ENVELOPE

STORMWATER MANAGEMENT PLAN

Mt Welcome

DOCUMENT CONTROL RECORD

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1.0 EXECUTIVE SUMMARY

Envelope Engineering Ltd has been engaged to prepare this Stormwater Management Plan (SMP) to support the proposed Mt Welcome residential development, located south of Pukerua Bay within the Porirua Northern Growth Area (NGA).

This SMP has been prepared in accordance with the objectives and policies of the Proposed Porirua District Plan, the Wellington Water Regional Standard for Water Services (RSWS v3.1), and Greater Wellington Regional Council (GWRC) Plan Change 1.

The purpose of this SMP is to provide an integrated framework for the design, implementation, and long-term management of stormwater infrastructure within the site. It addresses the potential hydrological and water-quality effects associated with the proposed development and demonstrates how the proposed stormwater system achieves compliance with regional and local requirements. The SMP confirms that the proposed stormwater management approach:

- Maintains hydraulic neutrality, ensuring post-development peak flows do not exceed pre-development levels for all storm events up to and including the 1 % AEP event
- Provides stormwater treatment achieving at least 85% of the Mean Annual Runoff Volume (MARV)
- Reduces contaminants such as suspended solids, copper, and zinc through a treatment-train approach incorporating water-sensitive urban design
- Protects downstream watercourses and flood capacity, ensuring no increase in flood risk or erosion potential
- Confirms that the 1% AEP event can be safely conveyed via defined overland flow paths through the road network and stormwater management system, with no increase in flood risk to proposed lots, downstream properties, or infrastructure.
- Integrates stormwater design with the site's landform and ecological corridors, supporting environmental enhancement and long-term sustainability.

Stormwater Management Approach

- The proposed system adopts a treatment-train and water-sensitive design philosophy,
- Centralised raingardens treating road and allotment runoff
- Retention wetlands and attenuation ponds providing flow detention and controlled discharge to pre-development rates
- Primary and secondary conveyance networks designed for the 10 % AEP and 1 % AEP events (including climate-change allowances)
- Erosion and scour protection at all outlet structures
- Developer-maintained devices during staging to protect operational wetlands and raingardens until vesting to Porirua City Council / Wellington Water

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2.0 INTRODUCTION

2.1 GENERAL

The proposed Mt Welcome Development is located south of Pukerua Bay, within the Porirua Northern Growth Area (NGA). The site comprises currently undeveloped land identified for residential development.

This Stormwater Management Plan (SMP) provides the framework for the design and implementation of stormwater management measures required to support the development. It outlines the hydrological, hydraulic, and water-quality strategies necessary to achieve compliance with Wellington Water's Regional Standard for Water Services and the Greater Wellington Regional Council Plan Change 1 requirements.

This SMP also includes a Stormwater Impact Assessment required under Schedule 29 of PC1, addressing all relevant matters including hydrology, water quality, flooding, erosion, ecological, and cultural considerations.

2.2 SITE DESCRIPTION

The site is located at 422 State Highway 59, Pukerua Bay, and encompasses a total area of 205.60 hectares. It formally comprises the following land parcels:

- Part Lot 1 DP 89102 (4.38 ha)
- Lot 2 DP 891020 (5.64 ha)
- Lot 1 DP 534864 (55.33 ha)
- Lot 2 DP 534864 (140.25 ha)
- Lot 1 DP 608433, Lot 1000 DP 608433 (34 Muri Road)
- Road Reserve (SH59 Corridor)

References to "the site" within this report refer collectively to all seven allotments, unless stated otherwise.

The site is situated in a rural area south of Pukerua Bay and north of Plimmerton, within the Porirua City boundaries in the Wellington region. It is bounded by State Highway 59 to the west and three adjoining land blocks to the north, east, and south.

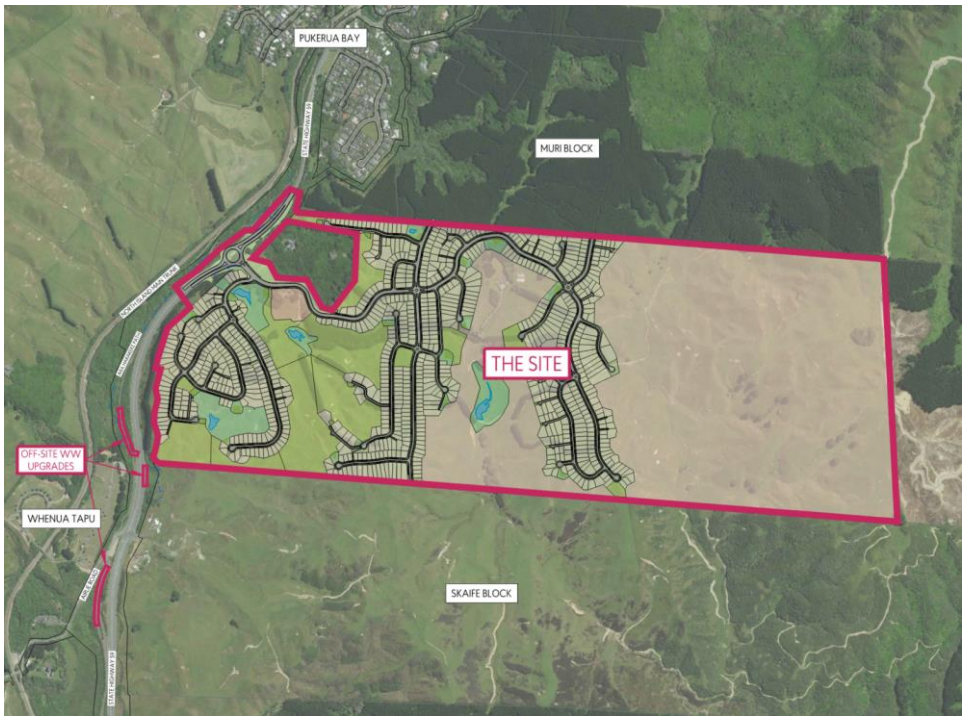


Figure 1. Site Extents Plan – Entire Site.

2.3 RELATIONSHIP TO OTHER PLANS

This report should be read in conjunction with the following plans and reports:

- Envelope Engineering Infrastructure Report.
- Envelope Engineering Draft ECMP
- Envelope Engineering Flood Assessment
- BlueGreen Ecology Assessment.
- Engeo Geotechnical Engineering Report.
- PDP Hydrological Assessment
- PDP Water Quality Assessment
- PDP Preliminary Site Investigation

3.0 SITE EVALUATION

3.1 SITE HISTORY

The site is currently used as a deer farm, comprising predominantly pastoral grassland with several existing homesteads, farm sheds, and associated agricultural infrastructure.

Historical aerial imagery dating back to 1942 shows the land as open pasture, and it has remained pasture since that time, with no significant changes in land use or built development.

3.2 DATA SOURCES & INVESTIGATIONS

The below table is a summary of the data sources and investigations that have informed this SMP.

Table 1. Data Sources

Existing Site Data	Source of Data
Topography	Porirua LiDAR 2023 Envelope topographical survey around site features
Geotechnical	ENGEO Geotechnical Investigation – Mt Welcome Development - Project Number 19796.000.002
Existing Stormwater Network	PCC GIS Maps Envelope site investigations
Streams	BlueGreen Ecological Assessment
Flood Hazards	PCC GIS Maps
Ecological	BlueGreen Ecological Assessment
Hydrological	PDP Hydrological Assessment
Contaminated Land	PDP Preliminary Site Investigation

3.3 SITE TOPOGRAPHY

The topography is varied and includes some land that is moderately steep and undulating, with elevations ranging from approximately RL 50 m near the western boundary (adjacent to SH59) to RL 300 m at the eastern extent of the site. The landform includes three prominent high points separated by two gullies. The western portion of the site comprises of rolling hills and shallow gullies, while the central and eastern areas are steeper, with slopes typically between 26° and 45°, and locally exceeding 45° in areas.

3.4 ECOLOGY AND ENVIRONMENTAL

BlueGreen Ecology have prepared the ecological assessment for the site. Their investigations identified that the existing streams, wetlands, and terrestrial habitats are of low ecological value, being largely exotic and modified by historic farming activities.

Overall, BlueGreen Ecology assess that the development will achieve a net ecological gain through riparian enhancement, stormwater quality treatment, and the removal of farming practices that currently degrade ecological values.

3.5 GEOTECHNICAL

ENGEO have completed a geotechnical report for the Mt Welcome development, which should be read in conjunction with this report. The key points relevant to the proposed civil works are summarised below:

- The site is located approximately 500 m from the mapped trace of the Pukerua Fault, within a seismically active area that also includes the Ohariu and Wellington Faults. While the site is not directly traversed by a known fault, ground rupture and regional subsidence could occur during a major seismic event on nearby or unmapped faults.
- Liquefaction risk is considered low within the developable areas but may occur locally in low-lying gullies and valley floors.
- Groundwater was recorded between approximately 0.4 m and 3.8 m below ground level, varying seasonally and by location. Continued groundwater monitoring is recommended to inform the detailed design of earthworks, stormwater ponds, and slope stability assessments.
- Soakage had not been deemed a suitable method of discharge, and no tests have been completed.
- Slopes steeper than 25 degrees require specific engineering assessment and mitigation where development is proposed above or below them. Specifically Engineered Design (SED) zones should be applied in these areas.
- Most surficial soils and Greywacke rock are suitable for reuse as engineered fill, subject to verification and field compaction testing.
- Detailed design of the proposed stormwater retention ponds and adjacent embankments is required by a chartered professional engineer.
- Installation of piezometers for ongoing groundwater monitoring for a minimum of four months prior to major earthworks is recommended to support final design and construction staging.

3.6 CONTAMINATION ASSESSMENT

Pattle Delamore Partners (PDP) have been engaged to carry out a Preliminary Site Investigation (PSI) to assess the risk of any previous land activities on the health of future residents. The investigation identified potential contamination sources from historical sheep dip/spray race operations and from older buildings that may have contributed asbestos and lead residues to surrounding soils.

PDP recommend that areas associated with these potential HAIL activities are subject to a Detailed Site Investigation (DSI) to confirm the extent of contamination and whether the National Environmental Standard for Assessing and Managing Contaminants in Soil (NESCS) will be triggered.

3.7 EXISTING HYDROLOGY

The Mt Welcome development lies within the Porirua Harbour Freshwater Management Area (FMA). The site discharges into four main catchments:

- Taupō Stream (T1, T2, T3, T)
- Kakaho Stream West
- Kakaho Stream East (K)
- Waimapihi Stream (Muri) (M)

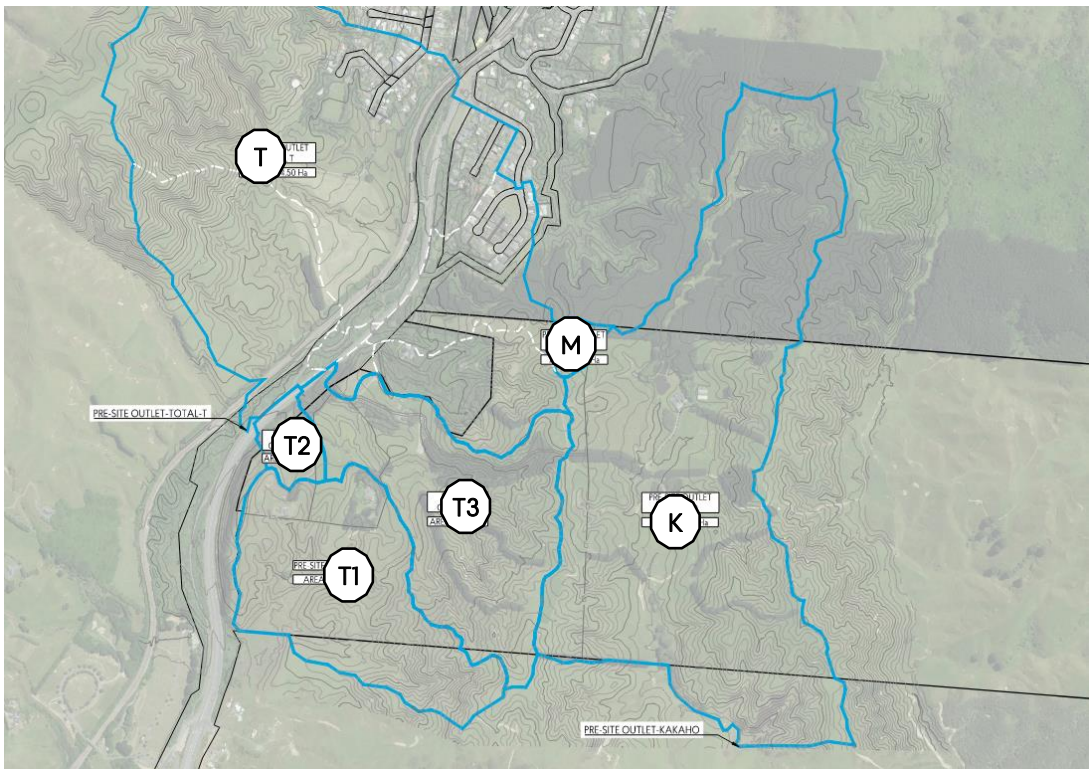


Figure 2. Existing Catchments

The pre-development catchments and their associated discharge points used in this assessment are shown in Figure 2. Further hydrological detail for each catchment is available in the PDP Hydrology Report. Catchment plans are provided on Sheet 4600 of the Civil Engineering drawings in Appendix 1.

3.7.1 TAUPŌ STREAM

The Taupō Stream catchment discharges west and south contributing to the headwaters of the Taupō Stream and Taupō Swamp. The catchment is divided into three sub-catchments all of which flow toward the Taupō Swamp complex, a regionally significant lowland wetland. The wetland is recognised for its high ecological and hydrological value and is a key receiving environment for stormwater generated from the site.

We have labelled the primary control catchments as **T1, T2, and T3**, representing the development discharge points immediately upstream of the receiving stream. **T** (the total catchment) represents the combined control point located slightly downstream of all discharge outlets and includes flows from the SH59 intersection and the upstream catchment. These control points are referenced throughout the report to compare pre- and post-development conditions.

