STORMWATER MANAGEMENT REPORT

Waitomokia

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WAITOMOKIA
MANGERE
AUCKLAND

BROWNFIELD INDUSTRIAL DEVELOPMENT

WAITOMOKIA PLAN CHANGE

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Executive Summary

The proposed Waitomokia Plan Change (WPC) forms part of the initial first steps, in a regulatory context, in an overall long-term development proposed by the applicant for the Waitomokia site. The WPC aims to protect the cultural, spiritual, and historical values associated with mana whenua and their relationship with the site. The proposed overlays are intended to ensure development over the long-term period is consistent with cultural and landscape values.

The protection of wai (water) and awa (river) is a key consideration to ensure cultural and landscape integrity is maintained in the developed context. This is also a key regulatory control mandated by the local government to meet similar goals of environmental protection in relation to stormwater.

The Waitomokia Plan Change - Stormwater Management Plan (WPC-SMP) provides the information to support the redevelopment of the Plan Change Area from a stormwater management perspective. The proposed stormwater management approach assists in the protection and enhancement of the natural characteristics that currently exist on site and associated receiving environment in a developed context.

The recommended methods of stormwater management within this report have been considered at a catchment level to confirm the stormwater management suitability. The SMP takes into consideration the principles of integrated stormwater management and how these can be used to mitigate potential negative impacts on the receiving environment.

The stormwater management approach has been determined through an assessment using available information and knowledge of the stormwater catchments, development scenarios and constraints. A stormwater model has also been developed on the findings of the previous investigations and has been used to identify key issues and is integral in supporting this SMP.

The following key challenges were identified with the proposed development and have the potential to impact on the way stormwater is managed:

- The topographical characteristics of the crater landform at the site.
- Increase in runoff, flow velocity and contaminants, resulting from increased impervious surfaces.
- The Oruarangi Creek receiving environment has been identified as a Significant Ecological Area (SEA) and Statutory Acknowledge Area (SAA).
- The potential for stream erosion if the increased runoff from development is not controlled to the stream environment.
- Flood risk areas and overland flow paths
- Effect of increase in impervious surfaces on water quality of the receiving watercourses.

A review of relevant stormwater guidelines and policies was carried out to determine the appropriate stormwater management practises to adopt in the SMP. This included a review of the Auckland Unitary Plan (AUP) policies and rules including the provisions of the Network Discharge Consent (NDC).

The following stormwater management options and outcomes are appropriate for development:

- Adoption of a toolbox of solutions derived from Auckland Council's GD01 and GD04 guidelines for the water quality of high contaminant generating surfaces.
- Provision of a combined centralised treatment and peak flow-detention basin.
- Provision of hydrological (retention and detention) mitigation devices for smaller rainfall events.
- Water quality treatment will be provided by a combination of at-source and centralized devices.
- Installation of a private stormwater pipe network to convey the 10% AEP storm.
- Preference for flows in exceedance of 10% AEP storm to be managed through overland flow.

The recommended stormwater management approach is the Best Practical Option and is in line with the objectives set out by the AUP policies and NDC provisions. This ensures that the wai generated post development will be treated to the levels required which protects the downstream awa. Furthermore, the proposed measures are in response to the craters natural shape, thereby maintaining the hydrological integrity of the relationship between the wai and the downstream awa to the land in a developed context.

1 Introduction

Increased intensity of urbanisation of a site drives a need for effective stormwater management to appropriately manage effects on the natural receiving environment. The health and vitality of urban streams is often a barometer to determine the effectiveness of stormwater management in the built environment. To mitigate effects of development, Auckland Council through the Auckland Unitary Plan (AUP) and Network Discharge Consents (NDC) mandates conditions and criteria that new developments need to satisfy to ensure adverse effects on the natural receiving environment are mitigated. Under Schedule 4 of the NDC, the proposed development is classified as a Large Brownfield development as it seeks to create more than 5000m^2 of impervious area related to light industrial land use. Due to the absence of an adopted SMP for the wider area in relation to the subject site, a site specific SMP is required.

The following SMP outlines how effects from the proposed development will be effectively managed to achieve best practice outcomes in accordance with NDC Schedule 4 and by extension the provisions of the AUP.

1.1 Site Description

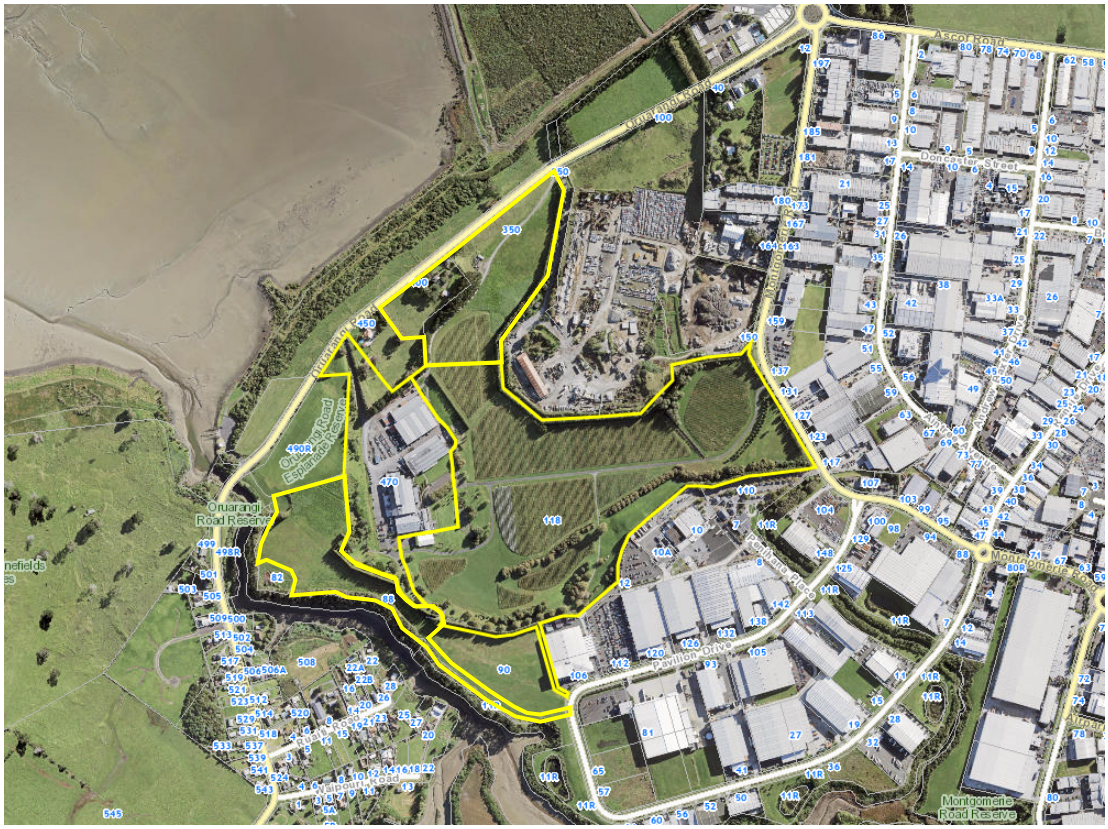


Figure 1: Aerial Map of Subject Site *Source: GeoMaps – Auckland Council*

Table 1.1 – Site Details					
Address	118 Montgomerie Road 88 Pavilion Drive 350 Oruarangi Road	400 Oruarangi Road 470 Oruarangi Road	**AUP Zone**	Business – Light Industry	
Legal Description	LOT 5 DP 581326 LOT 2 DP 581326 LOT 3 DP 209528	LOT 1 DP 36092 LOT 1 DP 581326	**Local Board**	Mangere-Otahuhu	
Property Area	231,239 m^2 45,491m^2 50,745 m^2	12791m^2 70,231m^2	**Council Property ID**	11524512 11524511 11358516	11354320 11524510

The majority of the development site area is situated within the Waitomokia crater which is approximately 41.05ha (Plan Change Area). The current land use relates to horticultural activities related to the Villa Maria Winery and two dwellings of rural-residential characters. The site coverage is a mix of vineyards, buildings, and carparks associated with winemaking, restaurants, and hosting facilities. Legal access to the site is off Oruarangi Road and Montgomerie Road. A, existing quarry/vehicle storage site is situated on the northern abutting boundary. The southern boundary is abutted by Oruarangi Creek and existing industrial buildings fronting Pavilion Drive and Penihana Place. The western boundary roughly straddles Oruarangi Road, which itself is a coastal road adjacent to Manukau Harbour. A portion of the western boundary abuts the Oruarangi Road Esplanade Reserve. The eastern boundary runs along Montgomerie Road for the most part. A portion of the development area sits outside the Waitomokia crater, located to the western boundary known as the Harbour View Block which is currently vacant land with grass cover. Access to Harbour View Block is off Pavilion Drive (refer to Appendix A for topographical survey information).

The site is not covered under an adopted SMP under the NDC nor is it subject to any precinct overlays/plans, but it has a Quality Sensitive Aquifer Management overlay. The downstream received environment, Oruarangi Creek, is subject to a Significant Ecological Area Overlay (SEA) and is under Coastal Inundation controls.

1.2 Catchment Context

The site is located within the Waitomokia Crater and is currently not subject to an existing operable adopted Stormwater Management Plan under the NDC. The site was under the defunct Ihumatao Network Discharge Consent (Consent Number 32503) as part of the overall Ihumatao Catchment, located in Sub-catchment 573a.

Oruarangi Creek is subject to a Significant Ecological Area (SEA) overlay, as such any adjacent developments will need to consider environmental impacts on the creek as the ultimate receiving environment. The site is located in a Quality Sensitive Aquifer Management Area (QSAM) which requires any proposed development to closely consider the effects on water quality impacts on the underlying water bodies as well.

Figure 2: Catchment Map – Colour Relief *Source: Sertus*

1.3 Existing Stormwater Network

The site is currently drained by a private stormwater network consisting of pipes, cesspits, & manholes which collect stormwater from impervious roof and pavement areas. This pipe network flows into a pond and an open channel running along the southern boundary. The open channel captures and conveys the surface water to a discharge point into the public stormwater open channel via existing culverts (approximately DN1200) located at the intersection of Montgomerie Road and the accessway to 110 Montgomerie Road. The downstream public network consists of a public open channel creek with two DN4000 culverts on Pavilion Drive prior to flowing into Oruarangi Creek. Given the expected increase in imperviousness and the proposed removal of stormwater and flood storage within the site to facilitate development, downstream infrastructure will not be sufficient to cope with the increase in flows. Refer to Section 3.4 for discussions on possible stormwater diversion options.

1.4 Proposed Development

The applicant, Goodman Nominee NZ Ltd seeks to redevelop the site in alignment with industrial zoned land into a light-industrial warehouses. The land-use activities are maintained between the pre and post development contexts in accordance with the zoning for the subject site. The proposed development aims to realise the industrial potential of the site with balancing the spiritual and cultural values imbued into the natural landscape of the site. Consequently, as a first step, a Plan Change is proposed to apply a Precinct Plan that includes provisions that safe-guard the aspirations in relation to spiritual, cultural and natural landscape target outcomes.

1.4.1 Proposed Precinct Plan Overlays

The applicant proposes a plan change to initiate precinct overlays to protect and ensure future development outcomes for the Waitomokia. Refer to the planning reports for detailed description of the proposed plan change and associated overlays including details on the mana whenua consultation.

The proposal aims to apply the Waitomokia Precinct in the sub-precincts as follows:

- **Sub-precinct A** is adjacent to the coastal environment and the Ōruarangi Creek. Land in this sub-precinct is at an elevation that offers views to Manukau Harbour.
- **Sub-precinct B** is intended to be the primary site for the development of light industry activities. While land in this sub-precinct has been modified over time, the Waitomokia tuff crater remains as a distinguishable landform feature of the original crater.
- **Sub-precinct C** is intended to be the area of the precinct providing for a broader range of commercial and community activities.
- **Sub-precinct D** represents the area containing existing buildings within the precinct and features a highly developed landform.

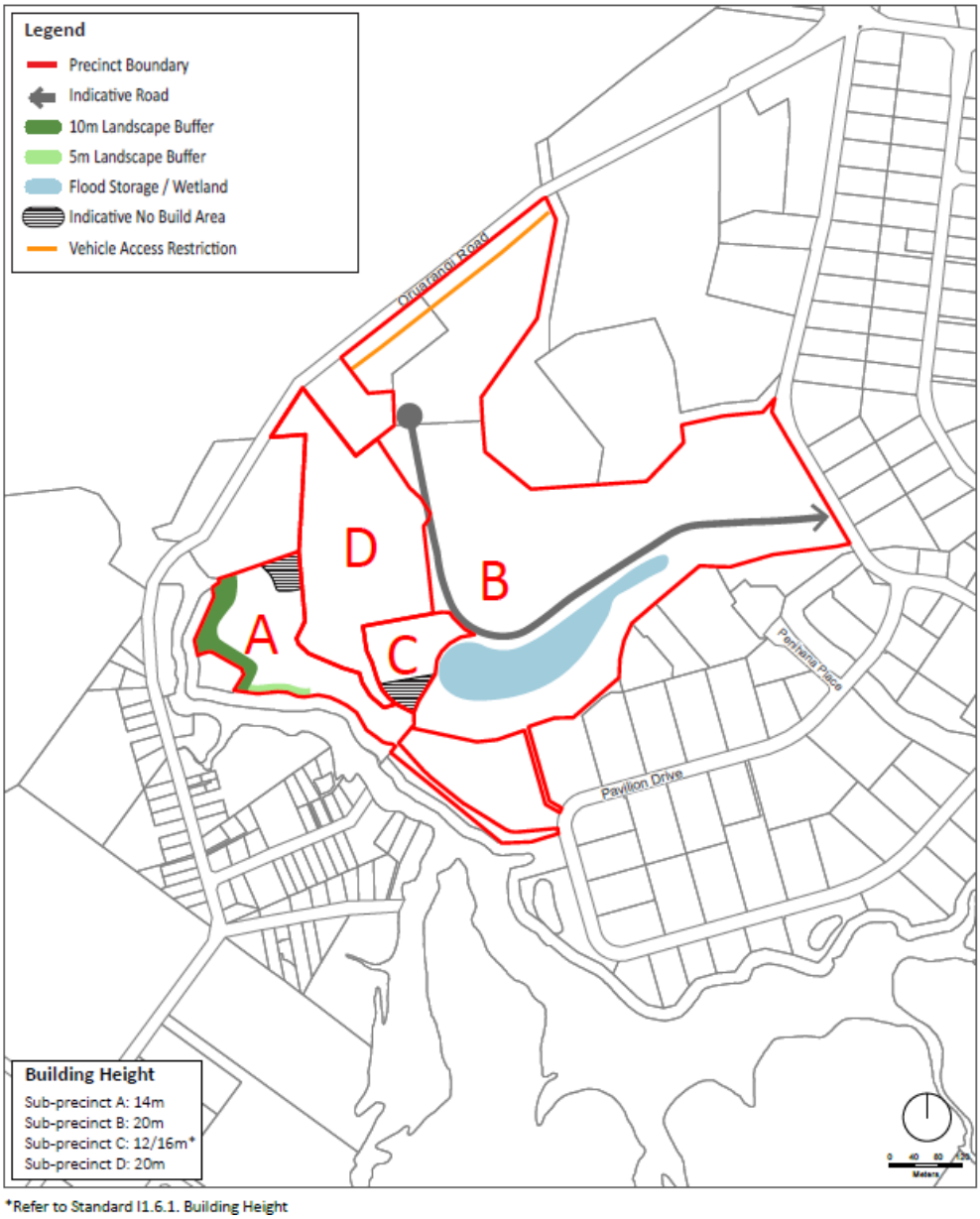


Figure 3: Proposed Precinct Plan *Source: Barkers & Associates*

1.4.2 Development Overview

The quantum of stormwater generated is highly dependent on the quantity of impervious surface coverage as positive linear relationship. As an industrial park, the development will create a significant increase in flows, especially given the pre-development or mitigation baseline will be based on mostly pervious surface coverage. The following tables outline existing and projected site coverages for sub-precincts A, B, C and D.

Table 1.2 Sub-Precinct Site Definition			
Sub-Precinct	**Description**	**Address**	**Site Area (m^2)**
Sub-Precinct A	Harbour View Block	88 Pavilion Drive	45,491
Sub-Precinct B	Villa - Future Industrial	118 Montgomerie Road, 350 & 400 Oruarangi Road	294,775
Sub-Precinct C	Commercial & Community	118 Montgomerie Road	Area included as part of Sub-Precinct B
Sub-Precinct D	Indevin - Existing Buildings	470 Oruarangi Road	70,231
Total Area			**410,497**

Table 1.3 Estimated Pre-Development Surface Coverage (%)			
Sub-Precinct	**Description**	**Pervious**	**Impervious**
Sub-Precinct A	Harbour View Block	90	10
Sub-Precinct B	Villa - Future Industrial	95	5
Sub-Precinct C	Commercial & Community	95	5
Sub-Precinct D	Indevin - Existing Buildings	20	80

Table 1.4 Estimated Post-Development Surface Coverage (%)			
Sub-Precinct	**Description**	**Pervious**	**Impervious**
Sub-Precinct A	Harbour View Block	10	90
Sub-Precinct B	Villa - Future Industrial	10	90
Sub-Precinct C	Commercial & Community	10	90
Sub-Precinct D	Indevin - Existing Buildings	20	80

Table 1.5 Future Industrial Lots (Sub-Precincts A & B) – Impervious Ratio	
Future Industrial Lots	**Expected Impervious Coverage**
Total Development Area	85% to 90% of total
Roof area	65% of each Lot
Access, Hardstand and Parking areas	25% of each Lot
Roads	80% impervious coverage

The stormwater runoff flows, and volumes have been calculated using the prescribed TP108 method (HEC-HMS software) for Auckland rainfall and runoff based on the proposed catchment's percentage impervious areas and including consideration of climate change. Catchment areas have been determined and measured using site survey drawings and LIDAR information sourced from LINZ. Table 1.6 below outlines the contrast between the pre-development and post development un-mitigated flows.

Table 1.6 Pre – Post Development Flowrates		
Discharge Scenario	**10% AEP Flowrates (m^3/s)**	**1% AEP Flowrates (m^3/s)**
Existing (ED)	8.21	12.60
Proposed (MPD - un-mitigated)	9.47	13.92

The table above demonstrates from a high-level perspective the increased effects in peak flow and volume for the 10% & 1% AEP storms from the pre-development baseline. These effects, along with the significant impervious surfaces proposed and the proximity of Oruarangi Creek requires water quality and hydrological impacts to be considered. The SMP will outline the mitigation measures to control outflows to acceptable levels including measures to avoid and minimise environmental effects.

1.4.3 SMP Objective

The overall purpose of the SMP is to provide guidance on the management of stormwater considering the potential impacts from the development proposed. This SMP considers the existing stormwater infrastructure, along with the site conditions and potential impacts of the redevelopment. The proposed stormwater management strategy is developed to be consistent with Auckland Council policies, plans, non- statutory policy, and planning documents were also considered in preparing this approach.

The purpose of the Waitomokia SMP is as follows:

- Provide a SMP to satisfy the AUP objectives and NDC provisions.
- Set minimum stormwater requirements for the development to mitigate potential negative impacts.
- Identify key problem areas, issues and constraints that impact the chosen stormwater management approach.
- Provide a preferred method of stormwater management to meet requirements along with protecting and promoting the natural and cultural values within the catchment.
- Consider a holistic approach to stormwater management, considering hydrology and the hydraulic processes and constraints.
- Provide a robust basis of guidance that can be used for future detailed design and investigation.

As the development is in the early-stages of masterplan development, and given this SMP is related to a Plan Change, detailed quantification of effects is not applicable at this stage. The mitigation controls proposed and associated toolbox of solutions in this report follow the Auckland Council prescribed design guidelines :

- Guideline Document 1 (GD01) - Stormwater Management Devices in the Auckland Region
- Guideline Document 4 (GD04) - Water Sensitive Design for Stormwater
- The Auckland Code of Practice for Land Development and Subdivision – Chapter 4: Stormwater
- Auckland Unitary Plan – Operative in Part (AUP)
- Auckland Council Stormwater Code of Practice (SWCoP)
  Auckland Council Stormwater Modelling Specification (AC SWMS)
- Auckland Transport Code of Practice (ATCoP)

- Stormwater Runoff Modelling Guidelines (TP108)
- Regionwide Stormwater Network Discharge Consent (Regionwide NDC)

1.4.4 Desired Outcomes

The resulting management strategy was assessed against AUP requirements and integrated stormwater management principles target by the NDC as well as the urban design criteria, promoting the protection of the receiving and natural environment.

The outcomes to be achieved by the Waitomokia Plan Change SMP are:

- The creation of the proposed development for light-industrial warehousing
- An integrated stormwater management approach that mitigates the impact of existing and future land use by mimicking the unique natural landform of the site
- Protection of the receiving environment from adverse effects.
- Protection of people and property from flooding through civil engineering infrastructure relating to underground drainage networks and overland flowpaths.

2 Regulatory Frameworks

2.1 Auckland Unitary Plan and Stormwater Requirements

Stormwater management for the development of Plan Change Area is subject to the rules of the AUP. The AUP includes consideration of stormwater management and flooding, with identification of activity status and rules to regulate development.

2.1.1 AUP - Section E Provisions

The general AUP policies for management of stormwater and flooding are covered in Section E – Auckland Wide rules as follows:

- Section E1 – Water quality and integrated management.
- Section E8 – Stormwater discharge and diversion.
- Section E36 – Natural hazards and flooding.
- Section D1 – High-use Aquifer Management Areas Overlay.

An integrated stormwater management approach, as outlined in Policy E1.3.10, should carefully consider the entirety of the following aspects.

- The nature and scale of the development and practical and cost considerations.
- The location and design of site and infrastructure to protect significant site features and minimise effects on receiving environments.
- The nature and sensitivity of receiving environments.
- Reducing stormwater flows and contaminants at source.
- The use and enhancement of natural hydrological features and green infrastructure where practicable.
- Avoiding, minimising or mitigating adverse effects of stormwater diversions and discharges (Policy E1.3.11).
- Managing contaminants in stormwater runoff from high contaminant generating carparks (> 30 cars) and high use roads (>5000 vehicles per day) to minimise adverse effects on water and sediment quality (Policy E1.3.12).
- Requiring stormwater quality or flow management to be achieved on-site unless there is a downstream communal device (Policy E1.3.13).
- Adopting the best practicable option to minimise the adverse effects of stormwater discharges (Policy E1.3.14).
- Utilising stormwater discharge to ground soakage where it is possible to do so in a safe, and effective manner (Policy E1.3.15).

2.2 Network Discharge Consent

Auckland Council has introduced the Network Discharge Consent (NDC) framework for assessment of stormwater aspects of new developments in the urban areas of the Auckland Region. The stormwater management approach targeted by the NDC is to support the Auckland region's substantial current and projected growth whilst providing a robust environmental protection framework as it relates to stormwater discharges into Auckland Council's public stormwater network. With an umbrella NDC specifying performance criteria for various development and natural contexts, the aim is to achieve consistency in regulation and asset performance outcomes across the region.

Schedule 4 of the NDC provides the performance critirea for stormwater management for proposed developments. The stormwater management approach outlined in this report will enable the proposed development to achieve compliance with Schedule 4 requirements.

