MOTT MACDONALD

Milldale Development Infrastructure Project 1 - Argent Lane Extension

Proposed Stormwater Management

1 October 2020

Mott MacDonald
Mason Bros. Building
Level 2, 139 Pakenham
Street West
Wynyard Quarter
Auckland
1010
PO Box 37525
Parnell 1151
New Zealand

T +64 (0)9 375 2400
mottmac.com

Auckland Transport
20 Viaduct Harbour Avenue
Westhaven
Auckland 1010

Milldale Development Infrastructure Project 1 - Argent Lane Extension

Proposed Stormwater Management

1 October 2020

Mott MacDonald New Zealand Limited
Registered in New Zealand no. 3338812

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	06/05/20	H. Law	C.O'Sullivan	P.Evans	For Approval
B	24/09/20	S. Perera	C.O'Sullivan	P.Evans	For Approval
C	01/10/20	C.O'Sullivan	H. Law	P.Evans	For Approval

Document reference: 402828-MMD-XX-XX-RP-CV-005

Information class: Standard

Contents

Tables

Figures

Executive summary

Mott MacDonald was engaged by Fulton Hogan Land Development (FHLD) on behalf of Auckland Transport (AT) to carry out engineering design for the proposed extension of Argent Lane. The extension works will consist of realigning the northern portion of Pine Valley Road and widening a portion of Pine Valley Road and Dairy Flat Highway. As part of the engineering design, Mott MacDonald will provide stormwater management design for the proposed works.

The project works have been divided into two design stages; Stage 1 (interim works stage) and Stage 2 (ultimate works stage). Stage 1 is expected to be constructed in 2021 and will consist of realigning the northern portion of Pine Valley Road and widening Dairy Flat Highway. The majority of Pine Valley Road will be widened as part of the Stage 1 works, with the exception of a section of Pine Valley Road located above an existing 3m diameter stream culvert. This culvert will be decommissioned during Stage 2 of this project, where it will be replaced with a bridge or culvert to facilitate the widening of Pine Valley Road in this portion of the site. The timeframe for Stage 2 is anticipated to be 20 years away.

To support the Resource Consent application for Stage 1 of this project, this report has been prepared to discuss the proposed stormwater management approach for the site (Stages 1 and 2) and to provide a summary of the proposed Stage 1 preliminary stormwater management design.

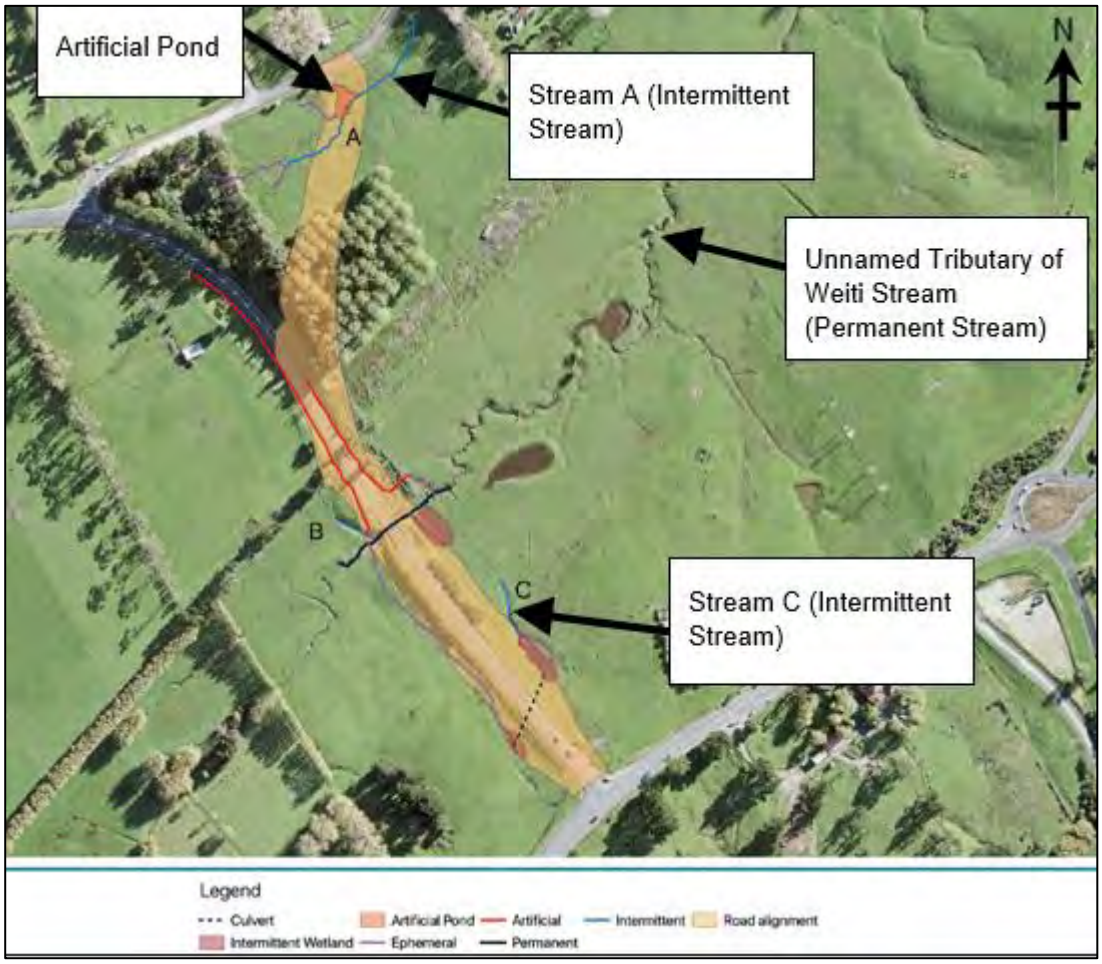
Site Description

The land use adjacent to the proposed works area is rural and has been identified as Future Urban in the Auckland Unitary Plan Operative in Part (AUP:OP). The Argent Lane Extension Geotechnical Interpretive Report (Mott MacDonald, dated 16 March 2020), indicates that the underlying geology of the site is predominantly Hukerenui Mudstone of Mangakahia Complex, part of the Northland Allochthon.

Available information from survey and Auckland Council GeoMaps indicates that there is no existing stormwater infrastructure servicing Pine Valley Road and the majority of Dairy Flat Highway. Runoff from these road areas therefore discharge to the adjacent road berms and drain to the watercourse network via surface flows. Two catchpits are located within the NZTA designation at the north eastern end of Dairy Flat Highway which capture runoff from a portion of this road. It is understood that these catchpits are connected to the downstream NZTA reticulation.

An unnamed tributary of the Weiti Stream (classified as permanent watercourse) is conveyed under Pine Valley Road via an existing 3m diameter culvert. A watercourse assessment carried out in September 2019 by Epoch Ecology also identified the presence of two intermittent streams, three intermittent wetlands and an artificial pond in the vicinity of the proposed works. A 375mm diameter culvert located under Pine Valley Road provides connectivity to two intermittent wetlands located on either side of the road. The locations of the existing watercourses are shown on Figure 1.1 below.

Figure 1.1: Existing Watercourses



Source: Epoch Ecology (September 2019)

Stormwater Management Requirements

The stormwater management requirements for the Argent Lane Extension are as follows:

- **Water Quality Treatment**
  - It is expected that the proposed works area will service more than 5,000 vehicles per day, which is considered to be an AUP:OP High Contaminant Generating Activity (HCGA). In accordance with Section E9 of the AUP:OP, water quality treatment will be provided for runoff generated from impervious areas within the site.
- **SMAF 1 Hydrological Mitigation**
  - To minimise the impact of changes in hydrology due to this increase in impervious area, SMAF 1 will be provided for new and re-developed impervious areas within the proposed works area.
  - The Mott MacDonald Geotechnical Interpretive Report notes that due to the erosive nature of the underlying geology soakage and retention through infiltration should be avoided. Based on this information, it is not proposed to provide retention for the site. Therefore, in accordance with Table E10.6.3.1.1. of the AUP:OP, the following SMAF 1 provisions will be provided for the site:

    - Detention (temporary storage) and a “drain down” period of 24 hours for the difference between the pre- development and post-development volumes from the 95th percentile 24-hour rainfall event (37mm rainfall depth) minus any retention volume that is achieved for new or redeveloped impervious area within the site.

- **Primary Stormwater Network**
  - A primary stormwater network is required to provide drainage from the site for runoff generated during a 10-Year Average Recurrence Interval (ARI) rainfall event (in accordance with Auckland Council Code of Practice for Land Development and Subdivision (Chapter 4 – Stormwater)).
  - Rainfall for the 10-year ARI event should be increased by 13.2% to account for the impacts of climate change in accordance with the Auckland Council Code of Practice for Land Development and Subdivision (Chapter 4 - Stormwater).
- **Secondary Stormwater Network**
  - The proposed roads must be designed to incorporate the conveyance of overland flowpaths generated in rainfall events up to and including the 100-year ARI event to minimise the risk to properties and people.
  - Rainfall for the 100-year ARI event will be increased by 16.8% to account for the impacts of climate change in accordance with the Auckland Council Code of Practice for Land Development and Subdivision (Chapter 4 - Stormwater).
- **100-Year ARI Floodplain Management**
  - It is proposed to widen a portion of Pine Valley Road which is currently located within the 100-year ARI floodplain. To facilitate the proposed road widening, approximately 1,350m² of fill is proposed within the floodplain.
  - Policy 21 in Section E36.3. of the AUP:OP requires that all development in the 1 per cent Annual Exceedance Probability (AEP) floodplain does not increase adverse effects from flood hazards or increased flood depths and velocities, to other properties upstream or downstream of the site.
  - An assessment was carried out using hydraulic modelling by WatRes Consulting to determine if there are upstream or downstream impacts on 100-year ARI flood levels. The model results predicted that there will be an increase in 100-year peak water level upstream of the Pine Valley Road culvert that results in a small localised increase in the 100-year ARI flood extent upstream of the culvert (increase of approximately 2.5%). The earthworks proposed as part of this project are therefore considered to have a less than minor impact on flooding.
  - The hydraulic modelling results for this project were provided to the Healthy Waters on 21st April 2020. Based on discussions with Healthy Waters (email correspondence with Kevin Fan on 21st April 2020), it was agreed that it is not necessary to provide flood mitigation for this project. A copy of this email correspondence can be found in Appendix D.

Proposed Water Quality Treatment and SMAF 1 Hydrological Mitigation

Raingardens are proposed be used to provide treatment of runoff and meet SMAF 1 requirements (retention and detention) for impervious areas within the site. Raingardens have been sized to provide mitigation for both Stage 1 and Stage 2, with the exception of Raingardens 32 and 33 (which have been designed for Stage 1 only).

Three raingarden types are proposed for the site; Battered Slope Raingardens, Cast In-Situ Raingardens and a Super Raingarden. To prevent infiltration of runoff from the raingardens into the ground (and reduce the risk of slope failure), the raingardens will be lined with an impermeable liner.

Proposed Primary Stormwater Network (Pipe Network)

The proposed road drainage network consists of raingardens, catchpits, conveyance channels and stormwater pipelines designed to convey runoff generated during the 10-year ARI storm event. The primary stormwater network for Stage 1 is proposed to discharge from the site via 5 discharge points:

a. An intermittent stream located adjacent to Old Pine Valley Road (Stream A) via new stormwater Outlet 5.
b. Downstream of the existing 3m diameter stream culvert to an unnamed watercourse via new stormwater Outlet 4.
c. Downstream of the existing 3m diameter stream culvert to an unnamed watercourse via new stormwater Outlet 1.
d. Upstream of the existing 3m diameter stream culvert to an unnamed watercourse via new stormwater Outlet 8.
e. Johns Creek via new stormwater Outlet 3.

To minimise upgrades to the Stage 1 stormwater pipe network during the construction of Stage 2, the proposed Stage 1 stormwater pipe network has been sized to convey runoff generated from both design stages. To facilitate the new stream culvert or bridge on Pine Valley Road in Stage 2 of the project, there may be changes to levels along Pine Valley Road. This may require additional stormwater infrastructure to be constructed or may require the relocation of some Stage 1 stormwater infrastructure during the construction of Stage 2.

Proposed Secondary Stormwater Network

The secondary drainage network consists of overland flowpaths conveying runoff which exceeds the primary network capacity during a 100-year ARI rainfall event. It is proposed to convey the 100-year ARI overland flowpaths through the site via surface flows within the Pine Valley Road and Dairy Flat Highway Road reserves.

The majority of 100-year ARI runoff generated from Pine Valley Road will discharge through the road reserve towards the low point of Pine Valley Road, located just north of the existing stream culvert. For the remainder of Pine Valley Road (approximate road chainage 557 to 624), the 100-year ARI overland flowpaths will be conveyed within the road reserve in a northerly direction towards the proposed roundabout on Old Pine Valley Road. For Dairy Flat Highway, the 100-year ARI overland flowpaths will be conveyed via the road reserve in a north easterly direction towards the Silverdale Interchange.

1 Introduction

Fulton Hogan Land Development (FHLD) are currently developing a residential subdivision (referred to as Milldale) in Silverdale, Auckland. To provide a direct transportation link from Milldale to the Silverdale Motorway interchange, it is proposed to extend Argent Lane (located within the Milldale Subdivision) to Pine Valley Road and Dairy Flat Highway through land zoned in the Auckland Unitary Plan Operative in Part (AUP:OP) as Future Urban. To facilitate the anticipated traffic flow through this link to Milldale, it is proposed to widen a section of Dairy Flat Highway and Pine Valley Road. In addition, it is proposed to realign the northern portion of Pine Valley Road, which will connect to a new roundabout located on Old Pine Valley Road (currently being designed by Woods).

Mott MacDonald was engaged by Fulton Hogan Land Development (FHLD) on behalf of Auckland Transport[1] (AT) to carry out engineering design for the proposed widening of Dairy Flat Highway and Pine Valley Road. Mott MacDonald will also be responsible for designing the realigned section of Pine Valley Road. The Dairy Flat widening will extend over 550m and the Pine Valley Road widening and realignment will extend over 625m. The extent of works can be seen in Figure 2.1 below. As part of the engineering design, Mott MacDonald will provide stormwater management design for the proposed works.

The project is to be delivered in two stages; Stage 1 (an interim works stage) and Stage 2 (the ultimate works stage). Stage 1 is expected to be completed in 2021. The timeframe for Stage 2 is anticipated to be 20 years away.

To support the Resource Consent application for Stage 1 of this project, this report has been prepared to set out the stormwater management requirements and to discuss the proposed stormwater management approach for the site. The information in this report will also provide a summary of the proposed preliminary stormwater management design and a high-level sizing of proposed stormwater management devices for Stage 1.

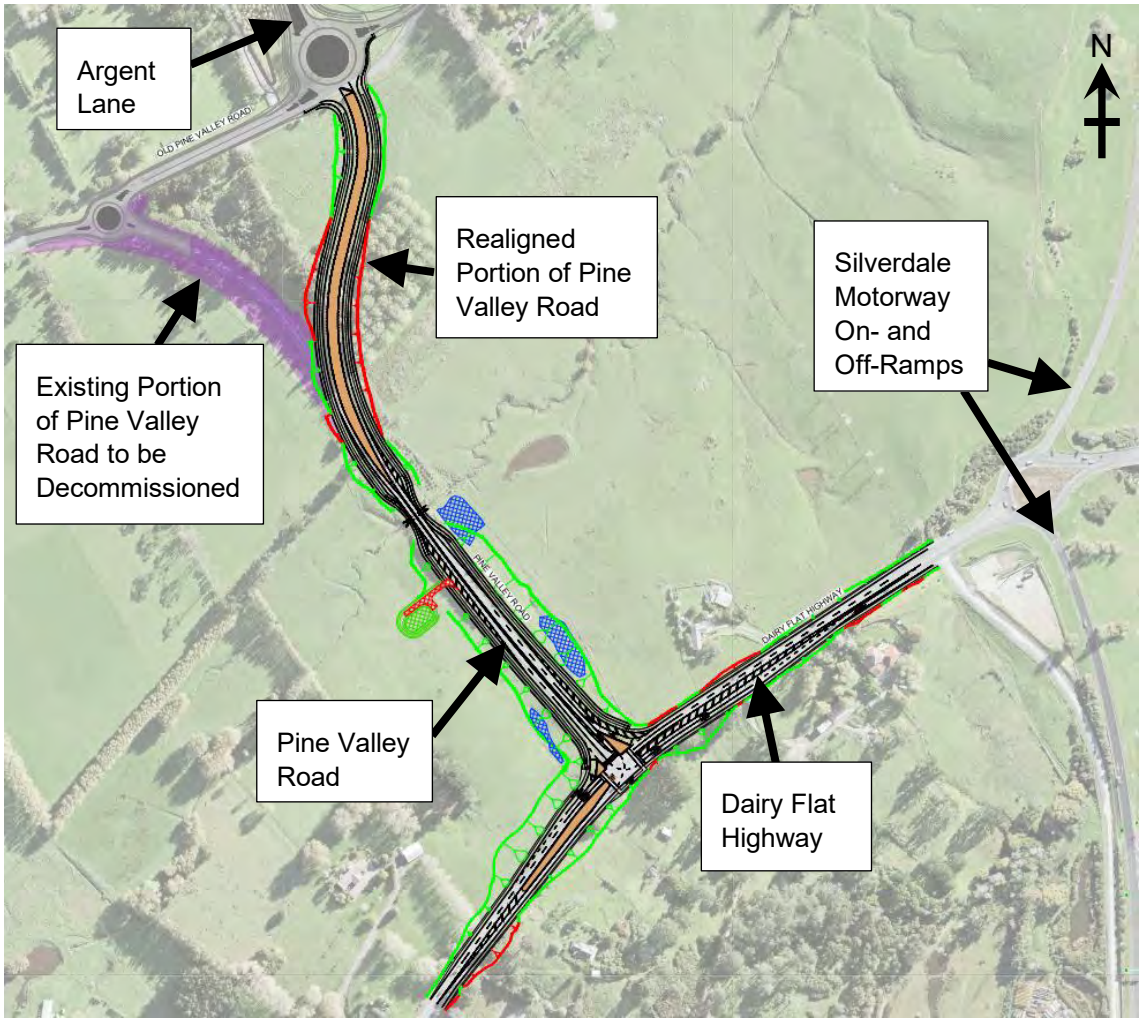
[1] Resource consent applicant and requiring authority for designation

2 Site Description

2.1 Location

The proposed works area is located on the eastern side of SH1 and ties in with an existing roundabout located at the top of the northbound Silverdale Off-ramp. The proposed works area can be seen on Figure 2.1 below.

Figure 2.1: Location Plan and Extent of Works (Stage 1)



Source: Aerial imagery sourced from Auckland Council GeoMaps (May 2020), Mott MacDonald (September 2020).

2.2 Land Use

The land use adjacent to the proposed works area is rural. It has been identified as Future Urban in the Auckland Unitary Plan Operative in Part (AUP:OP). A draft structure plan was prepared by Auckland Council in March 2019 for the Silverdale West and Dairy Flat area. This structure plan proposes to zone land adjacent to the proposed Argent Lane Extension works area as Light Industry.

Pine Valley Road and Dairy Flat Highway are identified as ‘arterial urban’ roads on Auckland Council GeoMaps. The proposed new section of Pine Valley Road is located in farmland.

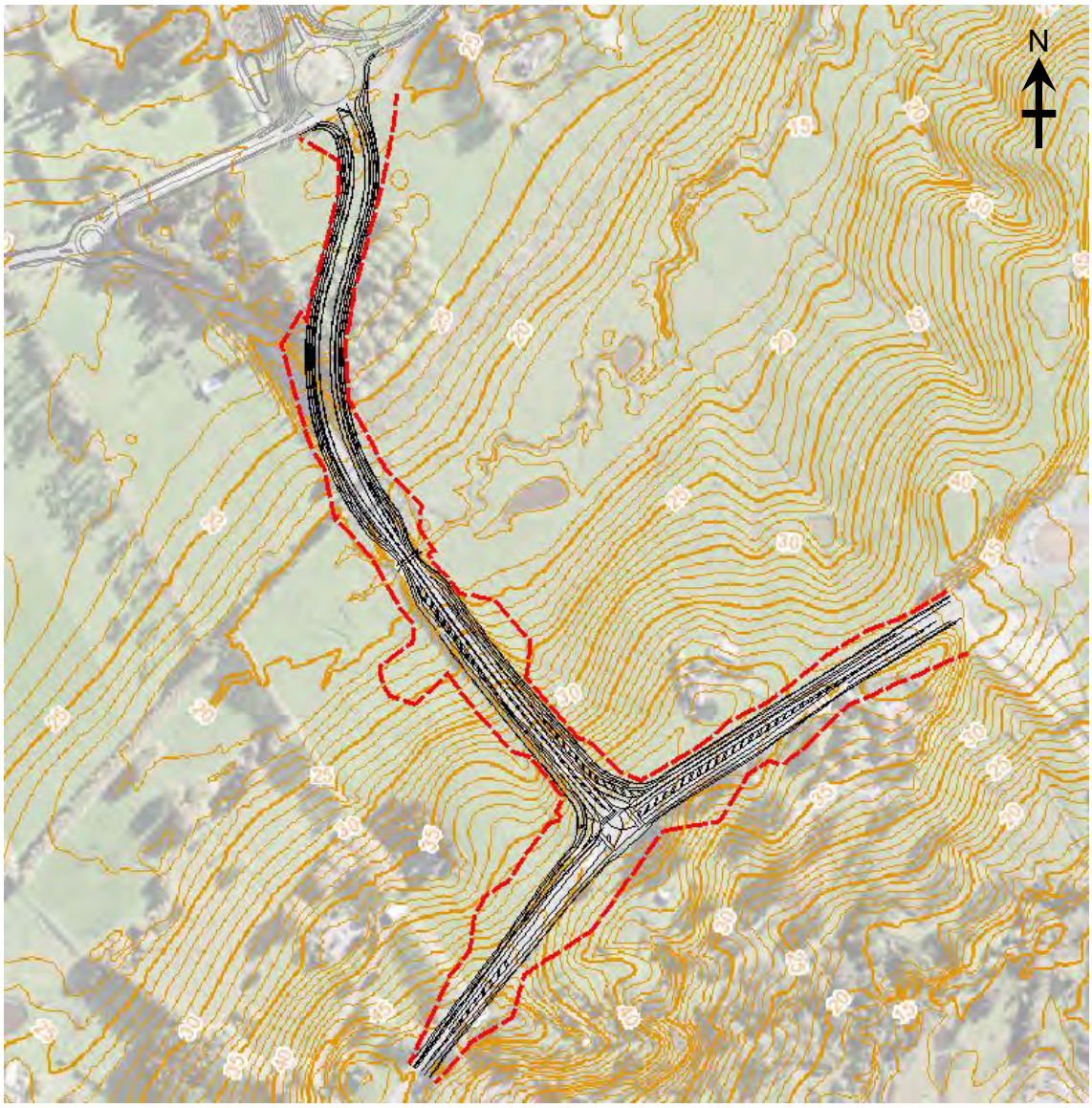
2.3 Topography

The existing site contours identified on Auckland Council GeoMaps are shown on Figure 2.2. Dairy Flat Highway is located on a ridgeline between the Pine Valley and Silverdale South Stormwater Catchments. The longitudinal gradient of the road falls gently in a north easterly direction towards SH1. The road cross sectional profile varies from being a single crossfall (falling in a southerly direction) to a crown road profile.

An existing stream culvert is located under Pine Valley Road. The southern end of Pine Valley Road, between the Dairy Flat Highway and the stream, falls sharply (9-12% gradient) in a north westerly direction towards the stream. The northern portion of the existing Pine Valley Road slopes in a south easterly direction, towards the stream, with moderate slopes.

The proposed location of the Pine Valley Road realignment is currently greenfield. The northern portion of this proposed realignment location currently falls in a northerly direction towards Old Pine Valley Road with gentle slopes. The remainder of this proposed new road location falls in a southerly direction towards the stream with gentle to moderate slopes.

Figure 2.2: Existing Site Topography



Source: Contours and aerial imagery sourced from Auckland Council GeoMaps (May 2020)

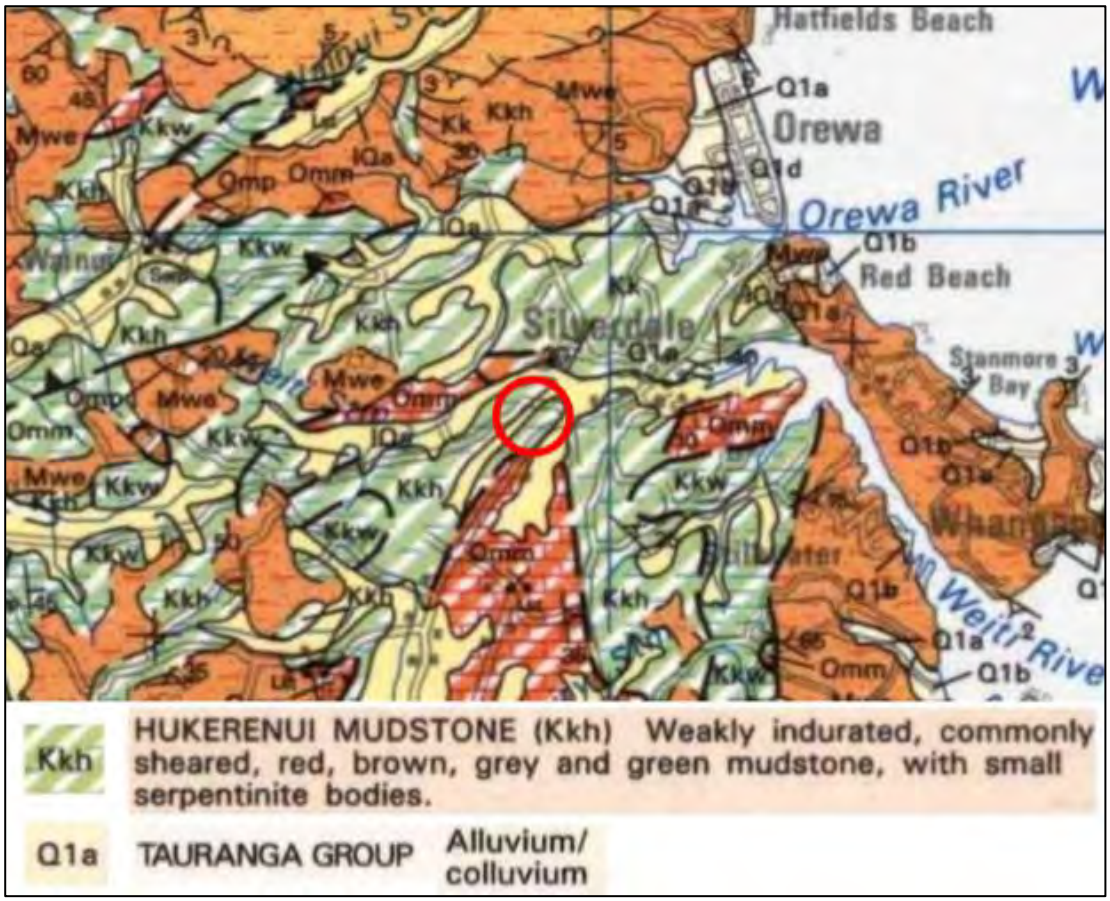
2.4 Geology

Mott MacDonald have prepared a geotechnical interpretive report on the ground investigation of the proposed works area. Details of this interpretive report have been summarised below. Additional information can be found in the geotechnical interpretive report, which will be provided as part of the Resource Consent application for this project.

The published geological map of the area indicates that the underlying geology of the site is predominantly Hukerenui Mudstone of Mangakahia Complex, part of the Northland Allochthon, with recent alluvial soils present in the flood plains and colluvial soils associated with existing hill slopes and stream networks. The underlying geology identified in the 1:250,000 Geological Map 3 (GNS Science) is illustrated on Figure 2.3 below. The approximate location of the site is circled in red.

Due to the erosive nature of the underlying soils and rocks, and limited soakage and infiltration capacity of the local soil, the geotechnical interpretive report recommends that any stormwater management design involving soakage and retention through infiltration should be avoided.

Figure 2.3: Regional Geological Map



Source: GNS Science– 1:250,000 Geological Map 3

2.4.1 Hydrogeology

Available investigation data from Auckland City Council indicates the following:

- The groundwater level is relatively low (deeper depth to groundwater) in Silverdale West area, with water likely to be present at depths of 3m or more below ground level.
- Groundwater flow across the Silverdale west area is typically from elevated areas towards streams and creeks, resulting groundwater levels being near to the surface within low-lying areas and gullies.
- Groundwater is expected to be perched within residual and alluvial soils in the area depending on soil thickness and proximity to the streams and creek.

As part of the ground intrusive investigations for this project, eleven hand-auger boreholes to depths of up to 5.2m below ground level were carried out. The locations of these hand-augers can be seen in the Mott MacDonald geotechnical interpretive report.

Groundwater levels encountered varied between 0.2m and 3.3m below ground level across the hand-augured boreholes. In some cases, groundwater was not encountered.

2.5 Existing Hydrology and Stormwater Infrastructure

2.5.1 General Catchment Drainage

Dairy Flat Highway is located on the ridgeline between the Pine Valley and Silverdale South Stormwater Catchments. The majority of the proposed works area is located within the Pine Valley Stormwater Catchment.

The watercourse network forms the existing primary drainage network for most of the proposed works area. Information from survey and Auckland Council GeoMaps indicates that there is no existing stormwater infrastructure servicing Pine Valley Road and the majority of Dairy Flat Highway. Runoff from Pine Valley Road and most of Dairy Flat Highway discharges to the adjacent road berms and drains to the watercourse network via overland flow.

NZTA infrastructure (catchpits and pipe network) servicing the Silverdale interchange is present at the northern end of Dairy Flat Highway. This network takes some runoff from Dairy Flat Highway as the longitudinal profile of the road falls towards the interchange. Two existing field catchpits are located adjacent to Dairy Flat Highway at the eastern extent of the proposed works. The indicative locations of these catchpits can be seen on Figure 2.4. It is understood that these catchpits are connected to the downstream NZTA reticulation.

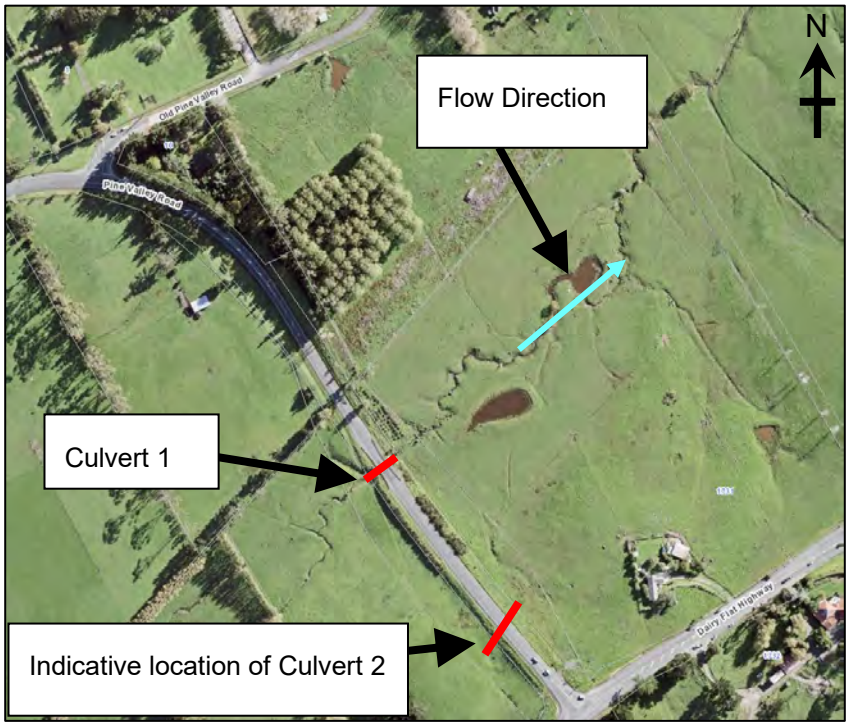
Figure 2.4: Field Catchpit Locations

Source: Auckland Council GeoMaps (December 2019)

2.5.2 Existing Stormwater Infrastructure

Existing stormwater infrastructure within the proposed works extent is limited to two culverts that cross Pine Valley Road. These culverts are not shown on Auckland Council GeoMaps. The indicative locations of these culverts are shown on Figure 2.5 below.

Figure 2.5: Pine Valley Road Culverts



Source: Auckland Council GeoMaps (December 2019)

Culvert 1 is a bolted steel structure. Site visit photos of this culvert are shown below on Figure 2.6. As part of this project, survey of the site was carried out in July 2019 by Woods. The survey information indicates that this culvert has an internal diameter of 3m.