3.7.2 KAKAHO STREAM CATCHMENTS (WEST AND EAST)

The Kakaho Stream West and Kakaho Stream East catchments discharge south toward the Kakaho Stream, which in turn flows into the Pāuatahanui Arm of Te Awarua-o-Porirua Harbour approximately 4.6 km downstream. This harbour is a sensitive estuarine environment, with elevated sedimentation and contaminant sensitivity identified in regional studies.

Upstream of the site, the Muri Road catchment remains largely rural, comprising commercial pine forestry and Significant Natural Areas (SNAs). Active pine harvesting is currently underway. Within the site, future development will follow a similar approach to the adjoining Mt Welcome area, with runoff conveyed through Kakaho stream catchments.

This catchment has been labelled **K**. For the civil engineering design, only the western portion has been assessed, as this area is attenuated within the proposed retention wetlands.

3.7.3 WAIMAPIHI STREAM CATCHMENT

A small portion of the northern site drains into the upper Waimapihi Stream catchment, flowing northwards through the Muri Road block before ultimately discharging to the coast at Pukerua Bay.

This catchment has been labelled **M** for reference.

3.8 MONITORING

Baseline water-quality and hydrological monitoring is being undertaken by PDP to characterise existing conditions within the receiving environments.

Existing water-quality data from the Taupō Swamp catchment, collected between July 2020 and August 2025, has been used to establish baseline conditions for the Taupō Stream and Swamp complex. Results and interpretation are provided in the PDP Hydrology and Water Quality Assessment.

At present, no long-term monitoring data is available within the Kakaho Stream catchments.

To understand the existing hydrological conditions at the site, PDP has installed water quality baseline monitoring stations within the wetlands and streams discharging from the site. The monitoring sites of relevance to this report are three surface water monitoring locations SW01, SW02 and SW03, which continuously measure turbidity in the streams at the boundary extent of the site. These key areas can be seen in figure 2 below.

Figure 3. PDP Key Surface Monitoring Locations

3.9 EXISTING RETICULATION NETWORK

There is no existing vested, piped stormwater infrastructure at the site. However, there are 20 existing culverts within area. The majority are related to existing agriculture activities and enable farm tracks through the low-lying areas. These have minimal effect or use on the proposed development and will generally be remove and replaced where not supporting hydrological, ecological functions or ongoing agricultural access. Existing culvert plans can be found within the Civil Design plans in Appendix 1 and are showed in Figure 4 below.

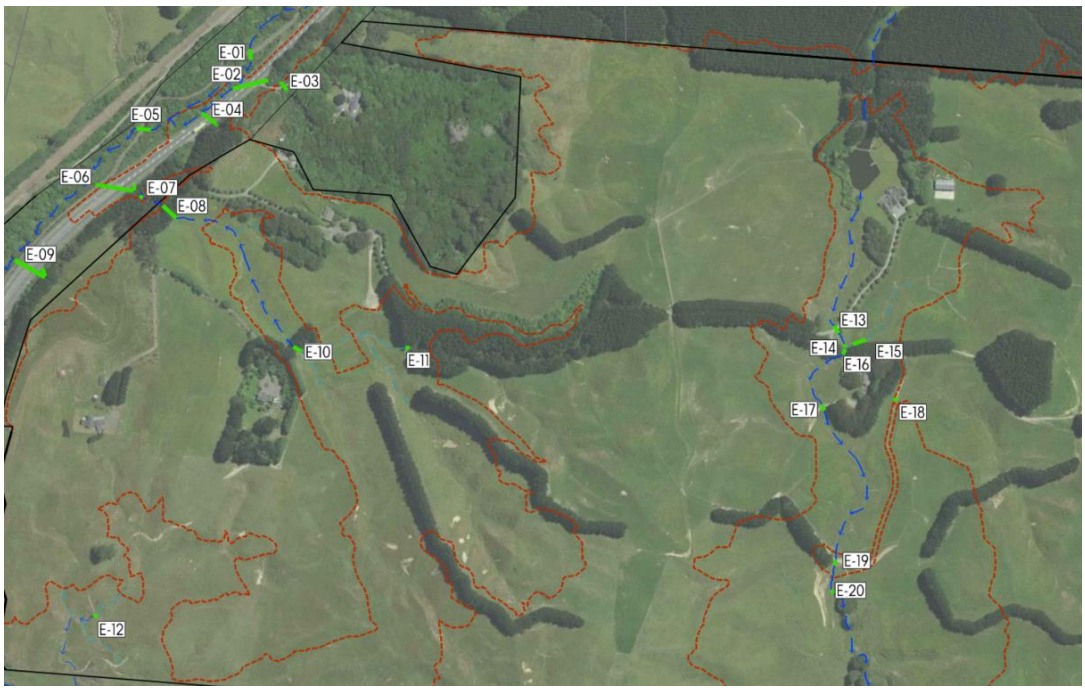


Figure 4. Site Wide Existing Culvert Locations

There are 8 culverts of varying sizes directly adjacent to the site along SH59 The culverts and narrow channels create constrictions which creates a flood risk on site. These culverts convey all stormwater towards the Taupo Swamp downstream. These culverts are further detailed within the Envelope Infrastructure Report and are shown in Figure 5 below.

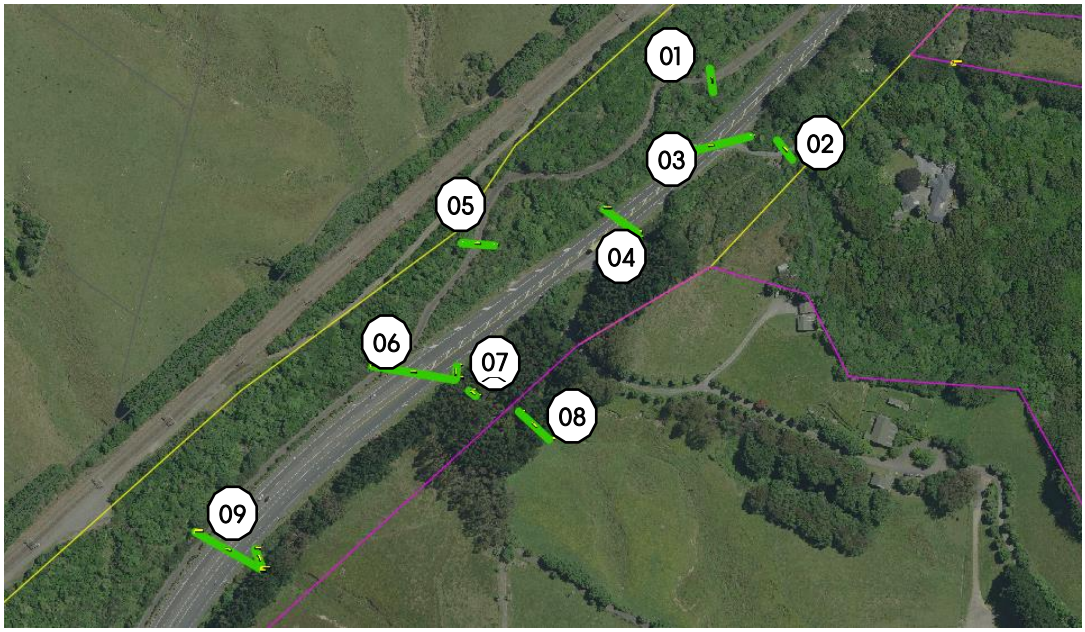


Figure 5. SH59 Existing Culvert Locations

Table 2 summarises the existing culvert dimensions, including size, length, and grade, based on field investigations and topographical survey data where access was available.

Table 2. Existing Culverts

Culvert ID	Diameter	Length	Grade	Note
E-01	900mm	14.5m	1.20%	No Change
E-02	375mm	48m	1.30%	To Be Removed
E-03	375mm	15m	4.70%	No Change
E-04	300mm	25m	---	To Be Removed
E-05	900mm	20m	1.30%	No Change
E-06	600mm	52m	3.60%	To Be Extended East
E-07	900mm	6m	4.00%	To Be Removed
E-08	675mm	25m	2.10%	No Change
E-09	450mm	45m	0.40%	No Change
E-10	525mm	12m	---	No Change
E-11	300mm	6m	3.60%	No Change
E-12	525mm	6m	5.00%	No Change
E-13	900mm	12m	1.80%	No Change
E-14	675mm	4.5m	0.00%	No Change
E-15	450mm	18.5m	4.00%	No Change
E-16	750mm	7m	5.50%	No Change
E-17	675mm	9m	1.60%	No Change
E-18	375mm	9m	3.90%	No Change
E-19	750mm	6.2m	1.80%	To Be Removed
E-20	750mm	6.2m	12.60%	No Change

3.10 EXISTING STREAMS

Stream corridors are mapped within the Proposed Porirua District Plan (PDP) and Wellington Water hydrology layers, which identify several defined stream environments across the Mt Welcome site.

These mapped features represent modelled drainage lines derived from LiDAR topography and catchment analysis and indicate where permanent or intermittent streams may occur.

Field assessments undertaken by PDP and BlueGreen Ecology have refined this mapping to confirm the actual extent, alignment, and flow permanence of the on-site streams.

The verified stream mapping and classifications have been used to define hydrological sub-catchments and inform the stormwater management design, ensuring that discharge locations correspond with existing flow paths and that downstream hydrology is maintained.

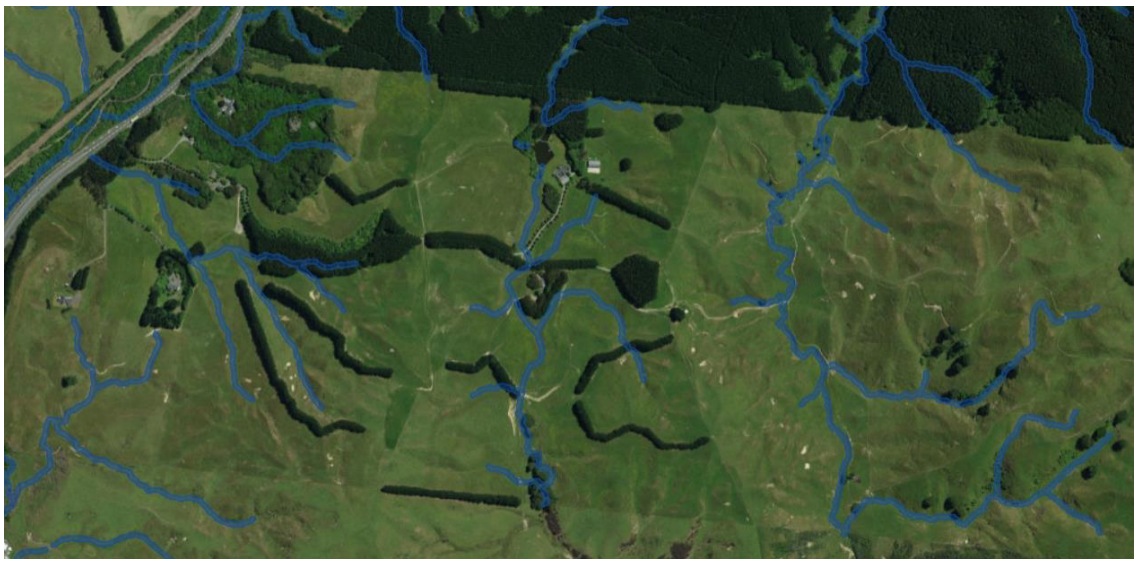


Figure 6. Porirua Proposed District Plan Stream Corridors

3.11 EXISTING WETLANDS

Existing wetlands within the site have been mapped by BlueGreen Ecology. Several natural and modified wetland features occur within and downstream of the Mt Welcome site, primarily associated with the Taupō Swamp complex and the headwaters of the Kākaho Stream.

These wetlands form part of the wider Porirua Harbour catchment network and are recognised as being of high ecological value. Further detail on wetland classification, extent, and hydrological monitoring is provided by PDP and BlueGreen Ecology.

3.12 EXISTING OVERLAND FLOW PATHS

The western side of the block discharges into the Taupo swamp downstream. This western catchment is conveyed through a series of stormwater culverts that have been installed under SH59. These culverts are generally undersized and would contribute to the localised flooding seen in Figure 7.

Flood modelling undertaken as part of the project flood risk assessment confirms that overland flow paths are generally confined to the natural valley systems and drainage corridors within the site. Existing overland flow paths are therefore not a dominant feature across the developable areas.

3.13 EXISTING FLOOD HAZARDS

Flood hazard areas are identified in both the Proposed Porirua District Plan and the Wellington Water “Rainfall Risks in Porirua” GIS database. The mapped flood extents generally align with the Flood Management Area (FMA) boundaries shown in the District Plan.

Minor flood hazards have been identified within low-lying gullies near SH59, as shown on the Wellington Water 1% AEP flood maps (refer to Figure 6). The flood risk is limited in extent and does not materially affect the proposed development or create downstream impacts. Some localised ponding occurs along the State Highway 59 corridor, where culverts are undersized and partially blocked by sediment, restricting hydraulic capacity. These areas will be retained as stormwater reserves, with no residential development proposed within them.

Additionally, some localised flooding occurs along the existing SH59 corridor and adjacent stream channels.

Figure 7. Wellington Water Flood Map

Updated draft flood maps are being prepared by Wellington Water and Porirua City Council for the Mana and Pukerua Bay catchments, incorporating overland flow paths for the Mt Welcome area. Preliminary review indicates that the draft mapping may over-represent flood ponding in the upper site where topography does not support such accumulation. The maps remain in draft form and are expected to be refined prior to being made operative under the District Plan.

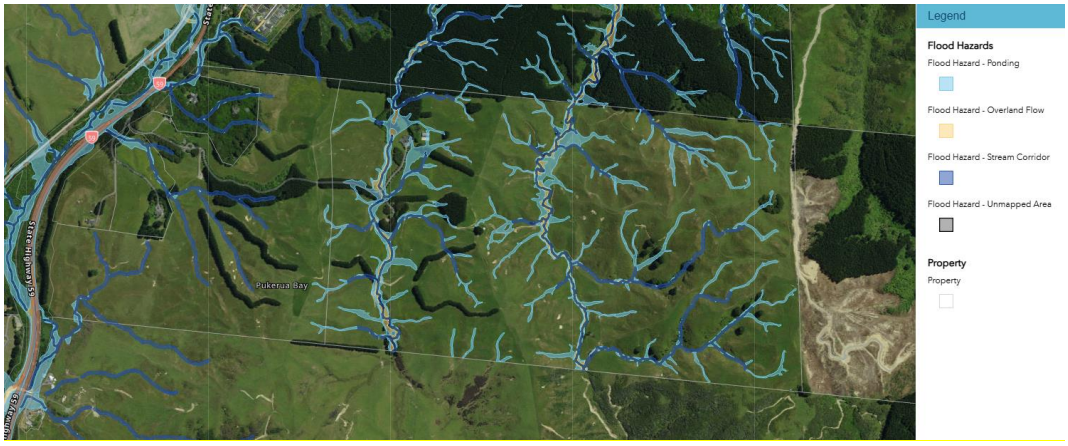


Figure 8. Porirua City Flood Maps (Draft)

Due to the site's elevated topography, flooding is not expected to pose a risk to the development area. Some localised flooding occurs along SH59 and will be addressed in coordination with NZTA during detailed design to confirm suitable mitigation measures and acceptable flood depths.

