DELMORE

STORMWATER INFRASTRUCTURE

Vineway Ltd

MCKENZIE & CO.

DOCUMENT CONTROL RECORD

PROJECT: Delmore

CLIENT: Vineway Ltd

PROJECT LOCATION: 53A, 53B & 55 Russell Road and 88, 130 & 132 Upper Ōrewa Road

Revision	Date	Originator	Checker	Approver	Description
A	17/12/24	JDK	JDK	JDK	Draft
B	07/02/24	JDK	RR	JDK	Resource Consent
C	10/02/24	JDK	RR	JDK	Resource Consent
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E	18/02/25	JDK	JDK	JDK	Resource Consent
F	02/07/2025	JDK	JDK	JDK	Resource Consent

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Engineering drawings attached separately.

1. EXECUTIVE SUMMARY

McKenzie & Co. Consultants has prepared this Stormwater Infrastructure Report to support Vineway Ltd.'s proposed 109-hectare residential development in Ōrewa, comprising approximately 1,250 lots. The report focuses on stormwater management, with related topics (e.g., earthworks, road access, water supply) covered in separate documents.

Regulatory & Design Framework

The stormwater network design aligns with relevant legislation and Auckland Council standards, including the Building Act, Auckland Unitary Plan, Stormwater Code of Practice (V4), Auckland Council's Regional Network Discharge Consent (NDC), and guidance documents like GD001, TP108, and TR 2013/018. Climate change projections of 2.1° for the 10% Annual Exceedance Probability (AEP) event, and 3.8° temperature increase 1% AEP event.

Existing Conditions

Currently, no public stormwater infrastructure is available on-site. The area is predominantly pastoral with pine plantation and covenanted bush areas, drained by several natural streams and wetlands. These features will remain protected where possible, with new culverts replacing outdated farm culverts and ensuring ecological connectivity.

Proposed Stormwater Management

Quality, Retention, & Detention: Low contaminant generating building materials, on lot tanks and raingardens, are proposed for lots. Gross pollutant traps (GPTs) & communal raingardens are proposed to treat runoff from roads and Joals.

Primary & Secondary Systems: Lots fronting streams will discharge direct to the streams. A new primary network of catchpits and pipes will manage flows up to the 10% AEP event, while secondary OLFPs within road reserves will handle 1% AEP events.

Culvert Crossings: Multiple box culverts and two circular culverts are designed to be embedded 25% below the streambed, with riprap to reduce erosion and maintain natural flow regimes.

Flood Management & Overland Flow: The design ensures no significant adverse flooding effects upstream or downstream, with proposed building platforms set above modelled flood levels and climate-change-adjusted flows.

Operations & Maintenance
Maintenance access is integrated into the design for culverts, raingardens, and riprap areas. Periodic checks, especially after major storms, will safeguard infrastructure performance and water quality.

Discharge Consent

A stormwater discharge consent will be required for discharges from the development. In the future if the land becomes zoned from Future Urban Zone to a residential zone, it is anticipated that the area will eventually be adopted into Auckland Councils Regionwide Stormwater Network Discharge Consent (NDC). The infrastructure has been designed with this in mind, with an accompanying draft Stormwater Management Plan that can be adopted as part of this process.

Conclusion

The proposed stormwater solution balances development needs with environmental protection, adhering to Auckland Council requirements and best-practice engineering. With careful consideration of flood risk, water quality, and climate change, the design will provide a robust and sustainable stormwater network for the new residential community.

2. INTRODUCTION

McKenzie & Co. Consultants have been engaged by Vineway Ltd to provide a Stormwater infrastructure report in support of the proposed 109Ha development located at 53A, 53B & 55 Russell Road and 88, 130 & 132 Upper Ōrewa Road, Ōrewa. The development is a residential development for approximately 1250 lots.

This report is prepared in support of Ltd.'s resource consent application for approvals under the Fast-track Approvals Act 2024 by addressing the key stormwater matters that relate to this proposal. It is important to note that this report only covers stormwater, while other infrastructure matters, including earthworks, sediment, and erosion control, roading and access, wastewater, water supply and utility works are addressed in separate Infrastructure reports.

The primary objective of this stormwater infrastructure report is to demonstrate how the proposed system is designed to manage stormwater runoff to minimise flood damage and adverse effects on both the built and natural environments.

To fully comprehend this report, it should be read together with the consent application, plan drawings, and other supporting documents referred to in this report.

3. LEGISLATION, CODES OF PRACTICE, & STANDARDS

The stormwater system has been designed in accordance with the below requirements, and reports:

- Building Act 2004
- NIWA Climate Projections for Auckland Region, 2020
- Auckland Unitary Plan

  - E1 Water quality and integrated management
  - E8 Stormwater – Discharge and diversion
  - E9 Stormwater quality – High contaminant generating car parks and high use roads
  - E10 Stormwater management area – Flow 1 and Flow 2
  - E36 Natural hazards and flooding
- Stormwater Code of Practice, V4
- Auckland Councils' Regional Network Discharge Consent (NDC)
- TP108 – Guidelines for Stormwater runoff modelling in the Auckland Region
- GD001 – Stormwater management devices in the Auckland region
- TR 2013/018 – Hydraulic Energy Management: Inlet and Outlet Design for Treatment Devices
- Auckland Transport TDM
- McKenzie & Co Flood Assessment Report, 2025
- NZS4404:2010
- National Policy Statement for Freshwater Management 2020 (updated 2024)
- New Zealand Coastal Policy Statement 2010
- Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011
- Resource Management (National Environmental Standards for Freshwater) Regulations 2020
- National Adaptation Plan (MfE, 2022)
- Health and Safety at Work Act 2015

4. SITE DESCRIPTION

The proposed development site is legally described as Lot 1 DP 336616, Lot 1 DP 497022 & Lot 2 DP 497022, Lot 2 DP 418770, Lot 1 DP 153477 & Lot 2 DP 153477, as illustrated in Figure 1 below. The site is zoned as Future Urban area.

The development is accessed from Grand Drive in the northeast, and Russell Road and Upper Ōrewa Road from the south.

Currently, the site is used for agricultural purposes with livestock roaming across a significant portion of the site. Some bush areas subject to consent notices that are generally proposed to remain, and a pine tree stand in the northeast corner of the site.

The location of the development is shown below in Figure 1.

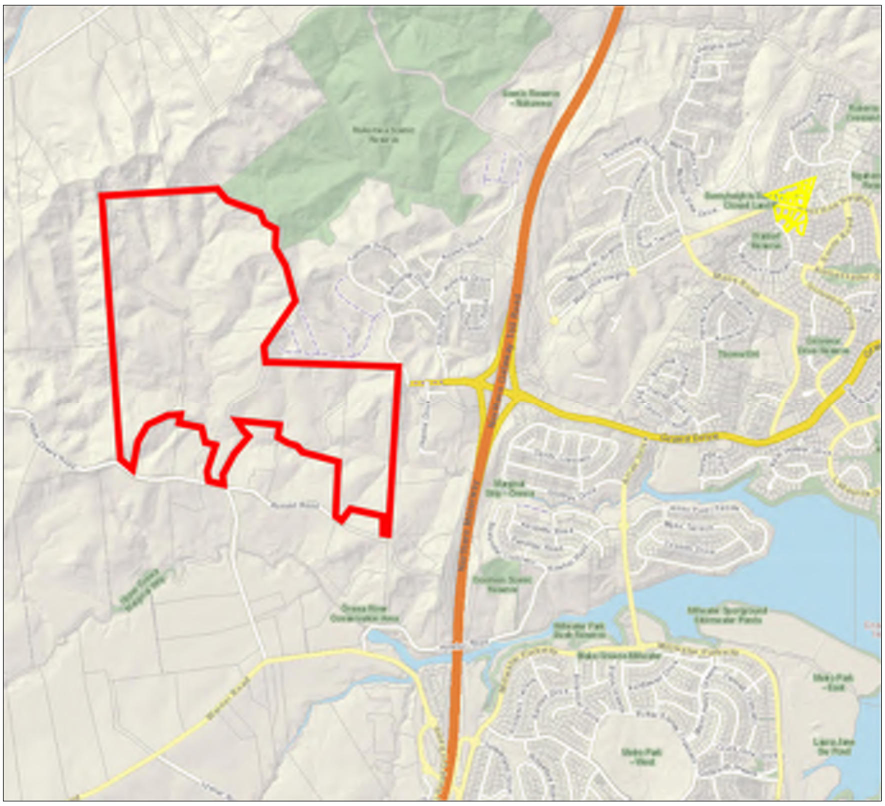


Figure 1 - Site Location – Extent of affected properties

5. EXISTING STORMWATER INFRASTRUCTURE

There is currently no public stormwater infrastructure within the site or available for connection at the boundary.

The development is fully contained within the Ōrewa West catchment, as shown below in Figure 2.

Several smaller sub-catchments within this catchment, contain several streams discharging into a single stream which flows out of the site at a single discharge point. The streams have been mapped and assessed by Viridis[1], and are shown in Figure 3. The sub-catchments are shown in Figure 4.

[1] Viridis Ecological Impact Assessment December 2024, Ref : 10122-002-A .

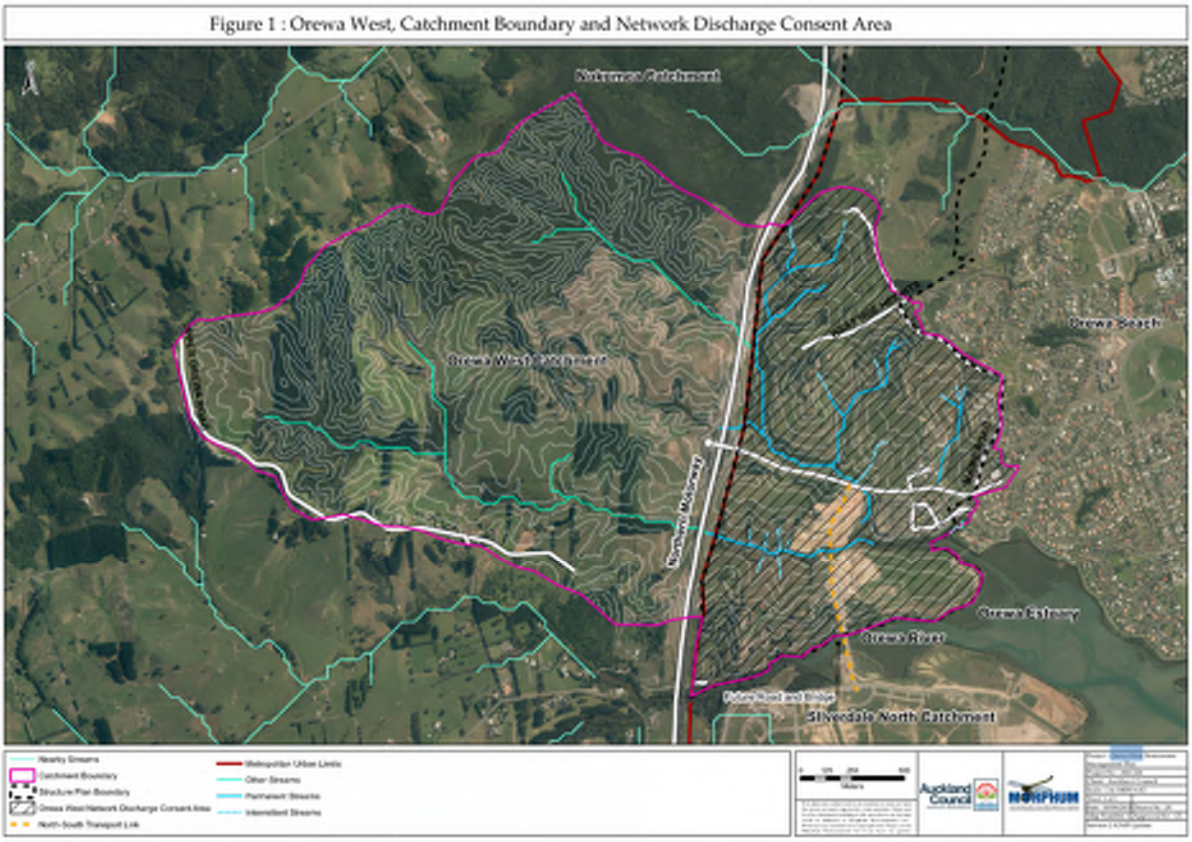


Figure 2 – Ōrewa West Catchment

The streams have existing driveway and farm culvert crossings and associated natural wetlands at various locations throughout the development. They also contain a network of natural wetlands. All wetland features and streams have been mapped, by Viridis consultants.

The existing farm culverts will be removed during the construction process to enable the streams to be reinstated to their original alignment and cross section.

Streams 31 & 38 comprise the main channel, which flows to the East to the lowest point of the catchment. The streams are shown below in Figure 3. This stream flows from West to the East, passes under State Highway 1, and discharges out to the upper reaches of the Ōrewa Harbour.

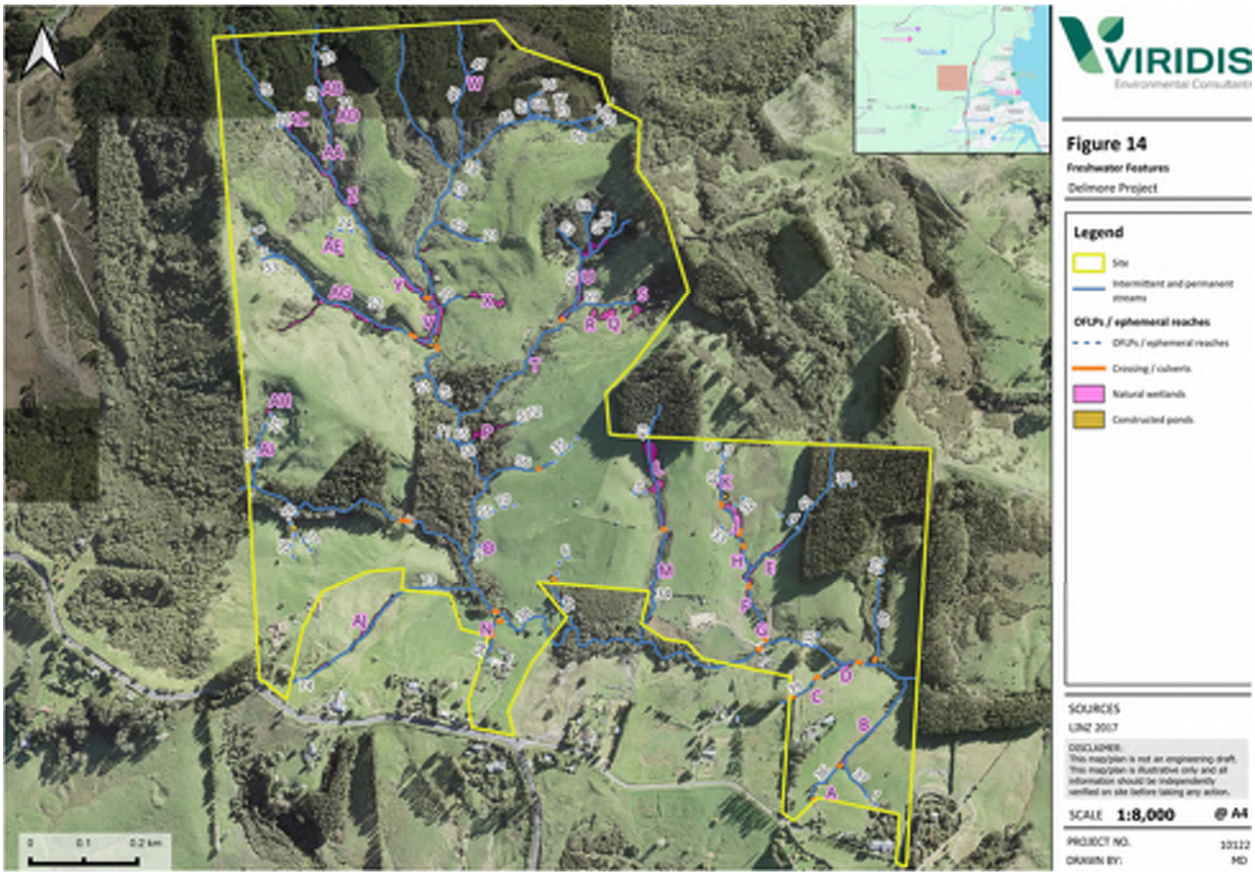


Figure 3 - Streams within the Delmore project site

Refer to Figure 4 shows the contributing sub-catchments which affect the site.

The site is predominantly pasture, with a pine plantation in the northeastern corner. Consent notices issued under s 221 of the Resource Management Act 1991 apply to some areas of the site protecting flora and freshwater features.

Several existing stream crossings that are currently used for farming are shown in Figure 3. Some of these existing crossings may be utilised temporarily during construction works, however will ultimately be removed and replaced with future culverts to enable road crossings over the streams. These are discussed in further detail in Section 10.