2.3 Stormwater Management Approach

The stormwater management approach for Plan Change Area is proposed to deliver the Best Practical Option (BPO) considering Water Sensitive Design Guidelines and Principles recognising the site is zoned for industrial development. With due consideration to AUP objectives, the requirements of NDC will also be used to inform the BPO measures to ensure compliance from the perspective of discharging into the existing connection to the public network. It should be noted that the AUP or NDC, either in combination or as a single path to consent ultimately achieve the same outcomes in terms of device design and minimum prescribed performance criteria. These is because both mechanisms refer consistently to the same rules and guideline documents with an overall emphasis on integrated stormwater catchment management approach.

The development requires consideration of the effects of the following issues within the site:

- Hydrology mitigation
- Stormwater quality
- Stormwater flows
- Flooding and overland flow paths

The management approach has been based on the proposed development impervious percentages, and an overall solution has been proposed to manage stormwater and mitigate flooding on the subject site. The solution involves installation of new private drainage assets and treatment devices to manage the quantity and quality of stormwater discharges to the downstream receiving environment, while improving ecological outcomes and recognise its cultural significance.

3 Proposed Stormwater Management

3.1 Principles Adopted

As per the discussions in Section 3 of the report, the following principles outlined below will guide the development for the management of stormwater for the proposed development:

- Interdisciplinary approach – integrated stormwater management.
- Manage stormwater at source where practical.
- Mimic natural systems and processes.
- Protect and enhance ecosystems.

The primary consideration for the assessment of the stormwater management approach under the AUP is the adoption of the BPO to prevent or minimise adverse effects. BPO under the RMA means the following:

***Best practicable option**, in relation to a discharge of a contaminant or an emission of noise, means the best method for preventing or minimizing the adverse effects on the environment having regard, among other things, to—*

(a) the nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and

(a) the financial implications, and the effects on the environment, of that option when compared with other options; and

(b) the current state of technical knowledge and the likelihood that the option can be successfully applied.

The following table summarises the target stormwater management specifications.

Table 1.7 Stormwater Management Performance Specifications

Stormwater management measure	Performance requirements
Hydrological Mitigation	Lot specific hydrological mitigation should allow for a retention volume of 5mm per 100m² of impervious area and a detention volume based on the pre-development mitigation baseline relative to the 95th percentile rainfall event. The detention volume should drain down over a period of 24 hours. Where the retention volume cannot be achieved due to site specific restrictions and reuse limitations, the retention volume requirement should be added to the detention volume requirement.
Water Quality	Water quality treatment devices should be designed in line with GD01 & GD04 requirements.
Water Quantity	Peak flow mitigation with detention storage to pre-development baseline for the 10% and 1% AEP storm events
Erosion Protection at Outlets	Erosion protection at outlets into the receiving environment should be designed in accordance with TR2013/018.

The following subsections describes the proposed management approach to meet the adopted stormwater management requirements.

3.2 Hydrological Management

It is noted that Waitomokia is not subject to the (Stormwater Management Area Flow) SMAF overlays under the provisions in the AUP and therefore the E10 rules do not apply. As the development will ultimately increase impervious areas significantly, the increased volume of stormwater will need to be mitigated. The downstream receiving environment (Oruarangi Creek) is within a SEA overlay, which generally relates to streams that have been identified that are sensitive to increases in stormwater flows. Therefore, the development will be required to mitigate the effects resulting from the introduction of new impervious surfaces.

Hydrological mitigation refers to minimising or mitigating changes in hydrology from changes in the imperviousness of a catchment and is predominantly related to mitigating erosion and stream bank instability and creating conditions that support healthy aquatic ecosystems such as maintaining base flows in streams. This is typically done by mitigating changes in hydrology through the retention and detention of runoff in stormwater devices. Furthermore, the NDC has determined that to achieve hydrology mitigation a development needs to provide the following as set out by the provisions in Schedule 4:

- Retention (volume reduction) of the first 5 mm of runoff from impervious surfaces; and
- Detention (temporary storage) of the difference in runoff volumes from a pre-development and post-development 95th percentile, 24-hour rainfall event minus the retention volume.

Where retention cannot be achieved due to compaction of earthworks and slope stability, this water volume can be managed by detention. It is noted that the retention for re-use for non-potable water demand is generally not high for industrial developments. The demand for greywater and landscape irrigation generated through this activity is low. The developer has indicated a minimum reuse component for washing down activities. Consequently, the balance of the net volume will be detained and drained over a 24-hour period.

3.3 Water Quality

3.3.1 Roofing Material

To reduce the risk of heavy metal contaminants entering the stormwater system, the use of pre-painted steel roofing will be required for all new roofs. The use of inert roofing material will result in zero contaminants being generated by roof areas which will decrease the risk of runoff contamination and do not require further treatment. However, the flows from the individual warehousing sites will be directed to the centralised basin, therefore extra-over treatment beyond the required baseline for inert roofing material will be achieved.

3.3.2 At-Source - Toolbox Devices

The creation of impervious paved surfaces beyond a 1000m^2 threshold, particularly in an industrial context is considered to be a High Contaminant Generating Activity (HCGA). The paved surfaces will consist of accessways, car parks and yards for turning movements and/or storage activities. The carpark itself is likely to generate more than 30 vehicle movements daily which further adds to the HCGA classification. Hard surfaces such as footpaths, pedestrian areas, patios etc. do not generally require stormwater treatment as these areas generate low runoff and negligible levels of contaminants. However, any industrial hardstand areas could generate high

levels of contaminant and may be located adjacent to these non-HCGA areas. Therefore, all hard stand areas within the site shall be provided with appropriate stormwater treatment.

To achieve the best environmental outcome for the development, it is likely that stormwater treatment to improve water quality for all hardstand surfaces will be achieved via proprietary underground treatment devices. Aside from being an effective water quality treatment solution, these devices maximise the utilisation of land for industrial activity as they are located underground. For car park and access areas, there is more opportunity for the provision of green landscape infrastructure which can be designed to incorporate stormwater treatment function (bio-retention swales, rain gardens etc). Treatment of all HCGA areas within the individual sites and internals roads will be undertaken to the 70% level with the balance of the treatment occurring at the centralised stormwater basin.

To aid the design of the proposed future warehouse sites and internal roads, Table 1.7 outlines a toolbox of stormwater management devices which can be implemented to ensure compliance with the regulatory requirements.

Table 1.8 Stormwater Management – Device Toolbox

Device	Water quality requirements addressed	Hydrological mitigation requirements addressed	Location in catchment	Most suitable application
Bioretention Swale	- Sediment - Metals - Hydrocarbons - Temperature	95th percentile detention	At source	Runoff from high use road corridor & Impervious car parks within lots
Propriety Filtration Device	- Sediment - Metals - Hydrocarbons	N/A	At source	Runoff from HCGA impervious areas within lots
Rain Garden	- Sediment - Metals - Hydrocarbons - Temperature	95th percentile detention	At-source	Runoff from road corridor & impervious areas within lots
Stormwater tree pit	- Sediment - Metals - Hydrocarbons - Temperature	N/A	At-source	Road corridor runoff
Planter box	- Sediment - Metals - Hydrocarbons - Temperature	N/A	At source	Road and carpark runoff
Swale	- Sediment - Metals (partial) - Hydrocarbons (partial) - Temperature	N/A	Mid catchment	Low use road corridor Runoff and car parks.

Grated catchpits and inlets	Trap gross pollutants at sumps to avoid overload of downstream devices	N/A	At-source	Roads, carparks, yards in combination with other devices

3.3.3 Centralised Stormwater Basin

The objective of the stormwater management response is to replicate the natural hydrological cycle of the catchment. This aligns with the overarching goal of developing the site in harmony with cultural values and the natural landscape, while preserving the existing topography, particularly the distinctive bowl or crater shape. This approach naturally advocates for a central low point, which is already present, offering an ideal location for centralized stormwater management.

The stormwater network will provide drainage for the individual sites, and the internal roads will drain into a centralised stormwater basin which will provide treatment and hydrological mitigation for up to 30% of the impervious areas. The basin's functional characteristics are as follows:

- Inlet structures at the inflow points to ensure flow velocities are low to avoid re-suspension of sediments/particulates in the basin.
- A forebay to temporarily detain flows to ensure entrapment of heavier suspended solids and any remaining gross pollutants. The forebay also acts to modulate the flow injection for the treatment zones in a more even manner.
- A lower stage one channel that will receive flows from the forebay and provide treatment and hydrological mitigation for up to 30% of the impervious surfaces associated with the inflow catchment. The low channel will be designed as a bio-retention swale with planting and interspaced rock dams. Flatter areas will be interspaced within the swale channel to act as bio-filtration zones.
- A higher stage two channel within the basin will provide temporary detention to attenuate flows from the 10% to 1% AEP events.
- Note the roof and building cladding material will be constructed from inert material which is not contaminant generating therefore not requiring treatment. However, all roof area discharge will be routed through the central stormwater basin which will therefore provision additional "polishing" treatment above the required minimum baseline.

3.4 Water Quantity

3.4.1 Flow Increases

Increased intensity of post development impervious surfaces will create higher Q10 peak flows. Post development peak Q10 flows will exceed the existing downstream network capacity.

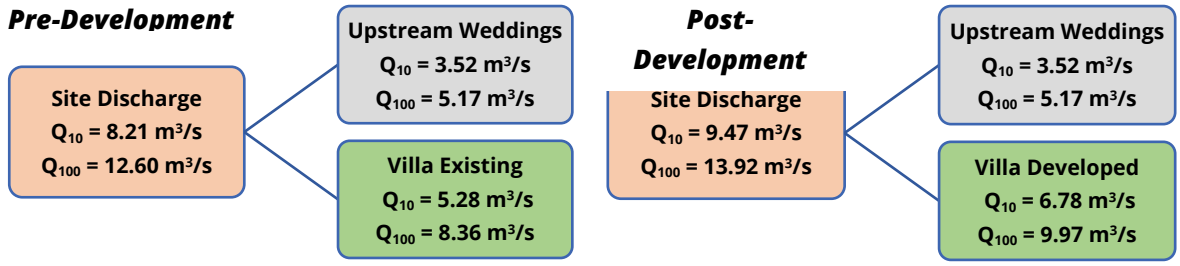


Figure 4: Pre & Post Development Flows

Weddings relates to the upper catchment within the Waitomokia Crater and Villa represents sub-precincts B, C

The diagrams above summarise the results of HEC-HMS flow analysis which show a 15% increase in the 10% AEP and 10% increase in 1% AEP between the pre-post development comparison.

3.4.2 Detention Strategy

To mitigate the effects of the increase in flowrates, the development will create 10% and 1% AEP detention to be provided in the two-stage centralised basin. A controlled outlet will throttle flows to the peak flow within the Villa catchment and appropriately sized detention storage will be provided. Currently, two discharge options are under consideration for further development which are the Montgomerie Outlet and the Oruarangi Outlet. For both cases, the flow diversion for the upper catchment (Weddings Parcels) will be provided to ensure flows are maintained to the existing outlet.

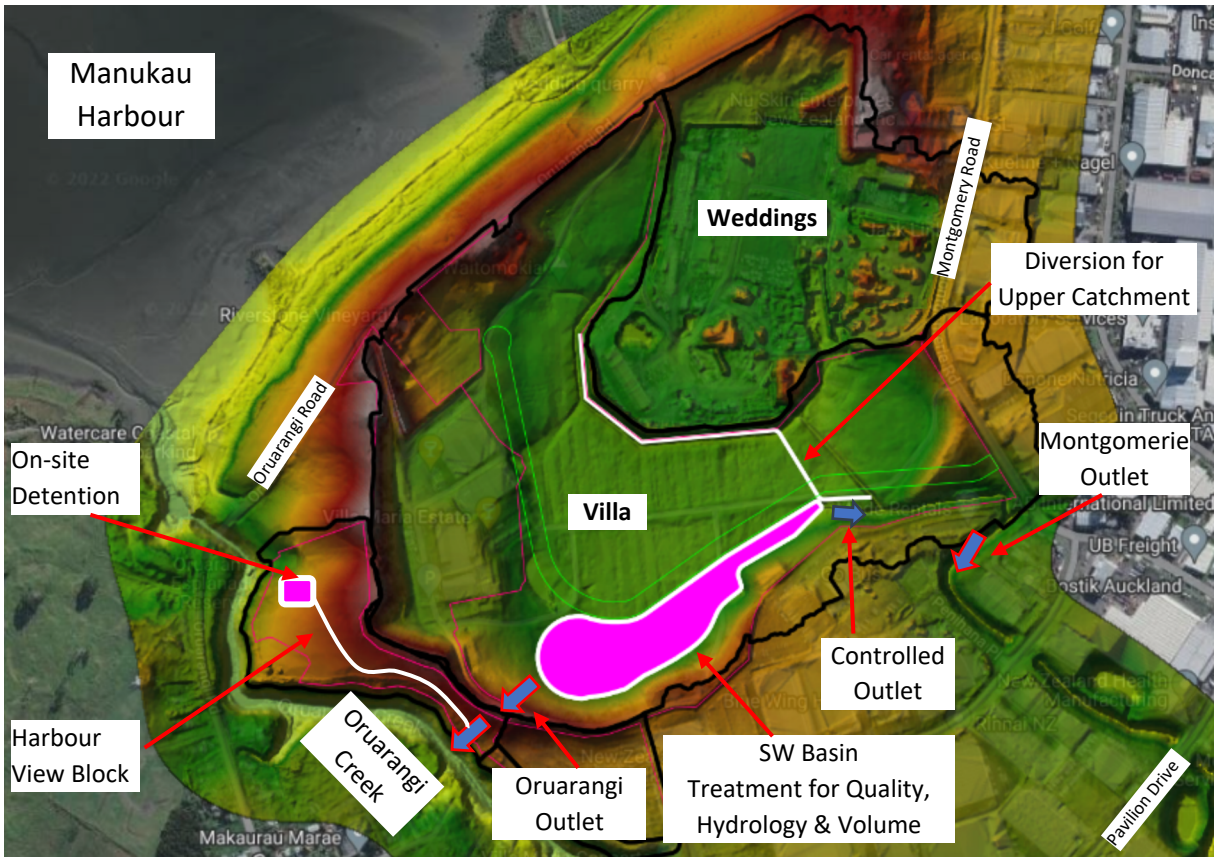


Figure 5: Detention Strategy – Two Outlet Options

3.4.3 Detention Distribution

Sub-Precinct A

Detention tank will be provided wholly onsite to service the new impervious areas, placed prior to the discharge point exiting the site boundaries.

Sub-Precinct B & C

Detention storage will be achieved within the central stormwater basin for all new impervious areas created within Sub-Precincts B & C. Preliminary analysis of the two outlet options under consideration indicate that storage volumes are viable with controlled outlet structures.

Sub-Precinct D

Precinct D consists of the existing buildings associated with the current winery operation on-site will be retained. Currently the stormwater from the existing buildings and impervious areas is routed through an existing stormwater pond that provides water quality and detention function. As this pond will be demolished to facilitate the future industrial development, its proposed to replicate the existing function and achieve the required detention in the new stormwater basin. Any new impervious areas created within Sub-Precinct D will achieve its detention obligations onsite.

3.4.4 Montgomerie Outlet

The Montgomerie outlet retains the existing discharge point into culverted drains under Montgomery Road. A controlled outlet will be placed internally within the site where the proposed stormwater basin interacts with the existing stream which will be retained in its current location.

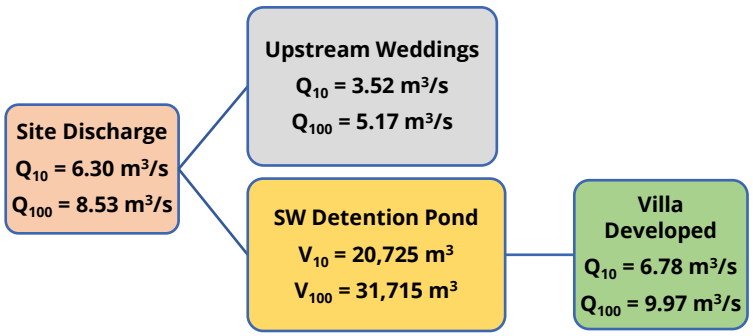


Figure 6: Montgomery Outlet Scenario Flows

Preliminary analysis of the Montgomerie discharge option shows that an appropriate level detention mitigation can be provisioned.

3.4.5 Oruarangi Outlet

This option proposes a new outlet to the Oruarangi Creek to be created. The Montgomerie Outlet will be maintained to service the upstream catchment. The new outlet will be placed under the crater rim through trenchless installation methods to discharge to the Oruarangi Creek via controlled discharge point. The upstream inlet point of the new pipe system will be controlled to ensure the appropriate level of peak flow mitigation is provided.

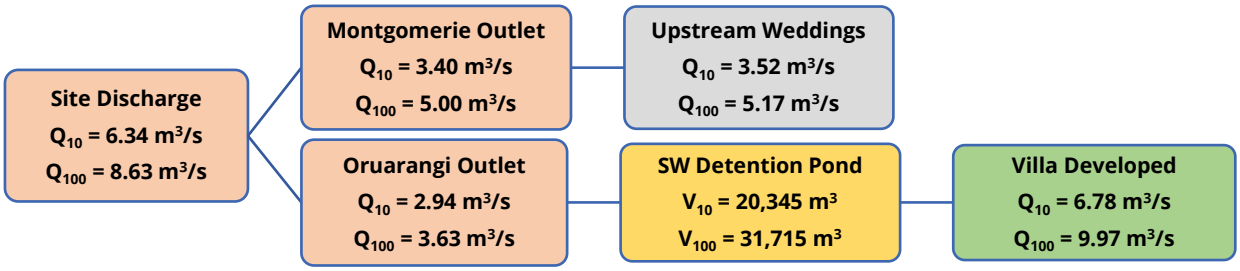


Figure 7: Oruarangi Outlet Scenario Flows

Preliminary analysis of the Oruarangi discharge option shows that an appropriate level of detention mitigation can be provisioned.

3.5 Flow Management

The stormwater and overland flows within the proposed site will need to be managed appropriately to control surface water and mitigate local nuisance flooding.
The stormwater flow management requirements for the development are:

- Primary (piped) private stormwater systems are designed to accommodate the 10% AEP storm event. Any new infrastructure conveying flows from the development must be able to convey these flows without causing flooding or nuisance.
- Secondary systems are designed to accommodate the 1% AEP storm event. The secondary systems within the property are the overland flow paths.

The development increases the impervious coverage from the existing baseline and is within permitted limits generally considered as the Maximum Probable Development (MPD). The increase in imperviousness will create additional run-off, however, given the proposal for a new outfall into Oruarangi Creek, considerations regarding downstream capacity issues are not required.

For events greater than the 10% AEP, up to the 1% AEP, flows will be conveyed as overland flow, typically within the accessways and yards. At key locations, additional inlet capacity over and above the 1% AEP may be provided to manage flood risks. Flooding and overland flow path management is further expanded upon in Section 3.7.

3.6 Upper Catchment Flow Diversion

The upper catchment of the Waitomokia Crater (predominantly consisting of the Weddings parcels) will be diverted to the existing Montgomerie Outlet under either discharge options. The diversion system will maintain the existing hydrology of the site and the discharge locations in relation to the upper catchment through formalised channels at the northern boundary and a pipeline discharge to the internal stream.

3.7 Flooding and Overland Flowpaths

In the event of the 1% AEP storm, the general requirement of a development is that there be no increase in flooding, potential or nuisance downstream, or flooding of habitable floor levels due to an increase in peak flows and volume. It should be noted that for the Oruarangi Outlet option, there are no buildings at risk of flooding as the creek channel is incised and the outlet is located sufficiently adjacent to the Manukau Harbour.

The site is at risk of flooding generally associated with stormwater generated within the crater catchment and an existing limited outlet to Montgomerie Road infrastructure. The character of the flooding is ponding where the surface waters build up at the low point within the crater can be managed accordingly, provided sufficient outlet flow conditions are met.

The site is also subject to localised flooding from minor overland flowpaths (OLFP) which represent a sheet flow condition to the local. Site visits have confirmed that OLFPs within the site are not channelised (linear flow) and rather represent a sheet flow condition (dispersal over a wider area).

A 2D flood model was created using Geo HEC-RAS to assess the overland flow paths which will be re-directed. This model will be used in the future management of stormwater on the site and to inform proposed level design to ensure efficient and safe conveyance of surface flows. The proposed development will be of a commercial nature and therefore will not be subject to freeboard clearance requirement as per the Building Code. However, as best practise, the sufficient clearance between the finished floor level to the adjacent overland flowpaths is recommended.

3.7.1 E36 - Flood Risk Hazard – Preliminary Assessment

Due to the proposed alteration of a minor overland flowpaths and proposed flood storage measures, a preliminary flood risk hazard assessment in accordance with the provisions of AUP E36 has been undertaken as follows:

(a) The frequency, duration and scale of the flooding hazard:
The site is subject to a flooding hazard due the crater bowl landform. The proposed works will formalise the existing landform in shape, level and increase imperviousness and therefore will impact the flood hazard. The introduction of a formalised flood detention storage basin with control outlets will much manage the flood hazards to lower areas of the crater.
Level of Assessed Risk: Medium

(b) The type of activity being undertaken and its vulnerability to flooding events:
The proposed development maintains the existing commercial use character of the site. The development and surrounding areas are defined as "less vulnerable activities' and are industrial activities. The minimum floor level of the future buildings is set at a level to account for floodplains and overland flow paths. The entry and exit points of overland flow paths are maintained or diverted to minimise effects. Commercial buildings are not required to have freeboard clearance from flooding or OLFPs, however as best practise, an appropriate level of protection from OLFPs and flood storage level will be provided.
Level of Assessed Risk: Low

(c) The consequences of a flooding event in relation to the proposed activity and the people likely to be involved in that activity:
There will be temporary flooding on site which will drain down over a period of 1 hour. The people likely to be affected are carpark/open area users as the carpark will temporarily flood in a major storm event.
Level of Assessed Risk: Low

(d) The potential effects on public safety and on other property:
Carpark areas are generally designed to flood in 1% AEP events to an acceptable depth. This will cause some inconvenience to users however is not a safety issue as the ponded water in carparks will eventually drain and the depths, flow and velocity will be designed to be within acceptable ranges. The new surface levels will be designed to ensure appropriate and efficient conveyance of any flood waters resulting from OLFPs.
Level of Assessed Risk: Low

(e) Any exacerbation of an existing flooding hazard risks or creation of a new flooding hazard risk:

The new surface levels will be designed to ensure appropriate conveyance is provided that doesn't exacerbate or create a flood risk to the new and existing buildings adjacent to the OLFPs and central basin.
Level of Assessed Risk: Low

(f) The design and construction of buildings and structures to mitigate the effects of flooding:
Buildings will be located outside of flood plains and overland flow paths. Overland flow paths will be concentrated within accessways and carparks.
Level of Assessed Risk: Low

(g) Site layout and management to avoid or mitigate the adverse effects of flooding hazard, including access and exit during a flooding event:
The site has a layout to avoid flooding of any buildings on site.
Level of Assessed Risk: Low

(h) Any measures and/or plans proposed to mitigate the flooding hazard or the effects of the flooding hazard:
All stormwater pipes on site will be sized to cater for 10% AEP storm flows. Overland flow paths will be designed to convey the 1% AEP storm flows and the earthworks design has been designed to minimise flood risk.
Level of Assessed Risk: Low

3.8 Summary – Site Specific Stormwater Management Approach

The overarching solution adequately addresses the stormwater management issues associated with development, including stormwater conveyance, hydrological mitigation, flooding, erosion, and water quality. Refinement of the overall solution as presented at the RC stage was undertaken in the detailed design phase in accordance with the approved SMP report to ensure the outcomes of this Stormwater Management Plan are achieved.