Figure 2.6: Culvert 1 Site Visit Photos

Source: Mott MacDonald Site Visit Photos (September 2019)

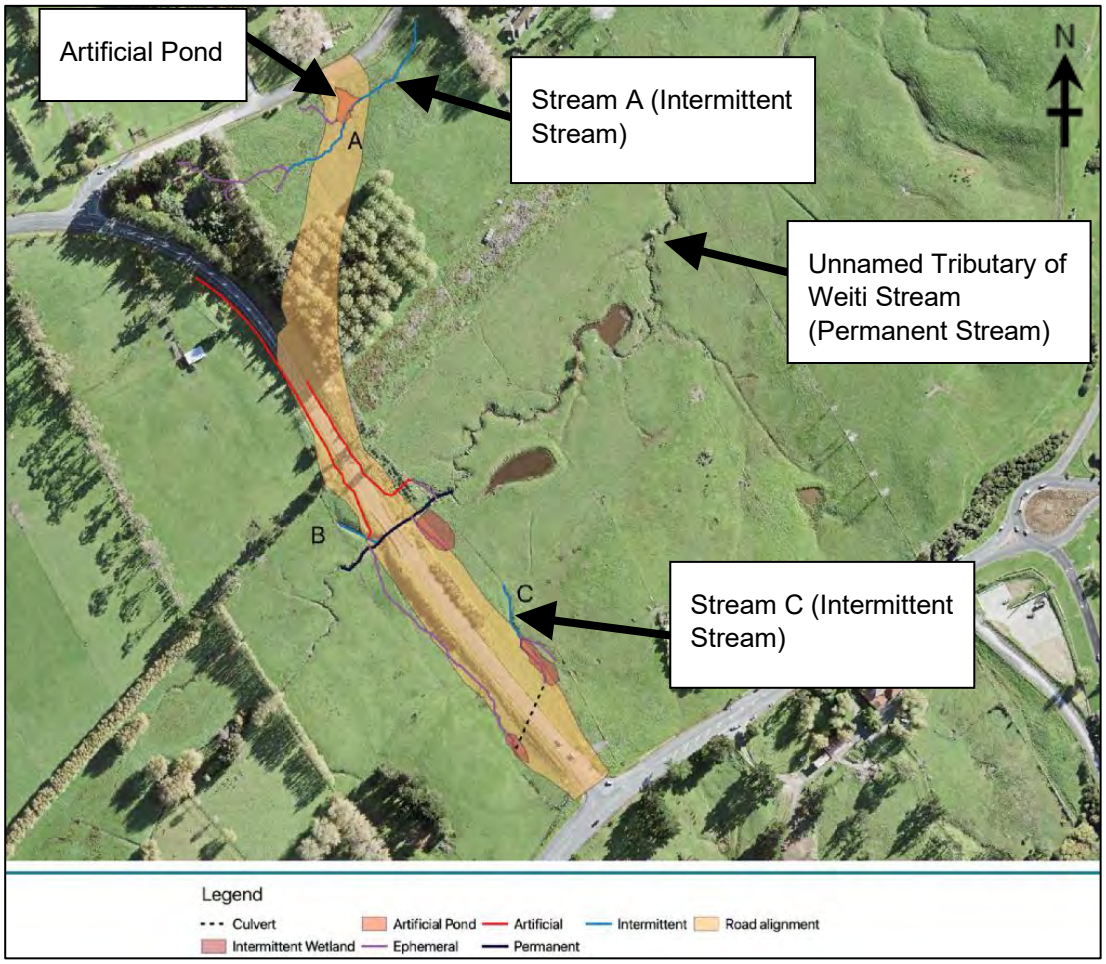
Culvert 2 is a small diameter plastic pipe that connects intermittent wetlands located on either side of Pine Valley Road. Survey information (Woods, July 2019) indicates that this culvert has a diameter of 375mm. The indicative location of the culvert and wetlands can be seen on Figure 2.7.

2.6 Watercourses and Wetlands

An unnamed tributary of the Weiti Stream is conveyed under Pine Valley Road via an existing 3m diameter culvert. This stream can be seen on Figure 2.7. A watercourse assessment carried out in September 2019 by Epoch Ecology identified that this is a permanent stream.

The watercourse assessment also identified the presence of two intermittent streams, three intermittent wetlands and an artificial pond in the vicinity of the proposed works. The location of these can be seen in Figure 2.7. Further information can be found in the Milldale Argent Lane Extension Watercourse Classification Summary memo (Epoch Ecology, 19th September 2019) which will be provided as part of the Resource Consent application for this project.

Figure 2.7: Site Waterway Classifications



Source: Epoch Ecology (September 2019)

An assessment was carried out on 20th November 2019 by Epoch Ecology to determine the extent of the existing intermittent wetlands. The intermittent wetland extents identified by Epoch Ecology are shown on Drawings 402828-MM-DWG-02-CV-DD-0800-02 to 402828-MM-DWG-02-CV-DD-0817-02 in Appendix A.

2.7 Receiving Environment

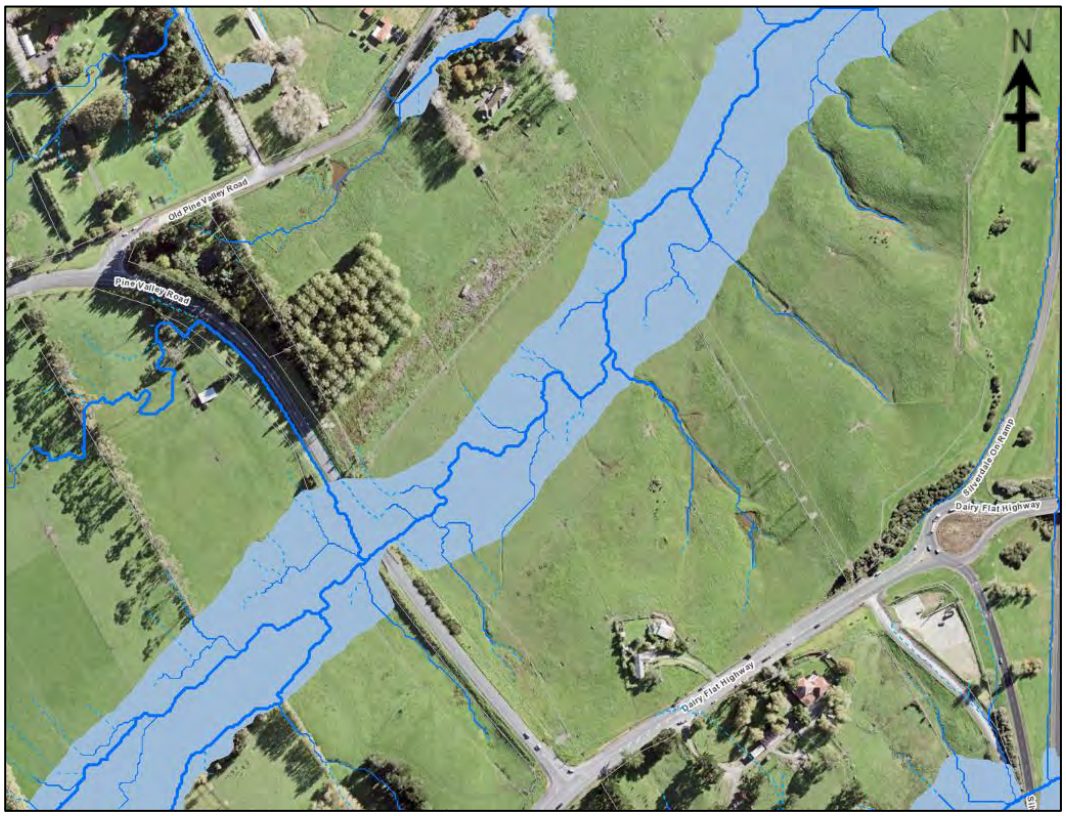
The receiving environment for runoff from the majority of the proposed extent of works is an unnamed tributary of the Weiti Stream (which is culverted under Pine Valley Road) and Johns Creek (located south of Dairy Flat Highway). Johns Creek is also a tributary of the Weiti Stream.

The Weiti Stream discharges to the Weiti Estuary, which subsequently discharges to the Hauraki Gulf. The Weiti Estuary is classified as a Significant Ecological Area (SEA) – Marine under the AUP:OP.

2.8 Overland Flowpaths and Flooding

The existing 100-year Average Recurrence Interval (ARI) overland flowpaths and floodplains identified by Auckland Council GeoMaps are shown on Figure 2.8 below. As shown on Figure 2.8, part of Pine Valley Road is located within a floodplain.

Figure 2.8: Auckland Council 100-Year ARI Floodplains and Overland Flowpaths



Source: Auckland Council GeoMaps (December 2019)

3 Proposed Development

3.1 Overview

The proposed works consists of widening a section of Pine Valley Road and Dairy Flat Highway to create additional traffic lanes, grass berms, footpaths and off-road cycleways. It is proposed to realign the northern portion of Pine Valley Road, which will connect to a proposed roundabout on Old Pine Valley Road (designed by others).

The proposed works have been divided into two stages; Stage 1 (interim works stage) and Stage 2 (ultimate works stage). Details of the two design stages are summarised below.

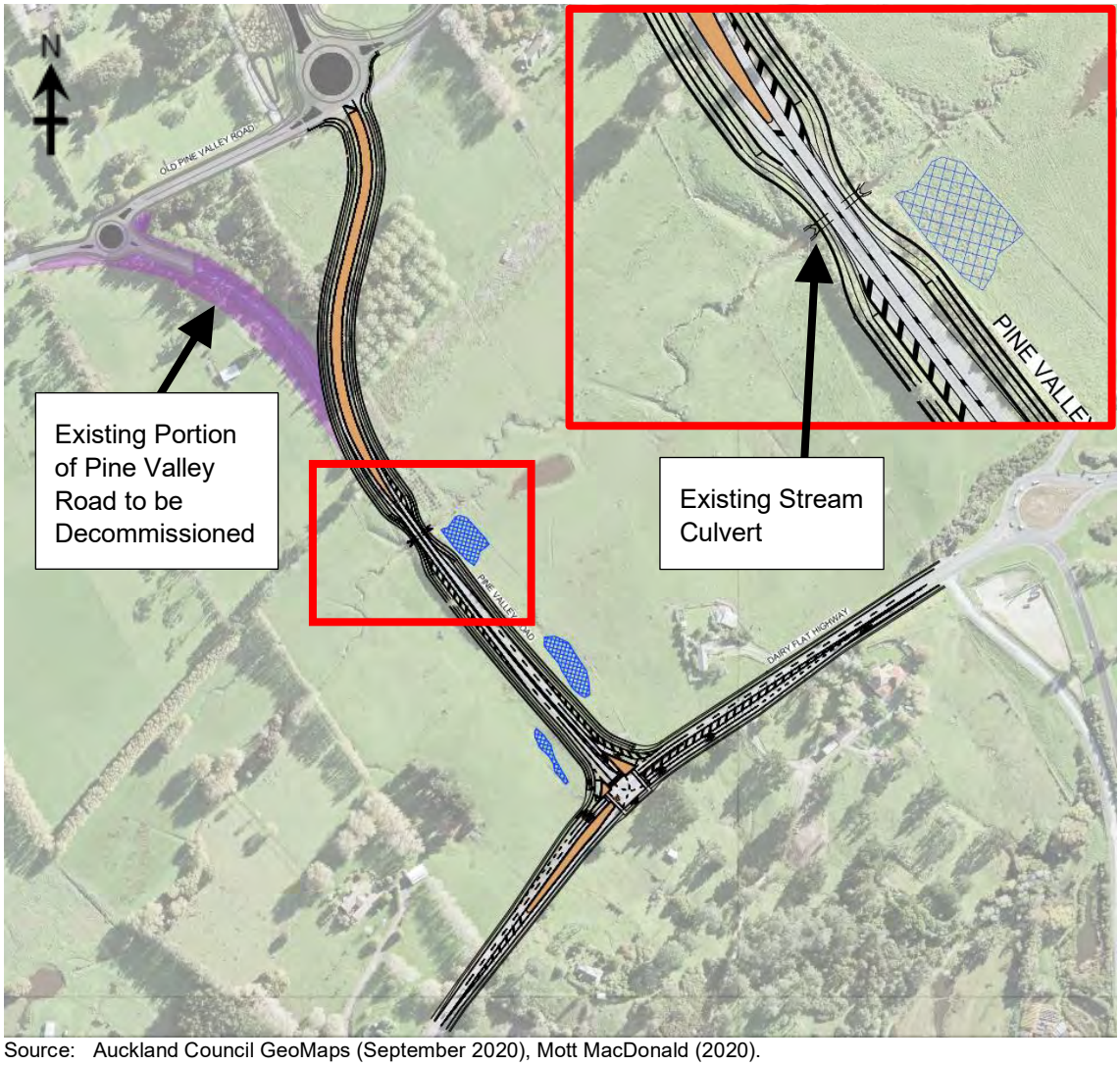
Construction of Stage 1 is expected to be completed in 2021. The timeframe for Stage 2 is anticipated to be 20 years away. The proposed stormwater design has been carried out with reference to both design stages. For example, the stormwater infrastructure has been sized and located (as much as possible) to cater for Stage 2 (rather than only designing for the interim stage) so that minimal replacements to the Stage 1 stormwater infrastructure and minimal construction of new stormwater infrastructure are required to facilitate Stage 2.

3.2 Stage 1 (Interim Works Stage)

The proposed Stage 1 road layout is shown below on Figure 3.1. The road carriageway width and total road reserve width for Stages 1 and 2 are proposed to be the same, with the exception of a portion of Pine Valley Road, which is located above the existing 3m diameter stream culvert.

For Stage 1, it is not proposed to upgrade the existing 3m diameter stream culvert under Pine Valley Road. Therefore, the Pine Valley Road reserve width is proposed to narrow over the existing culvert to match the existing road width (2 road lanes). The road reserve over the culvert will consist of 1 traffic lane in each direction and a shared footpath/cycleway on each side of the road, as shown below on Figure 3.1.

Figure 3.1: Proposed Stage 1 Road Alignment

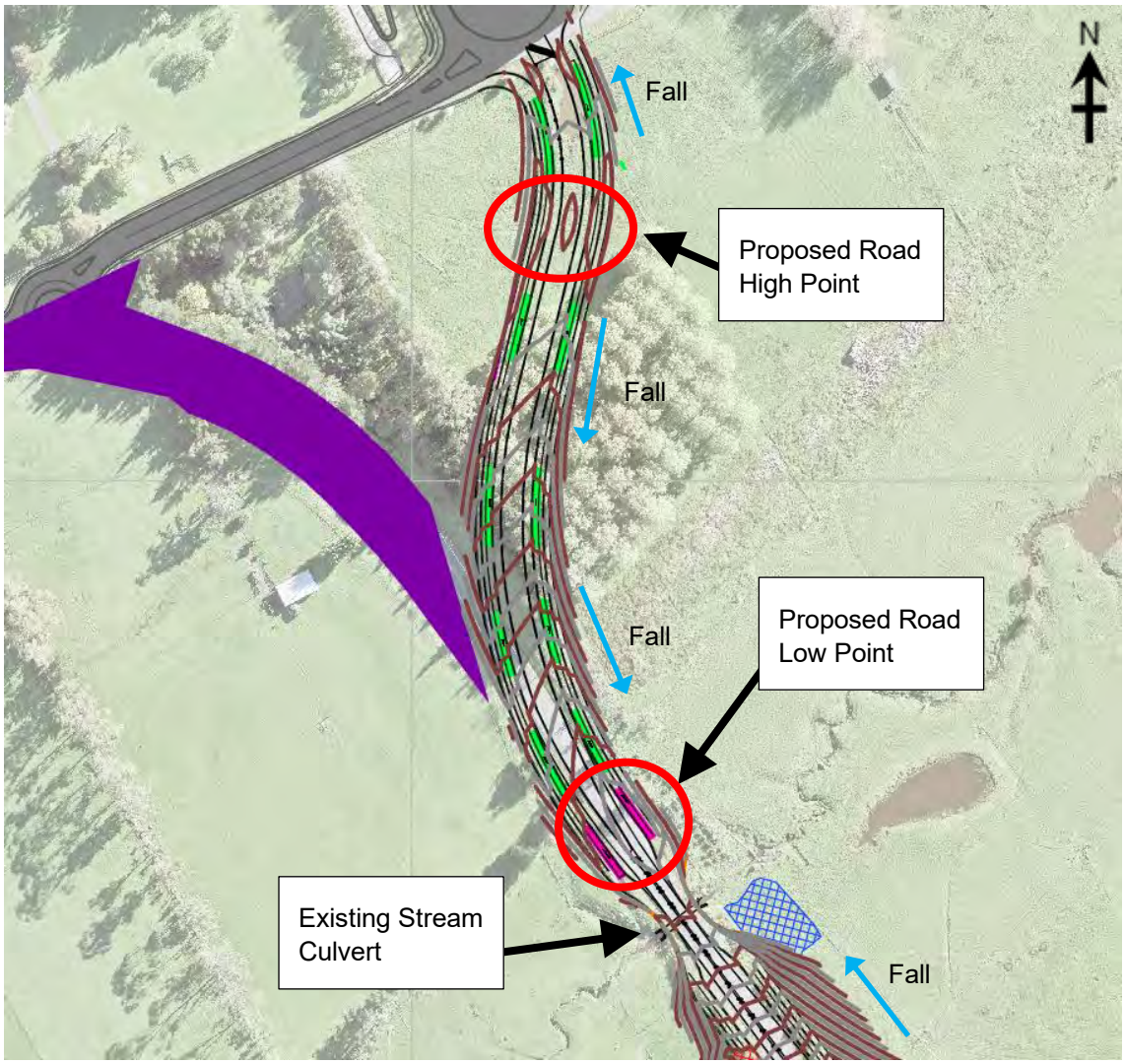


Source: Auckland Council GeoMaps (September 2020), Mott MacDonald (2020).

For Stages 1 and 2, Dairy Flat Highway is proposed to continue to fall in a north easterly direction towards the Silverdale Motorway On- and Off-Ramps. The southern portion of Pine Valley Road (road chainage 0 to 300) is proposed to fall with steep grades towards a low point in the road located on the northern side of the existing 3m stream culvert (as shown below on Figure 3.2). This low point is approximately located at Pine Valley Road chainage 300.

The majority of the realigned portion of Pine Valley Road (road chainage 300 to 557) falls from the proposed road high point to the road low point (as shown on Figure 3.2). Figure 3.2 illustrates that a small portion of Pine Valley Road (road chainage 557 to 624) is proposed to slope towards Old Pine Valley Road.

Figure 3.2: Proposed Stage 1 Pine Valley Road Contours



Source: Auckland Council GeoMaps (December 2019), Mott MacDonald (2020).

3.3 Stage 2 (Ultimate Works Stage)

Mott MacDonald understands that it is not proposed to alter the Dairy Flat Highway road carriageway width and total road reserve width as part of the Stage 2 works. For Stage 2, it is proposed to widen the section of Pine Valley Road over the existing 3m diameter stream culvert from 2 lanes to 4 lanes. To facilitate this road widening, it is proposed to decommission the existing 3m diameter stream culvert and construct a new culvert or bridge. The proposed Stage 2 road layout is shown on Figure 3.3 below.

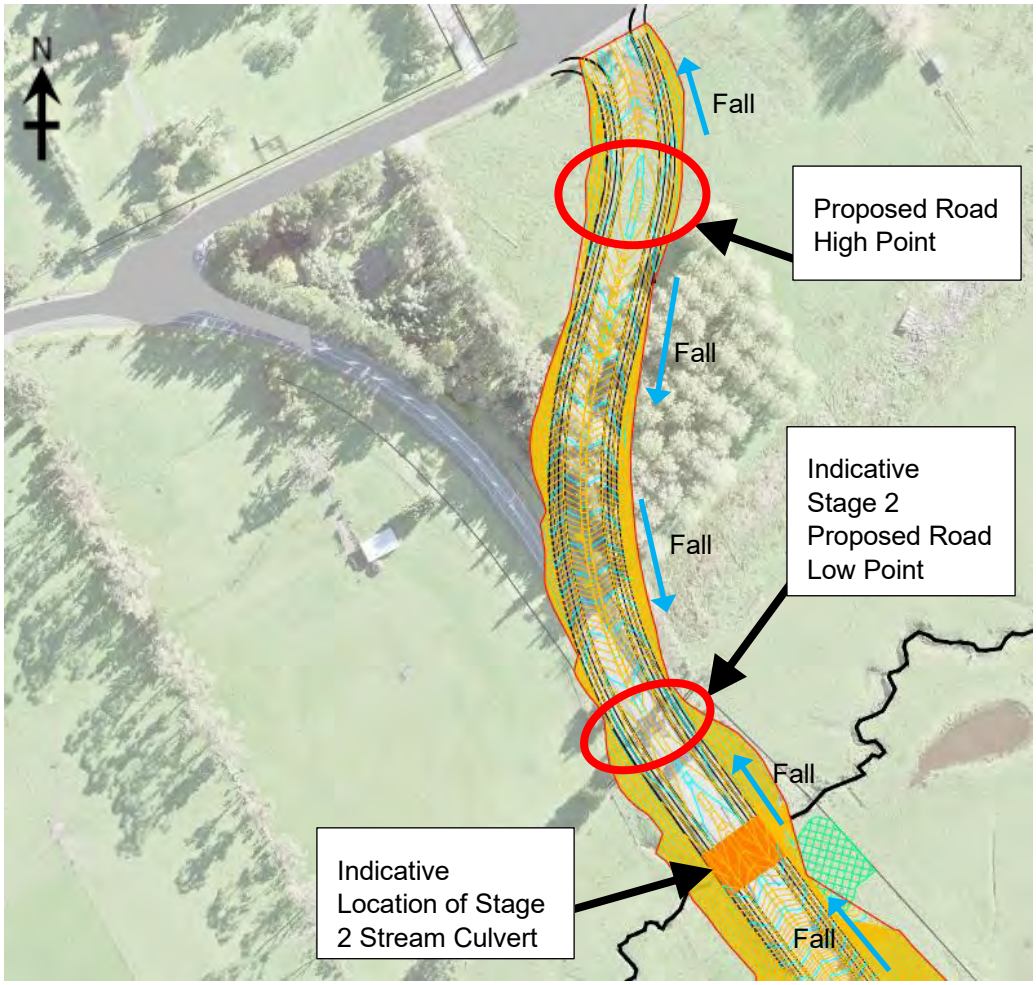
It should be noted that the design of this culvert or bridge will be carried out during the Stage 2 preliminary design of this project. It is understood that upsizing the culvert would need to be assessed at a catchment wide level by the Auckland Council Healthy Waters Catchment Planning Team. Therefore, the design of a new culvert or bridge is to be carried out in consultation with Healthy Waters.

Figure 3.3: Proposed Stage 2 Road Alignment

Source: Auckland Council GeoMaps (December 2019), Mott MacDonald (2020).

To facilitate the new culvert or bridge, it is likely that the Pine Valley Road levels above the stream will be raised for Stage 2. This would result in a portion of Pine Valley Road, on each side of the stream, to have different levels for Stage 1 and Stage 2. If the Pine Valley Road levels are raised above the stream culvert, this would result in the road low point shifting along Pine Valley Road in a northerly direction (located approximately at Pine Valley Road chainage 326). The indicative proposed Stage 2 contours for Pine Valley Road are shown below on Figure 3.4.

Figure 3.4: Indicative Stage 2 Pine Valley Road Contours



Source: Auckland Council GeoMaps (December 2019), Mott MacDonald (2020).

4 Stormwater Management Requirements

The stormwater management requirements for the site have been determined considering the following:

- Auckland Unitary Plan Operative in Part (AUP:OP):
  - Section E1: Water quality and integrated management.
  - Section E9: Stormwater quality – High contaminant generating carparks and high use roads.
  - Section E10: Stormwater management area – Flow 1 and Flow 2.
  - Section E36: Natural Hazards and Flooding.
- Silverdale West Dairy Flat Business Area Structure Plan Stormwater Management Plan which supported the Draft Silverdale West Dairy Flat Industrial Area Structure Plan (March 2019).
- Code of Practice for Land Development and Subdivision, Chapter 4- Stormwater (Auckland Council, November 2015).
- Auckland Transport Code of Practice, Chapter 17- Road Drainage (Auckland Transport, 2013) .
- Guideline Document 2017/001 *Stormwater Management Devices in the Auckland Region* (Auckland Council, December 2017) (GD01).
- Technical Publication Number 108 *Guidelines for Stormwater Runoff Modelling in the Auckland Region* (Auckland Regional Council, 1999) (TP108).
- Silverdale West Dairy Flat Business Area Structure Plan Stormwater Management Plan (SMP) (WSP Opus, November 2018).

4.1 Stormwater Quality Treatment

It is expected that the proposed works area will service more than 5,000 vehicles per day. Therefore, the proposed works area is considered to be an AUP:OP High Contaminant Generating Activity (HCGA). Section E9 of the AUP:OP requires that water quality treatment of runoff from HCGAs be provided.

Stormwater management devices to provide water quality treatment should be designed in accordance with Guideline Document 2017/001 Stormwater Management Devices in the Auckland Region (Auckland Council, December 2017).

Provision of stormwater treatment is in accordance with the SMP.

4.2 Hydrological Mitigation

The proposed works area is not located within an AUP:OP Stormwater Management Area for Flow (SMAF) control. The purpose of SMAF is to protect high value rivers, streams and aquatic biodiversity from degradation associated with stormwater runoff from urban development.

Policy 8 in Section E1.3. of the AUP:OP states that greenfield development should avoid as far as practicable, or otherwise minimise or mitigate, adverse effects of stormwater runoff on freshwater systems, freshwater and coastal water by:

- Minimising or mitigating changes in hydrology, including loss of infiltration, to:
  - Minimise erosion and associated effects on stream health and values
  - Maintain stream baseflows
  - Support groundwater recharge

The SMP states that the majority of the Structure Plan Area within the Silverdale South and Dairy Stream catchments were classified as SMAF Zone 1 in the technical analysis (TR2013/035) that supported SMAF classification in the Proposed AUP:OP. Additionally, the SMP advises that development within the Structure Plan Area will be required to apply hydrology mitigation.

For this project (Stages 1 and 2), it is proposed to create new or redevelop existing impervious area greater than 5,000m². To minimise the impact of changes in hydrology due to this increase in impervious area, SMAF 1 will be provided for new and re-developed impervious areas within the proposed works area. In accordance with Section E10.6.4.2. of the AUP:OP, the following must be provided:

- Retention (volume reduction) of at least 5mm of runoff depth from new or redeveloped impervious areas located within the site.
- Detention (temporary storage) and a “drain down” period of 24 hours for the difference between the pre-development and post-development runoff volumes from the 95th percentile 24-hour rainfall event (37mm) minus the 5mm retention volume for new or redeveloped impervious areas located within the site.

Table E10.6.3.1.1 of the AUP:OP notes the following exception to providing SMAF retention:

- If a suitably qualified person has confirmed that soil infiltration rates are less than 2mm/hr, or there is no area on the site of sufficient size to accommodate all required infiltration that is free of geotechnical limitations (including slope, setback from infrastructure, building structures or boundaries and water table depth) and rainwater reuse is not available due to:
  - The quality of the stormwater runoff is not suitable for on-site reuse (i.e. for non-potable water supply, garden/crop irrigation or toilet flushing); or
  - There are no activities occurring on the site that can re-use the full 5mm retention volume of water.

The Mott MacDonald Geotechnical Interpretive Report prepared for the proposed works identifies the presence of Northland Allochthon soils. The geotechnical report notes that due to the impermeable nature of the underlying geology, and limited soakage and infiltration capacity of the local soil, retention via infiltration into the ground should be avoided.

Based on this information, it is not proposed to provide retention for the site. The following SMAF 1 provisions will therefore instead be provided (in accordance with Table E10.6.3.1.1. of the AUP:OP):

- Detention (temporary storage) and a “drain down” period of 24 hours for the difference between the pre- development and post-development volumes from the 95th percentile 24-hour rainfall event (37mm rainfall depth) minus any retention volume that is achieved for new or redeveloped impervious area within the site

Stormwater management devices to provide SMAF 1 hydrology mitigation should be designed in accordance with Guideline Document 2017/001 *Stormwater Management Devices in the Auckland Region* (Auckland Council, December 2017).
Provision of SMAF 1 is a means of providing hydrology mitigation which is required to be provided by the SMP.

4.3 Primary Stormwater Network (Pipe Network)

The proposed road drainage will be designed to convey runoff generated during a 10-Year Average Recurrence Interval (ARI) rainfall event (in accordance with Auckland Council Code of Practice for Land Development and Subdivision (Chapter 4 – Stormwater)). Rainfall for the 10-year ARI event should be increased by 13.2% to account for the impacts of climate change in accordance with the Auckland Council Code of Practice for Land Development and Subdivision (Chapter 4 - Stormwater).

The proposed stormwater network will be designed in accordance with the Auckland Council Code of Practice for Land Development and Subdivision (Chapter 4 – Stormwater) and the Auckland Transport Code of Practice, Chapter 17 – Road Drainage (Auckland Transport, 2013).

4.4 Secondary Stormwater Network

The proposed roads must be designed to incorporate the conveyance of overland flowpaths generated in rainfall events up to and including the 100-year ARI event to minimise the risk to properties and people.

Flows for the 100-year ARI rainfall event will be calculated in accordance with the methods specified in Technical Publication Number 108 Guidelines for Stormwater Runoff Modelling in the Auckland Region (Auckland Regional Council, 1999) (TP108). Rainfall will be increased by 16.8% to account for the impacts of climate change in accordance with the Auckland Council Code of Practice for Land Development and Subdivision (Chapter 4 - Stormwater).

4.5 100-Year ARI Floodplain Management

A portion of Pine Valley Road is currently located within the 100-year ARI floodplain. Due to the proposed widening of Pine Valley Road, approximately 1,350m² of fill is proposed within the 100-year ARI floodplain as part of the Stage 1 earthworks for this project.

The SMP states that in greenfield areas, building in the floodplain should be avoided and flood tolerant activities should only occur if there are no downstream or upstream effects.

Similarly, Policy 21 in Section E36.3. of the AUP:OP requires that all development in the 1 per cent Annual Exceedance Probability (AEP) floodplain does not increase adverse effects from flood hazards or increased flood depths and velocities, to other properties upstream or downstream of the site. An assessment was carried out to determine the impacts of the proposed fill within the floodplain. Details of the assessment are summarised below in Section 5.6.

5 Proposed Stormwater Management

The proposed stormwater management design identified in this report is for Stage 1 of this project. To minimise upgrades to the Stage 1 stormwater pipe network during the construction of Stage 2, the proposed Stage 1 stormwater pipe network has been sized to convey runoff generated from both design stages.

As discussed in Section 3.3 of this report, there may be changes in levels along Pine Valley Road during the construction of Stage 2. This may require additional stormwater infrastructure to be constructed or may require Stage 1 stormwater infrastructure to be relocated in the vicinity of the existing culvert. This additional or relocated stormwater infrastructure is to be determined during the preliminary design of Stage 2.

The proposed Stage 1 stormwater network is shown on Drawings 402828-MM-DWG-02-CV-DD-0800-02 to 402828-MM-DWG-02-CV-DD-0817-02 in Appendix A. The proposed stormwater catchments for the Stage 1 pipe network are shown on Drawing 402828-MM-DWG-02-CV-DD-0850-02 in Appendix A.

5.1 Water Quality Treatment and SMAF 1 Hydrology Mitigation

It is proposed that raingardens be used to provide treatment of runoff and meet SMAF 1 requirements (retention and detention) for impervious areas within the site. Raingardens have been sized to provide water quality treatment and SMAF 1 hydrology mitigation for both Stage 1 and Stage 2, with the exception of Raingardens 32 and 33. This is discussed further in Section 5.1.3 of this report.

As discussed in Section 4.2 of this report, the Mott MacDonald Geotechnical Interpretive Report indicates that retention via infiltration to ground is not recommended due to slope stability issues. Therefore, retention will be provided in the raingardens as detention. To prevent infiltration of runoff from the raingardens into the ground (and reduce the risk of slope failure), the raingardens will be lined with an impermeable liner.

Three raingarden types are proposed for the site; Battered Slope Raingardens, Cast In-Situ Raingardens and a Super Raingarden. The locations of the proposed raingardens are shown on Mott MacDonald Drawings 402828-MM-DWG-02-CV-DD-0800-02 to 402828-MM-DWG-02-CV-DD-0817-02 in Appendix A. Details of these raingardens are discussed below.

5.1.1 Battered Slope Raingardens (Type A)

The majority of raingardens proposed within the site will be Battered Slope Raingardens (Type A) located within the road berms. These raingardens are proposed to be constructed using natural battered side slopes of 1V:1H, instead of using vertical sided concrete raingarden units. The raingardens are proposed to be constructed on grade with the road. Therefore, check dams are proposed to be constructed within the raingardens. Details of the Battered Slope Raingardens (Type A) are shown on 402828-MM-DWG-02-CV-DD-0840-02 in Appendix A.

The raingardens have been sized to provide water quality treatment and SMAF 1 hydrology mitigation for runoff generated from impervious areas within Stages 1 and 2. Runoff will enter the raingardens from cut-outs in the proposed road kerbs. Runoff in excess of the raingarden's design capacity (95th percentile rainfall event) will bypass the raingarden inlets and enter the proposed stormwater network via a catchpit located downstream of the raingarden.

5.1.2 Concrete Cast In-Situ Raingardens (Type B)

Due to limited available space between the existing stream culvert and the proposed Stage 1 Pine Valley Road low point, the proposed raingardens to provide water quality treatment and SMAF 1 hydrology mitigation for Catchments 32 and 33 will be Cast In-Situ Raingardens (Type B). These raingardens are proposed be located within the road berms at the Pine Valley Road low point. The Type B raingardens are proposed to consist of vertical walled concrete raingarden units, which are proposed to be cast in-situ.

Runoff will enter the raingardens from cut-outs in the proposed road kerbs. As it is proposed to locate the raingardens within the Pine Valley Road low point, runoff in excess of the raingarden's design capacity (95th percentile rainfall event) will discharge into the proposed stormwater network via manholes with scruffy dome inlets located within the raingardens. Details of the Cast In-Situ Raingardens (Type B) are shown on 402828-MM-DWG-02-CV-DD-0841-02 in Appendix A.

As previously discussed in Section 3.3 of this report, it is anticipated that the road levels in the vicinity of the existing stream culvert will be raised for Stage 2 of this project. Therefore, during the Stage 2, these cast in-situ raingardens (Raingardens 32 and 33) will need to be decommissioned. As a result, the proposed cast in-situ raingardens (Raingardens 32 and 33) have been designed to provide water quality treatment and SMAF 1 hydrology mitigation only for runoff generated from Stage 1 impervious areas.

5.1.3 Super Raingarden

The longitudinal profile of Pine Valley Road between Dairy Flat Highway and the existing stream culvert varies from 9-12%. Historically Auckland Council's Healthy Waters division have recommended that raingardens are not to be constructed on steep slopes (greater than 7%). Three different raingarden configurations for this section of road were discussed at a meeting with Auckland Transport on 22nd November 2019. It was agreed that constructing a single large raingarden (a 'super' raingarden) adjacent to Pine Valley Road was the most appropriate raingarden design for this section of road.