The Taupō Stream catchment ICM model provided by WWL was used as the basis for the Envelope flood risk assessment. The pre-development scenario results are presented in the report included in Appendix 5.

4.0 MANA WHENUA VALUES

4.1.1 GENERAL

This Stormwater Management Plan has been prepared to manage freshwater values in a manner consistent with Te Mana o te Wai and the principles of the National Policy Statement for Freshwater Management.

It aligns with the Te Awarua-o-Porirua Whaitua Implementation Programme and the freshwater objectives and policies of the Wellington Regional Natural Resources Plan.

The stormwater management approach recognises and provides for mana whenua values as expressed by Ngāti Toa Rangatira, the iwi with mana whenua status over the Porirua catchment. The

use of water-sensitive design, together with stream and wetland enhancement measures, is intended to sustain and enhance mauri and support the long-term health of receiving environments.

The proposed management approach seeks to uphold kaitiakitanga through protection of water quality, restoration of hydrological function, and enhancement of ecological and cultural values associated with downstream environments such as Taupō Swamp and Te Awarua-o-Porirua Harbour.

4.1.2 CONSULTATION

Engagement with Ngāti Toa Rangatira has been ongoing throughout the design and development process, ensuring iwi values and cultural considerations are incorporated into the design and implementation of the project. A summary of engagement is outlined below:

- 10 June 2025 – Initial meeting: Project overview, timeframes, process, and discussion of key issues to work through.
- 19 June 2025 – Site visit: Initial site orientation and walkover of the Lower Terrace to familiarise iwi representatives with the project area.
- 25 September 2025 – Hui: Progress update in response to further information sought on Structure Plan compliance, stormwater management, ecology, and works in waterways.
- 13 October 2025 – Site visit: Follow-up visit to discuss key areas of interest including the design of the roundabout, approach to ecology and archaeology, attended by the applicant's planning, ecology, archaeology, and engineering experts.
- 05 November 2025 – CVA: A Cultural Values Assessment was received and reviewed by the project team, which provided several comments on the development proposal and highlighted a number of matters. A follow-up meeting was subsequently scheduled, and these matters will be addressed through the AEE.

4.1.3 WHAITUA

The site lies within the Te Awarua-o-Porirua Whaitua, which encompasses the catchments draining to Porirua Harbour.

The Te Awarua-o-Porirua Whaitua Implementation Programme (2019) establishes outcomes and recommendations focused on improving water quality, managing sedimentation, and restoring ecological integrity within the harbour and its tributaries.

This Stormwater Management Plan supports those objectives by:

- Managing flows to achieve hydraulic neutrality and minimise erosion;
- Providing water-quality treatment for road and lot runoff through raingardens and retention wetlands
- Incorporating biodiversity and riparian planting to enhance ecological resilience and habitat connectivity.

The proposed design approach is therefore consistent with the Whaitua's objectives to protect the mauri of Te Awarua-o-Porirua Harbour and support sustainable water management across the wider catchment.

5.0 DEVELOPMENT OVERVIEW

5.1 DEVELOPMENT

The proposed development comprises approximately 950 residential allotments ranging in size from 316m² to 2,386m², enabling the construction of 950 future dwellings with an average lot size of around 523m². The development also includes a commercial centre to serve the new local community, together with associated three-waters infrastructure (wastewater, including storage facilities; stormwater management systems; and water reticulation), roading, and a connected network of pedestrian and cycling trails.

Earthworks will be undertaken to establish suitable finished surface levels for building platforms, roads, parks, and drainage systems. The proposal will also incorporate extensive landscaping and public open spaces, including recreation and drainage reserves for stormwater attenuation and conveyance. A new intersection with State Highway 59 will provide primary access to the site and integrate the development with the wider transport network.

5.2 STAGING

Development will occur in staged phases, allowing a progressive and coordinated delivery of housing and infrastructure. Indicative staging is shown on the drawings provided in Appendix 1. Staging will be managed to ensure that appropriate infrastructure (stormwater, wastewater, water supply, and access) is available for each stage prior to release. Additional staging details are provided in the accompanying Envelope Infrastructure Report.

5.3 IMPERVIOUSNESS ASSUMPTIONS

For stormwater modelling purposes, the site has been represented as 0 % impervious under pre-development conditions, reflecting its current pastoral state apart from minor structures. Two small external catchments from SH59 (assumed 90 % impervious) drain into the main gully before entering existing highway culverts. These have been included in the hydrological model to assess existing culvert capacity and downstream performance.

The proposed development will primarily comprise detached residential dwellings. The principal sources of impervious area within the residential lots will be building roofs, driveways, and paved outdoor areas.

In accordance with the Porirua Medium Density Residential Zone (MRZ) provisions, a maximum site coverage of 50 % applies to residential lots, providing sufficient allowance for dwellings and driveways while maintaining compliance with permeability standards. The District Plan also requires a minimum proportion of permeable surface to be retained within each lot to support infiltration and landscaping.

Roading will contribute additional impervious surfaces through sealed carriageways, kerbs, and footpaths. This has been allowed for based on the proposed road cross sections and layout.

For design purposes, the following imperviousness assumptions have been adopted:

Table 3: Post Developed Impervious

Catchment	Impervious %
Residential Lots	75%
Roads	85%
Commercial Area	90%
Recreational Reserves	0%

Imperviousness is expected to remain consistent across all stages of development and has been used to inform the hydrological modelling and stormwater management design.

6.0 STORMWATER MANAGEMENT

6.1 PRINCIPLES OF STORMWATER MANAGEMENT

The stormwater management approach for the Mt Welcome development has been guided by the principles of integrated catchment management, water-sensitive urban design, and hydraulic neutrality, consistent with the Wellington Water RSWS v3.1 and GWRC Plan Change 1. These principles ensure that stormwater is managed in a way that protects downstream environments, enhances ecological and cultural values, and supports long-term asset resilience and maintainability.

Key principles applied to this development include:

- Stormwater treatment and attenuation are centralised, minimising the use of on-lot devices and reducing operation and maintenance costs.
- Post-development catchments are aligned with pre-development catchments to maintain existing discharges and downstream receiving environments
- Apply Safety in Design principles and identify project specific risks
- Support of development staging to ensure the network can be constructed and commission progressively
- Recognise and protect the natural environment with low impact and water sensitive design
- Incorporate cultural values through engagement with mana whenua

6.2 DESIGN APPROACH

The development will increase the extent of impervious surfaces, which has the potential to elevate stormwater runoff to downstream environments if not appropriately mitigated. Mitigation measures have been incorporated into the civil design and verified through detailed stormwater modelling.

Table 4 summarises the design parameters used for stormwater conveyance, peak-flow attenuation, and flood-risk management.

Table 4. Hydrology & Flooding Design Criteria.

Design Criteria	Parameter	Reference
Primary Network	10% AEP + CC	Wellington Water Regional Standard for Water Services (RSWS), Version 3.0.
Secondary Network	1% AEP + CC	WWL RSWS v3.0
Freeboard	Residential Buildings – 0.3m	WWL RSWS v3.0
Attenuation	Hydraulic Neutrality of peak flows up to 1% AEP event	WWL RSWS v3.0
Rainfall	HIRDS RCP 6.0 2081 – 2100	NIWA HIRDS
Retention (Target)	85% Mean Annual Runoff Volume (MARV)	GWRC Plan Change 1 – Schedule 29
Water Sensitive Design	To meet WSD objectives	WWL Design for Stormwater: Treatment Device Design Guide (2021)

Detailed Hydrology and Hydraulic Modelling results are presented in Section 7 of this report.

6.3 PERFORMANCE CRITERIA

The Porirua District Plan, Wellington Water RSWS v3.1, and GWRC Plan Change 1 (Schedule 29) outline key requirements for stormwater management in subdivision and land-development projects. The design achieves compliance with these requirements through the following measures:

- A site-specific hydrologic and hydraulic assessment showing how stormwater will be collected, conveyed, treated, attenuated, and discharged in accordance with RSWS and PC1 hydrological control standards.
- Design all internal stormwater networks, overland flow paths, treatment, and attenuation facilities to integrate with the existing public network and comply with RSWS
- Provide stormwater treatment in accordance with GWRC Plan Change 1 and the Wellington Water Design for Stormwater: Treatment Device Design Guide, achieving at least 85% MARV treatment and target contaminant-load reductions.
- Implement erosion and sediment controls consistent with GWRC Erosion and Sediment Control Guidelines to protect treatment devices and downstream environments during construction.

- Ensure building platforms enable dwelling construction with a minimum 200mm freeboard above the 1 % AEP flood level
- Maintain on-site attenuation and hydraulic neutrality to ensure no increase in downstream flood risk.
- Recognise and provide for ecological and cultural values of the receiving environment and define long-term maintenance responsibilities consistent with Wellington Water's operation and maintenance expectations.

6.4 TREATMENT TRAIN APPROACH

The design of the stormwater piped network, including sizing and hydraulic calculations, is provided in the Envelope Infrastructure Report. The proposed stormwater management system is summarised as follows:

1. Lot Runoff (10% AEP): Stormwater from residential lots is collected via downpipes and lateral connections and discharged into the underground piped network.
2. Road Runoff (10% AEP): Stormwater from roads is captured through catchpits and conveyed into the same piped network.
3. Major Flow (1% AEP): During larger events, overland flow will be conveyed safely along road corridors and directed to downstream attenuation devices.
4. Primary Treatment: The piped network discharges to centralised bioretention basins (raingardens) sized to treat 85% MARV of the contributing impervious catchment. Larger events bypass the raingarden via an orifice and dedicated bypass pipe.
5. Secondary Treatment / Conveyance: Treated flows and bypass flows are conveyed to wetland retention ponds, while some smaller sub-catchments discharge directly to gullies where maintaining existing flow is required.
6. Attenuation and Storage: The wetland retention ponds provide both water-quality and quantity control—retaining and detaining runoff from frequent, low-intensity events and storing flows up to the 1% AEP storm.
7. Discharge: The ponds release flows back to existing watercourses at pre-development discharge rates, maintaining hydraulic neutrality and improving downstream water quality.

6.5 PRIMARY NETWORK

Stormwater runoff from events up to 10% AEP (with climate-change allowance) will be conveyed through the primary piped network and discharged to the retention wetlands located at 4 different locations within the development area. Due to the steep topography of the site, the proposed network has additional capacity to service greater events then the 10% AEP.

Catchpits are positioned at low points and regular intervals along the road corridors to capture runoff efficiently. Each residential lot will be provided with a lateral connection to the public piped stormwater network. The proposed network layout is shown on the 4000-series design drawings (Appendix 1).

The primary network discharges to centralised bioretention devices (raingardens), which have been designed with low-flow and high-flow outlets:

- Low-flow outlets convey runoff to the raingardens, sized for the water-quality flow event as defined in Wellington Water's Design for Stormwater: Treatment Device Design Guide. The water-quality flow has been calculated as 10 mm of rainfall over the contributing calculated water quality area.

- High-flow bypasses divert flows exceeding the water-quality event directly to the downstream outlet, ensuring bypass flows are conveyed without compromising treatment performance.

The raingarden outlets and associated high-flow bypasses combine and discharge at multiple outlet locations across the site. These discharge points have been strategically positioned along existing flow paths to maintain the site's pre-development hydrological flows. These outlet locations have been confirmed in consultation with PDP and BlueGreen Ecology to align with existing catchment hydrology and ecological values.

As the proposed development areas are typically situated on the upper terraces, with stormwater management devices located within the lower gullies, flows must be conveyed safely down steep embankments without compromising slope stability or causing erosion. In some locations, piped conveyance systems will be installed along the embankments, while in others, flow will discharge at the upper slope.

All stormwater outlets will incorporate energy-dissipation measures and scour protection to control flow velocity, prevent erosion, and protect the receiving environments. Further details are provided in Section 6.12.

6.6 SECONDARY NETWORK

The 1% AEP event will be conveyed as overland flow toward the retention wetlands via the road corridors. Due to the site's topography, all roads have been designed with defined secondary flow paths that discharge either directly to the retention wetlands or via raingardens that ultimately connect to the same system. No low points or areas of on-road ponding have been designed or are required, and there are no anticipated constraints in directing overland flows to suitable outlet locations. The site does not contain any flood-prone areas requiring minimum floor level or freeboard controls.

Overland flows descending the steeper embankments toward the ponds will generally follow the alignment of the primary network conveyance system. Appropriate erosion and scour protection—such as rock armouring, revegetation, or energy-dissipation structures, will be incorporated to ensure slope stability and protect receiving environments. Further details are provided in Section 6.12 – Scour and Erosion Control.

A flood assessment has been prepared by Envelope Engineering to assess flood risk and overland flow management across the site and is attached within Appendix 5. The modelling confirms that the proposed road corridors and retention wetlands provide effective conveyance and attenuation of the 1% AEP event, with flood effects generally limited to shallow flows within roads and stormwater management areas. No flood hazards are within proposed residential lots, and no material increase in flood risk to surrounding land or infrastructure.

6.7 HYDRAULIC NEUTRALITY & ATTENUATION

The proposed stormwater management system has been designed to achieve hydraulic neutrality, ensuring that post-development peak discharges do not exceed pre-development levels for all design events up to and including the 1% AEP storm.

To achieve this, the civil design incorporates four primary retention wetlands (A, B, C, and E) strategically located within the site's main gully systems. Each wetland provides both attenuation and retention functions, temporarily detaining runoff from its contributing sub-catchment before releasing flows to the receiving environment via controlled outlets.

