

CIVIL INFRASTRUCTURE REPORT

Cannon Point Development

Colorado Road
Totara Park
Upper Hutt
Wellington.

Project Number: 26014

PROVIDED FOR

Cannon Point Development

DATED

17 June 2026



DOCUMENT CONTROL

Project Number: 26014

Version	Date	Purpose	Author	Reviewer
A	17 June 2026	For Fast Track Consent.	CR	JM

Version	General Extent of Revision
A	N/A

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1.0 EXECUTIVE SUMMARY

This report has been prepared by Vecta Ltd for Cannon Point Development Ltd to provide civil engineering documentation relating to the proposed continuation of the Cannon Point subdivision located in Totara Park, Upper Hutt. The development is situated across several titles legally described as Lot 1000 DP 598401, Lot 2001 DP 588162, Lot 3 DP306622, and Lot 4 DP306622. The overall development has been structured as a multi-stage residential subdivision, with Stages 1 and 2 already completed and comprising 46 residential lots together with associated civil infrastructure and utility servicing.

The site is located on an elevated alluvial terrace adjacent to the Hutt River corridor and has been planned to work with the existing landform while minimising environmental effects, infrastructure constraints, and unnecessary earthworks. The proposed development continues the established subdivision pattern created by the earlier stages and has been designed to integrate with the surrounding residential environment and wider Totara Park area. Bulk earthworks, engineered fill placement, and retaining structures will be undertaken to create stable development platforms, road corridors, and infrastructure alignments consistent with the engineering approach adopted in the completed stages of the development.

The proposed works described within this report will deliver approximately 162 residential lots and 2 commercial lots together with all associated civil infrastructure required to service the development. The scope of works includes the construction and extension of internal roading networks, three waters reticulation, stormwater management systems, utility services, retaining structures, pedestrian and recreational walking connections, and associated public infrastructure upgrades. The transport network has been designed to integrate with the existing road layout while improving network resilience, emergency access, and connectivity through the provision of an additional public road connection forming a looped network arrangement.

Stormwater management for the development adopts a water sensitive urban design approach incorporating attenuation systems, treatment devices, raingardens, wetlands, and controlled conveyance systems to manage runoff quantity and quality while protecting downstream receiving environments. Earthworks and infrastructure construction will be undertaken in a staged manner with progressive erosion and sediment control measures implemented throughout construction to minimise environmental effects and maintain site stability.

The proposed works have been designed generally in accordance with relevant national and local standards, including NZS 4404, relevant Austroads guidance, Wellington Water standards, and the Upper Hutt City Council Code of Practice. Overall, the proposed development represents a logical



and efficient continuation of the established Cannon Point development and is considered capable of being constructed using conventional engineering methodologies and staging practices.



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2.0 INTRODUCTION

2.1. PROJECT BACKGROUND

The Cannon Point development is a staged residential subdivision located in Totara Park, Upper Hutt. The development is spread across multiple titles with a combined site area of approximately 28 ha.

The project has been structured as a multi-stage development. Stages 1 and 2 have been completed, delivering 46 residential sections. Subsequent intensification within these stages has increased the current yield to 51 titles, with an anticipated ultimate yield of approximately 60+ dwellings as remaining sites are developed.

The completion of Stages 1 and 2 has established the core subdivision infrastructure, including formed access, reticulated three waters services, power supply, and the primary access routes required to service the remaining stages. This provides a proven and established platform for the continuation of the development. The remaining stages will follow the same design principles, servicing strategy, and access arrangements as those implemented within the completed stages. Downstream infrastructure capacity has been assessed and is considered sufficient to accommodate the proposed development. Targeted upgrades have been identified, including bridge widening works, with the scope of these works having been developed in coordination with NZTA, Upper Hutt City Council, and Cannon Point Developments. Any additional constraints are minor in nature and can be addressed through localised upgrades within the development footprint.

Proposed Stages 3 and 4 represent logical extensions of the existing development. Design of these stages has been conducted through extensive engagement and discussions with Upper Hutt City Council, Greater Wellington Regional Council, and Wellington Water Limited. The resulting design as proposed in this document has the support of council.

The proposed stages will generally utilise infrastructure that has already been completed expanding on what has already been built. Stage 4 will provide an additional connection to the existing public road network, improving network connectivity and enabling increased resilience for transport and three waters infrastructure, as well as supporting future public transport opportunities.

The project is well advanced, with concept architectural designs completed for Stages 3 and 4, and engineering design has been advanced through to approximately 85% detailed design. Early contractor engagement undertaken to confirm construction methodology and staging. The development is fully funded and will be an extension on the previous stage's facilities.



The proposed stages will deliver approximately 65 residential lots in Stage 3 and 99 in Stage 4 with 2 commercial lots, increasing the total development yield to 162 residential lots. A further two stages remain for future development beyond those currently proposed.

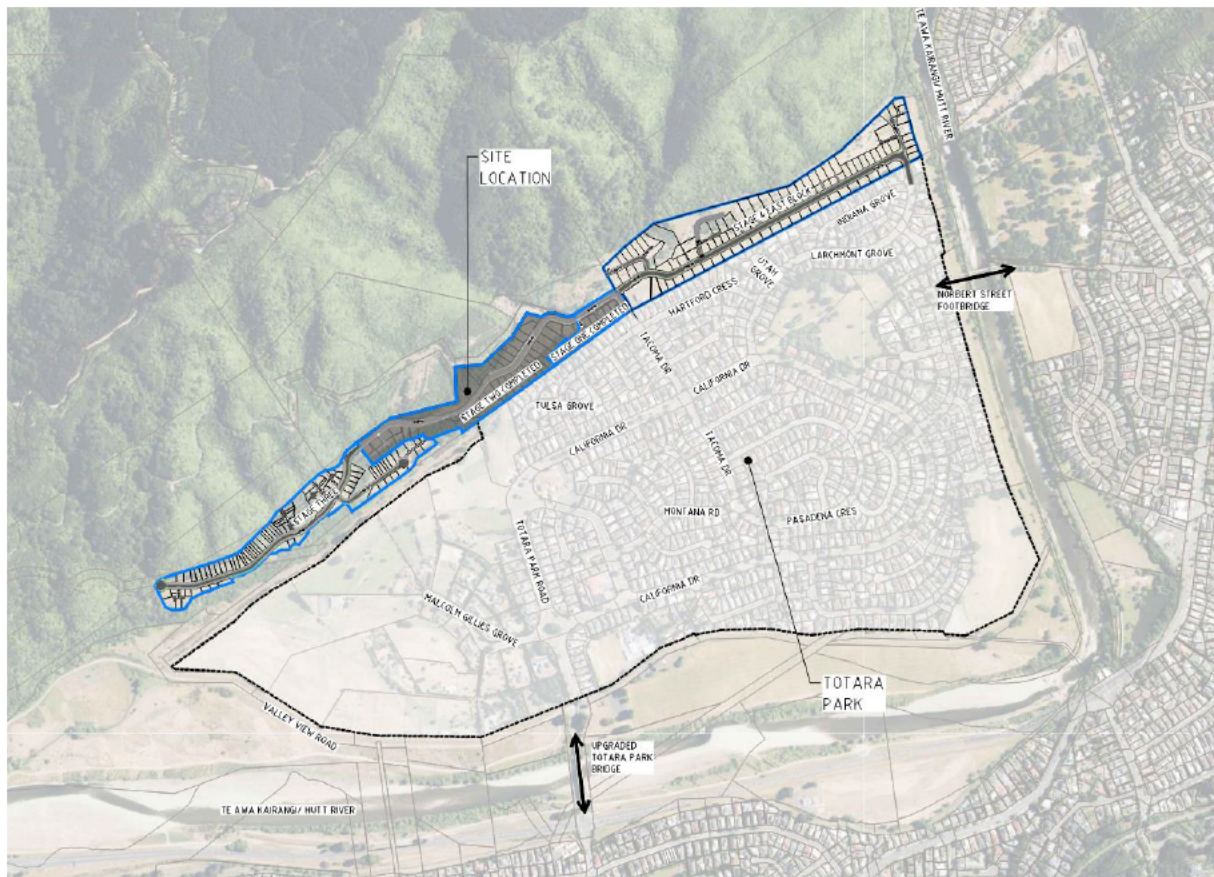


Figure 1. Site masterplan.

2.2. LOCATION

The Cannon Point development is located within the suburb of Totara Park in Upper Hutt, approximately 2 km north-east of Upper Hutt City Centre. The site is positioned on the Western side of the Hutt River and is accessed via Colorado Road, which has direct access to State Highway 2.

The development is situated within an established and expanding residential catchment, with existing urban development to the south and east, including previously completed stages of the Cannon Point subdivision. The surrounding area is characterised by a mix of low-density residential housing and areas of native bush.

The site benefits from strong connectivity to the wider transport network, with State Highway 2 providing direct access to Upper Hutt, Lower Hutt, and Wellington City. Local amenities, including schools, recreational facilities, and community services, are located within a short driving distance of the site.



The development is located in proximity to the Hutt River corridor and is bordered by areas of native vegetation and established walking tracks, contributing to the amenity and recreational value of the site.

Topographically, the site is characterised by its long relatively flat alluvial terrace extending around 3 km including the previously constructed stages and all planned future stages. The terrain, with development areas generally aligned along the terrace, with bulk earthworks planned to create level pads within the site, this will be consistent with the form established in earlier stages of the subdivision.

2.3. SCOPE OF WORKS

The proposed works relate to the development of Stages 3 and 4 of the Cannon Point subdivision and include the creation of approximately 162 residential lots, together with all associated civil infrastructure required to service the development.

The scope of works includes:

Subdivision Works

- Creation of approximately 162 residential lots across Stages 3 and 4
- Formation of dwelling platforms through bulk earthworks
- Provision of access, rights of way, and lot-specific servicing

Earthworks and Site Development

- Bulk earthworks to establish benched development platforms consistent with earlier stages
- Cut and fill operations to achieve levels and grades suitable for servicing and civil infrastructure
- Implementation of erosion and sediment control measures during construction

Access and Transport Infrastructure

- Extension of the existing internal roading network from Stages 1 and 2
- Construction of new internal roads to service proposed lots
- Formation of an additional connection to the existing public road network (Stage 4)
- Associated vehicle crossings, intersections, and road safety elements
- Construction of recreational walking tracks.

Three Waters Infrastructure

- Extension of existing water supply, wastewater, and stormwater networks to service all proposed lots
- Construction of new reticulation within Stages 3 and 4
- Integration with existing infrastructure delivered as part of earlier stages



- Implementation of stormwater management measures, including conveyance and attenuation and treatment where required

Utilities

- Extension of power and telecommunications services to each lot
- Integration with existing utility networks servicing earlier stages
- Undergrounding of the existing high voltage network.

External Works

- Bridge widening works to support increased traffic demand
- Drinking water DMA rezoning to improve network resilience and connectivity.

The proposed works represent a continuation of the established development pattern at Cannon Point, utilising and extending existing infrastructure and access networks. The design approach, construction methodology, and servicing strategy are consistent with those implemented and completed within Stages 1 and 2.



3.0 SITE DESCRIPTION

3.1. EXISTING SITE

The site comprises the remaining undeveloped land within the Cannon Point subdivision, located to the north and south of Stages 1 and 2. The existing site is partially developed, with Stages 1 and 2 already constructed and serviced, including formed roads, dwelling platforms, and reticulated three waters and utility infrastructure.

The undeveloped portions of the site are generally characterised by a mix of grassed areas, and some small amounts of native bush. The proposed development areas existing currently as raised, predominantly flat grassed areas along the top the existing natural terrace that runs the length of the bush clad hills to the north of the site. This terrace provides elevated building platforms with a amenity provided by the views of the Upper Hutt district and Pakuratahi Forest Park across the valley floor.

Existing access to the site is provided via Colorado Road through the established internal road network constructed as part of earlier stages.

Topographically, the site is defined by a long, relatively flat alluvial terrace, consistent with the landform established in Stages 1 and 2. Localised variations in level are present and will require further earthworks to establish suitable development platforms.

Existing infrastructure within and adjacent to the site includes:

- Internal roads and accessways constructed as part of Stages 1 and 2
- Water supply, wastewater, and stormwater reticulation
- Power and telecommunications services
- Existing bridge structure providing access to the development area

The site is also influenced by its proximity to the Hutt River corridor and adjacent areas of native vegetation, which contribute to the environmental and amenity context of the development.

3.2. PROPOSED DEVELOPMENT

The proposed development comprises Stages 3 and 4 of the Cannon Point subdivision and represents a continuation of the established development pattern.

The development will include:

- Creation of 162 residential lots and 2 commercial lots
- Formation of building platforms and civil infrastructure through bulk earthworks
- Extension of the internal roading network to service new lots
- Provision of an additional connection to the public road network (Stage 4)
- Extension of water supply, wastewater, and stormwater infrastructure



- Extension of power and telecommunications services

The layout of the proposed stages follows the established design principles applied in Stages 1 and 2, with residential dwellings to be constructed on both sides of a main trunk access road with some minor local roads extending off the main access road in several locations, these have all been provided with cul-de-sac turning heads and are similar to the existing network that exists within the wider Totara Park area.

The proposed development is aligned in principle with both the previously constructed stages within the development and with the wider Totara Park as a whole with respect to dwelling typologies while encourages pockets of higher density to meet the market demand for a range of different products.

The development area is aligned along the existing terrace landform to work with the land and provide a natural extension to the infrastructure from previously constructed networks.

Bulk earthworks will be undertaken to form level building platforms and road alignments, consistent with the approach adopted in earlier stages. Any required retaining structures will be incorporated to support the development platforms.

The proposed development has been designed to integrate with existing infrastructure and minimise the need for significant off-site upgrades, with identified works such as bridge widening forming part of the overall infrastructure strategy.

3.3. RESERVES AND OPEN SPACE

The development incorporates provision for reserves and open space to support amenity, recreation, and environmental outcomes.

Open space within the development will include:

- Areas of retained native vegetation
- Provision for recreational walking tracks integrated with the wider track network
- Localised reserve areas where required to support subdivision design and amenity
- Natural stormwater treatment devices such as wetlands and raingardens with public access tracks.

These areas are designed to complement the natural features of the site, including the Hutt River corridor and surrounding bush, and to provide accessible recreational opportunities for future residents. The open space network will integrate with existing and planned walking tracks within the



wider Cannon Point area, contributing to connectivity and enhancing the overall quality of the development.

3.4. STAGING

The Cannon Point development is being undertaken in a staged manner, with Stages 1 and 2 having been completed and Stages 3 and 4 forming the subject of this application. A fifth and sixth stage are proposed for future development but do not form part of this proposal.

The staging of the development has been structured to align with the progressive extension of infrastructure and access from the established portions of the site.

The staging approach enables efficient delivery of infrastructure, with each stage building directly off previously completed works. This reduces the need for temporary works and ensures that each stage can function independently while contributing to the overall development.

The proposed staging also allows for flexibility in construction sequencing while maintaining logical progression of works, ensuring that development can proceed in a coordinated and efficient manner.

3.4.1. STAGE 1 AND STAGE 2 (COMPLETED)

Stages 1 and 2 have been completed and include the construction of internal roads, dwelling platforms, and full reticulation of water supply, wastewater, stormwater, power, and telecommunications infrastructure. These stages have established the primary access and servicing framework for the development along with providing a large amount of the lead-in infrastructure for the currently proposed stages.

3.4.2. STAGE 3 (PROPOSED)

Stage 3 will extend the existing internal road and servicing networks from the end of Stage 2 into the adjoining development area. Works will include bulk earthworks to form development platforms, construction of internal roads, and extension of all required infrastructure to service the proposed lots. This extension of the existing infrastructure will service 65 residential lots and construct a large raingarden to provide stormwater treatment and amenity value for the development.

3.4.3. STAGE 4 (PROPOSED)

Stage 4 will extend northwards from the access point in Stage 1 to the turning head of Larchmont Grove. This will create a loop road through the development and facilitate another connection to the existing public infrastructure in Larchmont Gr. This stage will improve network connectivity and resilience and enable more efficient servicing of the wider development area. Associated infrastructure and earthworks will be undertaken consistent with earlier stages.



3.4.4. STAGE 5 AND 6 (FUTURE STAGES)

Stages 5 and 6 are future proposed stages that extend outwards from Stages 3 and 2 respectively. These are currently in concept only, and do not form part of this proposal.



4.0 SAFETY IN DESIGN

Safety in design has been a key consideration in the development of the Cannon Point subdivision, with risks identified and managed through the design process in accordance with the principles of the Health and Safety at Work Act 2015.

The design approach has prioritised the elimination of hazards where practicable, followed by risk reduction through engineering controls. Residual risks that cannot be eliminated have been identified and will be managed through construction methodologies and operational controls.

Key safety considerations incorporated into the design include:

4.1. EARTHWORKS AND GEOTECHNICAL STABILITY

- Geotechnical matters have been addressed by the geotechnical consultant, Engeo, to provide guidance on the proposed development.
- Development platforms and infrastructure corridors have been designed to minimise the need for steep cuts and unsupported slopes
- Batters and retaining structures have been designed to achieve stable configurations during both construction and long-term use
- Earthworks have been staged to maintain stability and minimise exposure of open faces

4.2. ACCESS AND CONSTRUCTION SAFETY

- Staging of works enables safe and controlled access for construction vehicles and personnel, with staging areas to be identified and prepped with each stage of work.
- Roading layouts have been designed to provide appropriate gradients, sightlines, and manoeuvrability
- Construction access aligns with established infrastructure from earlier stages, removing the need for temporary access arrangements

4.3. SERVICES AND UTILITIES

- Underground services have been coordinated to minimise conflicts and reduce installation risks
- Separation distances between services have been incorporated into the design
- High-voltage infrastructure will be undergrounded within the development area, removing overhead hazards



4.4. TRAFFIC AND PUBLIC INTERFACE

- The design and staging are planned so that there is minimal interaction between construction activities and public access areas
- Additional road connections (Stage 4) will improve network resilience and reduce reliance on a single access point

4.5. STORMWATER AND ENVIRONMENTAL SAFETY

- Stormwater attenuation systems have been designed to manage flows in accordance with the UHCC CoP and WWL's managing stormwater runoff documents.
- Stormwater treatment devices are provided and reduce the risk of uncontrolled discharge or erosion
- Erosion and sediment control measures will be implemented during construction to protect downstream environments

4.6. RESIDUAL RISK MANAGEMENT

Residual risks associated with construction activities, including earthworks, working around services, and traffic management, will be addressed through site-specific health and safety plans prepared by the contractor. These will include appropriate controls, methodologies, and supervision to ensure works are undertaken safely.

The safety in design process will continue through detailed design and construction, with ongoing review and coordination between designers, contractors, and relevant stakeholders to ensure risks are appropriately managed throughout the life of the project.



5.0 EARTHWORKS

5.1. OVERVIEW

The proposed development of Stages 3 and 4 will require bulk earthworks to form development platforms, internal roads, and associated infrastructure. The earthworks are consistent with those undertaken in Stages 1 and 2 and represent a continuation of the established development methodology.

Earthworks will involve cut and fill operations to achieve suitable levels and grades across the site, with development aligned along the existing alluvial terrace landform. The works will be undertaken in a staged manner to maintain stability and enable efficient construction sequencing.

5.2. STANDARDS AND COMPLIANCE

All earthworks will be designed and undertaken in accordance with relevant national and local standards, including:

- NZS 4404:2010 Land Development and Subdivision Infrastructure
- NZS 4431:2022 Engineered fill construction for lightweight structures
- Upper Hutt City Council Land Development and Subdivision Engineering Code of Practice
- Greater Wellington Regional Council Erosion and Sediment Control Guide for Land-Disturbing Activities in the Wellington Region.
- Engeo Geotechnical Report
- Blue Green Ecology Report

Earthworks will be carried out in accordance with best practice guidelines to ensure stability, durability, and environmental protection.

5.3. GEOTECHNICAL CONSIDERATIONS

The earthworks design has been undertaken in accordance with the recommendations outlined in the geotechnical report completed by Engeo.

5.4. GROUND CONTAMINATION

Based on the site history and investigations completed to date, no significant contamination issues have been identified that would preclude residential development. Should any unexpected contamination be encountered during earthworks, it will be managed in accordance with relevant guidelines and regulatory requirements.



5.5. ECOLOGICAL AND ENVIRONMENTAL ASSESSMENT

A detailed ecological and environmental assessment has been completed by Boffa Miskell, refer to their report no. BM260093 for a full assessment.

5.6. BULK EARTHWORKS

Bulk earthworks will be undertaken to form development platforms, road alignments, and infrastructure corridors.

The works will include:

- Cut and fill operations across the site
- Benching of slopes to create stable building platforms
- Placement and compaction of engineered fill
- Trimming and finishing of batters and platforms

Earthworks volumes are anticipated to be approximately 102,220 m³ cut and 120,052 m³ fill, with an overall balance achieved across the site where practicable, the additional fill required will be comprised of material removed from the trenching for the civil works, the road subgrade prep and from the dwellings foundation excavations.

All fill will be placed and compacted in accordance with engineering specifications to ensure long-term performance of building platforms and infrastructure.

5.7. EARTHWORKS STAGING

Earthworks will be undertaken in a staged, controlled, and progressive manner to enable efficient delivery of the development while appropriately managing environmental effects and construction risk.

The staging methodology has been developed to:

- Prioritise early delivery of critical infrastructure (particularly stormwater treatment and conveyance)
- Minimise the extent and duration of exposed earthworks at any one time
- Maintain stable access and construction platforms throughout the works
- Enable progressive stabilisation and rehabilitation of disturbed areas
- Align with the capacity and staging of erosion and sediment control measures

Works will generally commence from areas of established access and extend into new development areas, reducing reliance on temporary works and improving overall constructability.

Erosion and sediment control measures will be installed ahead of, or concurrently with, each stage of earthworks, and will be maintained and adapted as works progress to ensure continued performance



5.7.1. STAGE 3

Bulk earthworks for Stage 3 will be undertaken in two primary phases to align infrastructure delivery with environmental management and construction sequencing.

