however this area is heavily grazed and likely precludes native skinks. The habitat surrounding Old Pine Valley Road is generally unsuitable for native lizards. No suitable gecko habitat is present within the Project area.

5.4 Long-Tailed Bats

Long-tailed bats may potentially utilise the large poplar trees within the pasture of the Project area as roosting or foraging habitat. Long-tailed bats are known to use gullies and streams as flyways between roost sites and foraging areas. High activity will be found at favourable foraging sites such as linear bush margins, for example the adjacent SEA alongside Weiti Stream to the north. A survey by Opus International Consultants using Automatic Bat Monitors (ABM) found no bat activity along the SEA edge in 2015. Long-tailed bats could potentially be detected at least in passing through the landscape, however the vegetation within the Project area is low quality foraging habitat and not critical for any population of long-tailed bats.

Long-tailed bat activity has been detected relatively nearby at Okura, and Riverhead Forest is a known roosting site. Given the more favourable large tracts of pine forest within Riverhead Forest and native forest in the Waitakere Ranges, the likelihood the large trees within the Project area are being utilised for roosting is very low.

5.5 Waterway Classification

A total length of 93 m of stream reaches were classified as intermittent within the Project area (Figure 4). The longest reach is 49 m upstream from the artificial pond near Old Pine Valley Road at the northern edge of the proposed road (stream A). A smaller reach of approximately

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- - - Existing Culvert
Artificial Pond
Artificial
Intermittent
Extent of Construction
Intermittent Wetland
Ephemeral
Permanent

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Figure 4. Waterway classification within the road alignment

0 100 200 m

DATE: 26 May 2020

Projection: NZGD 2000
Source: Auckland Council Geomaps

43 m is located on the eastern side of the alignment draining a wetland on the slope adjacent to Pine Valley Road (stream B).

Artificial Channel

The artificial channels located either side of Pine Valley Road are an unnatural construct associated with the road and cannot be included in the natural watercourse classification criteria.

Ephemeral Reaches

Reaches classified as ephemeral failed to meet three out of the five criteria for intermittent streams and were therefore classed as ephemeral. The modelled catchment size of the ephemeral reaches were all under 1.2 ha, indicating that the catchment is too small to support intermittent stream criteria.

Intermittent Stream A

All intermittent reaches met three out of the five criteria-

a) It has natural pools;
b) It has a well-defined channel, such that the bed and banks can be distinguished;
c) Rooted terrestrial vegetation is not established across the entire cross-sectional width of the channel

The organic debris and substrate sorting criteria are often difficult to apply in pasture environments as there is minimal input to the stream in the absence of canopy cover.

The upstream point where Intermittent stream A crosses the alignment has a modelled catchment size of approximately 1.49 ha, and 2.22 ha at the downstream point. This indicates the reach within the alignment is intermittent. The site visit showed the reach below the boundary shown in Figure 4 had natural pools and held more water than any point upstream. Livestock pugging in pasture areas often makes it difficult to establish where the bed or banks are located. There was a definite change in the stream bed downstream from the point in Figure 4 so that banks were able to be distinguished. In addition, there was a definite change to aquatic vegetation within the channel.

Intermittent Stream B

Intermittent stream B is more difficult to classify as it has a modelled catchment area of less than 1 ha, however there is a well-defined channel, with minimal terrestrial vegetation and there is a substantial amount of water present compared to upstream. It appears that the flowpath on the western side of Pine Valley Road is contributing to the flow via the small culvert underneath the road, shown in Figure 4, and therefore the modelled catchment size could be underestimating the actual catchment size.

Permanent Stream

The modelled catchment size of the stream underneath the existing culvert of Pine Valley Road is approximately 127 ha, indicating the stream is likely to be permanent. Further site visits in summer would be required to confirm this, however it is very likely the stream is permanent.

5.5.1 Wetlands

Wetland areas met the classification of ‘wetland’ under the RMA as they are a least intermittently wet and contain the native wetland plant *Juncus edgariae* and the exotic *Juncus effusus* (Figure 4). More than half of the wetland areas are comprised of exotic pasture grass, interspersed with the *Juncus* spp.

These areas also have a wetter soil profile compared to surrounding pasture areas. Other *Juncus* species may be present, however the extensive livestock grazing makes it difficult to determine species. A white faced heron (*Egretta novaehollandiae*) was observed in proximity to one of the wetlands and it is possible pukeko (*Porphyrio melanotus*) and various duck species utilise the wetlands at least periodically. It is likely the wetland areas are intermittent, with water only present during the wet season approximately May to November.

A portion of the ephemeral stream reaches are located within wetland areas and there is often little distinction between an ephemeral stream reach with no channel and an intermittent wetland.

The wetland areas meet the natural wetland definition under the RMA, however the ecological value of the wetland areas is low. Livestock access has severely impacted these areas through pugging and grazing. The removal of livestock and planting of *Carex* spp would improve the wetland areas, however due to their small size and the lack of potential habitat provision for native fauna the restoration potential is limited. The wetland areas likely could contribute to ecosystem services such as flood attenuation or nutrient capture, but potential habitat values are very limited.