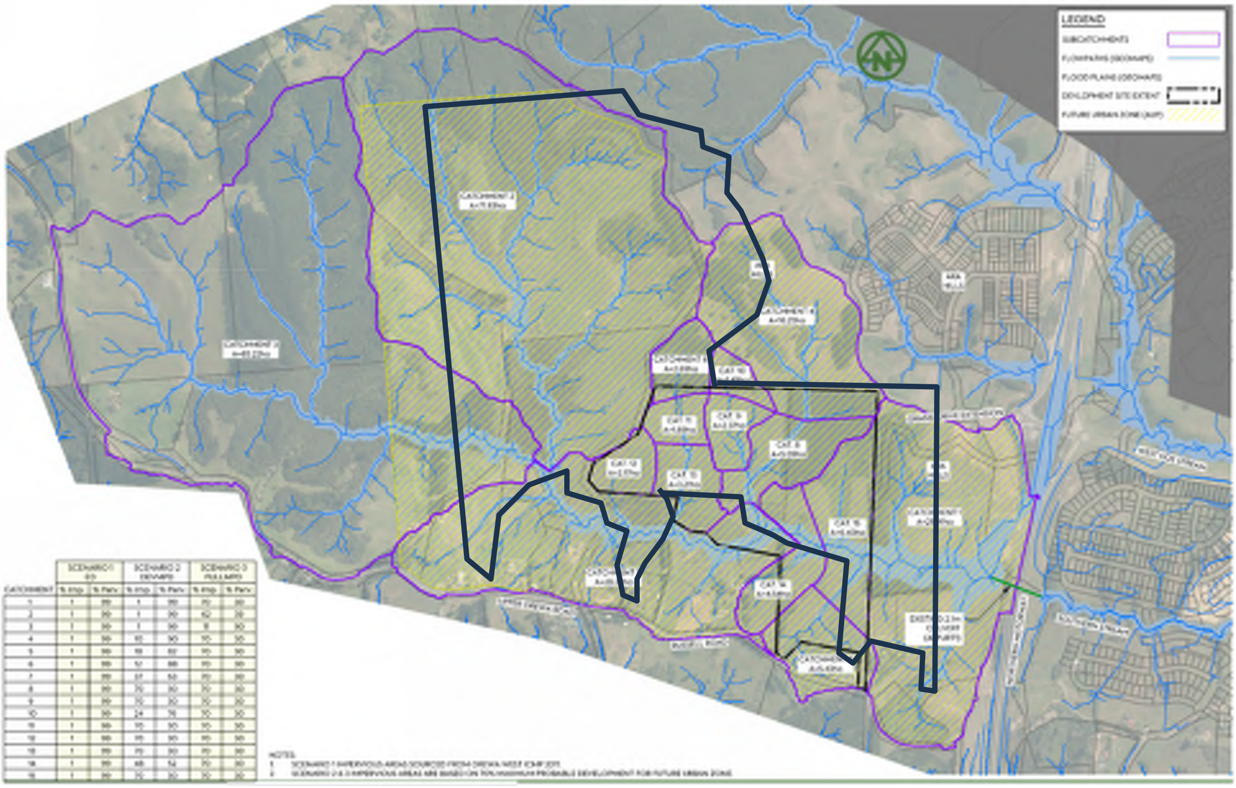


Figure 4 – Sub-Catchments and streams within the site

6. STORMWATER MANAGEMENT PLAN

The land is currently zone Future Urban, and as such is not currently included in the scope of Auckland Councils Region Wide Network Discharge Consent (NDC), therefore a site-specific stormwater discharge consent will be required for the public and private stormwater discharges. Ultimately, it is expected that the land will be re-zoned to a residential zone, and as such the stormwater infrastructure has been designed in accordance with a stormwater management plan, so in the future the public infrastructure can come under the NDC. The lots with private discharges will still need to comply with their with the private discharge consent.

A Stormwater Management Plan (SMP) for the site has been prepared by McKenzie and Co to demonstrate how the proposed stormwater management could comply with the with the NDC Green-field requirements.

The SMP identifies the following requirements for the site:

1. Water Quality – GD01 treatment for all impervious areas
2. Stream Hydrology – Equivalent hydrology to pre-development (5mm retention, 95th percentile detention)
3. Flooding - 10% AEP – Demonstrate sufficient capacity in downstream network
4. Flooding - 1% AEP – No effect on existing downstream building floor levels, achieves

SWCoP freeboard requirements.

This stormwater infrastructure report is consistent with the Stormwater Management Plan and shows how the development area can come under the councils NDC in the future.

7. INTEGRATED STORMWATER MANAGEMENT

An integrated stormwater management approach has been applied as far as possible, relying on natural components such as vegetation and soil media to cater for stormwater management as well as enhancing urban environments.

These have resulted in on lot devices, and raingardens being proposed for stormwater quality, retention and detention management for road and JOAL surfaces.

Tanks are proposed to provide on-lot mitigation. Lots adjacent to streams, are proposed to discharge via T-bar outlets to mimic pre-development conditions and to maintain flows to streams to support wetland health.

8. CATCHMENT & OFFSITE EFFECTS

8.1. Upstream

The development is located at the upper reaches of the currently zoned FUZ. To the north, it is bordered by the Nukumea Scenic Reserve, and to the west, an area of vegetation identified as significant under the Auckland Unitary Plan (identified as SEA_T_6652).

These natural features limit the potential for further upstream development, and it is expected the zoning will remain conservation/rural under the AUP. Consequently, the runoff coefficient is proposed to remain unchanged between the pre- and post-development scenarios.

8.2. Downstream

The downstream catchment is currently pasture between the development site, and State Highway 1 when a 2.1m diameter culvert discharges the flow to the upper reaches of the Ōrewa harbour. The downstream catchment and flows from the 1% AEP, Maximum Probable Development (MPD) with 3.8-degree Climate Change, is shown in Figure 5. Development in the downstream portion of the catchment, has been developed outside of the flood plain, in accordance with the Ōrewa West Integrated Catchment Management Plan.

There are no dwellings or buildings downstream of the development which may be affected by increased impervious area.

3.8-degree Climate change factor and sea level rise has been considered as part of the assessment of the downstream effects.

This is outlined in more detail in the Flood Risk Assessment report [2]

Figure 5 - Downstream catchment

9. PROPOSED STORMWATER INFRASTRUCTURE

Below is a summary of the key elements of the requirements of the proposed stormwater system.

9.1. Water Quality

Lots

Low contaminant generating building materials shall be required for all lots, to ensure contaminants do not generated on the site.

Driveways shall be treated with a $1m^2$ raingarden.

All roads and JOALs, will have water quality treatment provided by communal raingardens.

9.2. Retention & Detention

The following retention and detention are to be provided for all impervious areas –

- Retention (volume reduction) - 5mm runoff depth
- 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

[2] McKenzie & Co Flood Assessment Report, 2025

percentile, 24-hour rainfall event minus the 5 mm retention volume or any greater retention volume that is achieved.

For this development, the following depths for retention and detention have been calculated in accordance with TP108, using a design rainfall of 38mm (TR35) -

- Retention depth – 5mm
- Detention depth – 19.5mm

Calculations are included in Appendix B

9.3. Lots

Quality

Roof materials will be required to be made from low contaminant generating building materials. This mitigation will ensure that contaminants are not introduced at the source.

Discharge from the parking areas will require treatment, in the form of a 1m^2 raingarden. This size is required to provide sufficient area for plants to survive and provide meaningful treatment.

The communal raingardens have been sized to accommodate runoff from the driveways from these lots.

Retention and Detention

Water from the roof from each lot will be discharged into an on-lot tank, to be designed in accordance with GD01 section C5. This tank will be sized for retention and detention volumes. The retention volume can be used for irrigation and/or recycled water.

Lots that do not have a stream interface, are proposed to discharge to the public pipe network, from the on-lot retention/detention tank.

All lots are to have on-lot tanks to undertake retention and detention. Typical tank sizes for various lot sizes are below, based on 60% site coverage –

Lot area (m^2)	Retention Volume (m^3)	Detention volume (m^3)	Total volume (m^3)
200	0.06	2.34	2.94
250	0.75	2.93	3.68
300	0.90	3.51	4.41

Figure 6 – Tank examples - slimline or underground

A simplified graph for sizing the on-lot tanks is shown below in Figure 7.

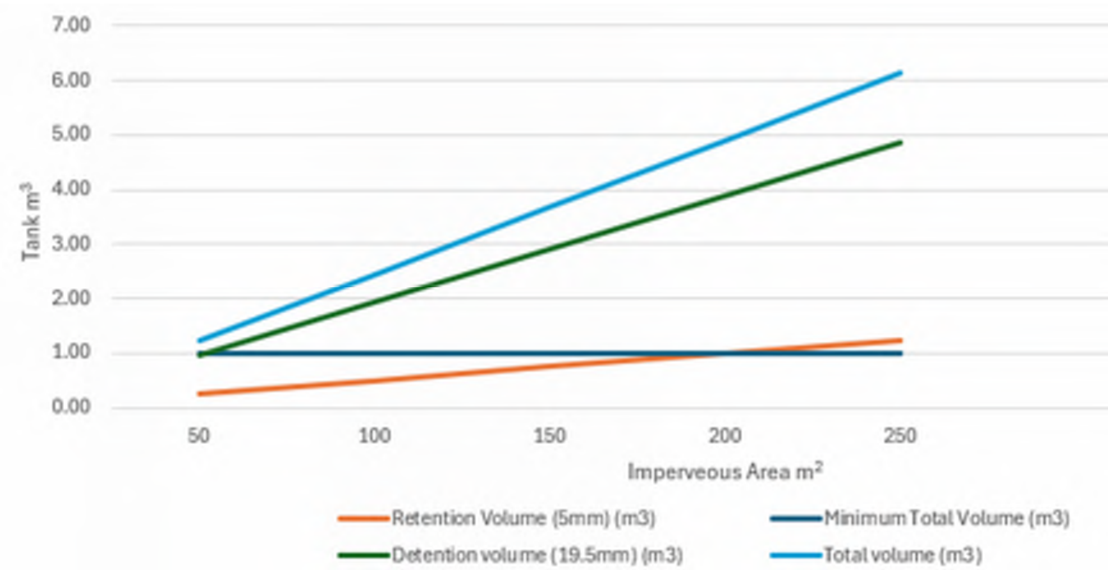


Figure 7 - On Lot tank sizing Chart

Discharge

To maintain stream base flows, it is proposed that lots facing the streams discharge direct to the streams, through a piped discharge or T bar level spreader, as shown below in Figure 8. This detail is also shown on drawing 3725-1-4360. This level spreaders are to have maintenance access maintained for regular checking for blockages, damage and checking for scouring or erosion.

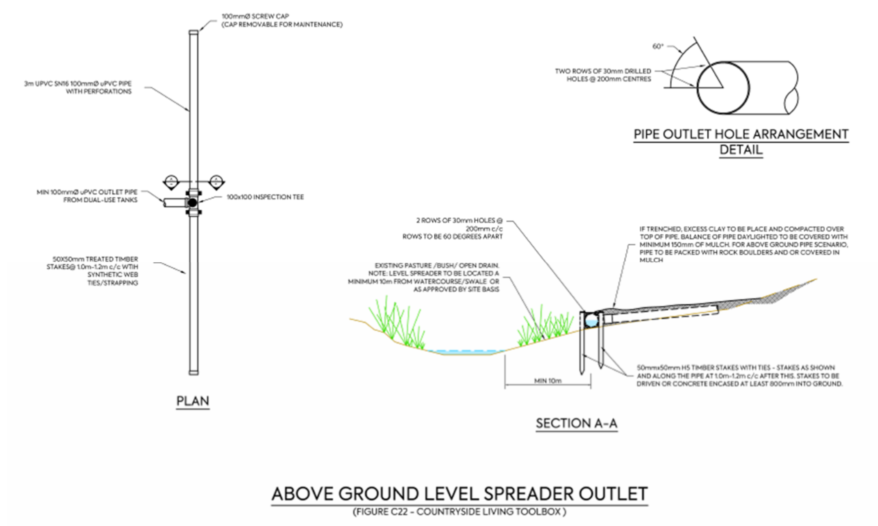


Figure 8 - T-Bar level spreader for private lots discharging to streams

Lots that do not discharge to streams will be required to connect to the public pipe network.

9.4. Roads & JOALs

It is proposed that all road and JOAL surfaces will discharge through a catchpit with a sump prior to discharging to the pipe network.

Stormwater will then be piped through a gravity pipe system, to a splitter manhole. This will split low flows for treatment in the raingarden, from high flows which will bypass the raingarden and be discharged directly to the streams. Low flows will first pass through a Gross Pollutant Trap (GPT) prior to being discharged to a GD01 compliant communal raingarden. The raingardens have been sized to undertake appropriate treatment, retention and detention for all roads and JOALs that do not discharge to streams.

Flows exceeding the water quality flow, which would otherwise be directed to the raingarden for treatment, will be diverted directly to the stream outlet. This diversion is designed to protect the raingarden from potential damage caused by high flow volumes and velocities.

9.1. Primary Stormwater System

A catchpit and pipe network will be constructed to convey flows from storms up to the 10% AEP storm events to the treatment devices. The network layout and catchment plans are shown on the 4000 series drawings for each stage.

Pipes and catchpit sizes, types, class, grades and hydraulics, are shown on the 4100 series long sections.

In accordance with SWCOP V4, a 2.1-degree climate change factor has been applied.

9.2. Secondary Stormwater System

Secondary flow paths have been designed within road carriageways for storms up to the 1% AEP storm event. Flows are generally contained within the road carriageway and subsequently discharge to adjacent streams. The 1% road flow discharge channel erosion protection plans are shown on the 4600 series, calculations are shown in Appendix B.

In accordance with SWCOP V4, a 3.8-degree climate change factor has been applied.

Riprap has been provided at low points to safely convey flows to the stream channels.

9.3. Communal Stormwater Treatment Devices

Catchpits

All catchpits will have a sump to capture gross pollutants and particulate matter.

Gross Pollutant Trap (GPT)

A GPT such as a Cascade Separator from SW360, is proposed as part of the treatment train approach. This will ensure a longer life for the raingarden and reduce the amount of sedimentation. A parking area for maintenance vehicles will be provided within approximately 50m to allow for a sucker truck to clean out the sump regularly.

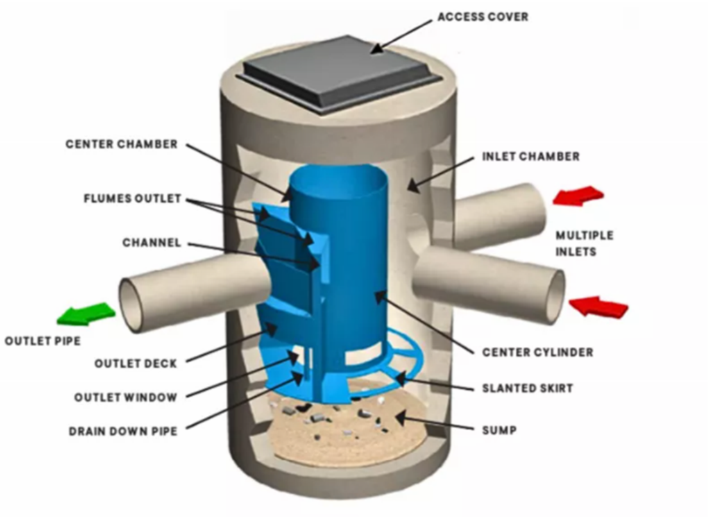


Figure 9 – example GPT

Communal Raingardens

Due to the topography and requirements for retention, it is considered that communal raingardens are the best practical option for the site.

The communal raingardens will be located within public drainage reserves. They are in areas where access for maintenance can be achieved, and where the natural catchment can discharge into.

The rain garden is provided with:

- Storage volume to meet retention and detention requirements.
- Forebay(s) equivalent to 15% of the permanent water area
- Orifice and overflow outlets
- High level overflow
- Emergency overflow
- Sufficient space for maintenance access

A typical raingarden configuration is shown below in Figure 10, showing the bio-media and drainage layers.

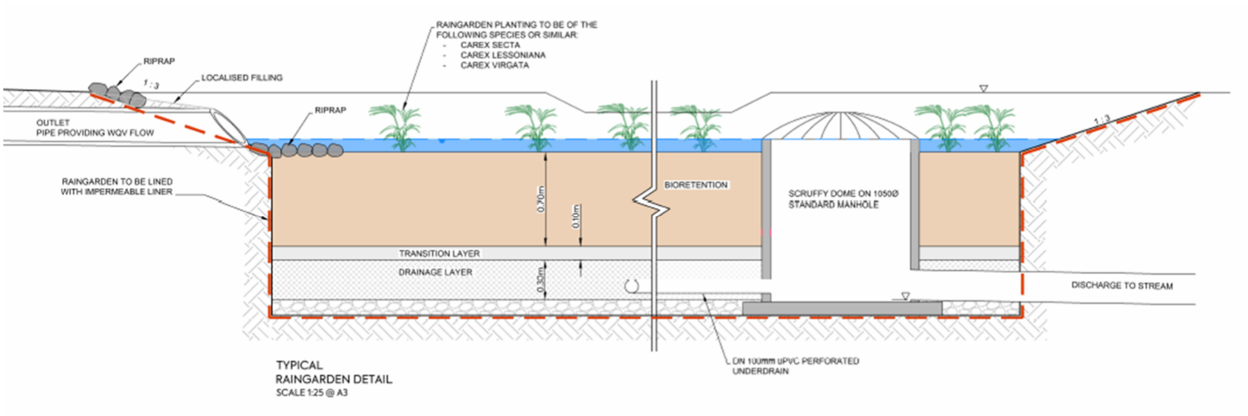


Figure 10 – Raingarden cross section

High flows – Diversion manhole and OLFP

Flows above the 95th percentile storm event will be diverted to protect the raingardens from high flows, using diversion manholes. In addition, OLFPs will not flow through raingardens but will be diverted around them to avoid damage from scour and erosion.