Phase 1 - Eastern Works (East of CH1000, Road 1)

The initial phase comprises all cut and fill earthworks east of CH1000 along Road 1. This phase is critical to establish primary infrastructure required for the functioning of the wider stage.

Key outcomes of Phase 1 include:

- Construction of the primary raingarden to provide stormwater treatment and controlled discharge for the entire Stage 3 area
- Establishment of lead-in infrastructure, including primary stormwater conveyance and associated services
- Formation of building platforms and construction of retaining walls to enable commencement of dwelling construction

This sequencing ensures that stormwater treatment and discharge infrastructure is operational prior to, or concurrent with, the generation of runoff from subsequent earthworks and development activities.

Phase 2 - Western Works (West of CH1000, Road 1)

The second phase comprises all cut and fill earthworks west of CH1000 along Road 1.

These works may proceed concurrently with civil construction activities initiated under Phase 1, provided that:

- Adequate erosion and sediment controls are in place and functioning
- Downstream stormwater infrastructure (including the raingarden) is operational or able to receive flows
- Construction access and safety can be maintained

Earthworks will generally achieve a balance of cut and fill, forming level building platforms and suitable subgrades for roads and services.

5.7.2. STAGE 4

Bulk earthworks for Stage 4 will follow a similarly staged approach, with sequencing refined through detailed design.

Staging will be determined based on:

- The spatial distribution and balance of cut and fill volumes
- The location and capacity of erosion and sediment control measures
- Infrastructure dependencies, particularly stormwater management systems
- Site access, constructability, and health and safety considerations

Earthworks will be sequenced to ensure that:



- Stormwater management systems are implemented in a timely manner relative to contributing catchments
- The extent of exposed surfaces is minimised at any point in time
- Progressive stabilisation is undertaken as areas reach final levels

5.8. EROSION AND SEDIMENT CONTROLS

5.8.1. STRATEGY

Erosion and sediment control (ESC) measures will be implemented to appropriately manage the environmental effects of earthworks and to protect downstream receiving environments throughout all stages of construction.

ESC measures will be designed, installed, and maintained in general accordance with the Greater Wellington Regional Council *Erosion and Sediment Control Guidelines for the Wellington Region* and relevant industry best practice.

The ESC strategy has been developed to:

- Minimise sediment generation at source
- Intercept, treat, and control sediment-laden runoff prior to discharge
- Limit the extent and duration of exposed surfaces
- Provide a staged and adaptable control system aligned with earthworks sequencing

Controls will be installed prior to, or concurrently with, the commencement of each stage of earthworks and will be progressively modified as the site develops.

5.8.2. PROPOSED EROSION AND SEDIMENT CONTROL MEASURES

The following measures will be implemented as appropriate to each stage of works:

- Sediment retention ponds (SRPs) for treatment of runoff from contributing catchments
- Decanting earth bunds (DEBs) for smaller or interim catchments
- Silt fences and filter socks for localised sediment interception
- Clean water diversion bunds to isolate upgradient catchments
- Dirty water diversion channels/bunds to direct flows to treatment devices
- Stabilised construction entrances to reduce sediment tracking onto public roads
- Grit traps and sump protection within the stormwater network
- Progressive stabilisation of exposed surfaces (e.g., topsoiling, hydroseeding, or mulching)

5.8.3. STAGING AND IMPLEMENTATION

ESC measures will be implemented in accordance with the staged earthworks methodology outlined in Section 5.7, such that:

- Primary treatment devices (e.g., sediment retention ponds and raingardens where applicable) are established early to service contributing catchments
- Controls are sized and located to reflect the active disturbance area for each stage



- Additional or upgraded controls are installed as catchments expand or change

No bulk earthworks will commence in any stage until the relevant ESC measures for that stage are in place and operational.

5.8.4. MONITORING AND MAINTENANCE

All ESC measures will be subject to regular inspection and maintenance to ensure continued performance. This will include:

- Routine inspections (including following rainfall events)
- Removal of accumulated sediment from control devices
- Repair or replacement of damaged or ineffective controls
- Ongoing adjustment of controls to reflect site conditions and construction progress

Monitoring and maintenance will be undertaken in accordance with best practice and relevant guidelines to ensure that sediment discharges are appropriately managed at all times.

5.8.5. PROGRESSIVE STABILISATION

Earthworks will be managed to minimise the extent and duration of exposed surfaces. Areas will be progressively stabilised as soon as practicable following completion of earthworks, particularly where works are paused or completed.

Stabilisation methods will be selected based on site conditions and may include vegetation establishment, mulching, or other surface protection techniques.

5.9. CUTTING

Cutting works will be undertaken to achieve the required development platforms, road alignments, and infrastructure corridors in accordance with the approved design levels.

All cuts will be carried out in a controlled manner to maintain slope stability, manage groundwater where encountered, and minimise environmental effects.

Cut batters will be formed to stable angles appropriate to the encountered materials and in accordance with geotechnical design parameters. Where required, cuts will be supported by engineered retaining structures designed in accordance with relevant standards.

Key controls for cutting operations include:

- Stripping and stockpiling of topsoil for later reuse in site rehabilitation
- Benching of cut slopes where required to improve stability and constructability
- Management of groundwater and surface water to prevent instability and erosion
- Limiting the extent of unsupported cuts and the duration of exposure
- Integration with erosion and sediment control measures to manage runoff from exposed areas

All cut surfaces will be progressively stabilised as soon as practicable following completion of works.



Cutting activities will be undertaken under geotechnical supervision and in accordance with the geotechnical report provided by ENGEO and all relevant NZ standards, with inspections carried out at key stages to confirm that ground conditions are consistent with design assumptions or to identify where design modifications may be required.

5.10. FILLING

Filling works will be undertaken to form building platforms, road subgrades, and service corridors in accordance with the approved design and in accordance with the geotechnical report provided by ENGEO.

Topsoil will be stripped from all fill areas and stockpiled for reuse in landscaping and site reinstatement.

Prior to placement of fill, the exposed subgrade will be inspected and approved by the project geotechnical engineer to confirm its suitability. Where unsuitable materials are encountered, they will be removed and replaced or otherwise treated as directed by the geotechnical engineer.

Fill will be placed in controlled layers and compacted to achieve the required engineering performance. Filling operations will be carried out in accordance with recognised standards and project specifications, including:

- Placement in horizontal layers of appropriate thickness
- Moisture conditioning to achieve optimum compaction
- Compaction to specified densities suitable for the intended end use (e.g., building platforms, pavements)
- Use of suitable engineered fill materials
- Key controls for filling operations include:
 - Ensuring stability of fill slopes and batters during and after construction
 - Integration with erosion and sediment control measures to manage runoff
 - Limiting the height and rate of fill placement to maintain stability
 - Progressive trimming and stabilisation of completed surfaces

All fill areas will be subject to geotechnical inspection and testing to verify compliance with design requirements. Upon completion, areas intended for structural support will be certified as suitable for their intended use.

5.11. RETAINING WALLS

To achieve the proposed finished levels for building platforms, roads, and infrastructure, a series of retaining walls and landscape walls are required across the site. The indicative locations and extents of these walls are shown in the Vecta drawing sets.



The retaining walls form an integral component of the earthworks and development strategy, enabling the creation of stable, usable platforms while minimising the overall footprint of earthworks and associated environmental effects.

5.11.1. DESIGN APPROACH

Retaining walls will be designed to ensure stability, durability, and serviceability for the intended design life of the development. Wall types are expected to include a combination of:

- Timber pole retaining walls
- Masonry block walls
- Reinforced concrete retaining walls (including pile or cantilever systems)
- Landscape (non-structural) retaining elements

Final wall selection will be confirmed at detailed design stage based on geotechnical conditions, retained heights, constructability, and cost efficiency.

All retaining walls will be designed in accordance with relevant New Zealand standards, including:

- NZ Building Code Clause B1 (Structure)
- NZS 3101 (where applicable)

Geotechnical design parameters will be derived from site-specific investigations and analyses, including assessment of soil strength, groundwater conditions, and global and local stability.

5.11.2. STAGING AND INTEGRATION

Construction of retaining walls will be integrated with the earthworks staging outlined in Section 5.7, such that:

- Retaining walls required to support cut or fill batters are constructed progressively with earthworks
- Walls forming building platforms are completed prior to, or concurrent with, the formation of finished platforms
- Wall construction aligns with the sequencing of infrastructure and access provision

This approach ensures that temporary instability risks are minimised and that construction can proceed efficiently.

5.11.3. BUILDING CONSENT AND DETAILED DESIGN

All retaining walls that meet the definition of a structure under the Building Act will be subject to building consent.

Detailed design of retaining walls will be undertaken at the building consent stage and will include:

- Structural and geotechnical design calculations
- Consideration of surcharge loads (including buildings, traffic, and services)



- Seismic design in accordance with applicable standards and guidance
- Drainage design to relieve hydrostatic pressures
- Durability design to achieve the required design life

Producer Statements (PS1 - Design and PS4 - Construction Review) will be provided as part of the building consent and construction process, as required.

5.11.4. CONSTRUCTION AND QUALITY ASSURANCE

Construction of retaining walls will be carried out under appropriate engineering supervision, with inspection hold points to confirm:

- Foundation conditions and bearing capacity
- Installation of structural elements (e.g., piles, reinforcement)
- Backfill material quality and compaction
- Installation of drainage systems

All walls will be constructed to achieve the performance requirements of the design and will be certified upon completion as suitable for their intended use.



6.0 TRANSPORT AND ACCESS

6.1. OVERVIEW

The proposed development provides for the extension of the existing internal road network established in Stages 1 and 2 to service Stages 3 and 4. The transport layout has been designed to deliver a safe, efficient, and integrated network that aligns with the established development and supports the planned scale of growth.

The roading network will provide access to all proposed lots and is configured to:

- Maintain consistency with the existing road hierarchy and design standards
- Provide safe and legible access for residents, visitors, and service vehicles
- Support efficient vehicle movements within and through the development
- Accommodate active modes where required

Stage 4 includes the formation of an additional connection to the public road network. This connection will:

- Improve network connectivity and permeability
- Provide alternative access for emergency services
- Increase overall network resilience in the event of disruption to a single access point
- Distribute traffic movements more evenly across the network

The transport network has been designed to integrate with existing infrastructure and to accommodate anticipated traffic demands generated by the development. Traffic volumes are consistent with a low-density residential environment and can be safely accommodated within the proposed road typologies.

6.1.1. DESIGN INTEGRATION AND STANDARDS

The road network has been developed in general accordance with relevant local authority requirements and recognised industry standards, along with the topography of the site to allow efficient including:

- NZS 4404
- Applicable local authority codes of practice for land development and roading
- Road geometry, widths, and layouts have been selected to achieve:
- Safe vehicle manoeuvring and appropriate visibility
- Operating speeds consistent with a residential environment
- Accommodation of service vehicles, including refuse collection and emergency access
- Integration with stormwater, three waters, and utility infrastructure



6.1.2. STAGING AND DELIVERABILITY

The transport network will be delivered in stages aligned with the overall development sequencing. Road construction will generally follow bulk earthworks and will be coordinated with the installation of underground services.

Key staging principles include:

- Progressive extension of the existing road network to maintain continuous and safe access
- Provision of temporary or permanent turning facilities where required
- Maintenance of safe and functional access at all times during construction
- Delivery of the Stage 4 connection at an appropriate stage to enhance network resilience and emergency access

6.2. STANDARDS AND COMPLIANCE

The roading and access design has been undertaken in general accordance with relevant standards and guidelines, including:

- NZS 4404:2010
- Upper Hutt City Council Land Development and Subdivision Engineering Code of Practice
- Austroads guidelines (where applicable)

The design provides for:

- Safe vehicle access to all lots
- Appropriate road geometry, including alignment, gradients, and sight distances
- Accommodation of service and emergency vehicles
- Compliance with relevant performance requirements of the New Zealand Building Code

6.3. PROPOSED ROAD NETWORK

The proposed road network extends from the existing roads constructed as part of Stages 1 and 2 and provides access to all new residential lots within Stages 3 and 4.

6.3.1. STAGE 3

Stage 3 represents a direct extension of the Stage 2 roading network and forms the primary access spine for this phase of development.

Works include the extension of Colorado Road by approximately 600 m, together with the construction of Road 2, which provides access to the lower terrace of the site. This lower terrace incorporates a defined green space, including a raingarden for stormwater treatment and a recreational walking track connecting to both Tulsa Park and the wider Cannon Point track network.

Network Function and Layout

The Stage 3 road network has been designed to:



- Extend the existing road network in a coherent and legible manner
- Utilise the same design philosophy as the previous stages
- Provide efficient access to all proposed residential lots
- Enable access to shared open space and recreational infrastructure
- Maintain a low-speed residential environment consistent with earlier stages

Road alignments generally follow the natural terrace landform, minimising earthworks, reducing retaining requirements, and maintaining practical longitudinal gradients.

Key Features

- Extension of Colorado Road (approx. 0.6 km) to service the primary development area
- Formation of Road 2 to provide access to the lower terrace and associated open space
- Integration of access to the raingarden and recreational walking connections
- Provision of turning heads or suitable manoeuvring facilities where required
- Road geometry designed to accommodate service vehicles, including refuse trucks and emergency services

Integration with Infrastructure and Open Space

The Stage 3 road network is integrated with stormwater and open space infrastructure, such that:

- The raingarden is accessed and serviced via the road network and forms part of the overall stormwater management system
- Road corridors accommodate underground services in accordance with standard practice
- Pedestrian connectivity is provided between residential areas, open space, and the wider walking track network

Design Performance

The Stage 3 roading network has been designed to achieve:

- Safe vehicle access and manoeuvring for all users
- Appropriate gradients and alignment in response to site topography
- Adequate visibility and sight distances
- Capacity to accommodate anticipated residential traffic volumes

6.3.2. STAGE 4

Stage 4 extends from the existing intersection established in Stage 1, where Stages 1 and 2 continue to the south. Stage 4 extends the network to the north via Road 1, which connects through to the existing cul-de-sac at Larchmont Grove, forming a looped road network of approximately 0.75 km in length.

This stage represents a key enhancement of the overall network by transitioning from a partially branched layout to a connected loop, improving accessibility and resilience.



Network Function and Layout

The Stage 4 road network comprises:

- Extension of Road 1 to form the primary loop connection
- Three minor public roads branching from Road 1
- A series of private accessways providing access to rear or offset building platforms

This arrangement enables efficient use of land while maintaining a coherent streetscape and providing flexibility in dwelling layout.

Key Features

- Formation of a continuous loop road connecting to Larchmont Grove
- Elimination of reliance on a single-access arrangement for this portion of the development
- Provision of secondary roads and accessways to service individual lots
- Consistent application of the established road hierarchy from earlier stages

The road design philosophy will be consistent with Stages 1 and 2, ensuring continuity in road typologies, geometry, and streetscape outcomes.

Network Resilience and Emergency Access

The looped configuration is a critical component of the transport strategy and provides:

- Redundant access routes for residents and emergency services
- Improved network resilience in the event of blockage, maintenance, or natural hazard events
- Enhanced circulation and reduced dependence on cul-de-sac arrangements

This approach aligns with best practice subdivision design and supports a robust and reliable transport network.

Public Transport and Connectivity

The formation of a continuous loop road improves the potential for future public transport integration. While public transport services are not currently proposed within the development, the layout:

- Provides a connected route capable of accommodating bus movements if required
- Improves accessibility to existing or future public transport routes in the wider area
- Supports walkable catchments and multi-modal connectivity

Design Performance

The Stage 4 road network has been designed to achieve:

- Safe operation within a low-speed residential environment
- Appropriate road geometry, gradients, and visibility
- Accommodation of service vehicles, including refuse collection and emergency services
- Integration with site topography and surrounding infrastructure



All roads are designed to accommodate standard urban service vehicles, including WB-12 design vehicles and fire appliances.

6.4. RECREATIONAL TRACKS AND TRAILS

The development provides for an integrated network of pedestrian and recreational walking tracks within the site and the wider local area. The track network forms a key linkage within the broader Cannon Point walking system and contributes to connectivity between existing open space, recreational assets, and residential areas.

The proposed tracks will:

- Provide a connection between Tulsa Park, the proposed raingarden, the Cannon Point walking track, and the Valley View Road walking track, which extends to Riverstone Terrace to the south-east of the site
- Include a Stage 4 walking track along the northern boundary, forming a recreational link between the Cannon Point track entry at Colorado Road, the Hutt River corridor, and Birchville Dam
- Create a continuous and interconnected network, with the development acting as a critical link between existing and planned walking routes

Network Function and Integration

The track network has been designed to:

- Integrate with the natural landform and existing vegetation
- Provide logical and legible pedestrian connections throughout the development
- Link residential areas with open space, stormwater features (including the raingarden), and the wider recreational network
- Support both local movement and longer recreational journeys

Key Outcomes

The proposed tracks will:

- Connect with existing and planned walking routes within the wider Cannon Point area and other suburbs
- Provide access to open space and areas of native vegetation
- Enhance connectivity, accessibility, and amenity for residents and the wider community

The alignment and design of tracks respond to site topography and environmental features, ensuring that earthworks are minimised and that the tracks integrate with the overall development layout.



6.5. STREETScape

The streetscape has been designed to provide a safe, functional, and visually coherent environment consistent with earlier stages of the development.

Key elements include:

- Street tree planting and landscaping where appropriate
- Pedestrian connectivity along road corridors
- Integration of services within the road reserve
- Consistent design detailing with Stages 1 and 2

The streetscape design supports residential amenity while maintaining practical and efficient infrastructure layout.

For detailing of the streetscape please refer to the landscaping plan completed by BLAC.

6.6. ROAD TYPOLOGIES

The proposed development will utilise a range of road typologies consistent with those implemented in earlier stages these consist of;

- Local roads serving residential lots
- Shared accessways and rights of way where appropriate
- Connections to the public road network

Road widths, cross-sections, and design parameters will be in accordance with relevant standards and tailored to the expected traffic volumes and site constraints. Where conflict exists between NZS4404 and the UHCC code of practice we have adopted the newer of the standards as the best practice, in this instance the UHCC CoP was last updated in 1998, therefore we consider the design criteria of NZS4404 to take precedence. Further discussions with UHCC were had at the completion of previous stages where it was also agreed that NZS4404 would create a more appropriate road for the development.



6.6.1. STAGE 3 ROAD TYPOLOGIES

Road 1

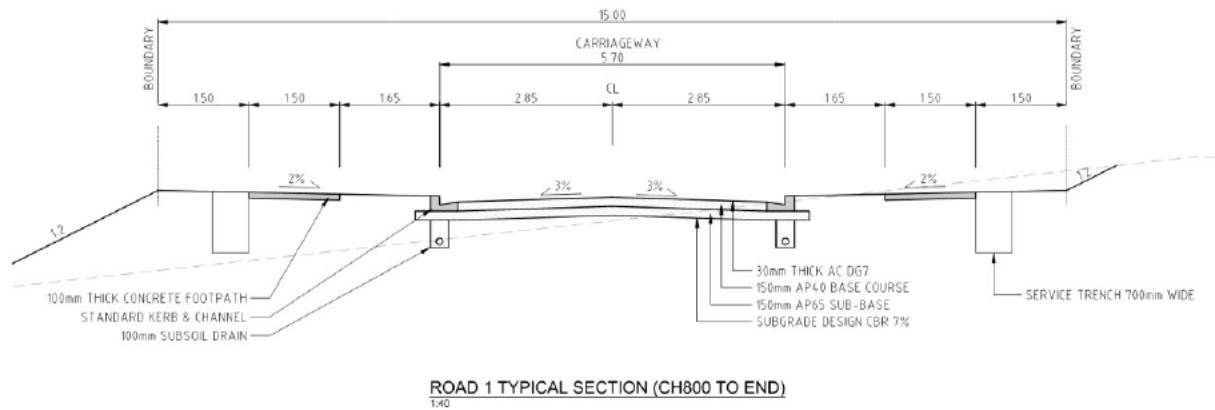


Figure 2. Road 1 Typical Section

Road 1 (Colorado Road) consists of the same general typology as road 1 within the earlier stages of the development, and is primarily based off NZS4404:2010 a compliance schedule has been provided for each roading typology.