A treatment train approach has been proposed to provide water quality treatment and SMAF 1 hydrology mitigation for this steep section of Pine Valley Road. Runoff from this portion of Pine Valley Road is proposed to discharge to grass conveyance channels located within the road berms. The conveyance channels will provide pre-treatment for runoff generated from the road.

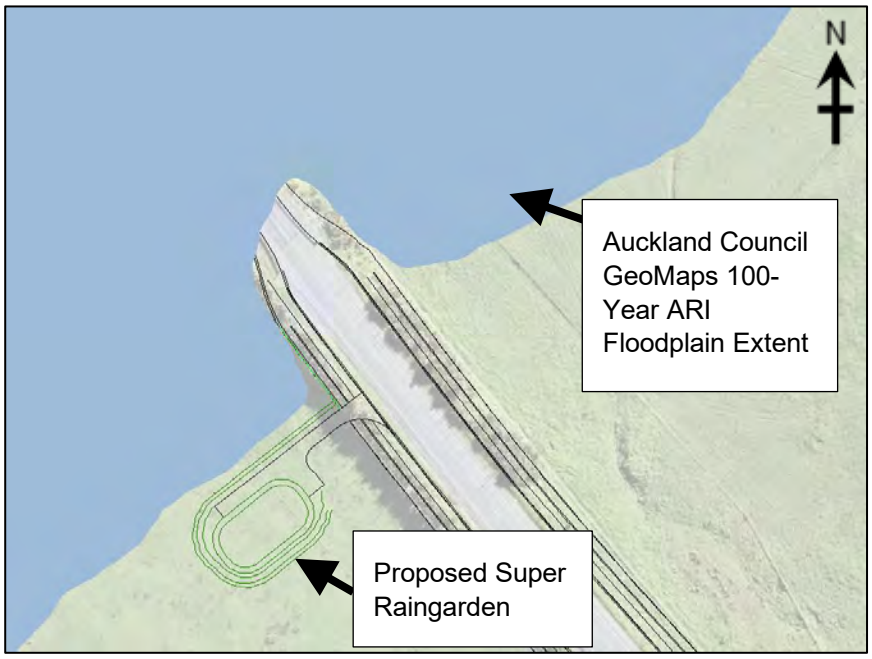
Runoff will discharge via the conveyance channels in a north westerly direction towards the stream. Runoff is proposed to discharge from the conveyance channels into the super raingarden via scruffy domes, located within the conveyance channels, and a short length of stormwater pipework.

The conveyance channels have been sized to convey the 10-year ARI storm event (including a climate change allowance). The conveyance channels are proposed to be a trapezoidal shape with a 600mm wide base, 1V:4H side slopes and a maximum depth of 200mm. The conveyance channel depth includes a freeboard allowance from the top of the 10-year ARI water level to the adjacent road of at least 100mm.

Due to the steep grades associated with Pine Valley Road, it is proposed to construct aggregate check dams within the conveyance channels where the longitudinal grade is 12% or greater. Details of the proposed conveyance channels are shown on Mott MacDonald Drawing 402828-MM-DWG-02-CV-DD-0831-02 in Appendix A.

The super raingarden is proposed adjacent to Pine Valley Road, as shown on Figure 5.1 below. Figure 5.1 illustrates that the raingarden has been located outside of the floodplain identified on Auckland Council GeoMaps.

Figure 5.1: Proposed Super Raingarden Location

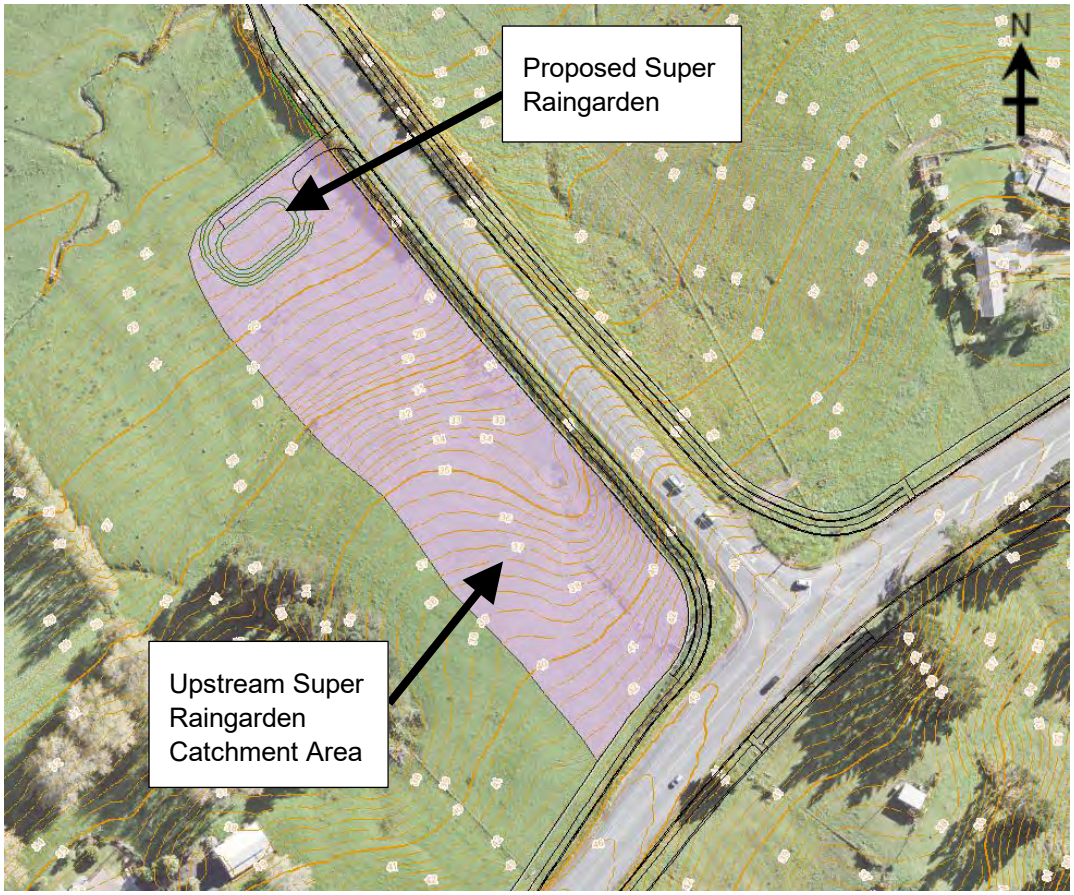


Source: Floodplain data from Auckland Council GeoMaps (December 2019)

The proposed super raingarden has been sized to provide water quality treatment and SMAF 1 hydrology mitigation for the southern portion of Pine Valley Road (stormwater Catchments 9, 19, 28 and 29). Runoff in excess of the raingarden's design capacity (95th percentile rainfall event) will discharge from the raingarden to the downstream proposed stormwater network via a 1400mm diameter scruffy dome. An emergency reinforced grass spillway has also been provided on the northern embankment of the raingarden so that flows in excess of the 10-year ARI storm event can overtop the spillway and flow down to the adjacent watercourse.

The raingarden outlet structure and emergency spillway have been sized to convey flows from the proposed swales and the undeveloped catchment area (1.08ha) which drains towards the super raingarden. The location of this undeveloped catchment area discharging to the super raingarden is shown on Figure 5.2

Figure 5.2: Undeveloped Super Raingarden Catchment Area



Source: Contours and aerial imagery sourced from Auckland Council GeoMaps (May 2020)

Details of the proposed super raingarden are shown on Mott MacDonald Drawing 402828-MM-DWG-02-CV-DD-0843-02 in Appendix A. As shown on Mott MacDonald Drawing 402828-MM-DWG-02-CV-DD-0843-02, a 3.5m wide maintenance access track has been provided around the northern side of the raingarden. A 1m working platform has also been provided around the remainder of the raingarden.

Calculations for the proposed conveyance channels and raingardens are provided in Appendix B. The locations of the proposed super raingarden and conveyance channels are shown on Mott MacDonald Drawings 402828-MM-DWG-02-CV-DD-0800-02 to 402828-MM-DWG-02-CV-DD-0817-02.

5.2 Primary Stormwater Network (Pipe Network)

The proposed road drainage network consists of raingardens, catchpits, conveyance channels (along part of Pine Valley Road) and stormwater pipelines. The proposed stormwater pipe network has been sized to convey flows generated within the proposed works area during a 10-year ARI rainfall event. During a 10-year ARI rainfall event, flows in excess of the raingarden design capacities will bypass the raingarden inlets and discharge to the proposed catchpits downstream of the raingardens or will discharge to scruffy domes located with the raingardens. The location of the proposed stormwater drainage is shown on Mott MacDonald Drawings 402828-MM-DWG-02-CV-DD-0800-02 to 402828-MM-DWG-02-CV-DD-0817-02 in Appendix A.

Rainfall for the 10-year ARI event was increased by 13.2% to account for the impacts of climate change in accordance with the Auckland Council Code of Practice for Land Development and Subdivision (Chapter 4 - Stormwater). Capacity calculations for the proposed stormwater network are provided in Appendix B.

For the proposed road drainage, catchment flows were calculated using the Rational Formula with an assumed time of concentration of 10 minutes. A 10-year ARI 10-minute peak rainfall intensity of 110.8mm/hour was used to calculate flows. This is based on 10-year 24-hour rainfall depth (with adjustments for climate change consideration) of 164.1mm and the Auckland Region design storm profile specified in Technical Publication Number 108 Guidelines for Stormwater Runoff Modelling in the Auckland Region (Auckland Regional Council, 1999) (TP108).

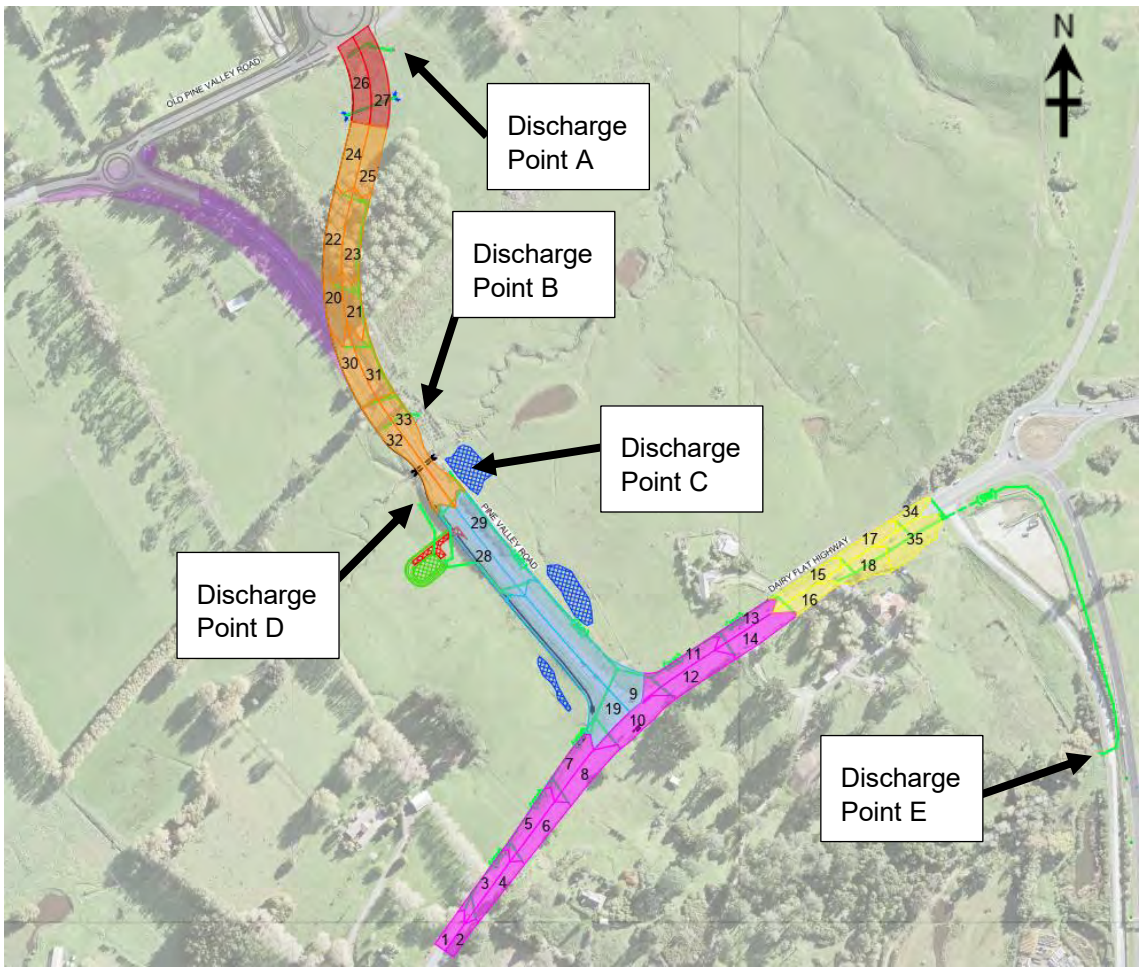
5.2.1 Discharge Locations for Proposed Reticulation

As discussed in Section 2.5, there is minimal existing reticulation within the proposed extent of works. The primary stormwater network (pipe network) for Stage 1 is proposed to discharge from the site via 5 discharge points:

a. An intermittent stream located adjacent to Old Pine Valley Road (Stream A) via new stormwater Outlet 5 (proposed stormwater Catchments 26 and 27).
b. Downstream of the existing 3m diameter stream culvert to an unnamed watercourse via new stormwater Outlet 4 (proposed stormwater Catchments 20-25 and 30-33).
c. Downstream of the existing 3m diameter stream culvert to an unnamed watercourse via new stormwater Outlet 1 (proposed stormwater Catchments 1-8 and 10-14).
d. Upstream of the existing 3m diameter stream culvert to an unnamed watercourse via new stormwater Outlet 8 (proposed stormwater Catchments 9,19, 28 and 29).
e. Johns Creek via new stormwater Outlet 3 (proposed stormwater Catchments 15-18 and 34-35).

The locations of these discharge points are illustrated below on Figure 5.3. Details of the proposed discharge locations are summarised below.

Figure 5.3: Proposed Pipe Network Discharge Locations



Source: Auckland Council GeoMaps (December 2019), Mott MacDonald (2020).

5.2.1.1 Discharge Point A (Discharge to Intermittent Stream)

As discussed in Section 3.2, a small portion of Pine Valley Road is proposed to fall towards Old Pine Valley. It is proposed to discharge runoff from this portion of Pine Valley Road (Catchments 26 and 27) to an adjacent intermittent stream (Stream A) via a new stormwater outlet (Outlet 5). To minimise the risk of erosion to the intermittent stream, it is proposed to provide riprap at the outlet.

5.2.1.2 Discharge Point B (Discharge Downstream of Existing 3m Diameter Stream Culvert via Outlet 4)

A new stormwater outlet (Outlet 4) is proposed adjacent to the downstream end of the existing 3m diameter stream culvert. It is proposed to discharge runoff from the northern end of Pine Valley Road (Catchments 20-25 and Catchments 30-33) to the stream via this outlet. To minimise the risk of erosion to the stream, it is proposed to provide a riprap lined channel prior to discharge to the stream.

5.2.1.3 Discharge Point C (Discharge Downstream of Existing 3m Diameter Stream Culvert via Outlet 1)

Runoff from a portion of Dairy Flat Highway (Catchments 1-8 and 10-14) will be conveyed via reticulation to a new outlet (Outlet 1) located downstream of the existing 3m diameter stream culvert. To minimise the risk of erosion to the stream, it is proposed to provide a riprap lined channel prior to discharge to the stream.

The longitudinal profile of the Dairy Flat Highway falls in a north easterly direction towards SH1. As Pipeline MH 2-3 to MH 1-4 is proposed to discharge flows in a south westerly direction, the proposed pipeline will be relatively deep (approximately a 6m depth to invert). Construction using trenchless techniques will be considered for this pipeline. The construction methodology for this pipeline will be determined during the detailed design stage of this project.

5.2.1.4 Discharge Point D (Discharge Upstream of Existing 3m Diameter Stream Culvert)

A new stormwater outlet (Outlet 8) is proposed upstream of the existing 3m diameter stream culvert. It is proposed to discharge runoff from the super raingarden (Catchments 9, 19, 28 and 29) to the unnamed tributary of the Weiti Stream via this new outlet. To minimise the risk of erosion to the stream, it is proposed to provide a riprap lined channel prior to discharge to the stream.

5.2.1.5 Discharge Point E (Discharge to Johns Creek)

The longitudinal profile of the Dairy Flat Highway falls in a north easterly direction towards SH1. Piping runoff from the eastern end of Dairy Flat Highway back to the intersection of Dairy Flat Highway and Pine Valley Road would result in a deep pipeline (approximately 12m deep). Due to the required pipeline depth, this was not considered to be a feasible solution for this project.

The majority of runoff within the project works area from Dairy Flat Highway is proposed to discharge to new Outlet 1 downstream of existing Pine Valley Road stream culvert (Discharge Point C). It is proposed to discharge runoff from the remainder of Dairy Flat Highway (eastern end) by constructing a new stormwater pipeline within the New Zealand Transport Agency (NZTA) designation. This pipeline would discharge to Johns Creek via a new outfall (Outlet 3). To minimise the risk of erosion to the intermittent stream, it is proposed to provide riprap at the outlet. We have spoken to Peter Mitchell of ASM about the potential of installing a new pipe and associated outlet within the NZTA designation and he has given approval in principle to this approach.

5.3 Proposed Intermediate Stream Culvert Under Pine Valley Road

An intermittent stream (Stream A – identified on Figure 2.7) currently crosses the proposed Pine Valley Road alignment at the northern end of the proposed works (road chainage 550). This stream will need to be culverted under the proposed road.

Pine Valley Road is currently identified as an ‘urban arterial’ on Auckland Council GeoMaps. Auckland Transport guidance is that arterial roads should not be overtopped in a 100-year ARI Maximum Probable Development (MPD) Climate Change (CC) event. Therefore, the culvert has been sized to convey the 100-year ARI MPD CC event. The culvert has also been sized to provide minimum freeboard of 500mm from the 100-year peak water level to the edge of the seal of the road (in accordance with the Auckland Council Code of Practice for Land Development and Subdivision (Chapter 4 - Stormwater)).

The approximate catchment area discharging to the proposed culvert is 1.54ha. This can be seen in Figure 5.4 below.

Figure 5.4: Catchment to Proposed New Culvert at Road Chainage 550m

Source: Contours and aerial imagery sourced from Auckland Council GeoMaps (May 2020)

The catchment is currently largely pervious. However, the catchment area is zoned Future Urban in the AUP:OP. Therefore, the catchment impervious area is likely to increase in the future (when the catchment is developed). Most of the contributing catchment area has been identified as light industry in the Draft Silverdale West Dairy Flat Industrial Area Structure Plan (March 2019). For the purpose of calculating flows to the culvert it was assumed that the contributing catchment area is 90% impervious.

A 100-year 24-hour rainfall depth of 210mm from TP108 was used. This was increased by 16.8% to account for the impacts of climate change (in accordance with Table 4.1 of the Auckland Council Code of Practice for Land Development and Subdivision (Chapter 4 - Stormwater)) resulting in a rainfall depth of 245.3mm.

The peak 100-year ARI flow for the proposed culvert catchment was calculated in accordance with the methods specified in TP108. The parameters associated with this calculation are tabulated below.

Table 5.1: Proposed Culvert Catchment Parameters

Catchment Area (ha)	Pervious Area (ha)	Impervious Area (ha)	Time of Concentration (hrs)	100-Year ARI 24-hour Rainfall Depth* (mm)	Peak 100-ARI Flow (m^3/s)
1.54	0.15	1.39	0.17	245.3	0.623

* Rainfall adjusted to include climate change consideration

There is limited road cover in the vicinity of the proposed culvert. A suitably sized circular culvert to convey the 100-year ARI flow was not feasible due to the exiting stream invert levels and available pipe cover under the road. As the minimum available height for a pre-cast box culvert is 1m, the proposed stream culvert will consist of a 0.75m high x 1.5m wide heavy-duty concrete channel with a concrete lid. It is proposed to partially bury the culvert 0.25m below the existing stream level.

As shown on Figure 5.5 below, the alignment of the intermittent stream is quite sinuous. Due to limitations with available cover over the proposed culvert, it is not practical to provide a culvert which matches the stream's alignment. Therefore, it is proposed to construct a culvert perpendicular to the road. The proposed orientation of the culvert can be seen on Figure 5.5 below and Mott MacDonald Drawing 402828-MM-DWG-02-CV-DD-0817-02 attached in Appendix A.

Figure 5.5: Intermittent Stream Alignment

A new parabolic shape channel will be created at the culvert outlet which will convey flow from the proposed culvert to the existing downstream intermittent stream, as shown above on Figure 5.5. The channel has been sized to convey the 100-year peak flow discharging from the proposed culvert and 10-year ARI flows generated from a small catchment area on the eastern side of the proposed road. The catchment area for the proposed channel is illustrated below on Figure 5.6.

The channel will have a 0.5% longitudinal slope, maximum depth of 600mm and a top width of 3.15m. The proposed channel depth has allowed for a 100mm freeboard. The parameters used for these calculations have been presented in Table 5.2 below. Refer to Appendix B for full calculations.

Table 5.2: Proposed Channel Catchment Parameters

Catchment Area (ha)	Pervious Area (ha)	Impervious Area (ha)	Time of concentration (hrs)	24-hour Rainfall depth* (mm)	Flow (m^3/s)
1.54	0.15	1.39	0.17	245.3 (100-Year)	0.623
0.25	0.025	0.23	0.17	164 (10-year)	0.068
			Total Proposed Channel Peak Design Flow (m^3/s)		0.691

* Rainfall adjusted to include climate change consideration

Figure 5.6: Catchment Draining to Proposed Channel

Source: Contours and aerial imagery sourced from Auckland Council GeoMaps (May 2020)

5.4 Existing Culvert Under Pine Valley Road

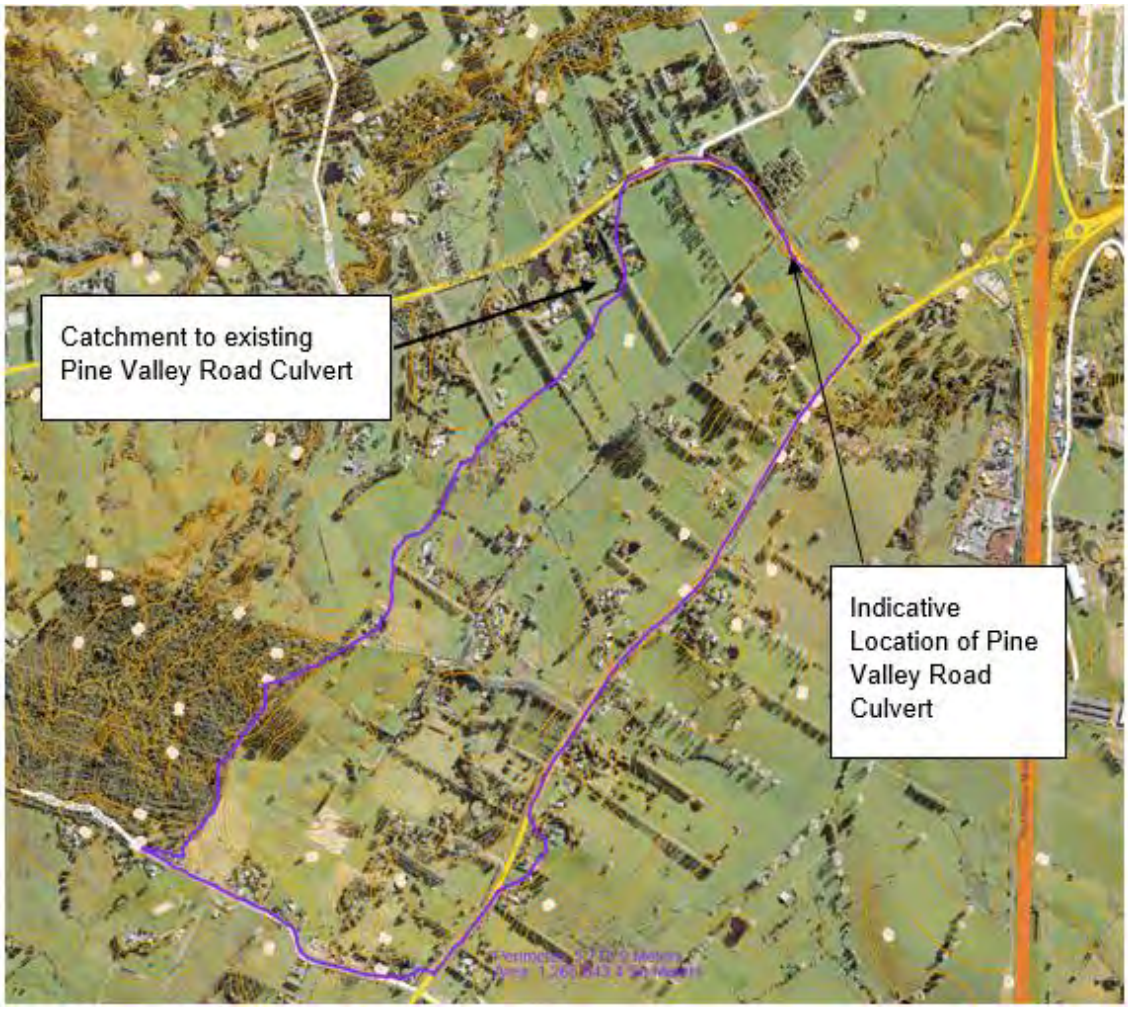
The catchment to the existing 3m diameter stream culvert was determined to be approximately 126.6ha. The catchment can be seen on Figure 5.7. The 100-year ARI flow to the culvert was calculated to be 25.1m³/s. The flow inputs are summarised in Table 5.3 below and the flow calculations have been attached in Appendix B. The upstream catchment is zoned Future Urban in the AUP:OP. The flow calculations are based on an assumed imperviousness of 70%.

Table 5.3: 100-Year ARI Flow to Existing Pine Valley Road Culvert

Parameter	Value
Catchment Area (ha)	126.56
Pervious Area (ha)	37.97
Impervious Area (ha)	88.59
Pervious Area Time of concentration (hrs)	1.13
Impervious Area Time of concentration (hrs)	0.86
100-Year ARI 24-hour rainfall depth* (mm)	245.3
Peak 100-Year Flow (m³/s)	25.1

* Rainfall adjusted to include climate change consideration

Figure 5.7: Catchment to Existing Culvert



Source: Auckland Council GeoMaps (December 2019)

As shown on Figure 2.8, Auckland Council GeoMaps indicates that there is a 100-year ARI floodplain located upstream and downstream of the existing stream culvert.

Auckland Transport guidance requires that arterial roads should not be overtopped in a 100-year ARI MPD climate change event. The Auckland Council GeoMaps floodplain extent (shown on Figure 2.8) indicates that the road will be overtopped in such an event. It should be noted that this floodplain extent has been generated from a Rapid Flood Hazard Assessment carried out by DHI in 2013 as part of the Auckland Council North and South Catchments Rapid Flood Assessment project. The AC North and South Catchments Rapid Flood Assessment (RFA) report (DHI, 2013) indicates that this existing 3m diameter stream culvert was not included in the model. Therefore, available stormwater modelling information cannot confirm if this culvert is adequately sized for the 100-year ARI MPD climate change event.

A high-level culvert sizing exercise was carried out in order to understand potential culvert sizing and any impacts on road levels for Stage 2. Replacing/upsizing the existing culvert is not proposed as part of the Stage 1 scope of works. It is understood that upsizing the culvert would need to be assessed at a catchment wide level by Healthy Waters. If the existing culvert is undersized, upsizing the culvert would allow additional flow to pass downstream which could have negative impacts (such as flooding) on downstream landowners.

High-level culvert sizing calculations indicate that a 3.5m wide x 3.0m high box culvert is required to convey the 100-year ARI MPD flow underneath the road. This sizing does not incorporate a blockage allowance.

It is noted that the NZTA bridge manual specifies a freeboard of 0.6m between the 100-year ARI event and the underside of the superstructure. Where the possibility exists that large trees may be carried down the waterway, then the freeboard requirement increases to 1.2m. Aerial photographs do not indicate the presence of many trees upstream. Therefore, the risk of blockage of the culvert by trees is considered to be minor. In addition, there is a 1m freeboard between the culvert headwater level and the road level which provides a factor of safety.

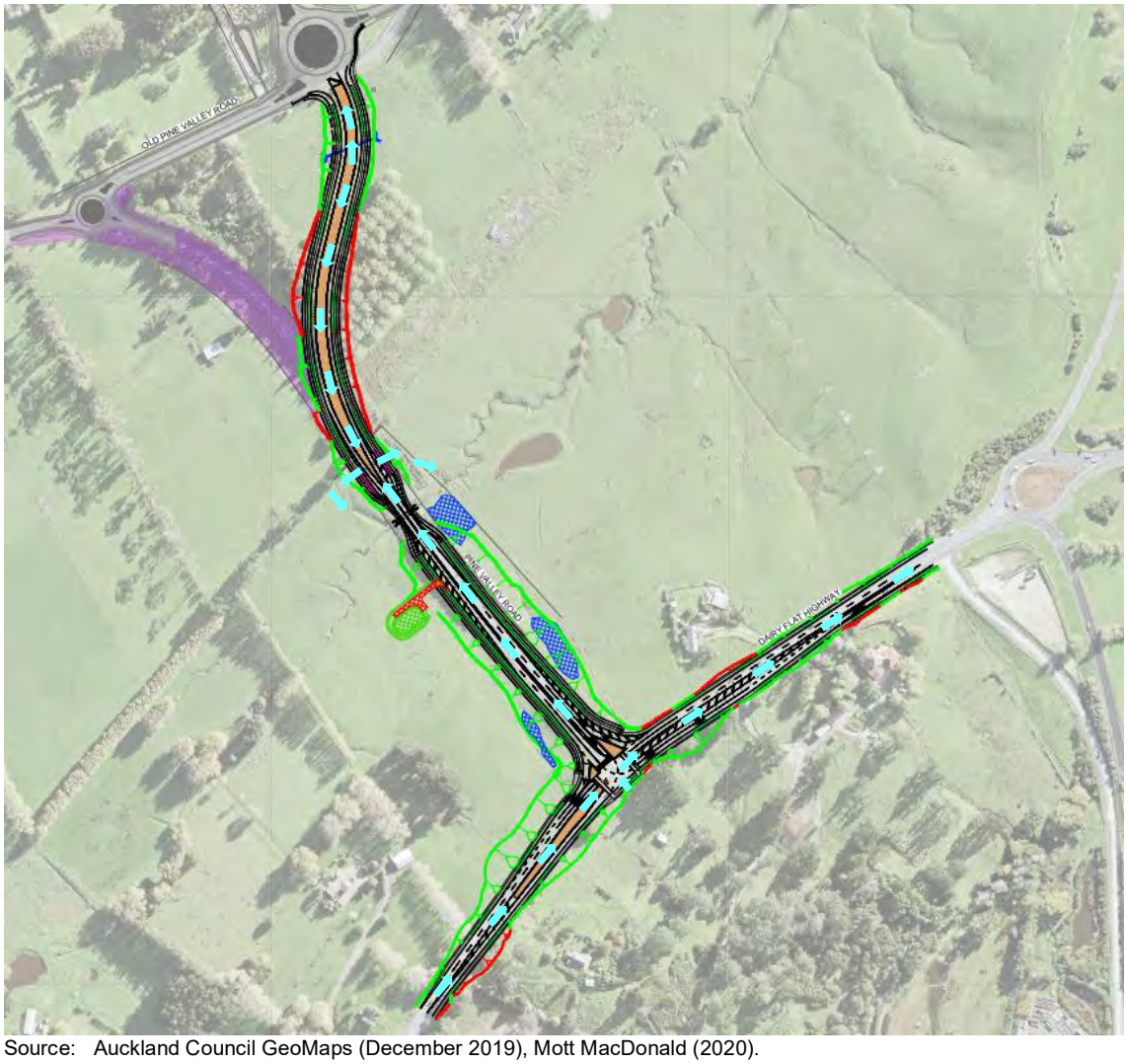
5.5 Secondary Stormwater Network (Overland Flowpaths)

The secondary drainage network consists of overland flowpaths conveying runoff which exceeds the primary network capacity during a 100-year ARI rainfall event. It is proposed to convey the 100-year ARI overland flowpaths through the site via surface flows within the Pine Valley Road and Dairy Flat Highway Road reserves.

For the northern portion of Pine Valley Road (approximate road chainage 557 to 624), the 100-year ARI overland flowpaths will be conveyed within the road reserve in a northerly direction towards the proposed roundabout on Old Pine Valley Road. The remainder of Pine Valley Road will convey 100-year ARI overland flowpaths within the road reserves towards the low point of Pine Valley Road located just north of the existing stream culvert.

For Dairy Flat Highway, the 100-year ARI overland flowpaths will be conveyed within the road reserve in a north easterly direction towards the Silverdale Interchange. The locations of the proposed 100-year ARI overland flowpaths are shown on Figure 5.8 below.

Figure 5.8: Proposed 100-Year ARI Overland Flowpaths



Source: Auckland Council GeoMaps (December 2019), Mott MacDonald (2020).

5.6 100-Year ARI Flood Assessment

It is proposed to widen a portion of Pine Valley Road which is currently located within the 100-year ARI floodplain. To facilitate the proposed road widening, approximately 1,350m² of fill is proposed within the floodplain.

An assessment was carried out using hydraulic modelling by WatRes Consulting to determine if there are upstream or downstream impacts on 100-year ARI flood levels. The latest Healthy Waters Silverdale South Stormwater Catchment model was adapted to assess the impact on 100-year ARI flood levels due the proposed Stage 1 earthworks. The Pine Valley Road Stormwater Modelling Technical Memo (WatRes Consulting, April 2020) is provided in Appendix C of this report.