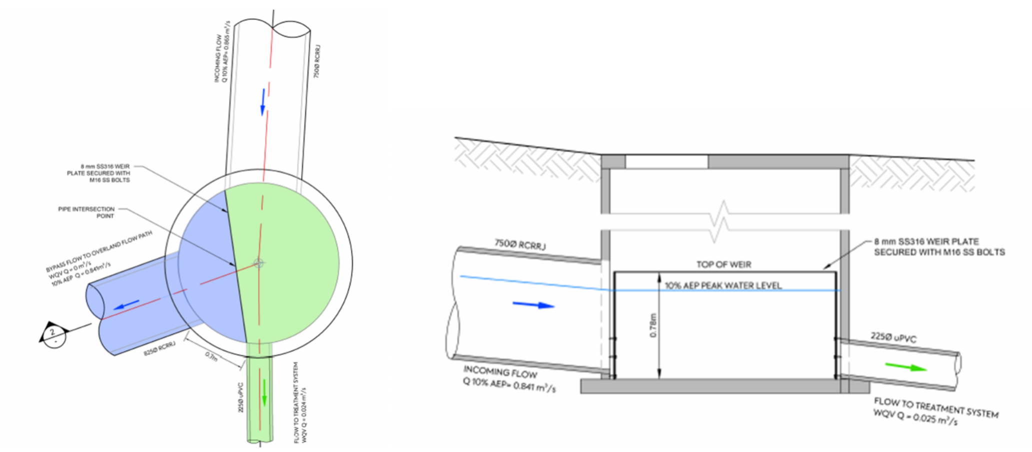


Figure 11 – Typical diversion manhole

Stormwater Reticulation

The development includes a new stormwater reticulation network to service the site. This consists of a new public pipe and manhole network, sized for the 10%AEP event.

The network extension has been designed in accordance with the Auckland Council Code of Practice for Land Development: Chapter 4 Stormwater v4 and sized to accommodate flows from the 10% AEP storm event, plus climate change.

Refer to drawings 3325-0-400 to 403 and 420 to 425.

Outlets to streams

Stream outlets will be designed to minimise scour and erosion, utilising headwalls, bubble up manholes, and rip rap to reduce velocities and provide erosion protection. It is anticipated that most outlets will be into streams.

Outlets will be combined into single outlet locations where possible. Access will be provided to outlet locations for maintenance purposes.

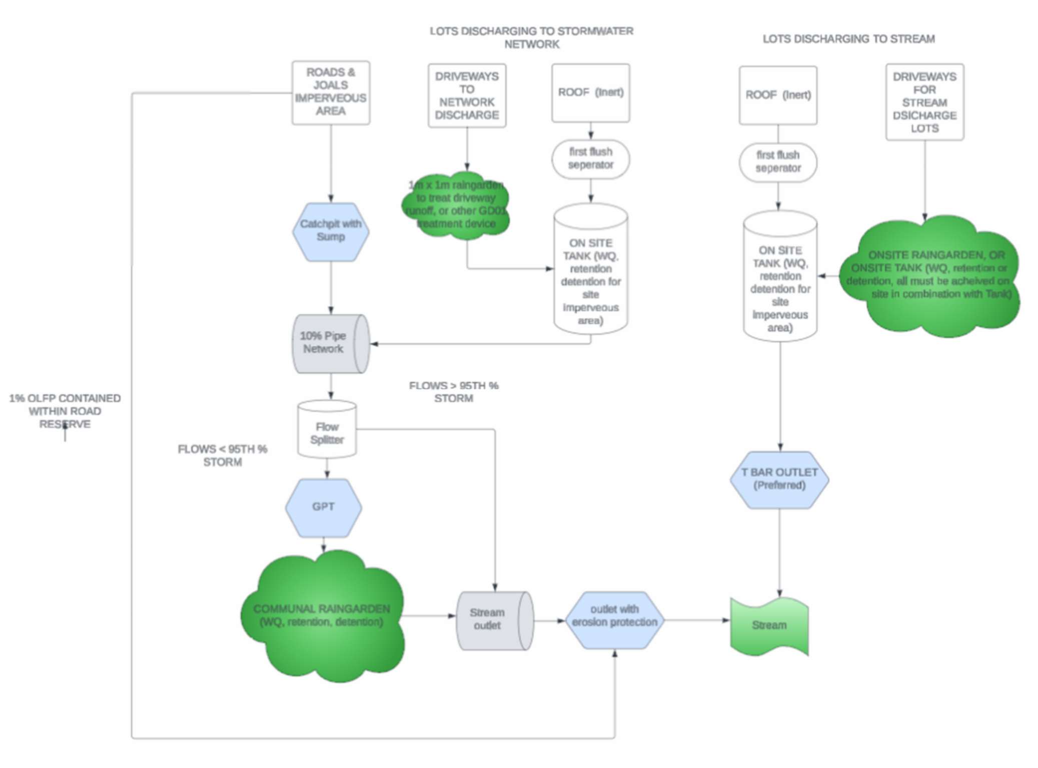


Figure 12: Summary of Stormwater Strategy

Maintenance

All public and private stormwater devices will require regular maintenance to ensure proper functionality and long-term operation. Comprehensive maintenance plans will be developed for both public and private devices, supported by conditions of consent and consent notices to guarantee ongoing upkeep.

9.4. Flooding and Overland Flow Paths (OLFPs)

Flooding

McKenzie & Co have prepared a flood assessment report[3] to assess the effects of the development on upstream and downstream properties and assess the effects of culverts on flows and flood levels on adjacent properties. It also includes an E36.9 Hazard Risk Assessment.

The report has modelled 17 scenarios for the 2, 5-, 10-, 20- and 50-year storm events, and for the pre- and post-development FUZ scenarios, both with and without the development surface for comparison. It concludes that the effects of the development will not result in adverse effects to properties upstream or downstream properties and therefore are less than minor.

Pre-Development

A predevelopment flood model has been prepared to model the catchment for various scenarios. Refer to Figure 13.

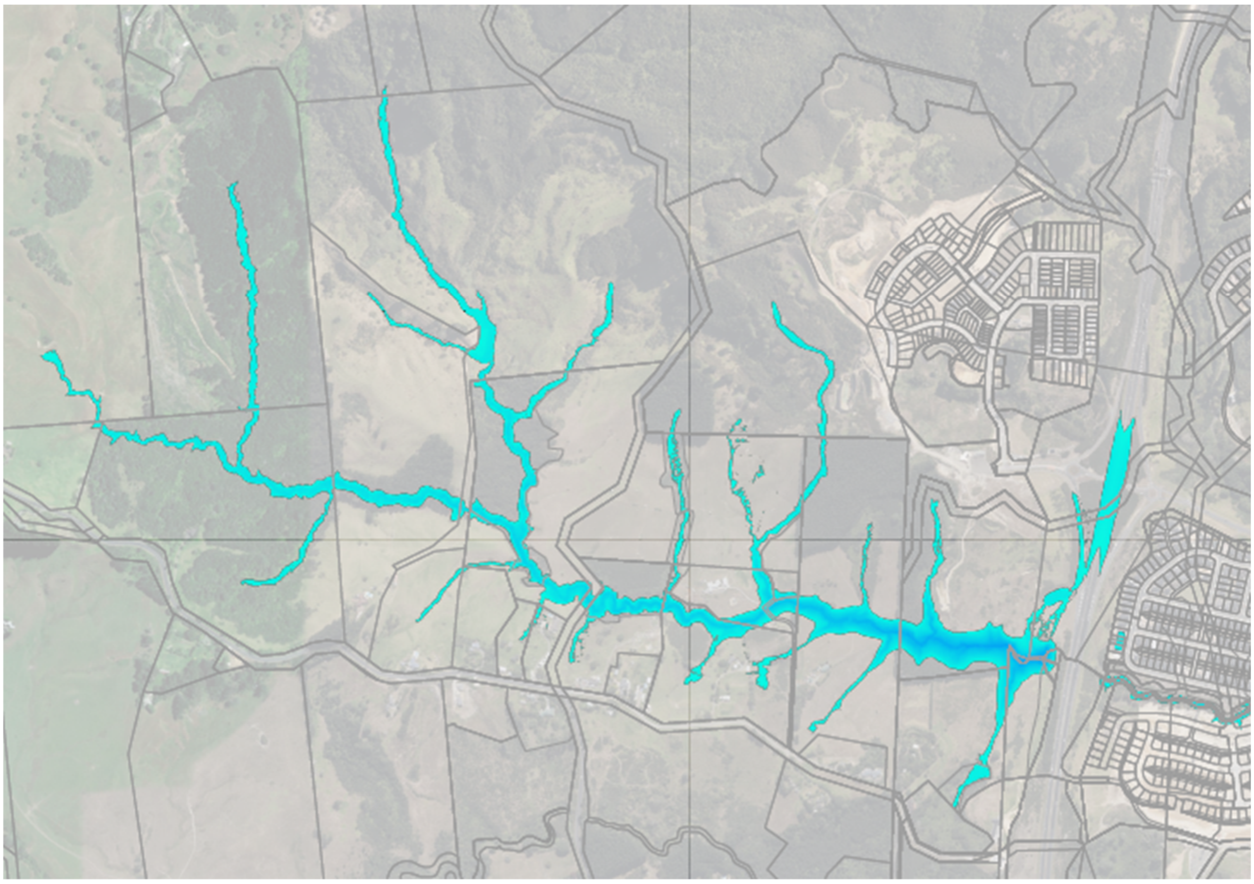


Figure 13. Pre-development 1% AEP MPD with 3.8-degree CC - flood depths

[3] McKenzie & Co Flood Hazard Assessment, 2025

Post Development

The design proposes to recontour the site, to provide road formations and flat lots for house construction. Post-development flood model scenarios have also been run. These are outlined in more detail in the Flood Assessment Report.

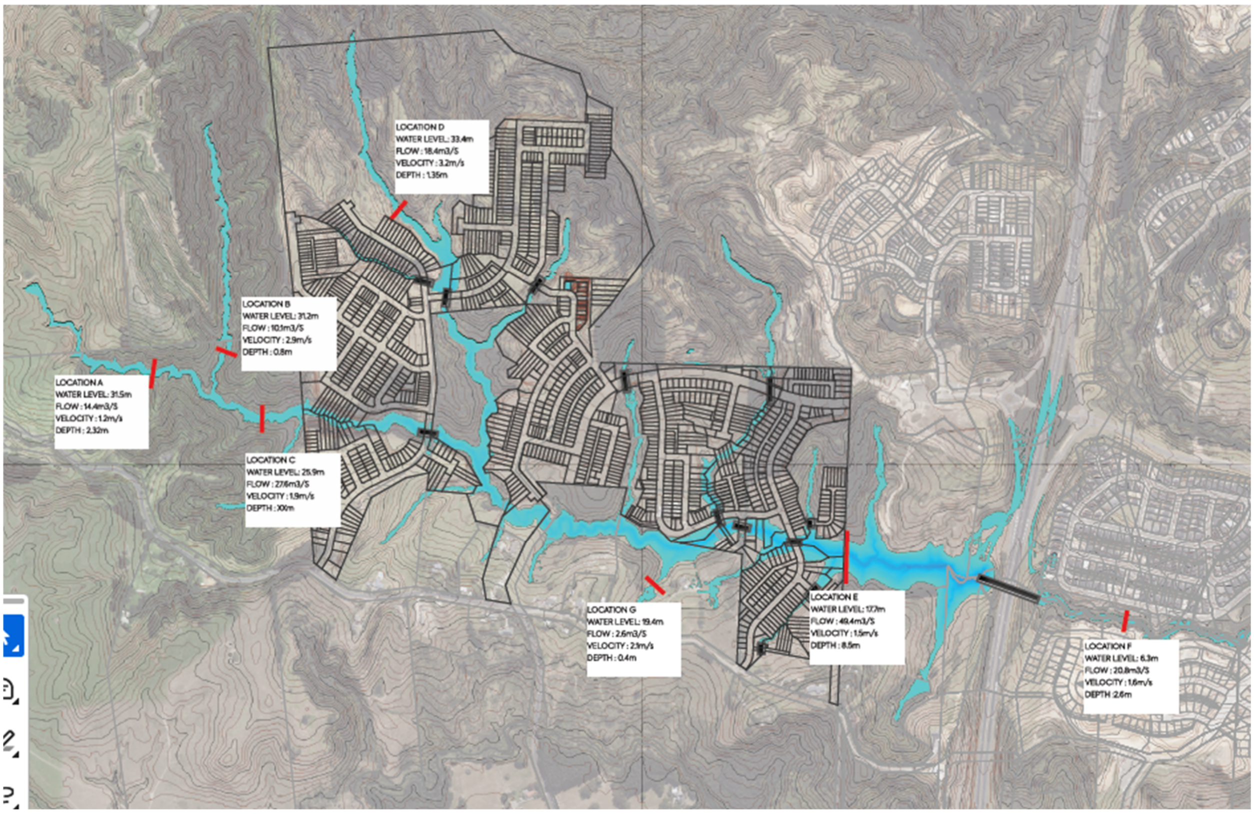


Figure 14 - Post development 1% AEP MPD with 3.8-degree CC - flood depths

Due to the site topography, the residential allotments are set well above the flood plain contained within the streams. OLFPs are contained within the road reserves. The flood risk to the proposed and existing dwellings is low, as all lots will be set above the flood plain.

Floor levels for habitable dwellings will be set above the 1% AEP Flood plain (3.8-degree Climate Change, and Maximum Probable Development) in accordance with requirements of Auckland Unitary Plan Operative in Part, Stormwater Code of Practice, and New Zealand Building Code.

Development downstream has been setback from the streams, to allow for the flood waters to safely pass through. Therefore no peak flow attenuation has been allowed for flood events.

This is consistent with the Ōrewa West ICMP.

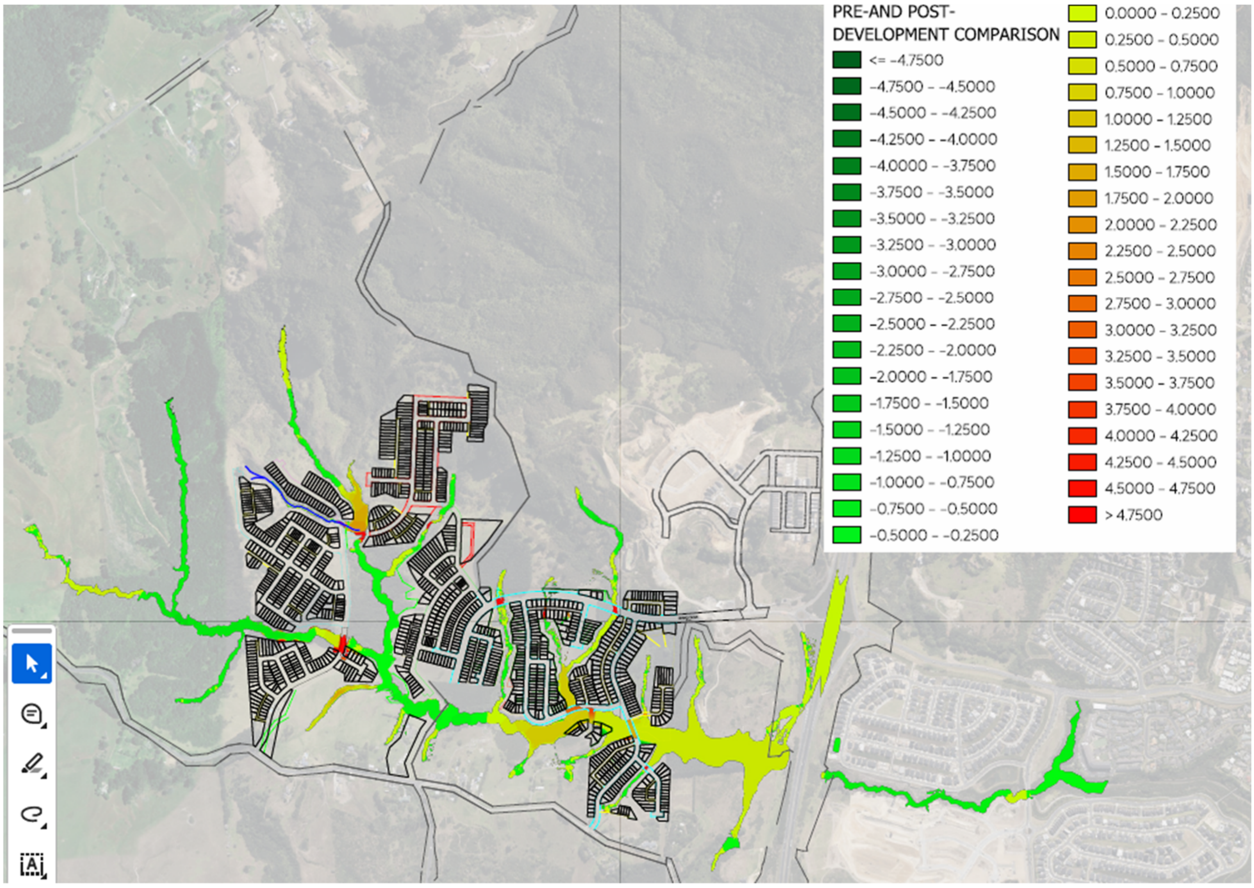


Figure 15 - Difference between the pre- and post-development scenarios for the 1% MPD 3.8-degree climate change scenario.