Road 2

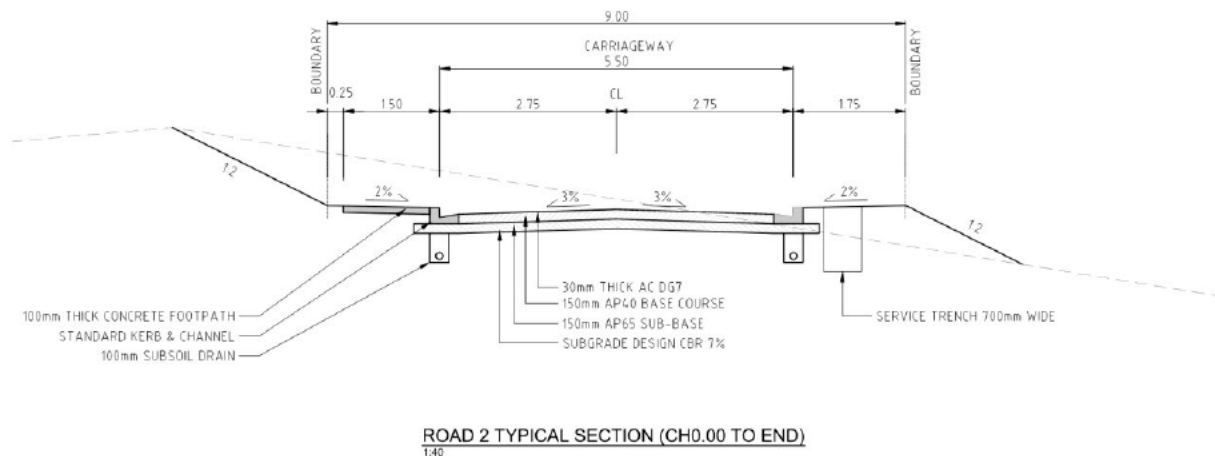
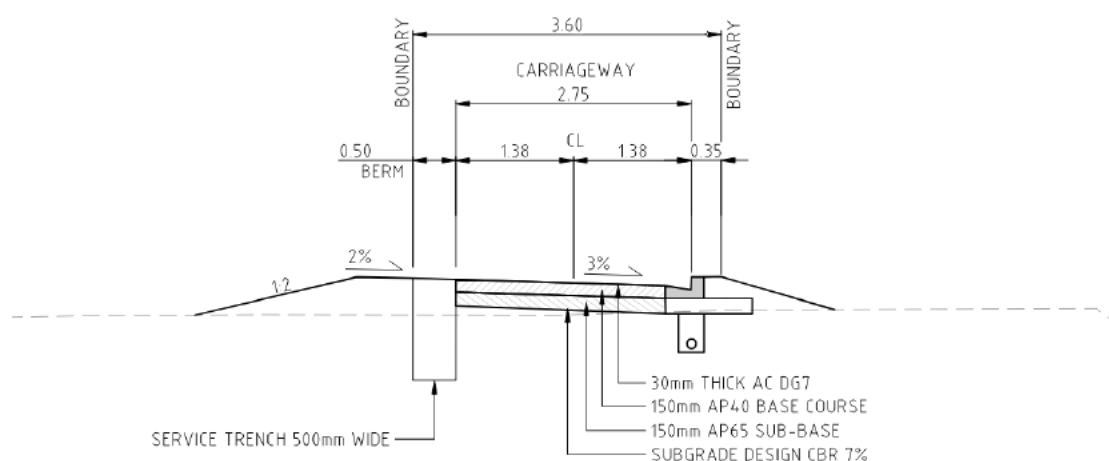


Figure 3. Road 2 Typical Section



Right of Way 1

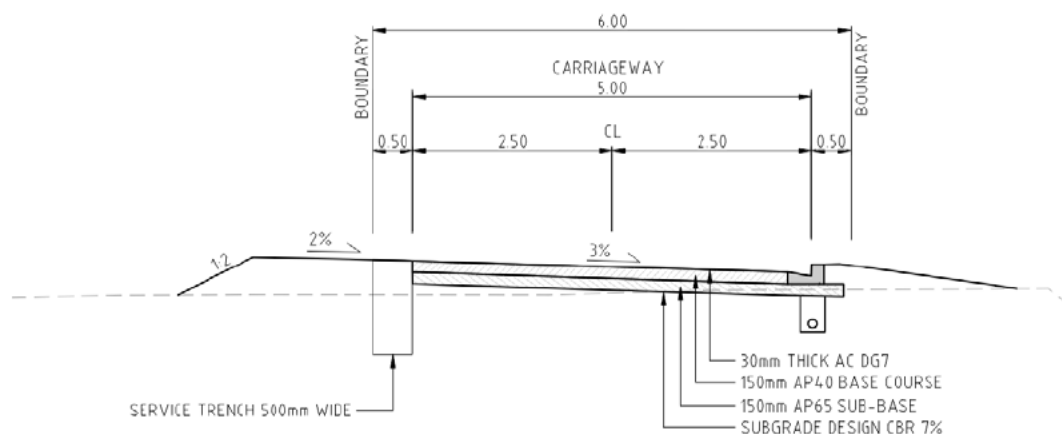


ROW 1 TYPICAL SECTION

1:40

Figure 4. Right of Way 1 Typical Section

Right of Way 2-4



ROW 2-4 TYPICAL SECTION

1:40

Figure 5. Right of Way 2-4 Typical Section.

Table 1. Compliance schedule for stage 3 road typologies.

Section Type	NZS4404	UHCC CoP	Comments.
Road 1	Complies	Does not comply	Consider NZS4404 to take precedence. Previous discussions with UHCC have agreed that NZS4404 should take precedence.
Road 2	Complies	Complies	
Right of way 1	Complies	Complies	
Right of Way 2-4	Complies	Complies	



6.6.2. STAGE 4 ROAD TYPOLOGIES

Road 1

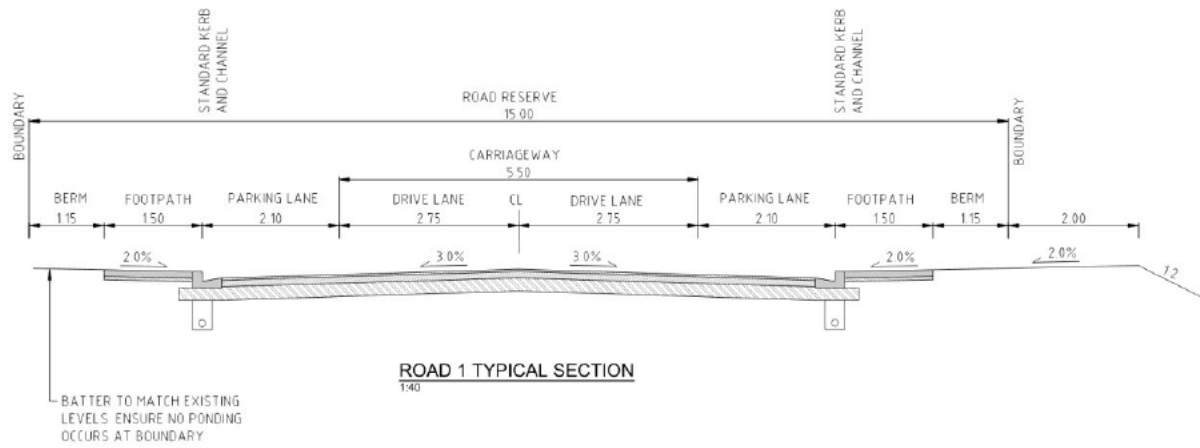


Figure 6. Road 1 Typical Section

Road 2 and 3

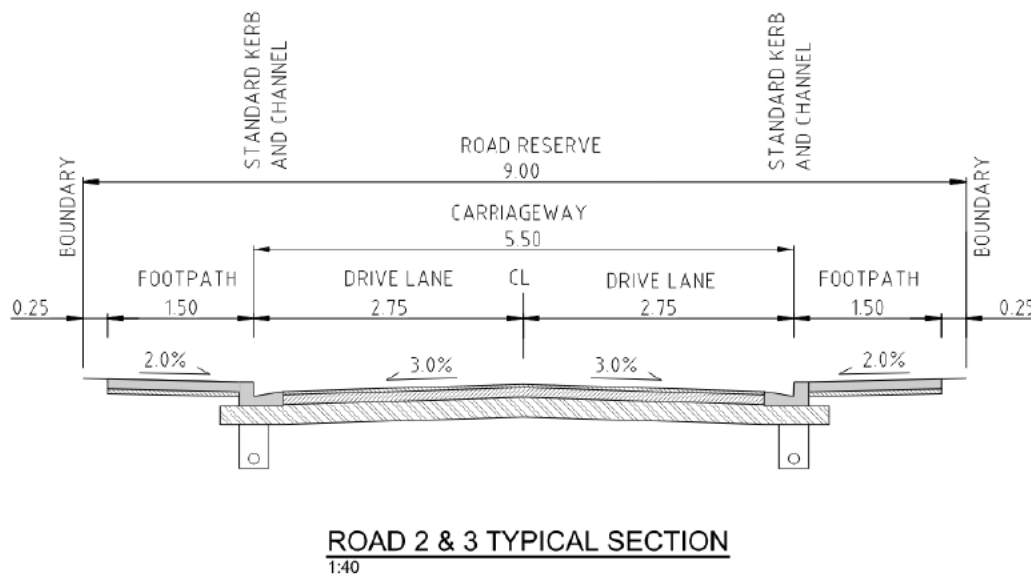
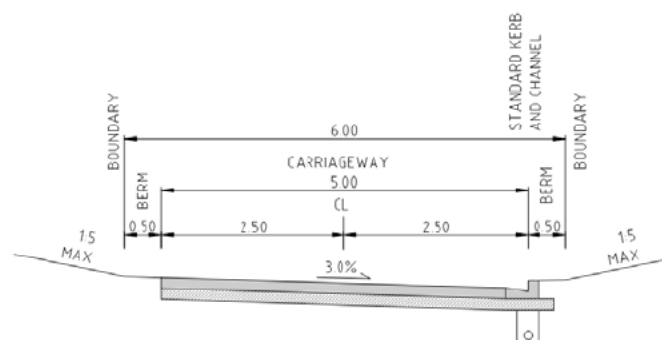


Figure 7. Road 2 and 3 typical section



Road 4

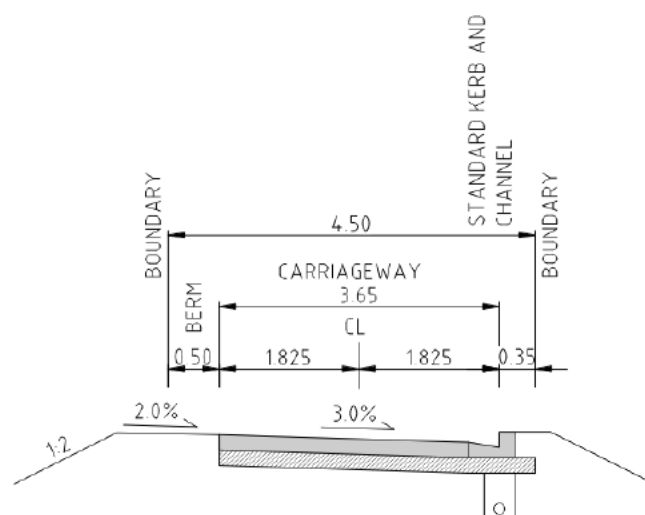


ROAD 4 TYPICAL SECTION

1:40

Figure 8. Road 4 typical section

Jointly Owned Access Lane (JOAL) 1-14



JOAL 1-14 TYPICAL SECTION

1:40

Figure 9. JOAL 1-14 typical section.

Section Type	NZS4404	UHCC CoP	Comments.
Road 1	Complies	Does not comply	Consider NZS4404 to take precedence. Previous discussions with UHCC have agreed that NZS4404 should take precedence.
Road 2 and 3	Complies	Complies	
Road 4	Complies	Complies	
Joal 1-14	Complies	Complies	



6.7. PRELIMINARY PAVEMENT DESIGN

The construction of any new pavement is limited to the proposed design shown in the Vecta civil engineering drawing set.

The pavement design for the construction of the roading has been carried out in accordance with the following design guidelines and standards.

1. Upper Hutt City Council Code of Practice for Civil Engineering Works 1998 (UHCC CoP 1998)
2. Austroads Part 2: Pavement Structural Design 2012
3. NZTA Supplement to Pavement design 2004

6.8. DESIGN TRAFFIC FOR PAVEMENT DESIGN

The geometric design of the road has been undertaken generally in accordance with UHCC CoP and Austroads, Part3, Geometric design.

Table 2: DESA Calculation - Design traffic for pavement design

Design Parameter Description		Design	Source
Design period		50 years	UHCC CoP 1998, Section B1.12.2
Annual Average Daily Traffic	AADT	750	Estimated based on UHCC CoP 1998 Appendix C, Figure 1
Directional Factor	DF	0.50	Austroads
Percentage heavy vehicles	(%HV)	4%	Estimated
Cumulative growth factor	CGF	112.8	Austroads Part 2 (2017) Equation 31 where R=3% & P=50years
Average number of axle groups per heavy vehicle in design lane	N _{HVAG}	2.5	Estimated.
Design Traffic Loading Calculation	ESA/HVAG	0.7	Estimated, based on Appendix D Austroads
$N_{DT} = 365 \times AADT \times DF \times \%HV/100 \times LDF \times CGF \times N_{HVAG}$ $N_{DT} = 365 \times 750 \times 0.50 \times 4/100 \times 1.0 \times 112.8 \times 2.5$ $N_{DT} = 1235160$			Equation 14, Austroads. Where N _{DT} is Design Traffic.
DESA= ESA/HVAG x N _{DT}			Austroads Equation 17
DESA= 0.7 x 1235160			
<u>DESA = 8.64 x 10⁵</u>			

CBR Method (Figure 8.4, Austroads, Part 2 (2012)) has been adapted appropriate for the design of the proposed pavement.

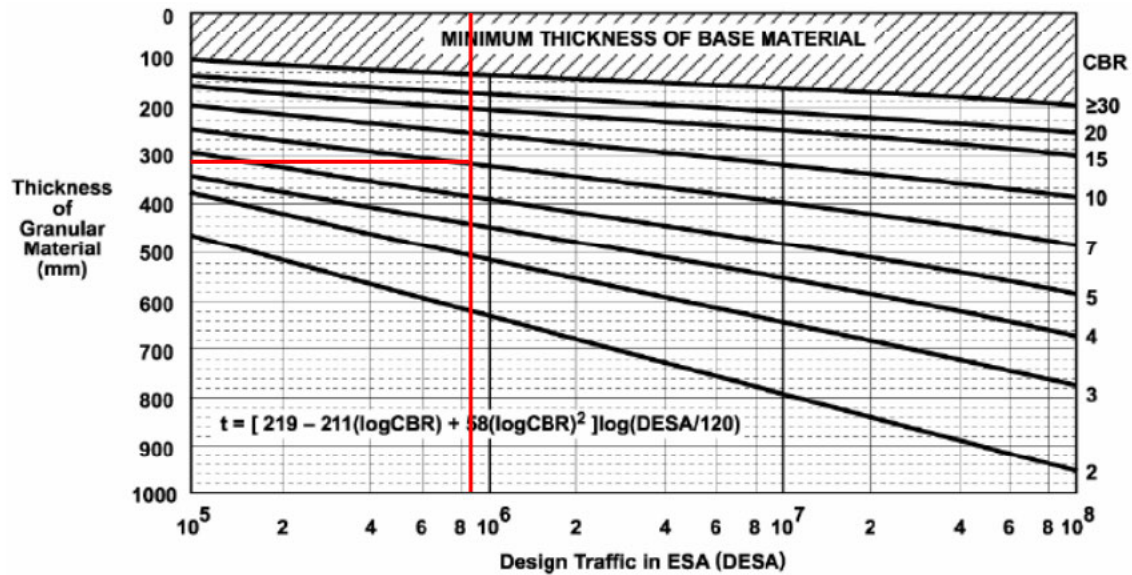


Figure 10: Design chart for granular pavements with thin bituminous surfacing. Adapted from Austroads Part 2, Figure 8.4.

6.9. STREETLIGHT DESIGN

Streetlighting will be designed by Spunlight Limited in conjunction with UHCC Engineers at the detailed design stage. The design will be in accordance with AS/NZ 1158 and satisfy the minimum requirements of B3.7 of the Code of Practice.

The lighting products will be similar to those previously used in the earlier stages of the project.



7.0 STORMWATER MANAGEMENT

7.1. OVERVIEW

This section provides guidelines and supporting information outlining how stormwater will be managed in accordance with the guiding and regulatory documents for the development at Cannon Point, Totara Park, Upper Hutt.

This section meets the requirements of a Stormwater Impact Assessment in accordance with Schedule 29 of Plan Change 1 to the Greater Wellington Regional Council Natural Resources Plan.

This section outlines:

- Concepts for the conveyance of non-urban runoff through the site
- Treatment and attenuation of urban runoff generated within the site

A stormwater management plan is presented for each of the development stages and the stages' catchments. The level of management and engineering detail for each stage varies depending on how advanced design is for that stage.

The flood hazard and associated risk are assessed in accordance with the National Policy Statement for Natural Hazards via overland flow models of the proposed development stages. These are detailed in Section 7.7.

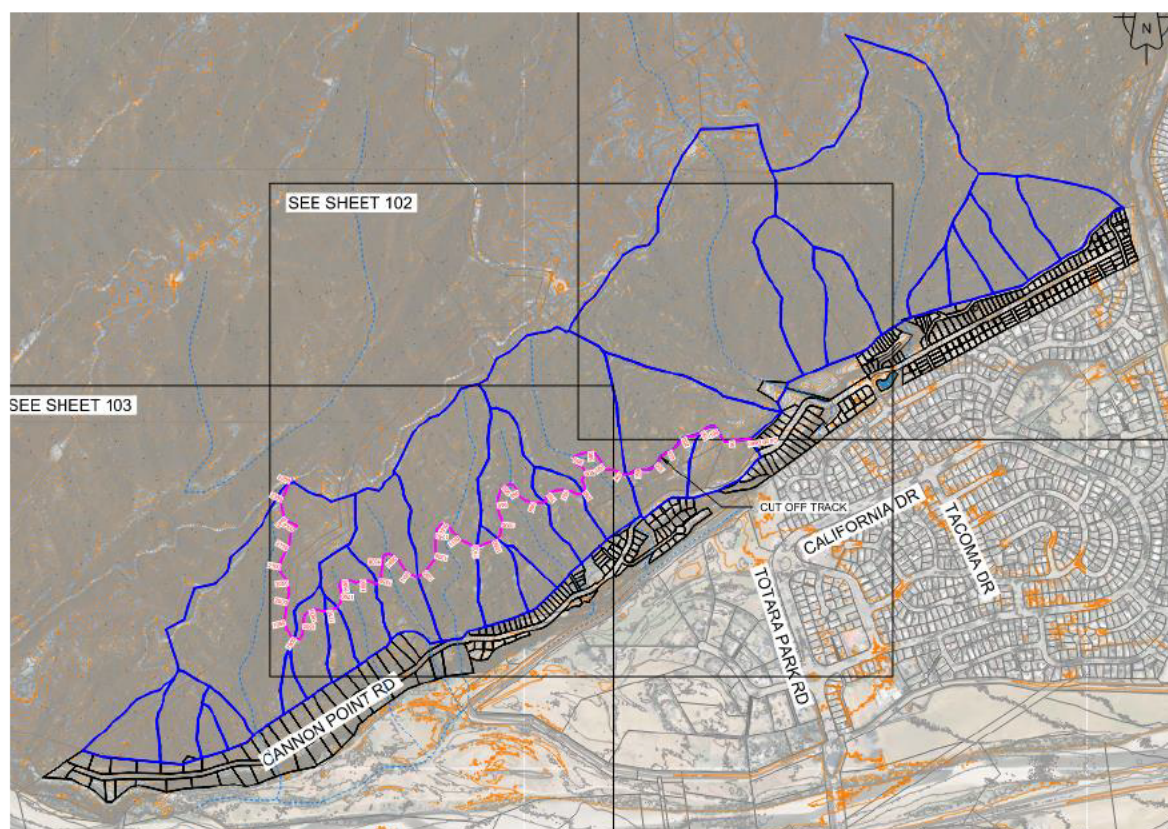


Figure 11: Cannon Point Development overview for Stages 1 through 5, showing upstream catchments.



7.2. STORMWATER OUTLINE CONCEPT

The stormwater management plan for each stage is built around four main plan components: clearwater flow, the primary conveyance network, stormwater neutrality, and water sensitive urban design. An outline of these is given below, followed by detailed descriptions for each stage.

7.2.1. CLEARWATER FLOW

The development site is situated on a terrace below a 137 ha bush and forested catchment (Figure 11). Runoff from this area currently discharges through and across the development site via numerous ephemeral overland flow paths draining each subcatchment (see Figure 11). These flows continue through and across the site as overland sheet flow or through concentrated paths to the existing open drainage channel of Totara Park, referred to as the main drain, or into one of several stormwater inlets into the existing network in Totara Park (see Figure 12).

Flows from the uphill catchments will be conveyed through the developed sections of the site in a manner that mitigates inundation risk to acceptable design levels. This diverted flow is termed clearwater flow in this stormwater management plan.

The throughflows are unaffected by the development, and as such do not require attenuation or treatment for water quality.

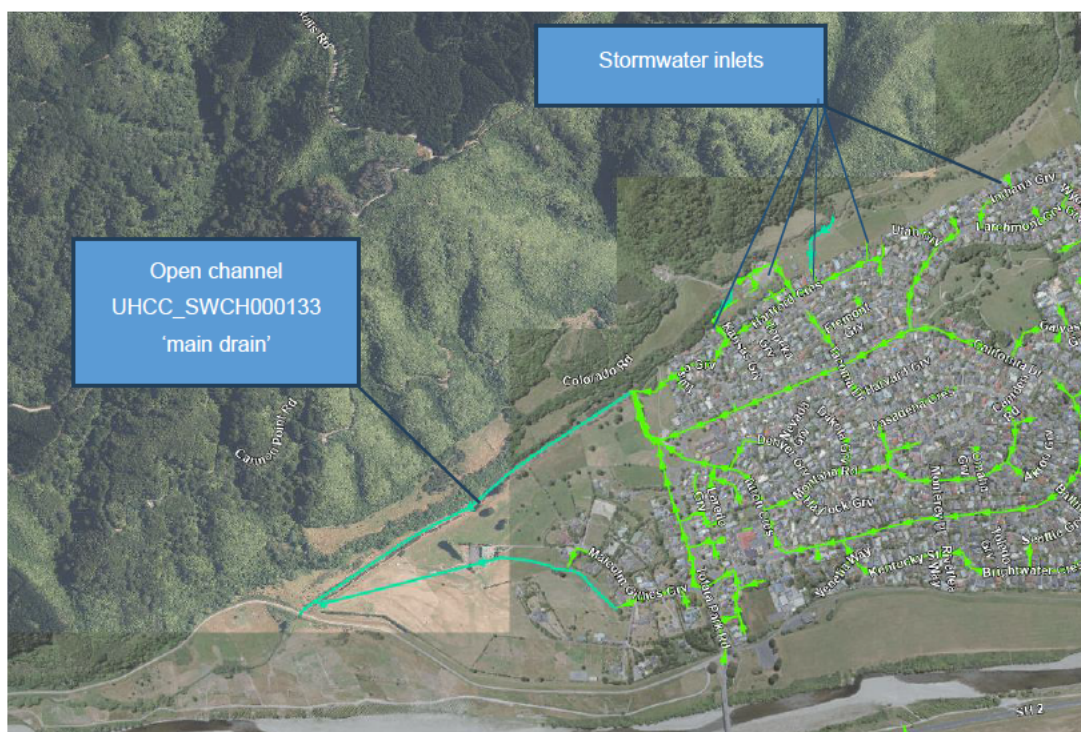


Figure 12: Existing Totara Park stormwater network (WWL GIS).