An additional, smaller retention wetland (D) is located at the northern extent of the site and discharges to the Muri Road catchment. This wetland will maintain a permanent water level but will likely require lining due to limited infiltration capacity. Its function is primarily for peak-flow attenuation rather than retention. The retention functions of these wetlands and detailed further into this report. These locations are shown in Figure A below

Table 5. Retention Wetland Storage Summary

Retention Wetland ID	Function	Catchment
A	Attenuation / Retention	T1
B	Attenuation / Retention	T3
C	Attenuation / Retention	T3
D	Attenuation	Muri
E	Attenuation / Retention	K1 / K2

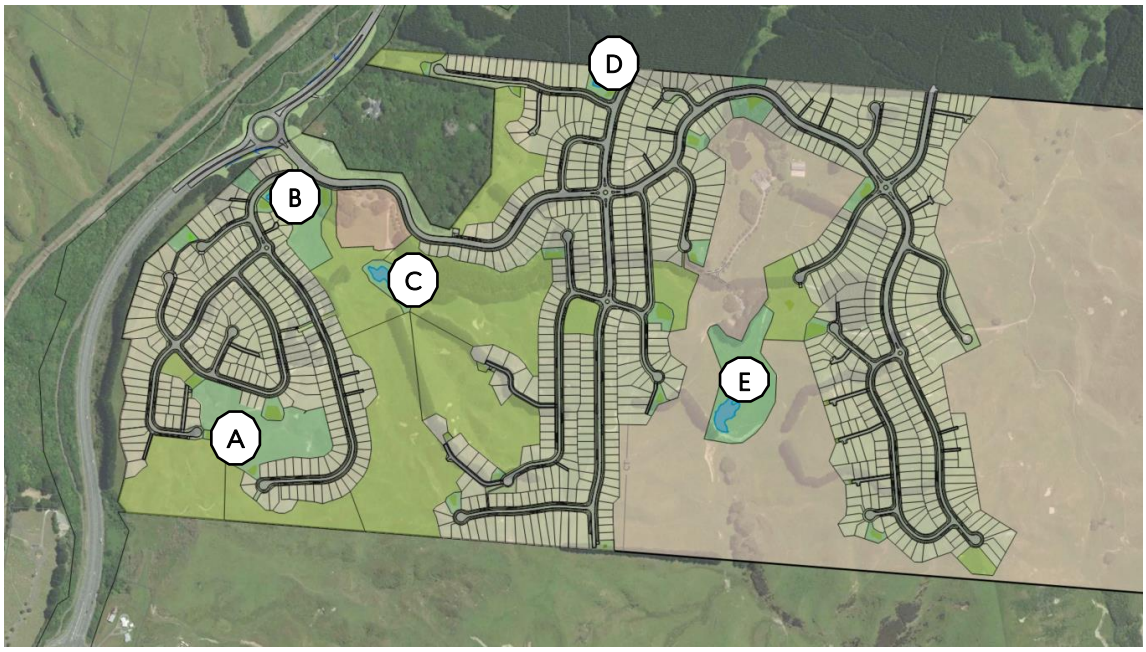


Figure 9. Attenuation & Retention Areas

The function and storage capacity of each wetland summarised in Table 6. This details the different water levels and stages of storage provided within each retention wetland.

Each wetland incorporates multi-stage outlet structures designed to regulate flow, maintain extended detention during frequent storm events, and dissipate energy to minimise downstream scour and erosion. The detailed design phase will confirm final outlet dimensions, including orifice sizes, weir levels, and specific energy-dissipation treatments.

This details on pre- and post-development discharge rates for all return periods (2-, 5-, 10-, and 100-year AEP) are provided in Section 7 of this report. The results demonstrate that the proposed system effectively attenuates runoff, maintains pre-development discharge rates, and provides improved hydrological control across all design events. PDP has undertaken independent hydrological modelling to verify post-development performance at each catchment outlet and can be found in the PDP Hydrological Assessment.

Table 6. Retention Wetland Design Summary

Outlet	Water Level (m RL)	Water Area (m²)	Water volume (m³)
Retention Wetland A			
Permanent	41.00	1,020	770
10% AEP	42.25	2,140	2,480
1% AEP	42.75	2,340	3,680

Outlet	Water Level (m RL)	Water Area (m²)	Water volume (m³)
Spillway	43.50	3,300	5,700
Retention Wetland B			
Permanent	54.30	1,050	480
10% AEP	55.90	2,270	3,020
1% AEP	56.65	3,110	4,980
Spillway	58.17	4,900	10,700
Retention Wetland C			
Permanent	64.50	880	720
10% AEP	65.73	1,940	2,350
1% AEP	66.50	2,600	4,050
Spillway	67.50	3,550	6,950
Retention Wetland D			
Permanent	108.80	200	50
10% AEP	109.17	270	130
1% AEP	109.36	310	180
Spillway	109.70	395	261
Retention Wetland E			
Permanent	91.40	1,840	1,090
10% AEP	92.74	5,350	5,820
1% AEP	93.21	6,690	8,150
Spillway	93.70	8,470	11,650

Together, these wetlands provide distributed flow control across the site, ensuring that downstream receiving environments are protected from increased peak flows, scour, and erosion, and that overall catchment behaviour remains hydraulically neutral post-development.

6.8 RETENTION FUNCTION

Retention wetlands are proposed within the site's existing gullies to provide the final stage of stormwater attenuation and hydrological control. As outlined in Section 6.7 of this report, these wetlands serve a dual purpose—attenuating peak flows and providing stormwater retention.

Each wetland integrates extended detention and permanent storage to manage frequent rainfall events, attenuate flows up to the 1% AEP storm, and retain 85% of the Mean Annual Runoff Volume (MARV). Key features include:

- Siting within natural gullies to maximise storage efficiency and minimise geotechnical and earthworks risks.
- Detention and retention volumes sized to achieve hydraulic neutrality and reduce peak flood flows.
- Controlled outlet structures designed to limit discharges to pre-development rates up to the 1% AEP event.
- Permanent pools that provide baseflow storage and promote sediment settlement.

- Bunds and access tracks to enable inspection, operation, and long-term maintenance.

Further details on pre- and post-development hydrological effects for each catchment are provided in the PDP hydrology report.

6.9 STORMWATER TREATMENT

The treatment objectives for this site are to limit the amount of runoff from the site and to limit the amount of contaminant laden stormwater (e.g. gross pollutants, contaminants etc.) that are discharged from the site.

Raingardens have been designed to provide water-quality treatment in accordance with GWRC Plan Change 1 (Schedule 28) and the Wellington Water Design for Stormwater: Treatment Device Design Guide.

For each sub-catchment (RG-01 to RG-30), the total impervious and water-quality contributing areas were calculated from the civil design model. The required bioretention area was then calculated from the Water Quality Flow (WQF) produced to determine to size the raingardens. Key design parameters use for the raingardens are summarized below.

Table 7. Raingarden Design Summary

Parameter	Design Value	Basis / Reference
Media infiltration rate	175 mm/hr	Bioretention media ensuring <24 hr drawdown
Ponding depth	300mm	Extended depth for increased volume
Media void ratio	40 %	Standard value per WWL guidance
Media depth	600mm	
Drawdown time	≤ 24 hours	Achieved under conservative assumption
Treatment target	≥ 85 % MARV	Schedule 28 – Hydrological control requirement
Treated event	Water Quality Event (WQE)	Based on WQV sizing and WQF from contributing impervious area

These results confirm that the proposed bioretention system satisfies hydrological control requirements and meets reduction targets. Table 1 summarises the estimated pollutant-removal performance.

Table 8. Estimated Raingarden Pollutant Removal Efficiency

Parameter	Estimated Removal Rates
TSS	90%
Total Nitrogen	40%
Total Phosphorus	60%
Zinc	90%
Copper	90%

Envelope Engineering has provided calculations within Appendix 2 demonstrating that the total capacity of the raingardens can accommodate the expected Water Quality Flow (WQF) from the impervious surfaces in the lots and roads. Based on the raingardens receiving the water quality flow event, it has been assumed they will treat the stormwater in accordance with the estimated removal rates provided in Table 8.

These structures are not designed to provide retention due to the geotechnical constraints of the site, but rather to improve the water quality of the run-off before being discharged to downstream

receptors. The retention wetlands, located downstream of the raingardens, will retain the flows from the site to ensure peak flows are lower than predevelopment, reducing the risk of large-scale sediment mobilisation.

Table 9. Summary of stormwater discharge outlets

Raingarden ID	WQA (m^2)	WQF (m^3/hr)	Raingarden Area (m^2)
RG-01	12054	120.5	160
RG-02	4332	43.3	61
RG-03	14652	146.5	175
RG-04	8278	82.8	110
RG-05	19167	191.7	250
RG-06	31243	312.4	420
RG-07	8160	81.6	100
RG-08	19210	192.1	241
RG-09	6805	68.0	80
RG-10	2359	23.6	31
RG-11	6912	69.1	80
RG-12	3785	37.9	43
RG-13	36602	366.0	450
RG-14	6458	64.6	80
RG-15	16789	167.9	190
RG-16	1933	19.3	24
RG-17	7304	73.0	90
RG-18	2586	25.9	35
RG-19	1912	19.1	24
RG-20	6173	61.7	80
RG-21	13487	134.9	170
RG-22	20409	204.1	260
RG-23	15738	157.4	190
RG-24	7220	72.2	90
RG-25	39141	391.4	500
RG-26	1819	18.2	18
RG-27	2356	23.6	14
RG-28	2043	20.4	20
RG-29	8573	85.7	105
RG-30	1463	14.6	15

6.10 WATER QUALITY ASSESSMENT

A Water Quality Assessment by PDP evaluated existing and potential effects of the Mt Welcome development on Taupō Swamp, Kākaho Stream, and Te Awarua-o-Porirua Harbour.

Baseline monitoring recorded slightly elevated nutrient and metal concentrations from existing deer-farming land use, but generally below guideline thresholds. Turbidity was high during rainfall events due to steep, erodible pasture slopes.

Following development, nitrogen and phosphorus loads will reduce as livestock are removed and land use transitions to residential. Raingardens will provide primary treatment and are critical for zinc and copper removal from road runoff, while retention wetlands will further attenuate flows and provide incidental sediment filtration.

PDP concluded that, with the proposed stormwater measures implemented and maintained, residual effects on downstream environments will be less than minor. Continued baseline monitoring prior to construction is recommended to confirm pre-development conditions.

6.11 STATE HIGHWAY 59

The new roundabout proposed within the State Highway 59 corridor will require significant stormwater upgrades and will generate approximately 4,000m² of new impervious surface. The following design measures have been adopted to achieve stormwater neutrality and align with best-practice stormwater management principles:

- Peak flow attenuation for the new impervious area will not be provided at the roundabout itself. Instead, Retention Wetland B has been intentionally oversized to compensate for the additional runoff, effectively mitigating any increase in downstream peak flows and maintaining overall catchment discharge neutrality.
- Retention within the roundabout footprint is not practicable due to poor infiltration conditions within the State Highway corridor. Accordingly, the impervious area is included within the Retention Wetland B catchment model, with post-development hydrological performance and downstream monitoring incorporating this contribution. Supporting analysis is provided in the PDP Hydrological Report.
- Roadside swales will provide first-flush treatment and contaminant removal prior to discharge for 2,660m² of the new impervious surfaces. This represents the best practicable option (BPO) for the constrained highway corridor, as standalone roadside raingardens are not preferred by NZTA and would be operationally difficult to maintain.
- Some existing culverts will be removed as outlined in Section 3.9 as part of the road widening works. The existing culverts are generally undersized and will be replaced with new, realigned culverts to accommodate the proposed roundabout, while maintaining existing flows to the Taupō Stream.

6.12 CULVERTS

A total of 11 culverts are proposed within the site. Five associated with the SH59 upgrades and seven within the development site. The four outlet structures from the retention wetlands have been classified as culverts. These will discharge from the wetlands via a controlled inlet structure within the pond (e.g., outlet and scruffy manhole or similar).

Culverts P30, P32, P33, P35 (Retention Wetland B), P38, and P40 (Retention Wetland E) will be designed to provide fish passage in accordance with Section 6.13. Any adjustments to culvert sizing required to accommodate fish passage requirements will be confirmed during detailed design.

The proposed culverts are shown in Figure 10 and summarised in Table 10 below. Detailed culvert plans are also included in Appendix 1. Detailed calculations, including 10- and 100-year peak flows and velocities, are provided in Appendix 2.

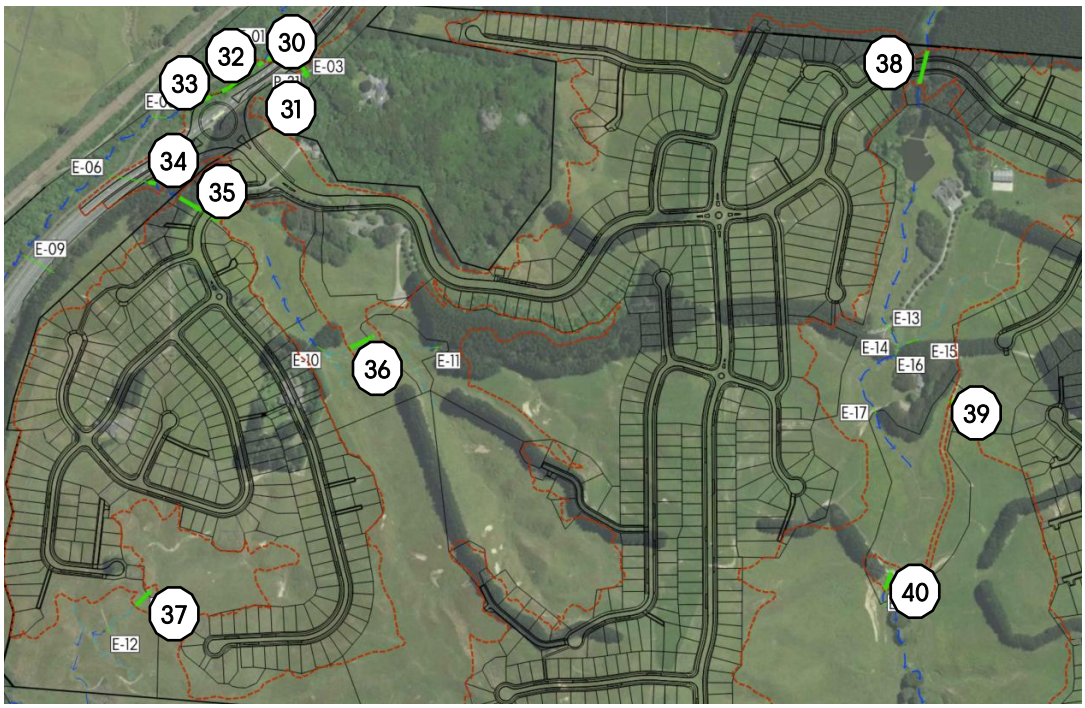


Figure 10. Proposed Site Wide Culverts

Table 10. Proposed SH59 Culverts

Culvert ID	Diameter	Length	Grade	Note
P-30	750mm	56m	1.20%	Replace E-02 with 750mm Dia
P-31	375mm	13m	10.00%	Second High Level Inlet With E-03
P-32	1500 x 1000 Box	45m	2.00%	Piping of stream to allow SH59 upgrade
P-33	1500 x 1000 Box	58m	3.00%	Piping of stream to allow SH59 upgrade
P-34	600mm	10m	3.60%	Extension of E-06
P-35	600 to 900 mm	60.5m	1.5% - 6%	Retention Wetland B Outlet
P-36	450 to 675 mm	36m	10% - 15%	Retention Wetland C Outlet
P-37	600mm	28m	14% - 25%	Retention Wetland A Outlet
P-38	900mm	44m	3.50%	Road/Stream Crossing
P-39	600mm	10m	2.00%	Replace E-18 with 600mm Dia
P-40	350 to 2100 mm	28.5m	5% - 6%	Retention Wetland E Outlet

Figure 11 below further detail the proposed culverts required to be installed for the SH59 intersection.