5.6 Fish Traps

The two fykes and two G-minnow traps were baited with cat food and deployed overnight in the artificial pond for one night in September 2019. A total of five short fin eels (*Anguilla australis*) were caught, ranging in size from 250 mm – 600 mm.

5.7 Aquatic Ecological Values

The northern intermittent stream (stream A) has an average wetted channel width (excluding the artificial pond) of 0.5 m. The ecological values of stream A are low, with pugging and livestock impacts similar to the wetlands adjacent to the Project area near Dairy Flat Highway. Habitat provision is very low, with no shade and minimal organic matter input for macroinvertebrates or fish. The channel is not well defined and water is absent for most of the year given the location high in the catchment near the ephemeral boundary. It is likely the stream would have a SEV score in the range of 0.3-0.4 based on the current ecological values.

The southern intermittent stream (stream B) has an average wetted channel width of 0.4 m. The ecological values of stream B are similar to stream A and the adjacent wetlands. Stream B has a fairly well defined channel, with likely artificially increased flow from the upstream wetlands either side of Pine Valley Road contributing to channel incision. The channel is present for approximately 43 m to a point where minimal channel is present and flow appears to have been historically diverted along a fenceline and into the downstream wetland adjacent to the permanent stream.

Removal of livestock and riparian planting would improve the ecological values, especially through shade provision and increased organic matter input. The improved habitat values may not benefit fish (except short fin eels for stream A) due to the general absence of water throughout much of the year and generally unfavourable habitat downstream, however the macroinvertebrate community could potentially respond positively to riparian improvement. Stream B appears to have artificially elevated flow from the input of the wetland on the west side of Pine Valley Road. The downstream reach along the fenceline would likely limit habitat value of Stream B.

6 Assessment of Ecological Significance

6.1 Assessment Methods

Guidelines for undertaking Ecological Impact Assessments (EcIA) have been published by the Environment Institute of Australia and New Zealand (EIANZ, 2015). Chapter 6 provides a proposed criteria for assigning value to vegetation or habitat for assessment purposes (Table 7) and criteria for describing the magnitude of effects (Table 8).

Table 7. Assigning value to vegetation or habitat for assessment purposes (From EIANZ, 2015).

Determining factors	Value

Supporting more than one national priority type	Very High
Supporting one national priority type or naturally uncommon ecosystem	High
Locally rare or threatened, supporting no threatened or at risk species	Moderate
Nationally and locally common, supporting no threatened or at risk species	Low

Table 8. Criteria for describing magnitude of effects (From EIANZ, 2015).

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

The level of effect can then be determined through combining the value of the ecological feature/attribute with the score or rating for magnitude of effect to create a criteria for describing level of effects (Table 9).

Table 9. Criteria for describing level of effects. (From EIANZ, 2015).

Ecological Value → **Magnitude** ↓	Very High	High	Moderate	Low
Very High	**Very High**	**Very High**	**High**	Moderate
High	**Very High**	**Very High**	**Moderate**	Low

Moderate	**Very High**	**High**	Low	Very Low
Low	**Moderate**	Low	Low	Very Low
Negligible	Low	Very Low	Very Low	Very Low

The cells in bold in Table 9 would represent a ‘significant’ effect. Cells with low or very low levels of effect represent low risk to ecological values rather than low ecological values per se. Moderate represents a level of effect that requires careful assessment and analysis of the individual case. These effects could be mitigated through avoidance, design, or extensive appropriate mitigation actions (EIANZ, 2015).

7 Assessment of Effects

7.1 Vegetation Effects

The mature poplar trees and pasture area that will be impacted by road construction has low ecological value and a low magnitude of effect. The native plantings along Pine Valley Road and the semi-mature totara adjacent to Dairy Flat Highway provide limited habitat for native fauna, and birds in particular.

Based on the ‘criteria for describing level of effects’ from the EIANZ matrix in table 9 above, the ecological effects on vegetation can be described as very low, or ‘less than minor’.

7.2 Construction Effects

Construction will comprise building a new road through the pasture area and installation of a culvert across an intermittent stream and creation of a new stream channel, and road widening with associated batters along Pine Valley Road up to Dairy Flat Highway, and Dairy Flat Highway itself. The artificial pond will be filled and a culvert, designed to allow fish passage, will be constructed to take flow underneath the proposed road. A new channel, designed to mimic the existing stream, will be created adjacent to the proposed road and will link the culvert with the existing downstream channel.

Construction debris, including concrete slurry and oil, or machinery has the potential to impact on the intermittent and permanent streams within, and adjacent to, the Project area. Sediment has the potential to reach these waterways indirectly from runoff during road construction. The level of effects from runoff can be kept very low through the application of industry standard sediment and erosion control devices and best practice sediment management techniques during road construction.

Shortfin eels are likely to be present within the artificial pond during wetter months of the year. There is the potential for adverse effects on any fish species present within the pond if the pond is decommissioned and the culvert is installed during wet periods of the year.