7.2.2. PRIMARY NETWORKS

Primary stormwater conveyance collects stormwater runoff from the developments' sections and road reserve. It is generally a traditional kerb and channel and gravity stormwater pipe collection system. The kerb runoff will be collected by sumps which will then discharge to the stormwater pipes. House downpipes and site drainage will discharge via attenuation tanks to the stormwater mains. The primary network within the site will ultimately discharge to the existing open channel drain (UHCC_SWCH000133) which flows to the Hutt River, either directly or via the existing network within Totara Park.

The primary network is sized to accommodate the levels of service set out in Wellington Water Limited's Regional Standard for Water Services (hereafter referred to as RSWS) section 4.2.6.

7.2.3. STORMWATER NEUTRALITY

Each residential lot will have an attenuation tank compliant with the guidelines of *Managing Stormwater Runoff* (WWL) such that each developed lot is stormwater neutral, issued on the titles as consent notices. This leaves only the road reserve requiring management to achieve stormwater neutrality.

Stormwater runoff from areas of the road reserve that have the potential to cause flooding risks to downstream properties will be attenuated. This will be achieved by centrally constructed dual-purpose wetlands or similar devices, designed following the Wellington Water Ltd *Water Sensitive Design for Stormwater: Treatment Device Design Guideline* (version 1.1, 2019), hereafter referred to as WWL-WSD.

Some areas of road reserve are not practicable to attenuate due to topographical constraints. These areas are to discharge directly to the open stormwater channel (UHCC_SWCH000133) and/or the Hutt River. The discharge from the areas have been demonstrated to have a negligible impact on the water level in the main drain and the Hutt River.

7.2.4. WATER SENSITIVE URBAN DESIGN (WSUD)

The water sensitive urban design approach for the site seeks to reduce the existing impact on the receiving environment by ensuring the development improves the quality of runoff, striving to emulate the quality and behaviour of runoff from natural catchments.

This is achieved through a multifaceted approach, including but not limited to:

Reduction of contaminant risk through use of cladding materials bearing no unfinished copper or zinc.
Increase retention through installation of rainwater reuse tanks at all dwellings, while also reducing mains water consumption.

Creation of constructed wetlands, raingardens, and other bioretention devices to remove contaminants from the runoff, as well as functioning as public amenity green spaces.

Attenuation of frequent and peak flows through installation of detention tanks.

The designs follow the WWL-WSD and are specific to each catchment.



7.3. STAGES 1 AND 2

Stages 1 and 2 of the development are complete.

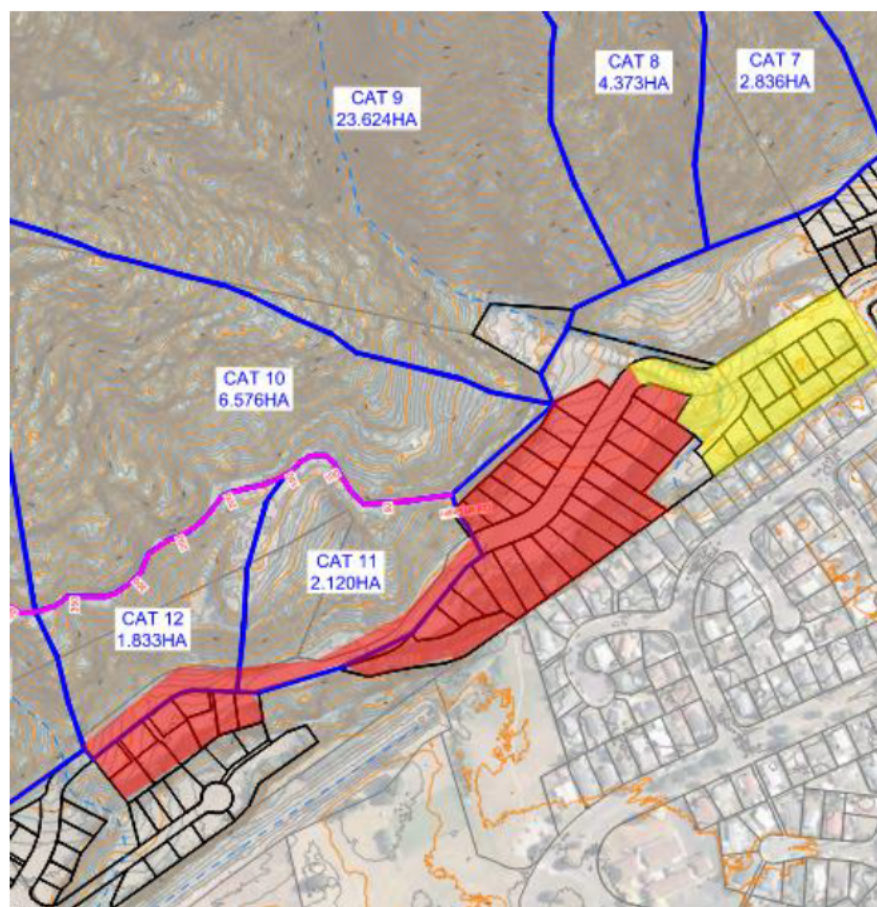


Figure 13: Stage 1 (yellow) and 2 (red) scheme layouts and clearwater catchments

7.3.1. CLEARWATER FLOW

Relevant clearwater catchments for Stages 1 and 2 are subcatchments 7 through 12 (Figure 13).

Subcatchments 7 through 10 discharge via an ephemeral stream into the existing network in Totara Park via the stormwater inlet UHCC_SW003781 and sumps within Tacoma Drive (see Figure 14). Runoff from subcatchment 10 joins this stream via the existing Cannon Point Road (magenta line, Figure 13), which currently acts as a cutoff drain. Flooding was experienced in low frequency events by properties in Hartford Cres before the development as a result of this overland flow exceeding the capacity of the stormwater inlets.

Subcatchments 11 and 12 discharge directly to the main drain. This is facilitated by the piped network under the road and the high flow bypass at the Stage 2 raingarden. These flows will be collected by cutoff drains above the road, with capacities at least 300% of the expected 1% AEP flow:



Catchment 11, 1% AEP flow 318 L/s				Surface width (m) = 2.50		Side slope = 18.43 degrees					
bed slope		0.005 m/m		= 1/ 200							
mannings		0.015						0.4000			
Area =		0.52 m ²									
Wetted Perimeter =		2.6298221 m									



Figure 14: Pre-existing stormwater network (WWL GIS). Subcatchment 9 culvert location shown in red.

7.3.1.1. Subcatchment 9 Culvert

Catchments discharging via the open stormwater channel UHCC_SWCH000077 are facilitated by a DN600 culvert under Road 1 (see Figure 14). This culvert has been inlet-restricted to a maximum of



800 L/s such that the capacity of the downstream stormwater inlet UHCC_SW003781 is not exceeded, reducing the flooding that was being experienced by Hartford Cres properties before these works. Flows in excess of 800 L/s continue northwards through the swale alongside Road 1 to the wetland inlet, detailed in section 7.3.4.1.

7.3.2. PRIMARY NETWORK

The primary network is designed to accommodate the 4% AEP (1 in 25-year) event. The piped network discharges to two low points in the road (see Figure 15):

Along the road corridor to the pre-existing stormwater network in Tacoma Drive
Directly to the main drain

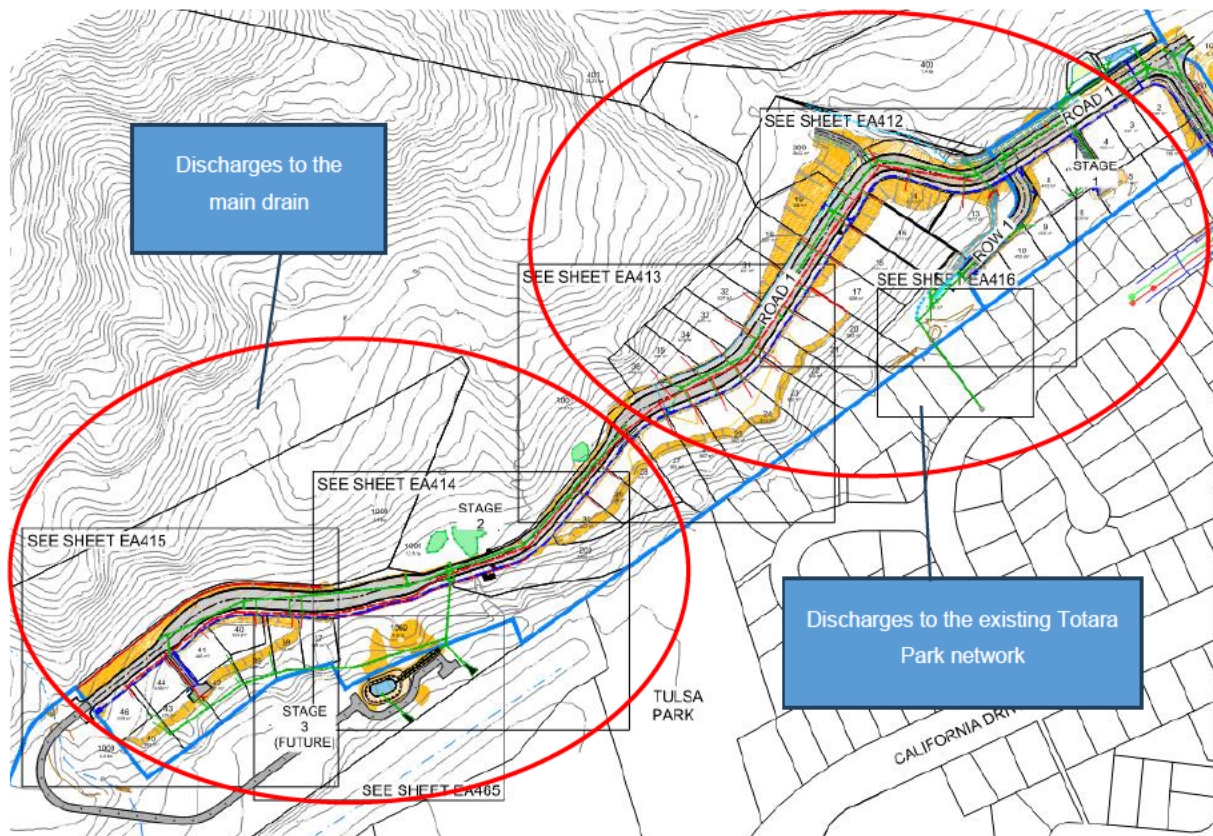


Figure 15: Stage 1 and 2 drainage overview

7.3.3. STORMWATER NEUTRALITY

Runoff from residential lots will be attenuated using on-site detention tanks, issued on the titles as consent notices. This runoff will discharge to the piped network either directly through laterals or via the kerb and channel, as suits each lot.

Runoff from the Stage 2 primary network (see Figure 15) discharges directly to the main drain and is unattenuated. The unattenuated flow has a negligible impact on downstream water levels (see Section 7.5).

Runoff from the primary network that discharges to the existing network in Tacoma Drive does require attenuation due to existing at-risk downstream properties. This applies to the Stage 1 and part of the



Stage 2 road reserve areas (Figure 15). Attenuation is achieved using a constructed wetland, detailed in section 7.3.4.1.

7.3.4. WATER SENSITIVE URBAN DESIGN

Water quality treatment of runoff from the road reserve of Stages 1 and 2 is achieved by a constructed wetland, servicing Stage 1 and part of Stage 2, and a raingarden servicing the remainder of Stage 2. Both have been designed following the Wellington Water Limited Water Sensitive Design for Stormwater: Treatment Device Design Guideline (version 1.1, 2019) and adhering to the requirements of the RSWs, detailed in the following.

The bioretention device inherently meets the stormwater contaminant treatment targets set by GWRC in Schedule 28 of PC1, as the treatment targets are defined as that achieved by bioretention.

7.3.4.1. Wetland

The wetland has been designed to perform a dual role. In high-frequency events (up to and including the 20% AEP event), the wetland's primary function is water quality treatment while still providing some attenuation benefits. At lower frequency events (4% AEP and above), the wetland functions as a water quality device until the peak of the storm event, at which point its function switches to that of attenuation.

The total footprint of the wetland is approximately 1500 m². An estimated 1300 m³ of storage is available while maintaining 300 mm of freeboard with nearly 1500 m³ available with no freeboard.

7.3.4.2. Wetland - Water Quality Treatment

The wetland area at the Permanent Water Level (PWL) is approximately 300 m² - this equates to a volume of roughly 245 m³. The required water quality volume from the development including the lots and the pervious surfaces (roading, foot paths etc) is calculated per the Water Sensitive Design guidelines Equations 1 and 2:

Equation 1: Calculation of the effective Impervious area.

$$A_{eq} = 0.95 \times A_{imp} + 0.15 \times A_{perv}$$

Where

A_{eq}	= Effective impervious area (m ²)
A_{imp}	= Impervious catchment area (m ²)
0.95	= Runoff coefficient for impervious landcover
A_{perv}	= Pervious catchment area (m ²)
0.15	= Runoff coefficient for pervious landcover

Equation 2: Calculation of the Water Quality Volume (WQV).

$$WQV = \frac{1}{3} P_{50\% AEP 24hr} A_{eq}$$

Where

WQV	= Water Quality Volume (m ³)
A_{eq}	= Effective impervious area (m ²)
$P_{50\% AEP 24hr}$	= 50% AEP 24 hour rainfall depth (m)

The 50% AEP 24-hour rainfall depth, determined from HIRDS rainfall data for the site, is 76.5 mm. The catchment area to be treated by the wetland is 19639 m², of which 4789 m² are impervious (A_{imp}) and 14850 m² pervious (A_{perv}). The resulting water quality volume is 173 m³.

Wetland - Attenuation

The wetland serves to attenuate runoff from the road reserve of Stage 1 and part of Stage 2 (Figure 15).



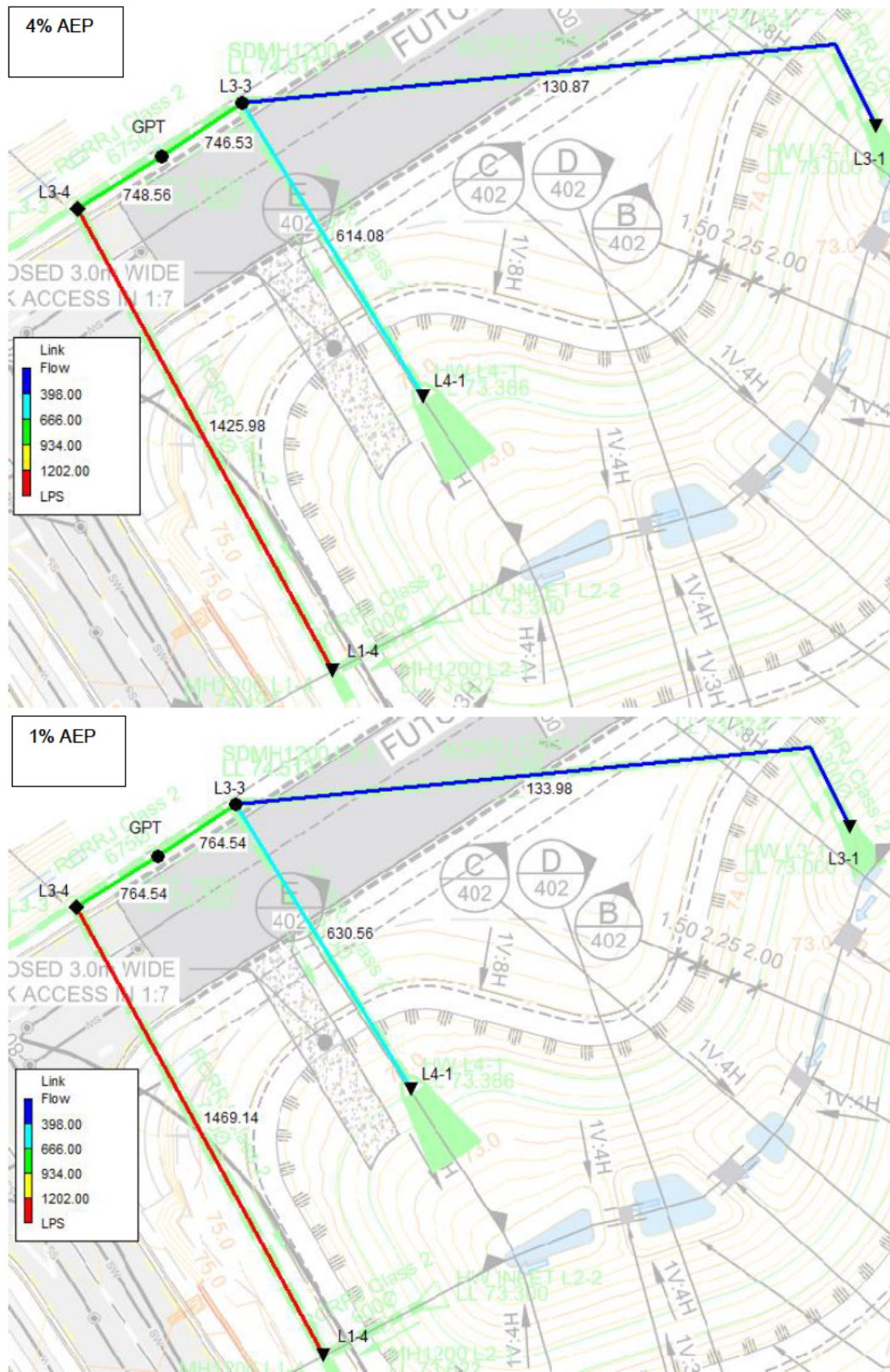
Following the WWL method, HEC-HMS software was used to evaluate the runoff expected from a 12-hour storm in the 4% and 1% AEP events, based on HIRDS rainfall data including a +20% factor to account for climate change. The road reserve runoff at the peak of the 12-hour storm events, pre- and post-development, are as follows:

	Pre-development (L/s)	Post-development (L/s)	Required flow reduction (L/s)
1% AEP	111	236	125
4% AEP	74	158	84

Additionally, flow from uphill subcatchments 7 through 10 arrive via the roadside swale to the wetland inlet manhole L3-4, for a peak 1% AEP flow of 4685 L/s.

The maximum capacity of the wetland's primary and high flow inlet pipes is 764 L/s, reached at the peak of the 1% AEP event (Figure 16, lower). At the peak of the 4% AEP event, inflow to the wetland is 746 L/s (Figure 16, top). Flows arriving at L3-4 in excess of this are conveyed through the high flow bypass (Figure 16, manholes L3-4 to L1-4). The wetland and high flow bypass convey the entire 4% AEP flow without surcharge. At the peak of the 1% AEP event, flow above the capacity of the high flow bypass surcharges from L3-4 and travels along the Tacoma Drive carriageway to be accepted into pre-existing sumps in Hartford Crescent.

Outflow from the wetland is controlled by a 500 mm orifice plate fitted in manhole L2-1. Set 1.22 m below the manhole lid, this orifice allows a maximum flow of 530 L/s (calculated with a coefficient of discharge = 0.62), attenuating the flow by 234 L/s in the 1% AEP and 214 L/s in the 4% AEP events. This more than achieves the required flow reduction in the 1% and 4% AEP events.



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7.3.4.3. Raingarden

The raingarden will provide water quality treatment for runoff from the road reserve areas of Stage 2b and Stage 3, before discharging to the main drain. The catchments for the raingarden are indicated in Figure 18.

The bioretention device inherently meets the stormwater contaminant treatment targets set by GWRC in Schedule 28 of PC1, as the treatment targets are defined as that achieved by bioretention. No attenuation is required for these areas, as described in Section 7.5. The raingarden will provide minor attenuation benefits, but these are not discussed here.

The total catchment for the raingarden comprises 2 ha of road reserve, of which 1.26 ha is impervious. Following the WWL-WSD section 4.3.2, the required filter media surface area is 2% of the contributing untreated impervious area, which equates to 252 m².

Inflow to the raingarden will be limited to the Water Quality Flowrate (WQF), calculated following Equation 3 of the WWL-WSD to be 37.9 L/s based on HIRDS rainfall data for the site. Inflow greater than the WQF will be diverted by high-flow bypasses in the two inlet structures directly to the main drain.

- There will be two inlet structures directing flow to the raingarden, shown indicatively in Figure 17.
- Runoff from Stage 2b will enter the raingarden from the northern end, controlled by the offset outlet pipes of manhole C1-1A (Figure 19). Inflows up to 20.6 L/s will continue to the raingarden via a grassed swale, while any flows in excess of 20.6 L/s will travel through the high flow bypass to the main drain.
- Runoff from the Stage 3 road reserve will be controlled in a traditional piped network enter the raingarden via a similar diversion manhole at the southern end of the raingarden. The diversion manhole will restrict inflow to the raingarden to no greater than 17.3 L/s via offset pipes (as at manhole C1-1A) or an overtopping-weir structure. Inflow in excess of 17.3 L/s will be directed by a high flow bypass directly to the main drain.