Overland Flow Paths

OLFP's have also been modelled for the road network. The catchments and flowpaths for OLFPs are shown on drawings 3325-0-460 and 461.

OLFP's are contained within the road reserve, where they will discharge to the stream network through discharge points stabilised with riprap or other means to dissipate energy to reduce the risk of erosion.

10. CULVERT CROSSINGS

13 culvert crossings are proposed as part of the establishment of the development. The culvert layout, long sections, and elevation view can be seen on plans 4800-4813.

All culverts, except for culverts 7, 9, and 10, have been designed to comply with the permitted activity requirements outlined in the NES-FW. Culverts 7, 9, and 10 do not meet these requirements due to the wetland's impractically wide shape, which exceeds the culvert width requirement of being at least 1.3 times the width of the stream.

All culverts have been designed to comply with the SWCOP v4.

All culverts are proposed to be embedded 25% into the existing stream bed and infilled with rock and soil to re-establish a stream bed. Riprap protection at the inlet and outlet is also provided to protect the upstream/downstream environment and the structure from high velocity flows.

A summary table of the culverts is shown below in Table 1.

All culverts are less than 30m in length.

Table 1 - Culvert summary

Culvert Number	Culvert Type	Dimensions (mm)	Catchment Area (ha)	10% AEP flow (m^3)	1% AEP flow (m^3)
01	Box	4000W x 2000H	5.4	**1.6**	**2.7**
02	Box	2000W x 1500H	3.6	**1.0**	**1.8**
03	Box	5000W x 5000H	225.1	**39.5**	**71.0**
04	Box	5000W x 5000H	220.3	**39.5**	**70.9**
05	Box	4000W x 2500H	25.8	**6.8**	**11.5**
06	Box	4000W x 2000H	16.3	**4.6**	**7.9**
07	Box	6000W x 2000H	2.9	**0.8**	**1.4**
08	Box	2000W x 2000H	9.6	**2.8**	**4.7**
09	Box	3000W x 3000H	41.4	**9.5**	**18.0**
10	Circular	2100	7.6	**1.8**	**3.0**
11	Box	4000W x 3000H	83.1	**21.0**	**37.7**
12	Circular	900	1.6	**0.47**	**0.8**
13	Circular	1500	0.5	**0.2**	**0.3**

Access for maintenance has been provided to the inlet and outlet for each culvert, with a 3m wide access track provided for clearing of debris and maintenance of riprap and structure. This will be protected with an easement where the access track does not lie within the drainage reserve area.

11.MODEL DESIGN INPUTS

11.1. Design Rainfall

The following rainfall has been modelled, which includes climate change allowances.

Table 2 - Rainfall data

	Historical Rainfall Depth (mm)	% Increase for Climate Change (SWCOP V4)	Design Rainfall Depth (mm)
10% AEP	155	17% (2.1° increase)	181.4
1% AEP	233	32.7 (3.8° increase)	309.2

11.2. Site coverage

The below site coverage factors have been modelled.

Table 3 - Site coverage

	Impervious area %
Lots	60
Roads	62
JOALs	90

11.3. Catchment Areas

Catchment areas are shown on plans 4400 for the 10% AEP storm events, and 4600 for the 1% Storm events.

11.4. Roughness Coefficients

Roughness coefficient applied in accordance with Table 4, SWCOP.

12. OPERATIONS & MAINTENANCE

Primary network

All manholes are located outside of road carriageways.

Secondary network

Riprap at outlet locations have been designed where discharge to streams can be maintained. Riprap will need to be checked periodically for damage, particularly after storm events.

Raingardens

All raingardens have been designed with maintenance access adjacent to the raingarden, minimum 3.5m wide and 1 in 8 grade. This will facility an excavator and/or truck for repair of outlets and replacement of raingarden media.

Culverts

Access to the inlets and outlets of the culverts have been designed for checking for debris, and replacement of riprap, if required.

13. MAINTENANCE

Ponds and other treatment devices are required to have maintenance manuals when vested. These assets are entered into Council's stormwater pond database and the asset is added to the maintenance programme.

For stormwater the maintenance contract covers the technical requirements associated with the stormwater assets.

14. CONSULTATION

The following consultation and correspondence have occurred with Auckland Council on stormwater matters. Records are included in Appendix C.

1) Flood model request

Mckenzie and Co have requested flood modelling and SMP information for the catchment. Correspondence to and from Auckland Council is included. This information was reviewed, the Orewa West ICMP regarding downstream flood effects.

2) Request to review model parameters prior to undertaking modelling

Mckenzie submitted a memo detailing the technical parameters of the model to Health Waters. The feedback, due to Health Water's review process requirements, the related materials could be formally reviewed until after the pre-application meeting. According to Healthy Water's requirements, all technical documentation will be further reviewed and processed after the pre-application meeting is completed. The specific parameters and detailed contents of the model are provided in the Flood Assessment Report, which includes the model's technical parameters and other relevant data for Health Water's review.

3) Pre-application meeting

On January 29, 2025, we held a pre-application meeting with Health Waters regarding the stormwater strategy for the site. The key issues raised by healthy Waters were –

a) Due to the land being un-zoned currently, the site can not fall under the NDC and would require a private discharge consent.

b) Healthy Waters prefer Wetlands and dry ponds, rather than raingardens for device selection.

c) The ability of raingardens to achieve retention in engineered fill.

d) HW preference for land intended to be vested as 'land in lieu of reserve'.

For further details, please refer to the attached meeting minutes.

In response to each item –

a) It is acknowledged that a private discharge consent will be required until such time as the land is re-zoned. The stormwater strategy has been developed with a supporting Stormwater Management Plan that can be used to transfer the public network to the NDC at that time.

b) We have reviewed the device selection strategy following the pre-application meeting, and the rationale for selection of raingardens instead of Wetlands or dry ponds is as follows;

Summary of Stormwater Device Selection for the Delmore Development
The stormwater management approach for the Delmore development must provide water quality treatment, retention, and detention, but does not require flood flow attenuation.

The Delmore site is highly undulating, with a series of wetlands throughout the development that need water to enable them not to dry out. Given these two factors, most of the catchments requiring treatment are small in nature, due to this topography. The size of the devices has been balanced to ensure that water flow is maintained to support the wetlands.

Given that most catchments are less than 1 hectare (Ha), with only one exceeding 2 Ha, the selected stormwater device must be suitable for small, distributed catchments. Based on GD01 guidelines, raingardens are the most appropriate choice as they provide water quality treatment, retention (if infiltration is feasible), and detention, while being adaptable to small catchment areas and slopes.

The undulating and steep topography of the site makes it impractical to combine multiple small catchments into larger ones that would be suitable for wetlands or dry basins. Due to the fragmented drainage paths and slope constraints, stormwater must be managed locally rather than being centralized into large treatment devices. Additionally, the steepness of the terrain limits the feasibility of large stormwater management devices, as they require significant grading, large footprint areas, and may pose slope stability risks.

An additional critical factor is the presence of wetlands that must be protected. The use of slightly more distributed raingardens ensures that stormwater is discharged back into natural flow paths at multiple locations, better mimicking the site's pre-development hydrology. By contrast, larger centralized devices such as wetlands or dry basins would consolidate runoff into fewer discharge points, increasing the volume of flow reaching the lower portions of the catchment and potentially impacting the wetlands.

Wetlands require a large contributing catchment of around, making them impractical given the fragmented catchments. Dry basins, while useful for peak flow attenuation, do not meet GD01's retention and treatment objectives and would be difficult to construct on steep terrain. Instead, raingardens allow for effective treatment at the source, ensuring compliance with GD01 while minimizing land take and infrastructure costs.

The table below summarizes the applicability of each stormwater device to the site:

Stormwater Device	Suitability for small <3Ha Catchments	Retention (Volume Reduction)	Detention (Peak Flow Control)	Water Quality Treatment	Topography Suitability
Raingardens	Suitable	May be suitable (if infiltration possible)	Suitable	Suitable	Suitable for steep and undulating terrain
Constructed Wetlands	Not Suitable	Not Suitable	Suitable	Suitable	Requires large flat areas, not suitable for steep sites
Dry Basins	Not Suitable	Not Suitable	Suitable	Not Suitable	Challenging to construct on steep terrain

Summary of options considered –

Raingardens – Ideal for small, distributed catchments. Provides treatment, retention (if infiltration possible), and detention.

Wetlands – Requires large catchments. Not feasible due to small, fragmented catchments and steep topography. Provides water quality, and detention but not retention.

Dry Basins – Do not provide retention or treatment. Steep terrain limits feasibility and increases construction challenges. Not suitable for this site.

By utilizing raingardens, the development will achieve compliance with GD01 and Auckland Council stormwater management requirements, while ensuring that stormwater is managed efficiently across small, localized catchments. This approach also ensures protection of natural wetlands by avoiding excessive centralized discharges that could alter the existing hydrological balance. If additional refinement is needed, other decentralized devices such as tree pits or permeable paving could be considered for specific areas, complementing the raingarden network.

c) Where possible, raingardens will be installed in non-engineered ground. Where this is not possible, the infiltration rate of the soils will be tested at each raingarden location, and if the infiltration rate cannot be achieved, then the raingarden will be lined and the retention volume added to the detention volume.

d) The request for 'land in lieu of reserve' will be considered, and the notation on the scheme plans can be amended on final agreement on this item.

15. CONCLUSION

The proposed development of Delmore has been designed to provide the required infrastructure necessary for use and enjoyment of the developed lots and follows the AUP and various Council standards.

The design has taken into consideration the possible impact of the proposed development and has minimised impacts to the receiving environment using accepted engineering practices.

APPENDIX A – Drawings

BOUND SEPARATELY

APPENDIX B – Calculations

CULVERT CHECKLIST
RAINGARDEN SIZING
OUTLET EROSION PROTECTION
OLFP EROSION PROTECTION

CULVERT CHECKLIST		Culvert 1		Culvert 2		Culvert 3		Culvert 4		Culvert 5		Culvert 6	
4.3.9.8	**Auckland Council SW CoP**	CHECK OK	COMMENTS	CHECK OK	COMMENTS	CHECK OK	COMMENTS	CHECK OK	COMMENTS	CHECK OK	COMMENTS	CHECK OK	COMMENTS
a)	If the culvert embankment can be considered a dam under the dam safety regulations, the requirements of those regulations shall take precedence over those stated here. The following thresholds under the AUP apply: 1)Vertical height from the downstream toe of the embankment to the top is more than 4 m and 2) The total stored volume of fluid is more than 20,000 m3	Y	Bottom to top of embankment more than 4m, storage less than 20,000m3.	Y	Bottom to top of embankment more than 4m, storage less than 20,000m3.	N	Bottom to top of embankment more than 4m, storage > 20000m3.	N	Bottom to top of embankment more than 4m, storage > 20000m3.	Y	Bottom to top of embankment more than 4m, storage less than 20,000m3.	N	Bottom to top of embankment more than 4m, storage > 20000m3.
b)	The culvert shall be designed to cater for the flows and water levels generated by the 1% AEP event without adversely affecting upstream or downstream property.	Y	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model	Y	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model	Y	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model	Y	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model	Y	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model	Y	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model
c)	The headwater pond created by the culvert during the 1% AEP event shall have a depth not exceeding 3.0 m above the invert of the pipe and shall provide 500 mm freeboard to the edge of the seal of the road (or similar feature) at the top of the embankment. For cases where the approach velocity is greater than 2 m/s, the freeboard shall be at least 1.5 times the velocity head at the entrance. The headwater pond created by the 10% AEP event shall not be higher than the soffit of the pipe.	Y	Headwater < 3m above embedment invert. Freeboard satisfied. 10% AEP headwater lower than soffit	Y	Headwater < 3m above embedment invert. Freeboard satisfied. 10% AEP headwater lower than soffit	Y	Headwater < 3m above embedment invert. Freeboard satisfied. 10% AEP headwater lower than soffit	Y	Headwater <3m above embedment invert. Freeboard satisfied. 10% AEP headwater lower than soffit.	Y	Headwater < 3m above embedment invert. Freeboard satisfied. 10% AEP headwater lower than soffit	Y	Headwater < 3m above embedment invert. Freeboard satisfied. 10% AEP headwater lower than soffit
d)	Culverts shall be designed such that the maximum velocity within the culvert generated by the 1% AEP event does not exceed 6.0 m/s. Higher velocities in culverts require approval from Auckland Council. High outlet velocities are likely to cause scour and erosion of natural channels and reference shall be made to Auckland Council technical report TR2013/018. Note that energy dissipation shall be required at far lower velocities than the maximum allowed within the conduit stated above.	Y	Velocity < 6m/s	Y	Velocity < 6m/s	N	Velocity > 6m/s. Approval to be sought through EPA and Resource Consent Process	N	Velocity > 6m/s. Approval to be sought through EPA and Resource Consent Process	Y	Velocity < 6m/s	Y	Velocity < 6m/s
e)	Culverts shall be designed such that for the 50% AEP design storm, an absolute minimum velocity of 0.6 m/s and desired minimum of 1.0 m/s is achieved.	Y	Minimum > 0.6m/s	Y	Minimum > 0.6m/s	Y	Minimum > 0.6m/s	Y	Minimum > 0.6m/s	Y	Minimum > 0.6m/s	Y	Minimum > 0.6m/s
f)	Culverts shall have a minimum internal diameter of 375 mm (for vehicle crossing standards refer to the Auckland Transport Code of Practice and Auckland Transport Technical Design Manual).	Y		Y		Y		Y		Y		Y	
g)	A suitable transition structure is required at both the inlet and outlet to the proposed culvert which shall ensure that there is no scour or erosion in the watercourse, private property and/or the road formation (refer to the Auckland Transport Code of Practice and Auckland Transport Technical Design Manual for special requirements adjacent to roads)	Y		Y		Y		Y		Y		Y	
h)	A secondary flow path shall be kept unobstructed at all times. The secondary flow path design shall assume the total blockage of the culvert in cases where it is less than DN1,500, and 50% capacity reduction if the culvert is greater than or equal to DN1,500 (1.77m^2), unless demonstrated by specific design to Auckland Council's approval that a lower blockage factor can be applied.	Y	Culvert has capacity if 50% blocked	Y	Culvert has capacity if 50% blocked	Y	Culvert overtops if 50% blocked. Road to be specially designed to allow overtopping	Y	Culvert overtops if 50% blocked. Road to be specially designed to allow overtopping	Y	Culvert has capacity if 50% blocked	Y	Culvert has capacity if 50% blocked
i)	Allowance for 100% blockage of pipes greater than DN1,500 may be necessary in some circumstances. The risk of blockage resulting from the contributing catchment shall be assessed on a case-by-case basis (this includes situations where a safety grille or debris screen is used) to determine if specific culvert design (including consideration of a secondary inlet) is required.	N/A		N/A		N/A		N/A		N/A		N/A	
j)	No obtrusive brand names on proprietary devices and other visible components of the stormwater system shall be visible once constructed.	N/A		N/A		N/A		N/A		N/A		N/A	
k)	For culverts whose inlets may be difficult to locate if submerged, green retro-reflective raised pavement markers shall be required to mark the presence of the culvert under the roadway. For all culverts associated with roads, markings shall be in accordance with Auckland Transport Code of Practice and Auckland Transport Technical Design Manual requirements.	N/A	Not required	N/A	Not required	N/A	Not required	N/A	Not required	N/A	Not required	N/A	Not required
l)	Provision of safety measures may be required, e.g. a barrier along the culvert headwall (refer to the Auckland Transport Code of Practice and Auckland Transport Technical Design Manual for special requirements adjacent to roads).	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC
m)	Culverts under road fencing or barriers are to be designed to Auckland Transport requirements.	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC
n)	Adequate provision shall be made for maintenance. This shall include, but not be limited to, access to inlet and outlet for inspection, debris removal and scour protection maintenance, and any other activities stated in the operation and maintenance manual.	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC
o)	Fish passage shall be provided in accordance with Section 4.2.8.	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC
p)	The need for debris screens shall be subject to specific design, considering the likelihood of debris flowing from the upstream catchment and potential impact on the culvert.	N/A	Not required	N/A	Not required	N/A	Not required	N/A	Not required	N/A	Not required	N/A	Not required
q)	Culverts shall be single-barrelled unless specific design is approved by Auckland Council.	Y	Single box culvert	Y	Single box culvert	Y	Single box culvert	Y	Single box culvert	Y	Single box culvert	Y	Single box culvert
	NES Freshwater Standards												
a)	The culvert must provide for the same passage of fish upstream and downstream as would exist without the culvert, except as required to carry out the works to place, alter, extend, or reconstruct the culvert	Y		Y		Y		Y		Y		Y	
b)	The culvert must be laid parallel to the slope of the bed of the river or connected area	Y		Y		Y		Y		Y		Y	
c)	The mean cross-sectional water velocity in the culvert must be no greater than that in all immediately adjoining river reaches	Y		Y		Y		Y		Y		Y	
d)	The culvert's width where it intersects with the bed of the river or connected area (s) and the width of the bed at that location (w), both measured in metres, must compare as follows: (i) where $w \leq 3$, $s \geq 1.3 \times w$: (ii) where $w > 3$, $s \geq (1.2 \times w) + 0.6$	Y		Y		Y		Y		Y		Y	
e)	The culvert must be open-bottomed or its invert must be placed so that at least 25% of the culvert's diameter is below the level of the bed	Y		Y		Y		Y		Y		Y	
f)	The bed substrate must be present over the full length of the culvert and stable at the flow rate at or below which the water flows for 80% of the time	Y		Y		Y		Y		Y		Y	
g)	The culvert provides for continuity of geomorphic processes (such as the movement of sediment and debris)	Y		Y		Y		Y		Y		Y	