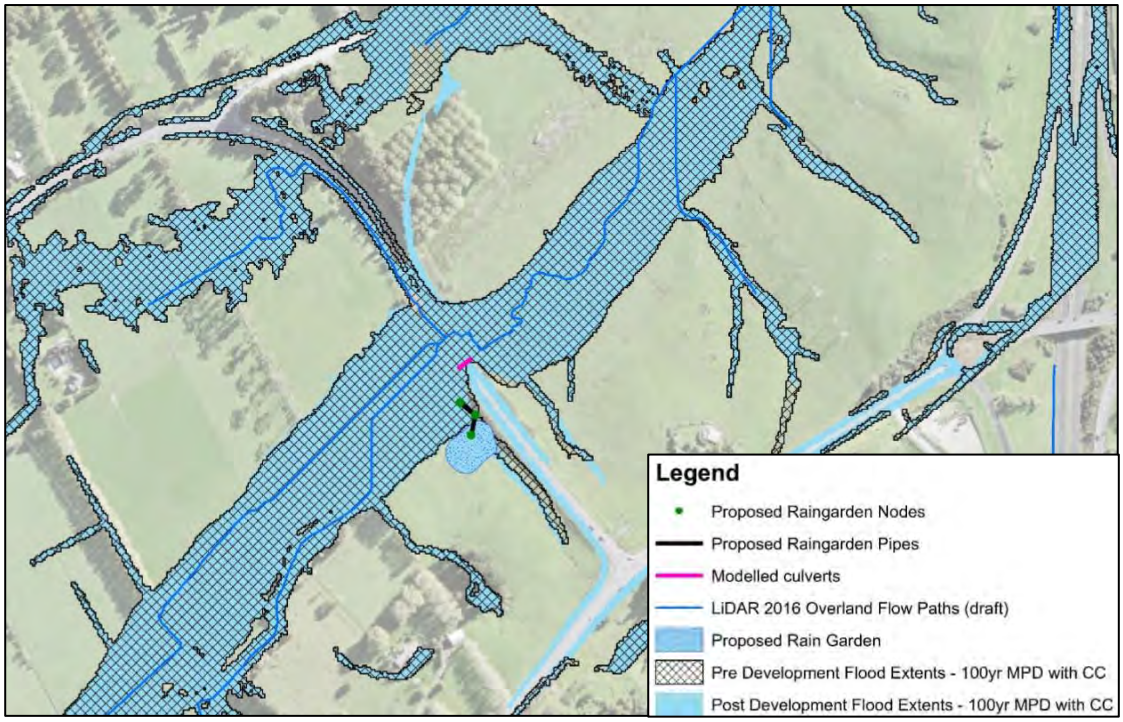
The model results from the Pine Valley Road Stormwater Modelling Technical Memo are summarised in the table below. The pre-development (existing scenario) and post-development (scenario with proposed Stage 1 earthworks) floodplain extents are shown below on Figure 5.9.

Table 5.4: Model Result Summary Table

Location	Pre-Development Result Value	Post-Development Result Value	Difference
Peak 100-Year ARI Water Level (mRL)			
Upstream of Pine Valley Road	21.10	21.37	0.27
Downstream of Pine Valley Road	18.89	18.87	-0.02
Upstream of Motorway Culvert	14.29	14.12	-0.17
Downstream of Motorway Culvert	9.97	9.95	-0.02
Peak 100-Year ARI Flow (m^3/s)			
Flow at Pine Valley Road	28.4	28.8	0.4

Source: Pine Road Valley Stormwater Modelling Technical Memo (WatRes Consulting, April 2020)

Figure 5.9: Model Result 100-Year ARI (with CC) Flood Extent Comparison



Source: Pine Road Valley Stormwater Modelling Technical Memo (WatRes Consulting, April 2020)

The model results indicate that during the 100-year ARI rainfall event, the proposed Stage 1 earthworks are predicted to increase the peak flood level upstream of the culvert by 0.27m and increase the flows downstream of Pine Valley Road by 0.4m^3/s. The results also indicate that the 100-year peak flood levels downstream will slightly reduce due to the proposed earthworks.

As a result of the predicted small increase in 100-year peak water level upstream of the Pine Valley Road culvert, the model results indicate that there will be a small localised increase in the 100-year ARI flood extent upstream of the culvert, as shown on Figure 5.9. The Pine Road Valley Stormwater Modelling Technical Memo indicates that the proposed Stage 1 earthworks will result in the 100-year ARI extent upstream of the culvert increasing by approximately 2.5%. The earthworks proposed as part of this project are therefore considered to have a less than minor impact on flooding.

The hydraulic modelling results for this project were provided to the Healthy Waters on 21st April 2020. Based on discussions with Healthy Waters (email correspondence with Kevin Fan on 21st April 2020), it was agreed that it is not necessary to provide flood mitigation for this project. A copy of this email correspondence can be found in Appendix D.

6 Conclusion

The stormwater management approach for the proposed works is based on AUP:OP regulatory policies and Auckland Council stormwater guideline documents. The stormwater management principles adopted include:

- Provision of at-source water quality treatment of runoff from the proposed works area.
- Provision of SMAF 1 for runoff generated within the proposed works area to minimise the impact of changes in hydrology due to the increase in impervious areas.
- Provision of a primary stormwater network sized to covey a 10-Year Average Recurrence Interval (ARI) rainfall event. The pipe network proposed to be constructed as part of Stage 1 has been sized to convey Stage 2 runoff. The purpose of this is to minimise pipe upgrades required as part of Stage 2.
- Provision of a secondary stormwater network by utilising the roads to convey overland flowpaths.
- Re-aligning an intermittent stream and conveying it under the realigned section of Pine Valley Road via a culvert.

Raingardens (sized in accordance with GD01) will be utilised to provide water quality treatment and SMAF 1 hydrological mitigation. Due to the erosive nature of the underlying geology, soakage and retention through infiltration is not proposed to be provided. Therefore, detention is proposed to be provided for the SMAF 1 retention and detention volumes.

Stormwater management for the steep section of Pine Valley Road will be delivered using a treatment train approach. The proposed stormwater treatment train consists of a conveyance channel discharging to a super raingarden.

The proposed widening of Pine Valley Road results in approximately 1350m^3 of new road embankment occupying the floodplain. Modelling indicates that there will be a negligible increase in flood extents. Therefore, floodplain mitigation storage is not proposed to be provided.

It is recommended that Fulton Hogan Land Development and Auckland Transport proceed with seeking a resource consent for the proposed works on the basis of the design described in this report.

Appendices

A. Argent Lane Extension Stormwater Drawings

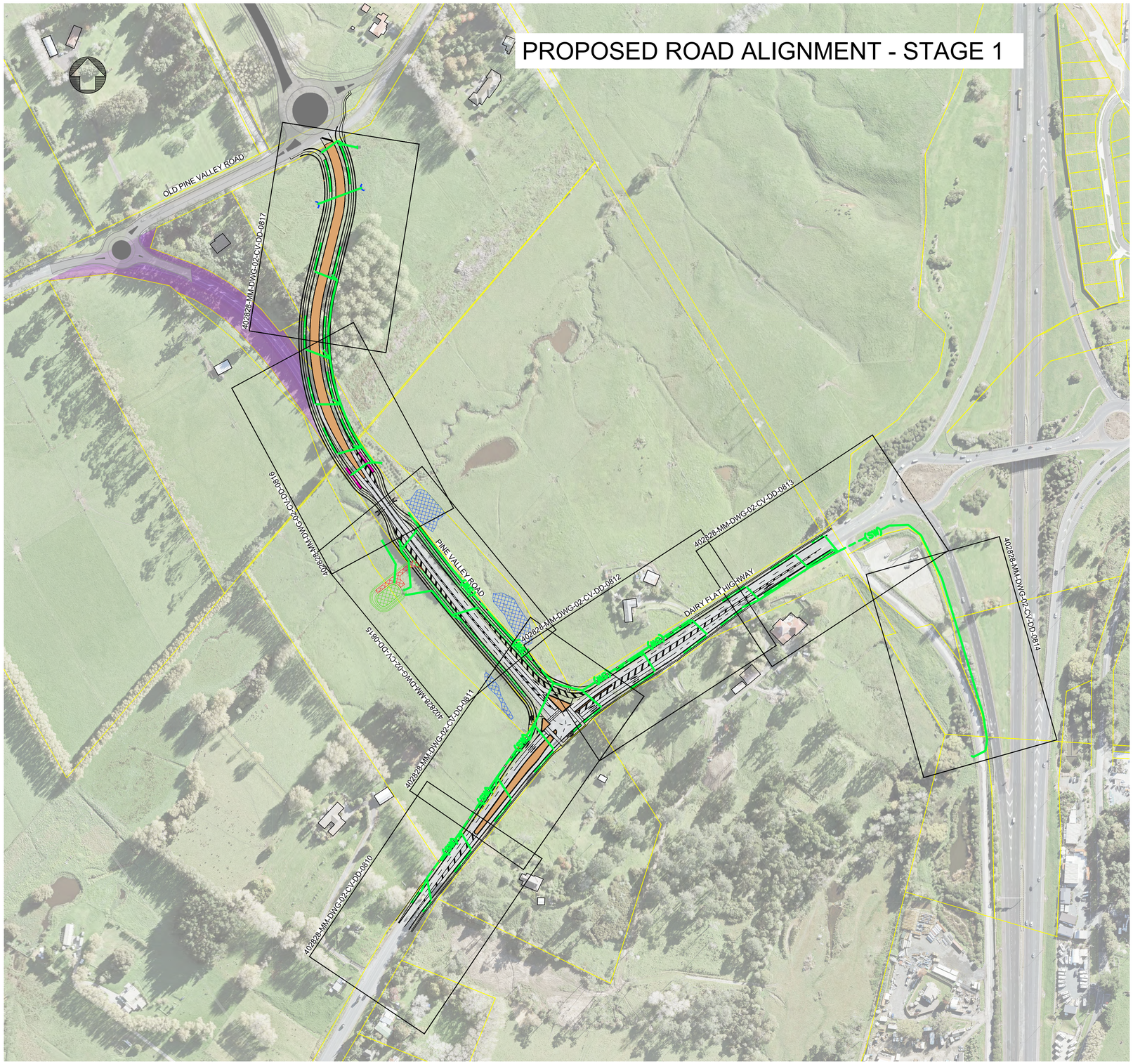
NOTES:

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 MATERIALS TO COMPLY WITH AUCKLAND TRANSPORT AND AUCKLAND COUNCIL 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 PRIOR 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. SETOUT COORDINATES ARE IN TERMS OF MT EDEN NZGD 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
- PROPOSED STORMWATER MANHOLE
- EXISTING BOUNDARIES

PROPOSED ROAD ALIGNMENT - STAGE 1



1:2000 0 100m 200m

DRAFT - FOR RESOURCE CONSENT

REV	DESCRIPTION	DATE
A	FOR APPROVAL	18/12/2019
B	DRAFT - FOR RESOURCE CONSENT	13/05/2020
C	DRAFT - REVISED DFH TIE-IN AND STAGE 1 OPTION	25/06/2020
D	DRAFT - AMENDMENTS FROM AT COMMENTS 04/09/20	11/09/2020

DRAWING Q.A.

DRAWN	S.PERERA
CHECKED	H.LAW
APPROVED	P.EVANS

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

CONSULTANT PROJECT NO.
MOTT MACDONALD : 402828

CONSULTANT
Mason Bros. Building
Level 1, 3 Westhaven St West
Auckland 1010
T +64 (0) 9 375 2400
MOTT MACDONALD

CLIENT
MILLDALE

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

DRAWING
Milldale Development, Argent Lane - Dairy Flat Highway Stormwater General Arrangement Plan

DRAWING NO.: 402828-MM-DWG-02-CV-DD-0800
REVISION: D
FOR RESOURCE CONSENT
SCALE (A1): 1:2000

P:\Auckland\NZL\01 Projects\402828 - Milldale\03 Design\Working\CAD\Drawings\02_Argent Lane (PVR & DFH)\402828-MM-DWG-02-CV-DD-0800.dwg Sep 10, 2020 - 2:47pm PERI76432

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 MATERIALS TO COMPLY WITH AUCKLAND TRANSPORT AND AUCKLAND COUNCIL 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 PRIOR 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. SETOUT COORDINATES ARE IN TERMS OF MT EDEN NZGD 2000.
8. DRAWING IS NOT TO BE USED FOR CONSTRUCTION.
9. PROPOSED CONTOURS ARE IN INTERVALS OF 0.5m

LEGEND:

- EXISTING STORMWATER (PUBLIC)
- PROPOSED STORMWATER
- PROPOSED RAINGARDEN TYPE A
- PROPOSED RAINGARDEN TYPE B
- PROPOSED CONVEYANCE CHANNEL
- EXISTING WETLAND
- PROPOSED CULVERT
- SCRUFFY DOME
- RIPRAP
- PROPOSED STORMWATER MANHOLE
- EXISTING BOUNDARIES
- DESIGN MAJOR CONTOURS (5.0)
- DESIGN MINOR CONTOURS

PROPOSED ROAD ALIGNMENT - STAGE 1

MH 1-8
MH 1-7
225 NB RCRRJ
RG #1- A1
RG #2 - A1
RG #3 - A4
RG #4 - A4
42.0
46.00
48.00
49.00
47.00
50.00
51.00
DAIRY FLAT HIGHWAY

1:250 0 12.5m 25m

P:\Auckland\NZL\01 Projects\402828 - Milldale\03 Design\Working\CAD\Drawings\02 Argent Lane (PVR & DFH)\402828-MM-DWG-02-CV-DD-0810.dwg Sep 10, 2020 - 2:56pm PER76432

REV	DESCRIPTION	DATE
A	FOR APPROVAL	18/12/2019
B	DRAFT - FOR RESOURCE CONSENT	13/05/2020
C	DRAFT - REVISED DFH TIE-IN AND STAGE 1 OPTION	25/06/2020
D	DRAFT - AMENDMENTS FROM AT COMMENTS 04/09/20	11/09/2020

DRAWING Q.A.

DRAWN	S.PERERA
CHECKED	H.LAW
APPROVED	P.EVANS

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

CONSULTANT PROJECT NO.
MOTT MACDONALD : 402828

CONSULTANT
Mason Bros. Building
Level 2, 157 Queen St West
Auckland 1010
T. +64 (0) 9 375 2400
MOTT MACDONALD

CLIENT
MILLDALE

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 Drainage Layout (Sheet 1 of 8)

DRAWING NO.: 402828-MM-DWG-02-CV-DD-0810
REVISION: D
FOR RESOURCE CONSENT
SCALE (A1): 1:250

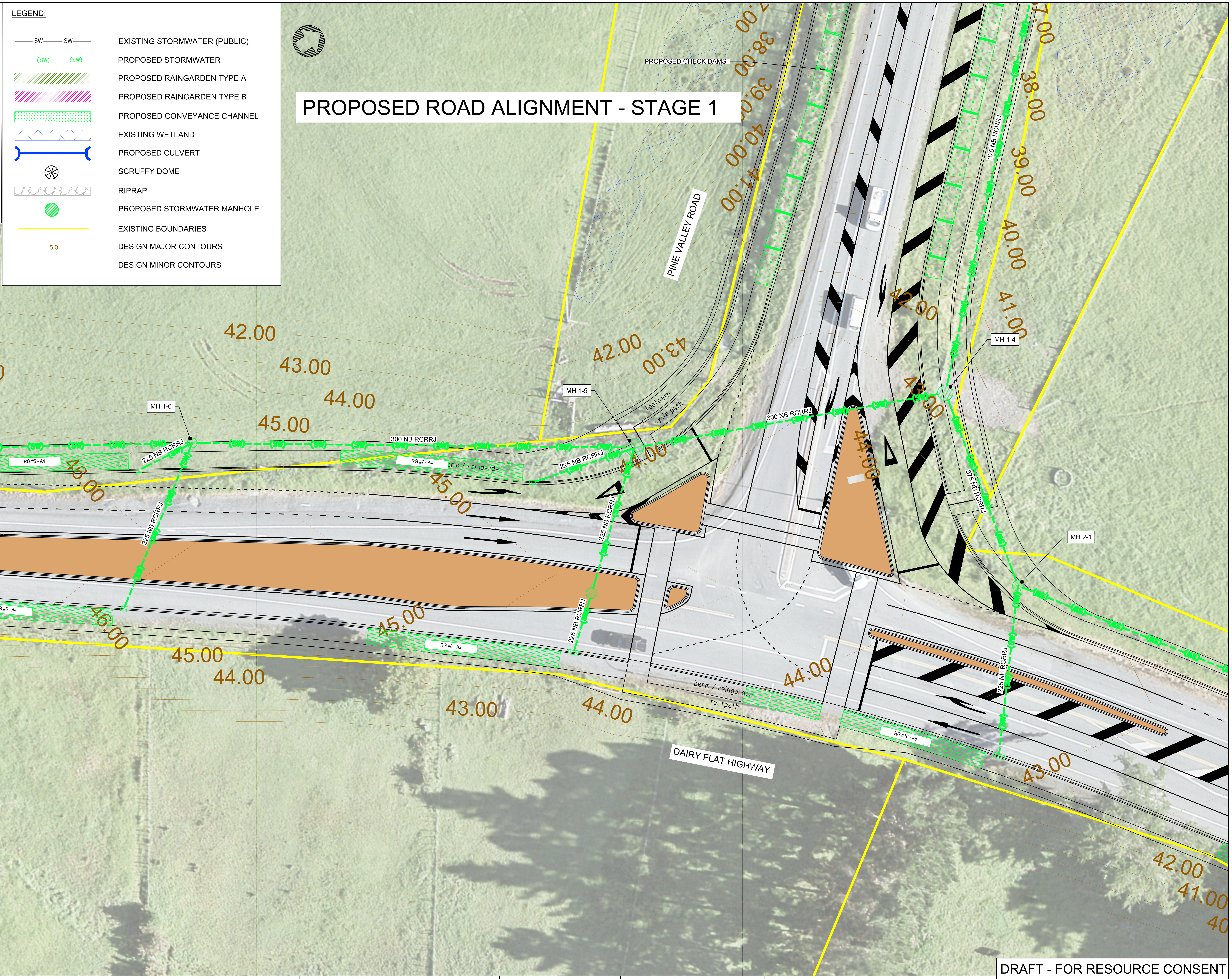
NOTES:

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 MATERIALS TO COMPLY WITH AUCKLAND TRANSPORT AND AUCKLAND COUNCIL 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 PRIOR 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. SETOUT COORDINATES ARE IN TERMS OF MT EDEN NZGD 2000.
8. DRAWING IS NOT TO BE USED FOR CONSTRUCTION.
9. PROPOSED CONTOURS ARE IN INTERVALS OF 0.5m

LEGEND:

- EXISTING STORMWATER (PUBLIC)
- PROPOSED STORMWATER
- PROPOSED RAINGARDEN TYPE A
- PROPOSED RAINGARDEN TYPE B
- PROPOSED CONVEYANCE CHANNEL
- EXISTING WETLAND
- PROPOSED CULVERT
- SCRUFFY DOME
- RIPRAP
- PROPOSED STORMWATER MANHOLE
- EXISTING BOUNDARIES
- DESIGN MAJOR CONTOURS
- DESIGN MINOR CONTOURS

PROPOSED ROAD ALIGNMENT - STAGE 1



DRAFT - FOR RESOURCE CONSENT

REV	DESCRIPTION	DATE
A	FOR APPROVAL	18/12/2019
B	DRAFT - FOR RESOURCE CONSENT	13/05/2020
C	DRAFT - REVISED DFH TIE-IN AND STAGE 1 OPTION	25/06/2020
D	DRAFT - AMENDMENTS FROM AT COMMENTS 04/09/20	11/09/2020

DRAWING Q.A.

DRAWN	S.PERERA
CHECKED	H.LAW
APPROVED	P.EVANS

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

CONSULTANT PROJECT NO.
MOTT MACDONALD : 402828

CONSULTANT
MOTT MACDONALD
Mason Bros. Building, L2, 139 Pakenham St West, Auckland 1010, T +64 (0) 9 375 2400

CLIENT
MILLDALE

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

DRAWING
Milldale Development, Argent Lane - Dairy Flat Highway Stormwater Drainage Layout (Sheet 2 of 8)

DRAWING NO.: 402828-MM-DWG-02-CV-DD-0811
REVISION: D
FOR RESOURCE CONSENT
SCALE (A1): 1:250

P:\Auckland\NZL\01 Projects\402828 - Milldale\03 Design\Working\CAD\Drawings\02 Argent Lane (PVR & DFH)\402828-MM-DWG-02-CV-DD-0811.dwg Sep 10, 2020 - 2:58pm PER76432

PROPOSED ROAD ALIGNMENT - STAGE 1

LEGEND:

- EXISTING STORMWATER (PUBLIC)
- PROPOSED STORMWATER
- PROPOSED RAINGARDEN TYPE A
- PROPOSED RAINGARDEN TYPE B
- PROPOSED CONVEYANCE CHANNEL
- EXISTING WETLAND
- PROPOSED CULVERT
- SCRUFFY DOME
- RIPRAP
- PROPOSED STORMWATER MANHOLE
- EXISTING BOUNDARIES
- DESIGN MAJOR CONTOURS
- DESIGN MINOR CONTOURS

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 MATERIALS TO COMPLY WITH AUCKLAND TRANSPORT AND AUCKLAND COUNCIL 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 PRIOR 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. SETOUT COORDINATES ARE IN TERMS OF MT EDEN NZGD 2000.
8. DRAWING IS NOT TO BE USED FOR CONSTRUCTION.
9. PROPOSED CONTOURS ARE IN INTERVALS OF 0.5m

MH 1-4
MH 2-1
MH 2-2
MH 2-3
DAIRY FLAT HIGHWAY
375 NB RCRRJ
225 NB RCRRJ
300 NB RCRRJ
RG #10 - A5
RG #11 - A2
RG #12 - A2
RG #13 - A4
RG #14 - A2
RG #15 - A4
RG #16 - A4
39.00
40.00
41.00
42.00
43.00

1:250 0 12.5m 25m

DRAFT - FOR RESOURCE CONSENT

REV	DESCRIPTION	DATE
A	FOR APPROVAL	18/12/2019
B	DRAFT - FOR RESOURCE CONSENT	13/05/2020
C	DRAFT - REVISED DFH TIE-IN AND STAGE 1 OPTION	25/06/2020
D	DRAFT - AMENDMENTS FROM AT COMMENTS 04/09/20	11/09/2020

DRAWING Q.A.

DRAWN	S.PERERA
CHECKED	H.LAW
APPROVED	P.EVANS

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

CONSULTANT PROJECT NO.
MOTT MACDONALD : 402828

CONSULTANT
Mason Bros. Building
Level 3, 350 Queen St West
Auckland 1010
T +64 (0) 9 375 2400
MOTT MACDONALD

CLIENT
MILLDALE

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

DRAWING
Milldale Development, Argent Lane - Dairy Flat Highway Stormwater Drainage Layout (Sheet 3 of 8)

DRAWING NO.: 402828-MM-DWG-02-CV-DD-0812
REVISION: D
FOR RESOURCE CONSENT
SCALE (A1): 1:250

P:\Auckland\NZL\01 Projects\402828 - Milldale\03 Design\Working\CAD\Drawings\02_Argent Lane (PVR & DFH)\402828-MM-DWG-02-CV-DD-0812.dwg Sep 10, 2020 - 4:16pm PER76432

PROPOSED ROAD ALIGNMENT - STAGE 1

39.00
39.00
38.00
37.00
RG #17 - A4
RG #18 - A4
RG #34 - A1
RG #35 - A4
225 NB RCRRJ
300 NB RCRRJ
(SW)
MH 3-15
MH 3-14
MH 3-13
MH 3-12
MH 3-11
MH 3-10
MH 3-9
MH 3-8
DAIRY FLAT HIGHWAY
SILVERDALE OFF RAMP
EXISTING CATCHPIT TO BE REMOVED AND EXISTING STORMWATER PIPE TO BE CAPPED. NEW CATCHPIT TO COLLECT ROAD RUNOFF AND DISCHARGE INTO PROPOSED PIPELINE 3.

LEGEND:

- EXISTING STORMWATER (PUBLIC)
- PROPOSED STORMWATER
- PROPOSED RAINGARDEN TYPE A
- PROPOSED RAINGARDEN TYPE B
- PROPOSED CONVEYANCE CHANNEL
- EXISTING WETLAND
- PROPOSED CULVERT
- SCRUFFY DOME
- RIPRAP
- PROPOSED STORMWATER MANHOLE
- EXISTING BOUNDARIES
- DESIGN MAJOR CONTOURS (5.0)
- DESIGN MINOR CONTOURS

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 MATERIALS TO COMPLY WITH AUCKLAND TRANSPORT AND AUCKLAND COUNCIL 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 PRIOR 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. SETOUT COORDINATES ARE IN TERMS OF MT EDEN NZGD 2000.
8. DRAWING IS NOT TO BE USED FOR CONSTRUCTION.
9. PROPOSED CONTOURS ARE IN INTERVALS OF 0.5m

1:250 0 12.5m 25m

DRAFT - FOR RESOURCE CONSENT

REV	DESCRIPTION	DATE
A	FOR APPROVAL	18/12/2019
B	DRAFT - FOR RESOURCE CONSENT	13/05/2020
C	DRAFT - REVISED DFH TIE-IN AND STAGE 1 OPTION	25/06/2020
D	DRAFT - AMENDMENTS FROM AT COMMENTS 04/09/20	11/09/2020

DRAWING Q.A.

DRAWN	S.PERERA
CHECKED	H.LAW
APPROVED	P.EVANS

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

CONSULTANT PROJECT NO.
MOTT MACDONALD : 402828

CONSULTANT
Mason Bros. Building
L3 2 Takutai Square St. West
Auckland 1010
T +64 (0) 9 375 2400
MOTT MACDONALD

CLIENT
MILLDALE

ROAD CONTROLLING AUTHORITY
Auckland Transport
An Auckland Council Organisation

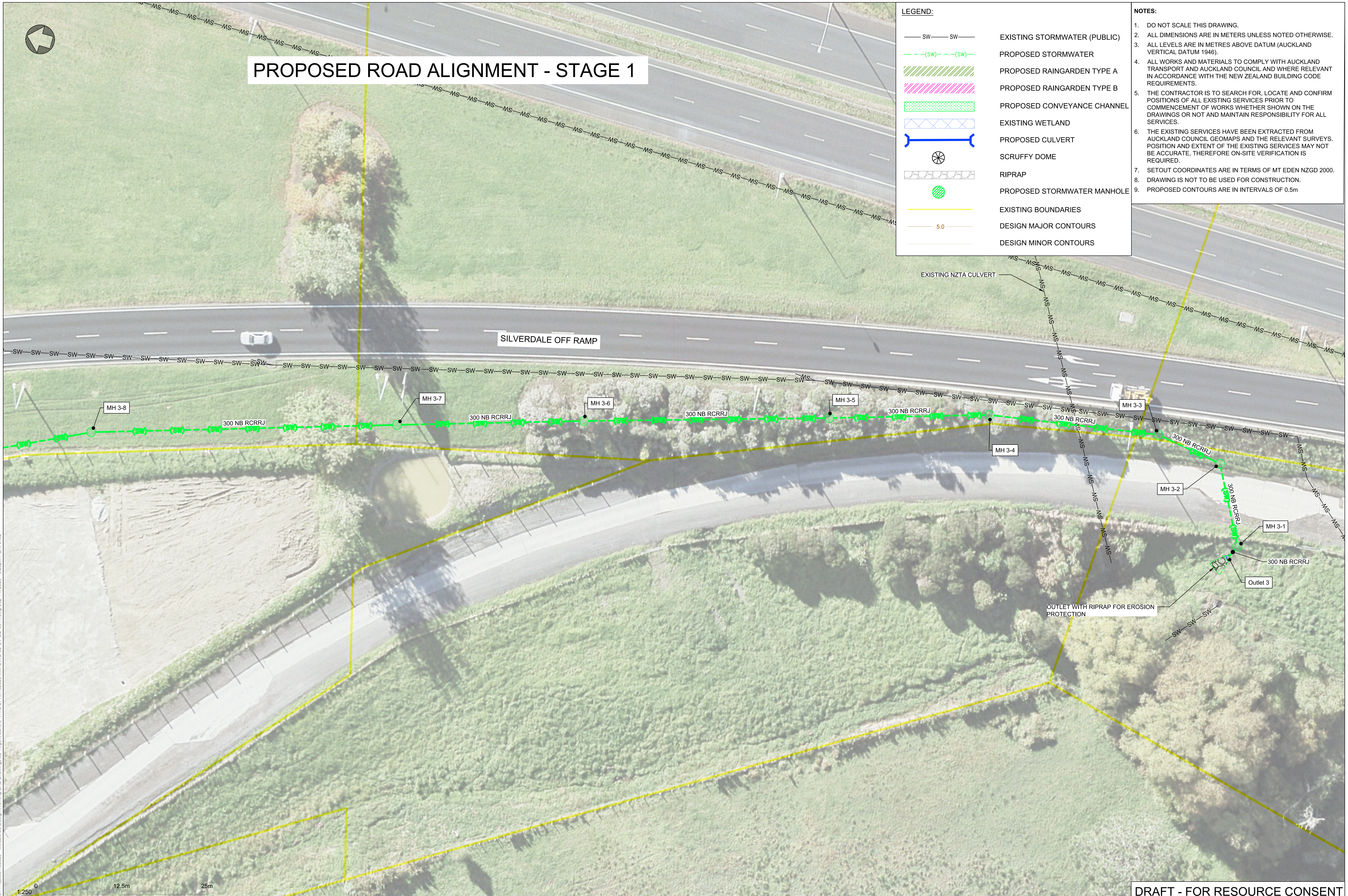
PROJECT
MILLDALE DEVELOPMENT
INFRASTRUCTURE PROJECTS

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

DRAWING
Milldale Development, Argent Lane - Dairy Flat Highway Stormwater Drainage Layout (Sheet 4 of 8)

DRAWING NO.: 402828-MM-DWG-02-CV-DD-0813
REVISION: D
FOR RESOURCE CONSENT
SCALE (A1): 1:250

P:\Auckland\NZL\01 Projects\402828 - Milldale\03 Design\Working\CAD\Drawings\02 Argent Lane (PVR & DFH)\402828-MM-DWG-02-CV-DD-0813.dwg Sep 11, 2020 - 2:58pm PERTRAM



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
	PROPOSED STORMWATER MANHOLE
	EXISTING BOUNDARIES
5.0	DESIGN MAJOR CONTOURS
	DESIGN MINOR CONTOURS

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 MATERIALS TO COMPLY WITH AUCKLAND TRANSPORT AND AUCKLAND COUNCIL 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 PRIOR 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. SETOUT COORDINATES ARE IN TERMS OF MT EDEN NZGD 2000.
8. DRAWING IS NOT TO BE USED FOR CONSTRUCTION.
9. PROPOSED CONTOURS ARE IN INTERVALS OF 0.5m

DRAFT - FOR RESOURCE CONSENT

REV	DESCRIPTION	DATE
A	FOR APPROVAL	18/12/2019
B	DRAFT - FOR RESOURCE CONSENT	13/05/2020
C	DRAFT - REVISED DFH TIE-IN AND STAGE 1 OPTION	26/06/2020
D	DRAFT - AMENDMENTS FROM AT COMMENTS 04/09/20	11/09/2020

DRAWING Q.A.	
DRAWN	S.PERERA
CHECKED	H.LAW
APPROVED	P.EVANS

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

CONSULTANT PROJECT NO.
MOTT MACDONALD : 402828

CONSULTANT
Mason Bros. Building
L2, 139 Pakenham St West
Auckland 1010
T +64 (0) 9 375 2400
MOTT MACDONALD

CLIENT
MILLDALE

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

DRAWING
Milldale Development, Argent Lane - Dairy Flat Highway
Stormwater Drainage Layout (Sheet 5 of 8)

DRAWING NO.: 402828-MM-DWG-02-CV-DD-0814
REVISION: D
FOR RESOURCE CONSENT
SCALE (A1): 1:250

\\mottmac\project\Auckland\NZL\01 Projects\402828 - Milldale\03 Design\Working\CAD\Drawings\02. Argent Lane (PVR & DFH)\402828-MM-DWG-02-CV-DD-0814.dwg Sep 11, 2020 - 3:23pm PER76432

PROPOSED ROAD ALIGNMENT - STAGE 1

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 MATERIALS TO COMPLY WITH AUCKLAND TRANSPORT AND AUCKLAND COUNCIL 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 PRIOR 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. SETOUT COORDINATES ARE IN TERMS OF MT EDEN NZGD 2000.
8. DRAWING IS NOT TO BE USED FOR CONSTRUCTION.
9. PROPOSED CONTOURS ARE IN INTERVALS OF 0.5m

LEGEND:

- EXISTING STORMWATER (PUBLIC)
- PROPOSED STORMWATER
- PROPOSED RAINGARDEN TYPE A
- PROPOSED RAINGARDEN TYPE B
- PROPOSED CONVEYANCE CHANNEL
- EXISTING WETLAND
- PROPOSED CULVERT
- SCRUFFY DOME
- RIPRAP
- PROPOSED STORMWATER MANHOLE
- EXISTING BOUNDARIES
- DESIGN MAJOR CONTOURS
- DESIGN MINOR CONTOURS

PROPOSED SUPER RAIN GARDEN

PROPOSED VEHICLE ACCESS LOCATION

OUTLETS TO SUPER RAINGARDEN WITH RIPRAP FOR EROSION PROTECTION

OUTLET TO STREAM WITH RIPRAP FOR EROSION PROTECTION

OUTLET TO STREAM WITH RIPRAP FOR EROSION PROTECTION

PINE VALLEY ROAD

SD 1, SD 2, SD 3, SD 4, SD 5

MH 1-1, MH 1-2, MH 1-3, MH 6-1, MH 6-2, MH 6-3, MH 7-1, MH 7-2, MH 7-3, MH 8-1

Outlet 1, Outlet 6, Outlet 7, Outlet 8

225 NB RCRRJ, 300 NB RCRRJ, 375 NB RCRRJ, 450 NB RCRRJ, 675 NB RCRRJ

1:250 0 12.5m 25m

DRAFT - FOR RESOURCE CONSENT

REV	DESCRIPTION	DATE
A	FOR APPROVAL	18/12/2019
B	DRAFT - FOR RESOURCE CONSENT	13/05/2020
C	DRAFT - REVISED DFH TIE-IN AND STAGE 1 OPTION	26/06/2020
D	DRAFT - AMENDMENTS FROM AT COMMENTS 04/09/20	11/09/2020

DRAWING Q.A.