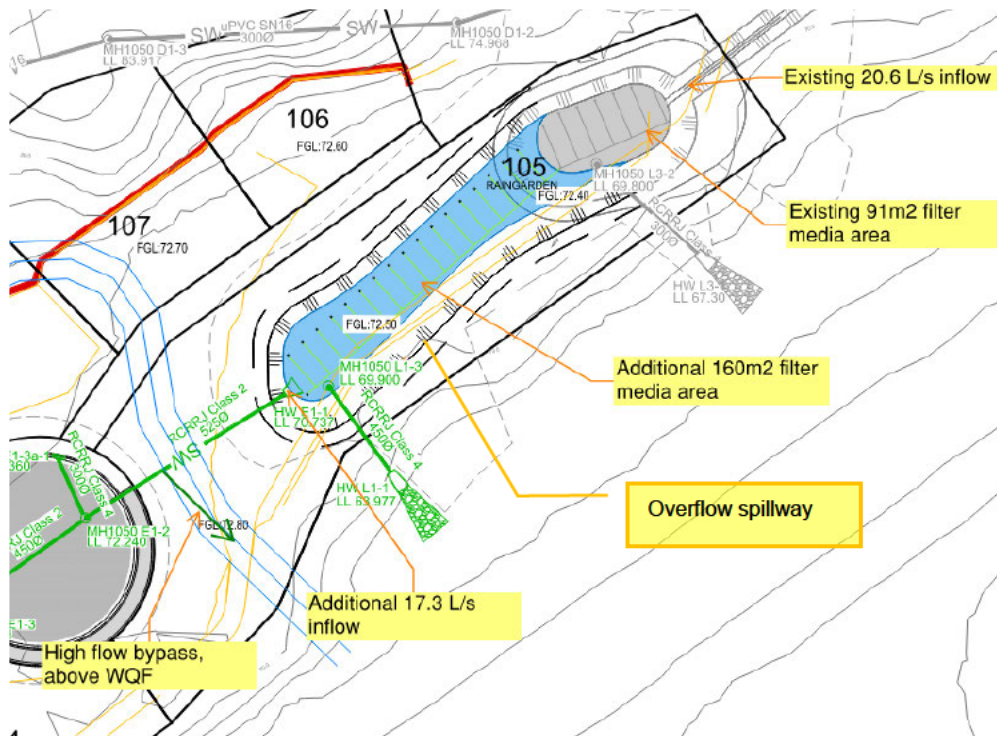


Figure 17: Indicative raingarden flows

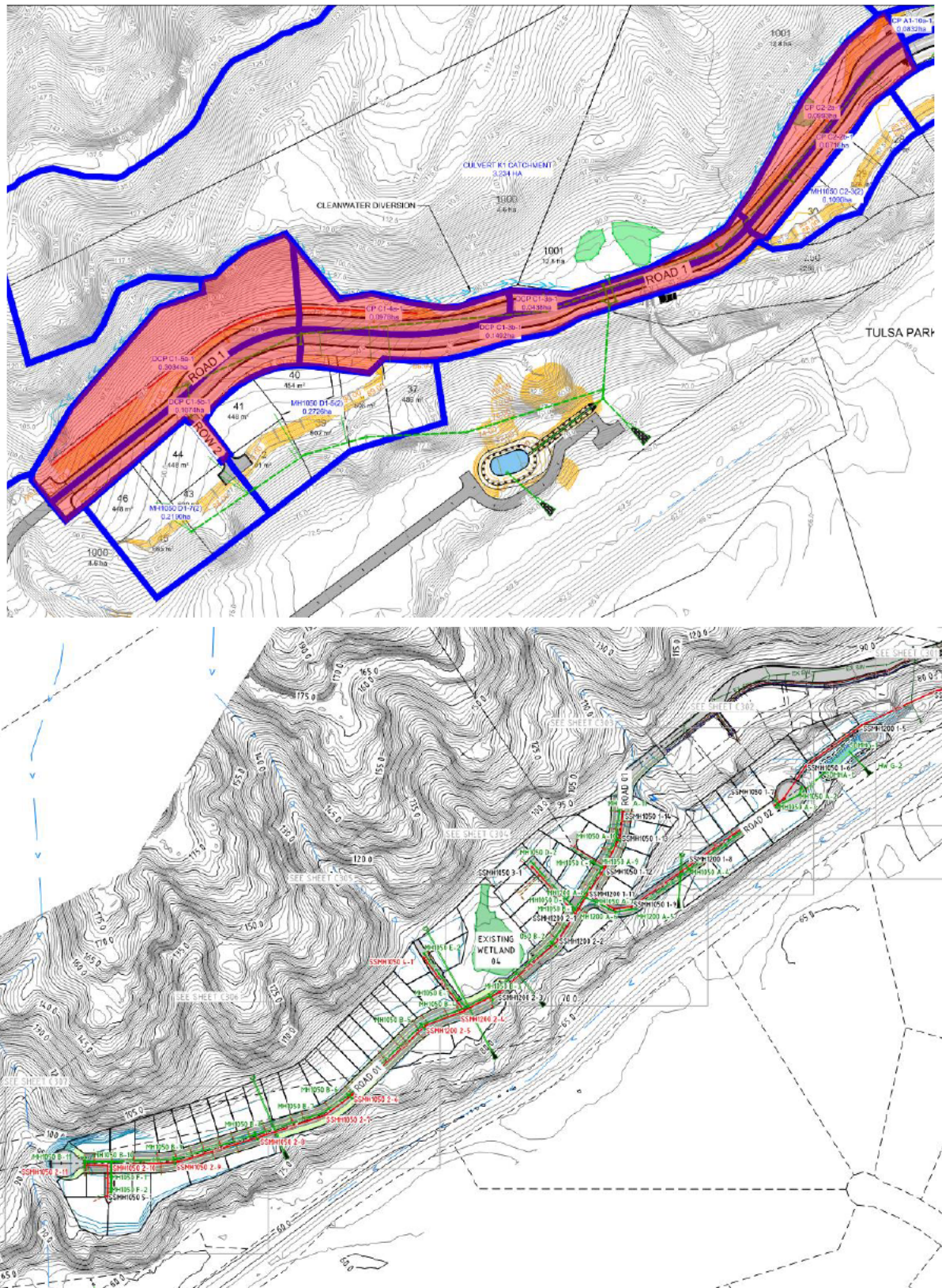
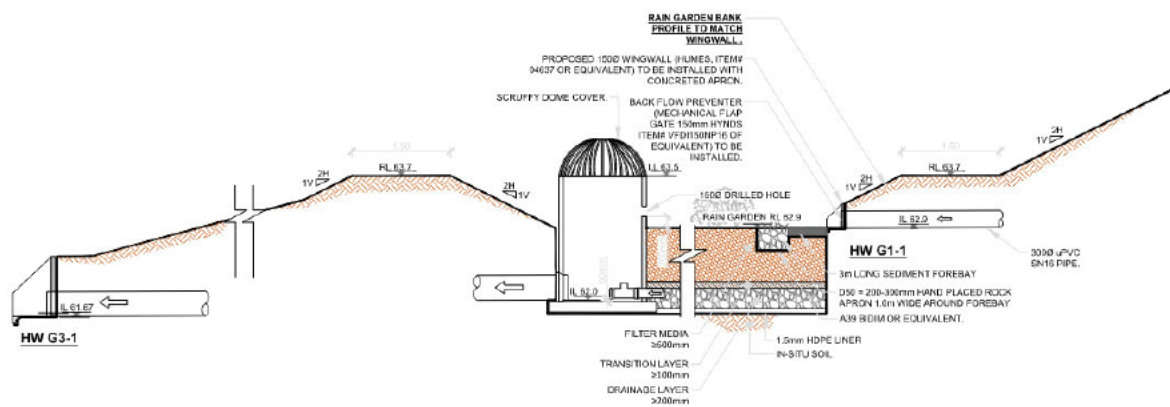
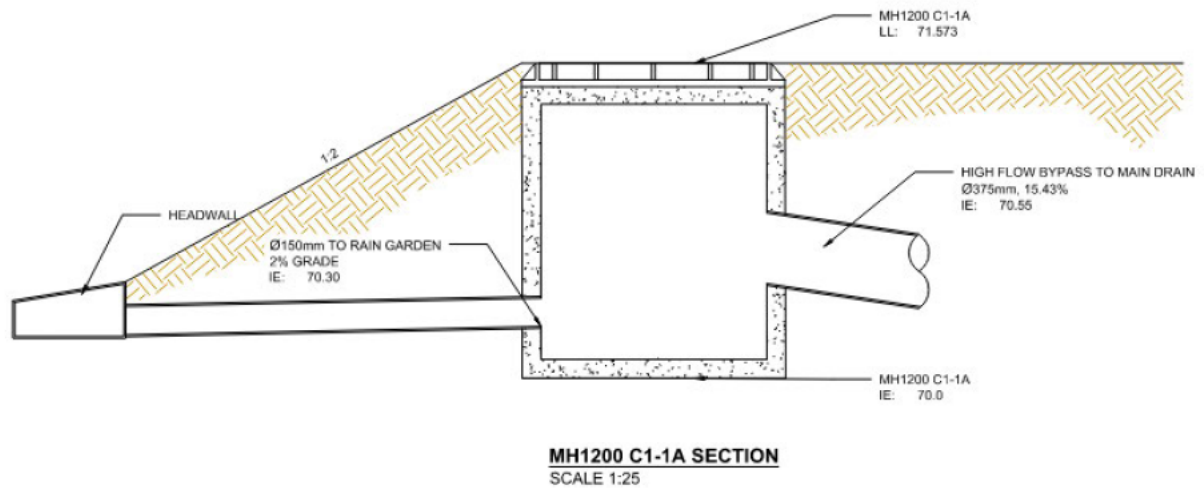


Figure 18: Rain garden catchment. Stage 2b (top) and road reserve of Stage 3 (bottom)





7.4. STAGE 3

The proposed drainage plan for Stage 3 of the development is shown in Figure 21.

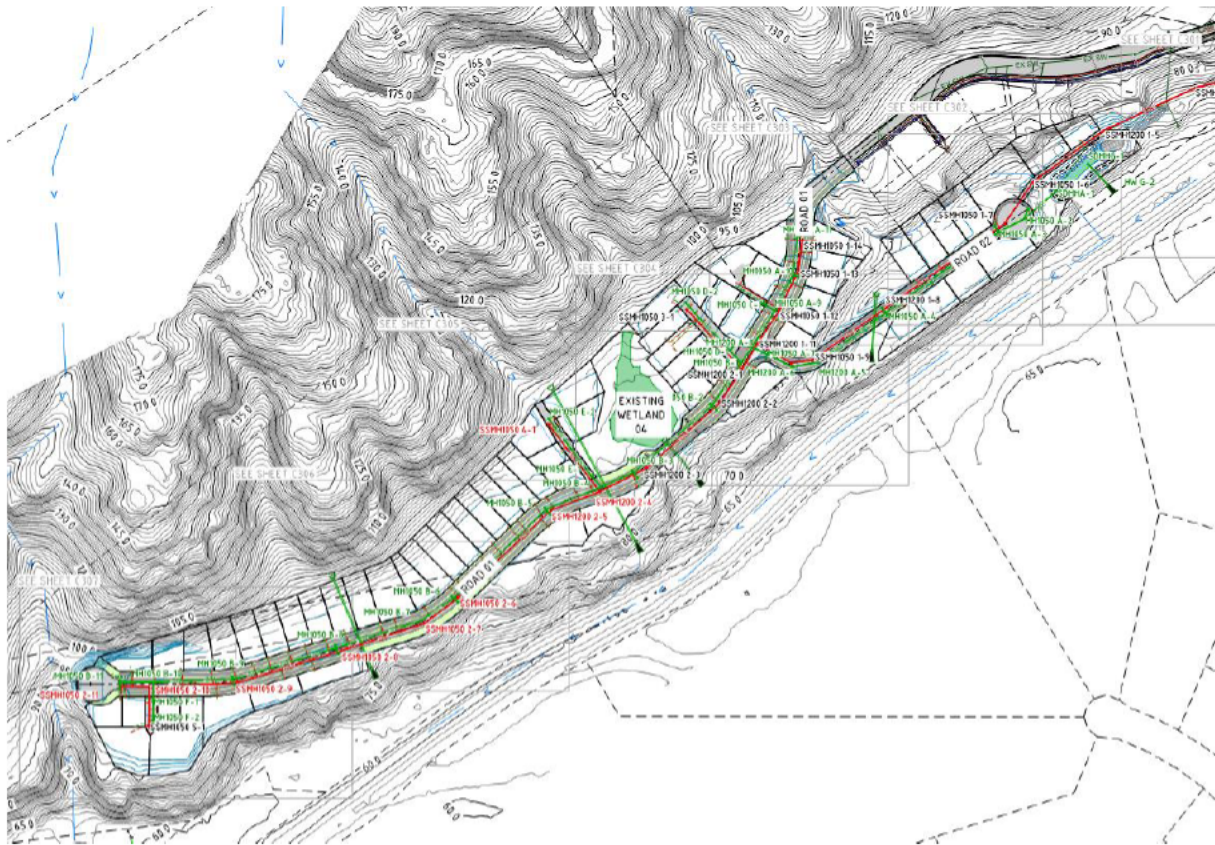


Figure 21: Stage 3 drainage overview

7.4.1. CLEARWATER FLOW

The following subsections outline the clearwater flow sources and details on how each are to be managed. An overall overland flow model and flood risk assessment is presented in Section 7.7.

Uphill catchments that discharge through the area proposed for Stage 3 are catchments 13 through 17. Overland flow from the uphill catchments will be controlled via cutoff drains, directing flow to bridges and/or bottomless culverts through the development, discharging to the main drain. All culvert outlets will have appropriate erosion protection installed (riprap or similar).

Control measures for each subcatchment are detailed in the following sections.

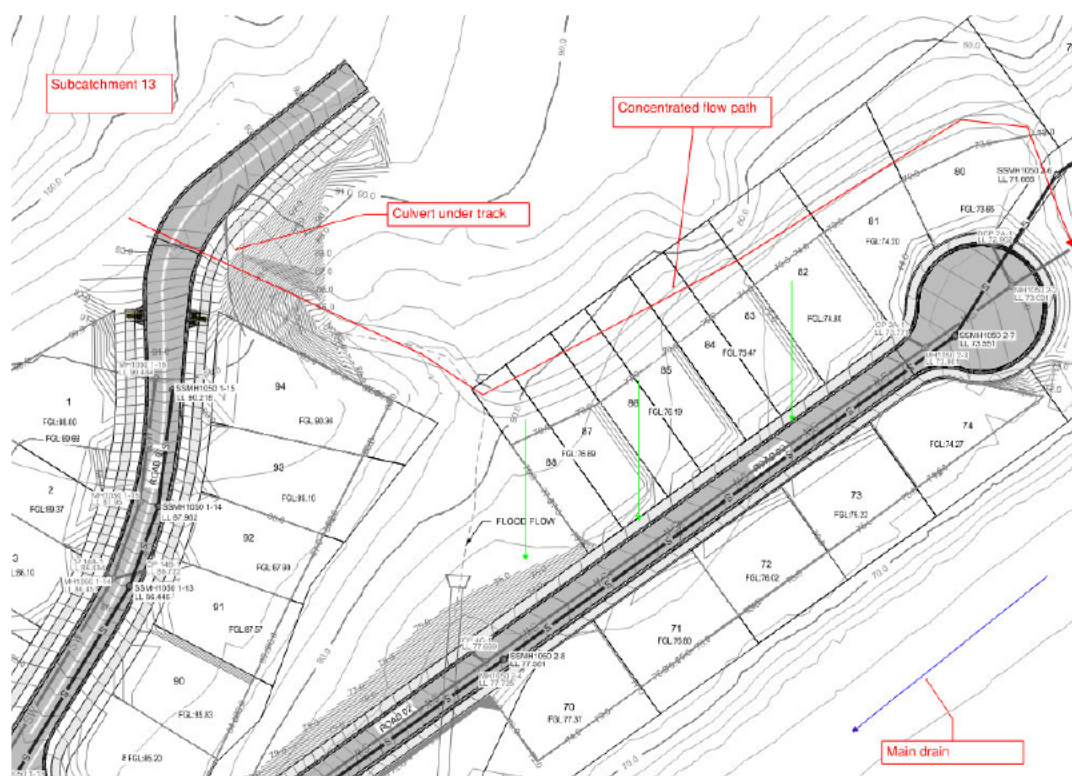
Peak flows from the subcatchments in the 1% AEP event were calculated using HEC-HMS software based on HIRDS data for the site, including a +20% factor to account for climate change, to be:



Subcatchment	Area (ha)	Peak 1% AEP flow (L/s)
13	11.449	1653
14	2.231	356
15	5.394	850
16	0.875	143
17	2.128	349

7.4.1.1. Subcatchment 13

Runoff from subcatchment 13 currently flows through a culvert under the track and through an ephemeral channel to the main drain (shown indicatively in Figure 22). It is possible that some small volumes may spill as overland sheet flow from the channel to the main drain (shown green in Figure 22).





at the peak of low-frequency storm events to a culvert under Road 2 to the main drain. This will prevent any potential hazardous overland flow (Figure 22) from entering the properties in Road 2. See the flood modelling results in section 7.7.

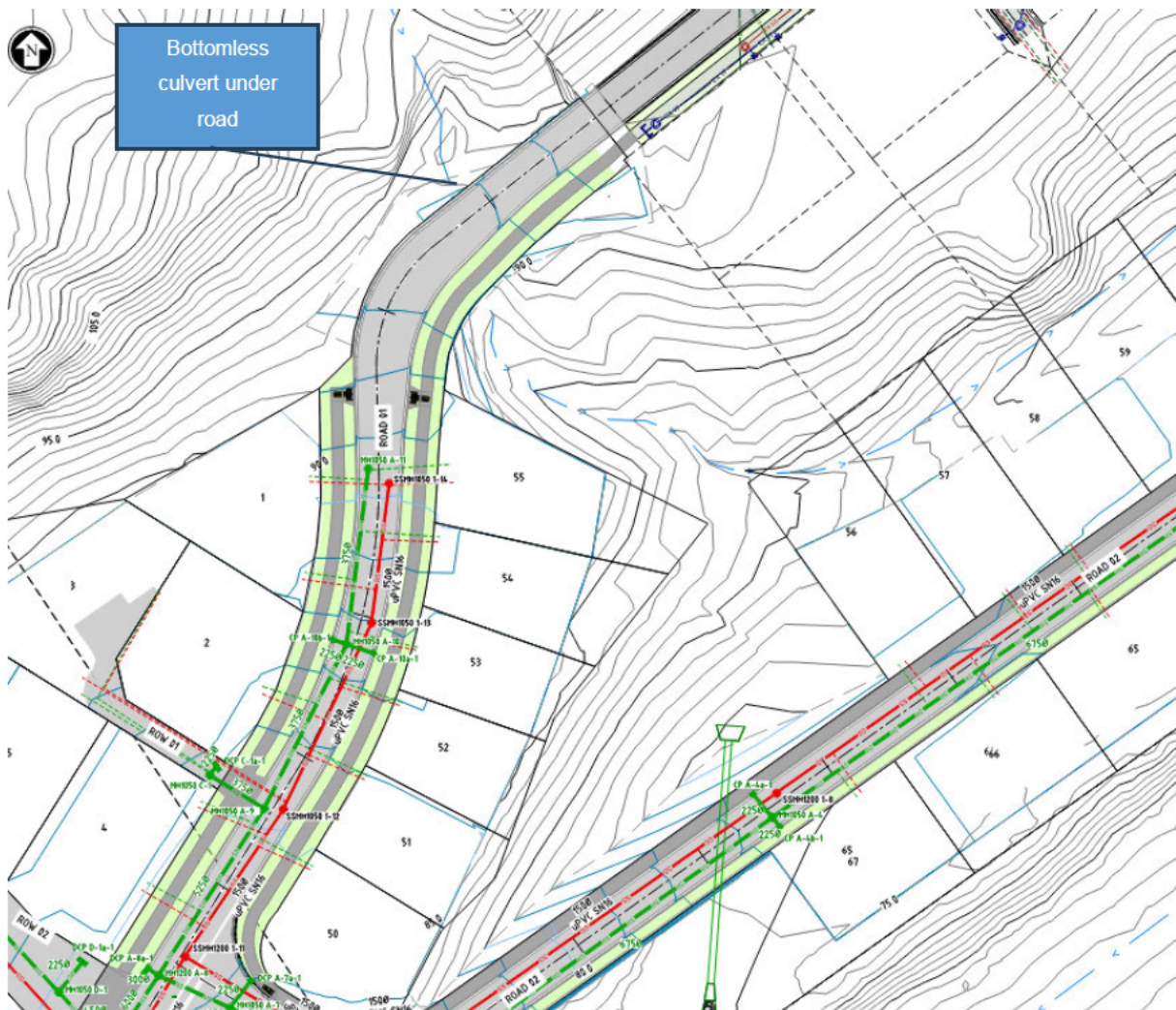


Figure 23: Subcatchment 13 drainage

7.4.1.2. Subcatchment 14

Subcatchment 14 feeds existing Wetland 04 (Figure 24) before flowing overland to the main drain. This flow into the wetland will not be altered. Wetland outflow will be piped under Road 1 to the main drain, with inlets set no lower than the wetland's ground level.

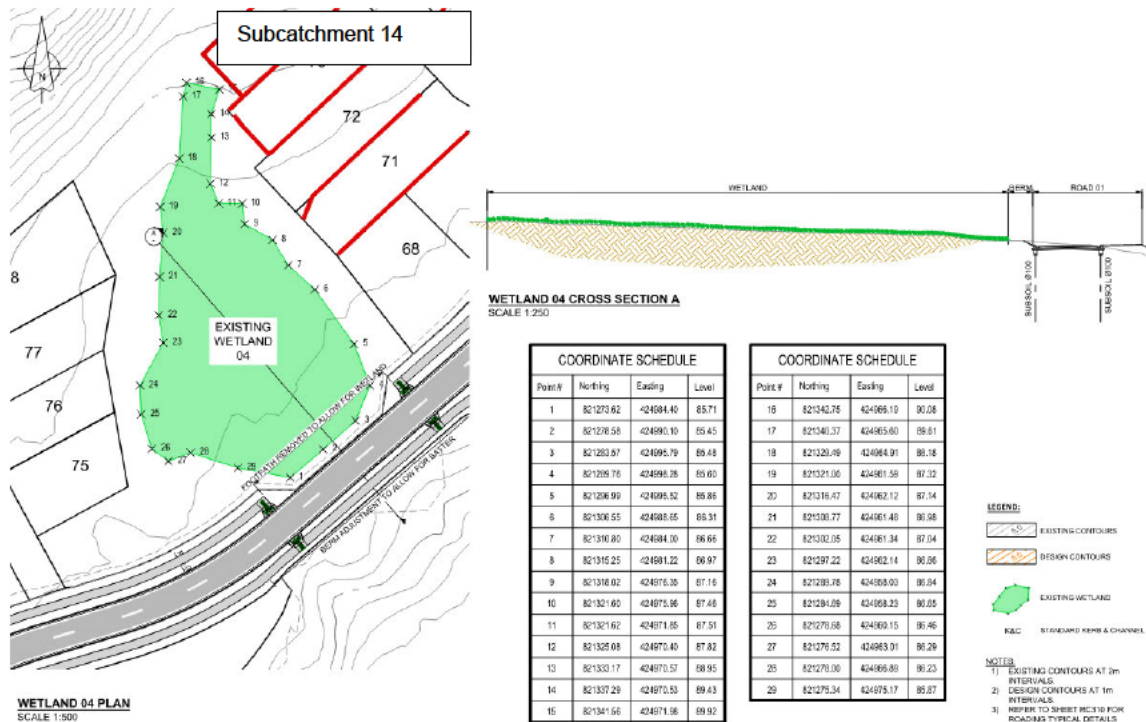


Figure 24: Existing wetland 04, draining subcatchment 14

7.4.1.3. Subcatchment 15

Runoff from subcatchment 15 currently flows through an ephemeral concentrated flow path to the main drain (Figure 25). The peak 1% AEP flow of 850 L/s will be controlled by a cutoff drain above lots 21 and 22, directing flow to a culvert that will follow the existing path. Calculated following Manning's equation, a DN450 pipe will successfully convey this flow without surcharge. Erosion protection (riprap apron or similar) will be installed at the outlet.