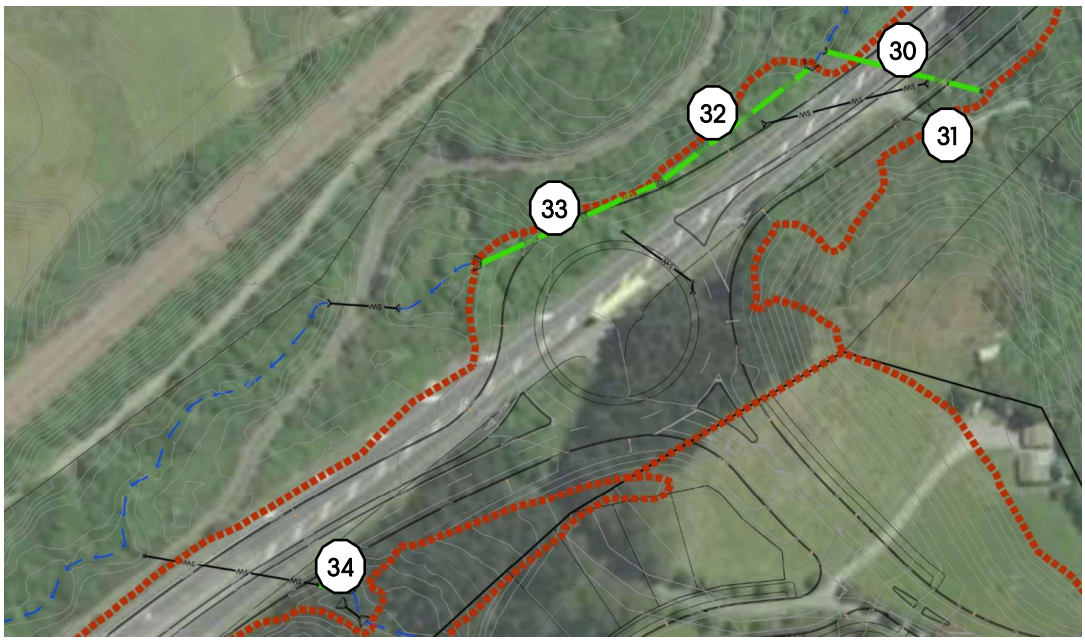


Figure 11. Proposed SH59 Culverts

6.13 FISH PASSAGE

During detailed design the culvert sizing will be reviewed against the New Zealand Fish Passage Guidelines (2018, NIWA) to ensure that all permanent crossings support fish movement.

Under the proposed development, several new or replacement culverts within perennial and intermittent stream reaches will be designed to enable the safe upstream and downstream passage of fish species under a range of flow conditions. Design measures include:

- Culvert Width and Embedment
    - For streams with a bank-full width less than 3m, the guidelines recommend a culvert width of at least 1.3 times the measured bank-full width to minimise hydraulic constriction and preserve natural channel processes.
    - The natural streambed will be reinstated within the culvert to approximately 25% of the culvert depth, using existing bed material (gravels, cobbles, fines) wherever practicable to replicate the natural substrate and roughness conditions.
    - The existing stream gradient will be maintained through the culvert to ensure consistent energy slope, reduce perching risk, and maintain velocities within the preferred range for native fish (< 0.3m/s for general passage, < 0.1m/s for climbing species under baseflow).

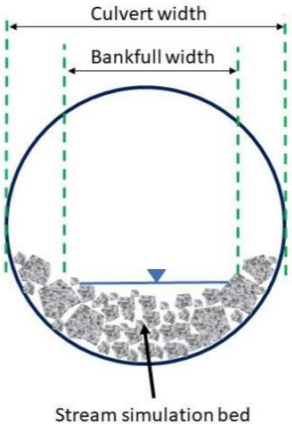


Figure 12. Stream Simulation Sketch (Extract from NZ Fish Passage Guidelines 2018)

- Steep Gradient Crossings

    - In steeper crossings (~6% gradient), baffles or roughened inverts should be incorporated to create resting zones and hydraulic diversity suitable for climbing species
    - Baffle spacing should follow NIWA guidance, typically 1–1.5 times the culvert diameter, and baffle height should not exceed 15% of culvert diameter to prevent debris accumulation and excessive head loss.
- Barrier Removal and Realignment
    - The perched middle culvert in the north-western tributary will be removed or re-graded to align with the natural stream bed, reinstating continuous fish passage and flow connectivity through the new stormwater wetland outfall.
- Retention Wetland Connectivity
    - Where required, the retention wetland outlet will incorporate a fish-passage capable weir within the outlet structure to maintain aquatic connectivity.
    - The outlet will provide a continuous wetted low-flow pathway to support fish passage and will be designed to maintain permanent baseflow connectivity, with internal roughness or texturing included to assist fish movement.
    - Vertical risers may be incorporated within the scour/scruffy manhole structure as an emergency overtopping measure during large storm events or blockage scenarios. These risers will be configured so they do not impede fish passage, with low-level cut-outs or similar features provided to maintain uninterrupted low flows and aquatic connectivity.
- SH 59 Roundabout Culvert
    - The 110 m Taupō Stream culvert will be installed at the existing stream gradient, with an inverted gravel bed to mimic the natural channel and promote hydraulic roughness.
    - Culvert alignment will be straight and consistent with the existing channel to avoid turbulence or flow separation.
    - Although downstream passage is currently limited by existing barriers, this culvert will be constructed to be fish-passage capable, providing for future connectivity improvements should downstream remediation occur.

Overall, the proposed culvert and wetland system will remove existing barriers, provide continuous aquatic connectivity, and result in a net improvement to fish habitat and passage relative to the current condition. Specific fish passage design details will be developed and finalised during the detailed design phase.

6.14 SCOUR AND EROSION

All stormwater outlets will be designed with energy-dissipation and scour-protection measures to prevent erosion of outlet channels, embankments, and downstream receiving environments. Materials and treatments will be sized to suit the discharge velocity at each outlet, in accordance with the Wellington Water Regional Standard for Water Services and TR2013/018, Hydraulic Energy Management: Inlet and Outlet Design for Treatment Device.

Many outlets are located at the base of steep embankments, where stormwater is conveyed by pipes discharging into gullies or retention wetlands. These piped sections are required to prevent uncontrolled surface flow and associated slope scour. Where velocities warrant, internal baffles or step-down structures will be incorporated within the pipes to further dissipate energy prior to discharge.

At each outlet, suitable erosion-resistant materials (rock, concrete, or geotextile reinforcement) will be used to stabilise the outfall zone. If additional energy-dissipation device, such as riprap aprons, bubble up manholes, or rock-mattress outfalls they will be provided to reduce flow velocity at discharge.

Vegetated riprap and native planting should be established around all outlet and receiving areas to promote long-term slope stability and natural filtration.

7.0 HYDROLOGY & HYDRAULIC MODELLING

7.1 OVERVIEW

Hydrological and hydraulic modelling for the Mt Welcome development was undertaken to assess peak flow attenuation, network performance, and hydrological neutrality. A summary of the key parameters and results is provided below, with the full model outputs included in Appendix C.

7.2 HYDROLOGY & HYDRAULIC MODELLING

The hydrological and hydraulic modelling for this development has been undertaken using Autodesk InfoDrainage (2025) in accordance with the Wellington Water Reference Guide for Design Storm Hydrology Standardised Parameters for Hydrological Modelling (April 2019) and the Regional Standard for Water Services. The model applies the SCS Curve Number (CN) method for runoff estimation, consistent with Wellington Water's standardised hydrological parameters

Soil infiltration and initial abstraction parameters were informed by site-specific geotechnical investigations, which confirmed the presence of low-permeability silt and clay soils characteristic of the surrounding area. Composite curve numbers ranging from CN 68 (pervious surfaces) to CN 98 (impervious surfaces) were adopted and applied consistently across both pre- and post-development scenarios. Attenuation and storage within the proposed retention wetlands have been represented in the model.

The InfoDrainage model simulates both sub-catchment hydrology and the hydraulic performance of the primary piped network. A two-dimensional (2D) surface-flow component was not included; therefore, localised overland-flow or surface-flooding effects under 1 % AEP events are considered qualitatively rather than dynamically modelled.

7.3 RAINFALL

Rainfall inputs were sourced from NIWA HIRDS v4 for the Whenua Tapu rainfall station (ID 140806), incorporating RCP 6.0 (2081–2100) to account for climate-change allowance. Figure 13 and Figure 14 below presents the design rainfall distribution curves exported from the model, illustrating the temporal pattern applied to all simulated design storms.

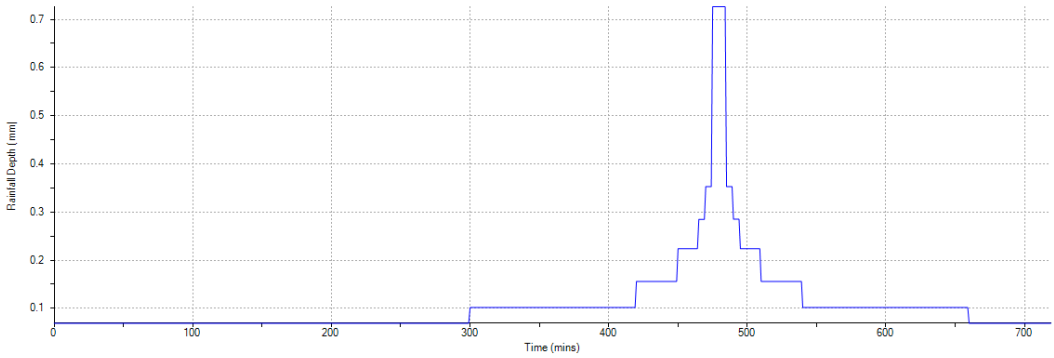


Figure 13. 10% AEP Rainfall Distribution

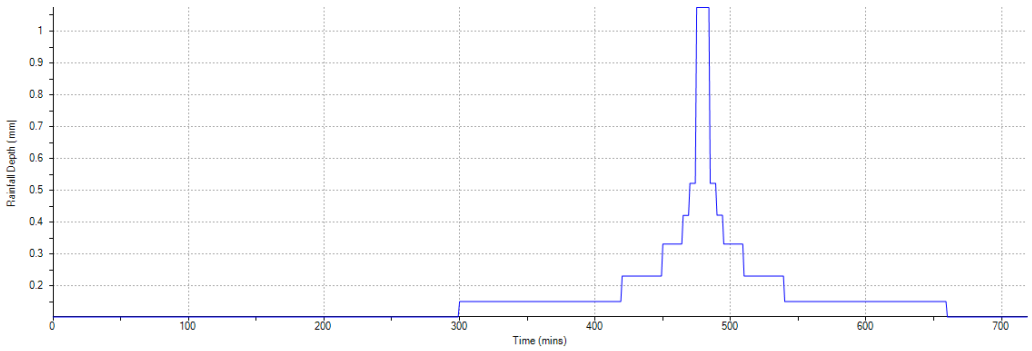


Figure 14. 1% AEP Rainfall Distribution

The below table outlines hydrological control based on the Greater Wellington Hydrological Control Guidance Note September 2025.

Table 11. Retention & Hydrological Control

Design Criteria	Parameter	Reference
HIRDS v4 location	Whenua Tapu (ID 140806)	Historic baseline (no CC uplift)
2-yr ARI, 24-h depth	68.1 mm	From HIRDS v4
Water-quality storm depth	22.7 mm ≈ 23 mm	= (2-yr, 24-h) ÷ 3

In lieu of site-specific data, data collected at the closest regional rain gauge at the Taupō Stream at the Whenua Tapu site (ID 140806) indicates that the average annual rainfall in the general site area is approximately 1,040 mm/year.

7.4 HYDROLOGICAL RETENTION RESULTS

PDP's hydrological modelling confirms that the proposed retention wetlands effectively manage post-development flows, with wetlands modelled to be wetter or unchanged more than 99% of the time and experiencing fewer dry-season drawdowns. The retention systems provide permanent or near-permanent water levels, attenuate 1% and 10% AEP peak flows, and collectively support hydraulic neutrality across the development. Ephemeral streams retain their overall character, with reduced peak-flow durations.

For full modelling results, water-level time-series, and detailed water-balance calculations, refer to the PDP Hydrology Assessment.

7.5 PEAK FLOW RESULTS

The results and comparison points below assess pre- and post-development conditions at key catchment outlets, rather than solely at the pond discharge points. These locations capture a broader range of contributing areas, including outlets that do not discharge to the main retention wetland, including the SH59 upgrades. The "T" catchments ultimately discharge to the Taupō Swamp, while the "K" catchments discharge to the Kauko Stream.

Table 12. Summary of stormwater model outputs.