DRAWN	S.PERERA
CHECKED	H.LAW
APPROVED	P.EVANS

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

CONSULTANT PROJECT NO.
MOTT MACDONALD : 402828

CONSULTANT
Mason Bros. Building
Level 3, 3 Shortland St West
Auckland 1010
T +64 (0) 9 375 2400
MOTT MACDONALD

CLIENT
MILLDALE

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

DRAWING
Milldale Development, Argent Lane - Dairy Flat Highway Stormwater Drainage Layout (Sheet 6 of 8)

DRAWING NO.: 402828-MM-DWG-02-CV-DD-0815
REVISION: D
FOR RESOURCE CONSENT
SCALE (A1): 1:250

P:\Auckland\NZL\01 Projects\402828 - Milldale\03 Design\Working\CAD\Drawings\02 Argent Lane (PVR & DFH)\402828-MM-DWG-02-CV-DD-0815.dwg Sep 10, 2020 - 3:18pm PERT6432

PROPOSED ROAD ALIGNMENT - STAGE 1

PINE VALLEY ROAD

Outlet 8
SD 6
SD 7
RG #32 - TYPE B
RG #33 - TYPE B
RG #30 - A2
RG #31 - A2
RG #20 - A4
RG #21 - A4
225 NB RCRRJ
375 NB RCRRJ
450 NB RCRRJ
300 NB RCRRJ
MH 1-1
MH 4-1
MH 4-2
MH 4-3
MH 4-4
MH 4-5
MH 4-6
Outlet 1
Outlet 4
OUTLET WITH RIPRAP FOR EROSION PROTECTION
OUTLET WITH RIPRAP FOR EROSION PROTECTION

21.00 22.00 23.00 24.00 25.00 19.80 20.00

1:250 0 12.5m 25m

LEGEND:

- EXISTING STORMWATER (PUBLIC)
- PROPOSED STORMWATER
- PROPOSED RAINGARDEN TYPE A
- PROPOSED RAINGARDEN TYPE B
- PROPOSED CONVEYANCE CHANNEL
- EXISTING WETLAND
- PROPOSED CULVERT
- SCRUFFY DOME
- RIPRAP
- PROPOSED STORMWATER MANHOLE
- EXISTING BOUNDARIES
- DESIGN MAJOR CONTOURS
- DESIGN MINOR CONTOURS

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 MATERIALS TO COMPLY WITH AUCKLAND TRANSPORT AND AUCKLAND COUNCIL 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 PRIOR 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. SETOUT COORDINATES ARE IN TERMS OF MT EDEN NZGD 2000.
8. DRAWING IS NOT TO BE USED FOR CONSTRUCTION.
9. PROPOSED CONTOURS ARE IN INTERVALS OF 0.5m.

REV	DESCRIPTION	DATE
A	FOR APPROVAL	18/12/2019
B	DRAFT - FOR RESOURCE CONSENT	13/05/2020
C	DRAFT - REVISED DFH TIE-IN AND STAGE 1 OPTION	26/06/2020
D	DRAFT - AMENDMENTS FROM AT COMMENTS 04/09/20	11/09/2020

DRAWING Q.A.	
DRAWN	S.PERERA
CHECKED	H.LAW
APPROVED	P.EVANS

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

CONSULTANT PROJECT NO.
MOTT MACDONALD : 402828

CONSULTANT
Mason Bros. Building
Level 3, 3 Shortland St West
Auckland 1010
T +64 (0) 9 375 2400
MOTT MACDONALD

CLIENT
MILLDALE

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 Drainage Layout (Sheet 7 of 8)

DRAWING NO.: 402828-MM-DWG-02-CV-DD-0816
REVISION: D
FOR RESOURCE CONSENT
SCALE (A1): 1:250

P:\Auckland\NZL\01 Projects\402828 - Milldale\03 Design\Working\CAD\Drawings\02 Argent Lane (PVR & DFH)\402828-MM-DWG-02-CV-DD-0816.dwg Sep 10, 2020 - 3:27pm PERT6432

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 MATERIALS TO COMPLY WITH AUCKLAND TRANSPORT AND AUCKLAND COUNCIL 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 PRIOR 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. SETOUT COORDINATES ARE IN TERMS OF MT EDEN NZGD 2000.
8. DRAWING IS NOT TO BE USED FOR CONSTRUCTION.
9. PROPOSED CONTOURS ARE IN INTERVALS OF 0.5m.

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
- PROPOSED STORMWATER MANHOLE
- EXISTING BOUNDARIES
- 5.0 — DESIGN MAJOR CONTOURS
- DESIGN MINOR CONTOURS

PROPOSED ROAD ALIGNMENT - STAGE 1

OLD PINE VALLEY ROAD

PINE VALLEY ROAD

EXISTING STREAM

PROPOSED CULVERT

1500 WIDE x 750 HIGH RECTANGULAR CHANNEL WITH HEAVY DUTY CONCRETE LID

RG #24 - A2

RG #25 - A2

RG #26 - A5

RG #27 - A3

225 NB RCRRJ

300 NB RCRRJ

MH 4-8

MH 4-9

MH 5-1

Outlet 5

OUTLET TO STREAM WITH RIPRAP FOR EROSION PROTECTION

NEW CHANNEL TO CONVEY FLOW TO EXISTING STREAM. CULVERT INVERT LEVEL WILL BE 250mm BELOW STREAM BED LEVEL.

26.00 27.00 27.00 27.00 26.00 26.30 26.00 27.00 27.00 27.00 26.00 26.00 27.00

1:250 0 12.5m 25m

DRAFT - FOR RESOURCE CONSENT

REV	DESCRIPTION	DATE
A	FOR APPROVAL	18/12/2019
B	DRAFT - FOR RESOURCE CONSENT	13/05/2020
C	DRAFT - REVISED DFH TIE-IN AND STAGE 1 OPTION	26/06/2020
D	DRAFT - AMENDMENTS FROM AT COMMENTS 04/09/20	11/09/2020

DRAWING Q.A.	
DRAWN	S.PERERA
CHECKED	H.LAW
APPROVED	P.EVANS

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

CONSULTANT PROJECT NO.
MOTT MACDONALD : 402828

CONSULTANT
Mason Bros. Building
L3 21 Pakenham St West
Auckland 1010
T +64 (0) 9 375 2400
MOTT MACDONALD

CLIENT
MILLDALE

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

DRAWING
Milldale Development, Argent Lane - Dairy Flat Highway Stormwater Drainage Layout (Sheet 8 of 8)

DRAWING NO.: 402828-MM-DWG-02-CV-DD-0817
REVISION: D
FOR RESOURCE CONSENT
SCALE (A1): 1:250

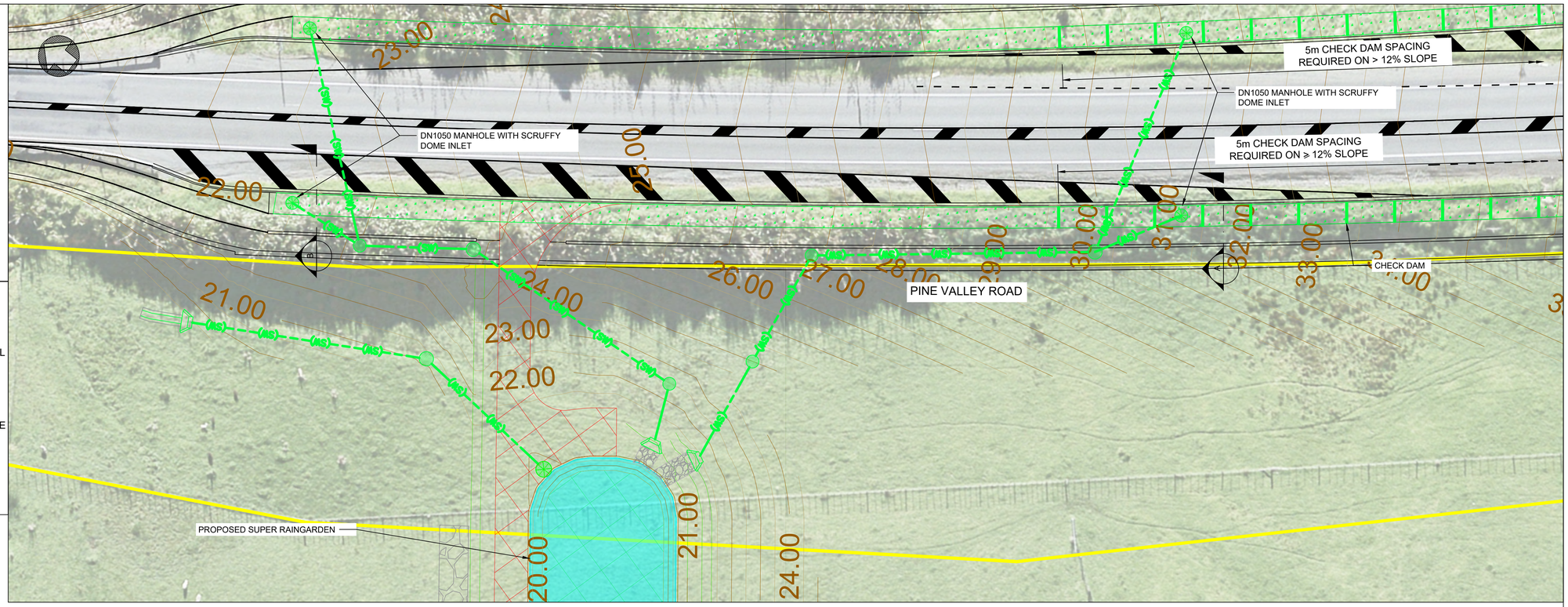
P:\Auckland\NZL\01 Projects\402828 - Milldale\03 Design\Working\CAD\Drawings\02 Argent Lane (PVR & DFH)\402828-MM-DWG-02-CV-DD-0817.dwg Sep 10, 2020 - 3:33pm PERTRAS

NOTES:

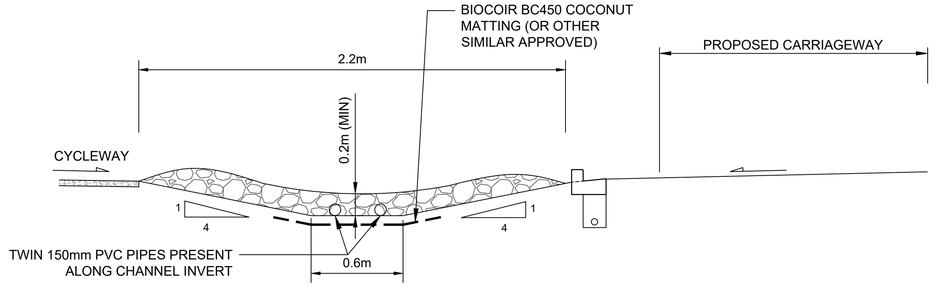
1. DO NOT SCALE THIS DRAWING.
2. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
3. ALL WORKS AND MATERIALS TO COMPLY WITH AUCKLAND TRANSPORT AND AUCKLAND COUNCIL STANDARDS AND WHERE RELEVANT IN ACCORDANCE WITH THE NEW ZEALAND BUILDING CODE REQUIREMENTS.
4. THE CONTRACTOR IS TO SEARCH FOR, LOCATE AND CONFIRM POSITIONS OF ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF WORKS WHETHER SHOWN ON THE DRAWINGS OR NOT AND MAINTAIN RESPONSIBILITY FOR ALL SERVICES.
5. DRAWING IS NOT TO BE USED FOR CONSTRUCTION.
6. THE CHECK DAMS MUST BE CONSTRUCTED ACROSS THE WIDTH OF THE CONVEYANCE CHANNEL AT A UNIFORM HEIGHT OF 0.2m, FOLLOWING THE TRAPEZIUM SHAPE OF THE CONVEYANCE CHANNEL TO ENSURE THAT ANY OVERFLOWS ARE DIRECTED OVER THE CENTRE OF THE DAM
7. BIOCOIR BC450 COCONUT MATTING (OR OTHER SIMILAR APPROVED) TO BE CONSTRUCTED ALONG THE CONVEYANCE CHANNEL BASE AND EXTENDED 0.6m UP THE CONVEYANCE CHANNEL SIDE SLOPES. MATTING TO BE CONSTRUCTED AS PER THE THE SUPPLIER SPECIFICATIONS.

LEGEND:

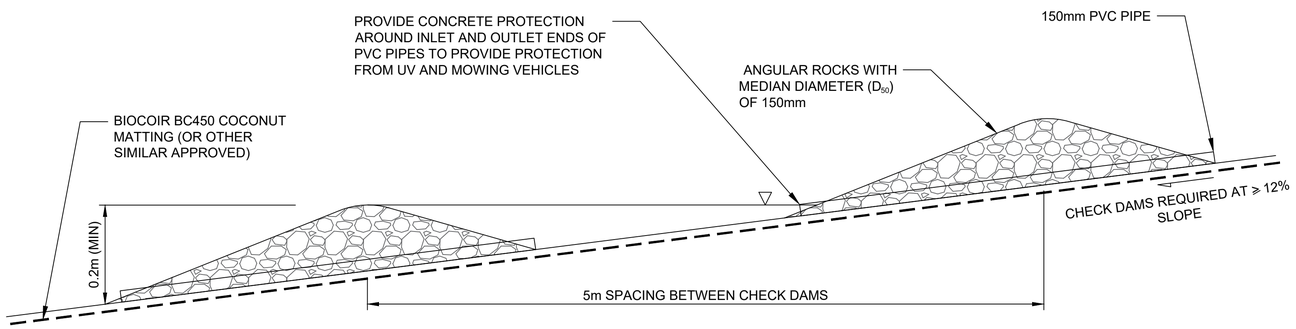
- PROPOSED STORMWATER
- PROPOSED CONVEYANCE CHANNEL
- SCRUFFY DOME
- RIPRAP
- PROPOSED STORMWATER MANHOLE
- EXISTING BOUNDARIES
- DESIGN MAJOR CONTOURS
- DESIGN MINOR CONTOURS



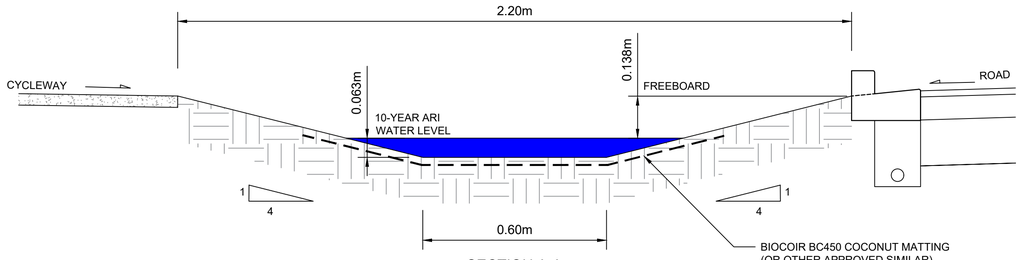
PLAN
SCALE 1:200



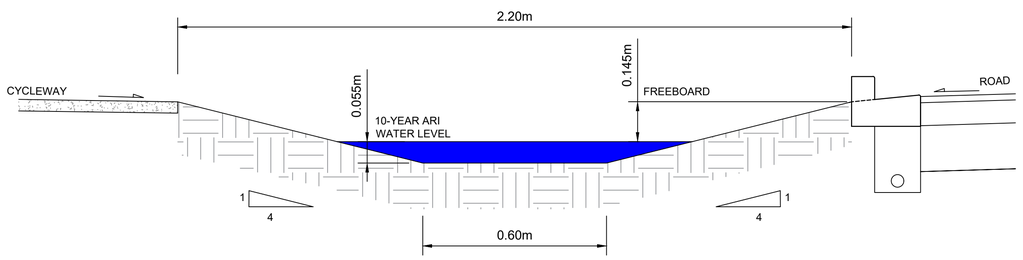
TYPICAL SECTION - CHECK DAM
NTS



ELEVATION - CHECK DAM
NTS



SECTION A-A
SCALE 1:10



SECTION B-B
SCALE 1:10

1:2000 0 100m 200m

DRAFT - FOR RESOURCE CONSENT

REV	DESCRIPTION	DATE
A	FOR APPROVAL	18/12/2019
B	DRAFT - FOR RESOURCE CONSENT	13/05/2020
C	DRAFT - REVISED DFH TIE-IN AND STAGE 1 OPTION	26/06/2020
D	DRAFT - AMENDMENTS FROM AT COMMENTS 04/09/20	11/09/2020

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.

CONSULTANT PROJECT NO.
MOTT MACDONALD : 402828

CONSULTANT
Mason Bros. Building
Level 3, 35 Victoria St West
Auckland 1010
T. +64 (0) 9 375 2400
MOTT MACDONALD

CLIENT
MILLDALE

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

DRAWING
Milldale Development, Argent Lane - Dairy Flat Highway Conveyance Channel Design

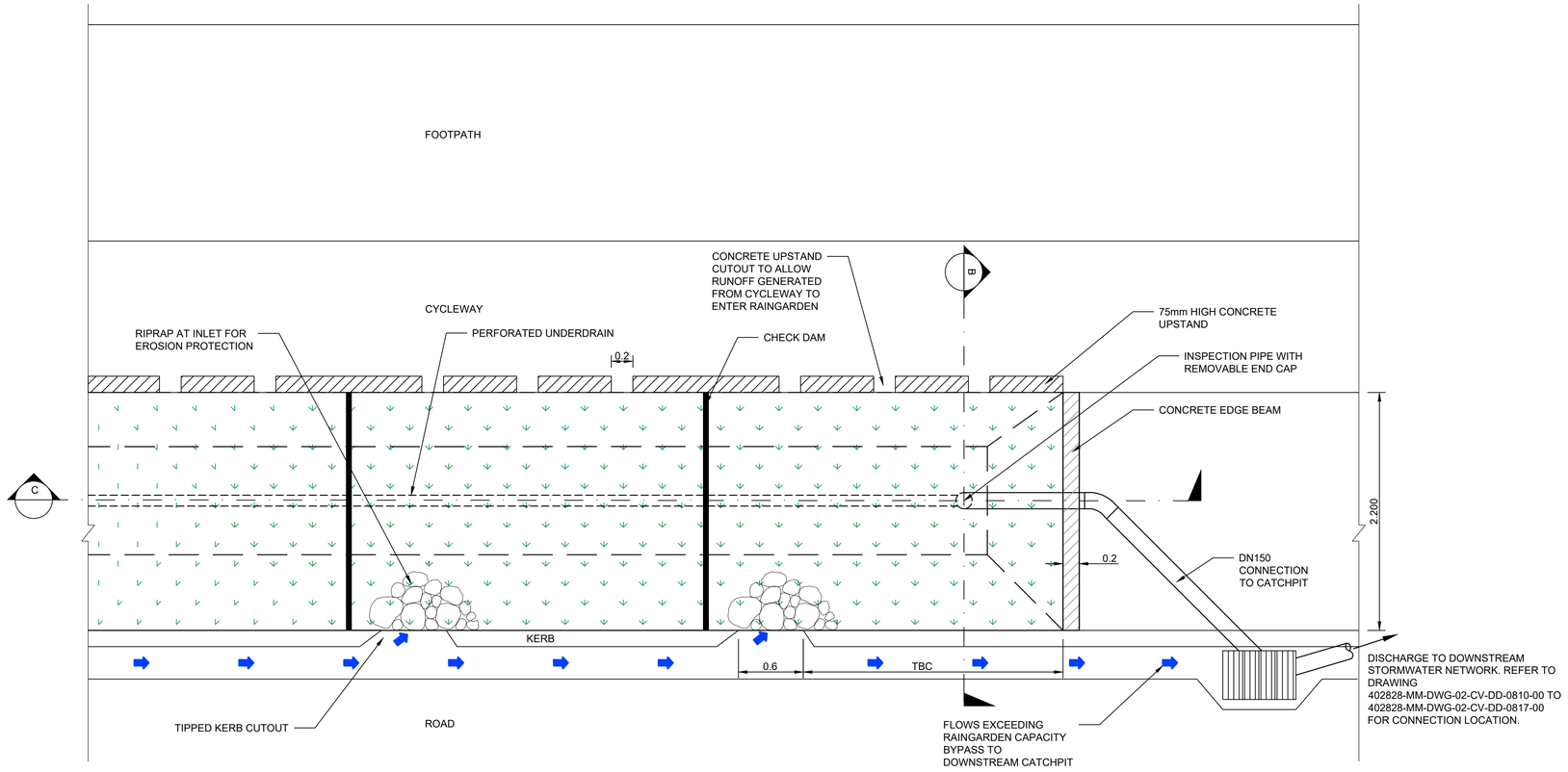
DRAWING NO.: 402828-MM-DWG-02-CV-DD-0831
REVISION: D

FOR RESOURCE CONSENT
SCALE (A1): AS SHOWN

P:\Auckland\NZL\01 Projects\402828 - Milldale\03 Design\Working\CAD\Drawings\02 Argent Lane (PVR & DFH)\402828-MM-DWG-02-CV-DD-0831.dwg Sep 10, 2020 - 3.39pm PERT6432

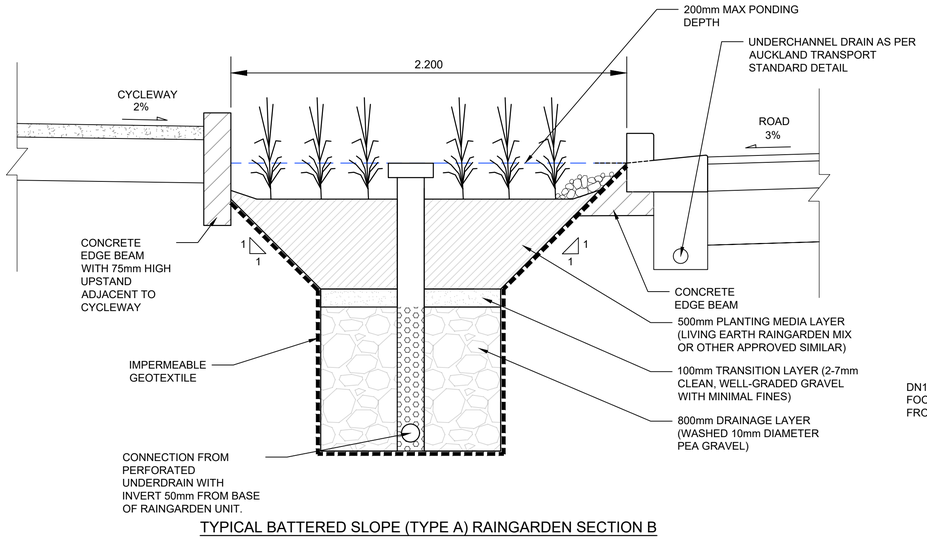
NOTES:

1. DO NOT SCALE THIS DRAWING.
2. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
3. ALL WORKS AND MATERIALS TO COMPLY WITH AUCKLAND TRANSPORT AND AUCKLAND COUNCIL STANDARDS AND WHERE RELEVANT IN ACCORDANCE WITH THE NEW ZEALAND BUILDING CODE REQUIREMENTS.
4. THE CONTRACTOR IS TO SEARCH FOR, LOCATE AND CONFIRM POSITIONS OF ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF WORKS WHETHER SHOWN ON THE DRAWINGS OR NOT AND MAINTAIN RESPONSIBILITY FOR ALL SERVICES.
5. RAINGARDENS HAVE BEEN SIZED TO PROVIDE WATER QUALITY TREATMENT AND SMAF 1 DETENTION. RETENTION VOLUME IS TO BE PROVIDED AS DETENTION.
6. DRAWING IS NOT TO BE USED FOR CONSTRUCTION.
7. PEA GRAVEL FOR DRAINAGE AND STORAGE LAYERS SHOULD HAVE LITTLE OR NO FINES AND A MINIMUM INFILTRATION RATE OF 4.0 MM/HOUR. THIS AGGREGATE SHOULD HAVE A MINIMUM VOID SPACE OF 0.35.
8. REFER TO DRAWING 402828-MM-DWG-02-CV-DD-0842-00 FOR CHECK DAM SPACING AND NUMBER OF CHECK DAMS.
9. REFER TO DRAWING 402828-MM-DWG-02-CV-DD-0810-00 TO 402828-MM-DWG-02-CV-DD-0817-00 FOR RAINGARDEN LOCATIONS.



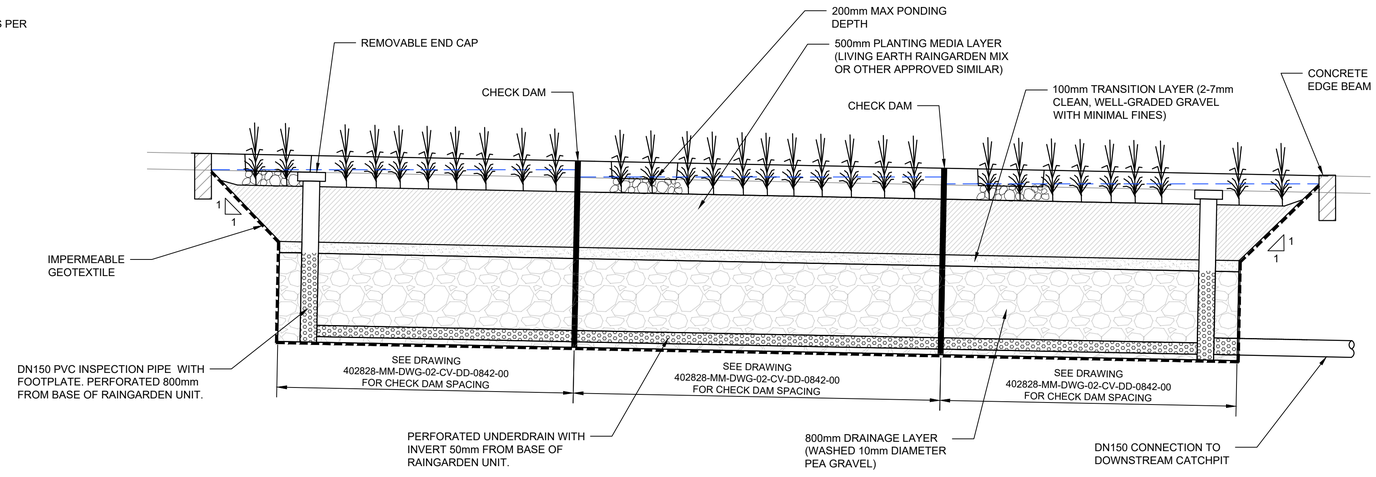
TYPICAL RAINGARDEN PLAN VIEW - BATTERED SLOPE RAINGARDEN (TYPE A)

SCALE 1:25



TYPICAL BATTERED SLOPE (TYPE A) RAINGARDEN SECTION B

Detail B
1:20 (A1)



TYPICAL BATTERED SLOPE (TYPE A) RAINGARDEN SECTION C

Detail C
1:25 (A1)

DRAFT - FOR RESOURCE CONSENT

REV	DESCRIPTION	DATE
A	FOR APPROVAL	18/12/2019
B	DRAFT - FOR RESOURCE CONSENT	13/05/2020
C	DRAFT - AMENDMENTS FROM AT COMMENTS 04/09/20	11/09/2020

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.

CONSULTANT PROJECT NO.
MOTT MACDONALD : 402828

CONSULTANT
Mason Bros. Building
Level 3, 280 Queen Street
Auckland 1010
T +64 (0) 9 375 2400
MOTT MACDONALD

CLIENT
MILLDALE

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

DRAWING
Milldale Development, Argent Lane - Dairy Flat Highway
Typical Road Raingarden Detail (Sheet 1 of 3)

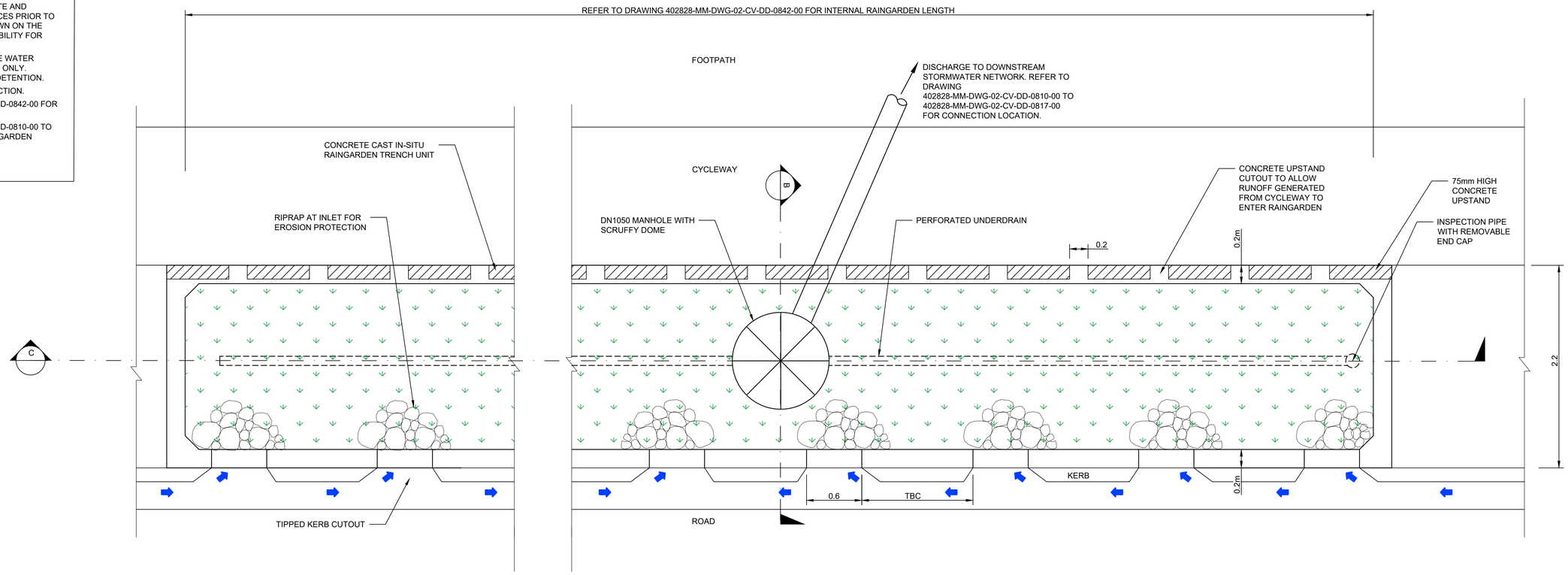
DRAWING NO. 402828-MM-DWG-02-CV-DD-0840
REVISION C

FOR RESOURCE CONSENT
SCALE (A1) AS SHOWN

P:\Auckland\NZL\01 Projects\402828 - Milldale\03 Design\Working\CAD\Drawings\02 Argent Lane (PVR & DFH)\402828-MM-DWG-02-CV-DD-0840.dwg Sep 10, 2020 - 5:12pm PERT8432

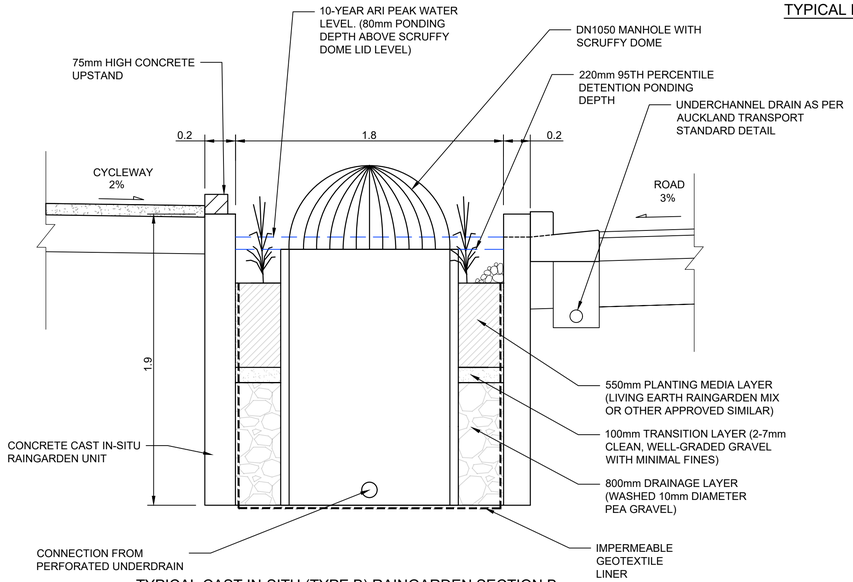
NOTES:

1. DO NOT SCALE THIS DRAWING.
2. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
3. ALL WORKS AND MATERIALS TO COMPLY WITH AUCKLAND TRANSPORT AND AUCKLAND COUNCIL STANDARDS AND WHERE RELEVANT IN ACCORDANCE WITH THE NEW ZEALAND BUILDING CODE REQUIREMENTS.
4. THE CONTRACTOR IS TO SEARCH FOR, LOCATE AND CONFIRM POSITIONS OF ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF WORKS WHETHER SHOWN ON THE DRAWINGS OR NOT AND MAINTAIN RESPONSIBILITY FOR ALL SERVICES.
5. RAINGARGENS HAVE BEEN SIZED TO PROVIDE WATER QUALITY TREATMENT AND SMAF1 DETENTION ONLY. RETENTION VOLUME IS TO BE PROVIDED AS DETENTION.
6. DRAWING IS NOT TO BE USED FOR CONSTRUCTION.
7. REFER TO DRAWING 402828-MM-DWG-02-CV-DD-0842-00 FOR INTERNAL RAINGARDEN LENGTH
8. REFER TO DRAWING 402828-MM-DWG-02-CV-DD-0810-00 TO 402828-MM-DWG-02-CV-DD-0817-00 FOR RAINGARDEN LOCATIONS



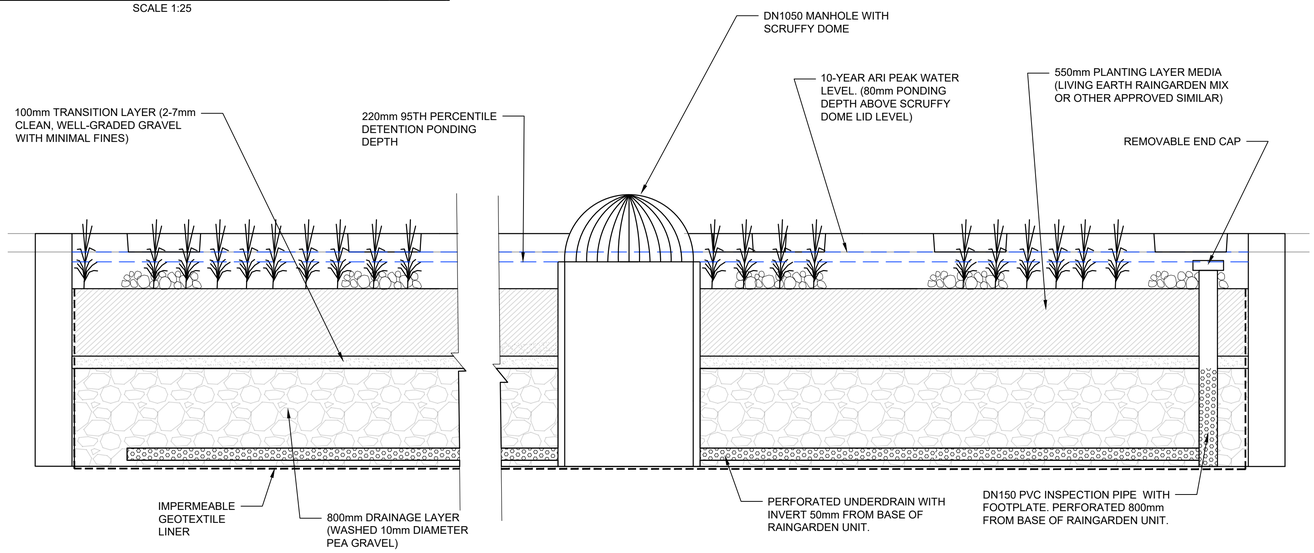
TYPICAL RAINGARDEN PLAN VIEW - CAST IN-SITU RAINGARDEN UNIT (TYPE B)

SCALE 1:25



TYPICAL CAST IN-SITU (TYPE B) RAINGARDEN SECTION B

Detail B
1:20 (A1)



TYPICAL CAST IN-SITU (TYPE B) RAINGARDEN SECTION C

Detail C
1:25(A1)

REV	DESCRIPTION	DATE
A	FOR APPROVAL	18/12/2019
B	DRAFT - FOR RESOURCE CONSENT	13/05/2020
C	DRAFT - AMENDMENTS FROM AT COMMENTS 04/09/20	11/09/2020

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.