The following stormwater requirements will be implemented within the Plan Change Area:

- All new buildings will use low contaminant-generating roofing material.
- All proposed hard stand areas and carparks within the site will be provided with stormwater quality treatment via appropriately sized proprietary stormwater filtration devices (approved Auckland Council device).
- Provision for hydrological mitigation (retention and detention) with a reuse tank and detention tanks.
- Installation of a private stormwater pipe network to convey the 10% AEP storm. Note all new stormwater assets within the site will be retained in private ownership including the treatment devices.
- Preference for overland flow paths to be concentrated in accessways.

Table 1.9 Stormwater Management Measures – Compliance & Design Requirements			
Component	**Minimum requirements**	**Recommended approaches**	**Design Guidelines**
Water Quality	- Stormwater management of runoff from all impervious surfaces before discharging into the receiving environment - Assessment under ITA rules for activities listed as high risk in Schedule 3 (lot specific requirements)	- At source treatment - Treatment train approach - Bioretention devices with additional detention benefits is preferred. - Consider additional requirements of Auckland Transport for stormwater devices in the road corridor	- Auckland Council GD01 - Auckland Council GD04 - Auckland Council - Unitary Plan stormwater management provisions TR2013/35
Stream Hydrology	- Detention for the difference in the runoff volume from the pre-development and post-development 95th percentile 24-hour rainfall event, excluding any retention that is achieved. - Retention of 5 mm runoff depth from all impervious areas, if practicable.	- Stormwater retention is achieved through tanks, where practicable - Detention is achieved through bioretention devices that have additional water quality benefits. - Riparian margin enhancement and planting	- Auckland Council GD01
Water Quantity	- Detention for the mitigation of flood events due to impervious area increase	- Peak flow mitigation for the 10% and 1% AEP storm events	- Auckland Council Stormwater Code of Practise
Erosion protection	- Required at all stormwater outlets into the receiving environment	- Green outfall designs are used where practicable. - Location of stormwater outfalls outside of SEA	- Auckland Council TR2013/018
Stormwater conveyance	- Convey runoff generated from the 10-year ARI through the stormwater network to the receiving environment. - Allowance for runoff flows greater than the 10-year ARI should be made in overland flow paths	- Green infrastructure is used where practicable. - Protection of overland flow paths	- Auckland Council GD01 - Auckland Council GD04 - Auckland Council Stormwater Code of Practice
Development staging	- Erosion and sediment control plans to be in place prior to development construction	- No impacts on existing stormwater/stream structures	- Auckland Council GD05

3.9 Stormwater Management Response to Precinct Provisions

The Waitomokia Plan Change proposes specific stormwater management provisions which targets development outcomes to enhance water quality and the health of the Ōruarangi Awa. These provisions, detailed in planning reports, focus on objectives for water quality improvement, roofing material selection, central stormwater basin establishment, and water harvesting. The stormwater management plan outlined in this report aligns with the proposed precinct provisions, thus addressing it's objectives. The detailed mitigation strategy contained in this report confirms the ability to meet the precinct provisions' objectives and intentions.

3.10 SMP Implementation

3.10.1 Staging/Timing

The staging of the development in terms of construction is currently being investigated. However, a substantial earthworks phase is expected due to pre-loading requirements after which the site development works will commence. Prior to the proposed implementation of the new impervious surfaces, the recommendations of WPC SMP will be utilised to develop a comprehensive SMP which will include the necessary details for the proposed devices.

3.10.2 Ongoing Ownership Maintenance and Management Responsibilities

It is envisaged that all new stormwater infrastructure and the associated operation and maintenance within site will remain private, barring the new pipeline connection to Oruarangi Creek. The operation, maintenance and monitoring requirements shall be determined during the detailed design stages.

4 Conclusion

This SMP provides a robust means of stormwater management to enable the Waitomokia Plan Change. The SMP demonstrates that the proposed stormwater management measures are the best practical option, taking into consideration the existing site features and nature of the development whilst responding to the cultural, spiritual, and natural landscape of the site.

The following table summarises the proposed stormwater management measures for the Waitomokia Plan Change.

Table 1.10 Summary of Proposed Stormwater Management	
Schedule 4 Land Use type	Brownfield over 5000m^2
Overall Hydrological Management Strategy	5mm retention and 95th percentile rainfall detention with onsite and centralised devices.
Overall Stormwater Quality Strategy	Treatment of all impervious HCGA surface areas with onsite and centralised devices. Use of inert roof and building cladding material
Overall Stormwater Quantity	Peak flow mitigation to pre-development baseline with the provision of detention storage in the central basin for the 10% and 1% AEP storm events.
Stormwater Management Distribution – Precinct Specific	
Sub-Precinct A – Harbour View Block (Single Lot)	100% at source (refer to toolbox) for hydrological mitigation, water quality and quantity

Sub-Precinct B - Villa Treatment Train Approach (Multiple Lots)	<u>Lots & Internal Roads:</u>
	- Hydrological & Water Quality Mitigation:
	  o 70% onsite (refer to toolbox)
	  o 30% central basin
	- Stormwater Quantity Q10 and Q100
	  o 100% central basin

Sub – Precinct C Commercial & Community Zone (Single Lot)	- Hydrological & Water Quality Mitigation:
	  o 70% onsite (refer to toolbox)
	  o 30% central basin
	- Stormwater Quantity Q10 and Q100
	  o 100% central basin

Sub – Precinct D Existing Buildings (Single Lot)	<u>Existing Impervious Areas</u>
	- Water Quality Mitigation (based on existing use):
	  o 100% central basin
	- Stormwater Quantity Q10 and Q100
	  o 100% central basin
	
	<u>New Impervious Areas</u>
	100% at source for hydrological mitigation, water quality and quantity.
	
	<u>Specific Contaminants Resulting from New Use</u>
	100% at source for water quality for any specific treatment triggered by new use of the existing impervious areas

Riparian Management	Maintain and improve 10m wide buffer either side of and stream edge
Primary Network	Underground stormwater drainage network designed for 10yr ARI rainfall event
Secondary Network	Overland flowpaths designed for 100yr ARI rainfall event

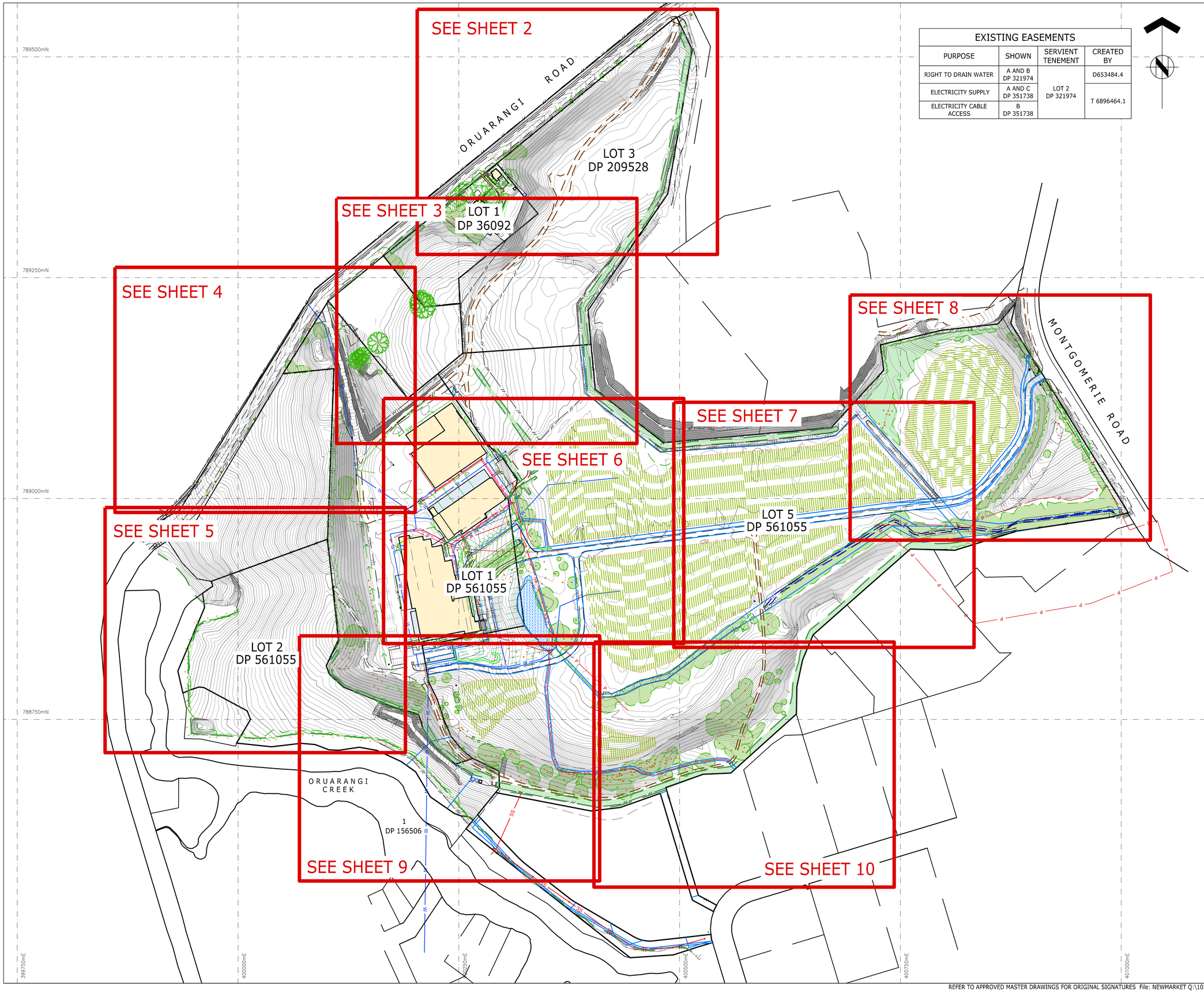
The proposed stormwater management measures as outlined in this SMP achieves best practice that is consistent with the target outcomes of the AUP and NDC as well compliance with prescribed guidelines for the Auckland Region. This SMP can form part of the assessment of future detailed designs to ensure that the design intent and mitigation philosophy of stormwater management has been retained.

5 Limitations

This report has been compiled for use by the developer and their consultant team directly involved with the project in relation to this site. The report will be used to support the development approval processes as part of an overall submission package. The report should not be used or relied upon for any other developments.

The report has been prepared for this specific project as described to Sertus and its extent is limited to the scope of work agreed between the parties. The assessment contained herein is largely desktop based relying on survey and architectural data provided, along with services information from Before U Dig including GIS data obtained from the Auckland Council GIS Viewer GeoMaps. All third-party information is considered current at the time of this document's production. No responsibility is accepted by Sertus for the accuracy of information from third party sources and/or the use of any part of this report in any other context or for purposes other than intended.

Appendix A - Topographical Survey Plan



EXISTING EASEMENTS			
PURPOSE	SHOWN	SERVIENT TENEMENT	CREATED BY
RIGHT TO DRAIN WATER	A AND B DP 321974	LOT 2 DP 321974	D653484.4
ELECTRICITY SUPPLY	A AND C DP 351738		T 6896464.1
ELECTRICITY CABLE ACCESS	B DP 351738		

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NOTES

1. LEVELS ARE IN TERMS OF AUCKLAND VERTICAL DATUM 1946
   ORIGIN OF LEVELS
   RM 7088 SO 63059
   RL 27.23
2. COORDINATES ARE IN TERMS OF MT EDEN CIRCUIT 2000
   ORIGIN OF COORDINATES
   RM 7088 SO 63059
   787805.79 mN
   399122.53 mE
3. CONTOURS ARE AT 0.20m INTERVALS. CONTOURS SHOWN ON THIS PLAN HAVE BEEN ELECTRONICALLY COMPUTED FROM SPOT HEIGHT DETERMINATIONS AND MAY NOT REPRESENT THE TRUE GROUND LEVELS. ANY CRITICAL HEIGHTS SHOULD BE CHECKED ON SITE PRIOR TO DESIGN AND CONSTRUCTION COMMENCING.
4. THIS PLAN HAS BEEN CARRIED OUT TO TOPOGRAPHICAL STANDARDS. ALL LEVELS SHOWN ARE CORRECT AT TIME OF SURVEY. CRITICAL DIMENSIONS AND LEVELS SHOULD BE VERIFIED.
5. BOUNDARIES SHOWN ON THIS PLAN HAVE BEEN ADOPTED FROM DP 561055, DP 209528 AND DP 36092 AND HAVE NOT BEEN SURVEYED. A BOUNDARY DEFINITION SURVEY SHOULD BE CARRIED OUT TO ESTABLISH EXACT BOUNDARY POSITIONS ON SITE.
6. ALL EASEMENTS, COVENANTS AND OTHER LEGAL INSTRUMENTS ASSOCIATED WITH THIS SITE MAY NOT BE SHOWN ON THIS PLAN. AN INVESTIGATION OF THE MOST CURRENT LEGAL RECORDS SHOULD BE UNDERTAKEN PRIOR TO DESIGN AND CONSTRUCTION COMMENCING.
7. SERVICES POSITIONS AND ALIGNMENT MAY HAVE BEEN OBTAINED FROM THIRD PARTY RECORDS AND SHOULD BE VERIFIED ON SITE PRIOR TO CONSTRUCTION COMMENCING. HARRISON GRIERSON DOES NOT IN ANY WAY GUARANTEE THE ACCURACY OF ANY UNDERGROUND SERVICE SHOWN ON THIS PLAN.
8. THIS PLAN MAY NOT PROVIDE ENOUGH INFORMATION FOR HEIGHT TO BOUNDARY CALCULATIONS. WHERE ANY PROPOSED BUILDING OR PART THEREOF IS REQUIRED TO MEET COUNCIL'S HEIGHT IN RELATION TO BOUNDARY CONTROLS, HARRISON GRIERSON SHOULD BE CONSULTED.
9. THESE NOTES ARE AN INTEGRAL PART OF THIS PLAN.
10. THIS PLAN IS ISSUED FOR A SPECIFIC PROJECT AND MAY NOT BE ALTERED OR USED FOR ANY OTHER PURPOSE WITHOUT THE PRIOR WRITTEN CONSENT OF HARRISON GRIERSON.
11. INDIVIDUAL SPOT HEIGHTS HAVE BEEN TURNED OFF ON THE PDF FOR CLARITY. PLEASE REFER TO THE DWG FILE FOR MORE INFORMATION.
12. LEGAL DESCRIPTION
    LOT 1 AND 2 DP 561055, LOT 3 DP 209528, LOT 1 DP 36092, AND LOT 5 DP 561055
    COMPRISED IN RT'S 991746, 991749, NA137B/839 AND NA934/268
    TOTAL AREA 40.9886ha

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B	CREEK SURVEY ADDED TO SHEETS 7 AND 8	SJW	29.09.22
A	CLIENT ISSUE	SJW	29.06.22

PROJECT:

GOODMAN NOMINEE
VILLA MARIA, MONTGOMERIE ROAD
MANGERE

TITLE:

2022 SITE SURVEY
OVERALL PLAN
SHEET 1 OF 10

ORIGINATOR: MJS	DATE: 20.06.22	SIGNED:	PLOT BY: HSJ
DRAWN: HSJ	DATE: 20.06.22	SIGNED:	PLOT DATE: 23.05.23
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- BANK BOTTOM
- DRIPLINE
- EDGE OF SEAL
- FENCE
- EDGE OF METAL
- KERB AND CHANNEL
- GRAPEVINES
- HEDGES
- SHELTER BELTS
- DRAIN
- POWER UNDERGROUND
- SANITARY SEWER
- SANITARY SEWER - TRADE WASTE
- STORMWATER
- SUB SURFACE DRAINAGE
- TELECOM
- WATERMAIN
- SS MANHOLE
- SW MANHOLE
- MANHOLE (UNKNOWN)
- CESSPIT
- GULLY TRAP
- FIRE HYDRANT
- VALVE
- WATER METER
- GAS BOX
- POWER BOX
- TELECOM PLINTH
- CHAMBER
- POWER POLE
- STREET LIGHT
- BOLLARD LIGHT
- GROUND LIGHT
- FENCE POST
- SIGN
- TREE
- TREE TRUNK
- POSTS
- IRRIGATION SPRINKLER
- FLOOR LEVEL

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GOODMAN NOMINEE
VILLA MARIA, MONTGOMERIE ROAD
MANGERE

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TITLE:

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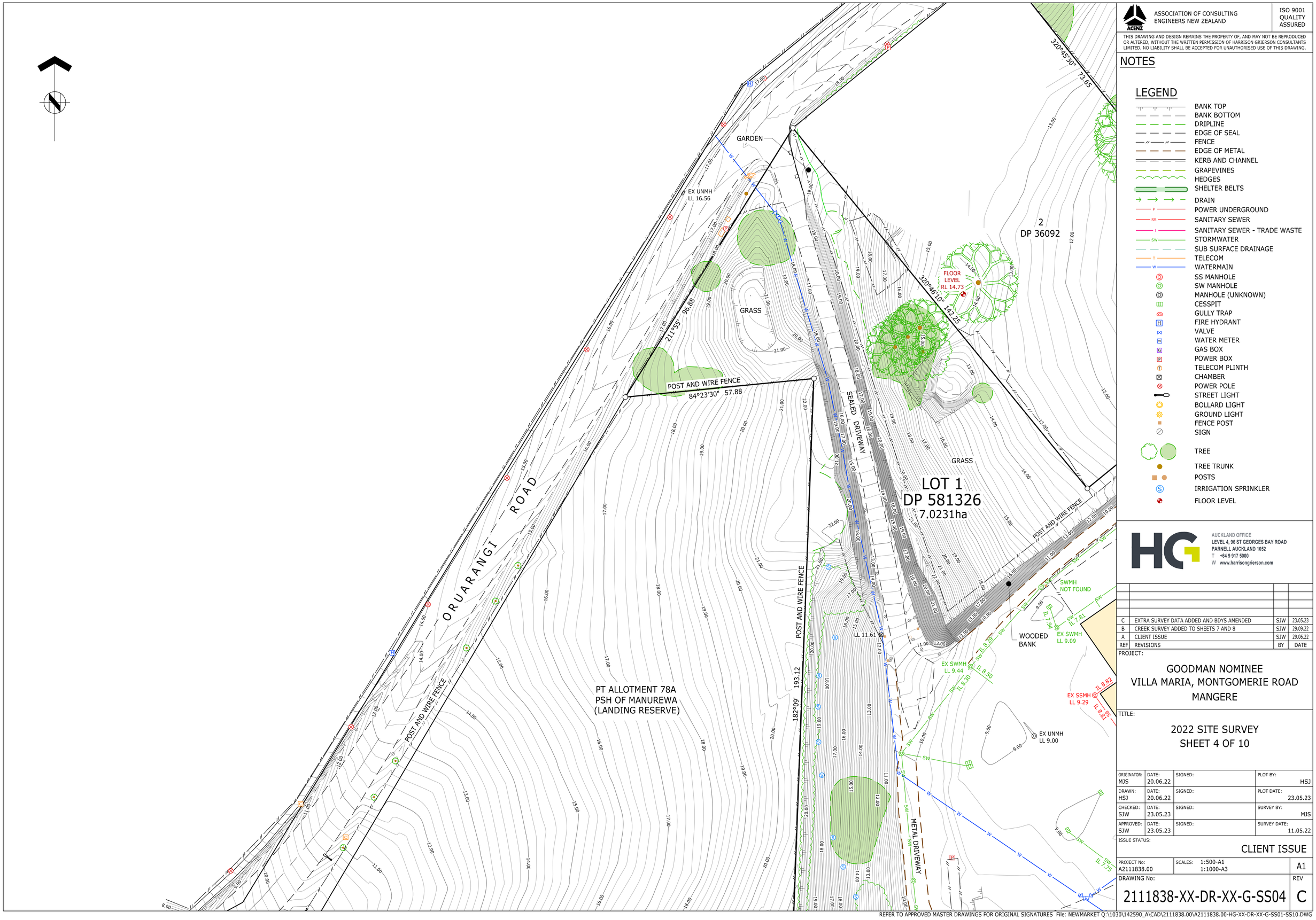

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SHEET 4 OF 10

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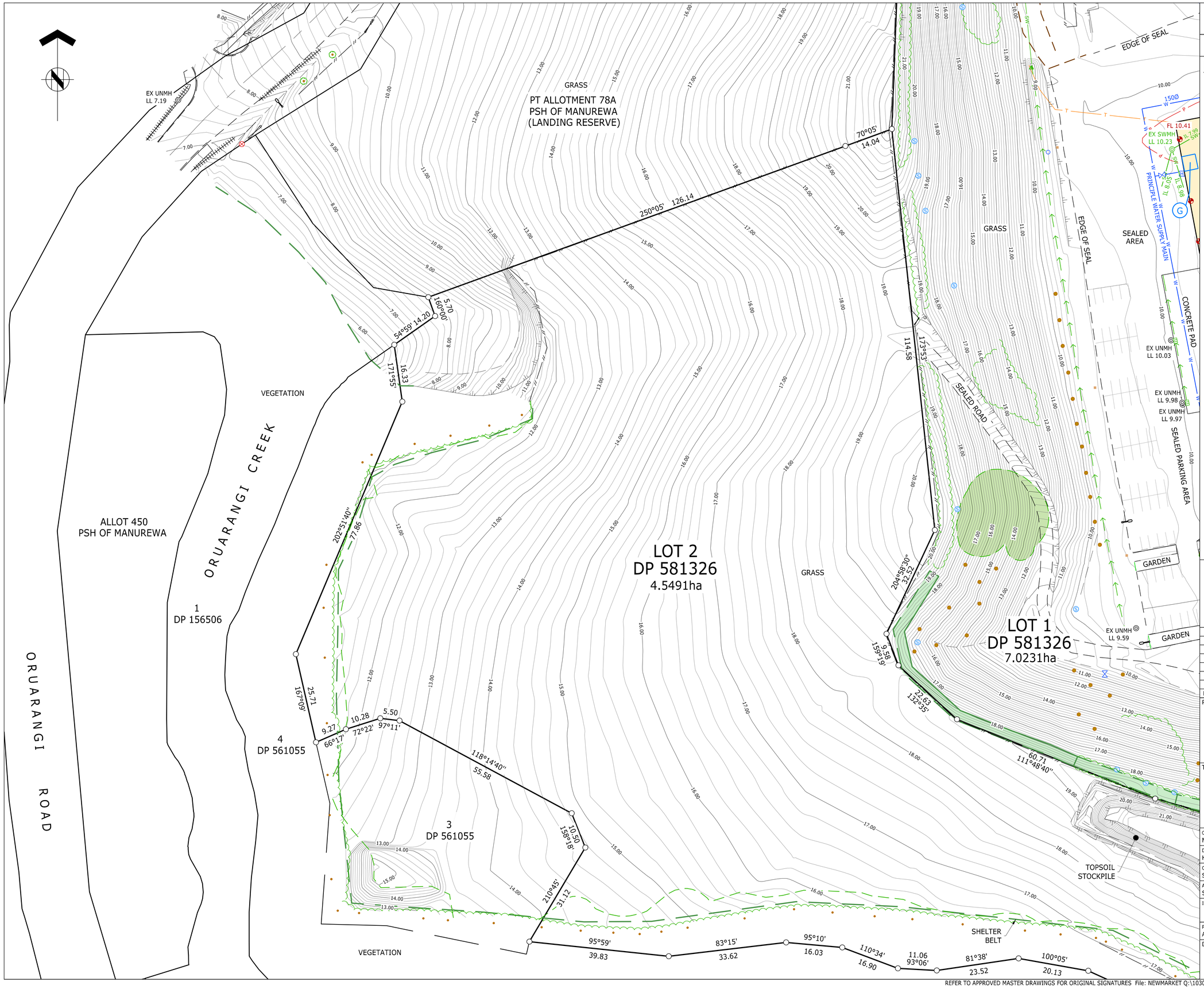