	10% AEP		1% AEP	
Catchment	Pre Dev (L/s)	Post Dev (L/s)	Pre Dev (L/s)	Post Dev (L/s)
T1	1583	1512	2788	2674
T2	188	209	330	325
T3	797	823	911	945
T (Total)	4057	3920	6869	5937
K		2285.3		3504.2
Muri	100	83	176	113

Figure 15. Pre/Post Comparison Outlets

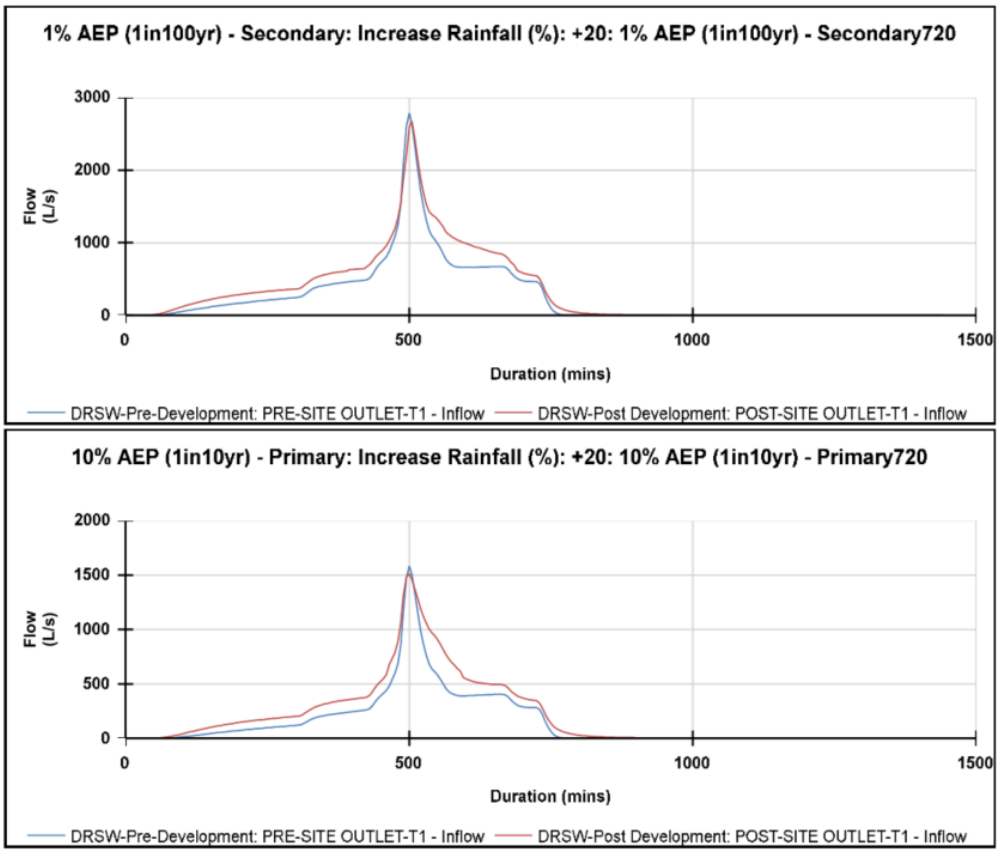


Figure 16. Pre and Post Development Comparison **(T1)** for the 10- and 100-Year Storm Events

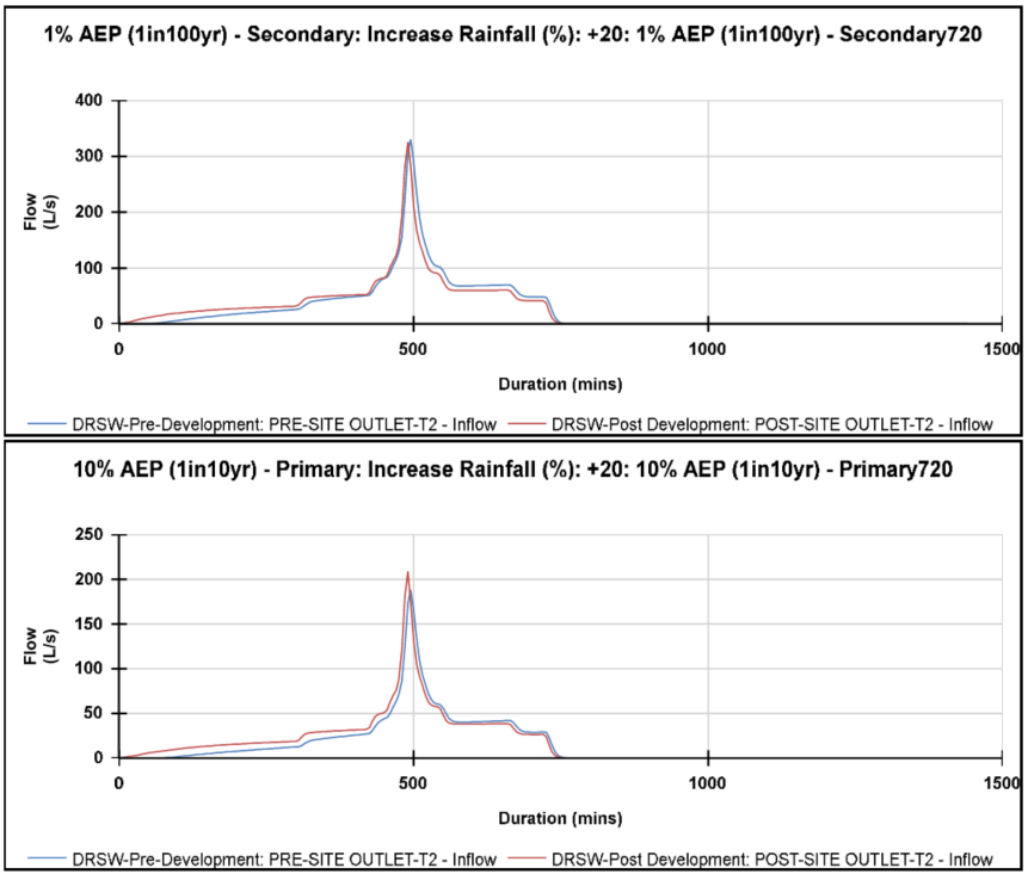


Figure 17. Pre and Post Development Comparison **(T2)** for the 10- and 100-Year Storm Events

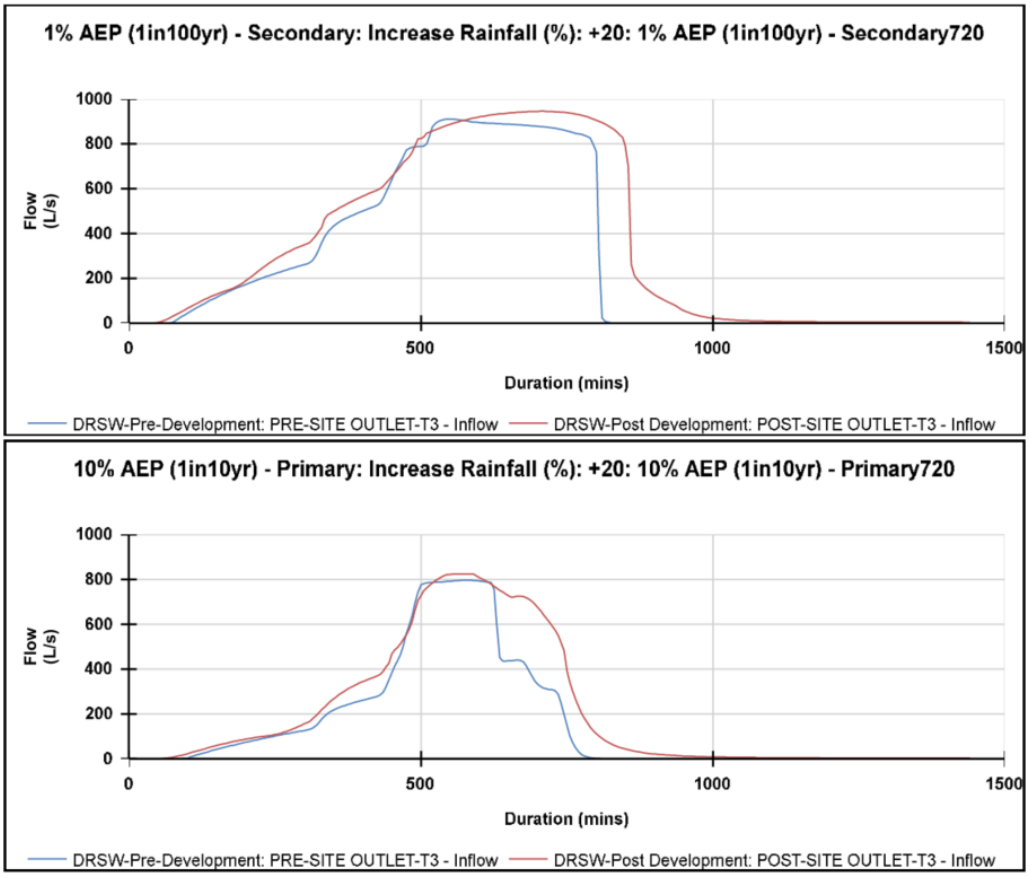


Figure 18. Pre and Post Development Comparison **(T3)** for the 10- and 100-Year Storm Events

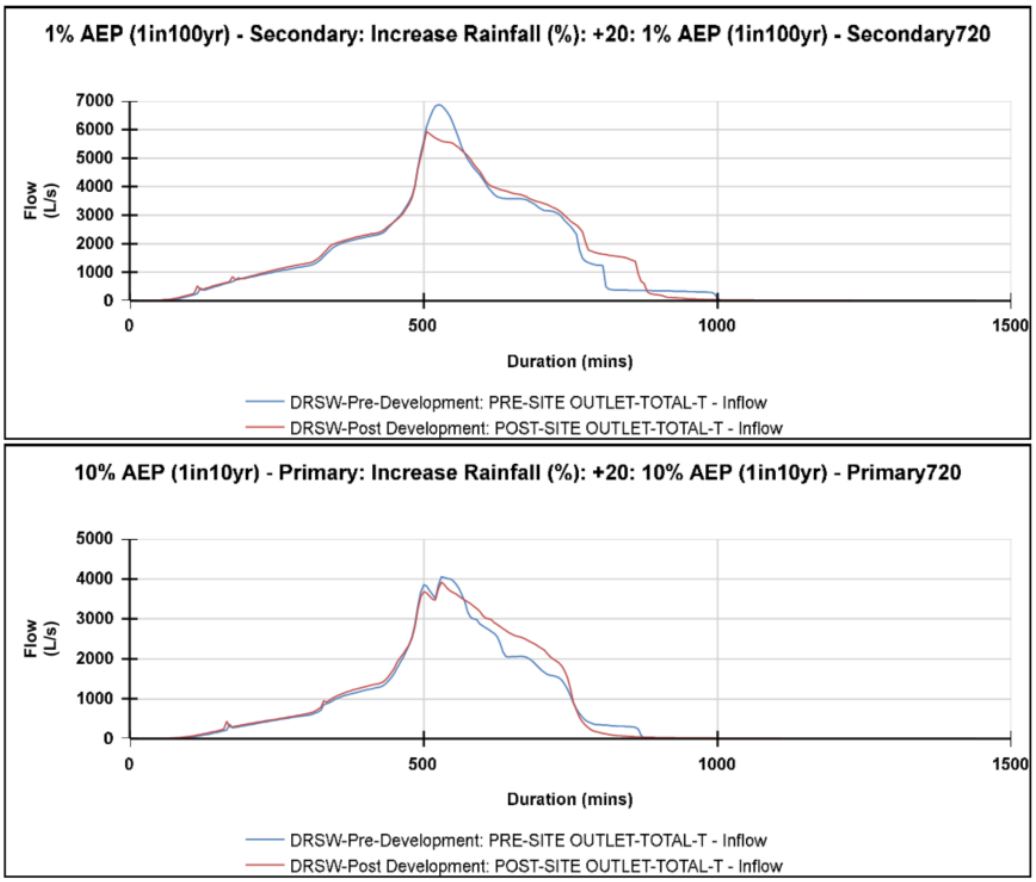


Figure 19. Pre and Post Development Comparison **(T-T)** for the 10- and 100-Year Storm Events

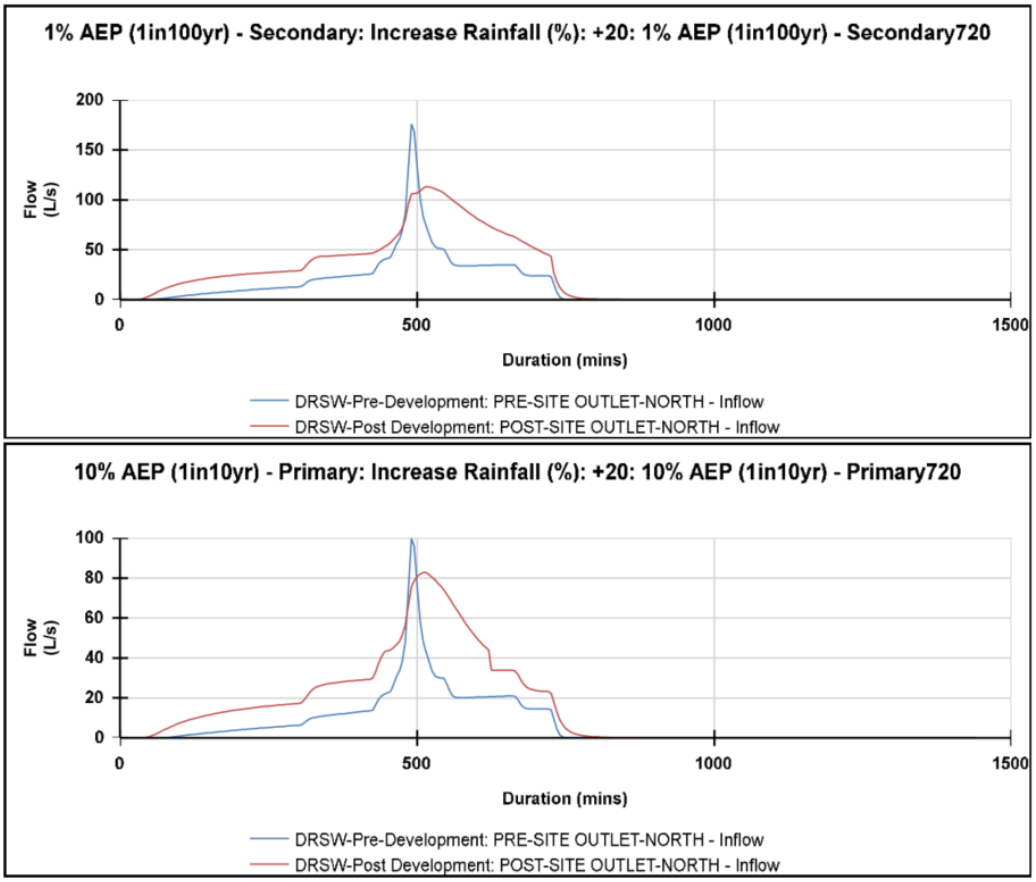


Figure 20. Pre and Post Development Comparison **(Muri)** for the 10- and 100-Year Storm Events

7.6 SUMMARY

The hydrological and hydraulic modelling confirms that the proposed stormwater management system achieves hydraulic neutrality, effective peak-flow attenuation, and maintains suitable wetland and downstream hydrological conditions. Key outcomes include:

- Peak flows are reduced or closely matched to pre-development levels across major catchments for both 10% and 1% AEP events.
- Retention wetlands maintain or improve water levels more than 99% of the time, with fewer dry-season drawdowns.
- Hydraulic neutrality is achieved through integrated raingardens, piped networks, and retention wetland storage.