A super raingarden will be located in the pasture area on the western side of Pine Valley Road, up the slope from the true right bank of the permanent stream. Riprap will be installed at each of the five new outlets to minimise scour and erosion within the various receiving streams. No machinery will be required to operate within any watercourses for riprap construction. With adequate sediment and erosion control, effects of super raingarden and riprap construction should be minimal.

7.3 Stream Effects

The construction of the proposed road over stream A results in the loss of 49 m of intermittent stream. The construction of batters adjacent to Pine Valley Road will fill 17 m of stream B. The loss of almost the entire upstream catchment of stream B from batter construction means the entire 43 m of stream B will likely be lost. The ecological value of these stream reaches is low, however riparian planting and stock removal would likely improve values through shade provision and organic matter input during periods of flow. Mitigation for the loss of these intermittent stream reaches is required to reduce the level of ecological effects to low.

7.4 Wetland Effects

The construction of batters for the widening of Pine Valley Road will result in the loss of a portion of three separate areas of wetland. The loss of portions of the wetlands, combined with the elimination of surface runoff input from the existing roads as a result of stormwater upgrades means the effective loss is like to be the total combined wetland area of approximately 1810 m^2. The ecological value of these wetland areas is low, with the values restricted to a functional role such as flood attenuation or nutrient capture. These functional values are important and given the very high magnitude of impact it is likely the level of effect is at least moderate under the EIANZ framework. Mitigation for the loss of these wetland areas is required to reduce the level of ecological effects to low.

7.5 Stormwater Effects

The increased runoff associated with the new impervious areas of the proposed road has the potential to result in:

- Higher levels of contaminants and sediment reaching adjacent streams due to increased traffic levels;
- Increased flow volumes resulting from a larger impervious area has the potential to modify the receiving environment through erosion, scour and flooding.

The new road will use kerb and channel to capture stormwater runoff, which will then pass through raingardens to filter contaminants in accordance with the Auckland Council guideline (GD 001) 'Stormwater management devices in the Auckland Region' (Cunningham et al, 2017). Check dams will be installed in conveyance channels down the slope of Pine Valley Road to slow water velocity before it moves through the raingardens. Check dams will reduce the velocity of runoff conveyed by the channel, where it will discharge into the super raingarden via a pipe network. The raingardens have also been designed to provide SMAF 1 detention (temporary storage and slowly releasing over 24 hours) to reduce the peak flow rate from the site (when compared to the predevelopment scenario).

Outlet and riprap dimensions will be designed during the detailed design stage in accordance with the Auckland Council guideline (TP 18) 'Hydraulic Energy and Management: Inlet and Outlet Design for Treatment Devices'.

7.6 Avifauna

Effects on birds can be either indirect during construction (i.e. increased noise, dust on food sources, human activity) or direct during operation (i.e. loss of habitat). No 'threatened' birds were noted during a site visit in spring and it is unlikely any threatened species utilise the habitat within the construction zone, therefore the habitat value for birds has been assessed as low.

The magnitude of the effects on birds during construction should be low as they are able to move away from construction activity. An exception is during the main bird nesting season (August-January inclusive). The mature exotic trees in the pasture area contain habitat that could be suitable for nesting. Management recommendations are detailed in Section 8.6 below to minimise potential adverse effects on nesting birds during construction.

The permanent loss of pasture and roadside habitat, and large poplar trees during road construction should have very low effects on birds.

7.7 Herpetofauna

The grazed pasture habitat within the pasture area, and the mature exotic trees, is low value and it is unlikely any native lizard species are present. Potential effects on lizards in the pasture area is likely to be very low.

7.8 Long-tailed Bats

It would be highly unlikely that bats utilise any trees within the construction zone for roosting, and unlikely for foraging.

Given the probable absence of bats at the site, the effects on long-tailed bats during construction and operation are likely to be very low.

8 Management of Effects

8.1 Vegetation Clearance

The effects of vegetation clearance are very low and any native landscape planting associated with the new road will compensate for the loss of roadside native vegetation during construction.

Native landscape planting should have a positive effect in the medium-long term as the trees mature and provide habitat for native fauna.

8.2 Construction

A construction environment management plan (CEMP) should be developed as a condition of consent to minimise construction debris, including potentially concrete slurry, oil, and machinery/equipment entering the permanent stream while works are occurring.

The CEMP should include details of how to keep the above construction debris, concrete slurry etc out of the water column or near the stream banks of the permanent stream. The CEMP should include measures to respond to any failure of the controls put in place during construction and to rectify any on-going adverse effects that may occur from such a failure. This measure is required in order to increase the likelihood overall ecological effects are very low.

It is recommended fish salvage is conducted for shortfin eels during pond decommission/culvert installation if water is present in the artificial pond during construction. A short technical memo detailing fish salvage methodology should be prepared as a condition of consent if fish salvage is necessary.

8.3 Streams

The decommissioning of the artificial pond and construction of a 49 m culvert for stream A requires mitigation for the 19 m over the permitted culvert length of 30 m. Similarly, the construction of batters over a portion of stream B and the effective loss of flow for the entire 43 m reach also requires mitigation. Land owner constraints mean the adjacent reaches are unavailable for enhancement and the use of offsets at an offsite location is required.