	CULVERT CHECKLIST	Culvert 7		Culvert 8		Culvert 9		Culvert 10		Culvert 11		Culvert 12		Culvert 13	
4.3.9.8	**Auckland Council SW CoP**	CHECK OK	COMMENTS	CHECK OK	COMMENTS	CHECK OK	COMMENTS	CHECK OK	COMMENTS	CHECK OK	COMMENTS	CHECK OK	COMMENTS	CHECK OK	COMMENTS
a)	If the culvert embankment can be considered a dam under the dam safety regulations, the requirements of those regulations shall take precedence over those stated here. The following thresholds under the AUP apply: 1)Vertical height from the downstream toe of the embankment to the top is more than 4 m and 2) The total stored volume of fluid is more than 20,000 m3	Y	Bottom to top of embankment more than 4m, storage less than 20,000m3.	Y	Bottom to top of embankment more than 4m, storage less than 20,000m3.	Y	Bottom to top of embankment more than 4m, storage less than 20,000m3.	Y	Bottom to top of embankment more than 4m, storage less than 20,000m3.	Y	Bottom to top of embankment more than 4m, storage less than 20,000m3.	Y	Bottom to top of embankment less than 4m, storage less than 20,000m3	Y	Bottom to top of embankment more than 4m, storage less than 20,000m3.
b)	The culvert shall be designed to cater for the flows and water levels generated by the 1% AEP event without adversely affecting upstream or downstream property.	Y	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model	Y	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model	Y	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model	Y	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model	Y	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model	Y	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model	Y	Caters to flows up to 1% AEP. Effect on neighbouring properties to be determined in flood model
c)	The headwater pond created by the culvert during the 1% AEP event shall have a depth not exceeding 3.0 m above the invert of the pipe and shall provide 500 mm freeboard to the edge of the seal of the road (or similar feature) at the top of the embankment. For cases where the approach velocity is greater than 2 m/s, the freeboard shall be at least 1.5 times the velocity head at the entrance. The headwater pond created by the 10% AEP event shall not be higher than the soffit of the pipe.	Y	Headwater < 3m above embedment invert. Freeboard satisfied. 10% AEP headwater lower than soffit	Y	Headwater < 3m above embedment invert. Freeboard satisfied. 10% AEP headwater lower than soffit	Y	Headwater < 3m above embedment invert. Freeboard satisfied. 10% AEP headwater lower than soffit	Y	Headwater < 3m above embedment invert. Freeboard satisfied. 10% AEP headwater lower than soffit	N	Headwater > 3m above embedment invert. Freeboard satisfied. 10% AEP headwater lower than soffit The deep water area is very limit, specific inlet design will be done later.	Y	Headwater < 3m above embedment invert. Freeboard satisfied. 10% AEP headwater lower than soffit	Y	Headwater < 3m above embedment invert. Freeboard satisfied. 10% AEP headwater lower than soffit
d)	Culverts shall be designed such that the maximum velocity within the culvert generated by the 1% AEP event does not exceed 6.0 m/s. Higher velocities in culverts require approval from Auckland Council. High outlet velocities are likely to cause scour and erosion of natural channels and reference shall be made to Auckland Council technical report TR2013/018. Note that energy dissipation shall be required at far lower velocities than the maximum allowed within the conduit stated above.	Y	Velocity < 6m/s	Y	Velocity < 6m/s	Y	Velocity < 6m/s	Y	Velocity < 6m/s	Y	Velocity < 6m/s	Y	Velocity < 6m/s	Y	Velocity < 6m/s
e)	Culverts shall be designed such that for the 50% AEP design storm, an absolute minimum velocity of 0.6 m/s and desired minimum of 1.0 m/s is achieved.	Y	Minimum > 0.6m/s	Y	Minimum > 0.6m/s	Y	Minimum > 0.6m/s	Y	Minimum > 0.6m/s	Y	Minimum > 0.6m/s	Y	Minimum > 0.6m/s	Y	Minimum > 0.6m/s
f)	Culverts shall have a minimum internal diameter of 375 mm (for vehicle crossing standards refer to the Auckland Transport Code of Practice and Auckland Transport Technical Design Manual).	Y		Y		Y		Y		Y		Y		Y	
g)	A suitable transition structure is required at both the inlet and outlet to the proposed culvert which shall ensure that there is no scour or erosion in the watercourse, private property and/or the road formation (refer to the Auckland Transport Code of Practice and Auckland Transport Technical Design Manual for special requirements adjacent to roads)	Y		Y		Y		Y		Y		Y		Y	
h)	A secondary flow path shall be kept unobstructed at all times. The secondary flow path design shall assume the total blockage of the culvert in cases where it is less than DN1,500, and 50% capacity reduction if the culvert is greater than or equal to DN1,500 (1.77m^2), unless demonstrated by specific design to Auckland Council's approval that a lower blockage factor can be applied.	Y	Culvert has capacity if 50% blocked	Y	Culvert has capacity if 50% blocked	Y	Culvert has capacity if 50% blocked	Y	Culvert has capacity if 50% blocked	Y	Culvert overtops if 50% blocked. Existing stream area will provide basin function. The effect for up/down stream property is lees than minior.	Y	Road to be specially designed to allow overtopping if completely blocked	Y	Culvert has capacity if 50% blocked
i)	Allowance for 100% blockage of pipes greater than DN1,500 may be necessary in some circumstances. The risk of blockage resulting from the contributing catchment shall be assessed on a case-by-case basis (this includes situations where a safety grille or debris screen is used) to determine if specific culvert design (including consideration of a secondary inlet) is required.	N/A		N/A		N/A		N/A		N/A		N/A		N/A	
j)	No obtrusive brand names on proprietary devices and other visible components of the stormwater system shall be visible once constructed.	N/A		N/A		N/A		N/A		N/A		N/A		N/A	
k)	For culverts whose inlets may be difficult to locate if submerged, green retro-reflective raised pavement markers shall be required to mark the presence of the culvert under the roadway. For all culverts associated with roads, markings shall be in accordance with Auckland Transport Code of Practice and Auckland Transport Technical Design Manual requirements.	N/A	Not required	N/A	Not required	N/A	Not required	N/A	Not required	N/A	Not required	N/A	Not required	N/A	Not required
l)	Provision of safety measures may be required, e.g. a barrier along the culvert headwall (refer to the Auckland Transport Code of Practice and Auckland Transport Technical Design Manual for special requirements adjacent to roads).	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC
m)	Culverts under road fencing or barriers are to be designed to Auckland Transport requirements.	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC
n)	Adequate provision shall be made for maintenance. This shall include, but not be limited to, access to inlet and outlet for inspection, debris removal and scour protection maintenance, and any other activities stated in the operation and maintenance manual.	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC
o)	Fish passage shall be provided in accordance with Section 4.2.8.	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC	Y	Details TBC
p)	The need for debris screens shall be subject to specific design, considering the likelihood of debris flowing from the upstream catchment and potential impact on the culvert.	N/A	Not required	N/A	Not required	N/A	Not required	N/A	Not required	N/A	Not required	N/A	Not required	N/A	Not required
q)	Culverts shall be single-barrelled unless specific design is approved by Auckland Council.	Y	Single box culvert	Y	Single box culvert	Y	Single box culvert	Y	Single circular culvert	Y	Single box culvert	Y	Single circular culvert	Y	Single circular culvert
	NES Freshwater Standards														
a)	The culvert must provide for the same passage of fish upstream and downstream as would exist without the culvert, except as required to carry out the works to place, alter, extend, or reconstruct the culvert	Y		Y		Y		Y		Y		Y		Y	
b)	The culvert must be laid parallel to the slope of the bed of the river or connected area	Y		Y		Y		Y		Y		Y		Y	
c)	The mean cross-sectional water velocity in the culvert must be no greater than that in all immediately adjoining river reaches	Y		Y		Y		Y		Y		Y		Y	
d)	The culvert's width where it intersects with the bed of the river or connected area (s) and the width of the bed at that location (w), both measured in metres, must compare as follows: (i) where w ≤ 3, s ≥ 1.3 × w: (ii) where w > 3, s ≥ (1.2 × w) + 0.6	N	Located in wide flat area. Impractical to span the bed completely	Y		N	Located in wide flat area. Impractical to span the bed completely	N	Located in wide flat area. Impractical to span the bed completely	Y		Y		Y	
e)	The culvert must be open-bottomed or its invert must be placed so that at least 25% of the culvert's diameter is below the level of the bed	Y		Y		Y		Y		Y		Y		Y	
f)	The bed substrate must be present over the full length of the culvert and stable at the flow rate at or below which the water flows for 80% of the time	Y		Y		Y		Y		Y		Y		Y	
g)	The culvert provides for continuity of geomorphic processes (such as the movement of sediment and debris)	Y		Y		Y		Y		Y		Y		Y	

TP 108 GRAPHICAL RUNOFF CALCULATION – SMAF VOLUME

PROJECT NAME	DELMORE	Created By		Date	23/01/2025
PROJECT Nos:	3725	Checked By		Date	23/01/2025

Input

ARI(yr)	95% event	
Design rainfall (mm)	38	(From TR035)
	CN	Ia (mm)
Pervious	74	5
Impervious	98	0

Detention Volume from impervious surfaces

$V_s = Q_{post} - Q_{pre}$ where

$$Q = \frac{(P - Ia)2}{(P - Ia) + S}$$

Q = runoff depth (mm)
P = rainfall depth (mm)
S = potential maximum retention after runoff begins

S = (1000 / CN - 10) 25.4

Output

Q_{pre}	8.91
Q_{post}	33.4
V_s	24.5

Detention = V_s - 5mm **19.5**

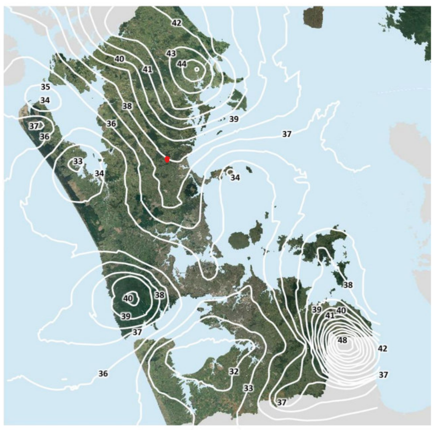


Figure 6: Map of 95th percentile 24-hour rainfall event
Source: Auckland Council TR 2013/035[10]

SMAF RAIN GARDEN SIZING – PRELIMINARY FOR RESOURCE CONSENT

PROJECT NAME DELMORE DEVELOPMENTS - STAGE 1 | Created By NC | Date 2/07/2025
PROJECT Nos: 3725 | Checked By | Date

Rain Garden	Construction	Material	Depth (m)	Void Ratio
1	Retention	Rock	0.3	35%
2	Drainage Layer	Rock	0.2	35%
3	Transition	Coarse Sand	0.1	30%
4	Detention	Bio Media	0.60	25%
5	Live Storage	None	0.3	100%
	Total		**1.5**	

RAINGARDEN SIZING

	CATCHMENT INFORMATION							1		Detention 2	3	4							
DEVICE NAME	**CATCHMENT (road reserve) m2**	**% impervious**	**CATCHMENT (JOALs) m2**	**% impervious**	**TOTAL CATCHMENT m2**	**TOTAL % imperviousness**	**Minimum Raingarden size Required (5%) m²**		**Retention Volume Required 5mm**	**Drainage Layer**	**Detention Volume Required 16.3mm**	**Retention Volume Available (m³)**	**Drainage Layer m3**	**Transition Layer Volume (m³)**	**Detention Volume Bio Media (m³)**	**Live Storage Volume**	**Total Detention Volume (m³)**	**Retention Volume Check**	**Detention Volume Check**
RG1	2781	0.6	607	0.9	3388	0.65	110.75		11.07		43.26	11.63	11.63	3.32	16.61	33.22	53.16	ok	ok
RG2	6800	0.6	2170	0.9	8970	0.67	301.65		30.17		117.83	31.67	31.67	9.05	45.25	90.50	144.79	ok	ok
RG4	7979	0.6	2348	0.9	10327	0.67	345.03		34.50		134.77	36.23	36.23	10.35	51.75	103.51	165.61	ok	ok
RG5	1505	0.6	159	0.9	1664	0.63	52.31		5.23		20.43	5.49	5.49	1.57	7.85	15.69	25.11	ok	ok
RG6	8419	0.6	1772	0.9	10191	0.65	332.31		33.23		129.80	34.89	34.89	9.97	49.85	99.69	159.51	ok	ok
RG7	2455	0.6	1692	0.9	4147	0.72	149.79		14.98		58.51	15.73	15.73	4.49	22.47	44.94	71.90	ok	ok
RG8	8829	0.6	0	0.9	8829	0.60	264.87		26.49		103.46	27.81	27.81	7.95	39.73	79.46	127.14	ok	ok
RG9	1332	0.6	432	0.9	1764	0.67	59.40		5.94		23.20	6.24	6.24	1.78	8.91	17.82	28.51	ok	ok
RG10	3769	0.6	0	0.9	3769	0.60	113.07		11.31		44.17	11.87	11.87	3.39	16.96	33.92	54.27	ok	ok
RG11	12253	0.6	1279	0.9	13532	0.63	425.15		42.51		166.06	44.64	44.64	12.75	63.77	127.54	204.07	ok	ok
RG14 (STG 2)	16117	0.6	4242	0.9	20359	0.66	674.40		67.44		263.42	70.81	70.81	20.23	101.16	202.32	323.71	ok	ok
RG11&14 TOTAL*	28370	0.6	5521	0.9	33891	0.65	1099.55		109.95		429.48	115.45	115.45	32.99	164.93	329.86	527.78	ok	ok
RG12	1055	0.6	581	0.9	1636	0.71	57.80		5.78		22.57	6.07	6.07	1.73	8.67	17.34	27.74	ok	ok

* Raingarden 11 & 14 is one device which treats catchments across two stages

SMAF RAIN GARDEN SIZING - PRELIMINARY FOR RESOURCE CONSENT

PROJECT NAME DELMORE DEVELOPMENTS - STAGE 2
PROJECT Nos: 3725

Created By NC   Date 2/07/2025
Checked By   Date

Rain Garden	Construction	Material	Depth (m)	Void Ratio
1	Retention	Rock	0.3	35%
2	Drainage Layer	Rock	0.2	35%
3	Transition	Coarse Sand	0.1	30%
4	Detention	Bio Media	0.60	25%
5	Live Storage	None	0.3	100%
	Total		**1.5**	

CATCHMENT INFORMATION

DEVICE NAME	CATCHMENT (road reserve) m2	% impervious	CATCHMENT (JOALs) m2	% impervious	TOTAL CATCHMENT m2	TOTAL % imperviousness	Minimum Raingarden size Required (5%) m^2
RG11	12253	0.6	1279	0.9	13532	0.63	425.15
RG14	16117	0.6	4242	0.9	20359	0.66	674.40
RG11&14 TOTAL*	28370	0.6	5521	0.9	33891	0.65	1099.55
RG15	1960	0.6	2202	0.9	4162	0.76	157.89
RG16	17209	0.6	1110	0.9	18319	0.62	566.22
RG17	3893	0.6	1549	0.9	5442	0.69	186.50
RG20	15924	0.6	1811	0.9	19648	0.57	559.22
RG21	13376	0.6	686	0.9	14424	0.60	432.15
RG22	7571	0.6	598	0.9	8169	0.62	254.04
RG23	2194	0.6	1204	0.9	3398	0.71	120.00
RG24	10745	0.6	0	0.9	10745	0.60	322.35
RG25	1541	0.6	0	0.9	1541	0.60	46.23