CONSULTANT PROJECT NO.
MOTT MACDONALD : 402828

CONSULTANT
Mason Bros. Building
L3, 279 Broadway, Newmarket
Auckland 1010
T +64 (0) 9 375 2400
MOTT MACDONALD

CLIENT
MILLDALE

ROAD CONTROLLING AUTHORITY
Auckland Transport
An Auckland Council Organisation

PROJECT
MILLDALE DEVELOPMENT INFRASTRUCTURE PROJECTS

PROJECT TYPE	PROJECT PHASE
NEW CONSTRUCTION	PRELIMINARY DESIGN

CONSULTANT PROJECT NO.
402828

DRAFT - FOR RESOURCE CONSENT

DRAWING
Milldale Development, Argent Lane - Dairy Flat Highway
Typical Road Raingarden Detail (Sheet 2 of 3)

DRAWING NO. 402828-MM-DWG-02-CV-DD-0841
REVISION C

FOR RESOURCE CONSENT
SCALE (A1) AS SHOWN

NOTES:

1. DO NOT SCALE THIS DRAWING.
2. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
3. ALL WORKS AND MATERIALS TO COMPLY WITH AUCKLAND TRANSPORT AND AUCKLAND COUNCIL STANDARDS AND WHERE RELEVANT IN ACCORDANCE WITH THE NEW ZEALAND BUILDING CODE REQUIREMENTS.
4. THE CONTRACTOR IS TO SEARCH FOR, LOCATE AND CONFIRM POSITIONS OF ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF WORKS WHETHER SHOWN ON THE DRAWINGS OR NOT AND MAINTAIN RESPONSIBILITY FOR ALL SERVICES.
5. RAINGARDEN HAVE BEEN SIZED TO PROVIDE WATER QUALITY TREATMENT AND SMAF1 DETENTION ONLY. RETENTION VOLUME IS TO BE PROVIDED AS DETENTION.
6. DRAWING IS NOT TO BE USED FOR CONSTRUCTION.
7. REFER TO DRAWING 402828-MM-DWG-02-CV-DD-0840-00 FOR RAINGARDEN TYPE A DETAILS
8. REFER TO DRAWING 402828-MM-DWG-02-CV-DD-0841-00 FOR RAINGARDEN TYPE B DETAILS
9. REFER TO DRAWING 402828-MM-DWG-02-CV-DD-0810-00 TO 402828-MM-DWG-02-CV-DD-0817-00 FOR RAINGARDEN LOCATIONS

Raingarden Location	Raingarden Number	Total Catchment Area (ha)	Required 95th Percentile Detention Volume (including Retention) (m^3)	Raingarden Type	95th Percentile Detention Volume (including Retention) Provided (m^3)	Internal Raingarden Length (m)	No. of Check Dams Required	Distance Between Check Dams (m)	External Raingarden Length (m)
Dairy Flat Highway	1	0.03855	7.87	A1	8.64	11.90	2	3.5	12.20
Dairy Flat Highway	2	0.02611	5.33	A1	8.64	11.90	2	3.5	12.20
Dairy Flat Highway	3	0.08078	16.48	A2	18.56	25.70	6	3.5	26.00
Dairy Flat Highway	4	0.05698	11.63	A4	15.98	24.30	6	3.3	24.60
Dairy Flat Highway	5	0.08902	18.17	A2	18.56	25.70	6	3.5	26.00
Dairy Flat Highway	6	0.06946	14.17	A4	15.98	24.30	6	3.3	24.60
Dairy Flat Highway	7	0.08723	17.80	A2	18.56	25.70	6	3.5	26.00
Dairy Flat Highway	8	0.08109	16.55	A2	18.56	25.70	6	3.5	26.00
Dairy Flat Highway	10	0.09850	20.10	A5	22.28	30.00	7	3.6	30.30
Dairy Flat Highway	11	0.09819	20.04	A5	22.28	30.00	7	3.6	30.30
Dairy Flat Highway	12	0.09190	18.75	A2	18.56	25.70	6	3.5	26.00
Dairy Flat Highway	13	0.07477	15.26	A2	18.56	25.70	6	3.5	26.00
Dairy Flat Highway	14	0.08588	17.52	A2	18.56	25.70	6	3.5	26.00
Dairy Flat Highway	15	0.08258	16.85	A2	18.56	25.70	6	3.5	26.00
Dairy Flat Highway	16	0.05136	10.48	A4	15.98	24.30	6	3.3	24.60
Dairy Flat Highway	17	0.07134	14.56	A4	15.98	24.30	6	3.3	24.60
Dairy Flat Highway	18	0.05270	10.75	A4	15.98	24.30	6	3.3	24.60
Pine Valley Road	20	0.06999	14.28	A4	15.98	24.30	6	3.3	24.60
Pine Valley Road	21	0.06423	13.11	A4	15.98	24.30	6	3.3	24.60
Pine Valley Road	22	0.10609	21.65	A5	22.28	30.00	7	3.6	30.30
Pine Valley Road	23	0.10165	20.74	A5	22.28	30.00	7	3.6	30.30
Pine Valley Road	24	0.08104	16.54	A2	18.56	25.70	6	3.5	26.00
Pine Valley Road	25	0.08164	16.66	A2	18.56	25.70	6	3.5	26.00
Pine Valley Road	26	0.09966	20.34	A5	22.28	30.00	7	3.6	30.30
Pine Valley Road	27	0.11660	23.79	A3	26.91	36.20	9	3.5	36.50
Pine Valley Road	30	0.08265	16.87	A2	18.56	25.70	6	3.5	26.00
Pine Valley Road	31	0.08155	16.64	A2	18.56	25.70	6	3.5	26.00
Pine Valley Road	32	0.12922	28.54	B	28.90	23.10	N/A	N/A	23.50
Pine Valley Road	33	0.12110	26.75	B	27.65	22.10	N/A	N/A	22.50
Dairy Flat Highway	34	0.03272	6.68	A1	8.64	11.90	2	3.5	12.20
Dairy Flat Highway	35	0.04971	10.14	A4	15.98	24.30	6	3.3	24.60

1:2000 0 100m 200m

REV	DESCRIPTION	DATE
A	FOR APPROVAL	18/12/2019
B	DRAFT - FOR RESOURCE CONSENT	13/05/2020
C	DRAFT - REVISED DFH TIE-IN AND STAGE 1 OPTION	24/06/2020
D	DRAFT - AMENDMENTS FROM AT COMMENTS 04/09/20	11/09/2020

DRAWING Q.A.

DRAWN	S.PERERA
CHECKED	H.LAW
APPROVED	P.EVANS

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

CONSULTANT PROJECT NO.
MOTT MACDONALD : 402828

CONSULTANT
Mason Bros. Building
Level 3, 350 Queen St / 51 West
Auckland 1010
T: +64 (0) 9 375 2400
MOTT MACDONALD

CLIENT
MILLDALE

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
Typical Road Raingarden Detail (Sheet 3 of 3)

DRAWING NO.: 402828-MM-DWG-02-CV-DD-0842
REVISION: D

FOR RESOURCE CONSENT
SCALE (A1)

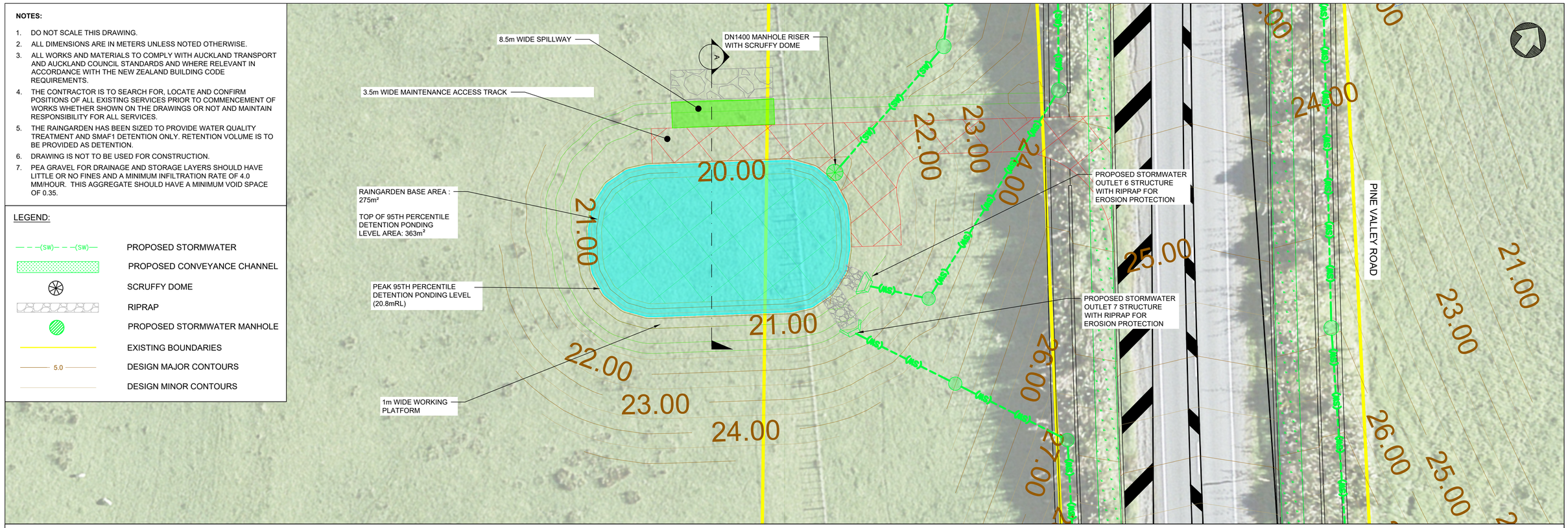
P:\Auckland\NZL\01 Projects\402828 - Milldale\03 Design\Working\CAD\Drawings\02_Argent Lane (PVR & DFH)\402828-MM-DWG-02-CV-DD-0842.dwg Sep 10, 2020 - 2:37pm PERT6432

NOTES:

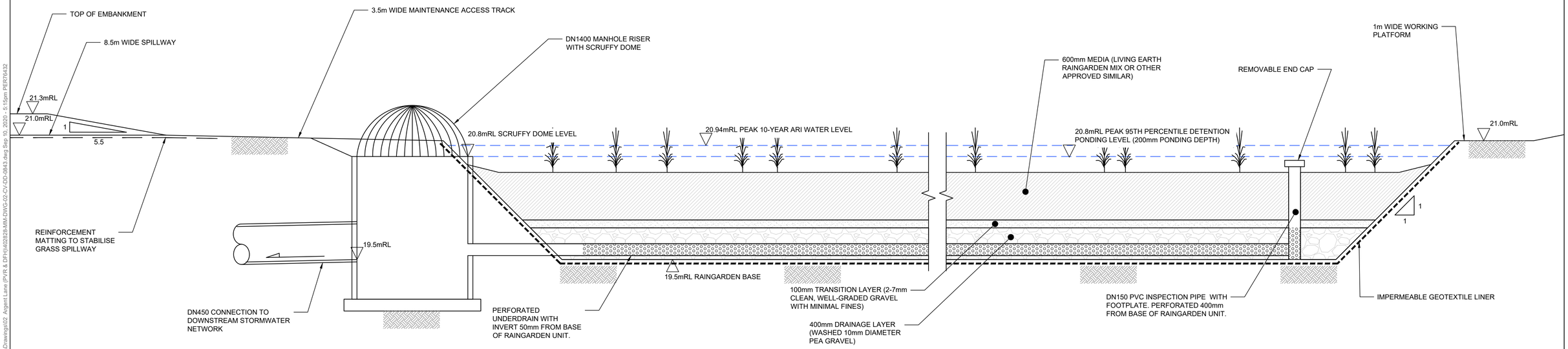
1. DO NOT SCALE THIS DRAWING.
2. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
3. ALL WORKS AND MATERIALS TO COMPLY WITH AUCKLAND TRANSPORT AND AUCKLAND COUNCIL STANDARDS AND WHERE RELEVANT IN ACCORDANCE WITH THE NEW ZEALAND BUILDING CODE REQUIREMENTS.
4. THE CONTRACTOR IS TO SEARCH FOR, LOCATE AND CONFIRM POSITIONS OF ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF WORKS WHETHER SHOWN ON THE DRAWINGS OR NOT AND MAINTAIN RESPONSIBILITY FOR ALL SERVICES.
5. THE RAINGARDEN HAS BEEN SIZED TO PROVIDE WATER QUALITY TREATMENT AND SMAF1 DETENTION ONLY. RETENTION VOLUME IS TO BE PROVIDED AS DETENTION.
6. DRAWING IS NOT TO BE USED FOR CONSTRUCTION.
7. PEA GRAVEL FOR DRAINAGE AND STORAGE LAYERS SHOULD HAVE LITTLE OR NO FINES AND A MINIMUM INFILTRATION RATE OF 4.0 MM/HOUR. THIS AGGREGATE SHOULD HAVE A MINIMUM VOID SPACE OF 0.35.

LEGEND:

- PROPOSED STORMWATER
- PROPOSED CONVEYANCE CHANNEL
- SCRUFFY DOME
- RIPRAP
- PROPOSED STORMWATER MANHOLE
- EXISTING BOUNDARIES
- DESIGN MAJOR CONTOURS (5.0)
- DESIGN MINOR CONTOURS



SUPER RAINGARDEN PLAN
SCALE 1:200



SUPER RAINGARDEN SECTION A
SCALE 1:25

1:2000 0 100m 200m

REV	DESCRIPTION	DATE
A	FOR APPROVAL	18/12/2019
B	DRAFT - FOR RESOURCE CONSENT	13/05/2020
C	DRAFT - REVISED DFH TIE-IN AND STAGE 1 OPTION	26/06/2020
D	DRAFT - AMENDMENTS FROM AT COMMENTS 04/09/20	11/09/2020

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.

CONSULTANT PROJECT NO.
MOTT MACDONALD : 402828

CONSULTANT
Mason Bros. Building
Level 3, 160 Lambton Quay West
Wellington 6011
Auckland 1010
T +64 (0) 9 375 2400
MOTT MACDONALD

CLIENT
MILLDALE

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
Super Raingarden Detail

DRAWING NO.: 402828-MM-DWG-02-CV-DD-0843
REVISION: D
FOR RESOURCE CONSENT
SCALE (A1): AS SHOWN

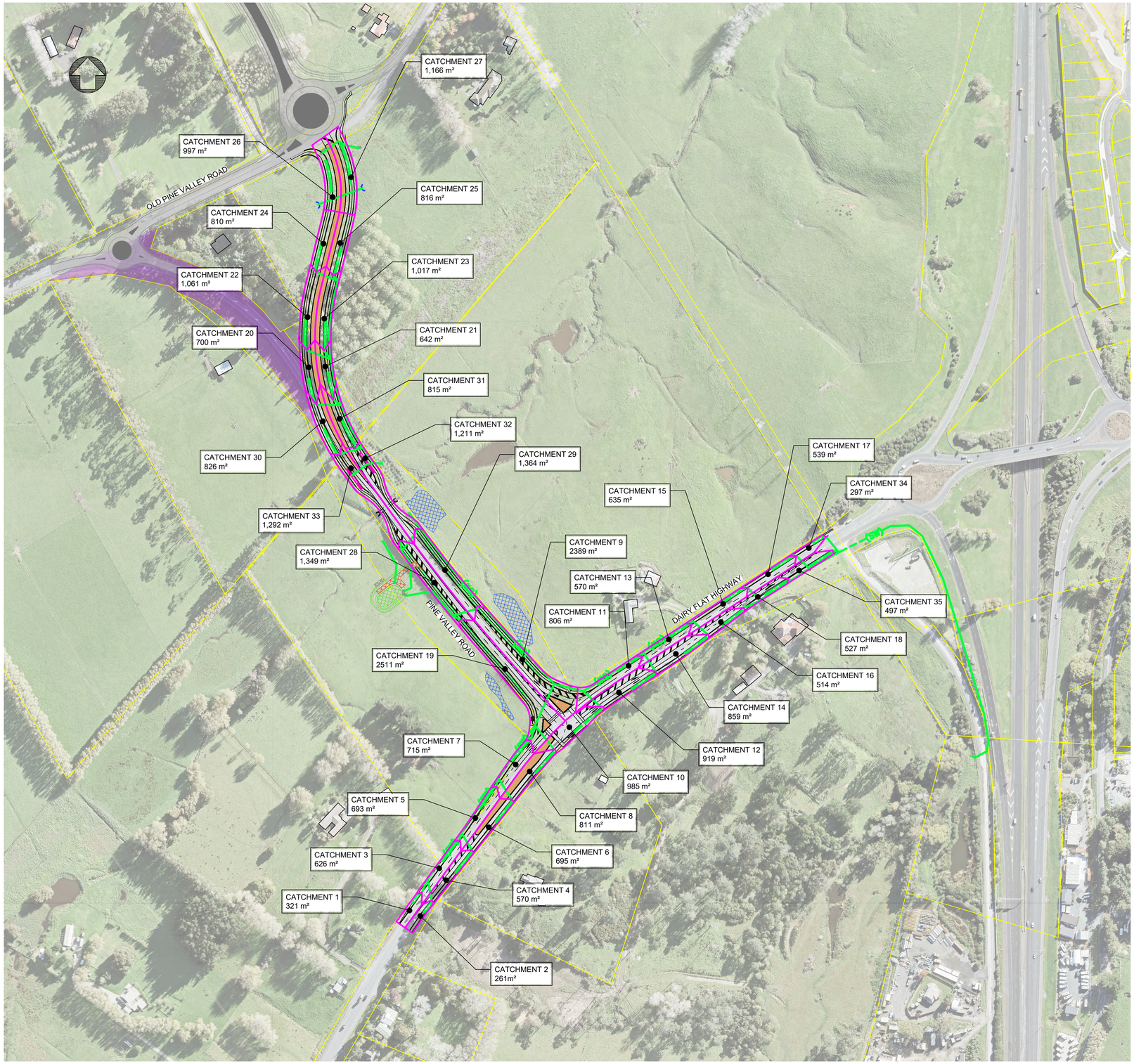
P:\Auckland\NZL101 Projects\402828 - Milldale\03 Design\Working\CAD\Drawings\02 Argent Lane (PVR & DFH)\402828-MM-DWG-02-CV-DD-0843.dwg Sep 10, 2020 - 5:15pm PER76432

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. SETOUT COORDINATES ARE IN TERMS OF MT EDEN NZGD 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
- PROPOSED STORMWATER MANHOLE
- EXISTING BOUNDARIES



1:2000 0 100m 200m

DRAFT - FOR RESOURCE CONSENT

REV	DESCRIPTION	DATE
A	FOR APPROVAL	18/12/2019
B	DRAFT - FOR RESOURCE CONSENT	13/05/2020
C	DRAFT - REVISED DFH TIE-IN AND STAGE 1 OPTION	25/06/2020
D	DRAFT - AMENDMENTS FROM AT COMMENTS 04/09/20	11/09/2020

DRAWING Q.A.

DRAWN	S.PERERA
CHECKED	H.LAW
APPROVED	P.EVANS

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

CONSULTANT PROJECT NO.
MOTT MACDONALD : 402828

CONSULTANT
Mason Bros. Building
L3 / 279 Broadway St West
Auckland 1010
T +64 (0) 9 375 2400
MOTT MACDONALD

CLIENT
MILLDALE

ROAD CONTROLLING AUTHORITY
Auckland Transport
An Auckland Council Organisation

PROJECT
MILLDALE DEVELOPMENT
INFRASTRUCTURE PROJECTS

PROJECT TYPE	PROJECT PHASE
NEW CONSTRUCTION	PRELIMINARY DESIGN

CONSULTANT PROJECT NO.
402828

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

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

FOR RESOURCE CONSENT SCALE (A1) 1:2000

P:\Auckland\NZL\01 Projects\402828 - Milldale\03 Design\Working\CAD\Drawings\02_Argent Lane (PVR & DFH)\402828-MM-DWG-02-CV-DD-0850.dwg Sep 10, 2020 - 6:11pm PERT9432

B. Argent Lane Extension Stormwater Calculations

Milldale Development - Argent Lane

SMAF 1 Volume Calculation Summary

Prepared By: HJL **Date:** 6/05/2020
Checked By: COS

Design Rainfall Depths (mm)

SMAF 95th Percentile Rainfall (mm) =	37
Retention Runoff Depth (mm)=	5

Catchment Parameters

		CN	Ia	Tc
Pre-Development	Pervious	74	5	0.167
	Impervious	98	0	0.167
Post-Development	Pervious	74	5	0.167
	Impervious	98	0	0.167

		Pre-Development			Post-Development			Pre-Development SMAF		Post-Development SMAF Volumes		Final SMAF Volumes	
Catchment Name	Total Catchment Area (ha)	% Imperviousness	Impervious Area (ha)	Pervious Area (ha)	% Imperviousness	Impervious Area (ha)	Pervious Area (ha)	Retention (m³)	95th Percentile Detention (including Retention) (m³)	Retention (m³)	95th Percentile Detention (including Retention) (m³)	Retention (m³)	95th Percentile Detention (including Retention) (m³)
1	0.0406	0.0%	0.0000	0.0406	85.0%	0.0345	0.0061	0.00	3.43	1.72	11.71	1.72	8.28
2	0.0389	0.0%	0.0000	0.0389	85.0%	0.0331	0.0058	0.00	3.29	1.66	11.24	1.66	7.95
3	0.0808	0.0%	0.0000	0.0808	85.0%	0.0687	0.0121	0.00	6.82	3.43	23.31	3.43	16.48
4	0.0788	0.0%	0.0000	0.0788	85.0%	0.0670	0.0118	0.00	6.66	3.35	22.74	3.35	16.09
5	0.0890	0.0%	0.0000	0.0890	85.0%	0.0757	0.0134	0.00	7.52	3.78	25.68	3.78	18.17
6	0.1042	0.0%	0.0000	0.1042	85.0%	0.0886	0.0156	0.00	8.80	4.43	30.06	4.43	21.26
7	0.0872	0.0%	0.0000	0.0872	85.0%	0.0741	0.0131	0.00	7.37	3.71	25.17	3.71	17.80
8	0.1179	0.0%	0.0000	0.1179	85.0%	0.1002	0.0177	0.00	9.96	5.01	34.02	5.01	24.06
9	0.2388	0.0%	0.0000	0.2388	85.0%	0.2030	0.0358	0.00	20.17	10.15	68.89	10.15	48.73
10	0.1308	0.0%	0.0000	0.1308	85.0%	0.1112	0.0196	0.00	11.05	5.56	37.73	5.56	26.69
11	0.0982	0.0%	0.0000	0.0982	85.0%	0.0835	0.0147	0.00	8.29	4.17	28.33	4.17	20.04
12	0.1317	0.0%	0.0000	0.1317	85.0%	0.1119	0.0198	0.00	11.12	5.60	37.99	5.60	26.87
13	0.0748	0.0%	0.0000	0.0748	85.0%	0.0636	0.0112	0.00	6.31	3.18	21.57	3.18	15.26
14	0.1261	0.0%	0.0000	0.1261	85.0%	0.1072	0.0189	0.00	10.65	5.36	36.38	5.36	25.73
15	0.0826	0.0%	0.0000	0.0826	85.0%	0.0702	0.0124	0.00	6.97	3.51	23.83	3.51	16.85
16	0.0782	0.0%	0.0000	0.0782	85.0%	0.0665	0.0117	0.00	6.61	3.32	22.57	3.32	15.96
17	0.0781	0.0%	0.0000	0.0781	85.0%	0.0664	0.0117	0.00	6.60	3.32	22.54	3.32	15.94
18	0.0907	0.0%	0.0000	0.0907	85.0%	0.0771	0.0136	0.00	7.66	3.86	26.18	3.86	18.52
19	0.2542	0.0%	0.0000	0.2542	85.0%	0.2161	0.0381	0.00	21.47	10.80	73.35	10.80	51.88
20	0.0700	0.0%	0.0000	0.0700	85.0%	0.0595	0.0105	0.00	5.91	2.97	20.19	2.97	14.28
21	0.0642	0.0%	0.0000	0.0642	85.0%	0.0546	0.0096	0.00	5.42	2.73	18.53	2.73	13.11
22	0.1061	0.0%	0.0000	0.1061	85.0%	0.0902	0.0159	0.00	8.96	4.51	30.61	4.51	21.65
23	0.1017	0.0%	0.0000	0.1017	85.0%	0.0864	0.0152	0.00	8.59	4.32	29.33	4.32	20.74
24	0.0810	0.0%	0.0000	0.0810	85.0%	0.0689	0.0122	0.00	6.84	3.44	23.38	3.44	16.54
25	0.0816	0.0%	0.0000	0.0816	85.0%	0.0694	0.0122	0.00	6.90	3.47	23.56	3.47	16.66
26	0.0997	0.0%	0.0000	0.0997	85.0%	0.0847	0.0149	0.00	8.42	4.24	28.75	4.24	20.34
27	0.1166	0.0%	0.0000	0.1166	85.0%	0.0991	0.0175	0.00	9.85	4.96	33.64	4.96	23.79
28	0.1402	0.0%	0.0000	0.1402	85.0%	0.1191	0.0210	0.00	11.84	5.96	40.44	5.96	28.60
29	0.1391	0.0%	0.0000	0.1391	85.0%	0.1182	0.0209	0.00	11.75	5.91	40.12	5.91	28.38
30	0.0826	0.0%	0.0000	0.0826	85.0%	0.0703	0.0124	0.00	6.98	3.51	23.85	3.51	16.87
31	0.0815	0.0%	0.0000	0.0815	85.0%	0.0693	0.0122	0.00	6.89	3.47	23.53	3.47	16.64
32	0.1292	0.0%	0.0000	0.1292	92.0%	0.1189	0.0103	0.00	10.91	5.94	39.45	5.94	28.54
33	0.1211	0.0%	0.0000	0.1211	92.0%	0.1114	0.0097	0.00	10.23	5.57	36.98	5.57	26.75
34	0.0423	0.0%	0.0000	0.0423	85.0%	0.0360	0.0063	0.00	3.57	1.80	12.21	1.80	8.63
35	0.1160	0.0%	0.0000	0.1160	51.7%	0.0600	0.0560	0.00	9.80	3.00	24.22	3.00	14.42
Total	**3.5946**	**0.0%**	**0.0000**	**3.5946**	**84.4%**	**3.0344**	**0.5603**	**0.00**	**303.60**	**151.72**	**1032.07**	**151.72**	**728.47**

Milldale Infrastructure Project 1 - Argent Lane

Pine Valley Road Swales - TP108 Calculation Summary

Date: 6/05/2020

Produced by: ARA
Checked by: HJL

24-Hour Design Rainfall Depth (mm)

10 Year ARI (mm)=	164.1

Catchment Parameters

		CN	Ia	Tc
POST-DEVELOPMENT	Pervious	74	5	0.167
	Impervious	98	0	0.167

Catchment	Area		
Catchment 19 (at 12% Grade LHS)	Total Area	0.2546	ha
	% Imperviousness	90%	
	Impervious area	0.22914	ha
	Pervious area	0.02546	ha
Catchment 9 (at 12% Grade RHS)	Total Area	0.2391	ha
	% Imperviousness	90%	
	Impervious area	0.21519	ha
	Pervious area	0.02391	ha
Catchment 28 (End of Swale LHS)	Total Area	0.1351	ha
	% Imperviousness	90%	
	Impervious area	0.1216	ha
	Pervious area	0.0135	ha
Catchment 29 (End of Swale RHS)	Total Area	0.1364	ha
	% Imperviousness	90%	
	Impervious area	0.1227	ha
	Pervious area	0.0136	ha

Peak Flow (m^3/s)

	Catchment 19 (at 12% Grade LHS)	Catchment 9 (at 12% Grade RHS)	Catchment 28 (End of Swale LHS)	Catchment 29 (End of Swale RHS)
	10 Year ARI	**10 Year ARI**	**10 Year ARI**	**10 Year ARI**
POST-DEVELOPMENT	0.0680	0.0639	0.0361	0.0364

Runoff Volume (m^3)

	Catchment 19 (at 12% Grade LHS)	Catchment 9 (at 12% Grade RHS)	Catchment 28 (End of Swale LHS)	(End of Swale RHS)
	10 Year ARI	**10 Year ARI**	**10 Year ARI**	**10 Year ARI**
POST-DEVELOPMENT	390.6	366.8	207.2	209.2

XS at 5.7% Grade

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	0.057 m/m
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Bottom Width	0.60 m
Discharge	36.10 L/s

Results

Normal Depth	53.8 mm
Flow Area	0.0 m²
Wetted Perimeter	1.0 m
Hydraulic Radius	42.0 mm
Top Width	1.03 m
Critical Depth	62.1 mm
Critical Slope	0.034 m/m
Velocity	0.82 m/s
Velocity Head	0.03 m
Specific Energy	0.09 m
Froude Number	1.273
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 mm
Length	0.0 m
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Downstream Velocity	Infinity m/s
Upstream Velocity	Infinity m/s
Normal Depth	53.8 mm
Critical Depth	62.1 mm
Channel Slope	0.057 m/m
Critical Slope	0.034 m/m

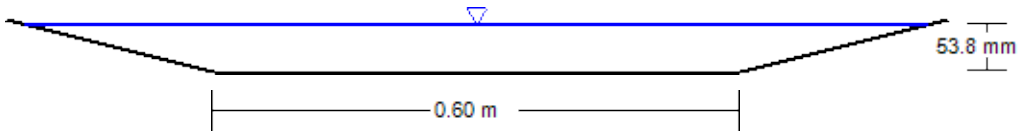
XS at 5.7% Grade

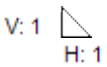
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	0.057 m/m
Normal Depth	53.8 mm
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Bottom Width	0.60 m
Discharge	36.10 L/s





Swale XS at 12% Grade

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	0.120 m/m
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Bottom Width	0.60 m
Discharge	68.00 L/s

Results

Normal Depth	62.0 mm
Flow Area	0.1 m²
Wetted Perimeter	1.1 m
Hydraulic Radius	47.3 mm
Top Width	1.10 m
Critical Depth	89.1 mm
Critical Slope	0.031 m/m
Velocity	1.29 m/s
Velocity Head	0.09 m
Specific Energy	0.15 m
Froude Number	1.885
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 mm
Length	0.0 m
Number Of Steps	0

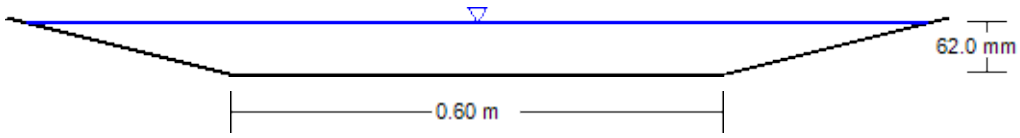
GVF Output Data

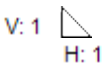
Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Downstream Velocity	Infinity m/s
Upstream Velocity	Infinity m/s
Normal Depth	62.0 mm
Critical Depth	89.1 mm
Channel Slope	0.120 m/m
Critical Slope	0.031 m/m