The Auckland Council Technical Report 2011/009 ‘Stream Ecological Valuation (SEV): a method for assessing the ecological functions of Auckland Streams’ provides guidelines for calculating an environmental compensation ratio (ECR) to mitigate for the adverse effects of stream reclamation and ensuring ‘no-net loss’ of biodiversity. The ECR formula compares the gains at the mitigation site with the losses at the impact site, and multiplies the result by a factor of 1.5 to account for time delays before benefits may be realised.

The following steps are described within the SEV Technical Report to calculate the environmental compensation ratio:

Step 1: Establish the ‘current’ SEV values for the site that will be impacted and for the proposed environmental compensation site (SEVm-C). (Note; do not include biotic functions (IFI and FFI) in this calculation because of the difficulty of predicting these outcomes).

Step 2: Determine the ‘potential’ SEV values for both the impact (SEVi-P) and environmental compensation sites (SEVm-P) by recalculating the variables using ‘predicted’ function scores assuming ‘best-practice’ remediation works have been carried out at both sites. Predictions are the best scores possible if the sites were to be restored as far as practical from present with current best-practice. (Note; do not include potential scores for biotic functions (IFI and FFI) in these calculations because of the difficulty of predicting these outcomes

Step 3: Determine the SEV value at the impact site (SEVi-I) again using predicted function scores but now assuming that the proposed development works (e.g., piping, filling) have been carried out. (Note; do not include potential scores for biotic functions (IFI and FFI) because of the difficulty of predicting these outcomes).

Step 4: Follow the formula for calculating an environmental compensation ratio below. This value will be the amount you have to multiply the area of the stream you are impacting by to determine how much area of stream needs to be restored.

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

The area of stream that will be impacted is calculated by multiplying length of impacted stream channel by the mean width (m) of the impacted stream.

The calculation for restoration length of the compensation site is as follows:

Restoration length = (impact area x ECR) / mean width of restoration site

The following assumptions can be made when calculating the compensation ratio-

- *For 'potential' scores, individual function scores are based on a 10 year time frame for a restored stream using best practice restoration work*
- *Restoration is assumed to include:*
  - *Permanent removal of stock.*
  - *Extensive high quality riparian planting (at least 20 m total width) using Auckland Regional Council riparian zone management technical publication (Auckland Regional Council, TP 148) to provide permanent shade, increased water quality, habitat and organic matter input.*
  - *Naturalisation of stream channels to modulate high flows and provide greater hydrologic capacity, thereby reducing scour and sedimentation.*
  - *Addition of instream heterogeneous habitat cover, including woody debris of various sizes.*

No SEVs were undertaken at the impact sites due to lack of stream flow, however typical SEV scores for both current and potential values can be used from similar rural streams taken from within the Milldale development. An available example 'like for like or similar' offset site approximately 41 km northeast of the Project area is located at Pakiri Regional Park. Other similar sites for compensation are still being investigated in partnership with Mana Whenua groups. SEVs have been undertaken at the compensation site for offsets within the Milldale development, therefore current and potential scores are available for the compensation site. The predicted SEV scores at the impacted sites after proposed works have been undertaken can also be produced. SEV values are provided in table 10 below-

Table 10. Summary of SEV values at impact and compensation reaches

Variable	Impact stream A	Impact stream B	Compensation stream
SEVi-C	0.412	0.395	n/a
SEVi-P	0.678	0.678	n/a
SEVi-I	0.2 (culvert)	0 (filled/no flow)	n/a
SEVm-C	n/a	n/a	0.302
SEVm-P	n/a	n/a	0.79
Stream width (m)	0.5	0.4	1.9

Stream A ECR = [(0.678 – 0.2)/ (0.79 – 0.302] x 1.5

= (0.478 / 0.488) x 1.5

= 1.47

Stream A Restoration length = (19 x 0.5) x 1.47)) / 1.9

= 7.35 m

Stream B ECR = [(0.678 – 0)/ (0.79 – 0.302)] x 1.5

= (0.678 / 0.488) x 1.5

= 2.08

Stream B Restoration length = (43 x 0.4) x 2.08)) / 1.9

= 18.83 m

The length for each offset reach as calculated by the ECR gives a total compensation length of 26.18 m. However, the SEV method requires no net loss of stream length as well as area. Therefore a total length of 62 m (43 m + 19 m) of stream length is required to be restored at the offset site.

Management of the offset reaches, including a site description, and legal protection details should be provided as a condition of consent.

The new channel that links the new culvert outfall from underneath the proposed road to the existing downstream channel will be designed during the detailed design stage. It is recommended a suitably qualified ecologist is involved with the design of the new channel. It is important the channel is designed to mimic a natural stream channel, including meandering where possible, native planting as wide as possible on the stream banks, and properly armoured to minimise erosion both on the banks and the new stream bed. Appropriate 'green' engineering will be required, as detailed in 'Environmentally Sensitive Channel and Bank Protection Measures', (McCullah and Grey, 2005), and 'Bioengineering Case Studies-Sustainable Stream Bank and Slope Stabilisation', (Goldsmith et al. 2014). An indicative streamworks methodology during construction, provided by Mott MacDonald, is detailed in Appendix 3 below.