RAINGARDEN SIZING

	1	Detention 2	3	4							
DEVICE NAME	**Retention Volume Required 5mm**	**Drainage Layer**	**Detention Volume Required 19.5mm**	**Retention Volume Available (m^3)**	**Drainage Layer m3**	**Transition Layer Volume (m^3)**	**Detention Volume Bio Media (m^3)**	**Live Storage Volume**	**Total Detention Volume (m^3)**	**Retention Volume Check**	**Detention Volume Check**
RG11	42.51		166.06	44.64	44.64	12.75	63.77	127.54	204.07	ok	ok
RG14	67.44		263.42	70.81	70.81	20.23	101.16	202.32	323.71	ok	ok
RG11&14 TOTAL*	109.95		429.48	115.45	115.45	32.99	164.93	329.86	527.78	ok	ok
RG15	15.79		61.67	16.58	16.58	4.74	23.68	47.37	75.79	ok	ok
RG16	56.62		221.17	59.45	59.45	16.99	84.93	169.87	271.79	ok	ok
RG17	18.65		72.85	19.58	19.58	5.59	27.97	55.95	89.52	ok	ok
RG20	55.92		218.43	58.72	58.72	16.78	83.88	167.76	268.42	ok	ok
RG21	43.22		168.80	45.38	45.38	12.96	64.82	129.65	207.43	ok	ok
RG22	25.40		99.23	26.67	26.67	7.62	38.11	76.21	121.94	ok	ok
RG23	12.00		46.87	12.60	12.60	3.60	18.00	36.00	57.60	ok	ok
RG24	32.24		125.91	33.85	33.85	9.67	48.35	96.71	154.73	ok	ok
RG25	4.62		18.06	4.85	4.85	1.39	6.93	13.87	22.19	ok	ok

* Raingarden 11 & 14 is one device which treats catchments across two stages

RIPRAP PROTECTION SIZING

PROJECT NAME: Delmore Stage 1 Created By SH Date 2/07/2025
PROJECT Nos: 3725 Checked By Date 2/07/2025

Location: **Outlet 1-1**

Pipe Dia. (D_o):	0.45	m
Slope:	20	%
Flow (Q):	0.159	m^3/s
Velocity (V):	3.16	m/s
Depth of flow in pipe(d_p):	0.16	m

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	2.5223		
Riprap Diameter (d_s)=	$0.25 \times D_o \times F_o$	=	0.28	m	
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.57	m	
Lengh of Riprap (L_a)=	$D_o \times (8 + 17 \times LogF_o)$	=	6.67	m	
Width of Riprap (W_A)=	$3 \times D_o$	=	1.35	m	< Wingwall Width
Height of Riprap (H)=	crown of pipe +300mm	=	0.75	m	

WINGWALL DIMENSIONS

Tail Width of Wingwall (W_w)=	2.15	m
Height of Wingall (H_w)=	1	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.28**	m
Thickness of Riprap (D_A)=	**0.57**	m
Lengh of Riprap (L_a)=	**6.67**	m
Head Width of Riprap (W_H)=	**2.15**	m
Tail Width of Riprap (W_T)=	**2.15**	m
Height of Riprap (H)=	**1.00**	m

RIPRAP PROTECTION SIZING

PROJECT NAME: Delmore Stage 2 Created By ZW Date 2/07/2025
PROJECT Nos: 3725 Checked By JK Date 2/07/2025

Location: **Outlet 1-1**

Pipe Dia. (D_o):	0.375	m
Slope:	16	%
Flow (Q):	0.249	m^3/s
Velocity (V):	6.3	m/s
Depth of flow in pipe(d_p):	0.15	m

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	5.1935		
Riprap Diameter (d_s)=	$0.25 \times D_o \times F_o$	=	0.49	m	
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.97	m	
Lengh of Riprap (L_a)=	$D_o \times (8 + 17 \times \text{Log}F_o)$	=	7.56	m	
Width of Riprap (W_A)=	$3 \times D_o$	=	1.13	m	< Wingwall Width
Height of Riprap (H)=	crown of pipe +300mm	=	0.68	m	

WINGWALL DIMENSIONS

Tail Width of Wingwall (W_w)=	2.15	m
Height of Wingall (H_w)=	1	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.49**	m
Thickness of Riprap (D_A)=	**0.97**	m
Lengh of Riprap (L_a)=	**7.56**	m
Head Width of Riprap (W_H)=	**2.15**	m
Tail Width of Riprap (W_T)=	**2.15**	m
Height of Riprap (H)=	**1.00**	m

RIPRAP PROTECTION SIZING

PROJECT NAME: Delmore Stage 2 Created By ZW Date 2/07/2025
PROJECT Nos: 3725 Checked By JK Date 2/07/2025

Location: **Outlet 2-1**

Pipe Dia. (D_o):	0.6	m
Slope:	14	%
Flow (Q):	0.387	m^3/s
Velocity (V):	1.74	m/s
Depth of flow in pipe(d_p):	0.44	m

<u>TR 2013/018</u>

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	0.8375		
Riprap Diameter (d_s)=	$0.25 \times D_o \times F_o$	=	0.13	m	
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.25	m	
Lengh of Riprap (L_a)=	$D_o \times (8 + 17 \times \log F_o)$	=	4.01	m	
Width of Riprap (W_A)=	$3 \times D_o$	=	1.80	m	< Wingwall Width
Height of Riprap (H)=	crown of pipe +300mm	=	0.90	m	

<u>WINGWALL DIMENSIONS</u>

Tail Width of Wingwall (W_w)=	2.15	m
Height of Wingall (H_w)=	1	m

<u>RIPRAP DIMENSIONS</u>

Riprap Diameter (d_s)=	**0.13**	m
Thickness of Riprap (D_A)=	**0.25**	m
Lengh of Riprap (L_a)=	**4.01**	m
Head Width of Riprap (W_H)=	**2.15**	m
Tail Width of Riprap (W_T)=	**2.15**	m
Height of Riprap (H)=	**1.00**	m

RIPRAP PROTECTION SIZING

PROJECT NAME: Delmore Stage 2 Created By ZW Date 2/07/2025
PROJECT Nos: 3725 Checked By JK Date 2/07/2025

Location: **Outlet 3-1**

Pipe Dia. (D_o):	0.6	m
Slope:	30.586	%
Flow (Q):	0.404	m^3/s
Velocity (V):	5.71	m/s
Depth of flow in pipe(d_p):	0.18	m

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	4.2970		
Riprap Diameter (d_s)=	$0.25 \times D_o \times F_o$	=	0.64	m	
Thickness of Riprap (D_A)=	$2 \times d_s$	=	1.29	m	
Lengh of Riprap (L_a)=	$D_o \times (8 + 17 \times \text{Log}F_o)$	=	11.26	m	
Width of Riprap (W_A)=	$3 \times D_o$	=	1.80	m	< Wingwall Width
Height of Riprap (H)=	crown of pipe +300mm	=	0.90	m	

WINGWALL DIMENSIONS

Tail Width of Wingwall (W_w)=	2.15	m
Height of Wingall (H_w)=	1	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.64**	m
Thickness of Riprap (D_A)=	**1.29**	m
Lengh of Riprap (L_a)=	**11.26**	m
Head Width of Riprap (W_H)=	**2.15**	m
Tail Width of Riprap (W_T)=	**2.15**	m
Height of Riprap (H)=	**1.00**	m

RIPRAP PROTECTION SIZING

PROJECT NAME: Delmore Stage 2 Created By ZW Date 2/07/2025
PROJECT Nos: 3725 Checked By JK Date 2/07/2025

Location: **Outlet 5-1**

Pipe Dia. (D_o):	0.225	m
Slope:	30	%
Flow (Q):	0.0847	m^3/s
Velocity (V):	4.94	m/s
Depth of flow in pipe(d_p):	0.1	m

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	4.9876		
Riprap Diameter (d_s)=	$0.25 \times D_o \times F_o$	=	0.28	m	
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.56	m	
Lengh of Riprap (L_a)=	$D_o \times (8 + 17 \times \log F_o)$	=	4.47	m	
Width of Riprap (W_A)=	$3 \times D_o$	=	0.68	m	< Wingwall Width
Height of Riprap (H)=	crown of pipe +300mm	=	0.53	m	

WINGWALL DIMENSIONS

Tail Width of Wingwall (W_w)=	1	m
Height of Wingall (H_w)=	0.52	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.28**	m
Thickness of Riprap (D_A)=	**0.56**	m
Lengh of Riprap (L_a)=	**4.47**	m
Head Width of Riprap (W_H)=	**1.00**	m
Tail Width of Riprap (W_T)=	**1.00**	m
Height of Riprap (H)=	**0.53**	m

RIPRAP PROTECTION SIZING

PROJECT NAME: Delmore Stage 2	Created By ZW	Date	2/07/2025
PROJECT Nos: 3725	Checked By JK	Date	2/07/2025

Location: **Outlet 12-1**

Pipe Dia. (D_o):	0.825	m
Slope:	48.439	%
Flow (Q):	0.88	m^3/s
Velocity (V):	4.79	m/s
Depth of flow in pipe(d_p):	0.31	m

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	2.7468		
Riprap Diameter (d_s)=	$0.25 \times D_o \times F_o$	=	0.57	m	
Thickness of Riprap (D_A)=	$2 \times d_s$	=	1.13	m	
Lengh of Riprap (L_a)=	$D_o \times (8 + 17 \times \text{Log}F_o)$	=	12.75	m	
Width of Riprap (W_A)=	$3 \times D_o$	=	2.48	m	< Wingwall Width
Height of Riprap (H)=	crown of pipe +300mm	=	1.13	m	

WINGWALL DIMENSIONS

Tail Width of Wingwall (W_w)=	3	m
Height of Wingall (H_w)=	1.675	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.57**	m
Thickness of Riprap (D_A)=	**1.13**	m
Lengh of Riprap (L_a)=	**12.75**	m
Head Width of Riprap (W_H)=	**3.00**	m
Tail Width of Riprap (W_T)=	**3.00**	m
Height of Riprap (H)=	**1.68**	m

RIPRAP PROTECTION SIZING

PROJECT NAME: Delmore Stage 2 Created By ZW Date 2/07/2025
PROJECT Nos: 3725 Checked By JK Date 2/07/2025

Location: **Outlet 15-1**

Pipe Dia. (D_o):	0.675	m
Slope:	39	%
Flow (Q):	1.314	m^3/s
Velocity (V):	10.21	m/s
Depth of flow in pipe(d_p):	0.26	m

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	6.3930		
Riprap Diameter (d_s)=	$0.25 \times D_o \times F_o$	=	1.08	m	
Thickness of Riprap (D_A)=	$2 \times d_s$	=	2.16	m	
Lengh of Riprap (L_a)=	$D_o \times (8 + 17 \times \mathrm{Log}F_o)$	=	14.65	m	
Width of Riprap (W_A)=	$3 \times D_o$	=	2.03	m	< Wingwall Width
Height of Riprap (H)=	crown of pipe +300mm	=	0.98	m	

WINGWALL DIMENSIONS

Tail Width of Wingwall (W_w)=	3	m
Height of Wingall (H_w)=	1.675	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**1.08**	m
Thickness of Riprap (D_A)=	**2.16**	m
Lengh of Riprap (L_a)=	**14.65**	m
Head Width of Riprap (W_H)=	**3.00**	m
Tail Width of Riprap (W_T)=	**3.00**	m
Height of Riprap (H)=	**1.68**	m

RIPRAP PROTECTION SIZING

PROJECT NAME: Delmore Stage 2 Created By ZW Date 2/07/2025
PROJECT Nos: 3725 Checked By JK Date 2/07/2025

Location: **Outlet 16-1**

Pipe Dia. (D_o):	0.45	m
Slope:	33	%
Flow (Q):	0.2576	m^3/s
Velocity (V):	7.34	m/s
Depth of flow in pipe(d_p):	0.12	m

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	6.7650		
Riprap Diameter (d_s)=	$0.25 \times D_o \times F_o$	=	0.76	m	
Thickness of Riprap (D_A)=	$2 \times d_s$	=	1.52	m	
Lengh of Riprap (L_a)=	$D_o \times (8 + 17 \times LogF_o)$	=	9.95	m	
Width of Riprap (W_A)=	$3 \times D_o$	=	1.35	m	< Wingwall Width
Height of Riprap (H)=	crown of pipe +300mm	=	0.75	m	

WINGWALL DIMENSIONS

Tail Width of Wingwall (W_w)=	2.15	m
Height of Wingall (H_w)=	1	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.76**	m
Thickness of Riprap (D_A)=	**1.52**	m
Lengh of Riprap (L_a)=	**9.95**	m
Head Width of Riprap (W_H)=	**2.15**	m
Tail Width of Riprap (W_T)=	**2.15**	m
Height of Riprap (H)=	**1.00**	m

RIPRAP PROTECTION SIZING

PROJECT NAME: Delmore Stage 2 Created By ZW Date 2/07/2025
PROJECT Nos: 3725 Checked By JK Date 2/07/2025

Location: **Outlet 20-1**

Pipe Dia. (D_o):	0.9	m
Slope:	8.545	%
Flow (Q):	1.016	m^3/s
Velocity (V):	6.17	m/s
Depth of flow in pipe(d_p):	0.28	m

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	3.7228		
Riprap Diameter (d_s)=	$0.25 \times D_o \times F_o$	=	0.84	m	
Thickness of Riprap (D_A)=	$2 \times d_s$	=	1.68	m	
Lengh of Riprap (L_a)=	$D_o \times (8 + 17 \times \log F_o)$	=	15.93	m	
Width of Riprap (W_A)=	$3 \times D_o$	=	2.70	m	< Wingwall Width
Height of Riprap (H)=	crown of pipe +300mm	=	1.20	m	

WINGWALL DIMENSIONS

Tail Width of Wingwall (W_w)=	3	m
Height of Wingall (H_w)=	1.675	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.84**	m
Thickness of Riprap (D_A)=	**1.68**	m
Lengh of Riprap (L_a)=	**15.93**	m
Head Width of Riprap (W_H)=	**3.00**	m
Tail Width of Riprap (W_T)=	**3.00**	m
Height of Riprap (H)=	**1.68**	m

RIPRAP PROTECTION SIZING

PROJECT NAME: Delmore Stage 2
PROJECT Nos: 3725

Created By ZW Date 2/07/2025
Checked By JK Date 2/07/2025

Location: **Outlet 21-1**

Pipe Dia. (D_o):	0.75	m
Slope:	34.583	%
Flow (Q):	0.644	m^3/s
Velocity (V):	1.99	m/s
Depth of flow in pipe(d_p):	0.52	m

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	0.8811		
Riprap Diameter (d_s)=	$0.25 \times D_o \times F_o$	=	0.17	m	
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.33	m	
Lengh of Riprap (L_a)=	$D_o \times (8 + 17 \times LogF_o)$	=	5.30	m	
Width of Riprap (W_A)=	$3 \times D_o$	=	2.25	m	< Wingwall Width
Height of Riprap (H)=	crown of pipe +300mm	=	1.05	m	

WINGWALL DIMENSIONS

Tail Width of Wingwall (W_w)=	3	m
Height of Wingall (H_w)=	1.675	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.17**	m
Thickness of Riprap (D_A)=	**0.33**	m
Lengh of Riprap (L_a)=	**5.30**	m
Head Width of Riprap (W_H)=	**3.00**	m
Tail Width of Riprap (W_T)=	**3.00**	m
Height of Riprap (H)=	**1.68**	m

RIPRAP PROTECTION SIZING

PROJECT NAME: Delmore Stage 2 Created By ZW Date 2/07/2025
PROJECT Nos: 3725 Checked By JK Date 2/07/2025

Location: **Outlet 28-1**

Pipe Dia. (D_o):	0.525	m
Slope:	21.2	%
Flow (Q):	0.289	m^3/s
Velocity (V):	3.75	m/s
Depth of flow in pipe(d_p):	0.2	m

<u>TR 2013/018</u>

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	2.6772		
Riprap Diameter (d_s)=	$0.25 \times D_o \times F_o$	=	0.35	m	
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.70	m	
Lengh of Riprap (L_a)=	$D_o \times (8 + 17 \times \text{Log}F_o)$	=	8.02	m	
Width of Riprap (W_A)=	$3 \times D_o$	=	1.58	m	< Wingwall Width
Height of Riprap (H)=	crown of pipe +300mm	=	0.83	m	

<u>WINGWALL DIMENSIONS</u>

Tail Width of Wingwall (W_w)=	2.15	m
Height of Wingall (H_w)=	1	m

<u>RIPRAP DIMENSIONS</u>

Riprap Diameter (d_s)=	**0.35**	m
Thickness of Riprap (D_A)=	**0.70**	m
Lengh of Riprap (L_a)=	**8.02**	m
Head Width of Riprap (W_H)=	**2.15**	m
Tail Width of Riprap (W_T)=	**2.15**	m
Height of Riprap (H)=	**1.00**	m

RIPRAP PROTECTION SIZING

PROJECT NAME: Delmore Stage 2	Created By ZW	Date	2/07/2025
PROJECT Nos: 3725	Checked By JK	Date	2/07/2025

Location: **Outlet 30-1**

Pipe Dia. (D_o):	0.45	m
Slope:	42	%
Flow (Q):	0.145	m^3/s
Velocity (V):	5.1	m/s
Depth of flow in pipe(d_p):	0.11	m