ASSOCIATION OF CONSULTING ENGINEERS NEW ZEALAND

ISO 9001 QUALITY ASSURED

NOTES

LEGEND

- BANK TOP
- BANK BOTTOM
- DRIPLINE
- EDGE OF SEAL
- FENCE
- EDGE OF METAL
- KERB AND CHANNEL
- GRAPEVINES
- HEDGES
- SHELTER BELTS
- DRAIN
- POWER UNDERGROUND
- SANITARY SEWER
- SANITARY SEWER - TRADE WASTE
- STORMWATER
- SUB SURFACE DRAINAGE
- TELECOM
- WATERMAIN
- SS MANHOLE
- SW MANHOLE
- MANHOLE (UNKNOWN)
- CESSPIT
- GULLY TRAP
- FIRE HYDRANT
- VALVE
- WATER METER
- GAS BOX
- POWER BOX
- TELECOM PLINTH
- CHAMBER
- POWER POLE
- STREET LIGHT
- BOLLARD LIGHT
- GROUND LIGHT
- FENCE POST
- SIGN
- TREE
- TREE TRUNK
- POSTS
- IRRIGATION SPRINKLER
- FLOOR LEVEL

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REF	REVISIONS	BY	DATE
C	EXTRA SURVEY DATA ADDED AND BDYS AMENDED	SJW	23.05.23
B	CREEK SURVEY ADDED TO SHEETS 7 AND 8	SJW	29.09.22
A	CLIENT ISSUE	SJW	29.06.22

PROJECT:

GOODMAN NOMINEE
VILLA MARIA, MONTGOMERIE ROAD
MANGERE

TITLE:

2022 SITE SURVEY
SHEET 5 OF 10

ORIGINATOR: MJS	DATE: 20.06.22	SIGNED:	PLOT BY: HSJ
DRAWN: HSJ	DATE: 20.06.22	SIGNED:	PLOT DATE: 23.05.23
CHECKED: SJW	DATE: 23.05.23	SIGNED:	SURVEY BY: MJS
APPROVED: SJW	DATE: 23.05.23	SIGNED:	SURVEY DATE: 11.05.22

ISSUE STATUS: CLIENT ISSUE

PROJECT No:	SCALES:	
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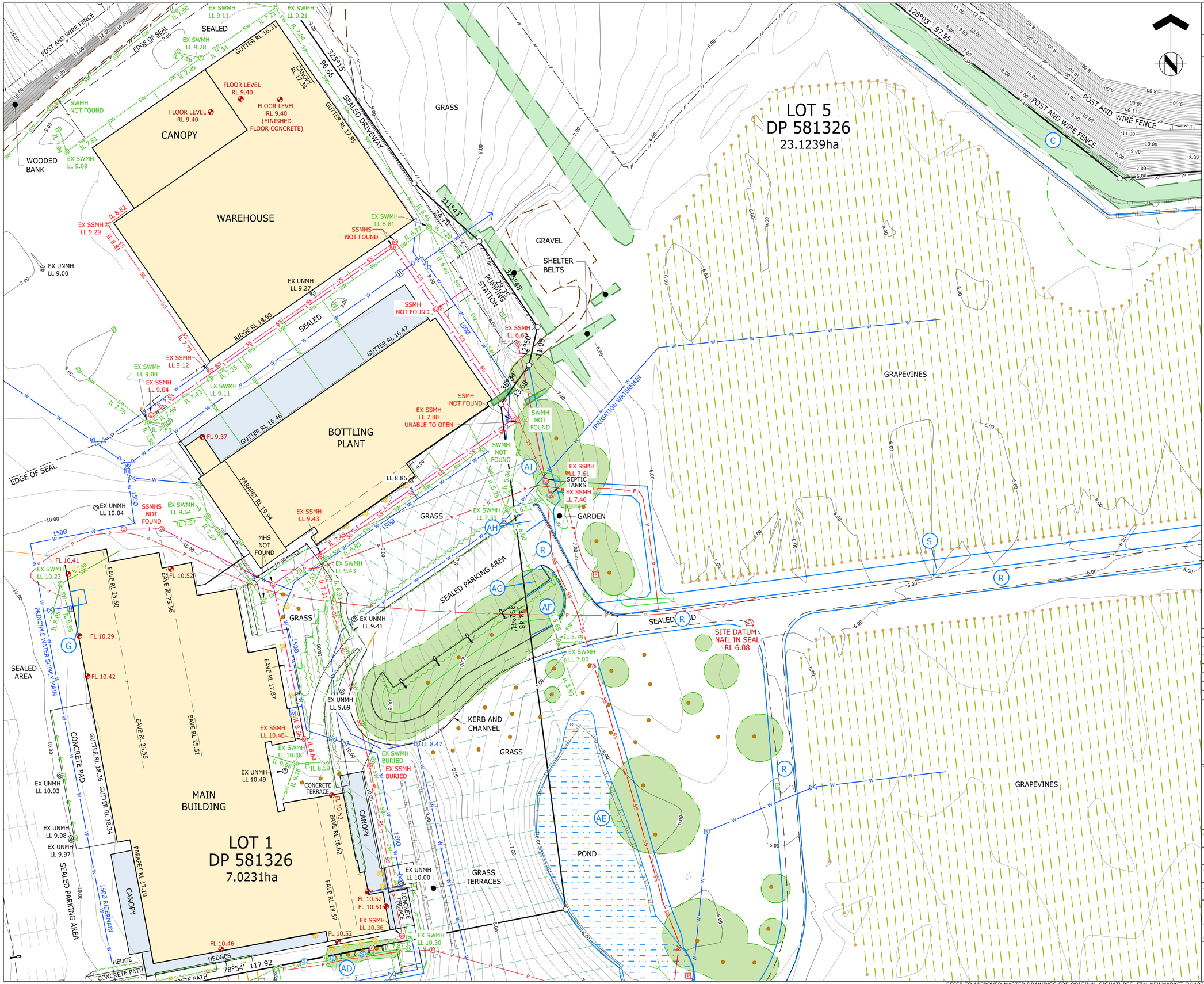
DRAWING No: 2111838-XX-DR-XX-G-SS05 REV C



ASSOCIATION OF CONSULTING ENGINEERS NEW ZEALAND

ISO 9001 QUALITY ASSURED

NOTES

LEGEND

- BANK TOP
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- DRIPLINE
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REF	REVISIONS	BY	DATE

PROJECT:

GOODMAN NOMINEE
VILLA MARIA, MONTGOMERIE ROAD
MANGERE

TITLE:

2022 SITE SURVEY
SHEET 6 OF 10

ORIGINATOR: MJS	DATE: 20.06.22	SIGNED:	PLOT BY: HSJ
DRAWN: HSJ	DATE: 20.06.22	SIGNED:	PLOT DATE: 23.05.23
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ISSUE STATUS: CLIENT ISSUE

PROJECT No: A2111838.00	SCALES: 1:500-A1 1:1000-A3	A1
DRAWING No: 2111838-XX-DR-XX-G-SS06		REV C

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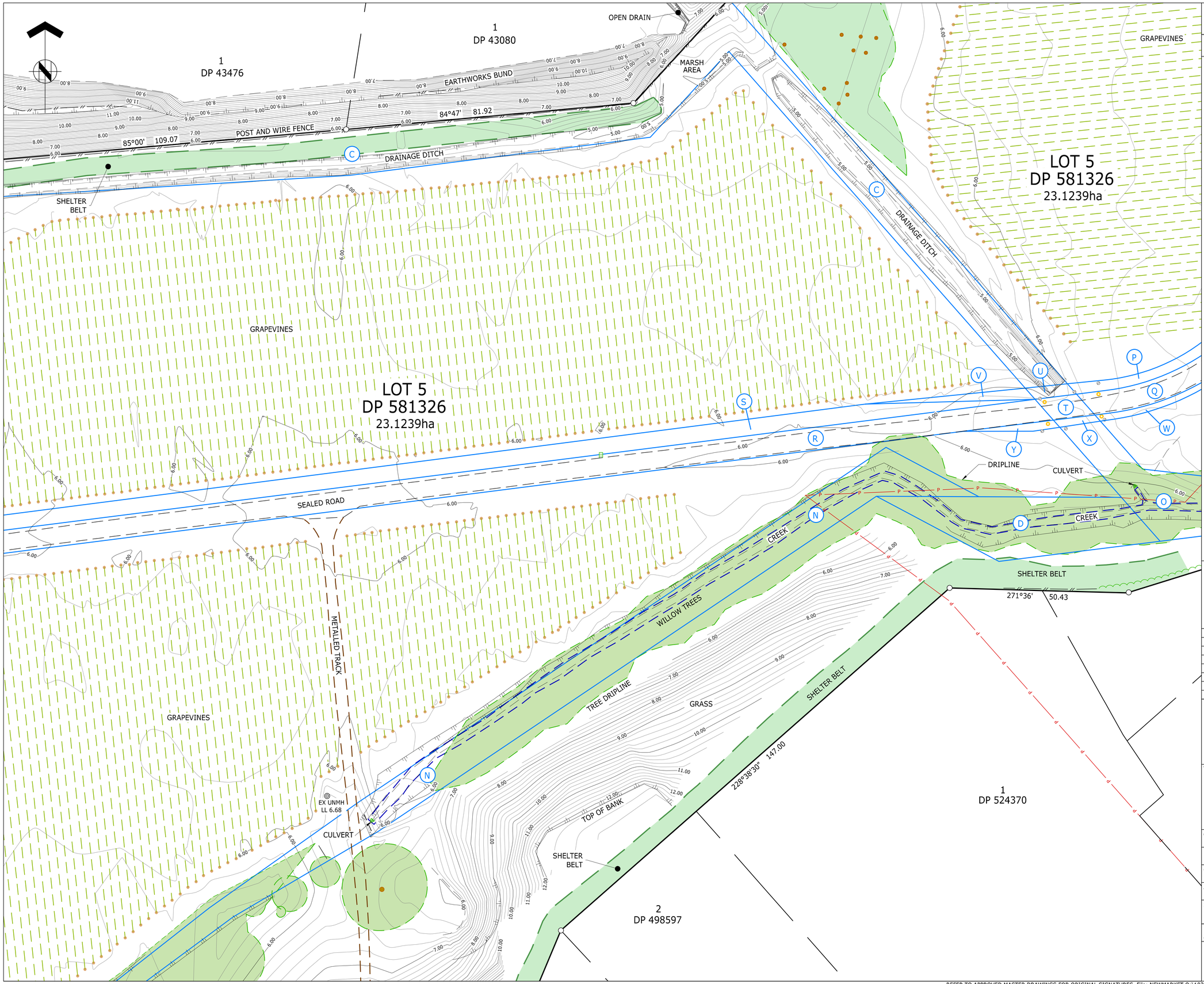

ASSOCIATION OF CONSULTING ENGINEERS NEW ZEALAND

ISO 9001 QUALITY ASSURED

NOTES

LEGEND

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- DRIPLINE
- EDGE OF SEAL
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A	CLIENT ISSUE	SJW	29.06.22
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PROJECT:

GOODMAN NOMINEE
VILLA MARIA, MONTGOMERIE ROAD
MANGERE

TITLE:

2022 SITE SURVEY
SHEET 7 OF 10

ORIGINATOR: MJS	DATE: 20.06.22	SIGNED:	PLOT BY: HSJ
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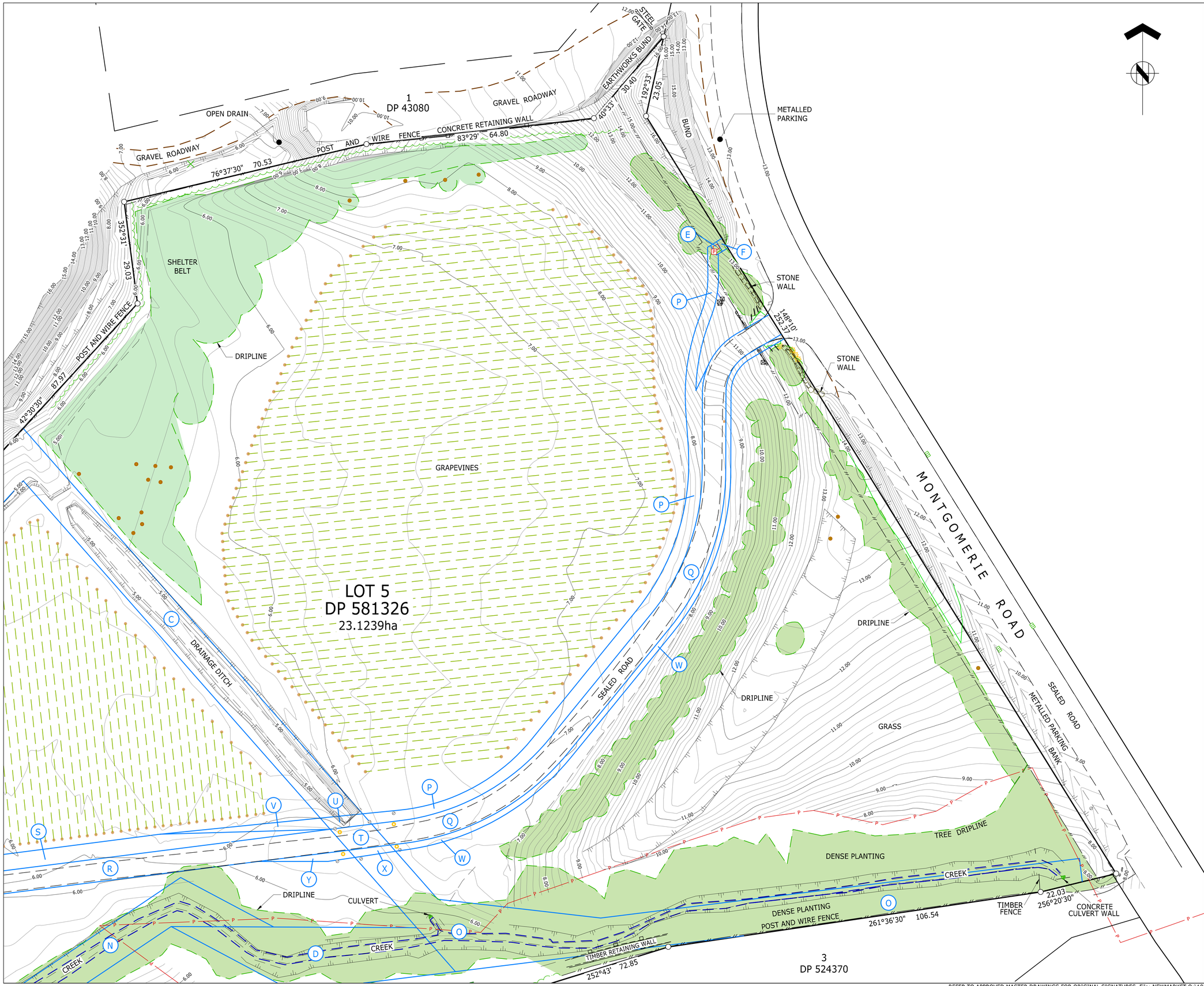
ISSUE STATUS: CLIENT ISSUE

PROJECT No: A2111838.00	SCALES: 1:500-A1 1:1000-A3	A1
DRAWING No: 2111838-XX-DR-XX-G-SS07		REV C



ASSOCIATION OF CONSULTING ENGINEERS NEW ZEALAND

ISO 9001 QUALITY ASSURED

NOTES

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A	CLIENT ISSUE	SJW	29.06.22

PROJECT:

GOODMAN NOMINEE
VILLA MARIA, MONTGOMERIE ROAD
MANGERE

TITLE:

2022 SITE SURVEY
SHEET 8 OF 10

ORIGINATOR: MJS	DATE: 20.06.22	SIGNED:	PLOT BY: HSJ
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APPROVED: SJW	DATE: 23.05.23	SIGNED:	SURVEY DATE: 11.05.22

ISSUE STATUS: CLIENT ISSUE

PROJECT No: A2111838.00 | SCALES: 1:500-A1, 1:1000-A3 | A1

DRAWING No: 2111838-XX-DR-XX-G-SS08 | REV C

ASSOCIATION OF CONSULTING ENGINEERS NEW ZEALAND

ISO 9001 QUALITY ASSURED

NOTES

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A	CLIENT ISSUE	SJW	29.06.22
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PROJECT:

GOODMAN NOMINEE
VILLA MARIA, MONTGOMERIE ROAD
MANGERE

TITLE:

2022 SITE SURVEY
SHEET 9 OF 10

ORIGINATOR: MJS	DATE: 20.06.22	SIGNED:	PLOT BY: HSJ
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ISSUE STATUS: CLIENT ISSUE

PROJECT No: A2111838.00	SCALES: 1:500-A1 1:1000-A3	A1

DRAWING No: 2111838-XX-DR-XX-G-SS09 | REV C

LOT 5
DP 581326
23.1239ha

1
DP 498597

2
DP 466893

1
DP 624366

1
DP 546096

WILLOW PLANTINGS
CREEK
EX SWMH
LL 5.51
METALLED TRACK
SHELTER BELT
GRAPEVINES
SECURITY FENCE
PAVILION DRIVE

30.91
202°44'
30.90
191°54'
30.91
181°05'
99.87
227°59'
31.29
267°30'
44.95
250°25'
47.90
250°25'
33.55
263°18'
126.38
343°13'30"
127.48
163°13'30"

ASSOCIATION OF CONSULTING ENGINEERS NEW ZEALAND
ISO 9001 QUALITY ASSURED

NOTES

LEGEND

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REF	REVISIONS	BY	DATE

PROJECT:

GOODMAN NOMINEE
VILLA MARIA, MONTGOMERIE ROAD
MANGERE

TITLE:

2022 SITE SURVEY
SHEET 10 OF 10

ORIGINATOR: MJS	DATE: 20.06.22	SIGNED:	PLOT BY: HSJ
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CHECKED: SJW	DATE: 23.05.23	SIGNED:	SURVEY BY: MJS
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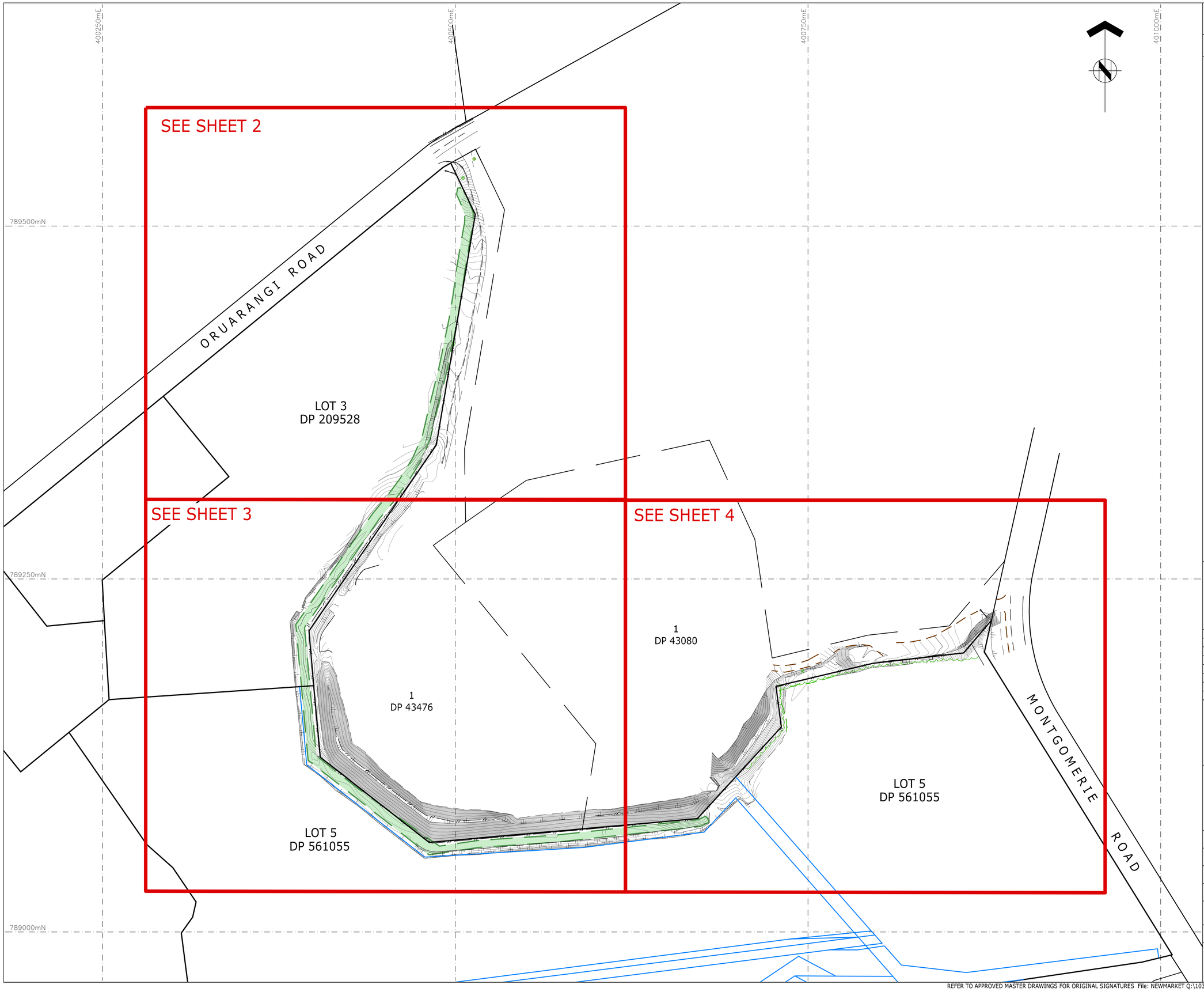
ISSUE STATUS: CLIENT ISSUE