8.4 Wetland Loss

The level of effect for the loss of approximately 1810 m^2 wetland area is moderate and will require mitigation to reduce the level of effect to low. Land owner constraints and the lack of wetlands available onsite to be enhanced require the use of offsets at an offsite location. A ratio of 2:1 would be acceptable for enhancement based on the current or potential ecological values of the wetland areas within the Project area.

8.4.1 Biodiversity Offset Design

The design of a biodiversity offset has five key steps that are necessary to maximise the potential for success (Guidance on Good Practice Biodiversity Offsetting in New Zealand, 2014)-

1. The goal: no net loss and preferably a net gain in biodiversity;
2. Describing the biodiversity: what to count and measure at the impact and offset sites;
3. Choosing a currency: to allow biodiversity to be categorised and exchanged;
4. The accounting framework: to help define the size, specification, location and successful implementation of the offset; and
5. Demonstrating additionality: how biodiversity gains are achieved and demonstrated at the offset site.

8.4.2 Offset Site

Offset site and maintenance details should be provided as a condition of consent. An example site is available at Pakiri Regional Park, adjacent to the stream site described above. The wetland at the offset site is in a similar degraded pasture setting to the impact site. No net loss or a net gain should be achieved through the enhancement of the offset site. No net loss or net gain can be difficult to demonstrate, however the offset site should be a 'like for like or better' offset based on the impact site having lower potential restoration values. In addition, the offset site forms part of a wider wetland area that can be restored through other offset programs, contributing to a larger restored area over time. The site at Pakiri has been assessed for suitability, but if another offset site is selected through consultation with Mana Whenua then it will also need to be assessed using the same biodiversity offset design criteria to confirm it's suitability.

8.4.3 Offset Currency and Additionality

Area is the simplest type of currency that measures the area of biodiversity being lost and is applicable here as the (current) type and quality of biodiversity is similar between the impact site and the offset site. A flaw of this currency is that any rare or vulnerable biodiversity that may be present will be protected only by chance. It is unlikely there are any threatened species present at either site and the area currency should capture the type, amount, and condition of biodiversity that will be lost and gained.

An important aspect of biodiversity offsets is the need to achieve conservation outcomes above and beyond results that would have occurred if the offset had not taken place. The offset site is within a Regional Park and is not scheduled to undergo any ecological restoration in the future.

8.4.4 Offset Planting

There will be an unavoidable time lag between when biodiversity is lost at the impact site and when biodiversity gains are fully delivered at the offset site. To help account for the time lag between biodiversity loss and gain, a ratio of 2:1 has been chosen for the offset restoration area. The available wetland offset site has higher restoration potential than the impacted wetlands and will result in a contiguous area of approximately 3620 m^2 being restored at a ratio of 2:1. The restoration of a larger contiguous area with higher potential compared to retaining and restoring three smaller individual wetlands within the Project area will likely result in an ecological gain at the offset site.

Planting at the offset site is proposed to occur the winter following the removal of vegetation at the impact site. The close timing between impact and offset occurrence should minimise the time lag for when biodiversity gains start at the offset site. It is likely that within 10-20 years the area of 3620 m^2 will provide a biodiversity gain in the form of habitat provision for native fauna, increased biomass, oxygen production, water uptake and transpiration, carbon sequestration, and organic debris and nutrients for soil.

8.5 Impervious Area and Runoff

The potential for adverse effects on the receiving waterways from runoff during road construction should be adequately managed through the implementation of sediment and erosion controls detailed in the Auckland Council Guide, 'Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region', June 2016 Guideline Document 2016/005 (GD05).

An indicative Erosion and Sediment Control Plan (ESCP) has been developed by Mott MacDonald and should result in controls put in place to avoid sedimentation generating ecological effects within the stream receiving environments during construction.

The ESCP should include measures to respond to any failure of the controls put in place during earthworks and to rectify any on-going adverse effects that may occur from such a failure. This measure is required in order to increase the likelihood overall ecological effects are very low.

Contaminants should be adequately treated through the use of 35 rain gardens and a super rain garden during the operational phase of the proposed road. The installation of a wingwall and riprap at the outlets should ensure erosion and scour is minimised within the stream receiving environments. If feasible, it is recommended the riprap is planted with *Carex* spp to help with scour protection.

8.6 Avifauna

The greatest potential for adverse effects on birds is if clearance of the mature poplar trees in the pasture area and juvenile roadside trees occurs during the main bird breeding season (August-January inclusive). If clearance occurs during the breeding season it is recommended a suitably qualified ecologist is present to monitor and clear nesting birds if they are present in any felled trees.

8.7 Herpetofauna

It is unlikely any native lizards will be impacted by construction. No further action is required.

8.8 Long-tailed Bats

Long-tailed bats are not anticipated to be present within any of the vegetation and any potential impacts on foraging habitat will be very low. No further action is required.

9 Conclusions

The large poplar trees within the pasture area, and the pasture area itself, and the road corridor of Pine Valley Road and Dairy Flat Highway contain minimal ecological value.