Full model outputs and detailed calculations are provided in Appendix B, C and D and the PDP Hydrology Assessment.

8.0 ASSET OWNERSHIP, OPERATION & MAINTENANCE

8.1 OWNERSHIP AND VESTING

All stormwater infrastructure located within road reserves, drainage reserves, and communal open spaces—including piped networks, manholes, raingardens, wetlands, and attenuation basins—will be vested in Porirua City Council and managed under Wellington Water's asset management framework.

Private laterals serving individual lots will remain the responsibility of the property owner beyond the boundary.

Where shared access lots (JOALs) are proposed, the underground piped network will be vested to Council, protected by a stormwater easement registered over the private land. However, catchpits within private accessways are expected to remain privately maintained, managed collectively by the benefiting lots through a residents' association or encumbrance.

The ownership and long-term maintenance of raingardens serving private roads will be discussed further with Wellington Water to determine whether vesting or private maintenance is preferred.

If these isolated treatment devices are to remain privately maintained, a proprietary treatment system may be adopted as an alternative to simplify the long-term maintenance regime while maintaining equivalent treatment performance.

8.2 ACCESS AND SAFETY PROVISIONS

All stormwater treatment and attenuation devices will include dedicated maintenance access for inspection, cleaning and media replacement.

- Maintenance access (3.0m wide, maximum gradient 1V:6H) will be provided to all centralised bioretention devices and ponds. This access extends around raingardens at a similar width to enable inspection and maintenance.
- Vehicle access (3.0 m wide) will be provided to and across all wetland retention bunds to allow desilting, maintenance, and periodic inspection.
- Council pedestrian access will be maintained to all pipes and structures located within the retention wetlands and receiving environment. Vehicle access will not be permitted in these areas to avoid damage to vegetation and wetland planting.
- Safety features, including appropriately graded batter slopes, will be incorporated where required to meet health and safety standards and Wellington Water's operational guidelines.
- Where assets are located adjacent to private property, stormwater easements will be established to provide legal access for inspection and ongoing maintenance.

8.3 OPERATIONS & MAINTENANCE MANUALS

Ongoing operation and maintenance (O&M) will be undertaken by Wellington Water, or by Porirua City Council following standard maintenance frequencies.

This Operation and Maintenance framework applies to all stormwater treatment and attenuation assets within the development, including raingardens and retention wetlands. These assets will be vested in Porirua City Council and managed under Wellington Water's asset-management framework following a minimum one-year maintenance and establishment period post-construction.

Standard underground stormwater networks, including pipes and manholes, will vest to Council at Section 224(c) certification and form part of the public stormwater system maintained under Wellington Water's regional operations contracts.

During the active maintenance period, the developer will carry out all operation, inspection, and maintenance activities to confirm effective vegetation establishment, hydraulic functionality, and structural integrity. A joint handover inspection with Porirua City Council and Wellington Water will be undertaken prior to vesting.

Key maintenance activities will include but are not limited to:

Stormwater Network (outlets, sumps,)

- Regular inspection and clearing of litter, debris, and sediment from sumps and outlet structures.
- Inspection and repair of erosion, scour, or blockage at structures.

Raingardens

- Removal of litter, debris, and sediment from inlets, outlets, and forebays.
- Re-mulching, weeding, and replanting to maintain vegetation cover.
- Sediment removal when accumulation exceeds 150 mm or 30% of the designed sediment storage volume.

Retention Wetlands

- Maintaining permanent access to inlet and outlet structures and clearing them of debris and sediment.
- Monitoring and maintaining vegetation, and replanting as required to achieve at least 80% vegetation cover in accordance with the landscape management plans.

Detailed operations and maintenance plans will be prepared as part of the detailed design process, in accordance with the Wellington Water Regional Standard for Water Services and submitted for approval prior to vesting.

Following vesting, Porirua City Council (via Wellington Water) will assume long-term maintenance responsibility.

8.4 RETENTION WETLANDS

Because the wetland retention ponds will service large upstream catchments, they will need to be operational and functional while adjacent earthworks and civil staging are still underway.

To de-risk sediment and debris entering these devices during construction, it is proposed that the developer extend the maintenance period for these assets beyond the initial 1-year establishment phase, until the majority of the contributing catchment is fully stabilised and civil works completed.

This approach will allow any required cleaning, sediment removal, or replanting to be undertaken prior to final vesting, ensuring the ponds are handed over in good operational condition. This will be detailed within a detailed O&M Manual during the detailed design phase.

8.5 WHOLE-OF-LIFE CONSIDERATIONS

The stormwater system has been designed with long-term maintenance, renewal, and operational sustainability in mind.

- Materials comply with WWL approved materials and design lives > 100 years.

- Raingardens have been located centrally to minimise maintenance requirements
- Sediment storage volumes in treatment devices have been sized for 10 years of accumulation before desilting is required.

Overall, the stormwater infrastructure has been designed to be robust, accessible, and maintainable in accordance with Wellington Water's operational expectations and Porirua City Council's asset-management practices.

9.0 CONSTRUCTION PHASE MANAGEMENT

9.1 EARTHWORKS AND ESC

Envelope Engineering have prepared a draft Earthworks and Construction Management Plan for the site. This outlines measures to ensure the environmentally conscious completion of works at the site. It is expected that the proposed contractor will prepare a stage-specific management plan for works at the site.

As large-scale earthworks proceed, it will therefore be important to manage erosion and sediment generation carefully, requiring the need for robust erosion and sediment control measures to maintain existing water quality standards during and after construction.

It is likely that control of sediment on this site will require the use of a flocculant and the use of this would be controlled a Flocculation Management Plan (FMP).

Further details of this are described in the Construction Phase Management below and within the draft ECMP.

9.2 WATER QUALITY

For water monitoring, turbidity will be continuously measured at the downstream monitoring points (SW01, SW02, and SW03) for the duration of the works, in accordance with the PDP Water Quality Assessment. While this data is not yet finalised, baseline water quality will be confirmed prior to the commencement of construction. This will continue to be monitored during and after construction and is further detailed in PDPs hydrology assessment.

9.3 DURING CONSTRUCTION

There will need to include measures to ensure that the proposed stormwater retention wetlands and treatment devices are protected during construction works, which could include:

- Isolating treatment devices so they remain offline until their contributing catchments are fully stabilised.
- Implementing erosion and sediment controls to prevent silt-laden runoff from entering treatment systems.
- Allowing an appropriate establishment period for planting prior to commissioning each device.
- Delaying the vesting of the retention wetlands until earthworks or civil construction within the upstream catchment has been completed to a suitable benchmark.

Once a contractor is appointed, a detailed construction methodology and protection plan will be developed to ensure the wetlands and treatment devices are constructed correctly and their functionality is safeguarded throughout the remaining works.

9.4 POST CONSTRUCTION

The proposed stormwater system incorporates centralised attenuation, retention, and treatment devices, minimising the number of assets requiring long-term maintenance by Council. Dedicated maintenance tracks are provided alongside the bioretention devices to allow safe and efficient access for Council maintenance crews. Access is also provided to key stormwater structures within the retention wetlands.

As all stormwater is treated prior to entering the retention wetlands, these wetlands are not expected to require the same level of maintenance or sediment removal as bioretention systems.

10.0 ALTERNATIVES CONSIDERED

Given the site's specific conditions, opportunities, and constraints, a range of stormwater management devices have been assessed for their suitability. The existing gullies present an opportunity to integrate stormwater retention and attenuation within natural landforms, reducing earthworks and enhancing downstream environments. Given the steeper road gradients and higher residential densities, roadside raingardens are not considered a practical or effective treatment option for this development and have been designed to be centralised.

10.1 DEVICE ALTERNATIVES

Table 13. Target Load Reductions for Copper and Zinc

Stormwater Device	Considerations	Suitability
Detention / Retention Basin	Provides peak-flow attenuation and supports hydrological stability of downstream environments. Can be integrated into existing gullies due to geotechnical limitations.	Yes – within existing gullies
Roadside Raingardens	Generally unsuitable for steeper roads due reduced treatment area and high flow velocities.	No
Centralised Raingardens	Suitable. Can be sized for 85% MARV treatment and located at existing flow paths. Centralised systems simplify long-term maintenance.	Yes
Tree Pits	Effective for localised treatment of small impervious areas but limited capacity for large catchments	No
Wetlands	Large area requirement to achieve hydrological and water-quality performance. Difficult to accommodate within the steep terrain and geotechnical constraints on earthworks areas.	Yes – within existing gullies
Bioswales	Generally unsuitable for steep slopes due to high flow velocities and erosion potential.	No
Proprietary Treatment	Compact and modular; useful for isolated areas such as JOALs. Simplifies maintenance where vegetated raingardens are impractical.	Yes – as alternative to private raingardens
Soakage Devices	Ground conditions are unsuitable for infiltration and may induce local instability due to low permeability soils and shallow groundwater.	No
Permeable Paving	High maintenance requirement and reduced performance on steep grades. Provides minimal hydrological benefit under current soil conditions.	No
On-lot rainwater re-use for non-potable	Installation, operation, and maintenance are the responsibility of individual homeowners, making long-term compliance and performance difficult to ensure. Systems increase build cost and complexity, require ongoing maintenance of pumps and filters, and often deliver limited hydrological benefit during wet periods when tanks remain full. Given the site's centralised stormwater management approach, on-lot reuse would add little additional value to overall system performance.	No - not adopted for this site

10.2 PREFERRED OPTION & OUTCOMES

The preferred stormwater management approach combines conventional pipe networks for conveyance with distributed WSUD devices (bioretention basins, detention/retention ponds, and wetlands) integrated within existing gullies.

This approach:

- Meets Wellington Water's Level of Service and RSWS v3.0 performance objectives for flow, water quality, and retention.
- Aligns with GWRC PC1 hydrological control policies by managing the frequency, volume, and quality of runoff before discharging to sensitive receiving environments.
- Minimises earthworks by utilising natural gully formations for treatment and attenuation, reducing disturbance and enhancing ecological outcomes.
- Balances constructability, cost, and long-term maintenance by centralising treatment in accessible locations while maintaining distributed hydrological control.
- Supports mana whenua and community outcomes through improved water quality, reduced downstream erosion, and enhancement of natural waterways and wetlands.

Overall, the preferred option provides a practical, resilient, and environmentally responsive stormwater solution that achieves the required technical, ecological, and cultural outcomes for the Mt Welcome development.

11.0 STORMWATER IMPACT ASSESSMENT

This SMP has been compiled to comply with the information requirements required by Schedule 29 of GWRC Plan Change 1. This section is included for ease of reference.

Table 14. GWRC Plan Change 1 – Schedule 29 Requirements

Requirement	Design Response
Site evaluation: the site must be assessed for its topography, soil type, land use, drainage patterns (including wetlands/water courses), natural features, topographical and geotechnical constraints and potential flood areas.	Section 3 of this report provides a comprehensive site evaluation, prepared in consultation with the wider project team and supported by technical inputs referenced in the SMP
Catchment evaluation: analyse catchment wide characteristics and requirements (utilising existing local authority stormwater management strategies where available) to consider the proposed development in a broader stormwater discharge and receiving environment context to understand relevant catchment issues, including flooding, climate change projections (frequency and volume), water quality and any additional design or mitigation measures required to address wider catchment matters.	Section 3 of this report provides a comprehensive catchment evaluation, prepared in consultation with the wider project team and supported by technical inputs referenced in the SMP
Stormwater discharge calculation: calculation of stormwater discharge volumes and flow rates along with analysis of stormwater contaminant generation from and new and/or redeveloped impervious surfaces.	Sections 7 and 8 of this report present the stormwater discharge modelling results, including runoff volumes and peak-flow rates for new and redeveloped impervious areas. Contaminant load assessments prepared by PDP, are referenced in this report and confirm the adequacy of the proposed treatment approach.

Requirement	Design Response
Identification of actual and potential stormwater impacts: undertake evaluation of the actual and potential impacts on the receiving environment, including water quality, natural flow regimes of waterways, soil erosion, flooding, changes in hydrology and climate change (frequency and volume).	Effective for localised treatment of small impervious areas but limited capacity for large catchments
Implementation of Water Sensitive Urban Design principles: provide an analysis of how Water Sensitive Urban Design measures have been identified and incorporated into the site design and layout, building and road/paving materials and features and how existing natural features and new stormwater treatment systems have been enhanced and integrated to mimic natural processes.	Sections 7 and 8 of this report assess the actual and potential stormwater impacts on the receiving environment through detailed hydrological and hydraulic modelling. Modelling results completed by Envelope and PDP confirm that post-development discharges are hydraulically neutral, with water quality and hydrological effects mitigated through the proposed stormwater management devices
Mitigation measures: Assessment of proposed mitigations to reduce the effect of stormwater discharges on water quantity and quality, including the approach to treat in accordance with Schedule 28 (contaminant treatment) and implement hydrological control. Measures must support achieving relevant target attribute states (beyond zinc and copper) for ecosystem health, including nutrients, visual clarity and E. coli or enterococci.	Sections 7 and 8 evaluate mitigation for water quality and quantity, including 85% MARV treatment and contaminant removal per Schedule 28. Hydrological control and Contaminant load modelling reports prepared by PDP confirm compliance.
Operation and maintenance of stormwater management systems: analyse the long-term (life-cycle) operational and maintenance requirements including funding mechanisms and identification of persons responsible for ongoing maintenance.	Section 9 details the operation and maintenance requirements, identifies responsible parties, and outlines management mechanisms to ensure ongoing performance.
Cultural considerations: to be informed by engagement with mana whenua.	Section 4 describes how this plan aligns with Te Mana o te Wai and has been informed by engagement with mana whenua to protect and enhance freshwater values.