PROJECT No: A2111838.00	SCALES: 1:500-A1 1:1000-A3	A1
DRAWING No: 2111838-XX-DR-XX-G-SS10		REV C



ASSOCIATION OF CONSULTING ENGINEERS NEW ZEALAND

ISO 9001 QUALITY ASSURED

NOTES

1. LEVELS ARE IN TERMS OF AUCKLAND VERTICAL DATUM 1946
   ORIGIN OF LEVELS
   RM 7088 SO 63059
   RL 27.23
2. COORDINATES ARE IN TERMS OF MT EDEN CIRCUIT 2000
   ORIGIN OF COORDINATES
   RM 7088 SO 63059
   787805.79 mN
   399122.53 mE
3. CONTOURS ARE AT 0.20m INTERVALS. CONTOURS SHOWN ON THIS PLAN HAVE BEEN ELECTRONICALLY COMPUTED FROM SPOT HEIGHT DETERMINATIONS AND MAY NOT REPRESENT THE TRUE GROUND LEVELS. ANY CRITICAL HEIGHTS SHOULD BE CHECKED ON SITE PRIOR TO DESIGN AND CONSTRUCTION COMMENCING.
4. THIS PLAN HAS BEEN CARRIED OUT TO TOPOGRAPHICAL STANDARDS. ALL LEVELS SHOWN ARE CORRECT AT TIME OF SURVEY. CRITICAL DIMENSIONS AND LEVELS SHOULD BE VERIFIED.
5. BOUNDARIES SHOWN ON THIS PLAN HAVE BEEN ADOPTED FROM DP 561055, DP 209528 AND DP 36092 AND HAVE NOT BEEN SURVEYED. A BOUNDARY DEFINITION SURVEY SHOULD BE CARRIED OUT TO ESTABLISH EXACT BOUNDARY POSITIONS ON SITE.
6. ALL EASEMENTS, COVENANTS AND OTHER LEGAL INSTRUMENTS ASSOCIATED WITH THIS SITE MAY NOT BE SHOWN ON THIS PLAN. AN INVESTIGATION OF THE MOST CURRENT LEGAL RECORDS SHOULD BE UNDERTAKEN PRIOR TO DESIGN AND CONSTRUCTION COMMENCING.
7. SERVICES POSITIONS AND ALIGNMENT MAY HAVE BEEN OBTAINED FROM THIRD PARTY RECORDS AND SHOULD BE VERIFIED ON SITE PRIOR TO CONSTRUCTION COMMENCING. HARRISON GRIERSON DOES NOT IN ANY WAY GUARANTEE THE ACCURACY OF ANY UNDERGROUND SERVICE SHOWN ON THIS PLAN.
8. THIS PLAN MAY NOT PROVIDE ENOUGH INFORMATION FOR HEIGHT TO BOUNDARY CALCULATIONS. WHERE ANY PROPOSED BUILDING OR PART THEREOF IS REQUIRED TO MEET COUNCIL'S HEIGHT IN RELATION TO BOUNDARY CONTROLS, HARRISON GRIERSON SHOULD BE CONSULTED.
9. THESE NOTES ARE AN INTEGRAL PART OF THIS PLAN.
10. THIS PLAN IS ISSUED FOR A SPECIFIC PROJECT AND MAY NOT BE ALTERED OR USED FOR ANY OTHER PURPOSE WITHOUT THE PRIOR WRITTEN CONSENT OF HARRISON GRIERSON.
11. INDIVIDUAL SPOT HEIGHTS HAVE BEEN TURNED OFF ON THE PDF FOR CLARITY. PLEASE REFER TO THE DWG FILE FOR MORE INFORMATION.
12. LEGAL DESCRIPTION
    LOT 1 AND 2 DP 561055, LOT 3 DP 209528, LOT 1 DP 36092, AND LOT 5 DP 561055
    COMPRISED IN RT'S 991746, 991749, NA137B/839 AND NA934/268
    TOTAL AREA 40.9886ha

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REF	REVISIONS	BY	DATE
A	CLIENT ISSUE	SJW	19.05.23

PROJECT:

GOODMAN NOMINEE
VILLA MARIA, MONTGOMERIE ROAD
MANGERE

TITLE:

SITE SURVEY
OVERALL PLAN
SHEET 1 OF 4

ORIGINATOR: MJS	DATE: 08.05.23	SIGNED:	PLOT BY: HSJ
DRAWN: HSJ	DATE: 12.05.23	SIGNED:	PLOT DATE: 23.05.23
CHECKED: SJW	DATE: 19.05.23	SIGNED:	SURVEY BY: MJS
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ISSUE STATUS: CLIENT ISSUE

PROJECT No:	SCALES:	
A2111838.00	1:1250-A1 1:2500-A3	A1

DRAWING No: 2111838-HG-XX-DR-XX-G-SS20 REV A

REFER TO APPROVED MASTER DRAWINGS FOR ORIGINAL SIGNATURES File: NEWMARKET Q:\1030\142590_A\CAD\2111838.00\A2111838.00-HG-XX-DR-XX-G-SS20-SS23.DWG

ASSOCIATION OF CONSULTING ENGINEERS NEW ZEALAND

ISO 9001 QUALITY ASSURED

LEGEND

- TOP OF WALL
- EDGE OF GRASS
- BANK TOP
- BANK BOTTOM
- DRIPLINE
- EDGE OF SEAL
- FENCE
- EDGE OF METAL
- KERB AND CHANNEL
- ROAD CROWN
- HEDGES
- SHELTER BELTS
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- CESSPIT
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PROJECT:

GOODMAN NOMINEE
VILLA MARIA, MONTGOMERIE ROAD
MANGERE

TITLE:

SITE SURVEY
SHEET 2 OF 4

ORIGINATOR: MJS	DATE: 08.05.23	SIGNED:	PLOT BY: HSJ
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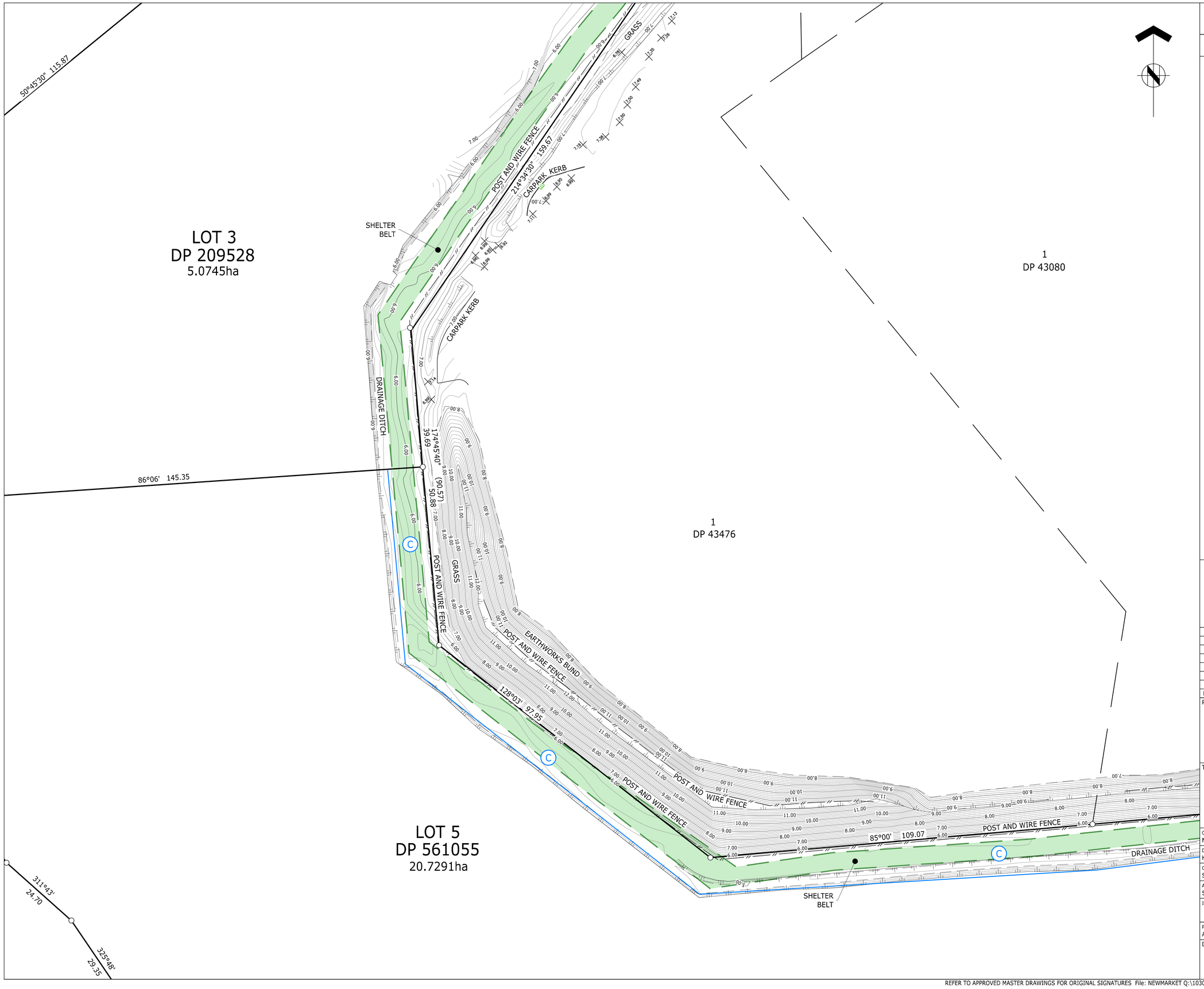
ISSUE STATUS: CLIENT ISSUE

PROJECT No:	SCALES:	
A2111838.00	1:500-A1 1:1000-A3	A1

DRAWING No: 2111838-HG-XX-DR-XX-G-SS21 REV A



ASSOCIATION OF CONSULTING ENGINEERS NEW ZEALAND

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PROJECT:

GOODMAN NOMINEE
VILLA MARIA, MONTGOMERIE ROAD
MANGERE

TITLE:

SITE SURVEY
SHEET 3 OF 4

ORIGINATOR: MJS	DATE: 08.05.23	SIGNED:	PLOT BY: HSJ
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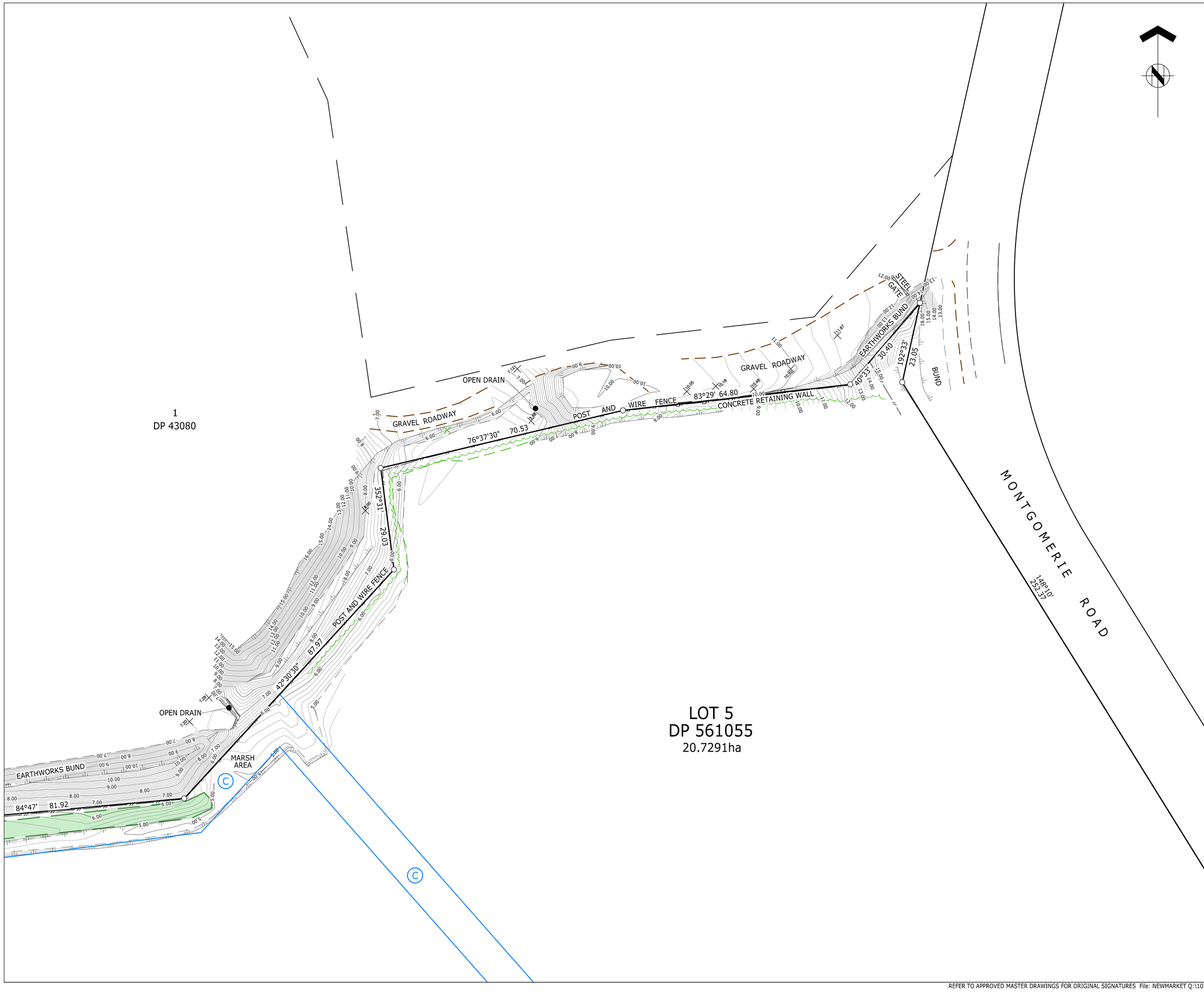
ISSUE STATUS: CLIENT ISSUE

PROJECT No:	SCALES:	
A2111838.00	1:500-A1 1:1000-A3	A1

DRAWING No: 2111838-HG-XX-DR-XX-G-SS22 REV A



ASSOCIATION OF CONSULTING ENGINEERS NEW ZEALAND

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PROJECT:

GOODMAN NOMINEE
VILLA MARIA, MONTGOMERIE ROAD
MANGERE

TITLE:

SITE SURVEY
SHEET 4 OF 4

ORIGINATOR: MJS	DATE: 08.05.23	SIGNED:	PLOT BY: HSJ
DRAWN: HSJ	DATE: 12.05.23	SIGNED:	PLOT DATE: 23.05.23
CHECKED: SJW	DATE: 19.05.23	SIGNED:	SURVEY BY: MJS
APPROVED: SJW	DATE: 19.05.23	SIGNED:	SURVEY DATE: 08.05.23

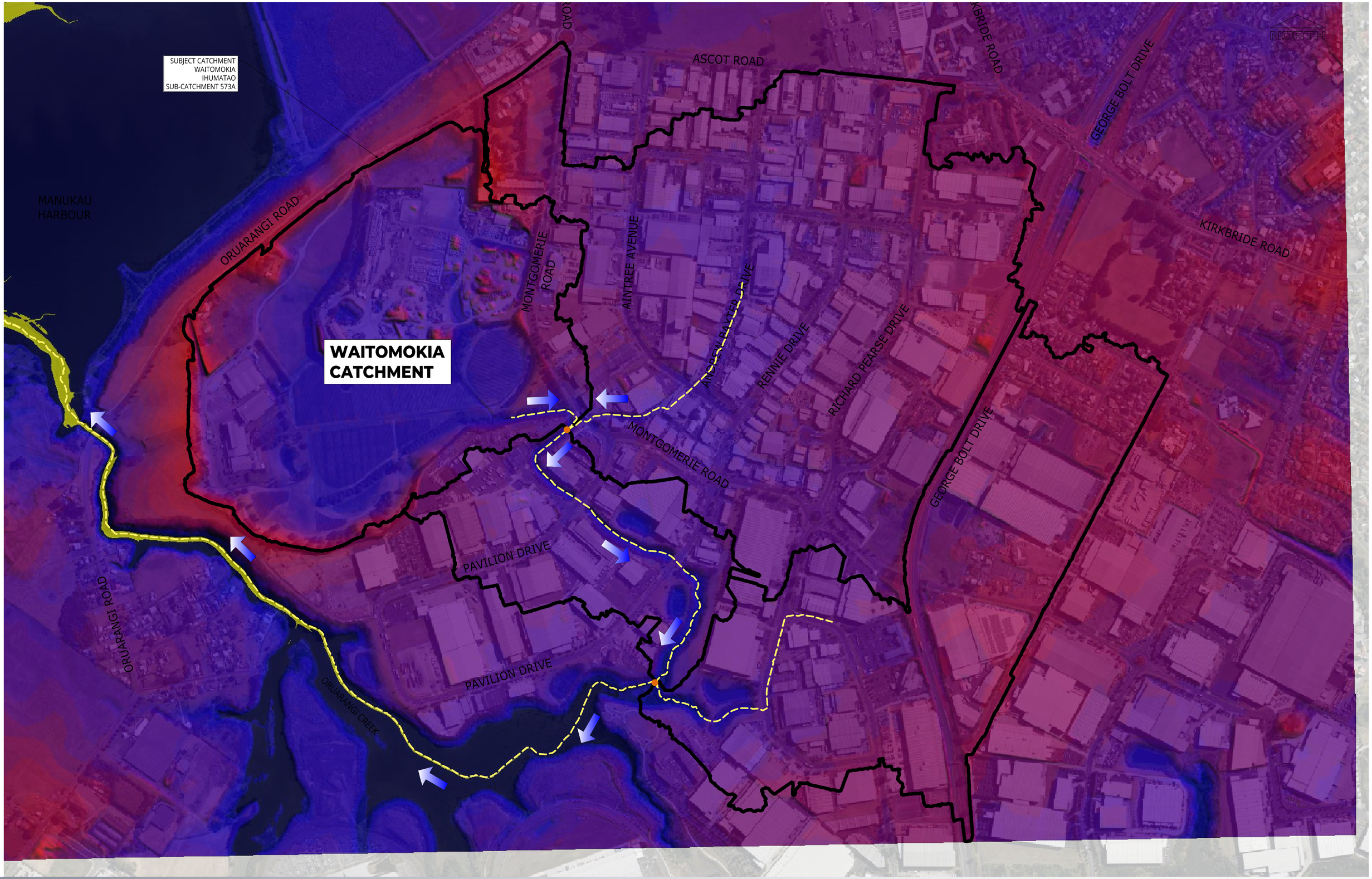
ISSUE STATUS: CLIENT ISSUE

PROJECT No:	SCALES:	
A2111838.00	1:500-A1 1:1000-A3	A1

DRAWING No: 2111838-HG-XX-DR-XX-G-SS23 REV A

REFER TO APPROVED MASTER DRAWINGS FOR ORIGINAL SIGNATURES File: NEWMARKET Q:\1030\142590_A\CAD\2111838.00\A2111838.00-HG-XX-DR-XX-G-SS20-SS23.DWG

Appendix B – Catchment Plan



ORIGINAL PLOT SIZE: A1
PLOT DATE: 13.11.2023
SURVEY BY:
SURVEY DATE:

#	REV	REVISIONS	DRAWN	CHECKED	APPROVED	DATE
	A	DEVELOPED DESIGN	WG	MR	DR	10.11.23

SERTUS civil engineering
LEVEL 3, 19 GRAHAM STREET AUCKLAND 1010

DEVELOPER: GOODMAN NOMINEE NZ LTD

PROJECT: WAITOMOKIA PLAN CHANGE

SITE ADDRESS: 88 PAVILION DR | 350, 400 & 470 ORUARANGI RD
118 MONTEGOMERIE DR, MANGERE

DRAWING TITLE: CATCHMENT PLAN OVERALL IHUMATAO CATCHMENT

DRAWING No: 100022-01-C-DR-010
REV: A
PROJECT No: 100022
SCALES: A1 1:4000 A3 1:8000
PROJECT PHASE: CONCEPT

SUB-CATCHMENT	AREA (M^2)	IMPERVIOUS PERCENTAGE	INCLUSIVE OF PLAN CHANGE SUB-PRECINCTS
WEDDINGS	212,400	80%	N/A
VILLA	426,800	20%	B, C & D
HARBOUR VIEW BLOCK	45,491	0%	A

ORIGINAL PLOT SIZE: A1
PLOT DATE: 13.11.2023
SURVEY BY:
SURVEY DATE:

#	REV	REVISIONS	DRAWN	CHECKED	APPROVED	DATE
	A	DEVELOPED DESIGN	WG	MR	DR	10.11.23

SERTUS civil engineering
LEVEL 3, 19 GRAHAM STREET AUCKLAND 1010

DEVELOPER: GOODMAN NOMINEE NZ LTD

PROJECT: WAITOMOKIA PLAN CHANGE

SITE ADDRESS: 88 PAVILION DR | 350, 400 & 470 ORUARANGI RD 118 MONTEGOMERIE DR, MANGERE

DRAWING TITLE: CATCHMENT PLAN WAITOMOKIA CATCHMENT

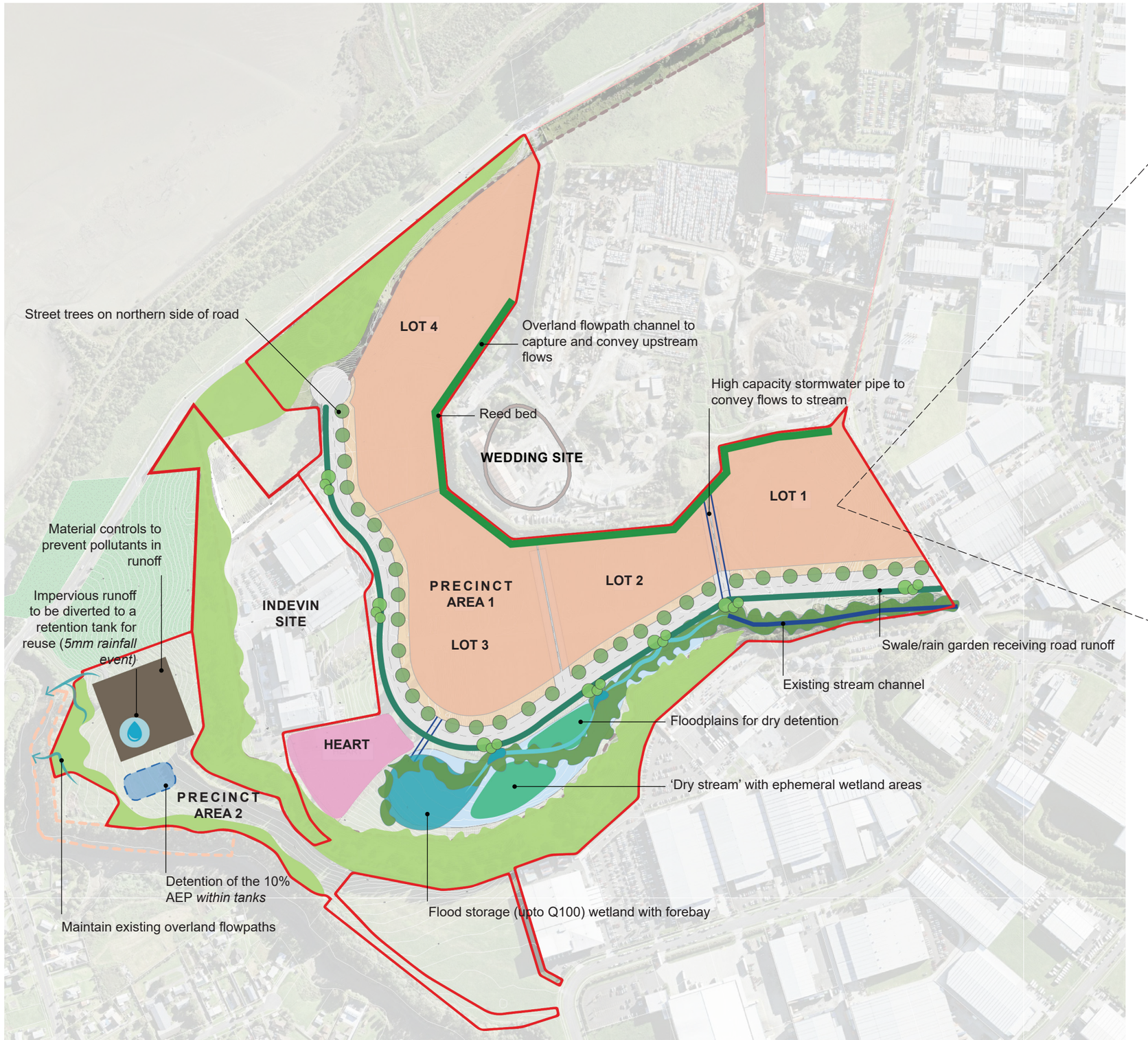
DRAWING No: 100022-01-C-DR-011 REV A

PROJECT No: 100022

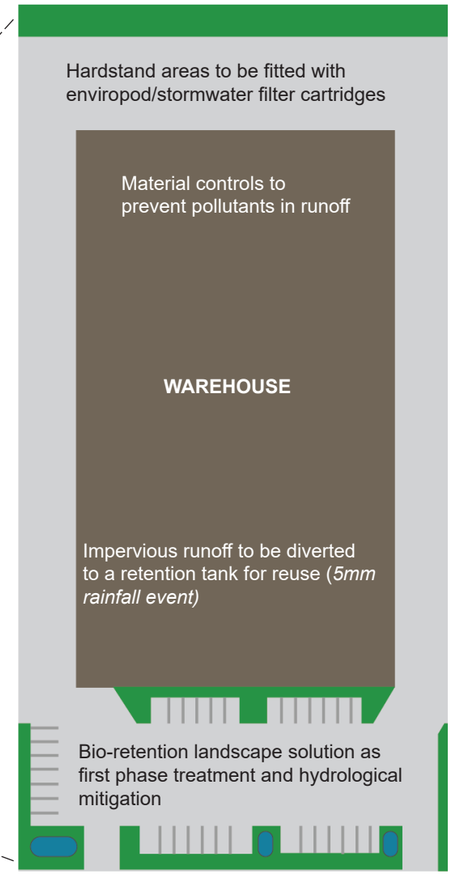
SCALES A1 1:2500 A3 1:5000

PROJECT PHASE: DEVELOPED DESIGN

Appendix C – Concept Stormwater Management Spatial Diagram



TYPICAL LOT STORMWATER MANAGEMENT



Boffa Miskell

www.boffamiskell.co.nz

N

Data Sources:

Projection:

LEGEND

SITE BOUNDARY

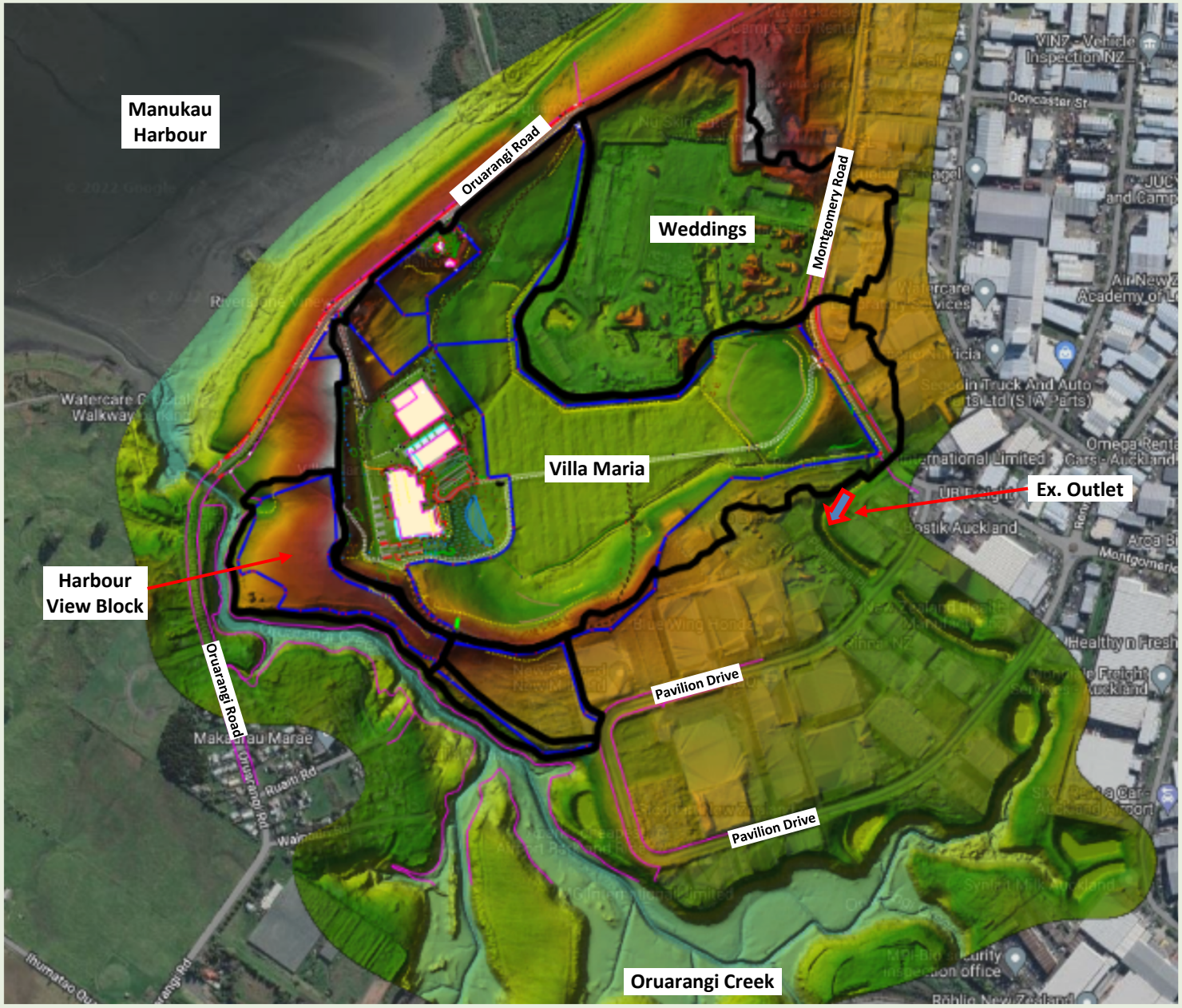
WAITOMOKIA GOODMAN VILLA MARIA SITE

SW Management Spatial Diagram

Date: 9 November 2023 | Revision: 0

Plan prepared by Boffa Miskell Limited
Project Manager: Rachel.deLambert@boffamiskell.co.nz

Appendix D – Concept Stormwater Management Schematic



Catchment Delineation

Highly modified extinct volcanic crater

Upper Catchment – Weddings Quarry Site

Lower Catchment – Villa Maria Vineyards

Harbour View Block – outside of crater rim

Catchment Characteristics

Bowl shaped topography with outlet to Montgomery Road drain

Existing low impervious surface coverage

Highly modified artificial streams within the site

Receiving environment – Manukau Harbour

Stormwater Challenges

- Upper Catchment Flow Diversion
- Increase in impervious coverage intensity
- Increase in volume of stormwater runoff
- Challenges for stream health – water quality & hydrology

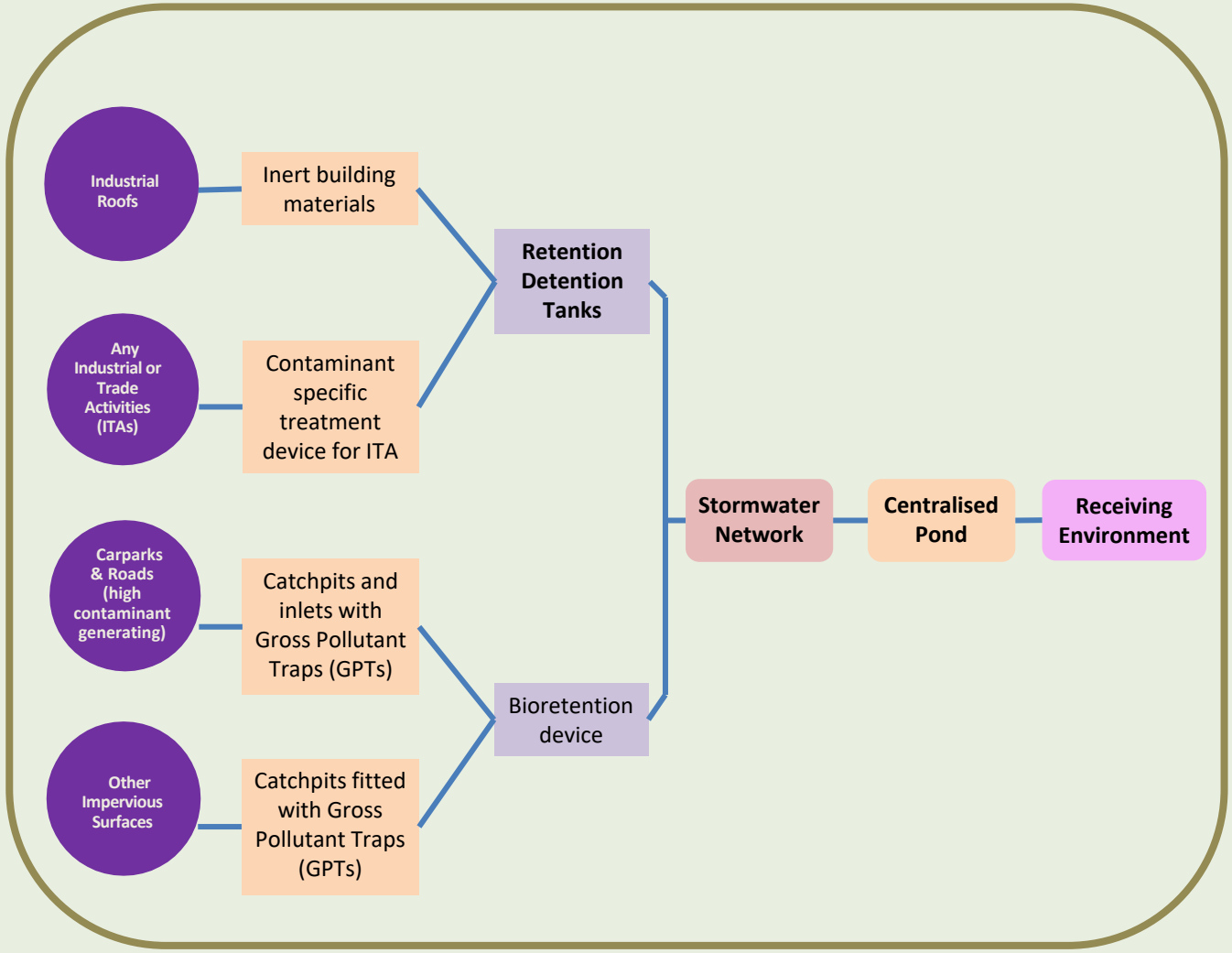
Stormwater Management Philosophy

- **Retain existing topography and drain patterns**
- **Maintain hydrologic neutrality**
- **Provide solutions for water quality & hydrology mitigation**

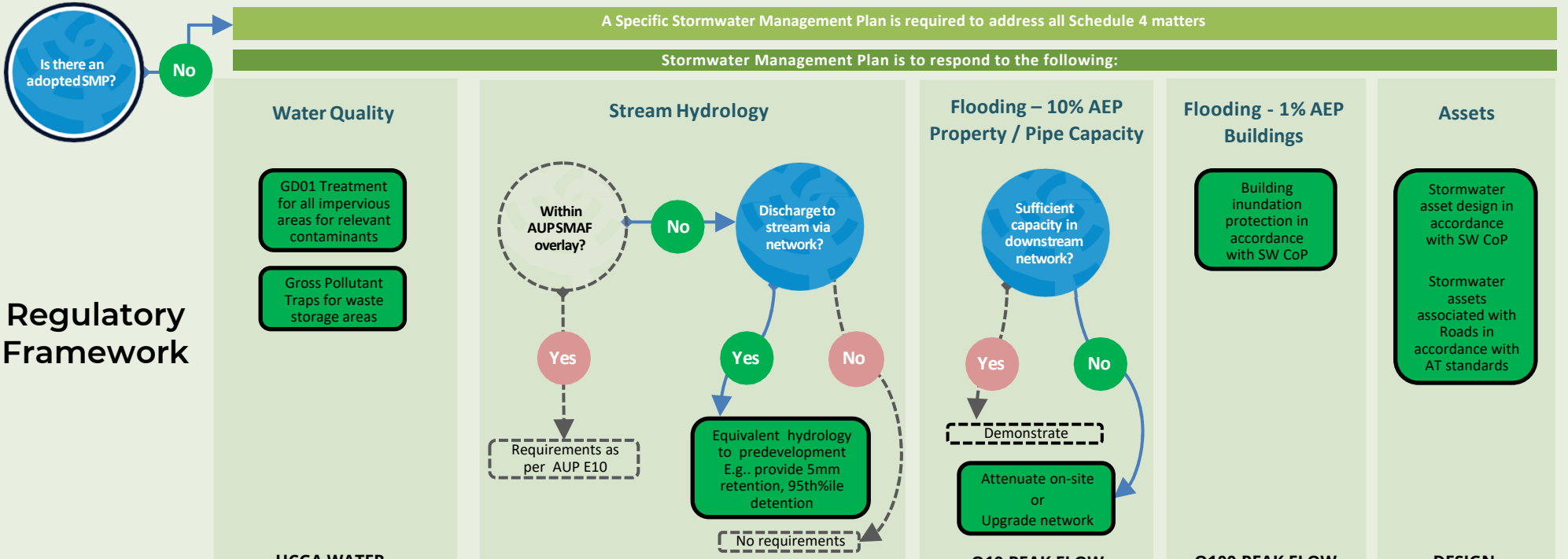
Design Response

- **Capture and divert upstream flows with formalised channels and drains**
- **Create a central low point as per existing topography**
- **Create central stormwater basin for water quality, hydrology and volume control**
- **All new proposed network within to flow into stormwater basin**

Stormwater Management System Schematic



Regulatory Framework



Overall Mitigation Summary

HCGA WATER QUALITY MITIGATION	HYDROLOGICAL MITIGATION	Q10 PEAK FLOW MITIGATION	Q100 PEAK FLOW MITIGATION	DESIGN STANDARD
Use of inert roof and building cladding material **Sub-Precinct A:** **- 100% onsite** **Sub-Precinct B & C:** **- 70% on-site** **- 30% at central basin** **Sub-Precinct D** **- 100% at central basin for existing HCGA areas** **- 100% onsite for new HCGA areas** **- 100% onsite for specific pollutants from new use of existing areas.** **Onsite treatment devices for areas subjected to gross & specific pollutants**	**The subject site are not in a SMAF zone. However, catchment areas discharges into an existing network that flows into an existing stream, as such hydrological mitigation is required for 5mm rainfall depth** **Sub-Precinct A:** **- 100% onsite** **Sub-Precinct B & C:** **- 70% on-site** **- 30% at central basin** **Sub-Precinct D:** **- 100% onsite for any new developments within the lot**	**Increased intensity of post development impervious surfaces will create higher Q10 peak flows which will exceed the existing downstream network capacity** **Sub-Precinct A:** **- 100% onsite** **Sub-Precinct B, C & D:** **- 100% at central basin**	**Increased intensity of post development impervious surfaces will create higher Q100 peak flows which will cause increased inundation** **Sub-Precinct A:** **– 100% onsite** **Sub-Precinct B, C & D:** **- 100% at central basin** **Building floors to be constructed above flood level**	**All proposed stormwater drainage and WSD assets designed to public standards**

Appendix E – Hydrological Calculations

Area Analysis

Project: Waitomokia Plan Change
Project Number: 100022
Date: November 2023

Pre-Development

Coverage	Area (m^2)
Existing Roof	0
Existing Paved	0
Existing Grass	45491
Total	45491

Post - Development

Coverage	Area (m^2)
Proposed Roof	29569
Proposed Paved	11372
Proposed Grass	4550
Total	45491

Summary

Surface Permeability - Pre-Development	Site Coverage	
	Area	%
Existing Impervious	0	0%
Existing Pervious	45491	100%

Surface Permeability - Post-Development	Site Coverage	
	Area	%
Proposed Impervious	40941	90%
Proposed Pervious	4550	10%

SMAF / Hydrological Mitigation Calculator

Project: Waitomokia Plan Change
Project Number: 100022
Date: November 2023

Initial Parameters

Total site area	45491	m²
SMAF Zone	N/A	

Pre-Construction Site Areas

Existing impervious area	0	m²
Existing pervious area	45491	m²
% Imperviousness	0.0%	%

Post-Construction Site Areas

New/Redeveloped impervious area	39600	m²
Existing impervious areas remaining untouched	1340.79	m²
Post-development pervious area	4550	m²
% New/Redeveloped imperviousness	87.1	%
Total new and redeveloped imperviousness >50% ?	YES	
Area for Hydrology Mitigation	45491	m²

Control Data

Rainfall depth (P_{24})	34	mm	90th Percentile 24Hr Rainfall
Pervious SCS Curve Number (CN)	74		Soil Class C
Impervious SCS Curve Number (CN)	98		
Pervious Initial Abstraction (I_a)	5	mm	
Impervious Initial Abstraction (I_a)	0	mm	
Pervious Storage (S)	89.2	mm	Soil Storage Equation: $\left(\left(\frac{1000}{CN}\right) - 10\right) \times 25.4$
Impervious Storage (S)	5.2	mm	
Pervious Runoff Depth (Q_{24})	7.1	mm	Runoff Depth Equation: $Q_{24} = \frac{(P_{24} - Ia)^2}{P_{24} - Ia + S}$
Impervious Runoff Depth (Q_{24})	29.5	mm	

Coverage Summary

	Total Impervious (m²)	Total Pervious (m²)	% total Impervious	% total pervious
Pre-development condition	0	45491	0.0	100.0
Post-development condition	40941	4550	90.0	10.0

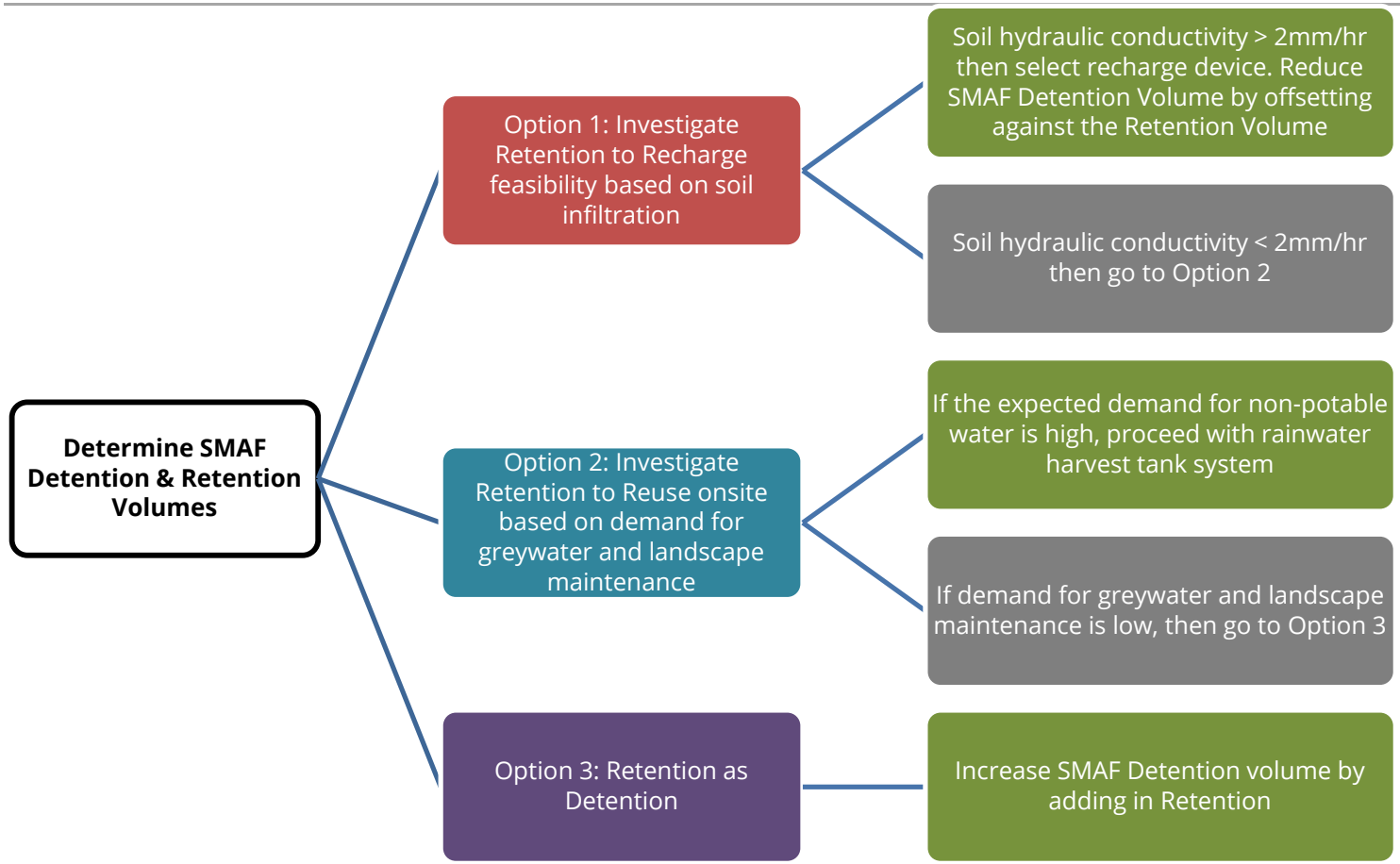
Hydrology Summary

Post-development runoff volume	1240.21	m³
Pre-development runoff volume	323.55	m³
Hydrology mitigation volume	916.65	m³
Retention Volume	**227.46**	**m³**
Detention Volume	**689.20**	**m³**

SMAF/HYDROLOGICAL MITIGATION DEVICE GUIDANCE

Project: Waitomokia Plan Change
Project Number: 100022
Date: November 2023

Device - Selection Hierachy



Notes:

1) Given that site will be highly developed with buildings and hardstands/car park areas, a high rate of compactive effort is anticipated in the earthworks which will compromise soil infiltration. As such Option 1: Retention to Recharge is not likely to be feasible.
2) Reuse demand in an industrial landuse context for toilet flushing and landscape watering is likely to be low. Client expects demand of 60m^3 for reuse.
3) Option 3 is most likely solution. This will result in a total hydrological mitigation volume of:

Retention Volume	227.46	m^3
Detention Volume	689.20	m^3
Total Volume	**916.65**	**m^3**
Applied Retention	60.00	m^3
Minimum Detention	856.65	m^3

Area Analysis

Project: Waitomokia Plan Change
Project Number: 100022
Date: November 2023

Pre-Development

Coverage	Area (m^2)
Existing Roof	1000
Existing Paved	13740
Existing Grass	280035
Total	294775

Post - Development

Coverage	Area (m^2)
Proposed Roof	191605
Proposed Paved	73695
Proposed Grass	29475
Total	294775

Summary

Surface Permeability - Pre-Development	Site Coverage	
	Area	%
Existing Impervious	14740	5%
Existing Pervious	280035	95%

Surface Permeability - Post-Development	Site Coverage	
	Area	%
Proposed Impervious	265300	90%
Proposed Pervious	29475	10%

SMAF / Hydrological Mitigation Calculator

Project: Waitomokia Plan Change
Project Number: 100022
Date: November 2023

Initial Parameters

Total site area	294775	m²	
SMAF Zone	N/A		

Pre-Construction Site Areas

Existing impervious area	14740	m²	
Existing pervious area	280035	m²	
% Imperviousness	5.0%	%	

Post-Construction Site Areas

New/Redeveloped impervious area	263959	m²	
Existing impervious areas remaining untouched	1340.79	m²	
Post-development pervious area	29475	m²	
% New/Redeveloped imperviousness	89.5	%	
Total new and redeveloped imperviousness >50% ?	YES		
Area for Hydrology Mitigation	294775	m²	

Control Data

Rainfall depth (P_{24})	34	mm	90th Percentile 24Hr Rainfall	
Pervious SCS Curve Number (CN)	74		Soil Class C	
Impervious SCS Curve Number (CN)	98			
Pervious Initial Abstraction (I_a)	5	mm		
Impervious Initial Abstraction (I_a)	0	mm		
Pervious Storage (S)	89.2	mm	Soil Storage Equation:	$\left(\left(\frac{1000}{CN}\right) - 10\right) \times 25.4$
Impervious Storage (S)	5.2	mm		
Pervious Runoff Depth (Q_{24})	7.1	mm	Runoff Depth Equation:	$Q_{24} = \frac{(P_{24} - Ia)^2}{P_{24} - Ia + S}$
Impervious Runoff Depth (Q_{24})	29.5	mm		

Coverage Summary

	Total Impervious (m²)	Total Pervious (m²)	% total Impervious	% total pervious
Pre-development condition	14740	280035	5.0	95.0
Post-development condition	265300	29475	90.0	10.0

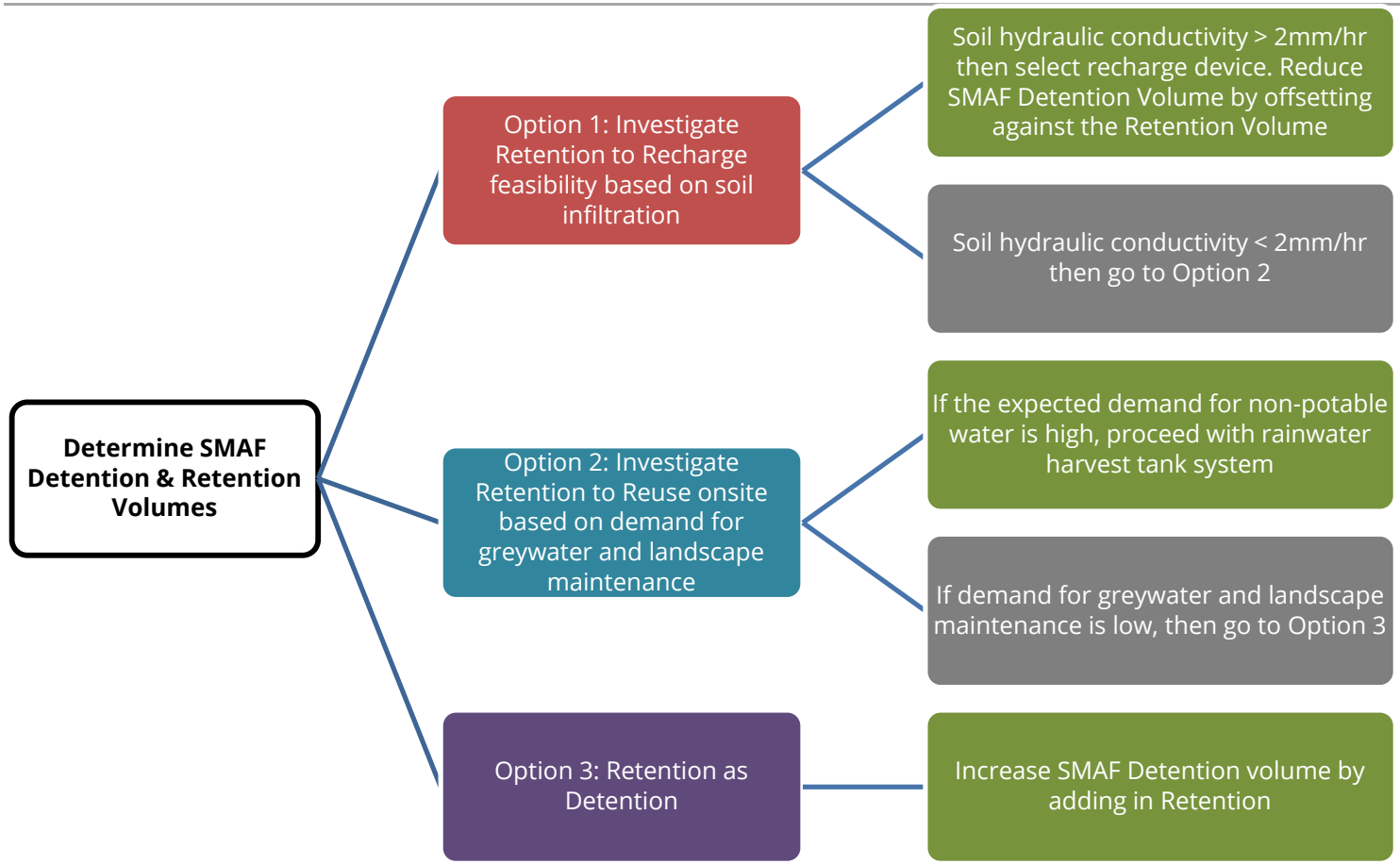
Hydrology Summary

Post-development runoff volume	8036.54	m³
Pre-development runoff volume	2096.57	m³
Hydrology mitigation volume	5939.97	m³
Retention Volume	**1473.88**	**m³**
Detention Volume	**4466.09**	**m³**

SMAF/HYDROLOGICAL MITIGATION DEVICE GUIDANCE

Project: Waitomokia Plan Change
Project Number: 100022
Date: November 2023

Device - Selection Hierachy



Notes:

1) Given that site will be highly developed with buildings and hardstands/car park areas, a high rate of compactive effort is anticipated in the earthworks which will compromise soil infiltration. As such Option 1: Retention to Recharge is not likely to be feasible.
2) Reuse demand in an industrial landuse context for toilet flushing and landscape watering is likely to be low. Client expects demand of 60m^3 for reuse.
3) Option 3 is most likely solution. This will result in a total hydrological mitigation volume of:

Retention Volume	1473.88	m^3
Detention Volume	4466.09	m^3
Total Volume	**5939.97**	**m^3**

Applied Retention	60.00	m^3
Minimum Detention	5879.97	m^3

Appendix F – Flow Modelling

STORMWATER MODELLING DATA

Waitomokia

Prepared For:
Goodman Nominee NZ Ltd

Project Number:
100022

Date:
November 2023

Revision:
01

WAITOMOKIA
MANGERE
AUCKLAND

BROWNFIELD INDUSTRIAL DEVELOPMENT

WAITOMOKIA PLAN CHANGE

draw on experience | engineer plans

SERTUS

civil engineering

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Nodes 26
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Sub-basins 28
Scenario 04 -10% AEP 30
Sub-Basin Flow Summary 30
Nodes 30
Routing Reaches 30
Detention Storage 31
Sub-basins 32

Purpose

The purpose of this hydrology study is to determine the peak runoff rates for pre-development and post-development scenarios.

Methodology Used

The HEC-HMS version 4.5 computer software was used in this hydrology study based on TP108 modelling guidelines. The **SCS Curve Number** infiltration (loss) method and **SCS Unit Hydrograph** runoff (transform) method was used for determining the stormwater runoff**.** The **Lag Time** routing method was used for routing the stormwater**.**

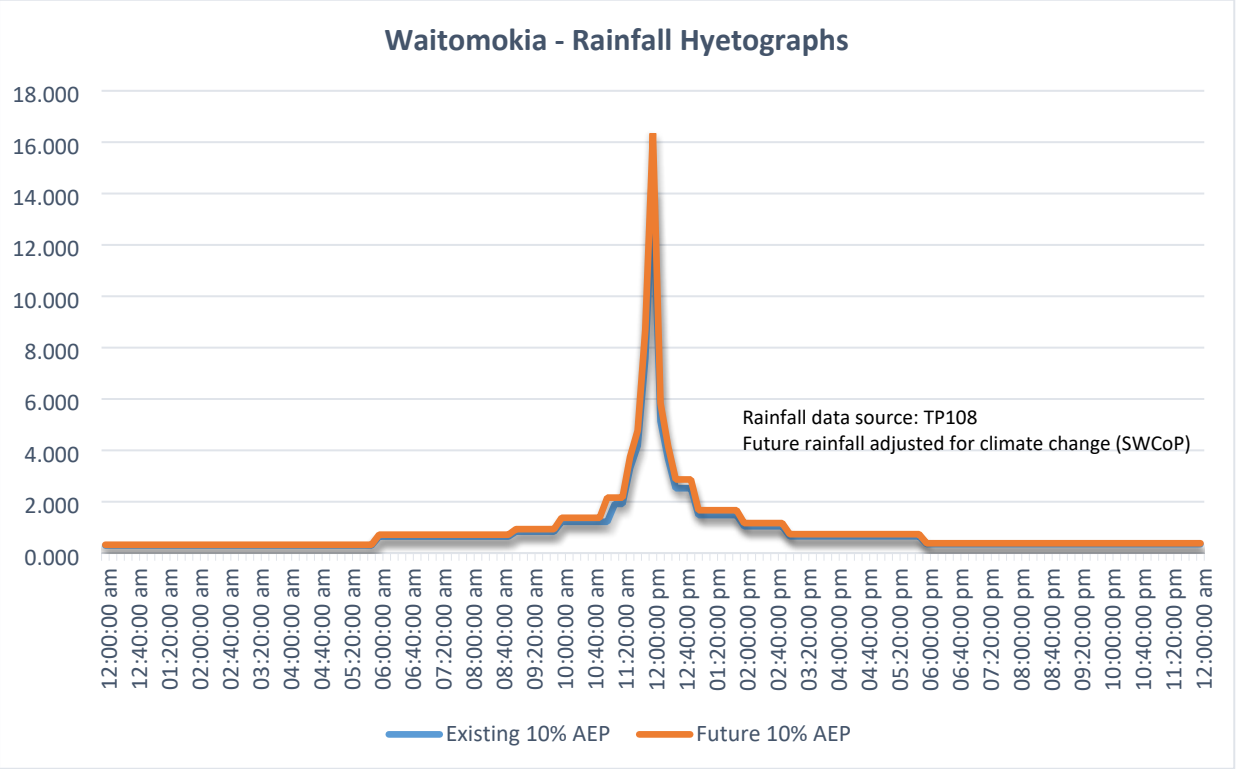
Scenarios

The following scenarios were analyzed in this hydrology study for the 1% and 10% AEP:

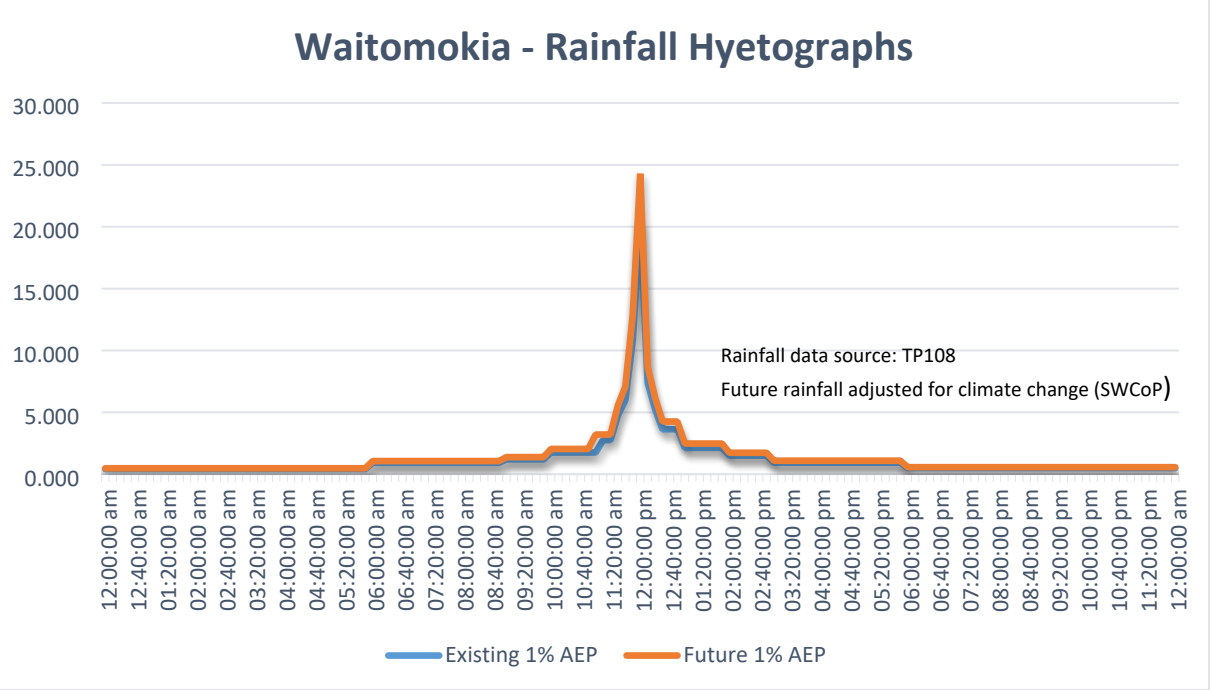
- Scenario 01 - Existing Discharge
- Scenario 02 - Developed Condition (unmitigated)
- Scenario 03 - Developed Condition – Montgomerie Outlet (mitigation)
- Scenario 04 - Developed Condition – Montgomerie & Oruarangi Outlets (mitigation)

Rainfall

10% AEP Event

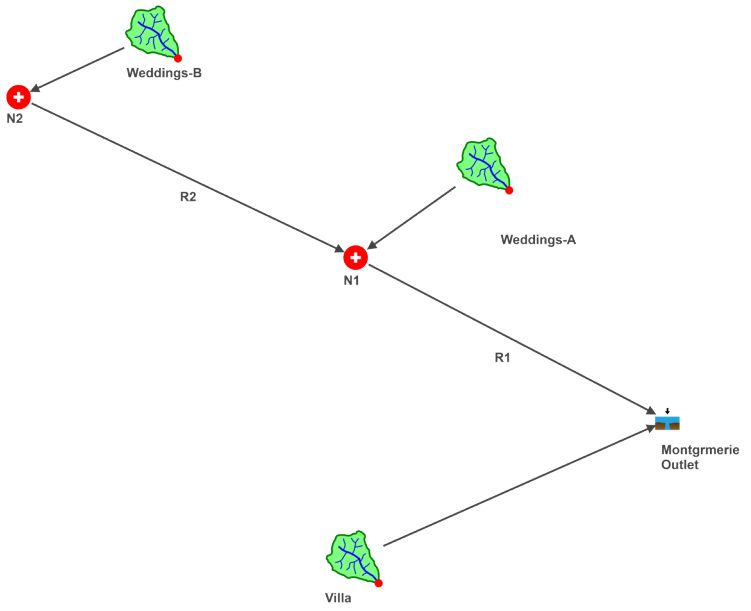


1% AEP Event

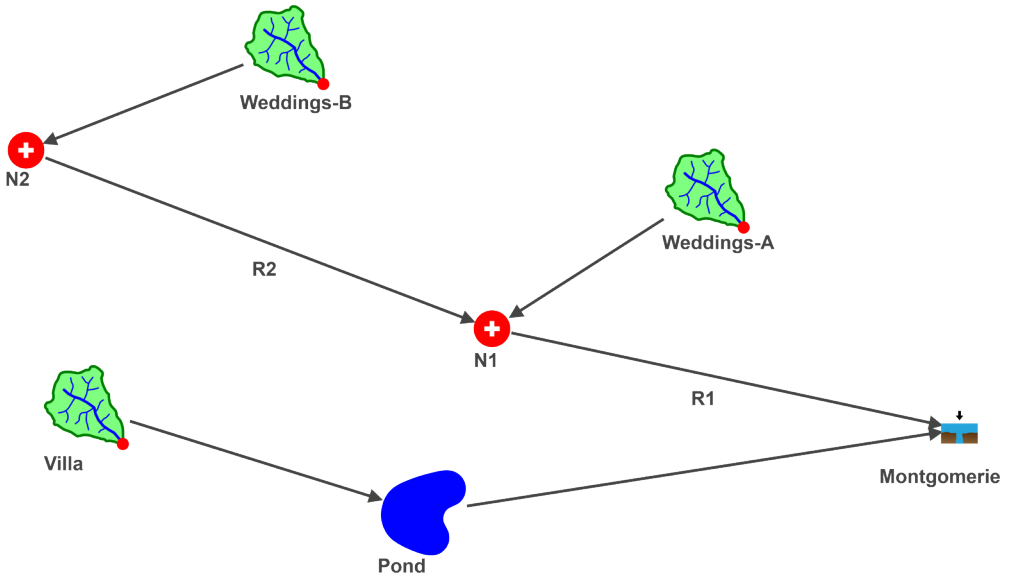


HEC-HMS Routing Diagrams

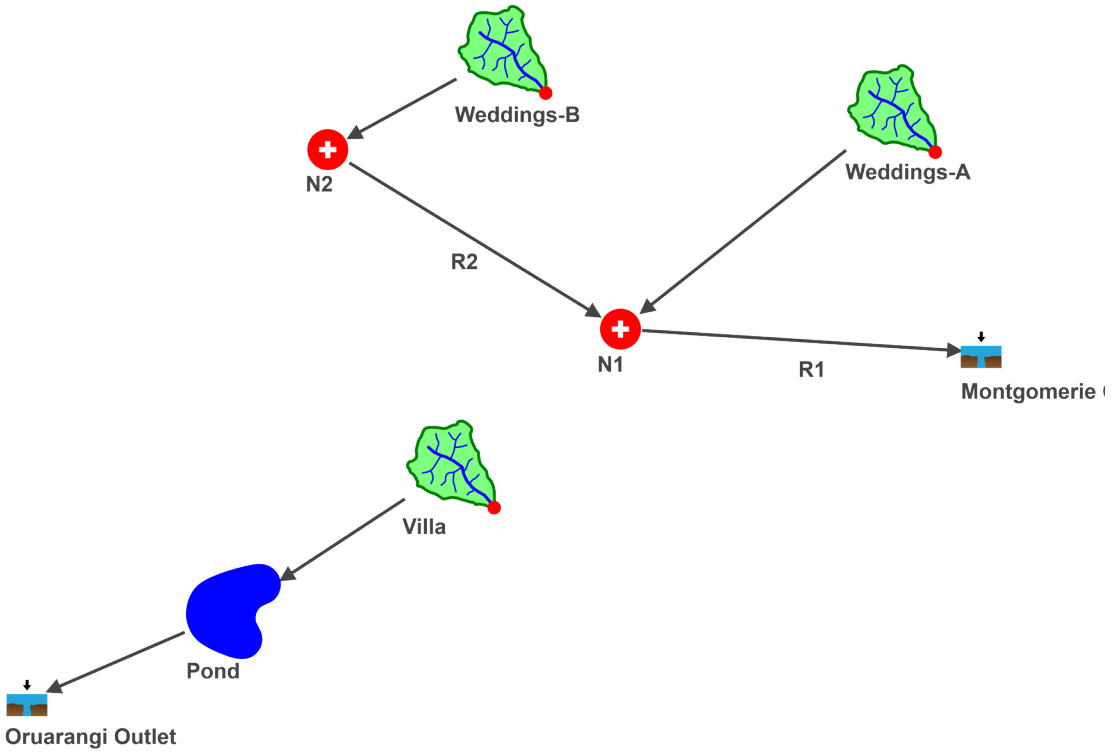
Scenario 01 & 02



Scenario 03



Scenario 04



Results

Scenario 01 - 1% AEP

Sub-Basin Flow Summary

Subbasin ID	Drainage Area (ha)	Initial Abstraction (mm)	Curve Number	Impervious Surface (%)	Lag Time (minutes)	Peak Discharge (cms)
Villa	42.675	14.9	84	20	40	8.36
Weddings-A	13.154	6.7	89	90	36	2.99
Weddings-B	8.084	6.7	89	85	25	2.18

Nodes

Element ID	Element Type	Peak Inflow (cms)	Peak Outflow (cms)	Peak Diverted Flow (cms)
N1	Junction	4.882	4.882	
N2	Junction	2.181	2.181	
Outlet	Sink	12.602		

Routing Reaches

Reach ID	Peak Inflow (cms)	Peak Outflow (cms)	Attenuated Flow (cms)
R1	4.882	4.861	0.02
R2	2.181	2.155	0.03