<u>TR 2013/018</u>

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	4.9095		
Riprap Diameter (d_s)=	$0.25 \times D_o \times F_o$	=	0.55	m	
Thickness of Riprap (D_A)=	$2 \times d_s$	=	1.10	m	
Lengh of Riprap (L_a)=	$D_o \times (8 + 17 \times \text{Log}F_o)$	=	8.89	m	
Width of Riprap (W_A)=	$3 \times D_o$	=	1.35	m	< Wingwall Width
Height of Riprap (H)=	crown of pipe +300mm	=	0.75	m	

<u>WINGWALL DIMENSIONS</u>

Tail Width of Wingwall (W_w)=	2.15	m
Height of Wingall (H_w)=	1	m

<u>RIPRAP DIMENSIONS</u>

Riprap Diameter (d_s)=	**0.55**	m
Thickness of Riprap (D_A)=	**1.10**	m
Lengh of Riprap (L_a)=	**8.89**	m
Head Width of Riprap (W_H)=	**2.15**	m
Tail Width of Riprap (W_T)=	**2.15**	m
Height of Riprap (H)=	**1.00**	m

RIPRAP PROTECTION SIZING

PROJECT NAME: Delmore Stage 2 Created By ZW Date 2/07/2025
PROJECT Nos: 3725 Checked By JK Date 2/07/2025

Location: **Outlet 41-1**

Pipe Dia. (D_o):	0.3	m
Slope:	20	%
Flow (Q):	0.0943	m^3/s
Velocity (V):	5.94	m/s
Depth of flow in pipe(d_p):	0.08	m

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	6.7051		
Riprap Diameter (d_s)=	$0.25 \times D_o \times F_o$	=	0.50	m	
Thickness of Riprap (D_A)=	$2 \times d_s$	=	1.01	m	
Lengh of Riprap (L_a)=	$D_o \times (8 + 17 \times \text{Log}F_o)$	=	6.61	m	
Width of Riprap (W_A)=	$3 \times D_o$	=	0.90	m	< Wingwall Width
Height of Riprap (H)=	crown of pipe +300mm	=	0.60	m	

WINGWALL DIMENSIONS

Tail Width of Wingwall (W_w)=	2.15	m
Height of Wingall (H_w)=	1	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.50**	m
Thickness of Riprap (D_A)=	**1.01**	m
Lengh of Riprap (L_a)=	**6.61**	m
Head Width of Riprap (W_H)=	**2.15**	m
Tail Width of Riprap (W_T)=	**2.15**	m
Height of Riprap (H)=	**1.00**	m

RIPRAP PROTECTION SIZING - TR 2013/018

PROJECT NAME	Delmore Development - STAGE 1	Created By	ZW	Date	30/06/2025
PROJECT Nos:	3725	Checked By	JK	Date	30/06/2025

Location: **DISCHARGE POINT 1**

Channel Width (W_o):	0.4	m	
Channel Side Slope:	1 IN 3		
Slope:	12	%	
Flow (Q):	0.713	m^3/s	
Velocity (V):	2.99	m/s	Manning's Calculation
Depth of flow in channel(d_c):	0.223	m	Manning's Calculation

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	2.0215	
Riprap Diameter (d_s)=	$0.25 \times W_o \times F_o$	=	0.20	m
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.40	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.20**	m
Thickness of Riprap (D_A)=	**0.40**	m
Total Channel Width=	**1.74**	m

Note in accordance with TR2013/018 minimum D50 to be 0.15m and minimum RipRap thickness to be 0.3m

RIPRAP PROTECTION SIZING - TR 2013/018

PROJECT NAME	Delmore Development - STAGE 1	Created By	ZW	Date	30/06/2025
PROJECT Nos:	3725	Checked By	JK	Date	30/06/2025

Location: **DISCHARGE POINT 2**

Channel Width (W_o):	0.5	m	
Channel Side Slope:	1 IN 3		
Slope:	34	%	
Flow (Q):	1.013	m^3/s	
Velocity (V):	4.784	m/s	Manning's Calculation
Depth of flow in channel(d_c):	0.195	m	Manning's Calculation

<u>TR 2013/018</u>

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	3.4589	
Riprap Diameter (d_s)=	$0.25 \times W_o \times F_o$	=	0.43	m
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.86	m

<u>RIPRAP DIMENSIONS</u>

Riprap Diameter (d_s)=	**0.43**	m
Thickness of Riprap (D_A)=	**0.86**	m
Total Channel Width=	**1.67**	m

Note in accordance with TR2013/018 minimum D50 to be 0.15m and minimum RipRap thickness to be 0.3m

RIPRAP PROTECTION SIZING - TR 2013/018

PROJECT NAME	Delmore Development - STAGE 1	Created By	ZW	Date	30/06/2025
PROJECT Nos:	3725	Checked By	JK	Date	30/06/2025

Location: DISCHARGE POINT 3

Channel Width (W_o):	0.5	m	
Channel Side Slope:	1 IN 3		
Slope:	23	%	
Flow (Q):	1.123	m^3/s	
Velocity (V):	4.256	m/s	Manning's Calculation
Depth of flow in channel(d_c):	0.225	m	Manning's Calculation

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	2.8647	
Riprap Diameter (d_s)=	$0.25 \times W_o \times F_o$	=	0.36	m
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.72	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.36**	m
Thickness of Riprap (D_A)=	**0.72**	m
Total Channel Width=	**1.85**	m

Note in accordance with TR2013/018 minimum D50 to be 0.15m and minimum RipRap thickness to be 0.3m

DISCHARGE POINT DIMENSIONS

DISCHARGE	FLOOD FLOW (m3/s)	FLOOD VELOCITY (m/s)	CHANNEL BED WIDTH Wb	GRADE (SLOPE) '%'	CHANNEL SIDE SLOPE	RIPRAP DIAMETER 'd^s' (m)	RIPRAP THICKNESS 'D^A' (m)
DISCHARGE POINT 1	0.713	2.99	0.4	12	1 IN 3	0.20	0.40
DISCHARGE POINT 2	1.013	4.784	0.5	34	1 IN 3	0.43	0.86
DISCHARGE POINT 3	1.123	4.256	0.5	23	1 IN 3	0.36	0.72
DISCHARGE POINT 4	0.951	OVER TOP AT CULVERT 5					
DISCHARGE POINT 5	0.674	OVER TOP AT CULVERT 4					
DISCHARGE POINT 6	0.412	OVER TOP AT CULVERT 2					
DISCHARGE POINT 7	1.984	OVER TOP AT CULVERT 3					
DISCHARGE POINT 8	0.03	OVER TOP AT CULVERT 12					

Refer to Engineering Calculations (TR2013/018)

RIPRAP PROTECTION SIZING - TR 2013/018

PROJECT NAME	Delmore Development - STAGE 2A-1, 2A-2 & 2B-1	Created By	ZW	Date	30/06/2025
PROJECT Nos:	3725	Checked By	JK	Date	30/06/2025

Location: DISCHARGE POINT 1

Channel Width (W_o):	0.5	m	
Channel Side Slope:	1 IN 3		
Slope:	21.651	%	
Flow (Q):	0.397	m^3/s	
Velocity (V):	3.12	m/s	Manning's Calculation
Depth of flow in channel(d_c):	0.139	m	Manning's Calculation

<u>TR 2013/018</u>

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	2.6719	
Riprap Diameter (d_s)=	$0.25 \times W_o \times F_o$	=	0.33	m
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.67	m

<u>RIPRAP DIMENSIONS</u>

Riprap Diameter (d_s)=	**0.33**	m
Thickness of Riprap (D_A)=	**0.67**	m
Total Channel Width=	**1.33**	m

Note in accordance with TR2013/018 minimum D50 to be 0.15m and minimum RipRap thickness to be 0.3m

RIPRAP PROTECTION SIZING - TR 2013/018

PROJECT NAME	Delmore Development - STAGE 2A-1, 2A-2 & 2B-1	Created By	ZW	Date	30/06/2025
PROJECT Nos:	3725	Checked By	JK	Date	30/06/2025

Location: DISCHARGE POINT 2

Channel Width (W_o):	0.5	m	
Channel Side Slope:	1 IN 3		
Slope:	25	%	
Flow (Q):	0.37	m^3/s	
Velocity (V):	3.261	m/s	Manning's Calculation
Depth of flow in channel(d_c):	0.13	m	Manning's Calculation

<u>**TR 2013/018**</u>

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	2.8877	
Riprap Diameter (d_s)=	$0.25 \times W_o \times F_o$	=	0.36	m
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.72	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.36**	m
Thickness of Riprap (D_A)=	**0.72**	m
Total Channel Width=	**1.28**	m

Note in accordance with TR2013/018 minimum D50 to be 0.15m and minimum RipRap thickness to be 0.3m

RIPRAP PROTECTION SIZING - TR 2013/018

PROJECT NAME	Delmore Development - STAGE 2A-1, 2A-2 & 2B-1	Created By	ZW	Date	30/06/2025
PROJECT Nos:	3725	Checked By	JK	Date	30/06/2025

Location: DISCHARGE POINT 3

Channel Width (W_o):	0.5	m	
Channel Side Slope:	1 IN 3		
Slope:	30	%	
Flow (Q):	0.03	m^3/s	
Velocity (V):	1.623	m/s	Manning's Calculation
Depth of flow in channel(d_c):	0.031	m	Manning's Calculation

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	2.9431	
Riprap Diameter (d_s)=	$0.25 \times W_o \times F_o$	=	0.37	m
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.74	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.37**	m
Thickness of Riprap (D_A)=	**0.74**	m
Total Channel Width=	**0.69**	m

Note in accordance with TR2013/018 minimum D50 to be 0.15m and minimum RipRap thickness to be 0.3m

RIPRAP PROTECTION SIZING - TR 2013/018

PROJECT NAME	Delmore Development - STAGE 2A-1, 2A-2 & 2B-1	Created By	ZW	Date	30/06/2025
PROJECT Nos:	3725	Checked By	JK	Date	30/06/2025

Location: DISCHARGE POINT 5

Channel Width (W_o):	0.5	m	
Channel Side Slope:	1 IN 3		
Slope:	15	%	
Flow (Q):	0.04	m^3/s	
Velocity (V):	1.412	m/s	Manning's Calculation
Depth of flow in channel(d_c):	0.045	m	Manning's Calculation

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	2.1252	
Riprap Diameter (d_s)=	$0.25 \times W_o \times F_o$	=	0.27	m
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.53	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.27**	m
Thickness of Riprap (D_A)=	**0.53**	m
Total Channel Width=	**0.77**	m

Note in accordance with TR2013/018 minimum D50 to be 0.15m and minimum RipRap thickness to be 0.3m

RIPRAP PROTECTION SIZING - TR 2013/018

PROJECT NAME	Delmore Development - STAGE 2A-1, 2A-2 & 2B-1	Created By	ZW	Date	30/06/2025
PROJECT Nos:	3725	Checked By	JK	Date	30/06/2025

Location: DISCHARGE POINT 7

Channel Width (W_o):	0.5	m	
Channel Side Slope:	1 IN 3		
Slope:	22	%	
Flow (Q):	0.12	m^3/s	
Velocity (V):	2.26	m/s	Manning's Calculation
Depth of flow in channel(d_c):	0.074	m	Manning's Calculation

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	2.6525	
Riprap Diameter (d_s)=	$0.25 \times W_o \times F_o$	=	0.33	m
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.66	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.33**	m	Note in accordance with TR2013/018 minimum D50 to be 0.15m and minimum RipRap thickness to be 0.3m
Thickness of Riprap (D_A)=	**0.66**	m	
Total Channel Width=	**0.94**	m	

RIPRAP PROTECTION SIZING - TR 2013/018

PROJECT NAME	Delmore Development - STAGE 2A-1, 2A-2 & 2B-1	Created By	ZW	Date	30/06/2025
PROJECT Nos:	3725	Checked By	JK	Date	30/06/2025

Location: DISCHARGE POINT 7

Channel Width (W_o):	0.5	m	
Channel Side Slope:	1 IN 3		
Slope:	12.89	%	
Flow (Q):	0.25	m^3/s	
Velocity (V):	2.31	m/s	Manning's Calculation
Depth of flow in channel(d_c):	0.124	m	Manning's Calculation

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	2.0944	
Riprap Diameter (d_s)=	$0.25 \times W_o \times F_o$	=	0.26	m
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.52	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.26**	m	Note in accordance with TR2013/018 minimum D50 to be 0.15m and minimum RipRap thickness to be 0.3m
Thickness of Riprap (D_A)=	**0.52**	m	
Total Channel Width=	**1.24**	m	

RIPRAP PROTECTION SIZING - TR 2013/018

PROJECT NAME	Delmore Development - STAGE 2A-1, 2A-2 & 2B-1	Created By	ZW	Date	30/06/2025
PROJECT Nos:	3725	Checked By	JK	Date	30/06/2025

Location: **DISCHARGE POINT 9**

Channel Width (W_o):	0.5	m	
Channel Side Slope:	1 IN 3		
Slope:	22.363	%	
Flow (Q):	0.04	m^3/s	
Velocity (V):	1.609	m/s	Manning's Calculation
Depth of flow in channel(d_c):	0.04	m	Manning's Calculation

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	2.5686	
Riprap Diameter (d_s)=	$0.25 \times W_o \times F_o$	=	0.32	m
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.64	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.32**	m
Thickness of Riprap (D_A)=	**0.64**	m
Total Channel Width=	**0.74**	m

Note in accordance with TR2013/018 minimum D50 to be 0.15m and minimum RipRap thickness to be 0.3m

RIPRAP PROTECTION SIZING - TR 2013/018

PROJECT NAME	Delmore Development - STAGE 2A-1, 2A-2 & 2B-1	Created By	ZW	Date	30/06/2025
PROJECT Nos:	3725	Checked By	JK	Date	30/06/2025

Location: **DISCHARGE POINT 10**

Channel Width (W_o):	0.5	m	
Channel Side Slope:	1 IN 3		
Slope:	10	%	
Flow (Q):	0.23	m^3/s	
Velocity (V):	2.052	m/s	Manning's Calculation
Depth of flow in channel(d_c):	0.127	m	Manning's Calculation

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	1.8384	
Riprap Diameter (d_s)=	$0.25 \times W_o \times F_o$	=	0.23	m
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.46	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.23**	m
Thickness of Riprap (D_A)=	**0.46**	m
Total Channel Width=	**1.26**	m

Note in accordance with TR2013/018 minimum D50 to be 0.15m and minimum RipRap thickness to be 0.3m

DISCHARGE POINT DIMENSIONS

DISCHARGE	FLOOD FLOW (m3/s)	FLOOD VELOCITY (m/s)	CHANNEL BED WIDTH Wb	GRADE (SLOPE) '%'	CHANNEL SIDE SLOPE	RIPRAP DIAMETER 'd^s' (m)	RIPRAP THICKNESS 'D^A' (m)
DISCHARGE POINT 1	0.397	3.12	0.5	21.651	1 IN 3	0.33	0.67
DISCHARGE POINT 2	0.37	3.261	0.5	25	1 IN 3	0.36	0.72
DISCHARGE POINT 3	0.03	1.623	0.5	30	1 IN 3	0.37	0.74
DISCHARGE POINT 4	0.73	OVERTOP AT CULVERT 9					
DISCHARGE POINT 5	0.04	1.412	0.5	15	1 IN 3	0.27	0.53
DISCHARGE POINT 6	0.76	OVERTOP AT CULVERT 8					
DISCHARGE POINT 7	0.12	2.26	0.5	22	1 IN 3	0.33	0.66
DISCHARGE POINT 8	0.25	2.31	0.5	12.89	1 IN 3	0.26	0.52
DISCHARGE POINT 9	0.04	1.609	0.5	22.363	1 IN 3	0.32	0.64
DISCHARGE POINT 10	0.23	2.052	0.5	10	1 IN 3	0.23	0.46

Refer to Engineering Calculations (TR2013/018)

RIPRAP PROTECTION SIZING - TR 2013/018

PROJECT NAME	Delmore Development - STAGE 2B-2, 2B-3 & 2C	Created By	ZW	Date	30/06/2025
PROJECT Nos:	3725	Checked By	JK	Date	30/06/2025

Location: **DISCHARGE POINT 1**

Channel Width (W_o):	0.5	m	
Channel Side Slope:	1 IN 3		
Slope:	70	%	
Flow (Q):	0.31	m^3/s	
Velocity (V):	4.491	m/s	Manning's Calculation
Depth of flow in channel(d_c):	0.1	m	Manning's Calculation

<u>TR 2013/018</u>

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	4.5343	
Riprap Diameter (d_s)=	$0.25 \times W_o \times F_o$	=	0.57	m
Thickness of Riprap (D_A)=	$2 \times d_s$	=	1.13	m

<u>RIPRAP DIMENSIONS</u>

Riprap Diameter (d_s)=	**0.57**	m
Thickness of Riprap (D_A)=	**1.13**	m
Total Channel Width=	**0.57**	m

Note in accordance with TR2013/018 minimum D50 to be 0.15m and minimum RipRap thickness to be 0.3m