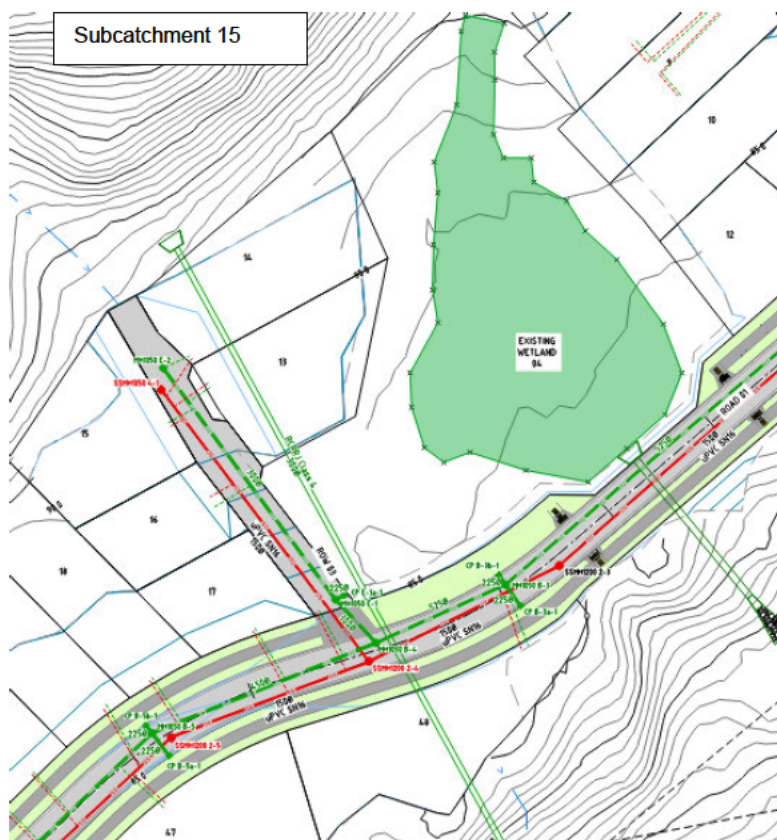


Figure 25: Subcatchment 15 drainage

The cutoff drain will be sized to accommodate at least 200% of the peak 1% AEP flow, with increased depth at the culvert inlet to provide driving head.

Catchment 15, 1% AEP flow 850 L/s		Surface width (m) =	3.15	Side slope =	18.43 degrees				
bed slope	0.005 m/m								
mannings	0.015								
Area =	0.825 m ²								
Wetted Perimeter =	3.3122777 m								
Area	Perimeter	R	V	V ² /2g	Q (m ³ /s)	Fr	shear (N/m ²)		
0.825	3.3122777	0.249073	1.866143	0.177497	1.539568	29.79069	12.21705	Supercritical	

7.4.1.4. Subcatchments 16 and 17

Runoff from subcatchments 16 and 17 currently flows through an ephemeral channel and as overland sheet flow to the main drain.

The ephemeral channel and overland sheet flows will be intercepted by cutoff drains above the residential lots, directing all flow to a culvert laid under the communal green space lot, passing under the road to the main drain (Figure 26). Calculated following Manning's equation, a DN375 culvert which will successfully convey the combined total 1% AEP peak flow without surcharge.

Erosion protection (riprap apron or similar) will be installed at the outlet.

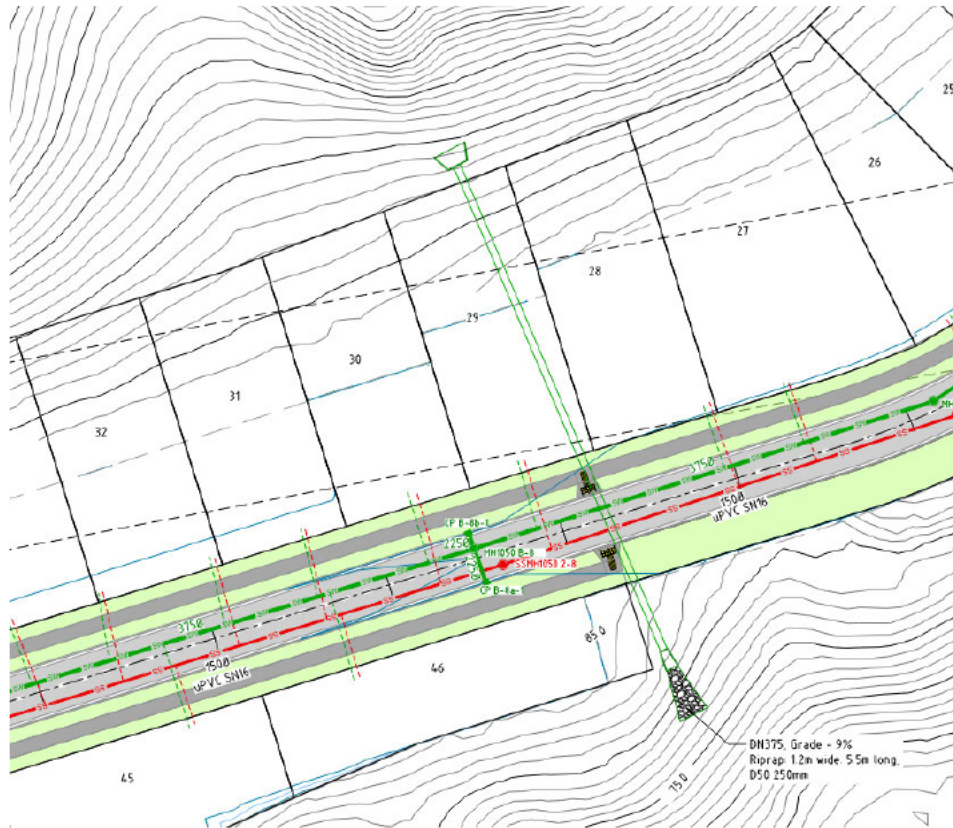


Figure 26: Subcatchment 16 and 17 drainage

The cutoff drains are sized to accommodate at least 200% of the entire combined 1% AEP peak flow along their length. The peak flow will self-evidently only be experienced at the culvert inlet.

Catchment 16-17, 1% AEP flow 143-349 L/s									
				Surface width (m) =	2.50	Side slope =	18.43	degrees	
bed slope	0.005	m/m							
mannings	0.015								
Area =	0.52	m ²							
Wetted Perimeter =	2.6298221	m							
Area	Perimeter	R	V	V ² /2g	Q (m ³ /s)	Fr	shear (N/m ²)		
0.52	2.6298221	0.197732	1.599969	0.130474	0.831984	25.54153	9.698755	Supercritical	

7.4.2. PRIMARY NETWORK

The primary network will be designed to accommodate the 4% AEP event. The piped network will direct runoff to a raingarden for treatment (an extension of the raingarden constructed to service Stage 2, see Figure 21 upper right), before discharging to the main drain.

7.4.3. STORMWATER NEUTRALITY

Runoff from residential lots will be attenuated using on-site detention tanks, issued on the titles as consent notices.



Runoff from the road reserve discharges directly to the main drain after treatment in the raingarden (see section 7.4.4 below) and does not require attenuation. The raingarden will provide minor attenuation benefits, but these are not considered here.

The road reserve comprises 11515 m² of pavement and grassed berms. Runoff is calculated following the WWL method using HEC-HMS software based on HIRDS rainfall data for the site, including a +20% factor to account for climate change. Runoff at the peak of the 1% AEP event is calculated to increase from 102 L/s (pre-development) to 273 L/s (post-development, see Figure 27), an increase of 171 L/s.

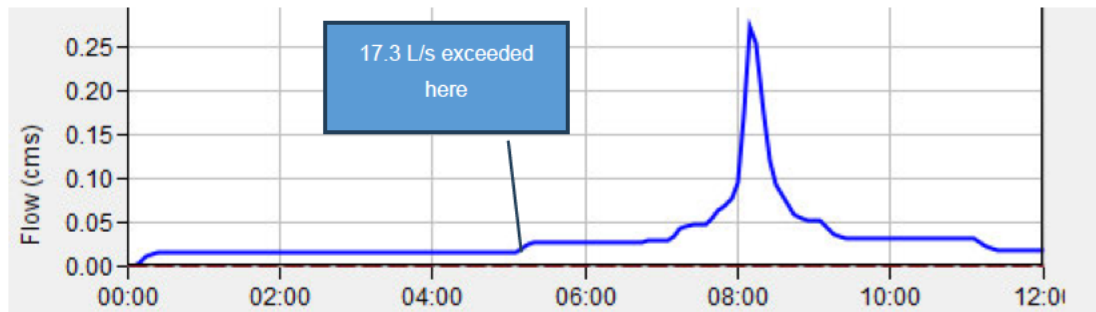


Figure 27: Stage 3 road reserve 1% AEP runoff – HEC-HMS

The downstream impact of this runoff is discussed in Section 7.5

7.4.4. WATER SENSITIVE URBAN DESIGN

Treatment of runoff from the road reserve will be achieved by directing runoff to the raingarden which also services Stage 2b, as detailed in Section 7.3.4 above.



7.5. MAIN DRAIN

Stages 1 through 3 discharge to the open channel UHCC_SWCH000133, referred to as the Totara Park 'main drain', either directly or via the existing Totara Park network as detailed above. The main drain is approximately 930 m long at an average bed slope of 1:430 (Figure 28), collecting stormwater from almost the entire Totara Park catchment. The drain is trapezoidal in shape with a 2 m wide base, 3.5:1 batters and is approximately 2.8 m deep (Figure 29).

The impact in the drain of the increased runoff from the development is assessed in this section.



Figure 28: UHCC_SWCH000133 'main drain' (yellow)



Figure 29: Main drain as seen from atop headwall outlet



A detailed hydrological assessment has not been carried out for the drain, but a comparative analysis of the impact of the extra flow has been carried out using Manning's formula (Figure 30). A nominal pre-development depth of 2.5 m (89% bankfull) has been used as the 1% AEP level due to the lack of detailed hydrology for the channel. This is suggested to be suitable for a comparative analysis.

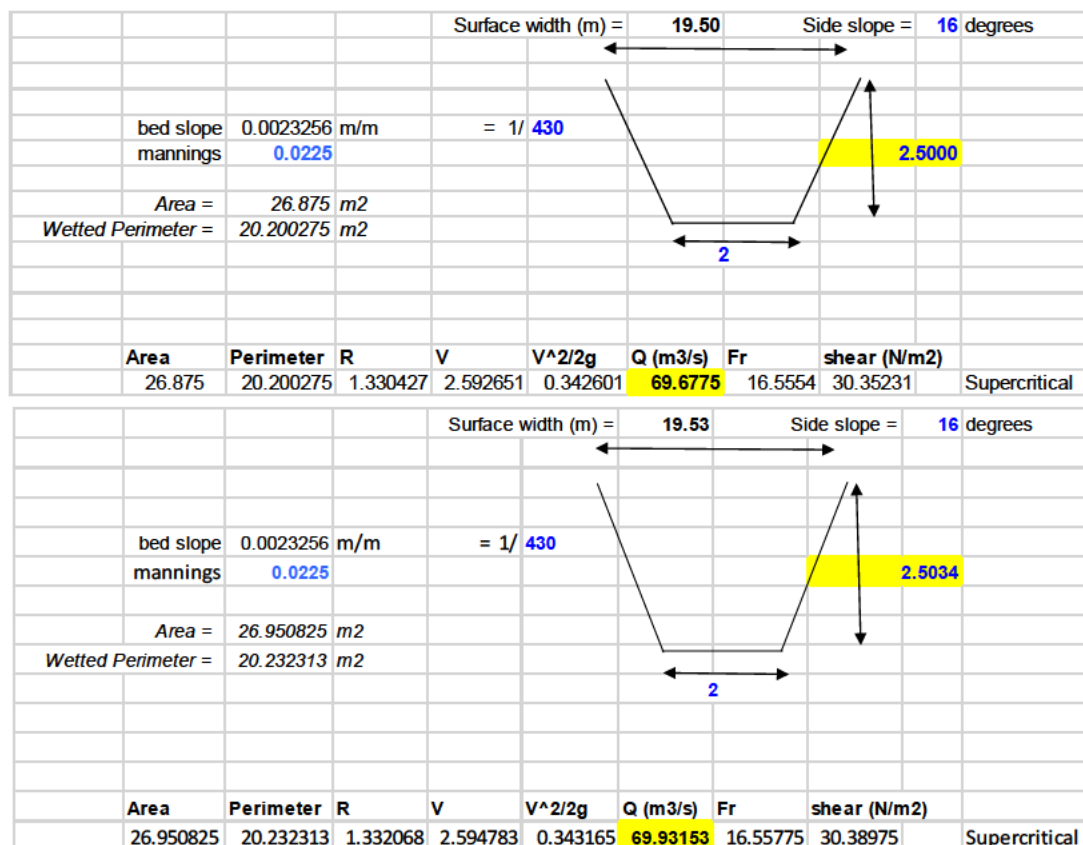


Figure 30: Flow in main drain channel. Top - @ 2.5 m deep (nominal). Bottom – with the development runoff

Figure 30 shows that the increase in depth in the drain from the development's runoff is 3.4 mm, which is considered negligible. The increase further downstream in the Hutt River will be much less than 3.4 mm.

As the main drain discharges directly to the Hutt River with no intervening properties (Figure 28), and the increase in depth is negligible, the flooding risk is therefore likewise negligible.

It follows that no further attenuation is required for the road reserve runoff from Stages 1 through 3.



7.6. STAGE 4

The provisional proposed scheme plan for Stage 4 of the development is shown in Figure 31.

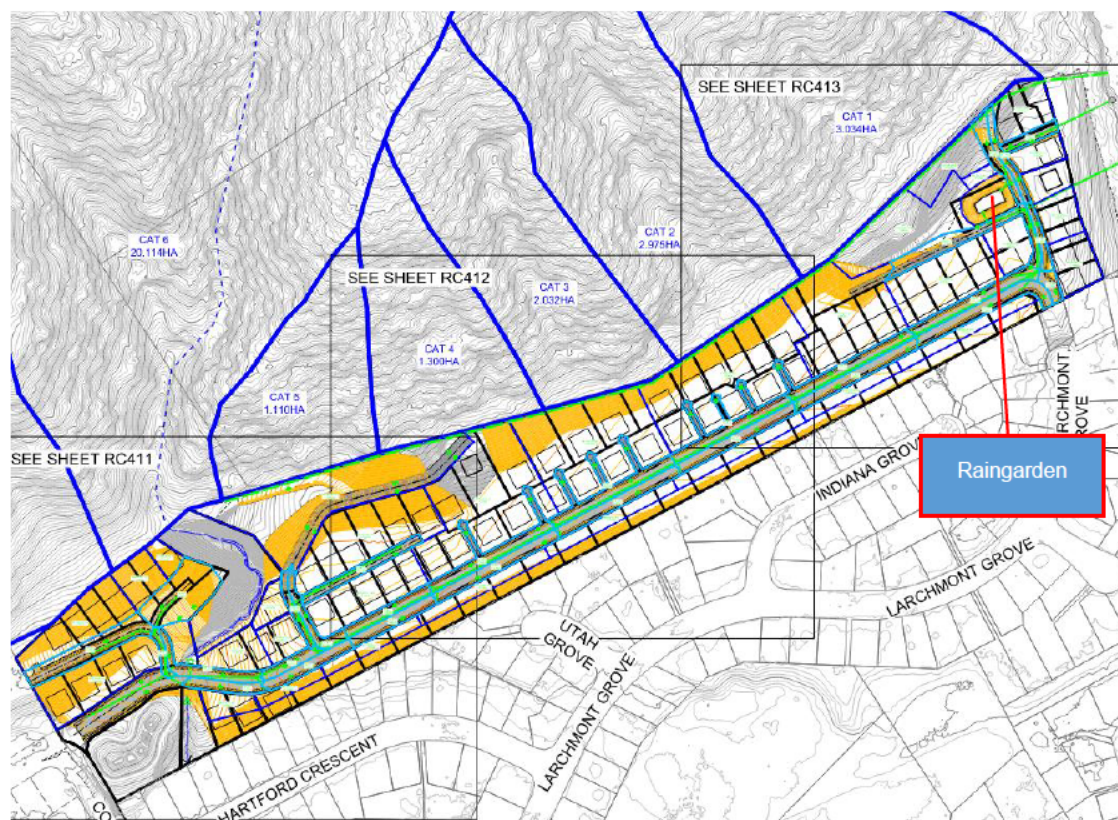


Figure 31: Stage 4 indicative scheme plan, uphill catchments, and raingarden location. Refer civil plans for detail

7.6.1. CLEARWATER FLOW

This section outlines the clearwater sources and flows. An overland flow model assesses the flood risk in Section 7.7.

Relevant uphill catchments for Stage 4 are subcatchments 1 through 6.

Peak flows from the subcatchments in the 1% AEP event were calculated using HEC-HMS software based on HIRDS data for the site, including a +20% factor to account for climate change, to be:

Subcatchment	Area (ha)	Peak 1% AEP flow (L/s)
1	3.091	507
2	2.975	488
3	2.032	333
4	1.300	213
5	1.110	182
6	20.114	2904

Subcatchment 6 discharges to the existing network in Totara Park via the stream/open stormwater channel UHCC_SWCH000080 (see Figure 32). The development will not alter this channel or its inlet



to the existing network, and these will continue to control the runoff from subcatchment 6. Where roads cross the channel, bottomless culverts will be installed sufficiently sized to accommodate at least the 1% AEP event with spans at least 1.3x the stream bank width. Preliminary measurements indicate that, for a bank-full width of 2.5 m at the peak of the 1% AEP event, the minimum span of the bottomless culvert must be at least $(1.3 \times 2.5 =) 3.25$ m.

Runoff from the remaining subcatchments 1 through 5 continues as overland sheet flow and is either accepted into the existing stormwater inlets (see Figure 32) or flows into Totara Park properties. There is currently no significant shaping of the ground directing flow to these inlets.

The capacity of these inlets, based on available GIS data, is calculated to be 121 L/s (UHCC_SW000339) and 291 L/s (UHCC_SW003775). It may be concluded that the remaining 1311 L/s at the peak of the 1% AEP event (refer the table above) flows as sheet flow into Totara Park properties as there is no significant ponding area able to detain this flow, presenting a flooding risk.

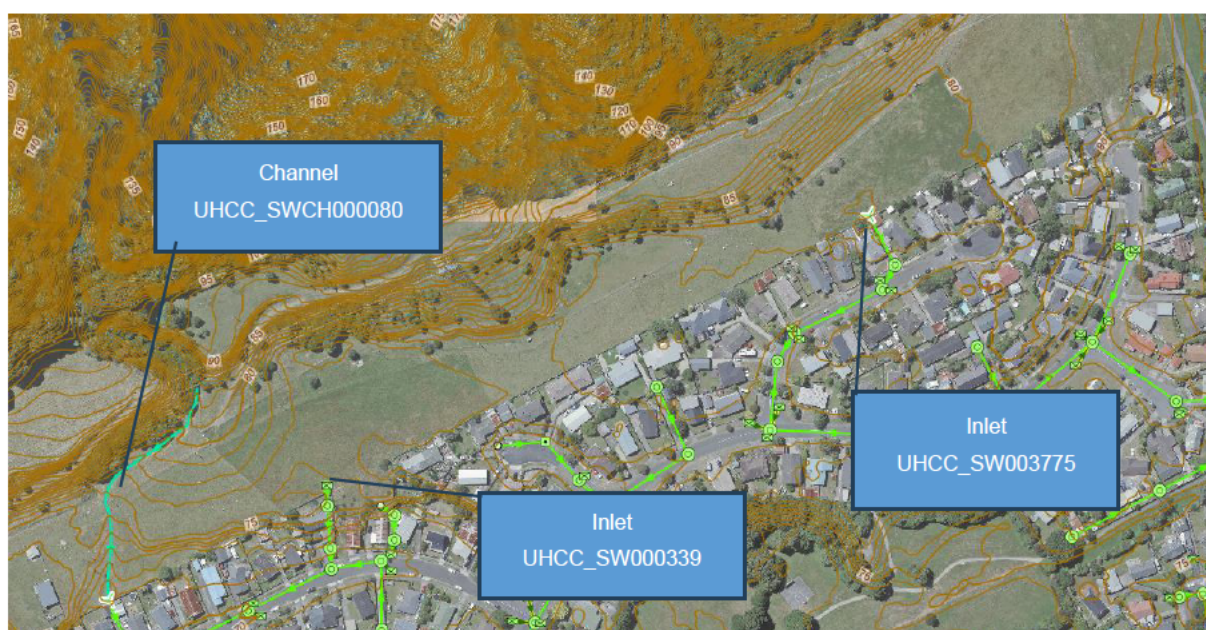


Figure 32: Stage 4 existing site and stormwater network (WWL GIS)

Clearwater flow from subcatchments 1 through 5 is allowed to pass as sheet flow into the development. This presents no flooding risk to the development or downstream properties, see Section 7.7.