Cross Section for XS at 12% Grade

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.035	
Channel Slope	0.120	m/m
Normal Depth	62.0	mm
Left Side Slope	4.000	H:V
Right Side Slope	4.000	H:V
Bottom Width	0.60	m
Discharge	68.00	L/s





Milldale Development Infrastructure Project 1- Argent Lane

Pine Valley Road Swale - Scruffy Dome Outlet Stage Discharge Table

Prepared By: ARA **Date:**
Checked By: HJL **Date:**

Design Summary

Peak 10-Year ARI Flow =	0.0680	m^3/s
Swale Invert Level =	0	m RL
Scruffy Dome Level =	0	m RL
Scruffy Dome Diameter =	1.050	m

Stage Discharge Table

Elevation (m RL)	Ponding Depth (m)	Discharge (m^3/s)	
0.000	0.000	0.0000	
0.050	0.050	0.0664	
0.051	0.051	0.0684	**Peak 10-Year ARI Ponding Depth**
0.055	0.055	0.0766	
0.060	0.060	0.0873	
0.100	0.100	0.1878	
0.150	0.150	0.3449	
0.200	0.200	0.5311	
0.250	0.250	1.1890	
0.300	0.300	1.3025	
0.420	0.420	1.5411	
0.450	0.450	1.5952	
0.500	0.500	1.6815	
0.550	0.550	1.7636	
0.600	0.600	1.8420	

Milldale Development Infrastructure Project 1 - Argent Lane Extension
Proposed Stormwater Pipeline Calculation - Stage 1 (Interim Stage)

Project Reference: 402828

Prepared By: Hannah Law Date: 6/05/2020

Checked By: Carmel O'Sullivan Date: 6/05/2020

Pipe Network Information							Stormwater Catchment Calculation						Pipe Capacity Check (Assuming Pipe Full)			
US Manhole ID	DS Manhole ID	Length (m)	US Pipe invert (mRL)	DS Pipe invert (mRL)	Slope (%)	Internal Pipe Diam (mm)	Catchment Increment Type	Catchment Increment Area (ha)	Catchment Increment Imperviousness (%)	Weighted Coefficient	Catchment Increment Flow (m3/s)	Cumulative Flow (m3/s)	Pipe Cross Sectional Area (m²)	Velocity (Pipe Full) (m/s)	Capacity (m³/s)	Capacity Check
Pipeline 1 (Long Section 1)																
MH 1-8	MH 1-7	53.42	47.55	45.94	3.01%	222	1	0.0406	90.0%	0.84	0.0105	0.0206	0.039	1.98	0.077	OK
							2	0.0389	90.0%	0.84	0.0101					
MH 1-7	MH 1-6	60.37	45.89	44.08	3.00%	302	3	0.0808	90.0%	0.84	0.0209	0.0618	0.072	2.42	0.173	OK
							4	0.0788	90.0%	0.84	0.0204					
MH 1-6	MH 1-5	59.83	43.28	41.49	2.99%	302	5	0.0890	90.0%	0.84	0.0230	0.1118	0.072	2.41	0.173	OK
							6	0.1042	90.0%	0.84	0.0269					
MH 1-5	MH 1-4	42.45	40.69	39.42	2.99%	302	7	0.0872	90.0%	0.84	0.0225	0.1648	0.072	2.41	0.173	OK
							8	0.1179	90.0%	0.84	0.0305					
MH 1-4	MH 1-3	69.95	37.4	32.22	7.41%	380	Pipeline 2 (Long Section 2)				0.1452	0.3100	0.113	4.41	0.500	OK
MH 1-3	MH 1-2	78.26	32.22	24.4	9.99%	380					0	0.3100	0.113	5.12	0.581	OK
MH 1-2	MH 1-1	51.12	24.18	20.71	6.79%	380					0	0.3100	0.113	4.22	0.479	OK
MH 1-1	Outlet 1	15.607	20.609	19.285	8.48%	380					0	0.3100	0.113	4.72	0.535	OK
Pipeline 2 (Long Section 2)																
MH 2-3	MH 2-2	52.72	38.86	38.35	0.97%	302	13	0.0748	90.0%	0.84	0.0193	0.0519	0.072	1.37	0.098	OK
							14	0.1260	90.0%	0.84	0.0326					
MH 2-2	MH 2-1	63.4	38.3	37.73	0.90%	380	11	0.0982	90.0%	0.84	0.0254	0.1114	0.113	1.53	0.174	OK
							12	0.1318	90.0%	0.84	0.0341					
MH 2-1	MH 1-4	25.66	37.68	37.45	0.90%	380	10	0.1308	90.0%	0.84	0.0338	0.1452	0.113	1.53	0.174	OK
Pipeline 3 (Long Section 3)																
MH 3-14	MH 3-13	37.18	37.558	36.748	2.18%	222	15	0.0826	90.0%	0.84	0.0214	0.0416	0.039	1.68	0.065	OK
							16	0.0782	90.0%	0.84	0.0202					
MH 3-13	MH 3-12	17.28	36.7	36.35	2.03%	302	18	0.0907	90.0%	0.84	0.0234	0.0650	0.072	1.98	0.142	OK
MH 3-12	MH 3-11	74.23	36.3	33.01	4.43%	302	17	0.0781	90.0%	0.84	0.0202	0.0852	0.072	2.94	0.210	OK
MH 3-11	MH 3-10	29.71	32.76	30.9	6.26%	302					0	0.0852	0.072	3.49	0.250	OK
MH 3-10	MH 3-9	14.29	30.76	29.88	6.16%	302					0	0.0852	0.072	3.46	0.248	OK
MH 3-9	MH 3-8	34.44	29.83	27.69	6.21%	302					0	0.0852	0.072	3.48	0.249	OK
MH 3-8	MH 3-7	37.32	27.64	25.24	6.43%	302					0	0.0852	0.072	3.54	0.254	OK
MH 3-7	MH 3-6	43.38	24.3	21.31	6.89%	302					0	0.0852	0.072	3.66	0.263	OK
MH 3-6	MH 3-5	35.82	20.46	17.99	6.90%	302					0	0.0852	0.072	3.67	0.263	OK
MH 3-5	MH 3-4	24.091	17.36	16.88	1.99%	302					0	0.0852	0.072	1.97	0.141	OK
MH 3-4	MH 3-3	22.819	16.933	16.587	1.52%	302					0	0.0852	0.072	1.72	0.123	OK
MH 3-3	MH 3-2	26.465	15.802	14.579	4.62%	302					0	0.0852	0.072	3.00	0.215	OK
MH 3-2	MH 3-1	8.659	14.56	14.406	1.78%	302					0	0.0852	0.072	1.86	0.133	OK
MH 3-1	Outlet 3	5.38	14.352	14.232	2.23%	302					0	0.0852	0.072	2.08	0.149	OK
Pipeline 4 (Long Section 4)																
MH 4-9	MH 4-8	20.66	24.35	23.94	1.98%	222	24	0.0810	90.0%	0.84	0.0209	0.0420	0.039	1.60	0.062	OK
							25	0.0816	90.0%	0.84	0.0211					
MH 4-8	MH 4-7	28.38	23.89	23.32	2.01%	302					0	0.0420	0.072	1.98	0.142	OK
MH 4-7	MH 4-6	24.44	22.82	22.33	2.00%	302					0	0.0420	0.072	1.97	0.141	OK
MH 4-6	MH 4-5	23.06	21.53	21.07	1.99%	302	22	0.1060	90.0%	0.84	0.0274	0.0957	0.072	1.97	0.141	OK
							23	0.1016	90.0%	0.84	0.0263					
MH 4-5	MH 4-4	21	21.02	20.6	2.00%	302					0.0000	0.0957	0.072	1.97	0.141	OK
MH 4-4	MH 4-3	25.07	20.55	20.05	1.99%	302	20	0.0699	90.0%	0.84	0.0181	0.1304	0.072	1.97	0.141	OK
							21	0.0642	90.0%	0.84	0.0166					
MH 4-3	MH 4-2	30.36	20	19.39	2.01%	380					0	0.1304	0.113	2.29	0.260	OK
MH 4-2	MH 4-1	17.04	19.34	19	2.00%	380	30	0.0826	90.0%	0.84	0.0214	0.1728	0.113	2.29	0.259	OK
							31	0.0815	90.0%	0.84	0.0211					
MH 4-1	Outlet 4	19.78	18.95	18.55	2.02%	457	32	0.1292	90.0%	0.84	0.0334	0.2375	0.164	2.59	0.425	OK
							33	0.1211	90.0%	0.84	0.0313					
Pipeline 5 (Long Section 5)																
MH 5-1	Outlet 5	25.98	26	25.63	1.42%	302	26	0.0997	90.0%	0.84	0.0258	0.0559	0.072	1.66	0.119	OK
							27	0.1166	90.0%	0.84	0.0301					
Pipeline 6 (Long Section 6)																
SD 2	MH 6-3	23.59	21.37	21.2	0.72%	222	29	0.1364	90.0%	0.84	0.0353	0.0353	0.039	0.96	0.037	OK
MH 6-3	MH 6-2	11.83	21.15	21.07	0.68%	302	28	0.1351	90.0%	0.84	0.0349	0.0702	0.072	1.14	0.082	OK
MH 6-2	MH 6-1	24.75	21.02	20.94	0.32%	445			90.0%	0.84	0	0.0702	0.156	1.02	0.158	OK
MH 6-1	Outlet 6	6.19	20.94	20.9	0.65%	445			90.0%	0.84	0	0.0702	0.156	1.44	0.224	OK
Pipeline 7 (Long Section 7)																
SD 3	MH 7-3	24.69	29.78	28.61	4.74%	222	9	0.2392	90.0%	0.84	0.0618	0.0618	0.039	2.48	0.096	OK
MH 7-3	MH 7-2	14.47	26.97	26.24	5.04%	302	19	0.2547	90.0%	0.84	0.0658	0.1277	0.072	3.13	0.225	OK
MH 7-2	MH 7-1	14.98	24.34	23.59	5.01%	302					0	0.1277	0.072	3.12	0.224	OK
MH 7-1	Outlet 7	17	21.92	20.9	6.00%	302					0	0.1277	0.072	3.42	0.245	OK
Pipeline 8																
MH 8-1	Outlet 8	24.903	19.705	19.643	0.25%	686	Flow from Super Raingarden				0.3838	0.3838	0.370	1.18	0.435	OK

Inputs

Parameter	Value
Tc (mins)	10
Rainfall Event	10 year ARI
10-Year ARI 10 Minute Peak Rainfall Intensity (mm/hr)*	110.8
Colebrook-White Pipe Coefficient k (mm) - Pipe diameters less than 1m	1.5
than 1m	0.6
Poly Viscosity (m²/s)	0.00000114

Runoff Coefficients

Pervious Area	0.3
Impervious Area	0.9

* Rainfall data based on the 24-hour 10-year ARI rainfall depth (increased by 13.2% for climate change consideration) and the Auckland Region 24 hour design storm profile specified in the Auckland Regional Council Guidelines for stormwater runoff m modelling in the Auckland Region (April 1999)

Milldale Development - Argent Lane

Proposed Intermittent Stream Culvert (at Chainage 550) - TP108 Calculation Summary

Date: 6/05/2020

Produced by: HJL
Checked by: COS

24-Hour Design Rainfall Depth (mm)

2 Year ARI (mm)=	95.9
10 Year ARI (mm)=	164.1
100 Year ARI (mm)=	245.3

Catchment Parameters

		CN	Ia	Tc
	Pervious	74	5	0.167
POST-DEVELOPMENT	Impervious	98	0	0.167

Area	Area	
	Total Area (ha)=	1.5450
	Imperviousness (%)=	90.0%
	Pervious Area (ha)=	0.1545
POST-DEVELOPMENT	Impervious Area (ha)=	1.3905

Peak Flow (m^3/s)

	2 Year ARI	10 Year ARI	100 Year ARI
POST-DEVELOPMENT	0.2350	0.4129	0.6231

Runoff Volume (m^3)

	2 Year ARI	10 Year ARI	100 Year ARI
POST-DEVELOPMENT	1336.2	2370.0	3610.6

HY-8 Culvert Analysis Report
Proposed Culvert at Chainage 550- 0% Blockage Scenario

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 22.001 cfs

Maximum Flow: 22.001 cfs

Table 1 - Summary of Culvert Flows at Crossing: Pine Valley Road- Proposed Culvert

Headwater Elevation (m)	Total Discharge (cms)	Proposed Culvert at Chainage 550 Discharge (cms)	Roadway Discharge (cms)	Iterations
25.98	0.00	0.00	0.00	1
25.99	0.06	0.06	0.00	1
26.00	0.12	0.12	0.00	1
26.02	0.19	0.19	0.00	1
26.04	0.25	0.25	0.00	1
26.07	0.31	0.31	0.00	1
26.10	0.37	0.37	0.00	1
26.13	0.44	0.44	0.00	1
26.16	0.50	0.50	0.00	1
26.19	0.56	0.56	0.00	1
26.22	0.62	0.62	0.00	1
27.21	1.47	1.47	0.00	Overtopping

Table 2 - Culvert Summary Table: Proposed Culvert at Chainage 550

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	25.98	0.000	0.287	0-NF	0.000	0.000	0.480	0.480	0.000	0.000
0.06	0.06	25.99	0.086	0.291	3-M1t	0.103	0.054	0.480	0.480	0.087	0.000
0.12	0.12	26.00	0.136	0.304	3-M1t	0.157	0.088	0.480	0.480	0.173	0.000
0.19	0.19	26.02	0.177	0.324	3-M1t	0.200	0.119	0.480	0.480	0.260	0.000
0.25	0.25	26.04	0.215	0.348	3-M1t	0.238	0.143	0.480	0.480	0.346	0.000
0.31	0.31	26.07	0.249	0.375	3-M1t	0.272	0.166	0.480	0.480	0.433	0.000
0.37	0.37	26.10	0.285	0.404	3-M1t	0.304	0.187	0.480	0.480	0.519	0.000
0.44	0.44	26.13	0.320	0.434	3-M1t	0.333	0.207	0.480	0.480	0.606	0.000
0.50	0.50	26.16	0.355	0.464	3-M1t	0.361	0.227	0.480	0.480	0.692	0.000
0.56	0.56	26.19	0.390	0.494	3-M1t	0.388	0.243	0.480	0.480	0.779	0.000
0.62	0.62	26.22	0.423	0.523	7-M1t	0.413	0.259	0.480	0.480	0.865	0.000

****

Straight Culvert

Inlet Elevation (invert): 25.70 m, Outlet Elevation (invert): 25.50 m

Culvert Length: 42.66 m, Culvert Slope: 0.0045

****

Site Data - Proposed Culvert at Chainage 550

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 25.45 m

Outlet Station: 42.66 m

Outlet Elevation: 25.25 m

Number of Barrels: 1

Culvert Data Summary - Proposed Culvert at Chainage 550

Barrel Shape: Concrete Box

Barrel Span: 1500.00 mm

Barrel Rise: 750.00 mm

Barrel Material: Concrete

Embedment: 250.00 mm

Barrel Manning's n: 0.0120 (top and sides)

Manning's n: 0.0350 (bottom)

Culvert Type: Straight

Inlet Configuration: Square Edge (90º) Headwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: Pine Valley Road- Proposed Culvert)

Flow (cms)	Water Surface Elev (m)	Depth (m)
0.00	25.98	0.48
2.20	25.98	0.48
4.40	25.98	0.48
6.60	25.98	0.48
8.80	25.98	0.48
11.00	25.98	0.48
13.20	25.98	0.48
15.40	25.98	0.48
17.60	25.98	0.48
19.80	25.98	0.48
22.00	25.98	0.48

Tailwater Channel Data - Pine Valley Road- Proposed Culvert

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 25.98 m

Roadway Data for Crossing: Pine Valley Road- Proposed Culvert

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 27.21 m

Roadway Surface: Paved

Roadway Top Width: 43.18 m

HY-8 Culvert Analysis Report
Proposed Culvert at Chainage 550- 50% Blockage Scenario

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 22.001 cfs

Maximum Flow: 22.001 cfs

Table 1 - Summary of Culvert Flows at Crossing: Pine Valley Road- Proposed Culvert

Headwater Elevation (m)	Total Discharge (cms)	Proposed Culvert at Chainage 550 Discharge (cms)	Roadway Discharge (cms)	Iterations
25.98	0.00	0.00	0.00	1
25.99	0.06	0.06	0.00	1
26.00	0.12	0.12	0.00	1
26.02	0.19	0.19	0.00	1
26.04	0.25	0.25	0.00	1
26.07	0.31	0.31	0.00	1
26.10	0.37	0.37	0.00	1
26.13	0.44	0.44	0.00	1
26.16	0.50	0.50	0.00	1
26.19	0.56	0.56	0.00	1
26.22	0.62	0.62	0.00	1
27.21	1.47	1.47	0.00	Overtopping

Table 2 - Culvert Summary Table: Proposed Culvert at Chainage 550

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	25.98	0.000	0.287	0-NF	0.000	0.000	0.480	0.480	0.000	0.000
0.06	0.06	25.99	0.086	0.291	3-M1t	0.103	0.054	0.480	0.480	0.087	0.000
0.12	0.12	26.00	0.136	0.304	3-M1t	0.157	0.088	0.480	0.480	0.173	0.000
0.19	0.19	26.02	0.177	0.324	3-M1t	0.200	0.119	0.480	0.480	0.260	0.000
0.25	0.25	26.04	0.215	0.348	3-M1t	0.238	0.143	0.480	0.480	0.346	0.000
0.31	0.31	26.07	0.249	0.375	3-M1t	0.272	0.166	0.480	0.480	0.433	0.000
0.37	0.37	26.10	0.285	0.404	3-M1t	0.304	0.187	0.480	0.480	0.519	0.000
0.44	0.44	26.13	0.320	0.434	3-M1t	0.333	0.207	0.480	0.480	0.606	0.000
0.50	0.50	26.16	0.355	0.464	3-M1t	0.361	0.227	0.480	0.480	0.692	0.000
0.56	0.56	26.19	0.390	0.494	3-M1t	0.388	0.243	0.480	0.480	0.779	0.000
0.62	0.62	26.22	0.423	0.523	7-M1t	0.413	0.259	0.480	0.480	0.865	0.000

****

Straight Culvert

Inlet Elevation (invert): 25.70 m, Outlet Elevation (invert): 25.50 m

Culvert Length: 42.66 m, Culvert Slope: 0.0045

****

Site Data - Proposed Culvert at Chainage 550

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 25.45 m

Outlet Station: 42.66 m

Outlet Elevation: 25.25 m

Number of Barrels: 1

Culvert Data Summary - Proposed Culvert at Chainage 550

Barrel Shape: Concrete Box

Barrel Span: 1500.00 mm

Barrel Rise: 750.00 mm

Barrel Material: Concrete

Embedment: 250.00 mm

Barrel Manning's n: 0.0120 (top and sides)

Manning's n: 0.0350 (bottom)

Culvert Type: Straight

Inlet Configuration: Square Edge (90º) Headwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: Pine Valley Road- Proposed Culvert)

Flow (cms)	Water Surface Elev (m)	Depth (m)
0.00	25.98	0.48
2.20	25.98	0.48
4.40	25.98	0.48
6.60	25.98	0.48
8.80	25.98	0.48
11.00	25.98	0.48
13.20	25.98	0.48
15.40	25.98	0.48
17.60	25.98	0.48
19.80	25.98	0.48
22.00	25.98	0.48

Tailwater Channel Data - Pine Valley Road- Proposed Culvert

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 25.98 m

Roadway Data for Crossing: Pine Valley Road- Proposed Culvert

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 27.21 m

Roadway Surface: Paved

Roadway Top Width: 43.18 m

Milldale Infrastructure Project 1 - Argent Lane

Proposed Channel from Culvert (at Chainage 550) - Catchment Summary

Date:
Produced by:
Checked by:

100-Year ARI Post-Development Catchment

Catchment	Total Area	Imperviousness	Impervious Area	Pervious Area	Peak Flow During 100-Year ARI Event
	ha	ha	ha	ha	m^3/s
Proposed Pine Valley Road Culvert	1.5450	90.0%	1.3905	0.1545	0.6231
Catchment on Eastern Side of Road (10-Year Flows)	0.2535	90.0%	0.2282	0.0254	0.0677
Total	**1.7985**	**90.0%**	**1.6186**	**0.1798**	**0.6908**

Milldale Development - Argent Lane

Date: 6/05/2020

Proposed Stream Channel from Culvert (at Chainage 550) -
Catchment on Eastern Side of Road TP108 Calculation

Produced by: HJL
Checked by: COS

24-Hour Design Rainfall Depth (mm)

2 Year ARI (mm)=	95.9
10 Year ARI (mm)=	164.1

Catchment Parameters

		CN	Ia	Tc
	Pervious	74	5	0.167
POST-DEVELOPMENT	Impervious	98	0	0.167

Area	Area	
	Total Area (ha)=	0.2535
	Imperviousness (%)=	90.0%
	Pervious Area (ha)=	0.0254
POST-DEVELOPMENT	Impervious Area (ha)=	0.2282

Peak Flow (m^3/s)

	2 Year ARI	10 Year ARI
POST-DEVELOPMENT	0.0386	0.0677

Runoff Volume (m^3)

	2 Year ARI	10 Year ARI
POST-DEVELOPMENT	219.3	388.9

Worksheet for Proposed Channel XS (Directly DS of Culvert)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.045	
Channel Slope	0.005	m/m
Constructed Depth	600.0	mm
Constructed Top Width	3.15	m
Discharge	623.10	L/s

Results

Normal Depth	476.7	mm
Flow Area	0.9	m^2
Wetted Perimeter	3.0	m
Hydraulic Radius	296.4	mm
Top Width	2.81	m
Critical Depth	299.8	mm
Critical Slope	0.036	m/m
Velocity	0.70	m/s
Velocity Head	0.02	m
Specific Energy	0.50	m
Froude Number	0.396	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.0	mm
Length	0.0	m
Number Of Steps	0	

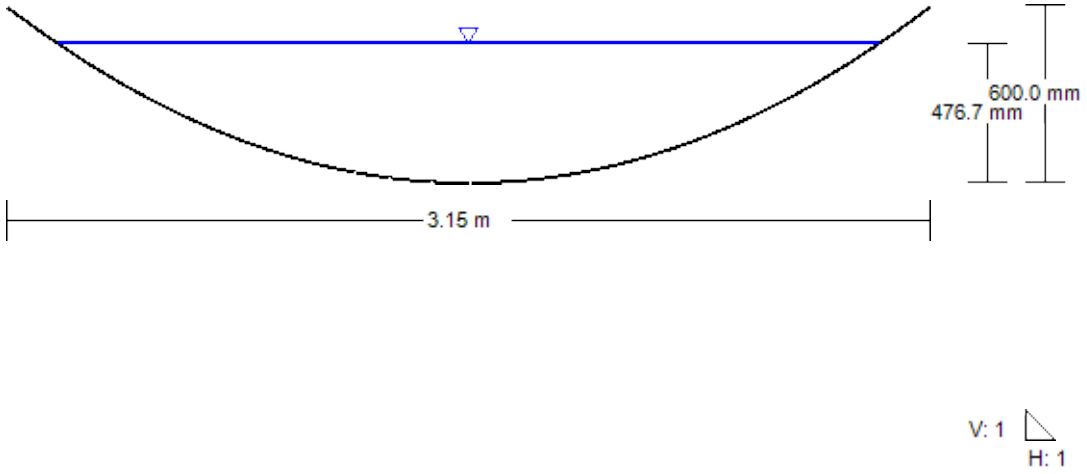
GVF Output Data

Upstream Depth	0.0	mm
Profile Description	N/A	
Profile Headloss	0.00	m
Downstream Velocity	0.00	m/s
Upstream Velocity	0.00	m/s
Normal Depth	476.7	mm
Critical Depth	299.8	mm
Channel Slope	0.005	m/m
Critical Slope	0.036	m/m

Cross Section for Proposed Channel XS (Directly DS of Culvert)

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.045
Channel Slope	0.005 m/m
Constructed Depth	600.0 mm
Normal Depth	476.7 mm
Constructed Top Width	3.15 m
Discharge	623.10 L/s



Worksheet for Proposed Channel (XS at End Proposed Channel)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.045	
Channel Slope	0.005	m/m
Constructed Depth	600.0	mm
Constructed Top Width	3.15	m
Discharge	690.80	L/s

Results

Normal Depth	500.4	mm
Flow Area	1.0	m²
Wetted Perimeter	3.1	m
Hydraulic Radius	310.1	mm
Top Width	2.88	m
Critical Depth	315.7	mm
Critical Slope	0.036	m/m
Velocity	0.72	m/s
Velocity Head	0.03	m
Specific Energy	0.53	m
Froude Number	0.398	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.0	mm
Length	0.0	m
Number Of Steps	0	

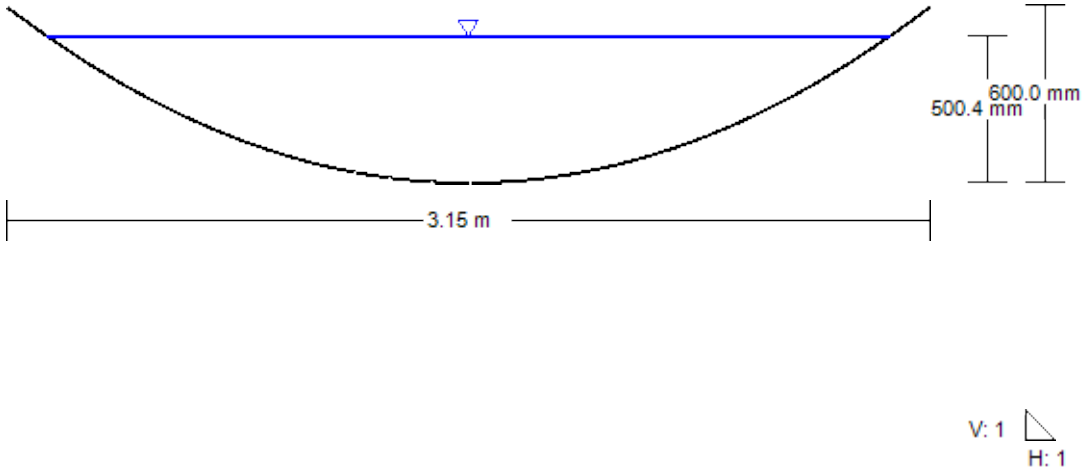
GVF Output Data

Upstream Depth	0.0	mm
Profile Description	N/A	
Profile Headloss	0.00	m
Downstream Velocity	0.00	m/s
Upstream Velocity	0.00	m/s
Normal Depth	500.4	mm
Critical Depth	315.7	mm
Channel Slope	0.005	m/m
Critical Slope	0.036	m/m

Cross Section for Proposed Channel (XS at End Proposed Channel)

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.045
Channel Slope	0.005 m/m
Constructed Depth	600.0 mm
Normal Depth	500.4 mm
Constructed Top Width	3.15 m
Discharge	690.80 L/s



C. Argent Lane Floodplain Assessment

WatRes Consulting

To:	**Carmel O'Sullivan (Mott MacDonald NZ)**	**Job:**	**Pine Road Valley – Stormwater Modelling**
From	**Ajay Desai**	**Date:**	**30/04/2020**
CC	**Devon Rollo (Mott MacDonald NZ)**		
Subject:	**Pine Road Valley – Stormwater Modelling – Technical memo**		

1. Background

Watres Consulting Ltd (WCL) was commissioned by Mott MacDonald (Motts) to undertake Stormwater hydraulic modelling to support the ongoing work that Motts are completing for Auckland Transport (AT). AT are proposing to widen part of Dairy Flat Highway and Pine Valley Road to create a cycleway and footpath. Widening of the road will result in road embankment being located within the floodplain and assessment if required by Healthy Waters (HW) team at Auckland Council to understand if the road embankment being located within the floodplain impacts on flood levels.

2. Objectives

The objective of this assessment is to develop a local hydraulic model using Healthy Waters Silverdale South Stormwater catchment to assess the differences in flood results with the proposed earthworks by AT along Dairy Flat Highway and Pine Valley Road.

All flood models, results and supporting files are provided with this memo.

3. Methodology, scope and requirements

The methodology followed in this work package is set out below:

1. Update Silverdale South Stormwater catchment model (Council model) to include the existing culvert under Pine Valley Road that has been recently surveyed by Woods Consultants
2. Develop a local pre-development model using Council model based on overland flow paths and flood results from Silverdale South model results in InfoWorks ICM v10.5.2
3. Define boundary conditions for upstream inflows and downstream water level boundaries based on the Council model
4. Run the local pre-development model for 10yr and 100yr Maximum Probable Development (MPD) with Climate Change (CC) scenarios
5. Update the local pre-development model to incorporate the proposed terrain along Dairy Flat Highway and Pine Valley Road to represent the post development terrain
6. Run the local post-development model for 10yr and 100yr Maximum Probable Development (MPD) with Climate Change (CC) scenarios
7. Generate water level difference plots comparing pre and post development scenarios for 10yr and 100yr MPD with CC scenarios
8. Extract flows through the culvert under Pine Valley Road for above scenarios and overland flows across Pine Valley Road
9. Document the findings of the assessment

4. Hydraulic Modelling

4.1 Pre-Development modelling

Auckland Council currently holds a Mike by DHI (v2014) Stormwater models for the Silverdale South catchment which is a Classic Grid model and takes over 7 – 10days to run a simulation. It was discussed with Healthy Waters and agreed to update the model to Flexi – Mesh approach to reduce model extents and run times. This trimming was based on –

- Overland flow paths
- Model results available for Council model for 10yr and 100yr MPD with CC scenarios

This Flexi – mesh approach was adopted for modelling using InfoWorks ICM using inputs from Council model are shown in Figure 1 below.

The model changes are listed below –

- The pre-development terrain from Council model was updated with recently completed topographical survey in the vicinity of proposed work extents around Pine Valley Road
- The culvert under Pine Valley Road was modelled based on survey data and applied with culvert inlet for appropriate losses
- 2D mesh was developed using the trimmed model extent shown below with a maximum element size of $4m^2$ and minimum element size of $2m^2$
- This was further refined within the flooded area upstream with a maximum element size of $3m^2$ and minimum element size of $1m^2$
- The proposed site extent and area enclosed Pine Valley Road and Northern Motorway was modelled with a finer mesh with a maximum element size of $2m^2$ and minimum element size of $2m^2$
- Two Inflows were applied as source points discharging on the 2D mesh with downstream water level boundary applied as a level file
- Spatially varying rainfall from Council model was represented using 3 rainfall zones and rainfall intensities were extracted from the dfs2 files as shown in Figure 1
- Roughness zones were modelled based on building footprints and impervious layers as per Council model with following Manning's M (1/n) roughness values:
    - Buildings – 1.0 (applied as roughness zone)
    - Impervious Areas – 0.05 (applied as roughness zone)
    - Everywhere else – 0.1 (applied to 2D mesh)
- Eddy viscosity of 0.4 was applied to the 2D mesh as per the Council model
- Existing culvert under Northern Motorway also modelled based on data available from Silverdale South model along with culvert inlet for appropriate losses
- All other inputs and modelling parameters were modelled as per the Council model

Pre-Development model was run for the following scenarios using the rainfall file provided with the Silverdale South models –

- Hotstart
- MPD with CC 10yr
- MPD with CC 100yr

Hotstart was run for 32hrs followed by the storm events for further 8hrs as per the Council model

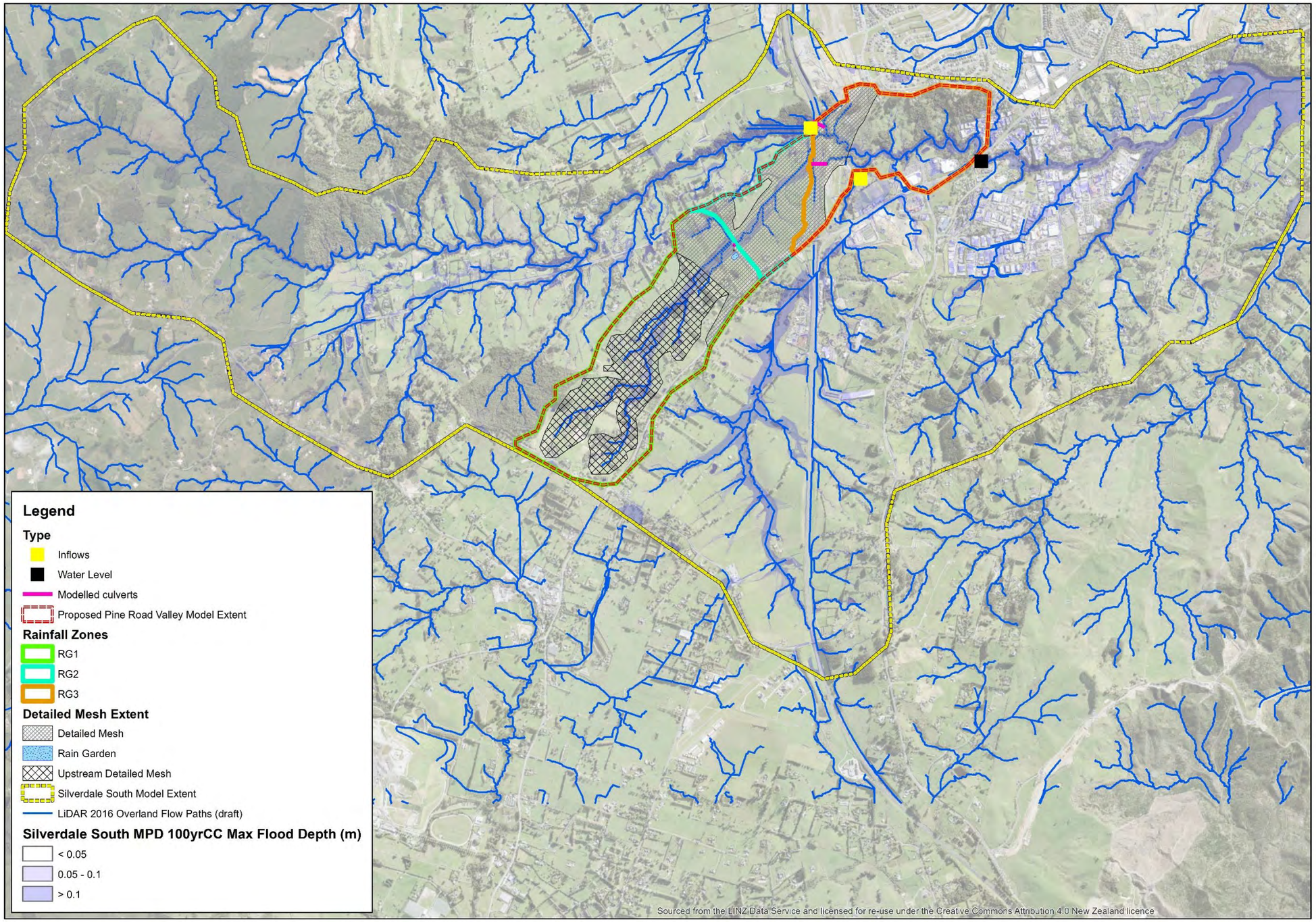


Figure 1: Model Extents and Boundary conditions

4.2 Post Development modelling

The pre-development model was updated with the proposed terrain along Pine Valley Road to develop the post-development terrain data. The proposed rain garden was modelled as a mesh zone along with the outlet arrangement modelled with the proposed pipe network.