The impacted vegetation provides potential non-critical habitat for a range of common and exotic birds. No long-tailed bats or native lizards are expected to be present within the site.

Two intermittent streams and three wetlands will be impacted by road construction. A new stream channel will be created to take flow from the new culvert to the existing intermittent stream at the northern end of the Project area. Low value wetlands and an intermittent stream will be filled during batter construction along Pine Valley Road.

Potential sedimentation during new road and stormwater infrastructure construction can be adequately managed through industry standard sediment and erosion control. An indicative Erosion and Sediment Control Plan (ESCP) has been developed by Mott MacDonald and should result in controls put in place to avoid sedimentation generating ecological effects within the stream receiving environments during construction.

Contaminants should be adequately captured using proposed raingardens for the new road, and rip rap and wingwall construction for the stormwater outlet should minimise scour and erosion of receiving streams.

A construction environment management plan (CEMP) should be developed as a condition of consent to minimise construction debris, including potentially concrete slurry, oil, and machinery/equipment entering the permanent stream while works are occurring.

Fish salvage, likely for shortfin eels, should be conducted if water is present in the artificial drainage pond during construction. A short technical memo detailing fish salvage methodology should be prepared prior to dewatering as a condition of consent if fish salvage is necessary.

Land ownership constraints mean that offsets are required to compensate for the loss of intermittent streams and wetlands. The available example offset site at Pakiri Regional Park has higher restoration potential compared to the impacted waterways. Proposed management at the offset site would adequately compensate for the stream and wetland loss at the Project area and could result in an ecological gain. Details of any offset site will need to be provided as a condition of consent and include the information discussed in sections 8.3 and 8.4 above.

10 References

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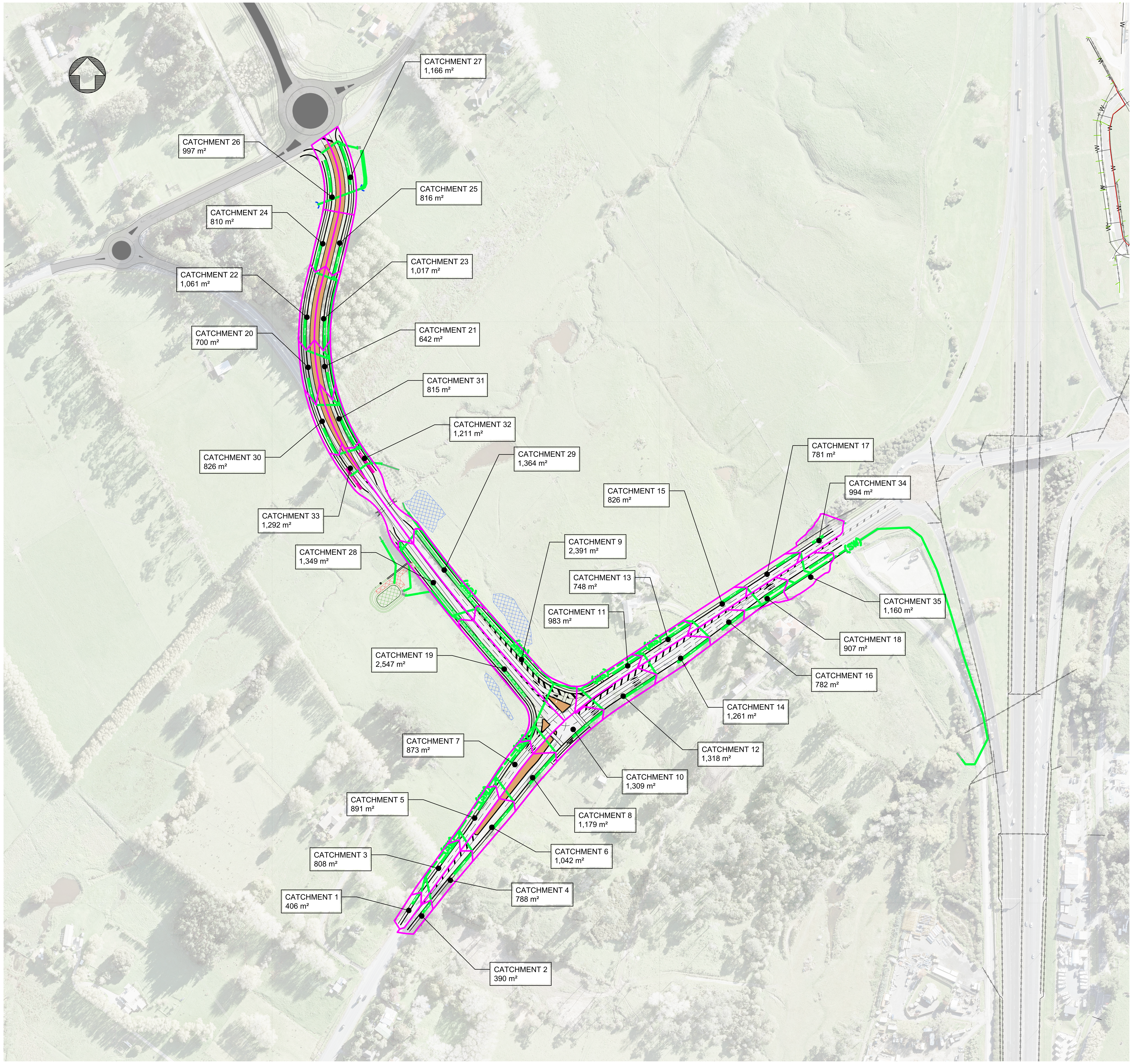
Appendix 1- Stormwater Details