7.6.2. PRIMARY NETWORK

The primary network in the road corridor will be sized to accommodate the 4% AEP event. The piped network will direct runoff along the road corridor to the northeast, where it will discharge to the Hutt River via a raingarden for water quality treatment (see below).

7.6.3. STORMWATER NEUTRALITY

Runoff from residential lots will be attenuated using on-site tanks, discharging to the road piped network.



Runoff from the road reserve area currently follows the same overland flow path into Totara Park as described above for the clearwater flow. It is proposed that the network will discharge directly to the Hutt River after treatment in a raingarden to improve water quality (see section 7.6.4), and will not require attenuation. The raingarden will provide minor attenuation benefits, but these are not considered here.

Runoff from the road reserve in the 1% AEP event is calculated using HEC-HMS software based on HIRDS data for the site, including a +20% factor to account for climate change, to increase from 288 L/s (pre-development) to 539 L/s (post-development), an increase of 251 L/s.

The discharge location will be near Land Air Water Aotearoa's Birchville measurement station, which has a 1 in 50 year (2% AEP) flow of $1598 \text{ m}^3\text{s}^{-1}$ (Figure 33). No 1% AEP flow is presented for the station. The 251 L/s increase in runoff from the unattenuated road reserve of Stage 4 represents a 0.016% increase in the projected 2% AEP flow for the Hutt River at this point, which may be considered negligible. The 1% AEP flow for the river will be greater, and therefore the percentage increase will be less than 0.016%. As the increase in river level is negligible, and existing flooding risk to Totara Park properties is being reduced by redirection of the uphill catchment flow, it is considered that attenuation of runoff from the road reserve is not required.

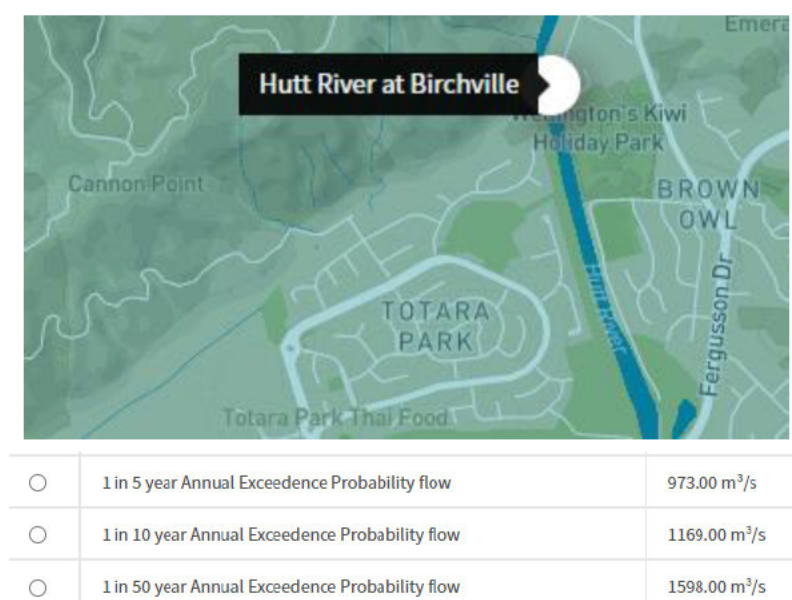


Figure 33: Land Air Water Aotearoa – Hutt River at Birchville station location and projected flow levels (lawa.org.nz)

7.6.4. WATER SENSITIVE URBAN DESIGN

Runoff from the road corridor will be treated in a raingarden to be located at northeastern end of the site (Figure 31). This will discharge directly to the Hutt River.

The bioretention device inherently meets the stormwater contaminant treatment targets set by GWRC in Schedule 28 of PC1, as the treatment targets are defined as that achieved by bioretention. The road reserve comprises 1.28 ha, of which 0.9 ha is impervious. Following the *Water Sensitive Design for Stormwater: Treatment Device Design Guideline* (version 1.1, 2019), the required filter



media surface area to treat this catchment is 180 m², and the Water Quality Flowrate (WQF) is 28 L/s. Flow in excess of the WQF will be directed through a high flow bypass to the Hutt River.

The high flow bypass will only be engaged after approximately five hours into the design 1% AEP storm when the raingarden inflow restriction of 28 L/s is exceeded (Figure 34). By this time the first flush from the road reserve has entered the raingarden for treatment, and any runoff directed through the high flow bypass may be considered clean.

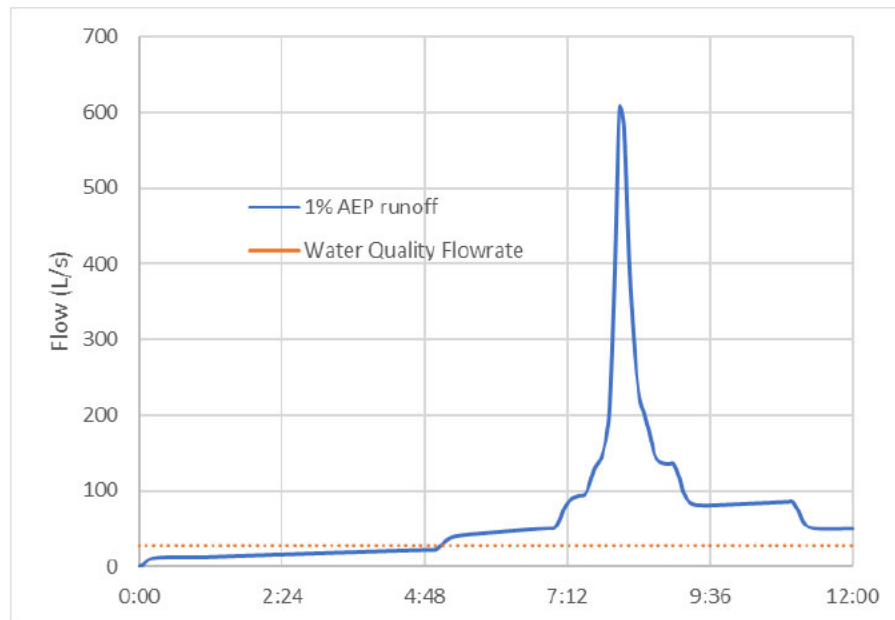


Figure 34: Stage 4 road reserve 1% AEP runoff – HEC-HMS



7.7. FLOOD HAZARD ASSESSMENTS

The flood hazard in the proposed stages of the development is assessed in accordance with the National Policy Statement for Natural Hazards. The hazards are assessed against the risk matrix presented in Appendix 1 of the NPS-NH in Section 7.7.3.

A HEC-RAS overland flow model of the site was developed for the site. Resulting overland flow is categorised following the standard for flood hazard classification, the Australian Rainfall and Runoff flood hazard scale, see Figure 35. In general:

- H1 = Acceptable everywhere.
- H2 = Acceptable in roads and in residential lots away from buildings.
- H3 = Unacceptable in residential lots and road centres. Acceptable in kerb channels.
- H4-6 = Acceptable only in dedicated drainage channels.

These overland flow models consider the 1% AEP event, including a +20% factor to account for climate change, in accordance with the WWL RSWS.

These models include the management methods detailed in the preceding sections (cutoff drains, culverts, raingardens etc).

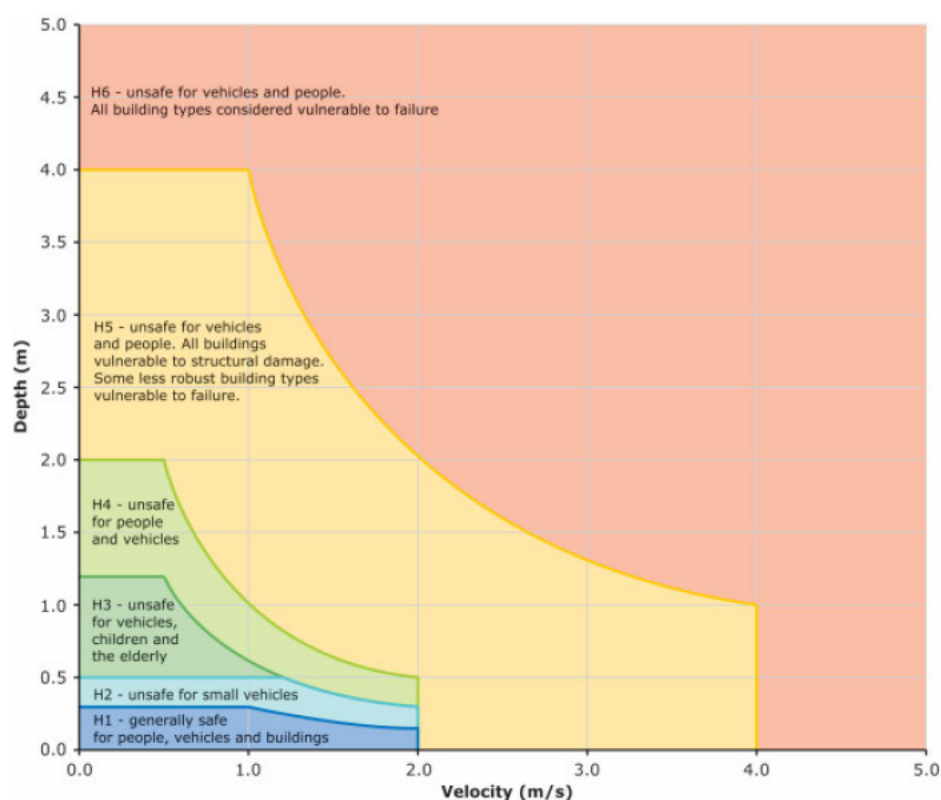


Figure 35: Hazard classification (Australian Rainfall and Runoff – Book 6 Flood Hydraulics)



7.7.1. STAGE 3 MODEL

Peak 1% AEP +CC flood hazard is shown in Figure 36.

Clearwater flow from the uphill catchments is generally well controlled by the cutoff drains detailed above, diverting flow to the main drain.

Some residual flow enters the residential lots and the road corridor, flowing to the low point at the cul de sac of road 2.

The flood hazard in residential lots is at most H1. This represents to risk to people or property.

In the road the hazard is predominantly H1, with H2 at the cul de sac of road 2. Per Figure 35, this represents some risk to small vehicles, but no risk to people or buildings.

Through the main drain the hazard is H3-4. In this dedicated stormwater channel this represents no risk.

The cutoff drains detailed above successfully divert flow to the main drain and eliminate risk to the proposed properties.

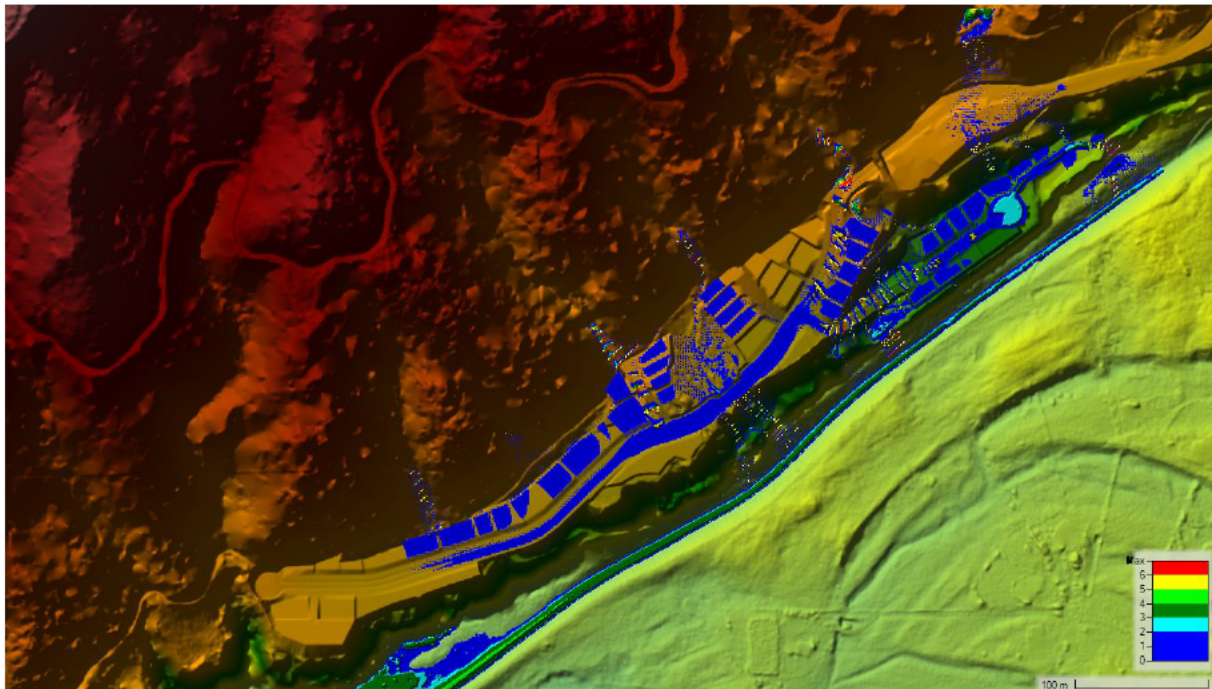


Figure 36: Stage 3 1% AEP HEC-RAS flood hazard.



7.7.2. STAGE 4 MODEL

Peak 1% AEP +CC flood hazard is shown in Figure 37

Overland flow passes through some residential lots to the road, where it is controlled by the road kerb and channel.

The flood hazard within the site in the 1% AEP event is at most H1, representing no risk to people or property.

There are minor areas of H2 in the road corridor of Wyoming Gr centred on the kerb channel, which again is no risk to people or property.

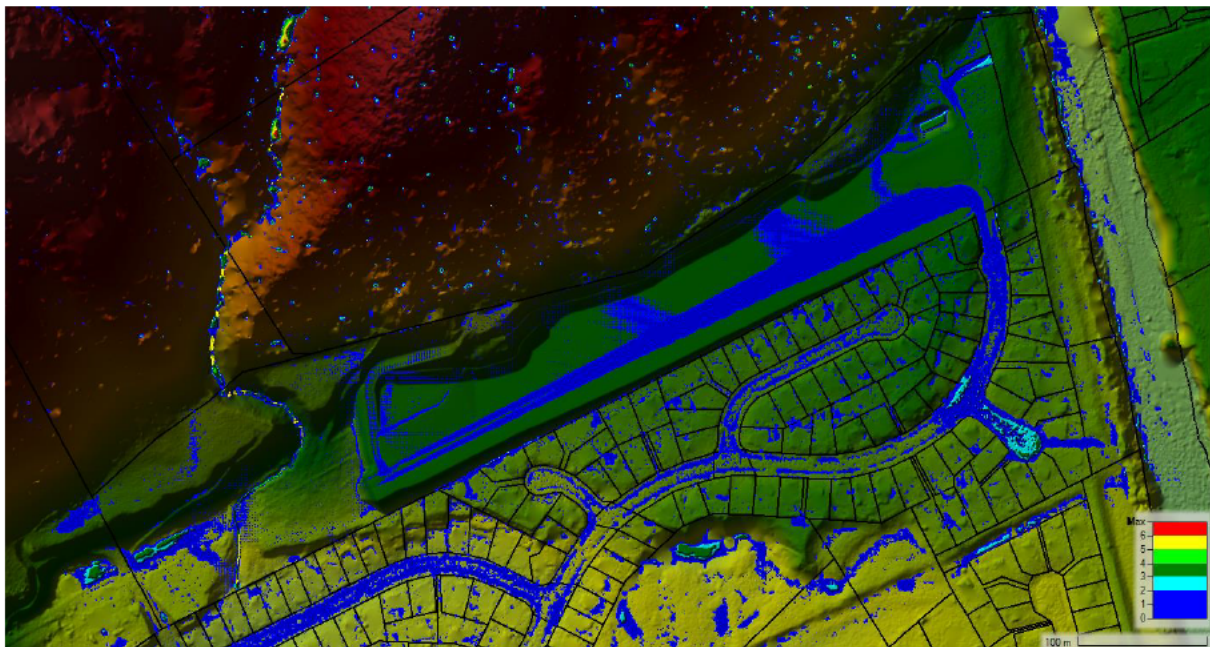


Figure 37: Stage 4 1% AEP HEC-RAS flood hazard.



7.7.3. NPS-NH ASSESSMENT

The National Policy Statement for Natural Hazards requires the risk from the flooding natural hazards detailed above to be assessed in a combined approach considering the likelihood of the hazard occurring and the material damage resulting from the hazard. The risk matrix of the NPS-NH Appendix 1 is reproduced below.

The flooding hazards, as detailed by the flood models above, are assessed accordingly.

- Likelihood level: The flood models considered the 1% AEP + Climate Change Factor event (100-year + conservative factor). Likelihood score = “Possible” to “Unlikely”.
- Consequence level. The hazard rating is H1 within residential properties, with areas of H2 in the road corridors. Conservatively assess that isolated minor injuries are possible, and minor damage to land and buildings is possible, with no loss of use and minimal repairs. Consequence score = “Minor”.

The risk is therefore Low (Unlikely/Minor) to Medium (Possible/Minor).

		Likelihood Level						
		Almost Certain	Very Likely	Likely	Possible	Unlikely	Rare	Very Rare
Consequence Level	ARI (years)	up to 10	10-20	20-50	50-100	100-500	500-5000	> 5000
	AEP	10% or more	10% to 5%	5% to 2%	2% to 1%	1% to 0.2%	0.2% to 0.02%	< 0.02%
	Catastrophic	Very High	Very High	Very High	High	Medium	Medium	Medium
	Major	Very High	Very High	High	High	Medium	Medium	Medium
	Moderate	High	High	High	Medium	Medium	Low	Low
	Minor	Medium	Medium	Medium	Medium	Low	Low	Low
	Negligible	Low	Low	Low	Low	Low	Low	Low



8.0 WASTEWATER

8.1. OVERVIEW

Wastewater from the development site drains under gravity to the public network in Totara Park, through to the Totara Park wastewater pump station.

Drainage for Stages 1 and 2 is constructed, connecting via Tacoma Dr. Due to the topography of the site, Stages 3 and 4 will drain to the Totara Park network via new connections. Stage 3 will drain to the network in Tulsa Park, while Stage 4 will drain to the network in Larchmont Gr.

8.2. WASTEWATER FLOWS

The proposed dwellings will increase the wastewater flow through the network, and increase demand on the pump station.

The network catchment flows of existing Totara Park properties and the Cannon Point Development are given below, calculated following the method of the WWL RSW5. Census 2023 data was available for Totara Park. The development's population was estimated as 3.5 people per dwelling.

Table 3 - Catchment flows

	Catchment Area (ha)	Population	ADWF (L/s)	PDWF (L/s)	PWWF (L/s)
Totara Park	93.9	2967	6.82	19.89	32.8
Stages 1 - 2	4.6	161	0.37	1.97	2.40
Stage 3	4.6	378	0.86	4.63	5.36
Stage 4	8.4	346	0.90	4.50	5.11
Development + Existing	111.53	3852	8.94	25.37	37.98



Figure 38 - Totara Park WWPS catchment, as existing

8.3. EXISTING NETWORK PERFORMANCE

The proposed development is upstream of the Totara Park WWPS. A theoretical system curve was calculated using the available as-built information. It was assumed that the 220 m rising main across the bridge was under pressure to be conservative.