There were no other changes undertaken with the post-development model.

The model was run for the following scenarios –

- Hotstart
- MPD with CC 10yr
- MPD with CC 100yr

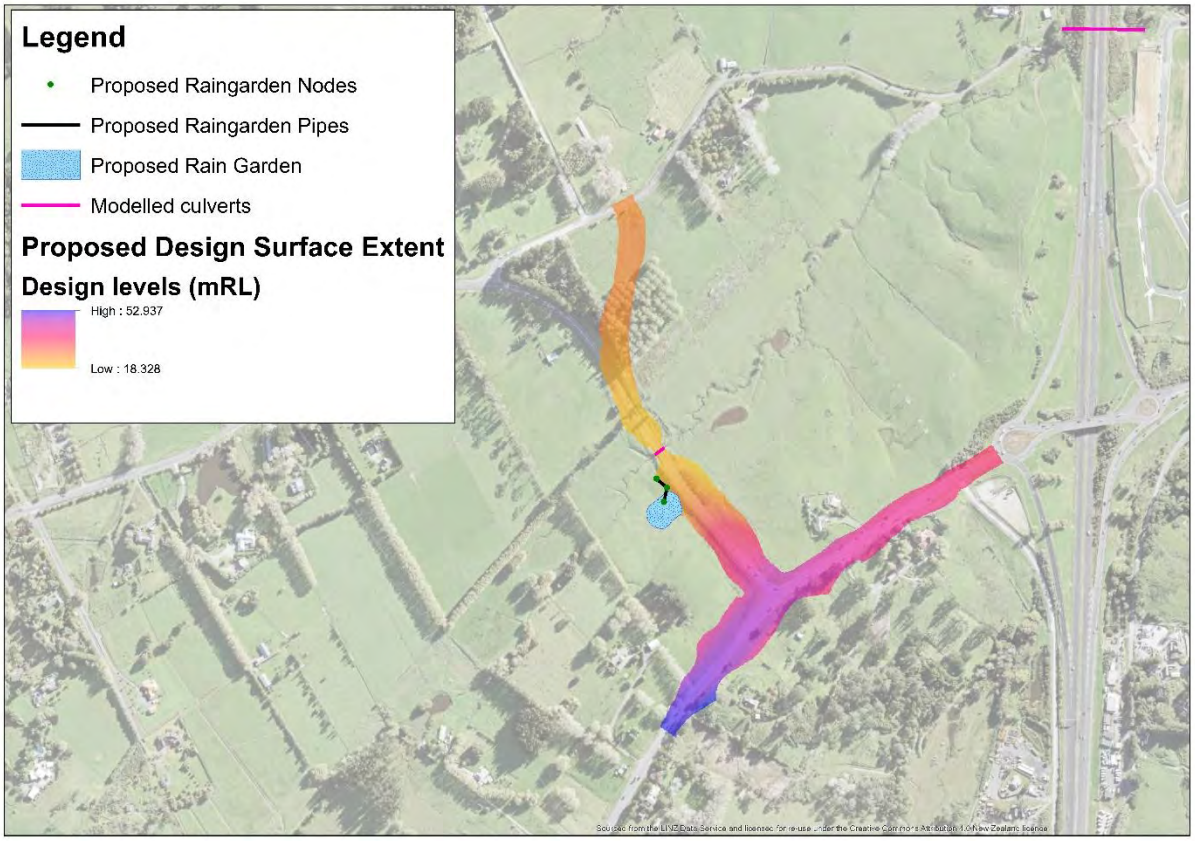


Figure 2: Proposed Development extent

5. Modelling results

The pre and post development models results were analysed for the 10yr and 100yr scenarios as follows –

- Water level differences
- Flood extent differences (filtered for 50mm for rain on grid models)
- Flow differences through the culvert under Pine Valley Road
- Overland flow across Pine Valley Road

Figures 3 - Figure 6 provide the comparison of water levels and flood extents for modelled scenarios.

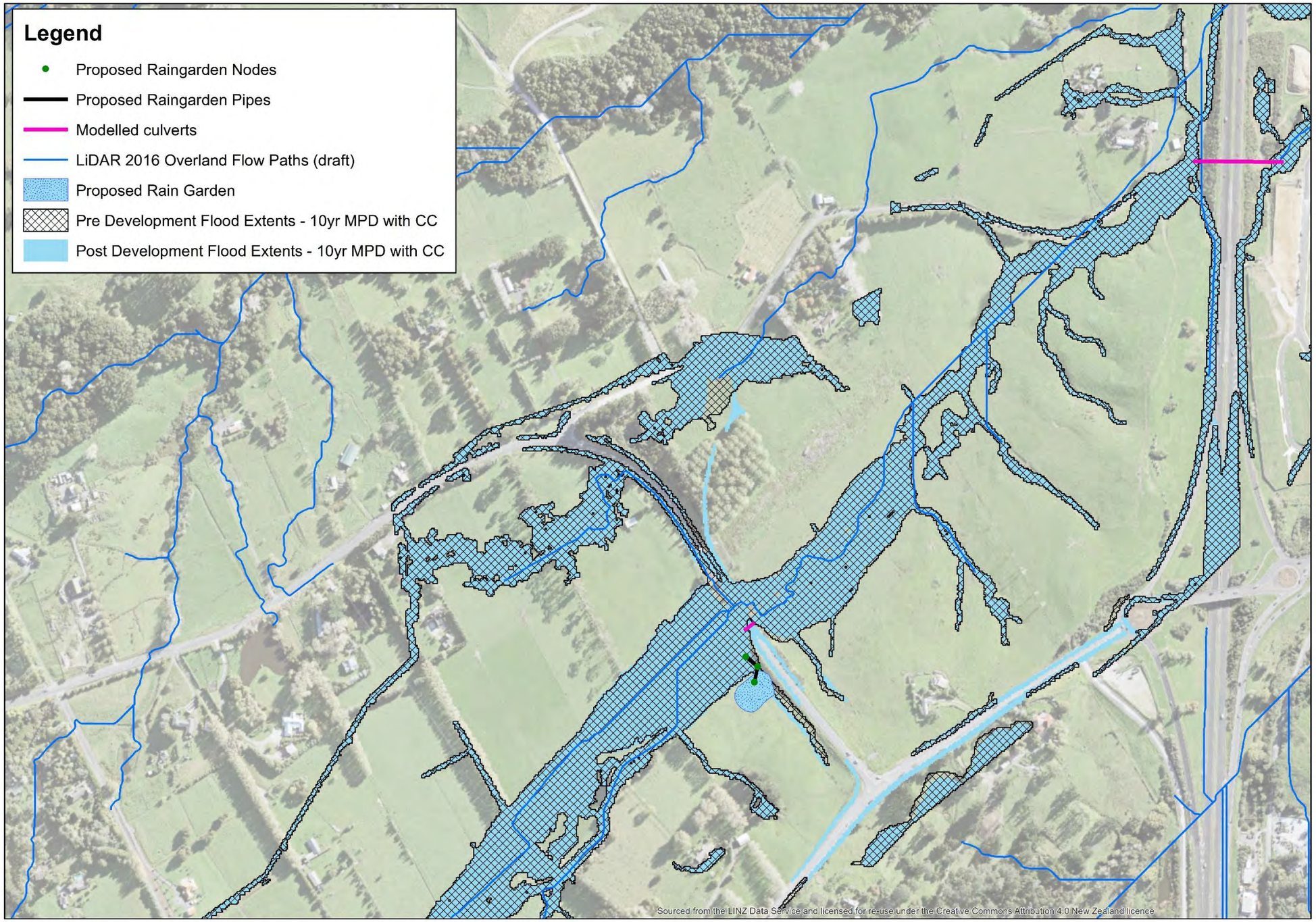


Figure 3: Flood Extent Comparison – 10yr MPD with CC

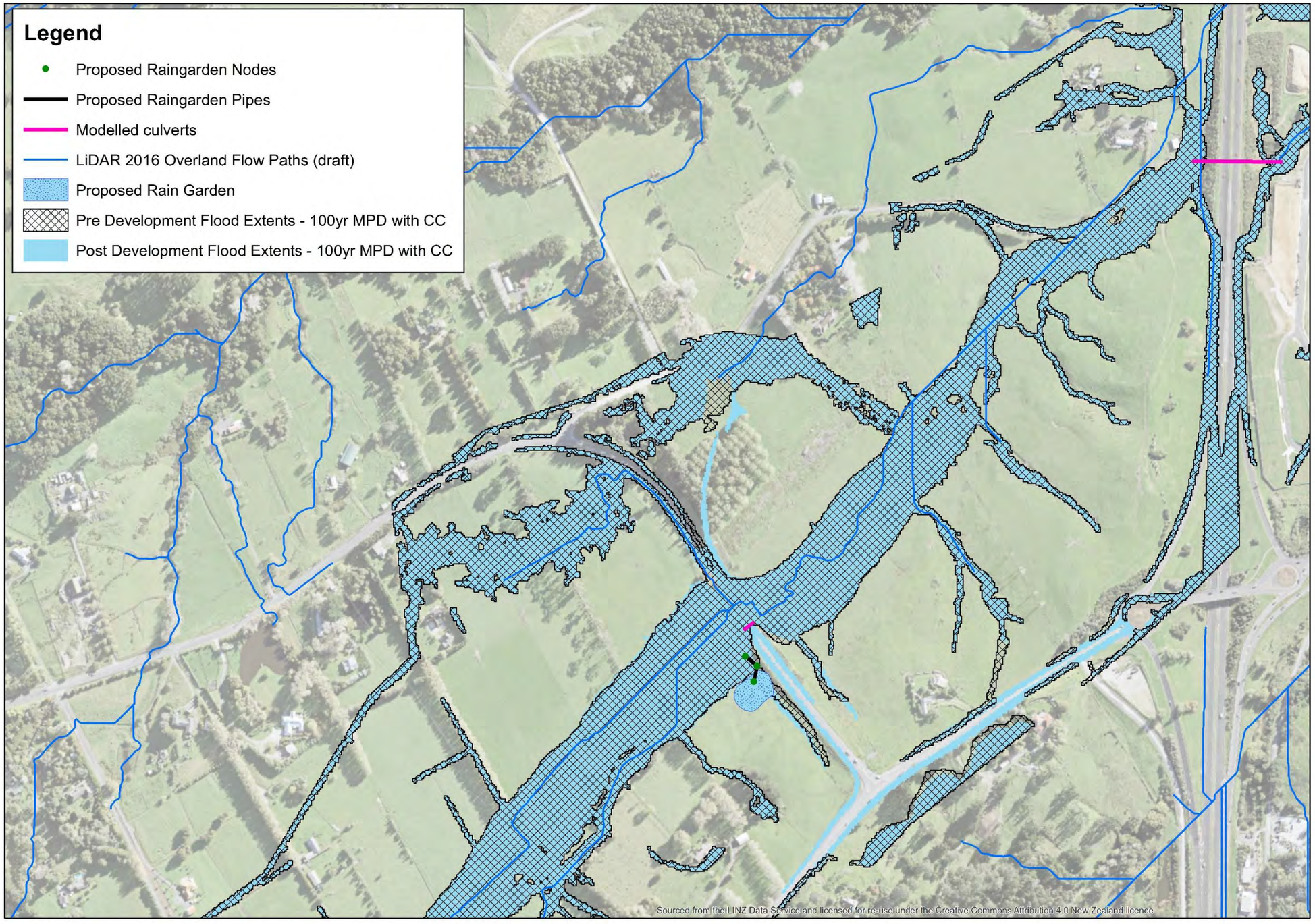


Figure 4: Flood Extent Comparison – 100yr MPD with CC

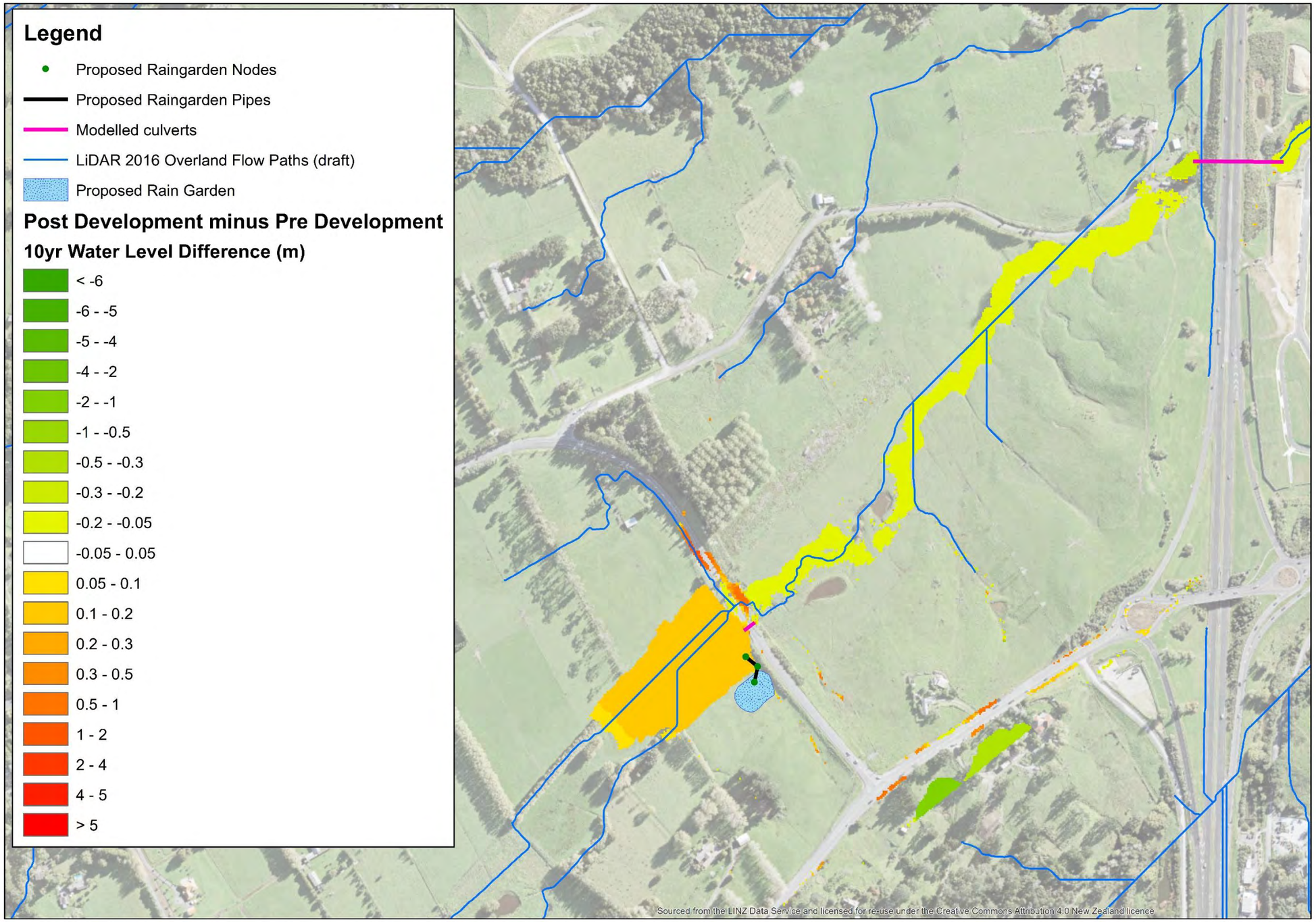


Figure 5: Water Level Differences – 10yr MPD with CC

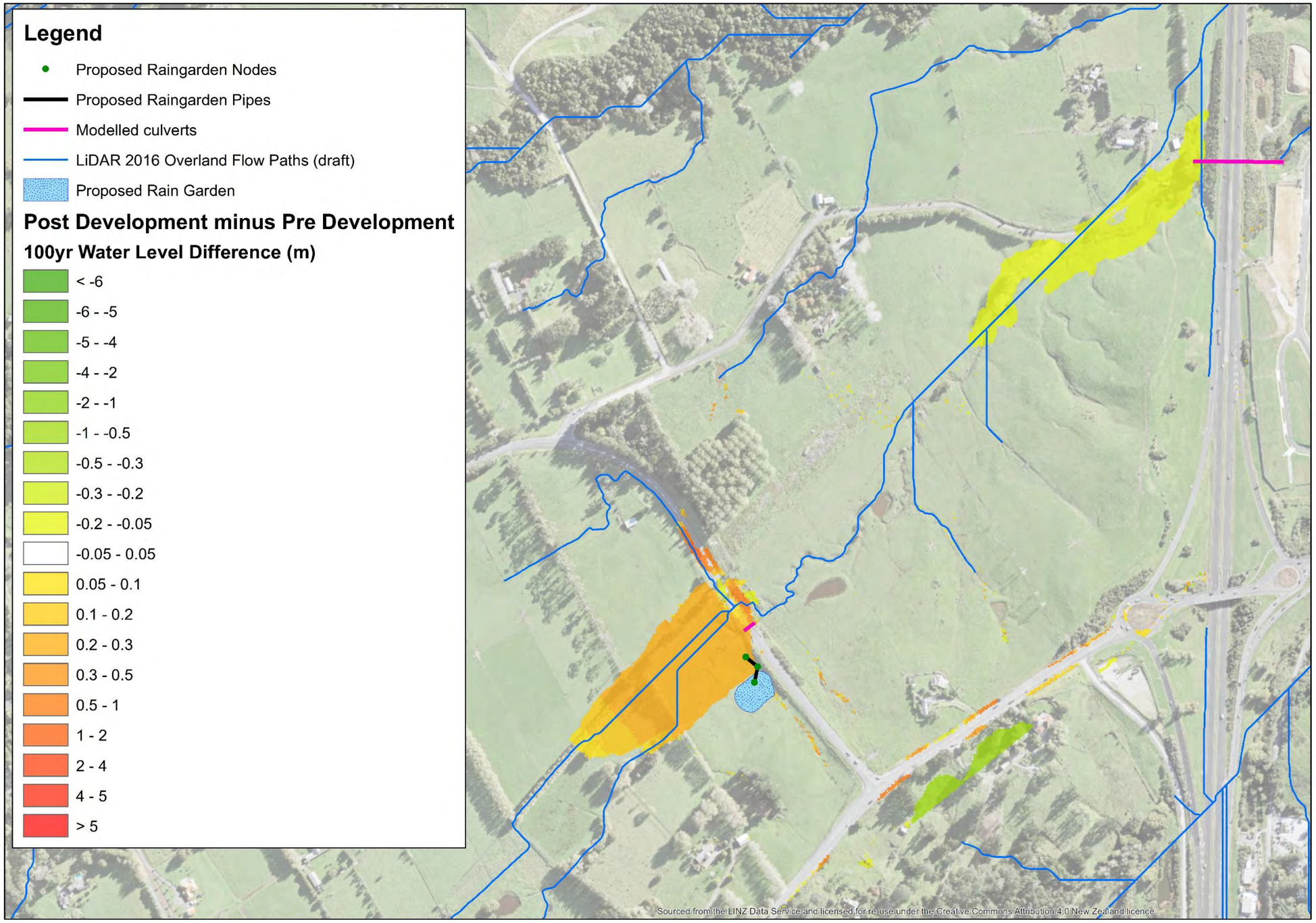


Figure 6: Water Level Differences – 100yr MPD with CC

Table 1 below provides the pre and post development flood levels for the modelled scenarios.

Location	Pre-Development		Post-Development		Post Development minus Pre-Development	
	10yr MPD with CC	100yr MPD with CC	10yr MPD with CC	100yr MPD with CC	10yr MPD with CC	100yr MPD with CC
Upstream of Pine Road Valley Road	20.87	21.10	21.05	21.37	0.18	0.27
Downstream of Pine Road Valley Road	18.64	18.89	18.59	18.87	-0.05	-0.02
Upstream of Motorway culvert	12.19	14.29	12	14.12	-0.19	-0.17
Downstream of Motorway culvert	9.63	9.97	9.53	9.95	-0.1	-0.02

Table 1: Model Results

The flood extents upstream of Pine Valley Road within the Area of Analysis shown in Figure 7 have been calculated and tabulated in Table 2 below.

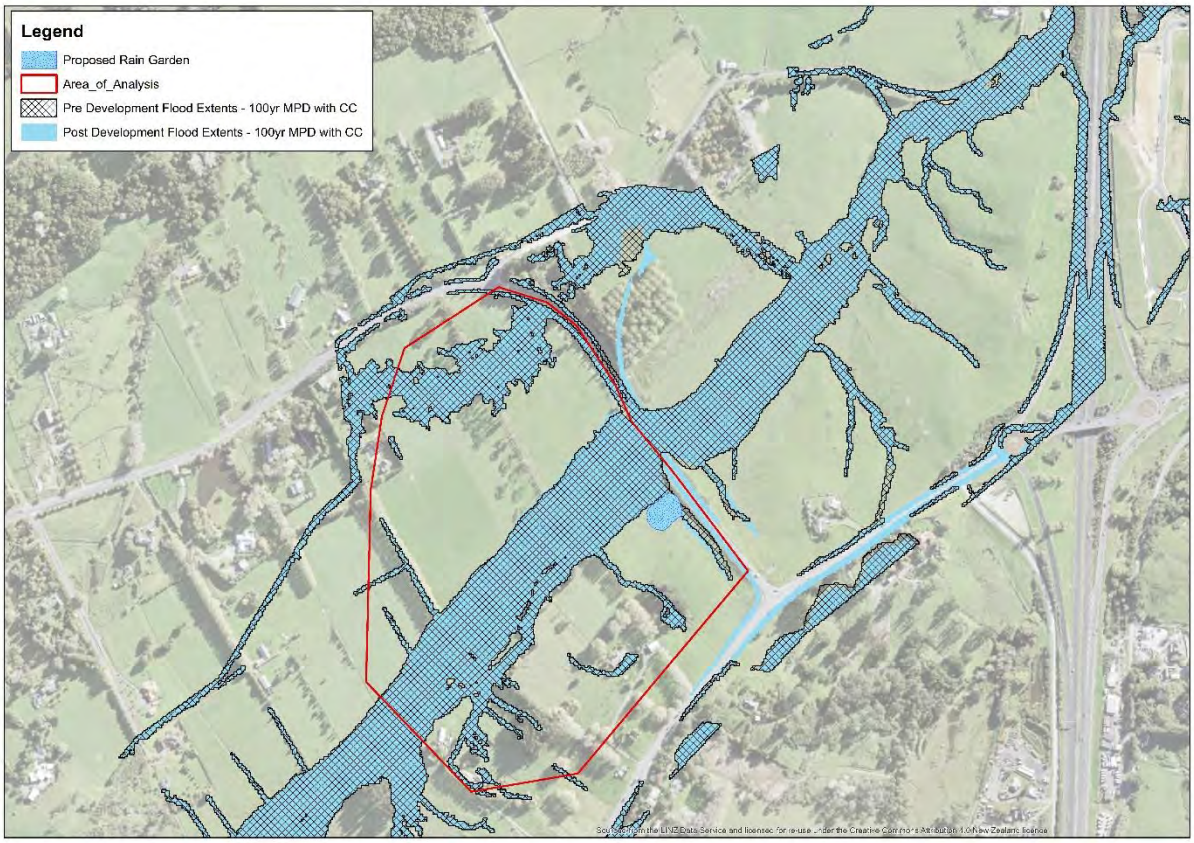


Figure 7: Flood Extents – Area of Analysis

Pre-Development Flood extents (m^2)		Post-Development Flood extents (m^2)		Post Development minus Pre-Development			
				Increase in Flood Extents (m^2)		Increase in Flood Extents (%)	
10yr MPD with CC	100yr MPD with CC	10yr MPD with CC	100yr MPD with CC	10yr MPD with CC	100yr MPD with CC	10yr MPD with CC	100yr MPD with CC
71648	85228	72873	87345	1225	2117	1.70%	2.50%

Table 2: Flood Extent comparison

The flows at Pine Valley Road are compared in Table 3 below.

Location	Pre-Development Flows (m^3)		Post-Development Flows (m^3)	
	10yr MPD with CC	100yr MPD with CC	10yr MPD with CC	100yr MPD with CC
Culvert Flows	9.8	12	10.4	13.6
Overland flow	4.5	16.4	2.2	15.1
Total Flows	**14.3**	**28.4**	**12.6**	**28.8**

Table 3: Model Flows

6. General Model Limitations

- The quantitative accuracy of the results from any modelling is dependent on a range of factors, including the quality of the input data, the modelling methodology, the resolution of the model and the available measured data for the validation.
- All limitations associated with Healthy Waters Silverdale South model (Council model) are applicable to these models as the model parameters were retained while converting and trimming the model from Mike by DHI to InfoWorks ICM
- Survey undertaken is limited to the project area around Pine Valley Road and includes the culvert under the road
- The Silverdale South model is based on LiDAR 2013 data has an absolute vertical accuracy of +/- 0.10m. Deviations in vertical accuracy can occur in areas of dense vegetation. Below water ground levels are not reliably represented in the LiDAR data.
- Boundary conditions are extracted from Council models only and there is no measured flow data for applied inflows
- The mesh resolution is kept similar to the Council model with maximum area retained to a maximum of $4m^2$ and further refined in area on interest around Pine Valley Road
- The model is considered fit for purpose for planning and development control purposes and could also be used for comparative assessments for engineering options around Pine Valley Road only
- There was no model validation carried out as a part of this study

7. Modelling files

All modelling files are provided in an InfoWorks ICM icmt file generated using InfoWorks ICM v10.5.2 and includes the DEM surfaces and results for pre and post development scenarios.

Model Files	Names	Comments
InfoWorks ICM	SilverdaleSouth_PineValleyRd.icmt	Icmt file with all modelling files including results and DEM data
	SilverdaleSouth_PineValleyRd_ NoResults_NoDEM.icmt	Icmt file without all modelling files including results and DEM data
Network	Silverdale_South_Trimmed	
Scenarios	Base	Not validated or used for model runs
	PreDev	Pre-Development scenario
	PostDev	Post-Development scenario
DEM (topography)	SilverdaleDem_Lidar2013_Survey	Pre-Development scenario terrain (includes recent survey around Pine Valley Road)
	SilverdaleDem_Lidar2013_Survey_Design	Post-Development scenario terrain (includes recent survey around Pine Valley Road as well as proposed design surface)
Inflows	Inflow10yr	Same for pre and post development scenarios
	Inflow100yr	
Levels	Level10yr	Same for pre and post development scenarios
	Level100yr	
Rainfall	10yrCC	Same for pre and post development scenarios extracted from Silverdale South model (Maximum Probable Development with Climate Change uplift)
	100yrCC	
Model Runs	Hotstart	Run separately for pre and post development scenarios
	Pre10yr	Pre-Development scenario – 10yr Maximum Probable Development with Climate Change uplift
	Pre100yr	Pre-Development scenario – 100yr Maximum Probable Development with Climate Change uplift
	Post10yr	Post-Development scenario – 10yr Maximum Probable Development with Climate Change uplift
	Post100yr	Post-Development scenario – 100yr Maximum Probable Development with Climate Change uplift

D. Email Correspondence with Healthy Waters

Law, Hannah J

From: Kevin Fan <Kevin.Fan@aucklandcouncil.govt.nz>
Sent: Tuesday, 21 April 2020 1:22 PM
To: O'Sullivan, Carmel
Cc: Ajay Desai; Law, Hannah J; Rollo, Devon C; Ken Tomkins
Subject: RE: Pine Valley Road Widening Project - Meeting with Pine Valley Catchment Planner

Hi Carmel

The modelling approach and modelled scenarios are fine for me. I don't think there are necessities to provide mitigation, however we would like to see the causing of flood level increasing and the requirements of the culvert upgrade. Council's consent team may need a more clear picture of flood level increased. Would it be possible to provide the following additional information in your report:

1) The capacity of existing culvert, the likely culvert size to be upgraded.
2) The volume of the natural storage area reduced from the Widening project.
3) The area of the flood extent increased.

Kind regards

Kevin Fan | **Senior Healthy Waters Specialist**
Healthy Waters | Infrastructure & Environmental Services
Mobile +64 21 872 643
Auckland Council, Level 3 South, 24 Wellesley Street, Auckland Central
Visit our website: www.aucklandcouncil.govt.nz

From: O'Sullivan, Carmel <Carmel.O'Sullivan@mottmac.com>
Sent: Tuesday, 21 April 2020 9:43 AM
To: Kevin Fan <Kevin.Fan@aucklandcouncil.govt.nz>
Cc: Ajay Desai <ajay.desai@watresconsulting.com>; Law, Hannah J <Hannah.Law@mottmac.com>; Rollo, Devon C <Devon.Rollo@mottmac.com>
Subject: RE: Pine Valley Road Widening Project - Meeting with Pine Valley Catchment Planner

Hi Kevin

The existing council model did not have a culvert in the model at the point of interest (1731 Dairy Flat Highway). We understand (from survey carried out by Woods) that there is a 3m dia culvert at this location. I have seen the culvert myself but (unfortunately) never measured it. I can provide a picture of it to you if that would be helpful?

Ajay inserted the culvert in the model and assessed flood levels upstream and downstream of the culvert. This is considered to be the pre-dev scenario. He then inserted the proposed road embankment into the model and assessed flood levels upstream and downstream of the culvert. We have called this the post-development scenario.

The pre + post dev flood levels have been provided in the table below. The difference between the pre + post flood levels can also be seen in the table below.

Flood maps showing the difference in flood extents between the pre + post scenarios have been attached. Because there is minimal difference in flood extents between the pre + post dev scenarios we consider that the effect of the proposed works (ie road widening to enable construction of a footpath + cycleway) is negligible. Therefore, we consider that the provision of replacement flood plain storage is not required in this case.

The stream invert is about 18mRL (based on Woods survey). The depth of flow in the vicinity of the culvert is therefore about 3m. An increase in flood depth of 200-300mm is considered to be minor when considered against a flood depth of 3m.

It should be noted that the proposed road works are being carried out as part of a suite of infrastructure upgrades involving Auckland Council, Auckland Transport, Watercare, the government through CIP and developers to support and enable the provision of required housing growth.

Given that there is a negligible increase in flood extents + that the purpose of the proposed works is to enable growth we therefore request that replacement flood plain storage not be required to be provided.

With respect to the model build please note that Ajay used a cut down model with inflows and boundary conditions from the Silverdale catchment. He has a

1. Pre Development model with culvert under Pine Valley Road included – 10yr and 100yr
2. Post Development model with design surface and rain garden (includes culvert under Pine Valley Road) – 10yr and 100yr

The purpose of this email is to get your feedback on whether you are comfortable with not providing mitigation storage. Once the modelling is complete we will provide the model + supporting documentation (model memo) to you for review. I'm really sorry to ask but we would really appreciate if you could give us your feedback this week. I do realise that you have a lot on as there are only 3 of you trying to cover all dev queries for the Auckland Region as well as do your own work.

Please contact Ajay if you have any queries about the modelling. I can (hopefully!) answer any other queries. Also, please let me know if you need further info. Thank you

Location	Pre Development		Post Development		Post Developmen Developm	
	10yr MPD with CC	100yr MPD with CC	10yr MPD with CC	100yr MPD with CC	10yr MPD with CC	
Upstream of Pine Road Valley Road	20.94	21.14	21.14	21.41	0.2	
Downstream of Pine Road Valley Road	18.93	19.18	18.88	19.17	-0.05	
Upstream of Motorway culvert	13.68	15.30	13.58	15.19	-0.1	
Downstream of Motorway culvert	9.66	9.83	9.65	9.83	-0.01	

Best Regards

Carmel O'Sullivan
Principal Civil Engineer

D 00 64 9 973 7454 M 00 64 21 081 22294
carmel.o'sullivan@mottmac.com

From: Kevin Fan <Kevin.Fan@aucklandcouncil.govt.nz>
Sent: Thursday, 9 April 2020 3:22 p.m.
To: O'Sullivan, Carmel <Carmel.O'Sullivan@mottmac.com>
Cc: Ajay Desai <ajay.desai@watresconsulting.com>
Subject: RE: Pine Valley Road Widening Project - Meeting with Pine Valley Catchment Planner

Hi Carmel

Change the model to flexi mesh is fine for me.

Kind regards
Kevin Fan

From: O'Sullivan, Carmel <Carmel.O'Sullivan@mottmac.com>
Sent: Thursday, 9 April 2020 1:16 PM
To: Kevin Fan <Kevin.Fan@aucklandcouncil.govt.nz>
Cc: Ajay Desai <ajay.desai@watresconsulting.com>
Subject: FW: Pine Valley Road Widening Project - Meeting with Pine Valley Catchment Planner

Hi Kevin

Sorry to bother you again.

With respect to my email below is it acceptable to you to change the model to flexi mesh? I understand from Ajay that the model run time (with classic grid) is about a week.

Thanks
Best Regards
Carmel

Carmel O'Sullivan

mottmac.com