RIPRAP PROTECTION SIZING - TR 2013/018

PROJECT NAME	Delmore Development - STAGE 2B-2, 2B-3 & 2C	Created By	ZW	Date	30/06/2025
PROJECT Nos:	3725	Checked By	JK	Date	30/06/2025

Location: DISCHARGE POINT 4

Channel Width (W_o):	0.5	m	
Channel Side Slope:	1 IN 3		
Slope:	39	%	
Flow (Q):	0.94	m^3/s	
Velocity (V):	4.934	m/s	Manning's Calculation
Depth of flow in channel(d_c):	0.182	m	Manning's Calculation

<u>TR 2013/018</u>

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	3.6926	
Riprap Diameter (d_s)=	$0.25 \times W_o \times F_o$	=	0.46	m
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.92	m

<u>RIPRAP DIMENSIONS</u>

Riprap Diameter (d_s)=	**0.46**	m
Thickness of Riprap (D_A)=	**0.92**	m
Total Channel Width=	**1.59**	m

Note in accordance with TR2013/018 minimum D50 to be 0.15m and minimum RipRap thickness to be 0.3m

RIPRAP PROTECTION SIZING - TR 2013/018

PROJECT NAME	Delmore Development - STAGE 2B-2, 2B-3 & 2C	Created By	ZW	Date	30/06/2025
PROJECT Nos:	3725	Checked By	JK	Date	30/06/2025

Location: DISCHARGE POINT 5

Channel Width (W_o):	0.5	m	
Channel Side Slope:	1 IN 3		
Slope:	15	%	
Flow (Q):	0.91	m^3/s	
Velocity (V):	3.44	m/s	Manning's Calculation
Depth of flow in channel(d_c):	0.225	m	Manning's Calculation

TR 2013/018

Froude number (F_o)= $V/(g \times d_p)^{0.5}$	=	2.3154	
Riprap Diameter (d_s)= $0.25 \times W_o \times F_o$	=	0.29	m
Thickness of Riprap (D_A)= $2 \times d_s$	=	0.58	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.29**	m
Thickness of Riprap (D_A)=	**0.58**	m
Total Channel Width=	**1.85**	m

Note in accordance with TR2013/018 minimum D50 to be 0.15m and minimum RipRap thickness to be 0.3m

RIPRAP PROTECTION SIZING - TR 2013/018

PROJECT NAME	Delmore Development - STAGE 2B-2, 2B-3 & 2C	Created By	ZW	Date	30/06/2025
PROJECT Nos:	3725	Checked By	JK	Date	30/06/2025

Location: **DISCHARGE POINT 6**

Channel Width (W_o):	0.5	m	
Channel Side Slope:	1 IN 3		
Slope:	11.57	%	
Flow (Q):	2.04	m^3/s	
Velocity (V):	3.847	m/s	Manning's Calculation
Depth of flow in channel(d_c):	0.345	m	Manning's Calculation

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	2.0911	
Riprap Diameter (d_s)=	$0.25 \times W_o \times F_o$	=	0.26	m
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.52	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.26**	m
Thickness of Riprap (D_A)=	**0.52**	m
Total Channel Width=	**2.57**	m

Note in accordance with TR2013/018 minimum D50 to be 0.15m and minimum RipRap thickness to be 0.3m

RIPRAP PROTECTION SIZING - TR 2013/018

PROJECT NAME	Delmore Development - STAGE 2B-2, 2B-3 & 2C	Created By	ZW	Date	30/06/2025
PROJECT Nos:	3725	Checked By	JK	Date	30/06/2025

Location: **DISCHARGE POINT 8**

Channel Width (W_o):	0.5	m	
Channel Side Slope:	1 IN 3		
Slope:	10.6	%	
Flow (Q):	0.07	m^3/s	
Velocity (V):	1.491	m/s	Manning's Calculation
Depth of flow in channel(d_c):	0.067	m	Manning's Calculation

TR 2013/018

Froude number (F_o)=	$V/(g \times d_p)^{0.5}$	=	1.8391	
Riprap Diameter (d_s)=	$0.25 \times W_o \times F_o$	=	0.23	m
Thickness of Riprap (D_A)=	$2 \times d_s$	=	0.46	m

RIPRAP DIMENSIONS

Riprap Diameter (d_s)=	**0.23**	m
Thickness of Riprap (D_A)=	**0.46**	m
Total Channel Width=	**0.90**	m

Note in accordance with TR2013/018 minimum D50 to be 0.15m and minimum RipRap thickness to be 0.3m

APPENDIX C – Correspondence

James Kitchen

From: HWDevelopment <HWDevelopment@aucklandcouncil.govt.nz>
Sent: Wednesday, 20 March 2024 2:44 pm
To: James Kitchen
Subject: FW: Russell Road Flood modelling
Attachments: Russell Road Flood Model.pdf

Hi James

Please see the specialist comments in red below:

- Can we please get a copy of the latest flood modelling in this area ? We do not provide models. However, I have extracted information from our flood viewer to help you gain a better understanding of the current flood situation in this catchment.
- Can I please get a copy of the Orewa West SMP? There is no adopted SMP for the area of interest, we have one ICMP. I have attached them in the link below.
- Is there a SMP for the Ara Hills development to the north that I could please get a link to? We do not have an approved SMP yet.

Orewa West Approved SWICMP 2010_notified Feb 2011 (2).zip

Ngā mihi | Kind Regards,

Rani Sharma
Customer Specialist | Mātanga | Kirihoko
Healthy Waters Infrastructure and Environmental Services
Auckland Council, Level 17, Auckland House.
Visit our website: www.aucklandcouncil.govt.nz

Auckland Council
Te Kaunihera o Tāmaki Makaurau

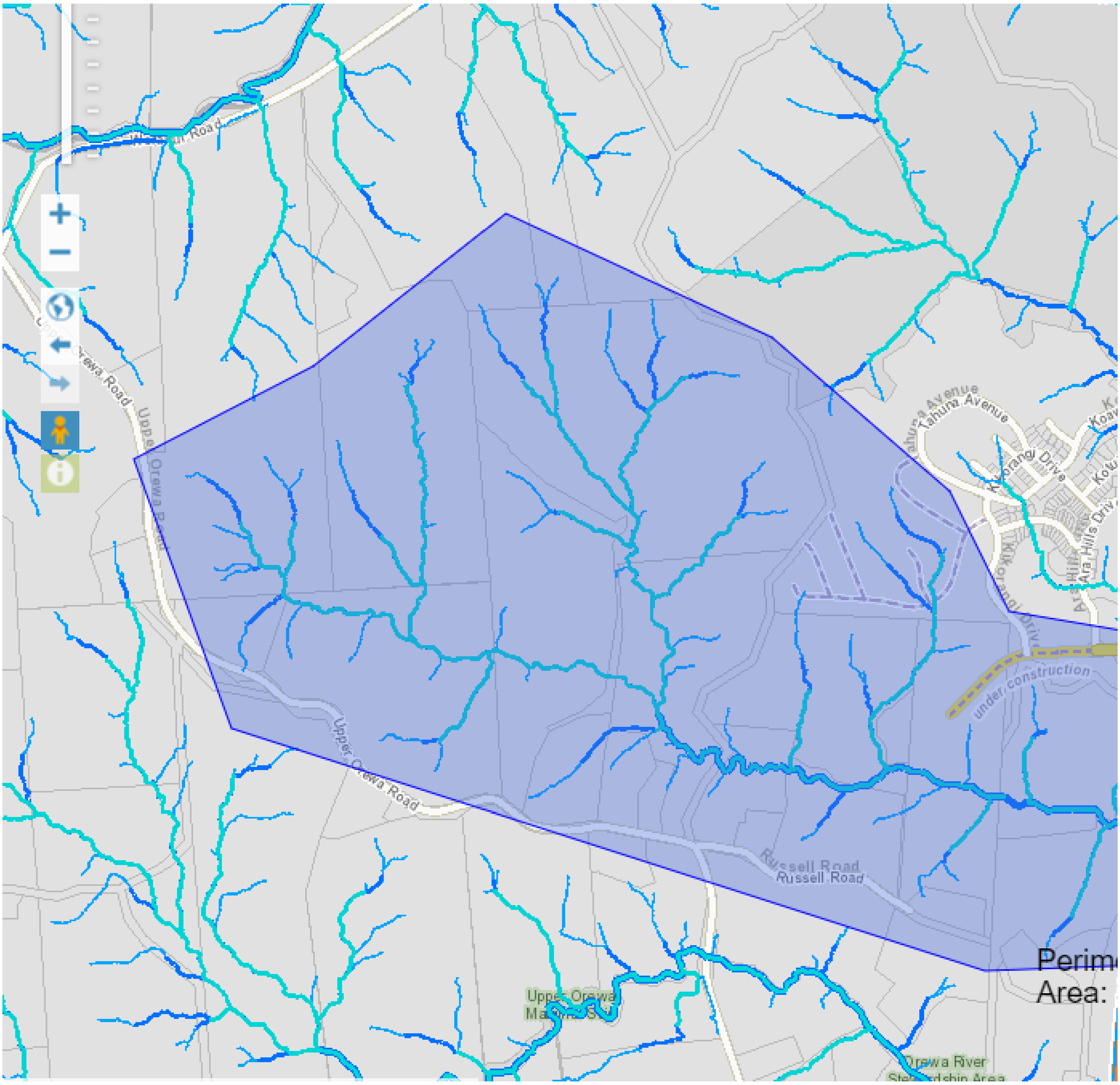
From: James Kitchen <james@mckenzieandco.co.nz>
Sent: Monday, 18 March, 2024 10:53 AM
To: HWDevelopment <HWDevelopment@aucklandcouncil.govt.nz>
Cc: Brin Hingston <brin.hingston@mckenzieandco.co.nz>
Subject: Russell Road Flood modelling

Hi,
We are preparing a stormwater management plan for a development in the area shaded in blue below.

- Can we please get a copy of the latest flood modelling in this area ?
- Can I please get a copy of the Orewa West SMP ?
- Is there a SMP for the Ara Hills development to the north that I could please get a link to?

I would also like to have a chat with the catchment manager on requirements for a site specific flood model for this catchment, to confirm our model inputs and methodology before we start on this modelling.

Many thanks !



Ngā mihi,

James Kitchen CMEngNZ, CPEng, IntPE(NZ)
Director
021 951 230

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James Kitchen

From: HWDevelopment <HWDevelopment@aucklandcouncil.govt.nz>
Sent: Friday, 29 November 2024 2:56 pm
To: Ed Hall
Subject: FW: [#3725] Delmore Flood Model Parameter draft memo - Healthy Waters (Rani Sharma)

Kia ora Ed

Thank you for your email.
Please note that as per our modelling team, we do not review or provide feedback on development inputs or information upfront. The development must be lodged at least to the pre-application stage for us to proceed.

Here is the link for the pre-application meeting: https://www.aucklandcouncil.govt.nz/building-and-consents/ask-for-guidance/Pages/resource-consent-pre-application-guidance.aspx

Ngā mihi | Kind Regards,

Rani Sharma
Customer Specialist
Healthy Waters and Flood Resilience I Te wāhanga mō ngā Wai Ora me te Manawaroa ā-Waipuke
Auckland Council, Level 17, Auckland House.
Visit our website: www.aucklandcouncil.govt.nz

Auckland Council
Te Kaunihera o Tāmaki Makaurau

From: Ed Hall <Ed.Hall@mckenzieandco.co.nz>
Sent: Wednesday, 20 November, 2024 12:58 PM
To: HWDevelopment <HWDevelopment@aucklandcouncil.govt.nz>
Cc: James Kitchen <james@mckenzieandco.co.nz>; Haka Subagio <Haka.Subagio@mckenzieandco.co.nz>
Subject: [#3725] Delmore Flood Model Parameter draft memo - Healthy Waters (Rani Sharma)

Hi Rani

Attached is the 'Delmore' project (Orewa) Flood Model Parameter draft memo for review.

Before we commence running of the model, we request that the input parameters and model set up is reviewed by Healthy Waters, and accepted.

Note that we are waiting on survey information however we confirm the culverts/bridges that will be in the model.

Can you please and providing comments on model set up ?

We are happy to come and meet, or alternatively please direct all technical queries through to Haka Subagio.

Regards
Ed

Ed Hall
Senior Development Manager
0275 428 873

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RC Pre-application Minutes – Healthy Waters

Planner-led Pre-application No.	PRR00042317 – Delmore Fast Track Pre-App	
Applicant	Andrew Allsopp-Smith: Vineway Limited	
Contact details	**Contact**	Nicole Heron – Barkers (Agent)
	Email	mailto:nicoleh@barker.co.nz
Site address	88 Upper Orewa Road Upper Orewa 0992, 472117 - Lot 2 DP 418770	
Proposal	Fast Track: Residential development on Future Urban Zoned land To subdivide the 109-hectare site and construct a master-planned residential development providing a complete urban outcome of approximately 1,250 homes complete with parks, river-side walkways, and supporting infrastructure (including the provision of the NOR 6 road within the site)	
Plans and information	Stormwater Management Plan and raingarden plans circulated 24 January	
Meeting		
Date, Time, Room	Wednesday 29 January 2025 3- 3.25pm. – Teams online	
Proposed meeting participants – Customer / Agents	Djordje Petkovic Nicole Heron Gerard Thompson James Kitchen	Myland Partners Barker & Associates Barker & Associates McKenzie & Co
Proposed meeting participants – Council	Carly Hinde Dylan Pope Samuel Holmes Martin Meyer Hillary Johnston	Principal Project Lead - Auckland Council External Planner – DCS Project Manager Reg Engineering - Auckland Council Stormwater Specialist – Auckland Council Healthy Waters (TEKTUS)
Minutes issued	4 February 2025	

Summary of key considerations and issues	
1 - Introductions	-
2 – Site & General Project Overview	It was confirmed that the Delmore fast track application is proposed to be lodged within the next few weeks. Gerard noted that the purpose of this introductory pre-app meeting is to introduce the scheme to the stormwater specialists and obtain initial feedback, with further engagement / pre-app meetings envisaged during the post-lodgement stages.

	DJ provided an overview of the scheme, noting it will be delivered in two stages and will comprise approx. 1,200 houses. There is an SEA, NOR6, three consent notice areas and various streams throughout the site.
3 – Overall stormwater strategy for the site	James provided an overview of the existing site, noting there is one large catchment which all flows from west to east, which discharges to a culvert under the motorway – there is one exit discharge point. There are various wetlands and streams which will be protected and enhanced. The overall strategy seeks to incorporate rain gardens for the whole site to treat high contaminant generating surfaces (via network discharge consent) – these will provide some retention and detention for the roads and JOALs, plus treatment to GD01 standards. It is proposed that the high flows will bypass the rain gardens and deal with the treatment component and just intended to manage the JOALs and roads, and lots adjacent to streams will have their own discharge points. This will ensure the flows do not all go to the raingardens at the bottom of the catchment and instead go to the wetlands, thereby retaining their condition. Any lots that do not front onto wetlands / streams will go via pipe network and treated through the rain gardens at the bottom of the catchment. James illustrated the location of the proposed raingardens which have been scattered around the site, including approx. 12 in Stage 1. The number of devices has been based on the undulating nature of the land, but using smallest possible because of on-site lots treatment and individual discharge points along stream edges. A flood assessment has been undertaken – all the downstream development is away from flood plain and flood flows will be passed downstream. The culverts have been sized to ensure upstream and downstream effects are mitigated. All of the development will be above the 1% storm levels and comply with Healthy Waters flood level standards. James noted that they were proposing rain gardens which will provide retention and detention (rather than wet land / dry basins), with various options considered. The on-lot tanks have been maximised as much as possible to keep as much on-lot as possible and minimise the size of the rain gardens. Samuel queried whether these will be able to achieve the retention component because of the engineered fill and earthworks. James confirmed that discussions

	have been undertaken with their geotechnical engineer and as a worst scenario if individual gardens cannot achieve the required infiltration or there are slope stability issues, then they will be lined. Based on his high-level review, Samuel suggested that from experience, heavily engineered soils cannot achieve the retention function of the rain garden and can be costly to maintain if they only provide detention, but if they provide treatment option there would be a necessity. Healthy Waters tend to prefer other options, for example dry basins or wetlands – James happy to review this further. All lots will have on-site tanks and units shown with a 'T' on the plans have individual outlet to stream edge. It was confirmed that the rain gardens are solely for the road and JOAL volumes. Hillary flagged that because of the FUZ land zoning it would not go under the regionwide network discharge consent and would need to have private consent until the zoning is changed. Any lots which discharge to stream environment ('T') will be private regardless – this is not an issue and the requirements are similar (nb maintenance requirements will vary), she just wanted to advise. Hillary asked for the contact details of the Healthy Waters catchment specialist who has provided the 2D modelling information and preliminary data. James confirmed he would provide their details and forward any wetlands / flooding information. Martin had no further comments based on his initial review of the SMP. It is intended that the rain gardens will be vested to Council and located within stormwater reserves. HW preference for land intended to be vested as 'land in lieu of reserve'. It was confirmed that maintenance vehicle access to these will be necessary and easements required from public road.