NOTES:

1. DO NOT SCALE THIS DRAWING.
2. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
3. ALL LEVELS ARE IN METRES ABOVE DATUM (AUCKLAND VERTICAL DATUM 1946).
4. ALL WORKS AND METERIALS TO COMPLY WITH AUCKLAND TRANSPORT AND AUCKLAND COUNCIL STANDARDS AND WHERE RELEVANT IN ACCORDANCE WITH THE NEW ZEALAND BUILDING CODE REQUIREMENTS.
5. THE CONTRACTOR IS TO SEARCH FOR, LOCATE AND CONFIRM POSITIONS OF ALL EXISTING SERVICES PIROR TO COMMENCEMENT OF WORKS WHETHER SHOWN ON THE DRAWINGS OR NOT AND MAINTAIN RESPONSIBILITY FOR ALL SERVICES.
6. THE EXISTING SERVICES HAVE BEEN EXTRACTED FROM AUCKLAND COUNCIL GEOMAPS AND THE RELEVANT SURVEYS. POSITION AND EXTENT OF THE EXISTING SERVICES MAY NOT BE ACCURATE, THEREFORE ON-SITE VERIFICATION IS REQUIRED.
7. SITE SETTING OUT IS TO MT EDEN 2000.
8. DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

LEGEND:

- SW — SW — Existing Stormwater (Public)
- (SW) - - (SW) Proposed Stormwater
- Proposed Raingarden Type A
- Proposed Raingarden Type B
- Proposed Conveyance Channel
- Existing Wetland
- Proposed Culvert
- Scruffy Dome
- Riprap



1:2000 0 100m 200m

REV	DESCRIPTION	DATE
A	FOR APPROVAL	18/12/2019
B	DRAFT - FOR RESOURCE CONSENT	13/05/2020

DRAWING Q.A.

DRAWN	H.LAW
CHECKED	C.O'SULLIVAN
APPROVED	P.EVANS

DO NOT SCALE OFF THIS DRAWING.
VERIFY ALL DIMENSIONS ON SITE
BEFORE COMMENCING ANY WORK.

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ROAD CONTROLLING AUTHORITY
Auckland Transport
An Auckland Council Organisation

PROJECT
MILLDALE DEVELOPMENT
INFRASTRUCTURE PROJECTS

PROJECT TYPE: NEW CONSTRUCTION
PROJECT PHASE: PRELIMINARY DESIGN
CONSULTANT PROJECT NO.: 402828

DRAFT - FOR RESOURCE CONSENT

DRAWING
Milldale Development, Argent Lane - Dairy Flat Highway
Stormwater Pipe Network Catchment Plan

DRAWING NO.: 402828-MM-DWG-02-CV-DD-0850
REVISION: B

FOR RESOURCE CONSENT
SCALE (A1) 1:2000

\\mottmac\project\Auckland\NZL\01 Projects\402828 - Milldale\03 Design\Working\CAD\Drawings\02_Argent Lane (PVR & DFH)\402828-MM-DWG-02-CV-DD-0850.dwg May 13, 2020 - 10:01PM LAW87033

Appendix 2- Site Photos

Plate 1. View downstream at approximate location of ephemeral/intermittent boundary for Stream A.

Plate 2. View upstream at approximate boundary of Stream B and the intermittent wetland adjacent to Pine Valley Road.

Appendix 3- Streamworks Methodology

Argent Lane – Indicative Streamworks Methodology

To enable construction of the project, streamworks will be undertaken:

- Where Stream A is realigned and a new culvert is to be installed, with the old Stream A Channel infilled; and
- Where Stream B between the existing wetland is infilled.

In order to construct the culvert, the existing intermittent stream will need to be diverted to a temporary culvert or dammed and pumped. This section sets out indicative stream work principles which should be confirmed and developed into a methodology by the contractor and adhered to during the construction period. This will ensure that the ecology of the stream will not be damaged. These principles have been adapted from GD05: Erosion and Sediment Control for Land Disturbing Activities in the Auckland Region, Auckland Council, 2016.

Infilling of the wetlands will result in the functional loss of the wetlands, as well as stream B which currently connects them. Therefore, these infilling activities will be covered by the Erosion and Sediment Control Plan for earthworks, which will ensure no downstream sediment impacts in the adjacent stream as a result of the activities.

Winter works

Undertaking streamworks should be avoided during winter. This is due to periods of higher and more frequent flows. Consented streamworks will be required to be undertaken before winter and it is unlikely Auckland Council will grant approval to undertake streamworks in winter.

Culvert crossings

Streamflows will need to be diverted during installation of the temporary culvert so that the works can be undertaken in dry conditions. Refer to Sections G4.2.2 and G4.2.3 below for methodologies to complete streamworks in dry conditions.