12.0 CONCLUSION

This Stormwater Management Plan presents an integrated approach to managing stormwater for the Mt Welcome development. The proposed system combines hydrological control, water-quality treatment, and conveyance to ensure the development operates effectively and in accordance with local council rules and guidelines. Key outcomes of the SMP include:

- Post-development peak flows are reduced or comparable to pre-development levels.
- Retention Wetlands provide stable long-term retention and support hydraulic neutrality across all catchments.
- Raingardens and the treatment train effectively remove sediment, metals, and nutrients from impervious runoff.

- Improved land cover and treatment devices result in cleaner, lower-impact discharge to downstream environments.
- The primary network meets WWL levels of service, with defined overland flow paths and maintenance access.
- Devices can be isolated during construction, with erosion and sediment controls ensuring protection until systems are established.

13.0 ADHERENCE TO THE EXPERT CONDUCT CODE.

While this is not a matter before the Environment Court, the author of this report has read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023 ('Code'). The author has complied with the Code in the preparation of this report.

The data, information, facts and assumptions the author has considered as part of this report are set out in this report. The reasons for the conclusions of the report are also set out in this report. Unless stated otherwise, this report is within the author's expertise and the author has not omitted to consider material facts known to him that might alter or detract from the opinions expressed.

14.0 LIMITATIONS

This report has been prepared for the project described to us and its extent is limited to the scope of work agreed between the client and Envelope Engineering Limited. No responsibility is accepted by Envelope Engineering Limited or its directors, servants, agents, staff or employees for the accuracy of information provided by third parties and/or the use of any part of this report in any other context or for any other purposes.

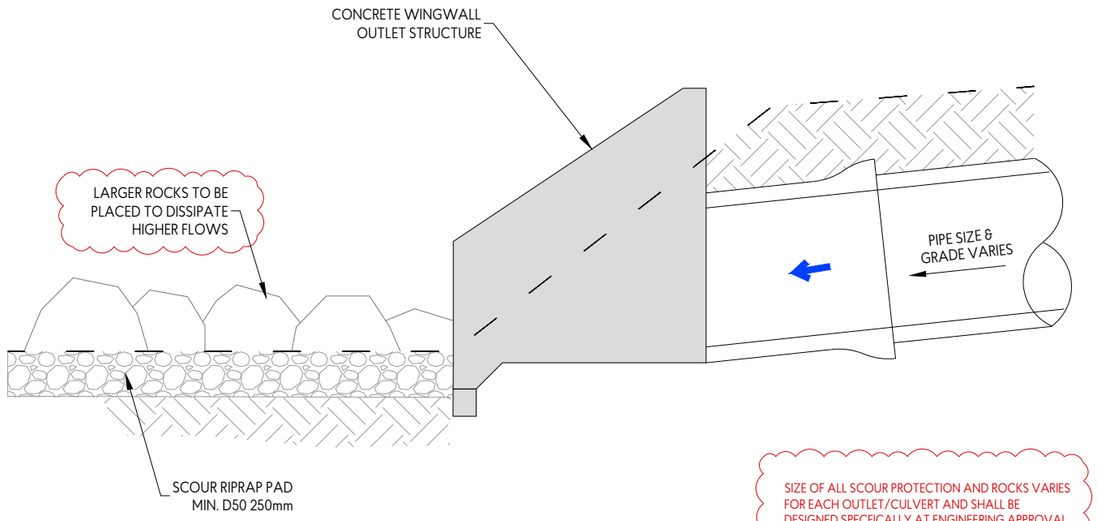
APPENDICES

APPENDIX 1 ENGINEERING PLANS

The full drawing package is provided as a separate attachment.

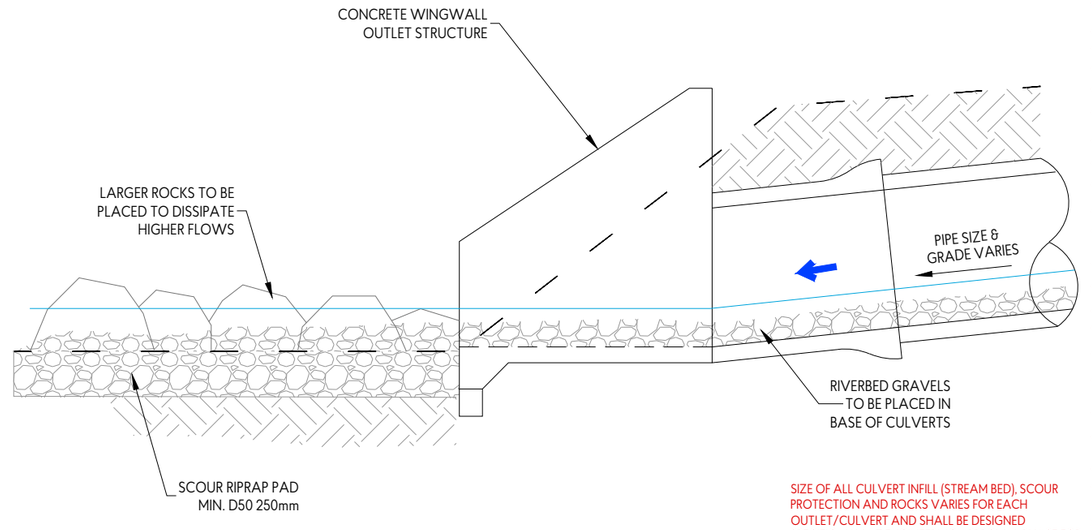
NOTES:

1. DETAILS SHOWN ARE TYPICAL DETAILS.
2. DETAILED SPECIFIC STORMWATER OUTLETS FOR EACH OUTLET WILL BE DESIGNED AND SUBMITTED FOR APPROVAL AT ENGINEERING APPROVAL.



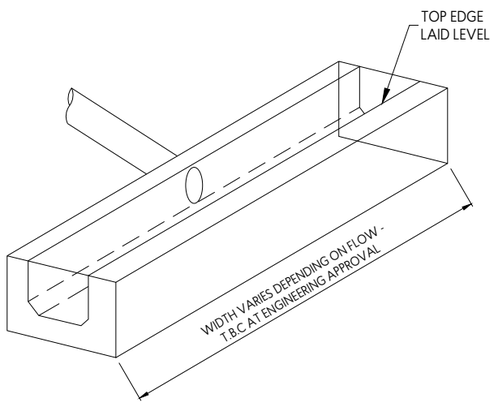
TYPICAL STORMWATER DISCHARGE
HEADWALL OUTLET

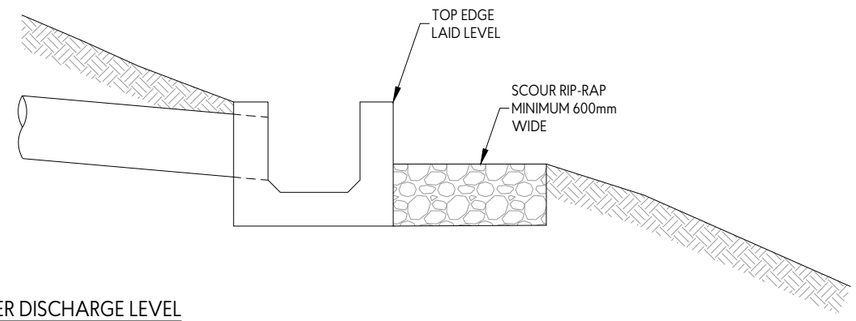
SIZE OF ALL SCOUR PROTECTION AND ROCKS VARIES FOR EACH OUTLET/CULVERT AND SHALL BE DESIGNED SPECFICALLY AT ENGINEERING APPROVAL PHASE FOR EACH OUTLET/CULVERT.



TYPICAL STORMWATER CULVERT & DISCHARGE
HEADWALL OUTLET WITH FISH PASSAGE

SIZE OF ALL CULVERT INFILL (STREAM BED), SCOUR PROTECTION AND ROCKS VARIES FOR EACH OUTLET/CULVERT AND SHALL BE DESIGNED SPECIFICALLY AT ENGINEERING APPROVAL PHASE FOR EACH OUTLET/CULVERT IN ACCORDANCE WITH NEW ZEALAND FISH PASSAGE GUIDELINES.





TYPICAL STORMWATER DISCHARGE LEVEL
SPREADER OUTLET - OPTION 1

REVISIONS:

REV	NOTES	BY	DATE
R1	RESOURCE CONSENT ISSUE	PWJ	13-11-2025
R2	SW OUTLET WITH FISH PASSAGE ADDED	PWJ	04-06-2026

PROJECT:

PUKERUA PROPERTY GROUP LP
MT WELCOME - PUKERUA BAY
PORIRUA

TITLE:

TYPICAL STORMWATER OUTLET DETAILS
SHEET 5 OF 5

ENVELOPE
WWW.ENVELOPE-ENG.CO.NZ

DESIGNED: PWJ
DRAWN: MJP
CHECKED: KD
PLOT DATE: 04-06-2026
SCALE A1: 1:10
SCALE A3: 1:20
STATUS: RESOURCE CONSENT
PROJECT No: 1753-02
DRAWING No: 4904
REVISION: R2

APPENDIX 2 STORMWATER CALCULATIONS

Client	Pukerua Property Group LP
Project Site	Mt Welcome
Envelope Ref	1753-02
Version	1
Date	3/6/2026

Outputs from ICM Cut-Off Model

POST DEVELOPMENT - 10 YEAR

Culvert ID	Diameter	Length	Grade	Note	MODEL ID-POST	Model Diam	Length (m)	Gradient (m/m)	Max flow (m³/s)	Max velocity (m/s)
P-30	750mm	56m	1.20%	Replace E-02 with 750mm Dia	SW-OUT-94-1.1	CIRC	46.5	1.2%	1.7	3.1
P-31	375mm	56m	10.00%	Second High Level Inlet With E-03	SW-IN-94-1C.1	CIRC	14.8	10.0%	0.1	3.9
P-32	1500 x 1000 Box	45m	2.00%	Piping of stream to allow SH59 upgrade	SW-IN 90-3.1	RECT	54.5	2.0%	3.7	1.8
P-33	1500 x 1000 Box	58m	3.00%	Piping of stream to allow SH59 upgrade	SWMH 90-2.1	RECT	57.5	3.0%	3.7	1.8
P-34	600mm	10m	3.60%	Extension of E-06	EX-SW-IN-02.1	CIRC	51.2	3.6%	1	2.9
P-35	600 to 900 mm	60.5m	1.5% to 6%	Retention Wetland B Outlet	SWMH 01-2 (SD-IN).1	CIRC	57.5	6.0%	1.1	1.5
P-36	450 to 675 mm	36m	10% to 15%	Retention Wetland C Outlet	SWMH 23-2 (SD-IN).1	CIRC	31	10.0%	1.1	2.9
P-37	600mm	28m	14% to 25%	Retention Wetland A Outlet	SWMH 20-2 (SD-IN).1	CIRC	26	14.0%	1.2	3.5
P-38	900mm	44m	3.50%	Road/Stream Crossing	SW-IN 74-2.1	CIRC	41.5	3.5%	1.8	2.6
P-39	600mm	10m	2.00%	Replace E-18 with 600mm Dia	SW-IN 73-2.1	CIRC	10	2.0%	1	2.7
P-40	350 to 2100 mm	28.5m	5% to 6%	Retention Wetland E Outlet	SWMH 72-2.1	CIRC	25.5	6.0%	4.1	3.8

POST DEVELOPMENT - 100 YEAR

Culvert ID	Diameter	Length	Grade	Note	MODEL ID-POST	Model Diam	Length (m)	Gradient (m/m)	Max flow (m³/s)	Max velocity (m/s)
P-30	750mm	56m	1.20%	Replace E-02 with 750mm Dia	SW-OUT-94-1.1	CIRC	46.5	1.2%	2.4	4.2
P-31	375mm	56m	10.00%	Second High Level Inlet With E-03	SW-IN-94-1C.1	CIRC	14.8	10.0%	0.3	4.6
P-32	1500 x 1000 Box	45m	2.00%	Piping of stream to allow SH59 upgrade	SW-IN 90-3.1	RECT	54.5	2.0%	8.1	2.6
P-33	1500 x 1000 Box	58m	3.00%	Piping of stream to allow SH59 upgrade	SWMH 90-2.1	RECT	57.5	3.0%	8.1	2.6
P-34	600mm	10m	3.60%	Extension of E-06	EX-SW-IN-02.1	CIRC	51.2	3.6%	1	3.1
P-35	600 to 900 mm	60.5m	1.5% to 6%	Retention Wetland B Outlet	SWMH 01-2 (SD-IN).1	CIRC	57.5	6.0%	1.9	2.5
P-36	450 to 675 mm	36m	10% to 15%	Retention Wetland C Outlet	SWMH 23-2 (SD-IN).1	CIRC	31	10.0%	1.5	3.7
P-37	600mm	28m	14% to 25%	Retention Wetland A Outlet	SWMH 20-2 (SD-IN).1	CIRC	26	14.0%	1.5	4.4
P-38	900mm	44m	3.50%	Road/Stream Crossing	SW-IN 74-2.1	CIRC	41.5	3.5%	2.5	3.7
P-39	600mm	10m	2.00%	Replace E-18 with 600mm Dia	SW-IN 73-2.1	CIRC	10	2.0%	1.1	2.7
P-40	350 to 2100 mm	28.5m	5% to 6%	Retention Wetland E Outlet	SWMH 72-2.1	CIRC	25.5	6.0%	6.1	4.7

APPENDIX 3 INFODRAINAGE OUTFLOW SUMMARY

APPENDIX 4 INFODRAINAGE CONTROL SUMMARY

APPENDIX 5 FLOOD RISK REPORT