The as-builts indicate that there are three Flygt 3127 pumps. The exact model was not shown on the document. Therefore the largest and smallest impeller options were compared from the Flygt 3127 MT range. The following performance characteristics were estimated:

- Duty-standby-standby: 36-51 L/s
- Duty-assist-standby: 54-74 L/s

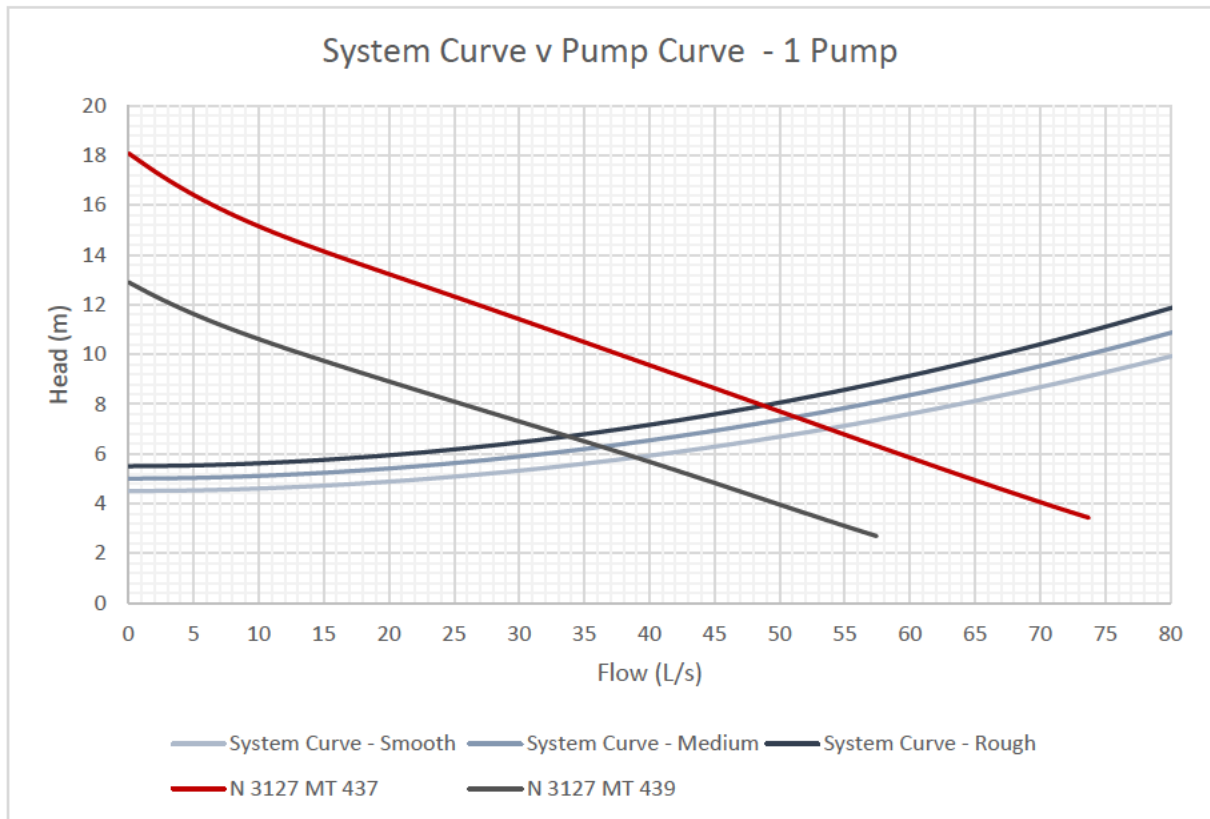


Figure 39 - Existing pump performance - Duty-standby-standby

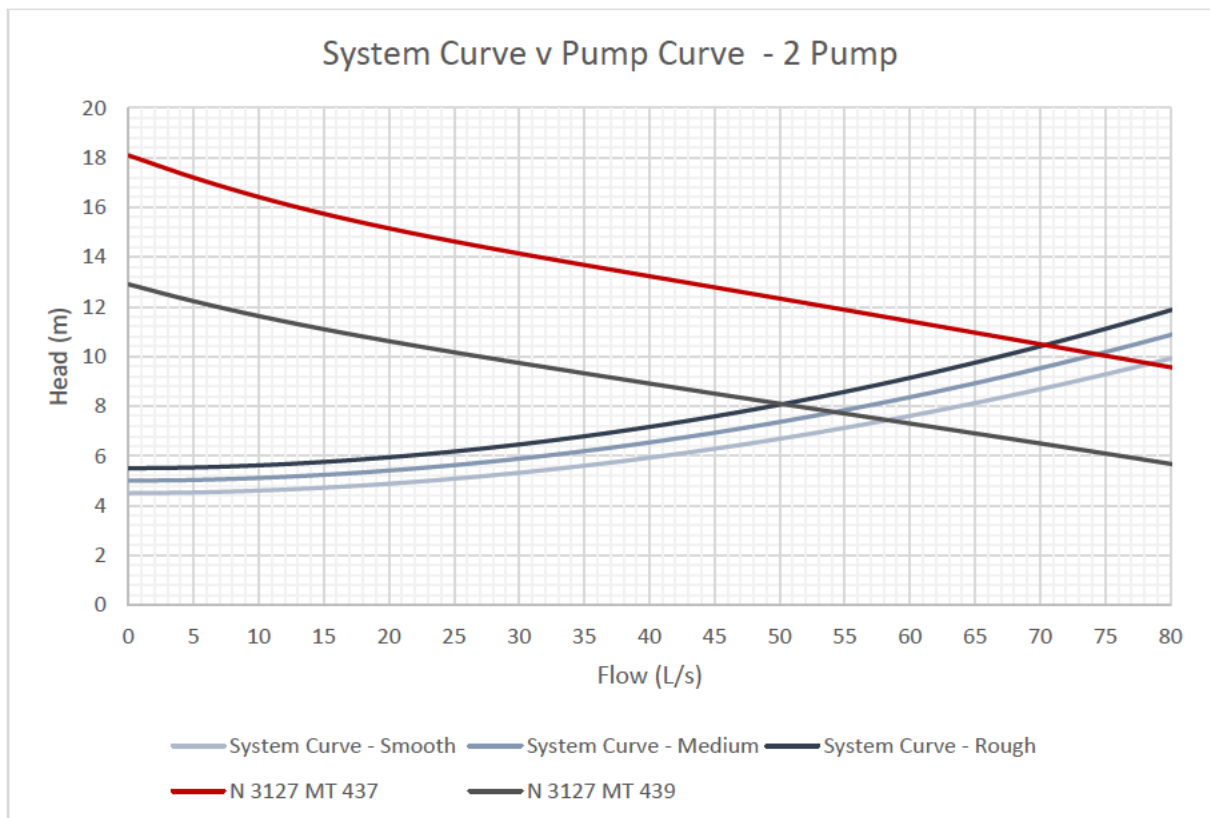


Figure 40 - Existing pump performance - Duty-assist-standby



From the existing SCADA data obtained between 10/12/2020 to 18-02-2021 to analyse the existing pump flows. Figure 41 details the obtained combined pump flow data. The combined flows are noted to be 35-45 L/s which is within the margins calculated theoretically.

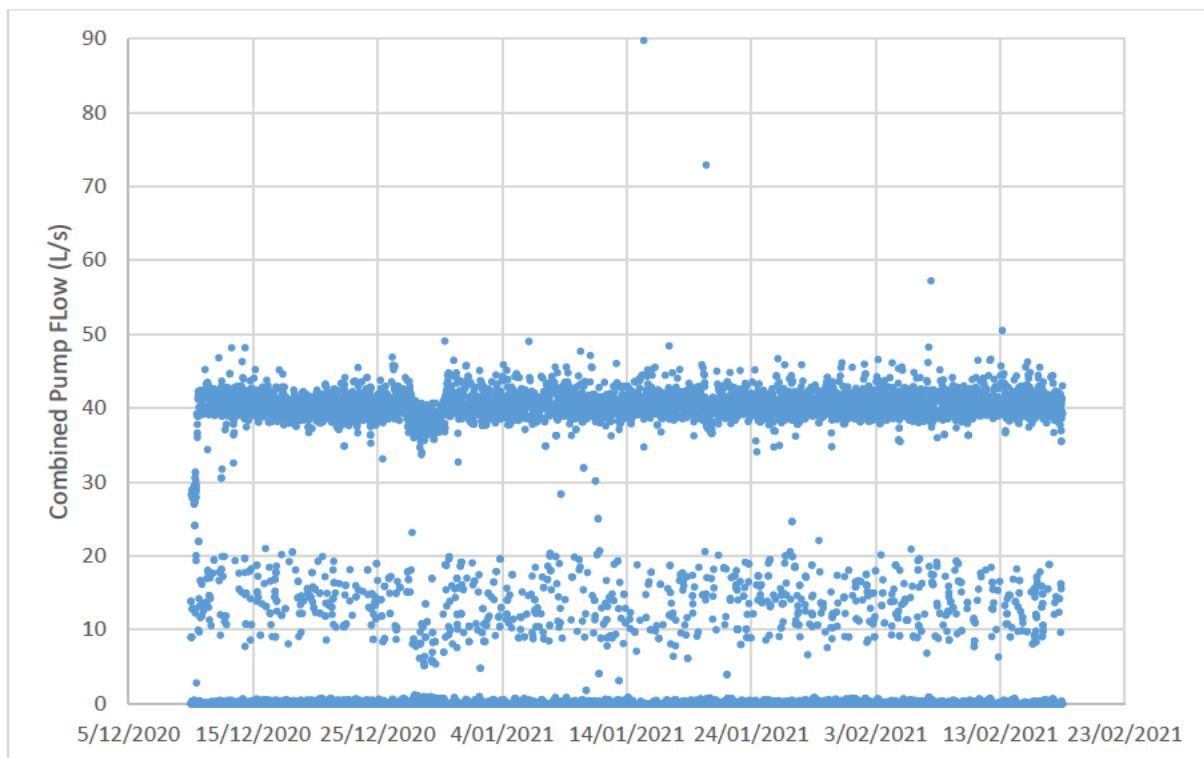


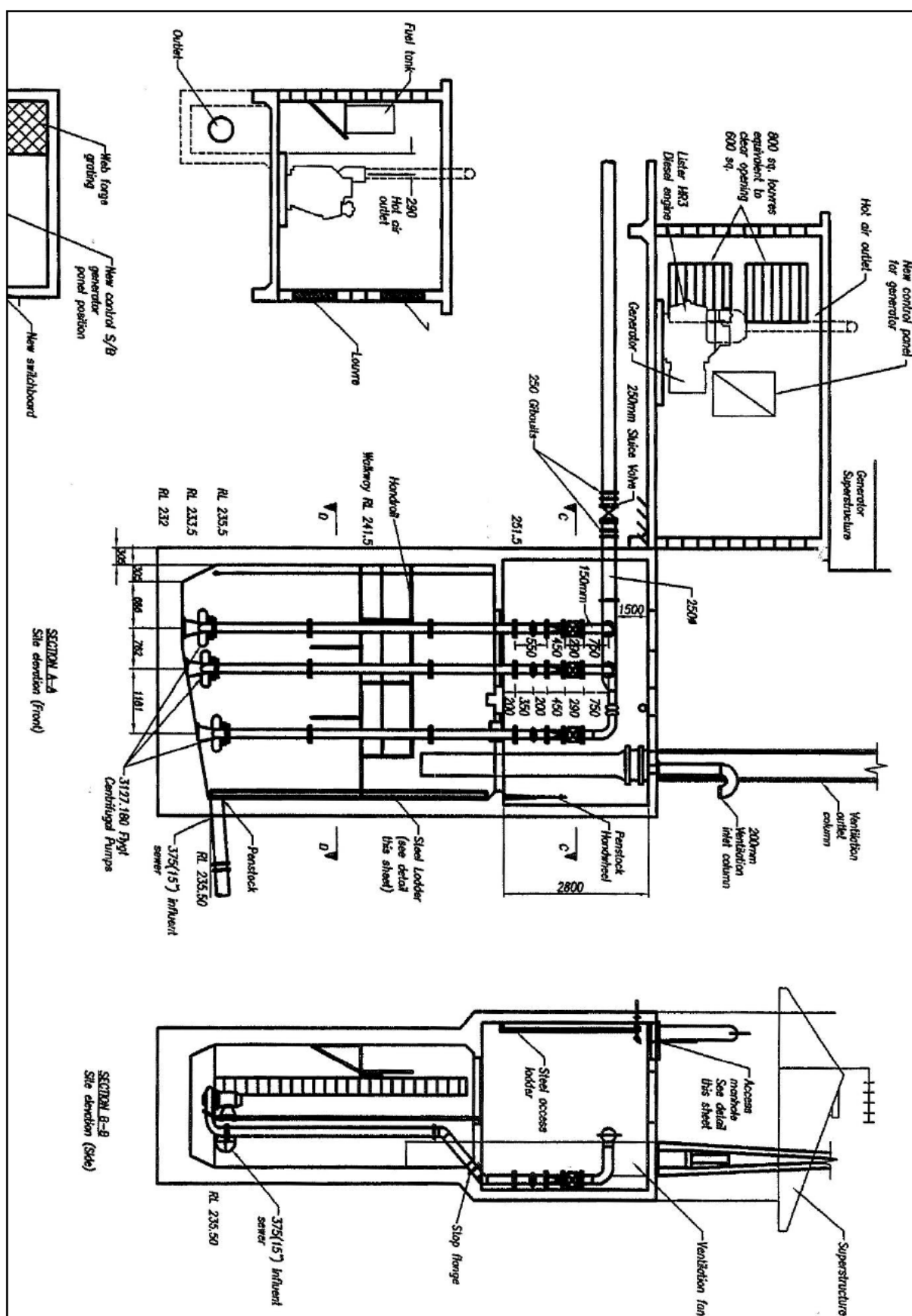
Figure 41 - Pump flows

8.4. CONCLUSIONS

From the analysis the following conclusions were made:

- Existing Totara Park catchment has a PWWF of 32.8 L/s.
- The flow is expected to increase to 38.0 L/s (5.2 L/s increase) with the proposed development.
- The current capacity of the Totara Park WWPS is estimated to be:
- Duty-standby-standby: 36-51 L/s
- Duty-assist-standby: 54-74 L/s
- From initial investigations it is determined that the pumps at Totara Park WWPS will NOT require upgrading to accommodate the increase of flows from the proposed development.

8.5. EXISTING PUMP STATION AS- BUILTS





9.0 POTABLE WATER SUPPLY

The development site is located on a terrace adjacent to DMA zone Totara Park. The zone is supplied by the Cruikshank Reservoirs across the Totara Park bridge, with a secondary supply from Timberlea Reservoir via the Norbert St bridge, see Figure 42.

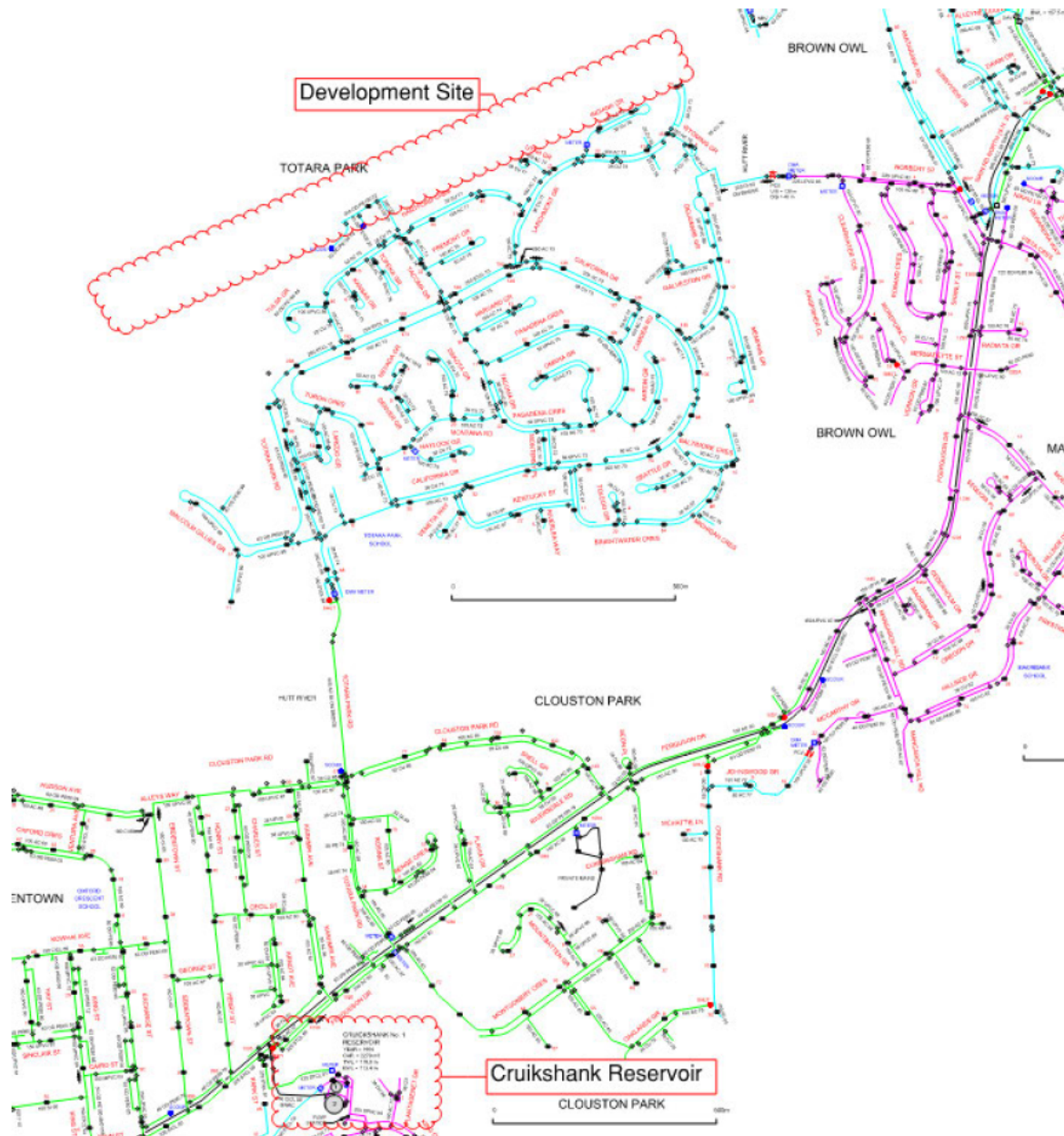


Figure 42: UHCC water network plan. Development site and source reservoirs indicated.



The development will be supplied for potable water by connection to the existing network in Totara Park, supplying the development with potable water and fire water compliant with the requirements of the RSWs and the SNZ PAS 4509.

Indicative reticulation is shown on the UHCC network plan in Figure 43. Refer to civil plans for full detail. In general, the reticulation will consist of DN200 principal mains with DN50 rider mains as appropriate. Each dwelling will be provided with individual manifold connections. Fire hydrants will be constructed in accordance with the SNZ PAS 4509.

Reticulation for Stages 1 and 2 is constructed, with a connection to Tacoma Dr. Reticulation for Stage 3 will continue from Stage 2 to the west. Reticulation for Stage 4 will connect the Stage 1 network northwards to the existing network in Larchmont Grove, improving the connectivity and resilience of the reticulation through the development.

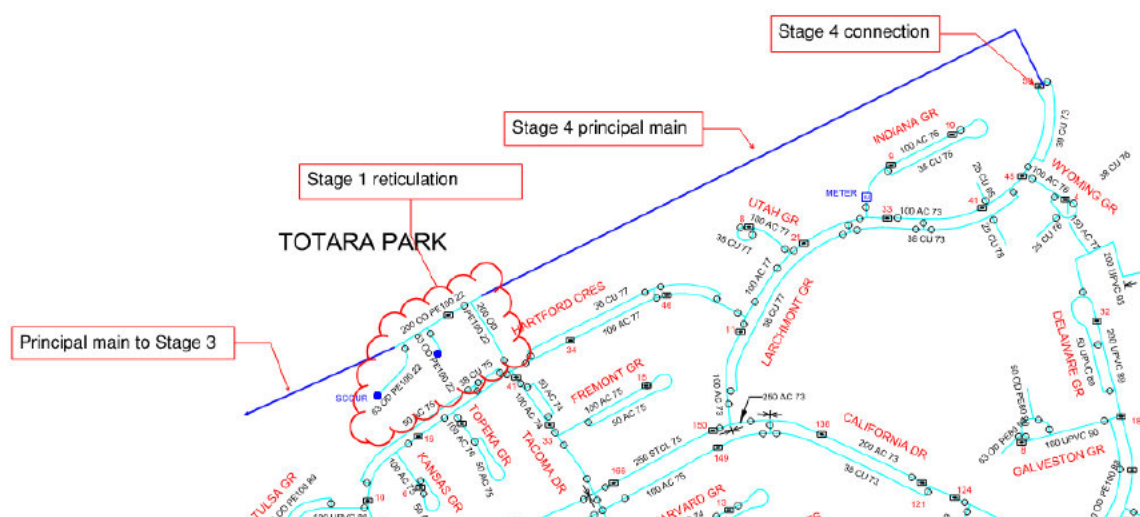


Figure 43: Indicative principal water reticulation, on UHCC water network plan. Refer civil plans for detail.

Water network modelling has previously been conducted to demonstrate the peak demand and firefighting meet the required pressures and flows stipulated in the RSWs and the SNZ PAS 4509. This modelling has been reviewed and accepted by Wellington Water Ltd, with the results briefly summarised below:

- The minimum peak pressure achieved in Stage 3 is 25.1 m.
- The minimum peak pressure achieved in Stage 4 is 30 m (most conservative case, fed from Larchmont Gr only without connection to Tacoma Dr).
- The minimum residual firefighting pressure in Stage 3 is 18.3 m.
- The minimum residual firefighting pressure in Stage 4 is 13.8 m (most conservative case, fed from Larchmont Gr only without connection to Tacoma Dr).



10.0 SERVICES (POWER, PHONE & GAS)

- Power - Wellington Electricity has been consulted for a design on the reticulation system.
- Phone - Chorus has been consulted for a design on the reticulation system.
- Gas - PowerCo has been consulted for a design on the reticulation system.

11.0 CONCLUSION

This Infrastructure Report has been prepared to support Civil Engineering Plan for the proposed subdivision that is to be undertaken.

We propose that the proposed subdivision is broadly compliant with the relevant codes and standards applicable.

11.1. WASTEWATER

There is sufficient grade to discharge the wastewater network to a single point in the existing network at the intersection of California Drive and Totara Park Road.

The proposed wastewater reticulation system has been designed in accordance with UHCC CoP and WWL Standards.

11.2. STORMWATER

The reticulation system has been designed based on UHCC CoP and the WWL RSWS

Stormwater will discharge from the site to the main drain to Hutt River. Attenuation will be provided on each lot by an on-site detention facility mandated through a consent notice. Attenuation for road reserve has been determined unnecessary due to less than minor downstream impact.

Runoff from road reserve will discharge directly to the main drain after treatment in the raingarden and does not require attenuation.

11.3. POTABLE WATER

Adequate water supply (flow & pressure) is available for supply & firefighting by extending the network constructed in Stages 1 & 2 with a 200mm principal main and DN50 rider mains.

11.4. SERVICES

Power, phone (chorus) and gas reticulation providers have confirmed that the subdivision can be reticulated.

11.5. ROADING

Proposed geometric design, layout and configuration is generally in accordance with NZS4404 and UHCC CoP.



12.0 LIMITATION

This report has been prepared for the benefit of Cannon Point Development Ltd as our client with respect to the design undertake as defined in the project brief. The purpose of this work is to determine adequate system suitable for client's needs. It shall not be relied upon for any other purpose. The reliance by other parties on the information or opinions contained in this report shall, without our prior review and agreement in writing, be at such parties' sole risk.

Opinions and judgments expressed herein are based on our understanding and interpretation of current regulatory standards and should not be construed as legal opinions. Where opinions or judgments are to be relied on, they should be independently verified with appropriate legal advice. Any recommendations, opinions, or guidance provided by Vecta Ltd or its consultants in this report are limited to technical engineering requirements and are not made under the Financial Advisers Act 2008.

Vecta Ltd have performed the services for this project in accordance with the standard agreement for consulting services and current professional standards. No guarantees are either expressed or implied.