A temporary culvert may be used to divert the intermittent stream whilst the permanent culvert is constructed. As far as practicable, the temporary culvert should be located in a section of the watercourse that is to be modified as part of the permanent design (i.e. a section of stream that may be filled as a result of a new culvert crossing).

When installing a temporary culvert, sizing is important as stormflows could cause erosion or overtop the culvert causing failure of the temporary access. For temporary stream crossings, the cross-section of the culvert should be sized for approximately 85% of the channel cross-section.

To ensure minimal adverse impacts, scour protection is also required to ensure the integrity of the crossing in the event of overtopping.

Consideration must be given to overland flowpaths to ensure that larger flows do not cause excessive safety or environmental impacts. This will typically include confirming that in larger floods, there is no increase in flood level upstream (up to the 1% AEP storm in flood-sensitive areas).

Even though culverts are temporary, ensure that fish passage is not impeded in permanent streams (refer to TP131 for details).

Maintenance and decommissioning

Inspect temporary watercourse crossings after rain to check for any channel blockages, erosion of the banks, channel scour or signs of instability. Make all repairs immediately to prevent further damage to the installation.

When the structure is no longer needed, remove it and all material from the site. This will largely be undertaken in reverse of the installation methodology. Streamflows will need to be diverted while the removal and reinstatement of the stream is underway.

Immediately stabilise all areas disturbed during the removal process by revegetation or artificial protection as a short-term control measure. Keep machinery clear of the watercourse while removing the structure.

Dam and pump or dam and divert device

Damming a stream and pumping the flows around the worksite back to the stream considerably minimises disturbance relative to constructing a new diversion channel. With high flow streams, diversions are sometimes the only option; however, with most small streams, damming and pumping are less harmful to the environment and relatively simple to carry out.

The dam is constructed across the stream with stabilised materials such as sandbags, sheet metal plate or other suitable construction materials. A pump is installed in the dam and sufficient hose length must be available to reach below the extent of in-stream works. The pump inlet should be placed in a drum with holes to minimise the possibility of sucking sediment from the bottom of the dam. Inclusion of a fish screen is recommended and as noted in section XX a fish salvage note will be prepared to set out the methodology for this. The outlet should be directed to a stabilised area with an energy dissipater such as rip-rap boulders or similar.

A dam and pump methodology can only be used for works with a short duration or where the site can be stabilised at the end of each work day, so that flows can continue through the stream channel.

Sizing the pumped diversion for a given storm event depends on the duration of the stream diversion. As a minimum, the temporary pumping should be sized for a one-year peak discharge from the contributing catchment. These design parameters are based on the assumption that full channel 5% AEP (20 year) capacity is made available overnight or when storm events are predicted.

Construction and operation

Consider the following when construction and/or operating these devices:

• The dam must be capable of holding back the incoming flows

• The pump must be capable of conveying the flows, as overtopping the dam will cause environmental and construction issues with flows passing through the work site.

Temporary watercourse diversions

Temporary waterway diversions enable in-stream works to be undertaken without working in wet conditions and without moving sediment into the watercourse.

Temporary watercourse diversions are used as temporary measures to allow any works to be undertaken within permanent, intermittent and ephemeral watercourses.

Design

These measures seek to divert all flow via a stabilised system around the area of works and discharge it back into the channel below the works to avoid scour of the channel bed and banks.

Step 1

The diversion channel should be excavated leaving a plug at each end so that the watercourse does not breach the diversion.

Size the diversion channel to allow for a 5% AEP rain event, but consider the implications for secondary flow paths and upstream flood effects of having a larger event, up to 1% AEP.

The diversion channel should be appropriately stabilised to ensure it does not become a source of sediment. Suitable geotextile cloth (as discussed in Section E3.5) should be anchored in place to the manufacturer's specifications, which will include trenching into the top of both sides of the diversion channel to ensure that the fabric does not rip out.

Once the channel is stabilised, open the downstream plug to allow water to flow up the channel, keeping some water within the channel to reduce problems when the upstream plug is excavated. Then open the upstream plug, allowing water to flow into the channel.

Step 2

A non-erodible dam should be placed immediately in the upstream end of the existing channel. Where a compacted earth bund is used, it must be stabilised with an appropriate geotextile pinned over the upper face and adjacent to the lower face for scour protection. In most cases, sandbag dams can be used to construct the dam.

If there is a need to relocate fish trapped in the existing watercourse as a result of the diversion, please refer to fish salvage note.

Step 3

A non-erodible downstream dam should then be installed to prevent backflow into the construction area. The existing watercourse is subsequently drained by pumping to a sediment retention pond, where the ponded water can be treated before it re-enters the live section of the watercourse. The structure and all channel works are then completed.

Step 4

The downstream dam should be removed first, allowing water to flood back into the original channel. The upstream dam is then removed, and both ends of the diversion channel are filled in with non-erodible material. Any sediment-laden water should be pumped to a sediment retention pond or dewatered (refer Section G1.0). The remainder of the diversion channel should be filled in and stabilised.