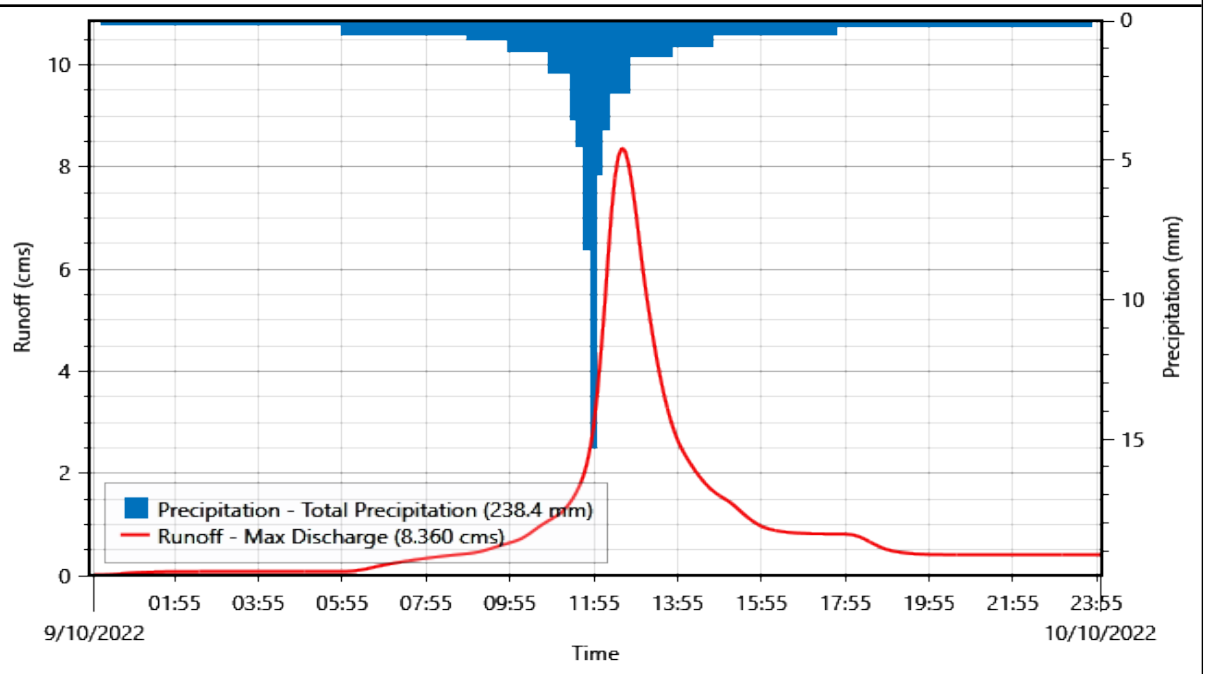
Subbasins

Subbasin ID:	**Villa**			
Scenario:	**1% AEP**		**Depth**	**Volume**
Peak discharge:	8.36 cms	**Time of peak:**	09 Oct 2022, 12:35	
Drainage area:	42.675 ha	**Total rainfall:**	238.4 mm	101,758.936 m³
Initial abstraction:	14.9 mm	**Losses:**	43.8 mm	18,683.935 m³
Curve Number:	84	**Precip excess:**	194.6 mm	83,075.002 m³
Impervious surface:	20%	**Direct runoff:**	191.8 mm	81,849.10 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	40 minutes	**Total runoff:**	191.8 mm	81,849.10 m³

Weighted Curve Number Calculations

Area (ha)	Area (%)	CN	Description
0.622	1.46	98.00	Road
3.911	9.16	80.00	Stream Corridor
8.061	18.89	91.00	Industrial
0.712	1.67	77.00	Residential
5.930	13.90	74.00	Grass
0.245	0.57	74.00	Reserve
1.927	4.52	92.00	Private Road
2.869	6.72	78.00	Bank

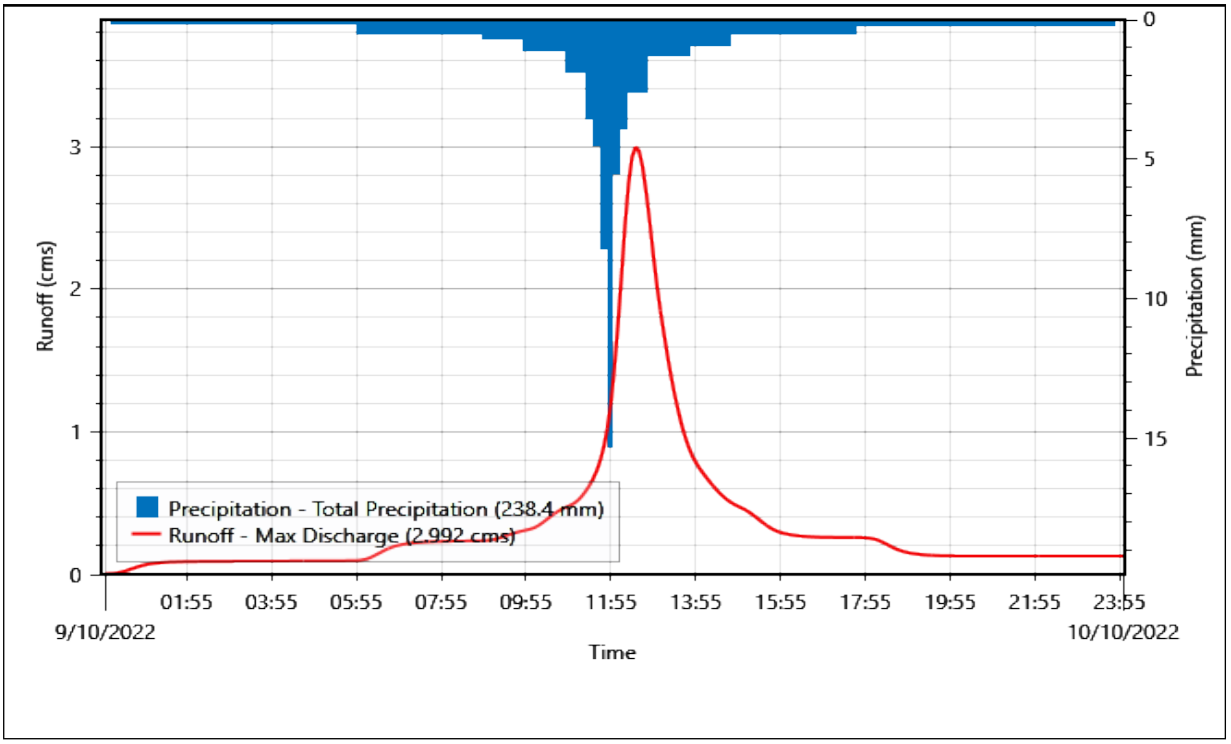
18.398	43.11	85.00	Vineyard
42.675	**100.00**	**84**	**Weighted Average**



Subbasin ID:	**Weddings-A**			
Scenario:	**1% AEP**		**Depth**	**Volume**
Peak discharge:	2.99 cms	**Time of peak:**	09 Oct 2022, 12:30	
Drainage area:	13.154 ha	**Total rainfall:**	238.4 mm	31,352.624 m³
Initial abstraction:	6.7 mm	**Losses:**	3.5 mm	465.402 m³
Curve Number:	89	**Precip excess:**	234.9 mm	30,887.222 m³
Impervious surface:	90%	**Direct runoff:**	232.2 mm	30,538.28 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	36 minutes	**Total runoff:**	232.2 mm	30,538.28 m³

Weighted Curve Number Calculations

Area (ha)	Area (%)	CN	Description
0.018	0.14	80.00	Stream Corridor
0.392	2.98	98.00	Road
0.020	0.15	79.00	Residential
1.974	15.01	74.00	Grass
0.032	0.25	74.00	Reserve
10.718	81.48	91.00	Industrial
13.154	**100.00**	**89**	**Weighted Average**



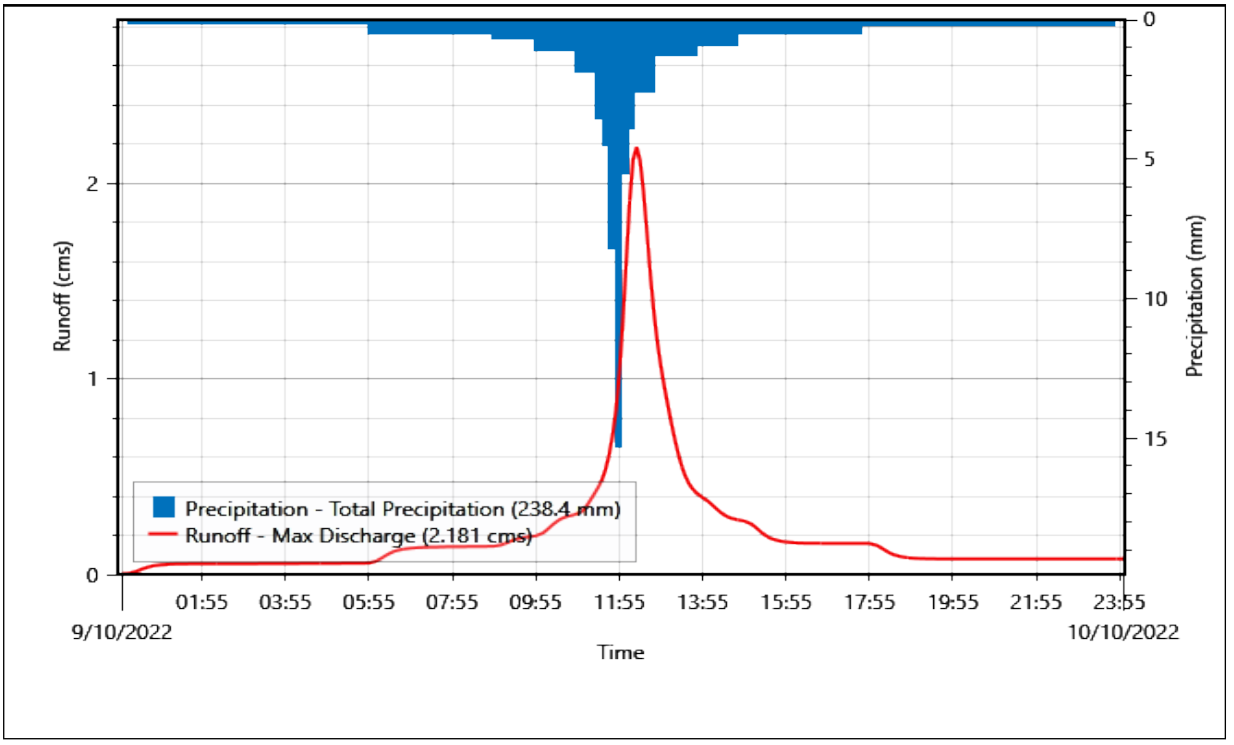
Subbasin ID:	Weddings-B			
Scenario:	**1% AEP**		**Depth**	**Volume**
Peak discharge:	2.18 cms	**Time of peak:**	09 Oct 2022, 12:20	
Drainage area:	8.084 ha	**Total rainfall:**	238.4 mm	19,264.578 m³
Initial abstraction:	6.7 mm	**Losses:**	5.3 mm	424.731 m³
Curve Number:	89	**Precip excess:**	233.2 mm	18,839.847 m³
Impervious surface:	85%	**Direct runoff:**	231.3 mm	18,690.07 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	25 minutes	**Total runoff:**	231.3 mm	18,690.07 m³

Weighted Curve Number Calculations

Area (ha)	Area (%)	CN	Description
0.000	0.00	98.00	Road
0.021	0.26	80.00	Stream Corridor
1.071	13.25	74.00	Grass
6.991	86.48	91.00	Industrial
8.084	**100.00**	**89**	**Weighted Average**

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	Length (m)	Slope (m/m)	Velocity (m/s)	Description
4	6.146	0.09637	1.1533	Sheet Flow
2	65.380	0.07375	8.9680	Shallow Concentrated Flow
7	116.517	0.01651	4.2426	Shallow Concentrated Flow
24	437.417	0.00235	1.6001	Shallow Concentrated Flow
0	30.767	0.04420	7.8106	Channel Flow
38	**656.227**	**Total**	**Lag Time = 23 minutes**	



Scenario 01 -10% AEP

Sub-Basin Flow Summary

Subbasin ID	Drainage Area (ha)	Initial Abstraction (mm)	Curve Number	Impervious Surface (%)	Lag Time (minutes)	Peak Discharge (cms)
Villa	42.675	14.9	84	20	40	5.28
Weddings-A	13.154	6.7	89	90	36	2.04
Weddings-B	8.084	6.7	89	85	25	1.48

Nodes

Element ID	Element Type	Peak Inflow (cms)	Peak Outflow (cms)	Peak Diverted Flow (cms)
N1	Junction	3.322	3.322	
N2	Junction	1.482	1.482	
Outlet	Sink	8.213		

Routing Reaches

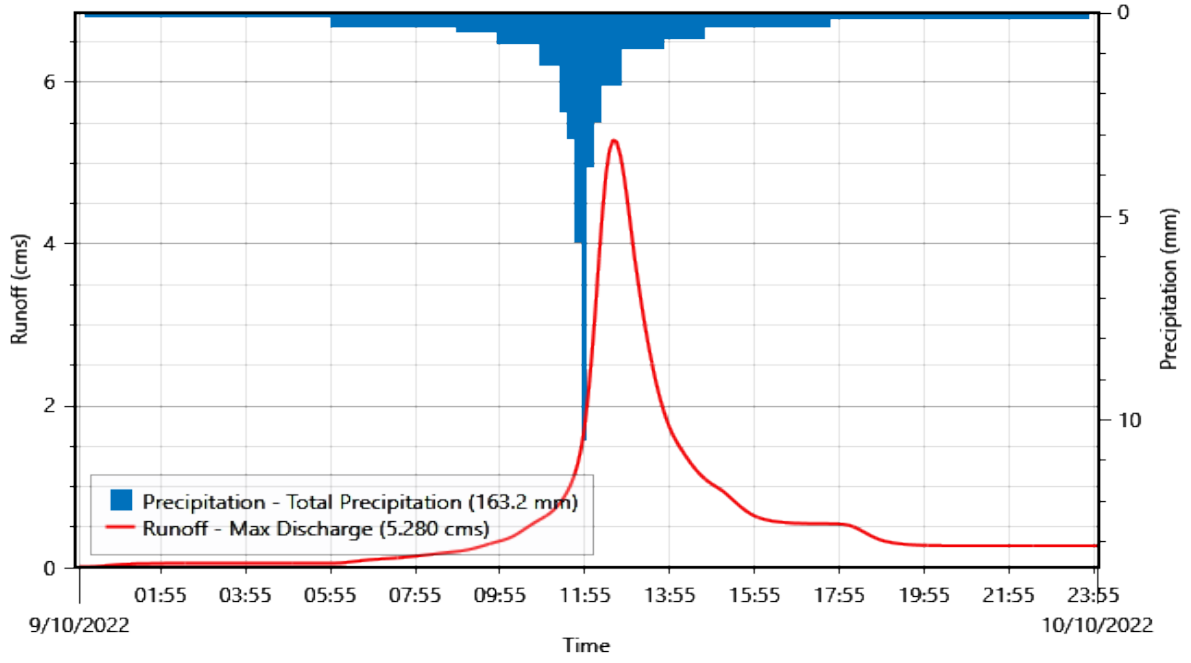
Reach ID	Peak Inflow (cms)	Peak Outflow (cms)	Attenuated Flow (cms)
R1	3.322	3.308	0.01
R2	1.482	1.465	0.02

Subbasins

Subbasin ID:	Villa			
Scenario:	**10% AEP**		**Depth**	**Volume**
Peak discharge:	5.28 cms	**Time of peak:**	09 Oct 2022, 12:35	
Drainage area:	42.675 ha	**Total rainfall:**	163.2 mm	69,649.065 m³
Initial abstraction:	14.9 mm	**Losses:**	41.1 mm	17,556.888 m³
Curve Number:	84	**Precip excess:**	122.1 mm	52,092.177 m³
Impervious surface:	20%	**Direct runoff:**	120.1 mm	51,274.01 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	40 minutes	**Total runoff:**	120.1 mm	51,274.01 m³

Weighted Curve Number Calculations

Area (ha)	Area (%)	CN	Description
0.622	1.46	98.00	Road
3.911	9.16	80.00	Stream Corridor
8.061	18.89	91.00	Industrial
0.712	1.67	77.00	Residential
5.930	13.90	74.00	Grass
0.245	0.57	74.00	Reserve
1.927	4.52	92.00	Private Road
2.869	6.72	78.00	Bank
18.398	43.11	85.00	Vineyard
42.675	**100.00**	**84**	**Weighted Average**

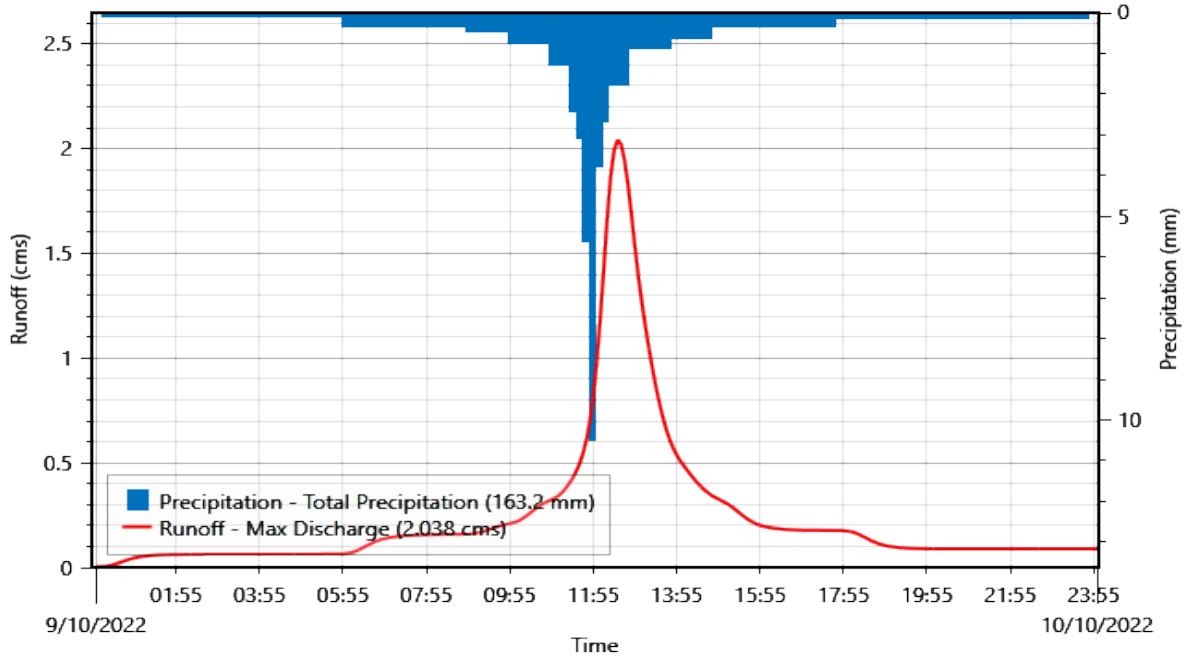


Subbasin ID:	Weddings-A			
Scenario:	**10% AEP**		**Depth**	**Volume**
Peak discharge:	2.04 cms	**Time of peak:**	09 Oct 2022, 12:30	

Drainage area:	13.154 ha	**Total rainfall:**	163.2 mm	21,459.354 m³
Initial abstraction:	6.7 mm	**Losses:**	3.4 mm	444.204 m³
Curve Number:	89	**Precip excess:**	159.8 mm	21,015.149 m³
Impervious surface:	90%	**Direct runoff:**	158.0 mm	20,776.88 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	36 minutes	**Total runoff:**	158.0 mm	20,776.88 m³

Weighted Curve Number Calculations

Area (ha)	Area (%)	CN	Description
0.018	0.14	80.00	Stream Corridor
0.392	2.98	98.00	Road
0.020	0.15	79.00	Residential
1.974	15.01	74.00	Grass
0.032	0.25	74.00	Reserve
10.718	81.48	91.00	Industrial
13.154	**100.00**	**89**	**Weighted Average**



Subbasin ID:	**Weddings-B**			
Scenario:	**10% AEP**		**Depth**	**Volume**
Peak discharge:	1.48 cms	**Time of peak:**	09 Oct 2022, 12:20	
Drainage area:	8.084 ha	**Total rainfall:**	163.2 mm	13,185.671 m³
Initial abstraction:	6.7 mm	**Losses:**	5.0 mm	405.652 m³
Curve Number:	89	**Precip excess:**	158.2 mm	12,780.019 m³
Impervious surface:	85%	**Direct runoff:**	156.9 mm	12,677.82 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	25 minutes	**Total runoff:**	156.9 mm	12,677.82 m³

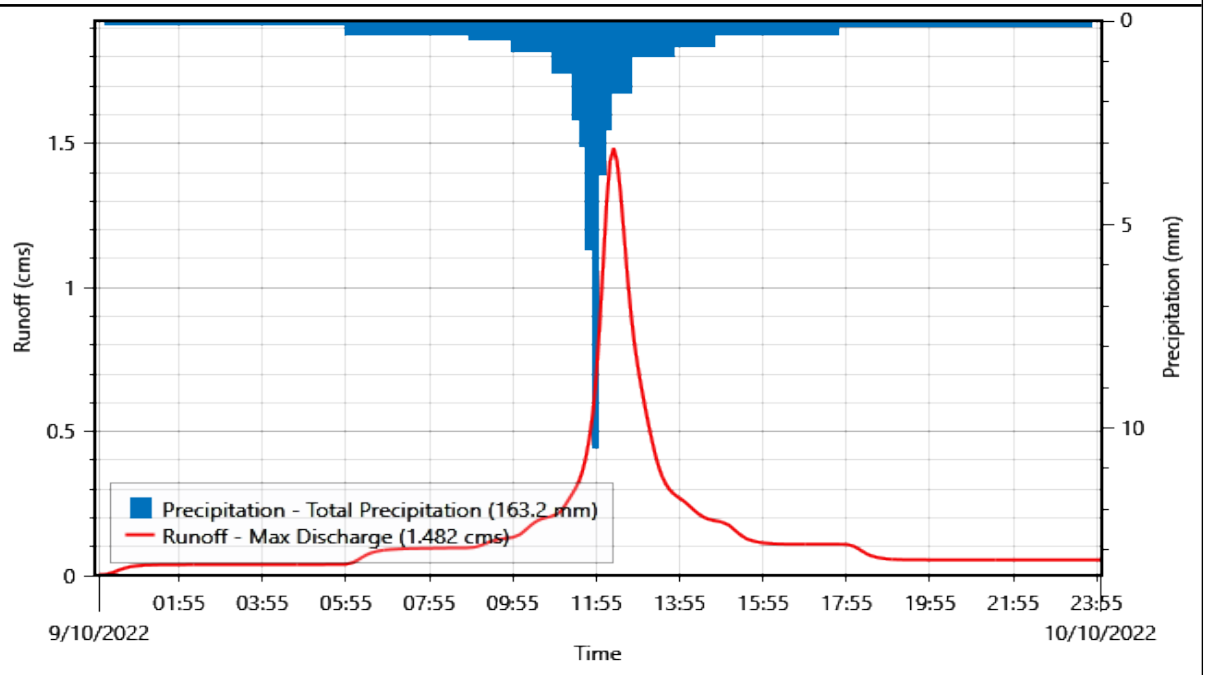
Weighted Curve Number Calculations

Area (ha)	Area (%)	CN	Description
0.000	0.00	98.00	Road
0.021	0.26	80.00	Stream Corridor

1.071	13.25	74.00	Grass
6.991	86.48	91.00	Industrial
8.084	**100.00**	**89**	**Weighted Average**

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	Length (m)	Slope (m/m)	Velocity (m/s)	Description
4	6.146	0.09637	1.1533	Sheet Flow
2	65.380	0.07375	8.9680	Shallow Concentrated Flow
7	116.517	0.01651	4.2426	Shallow Concentrated Flow
24	437.417	0.00235	1.6001	Shallow Concentrated Flow
0	30.767	0.04420	7.8106	Channel Flow
38	**656.227**	**Total**	**Lag Time = 23 minutes**	



Scenario 02 -1% AEP

Sub-Basin Flow Summary

Subbasin ID	Drainage Area (ha)	Initial Abstraction (mm)	Curve Number	Impervious Surface (%)	Lag Time (minutes)	Peak Discharge (cms)
Villa	42.675	4.8	91	80	34	9.97
Weddings-A	13.154	6.7	88	90	36	2.99
Weddings-B	8.084	6.7	88	85	25	2.18

Nodes

Element ID	Element Type	Peak Inflow (cms)	Peak Outflow (cms)	Peak Diverted Flow (cms)
N1	Junction	5.000	5.000	

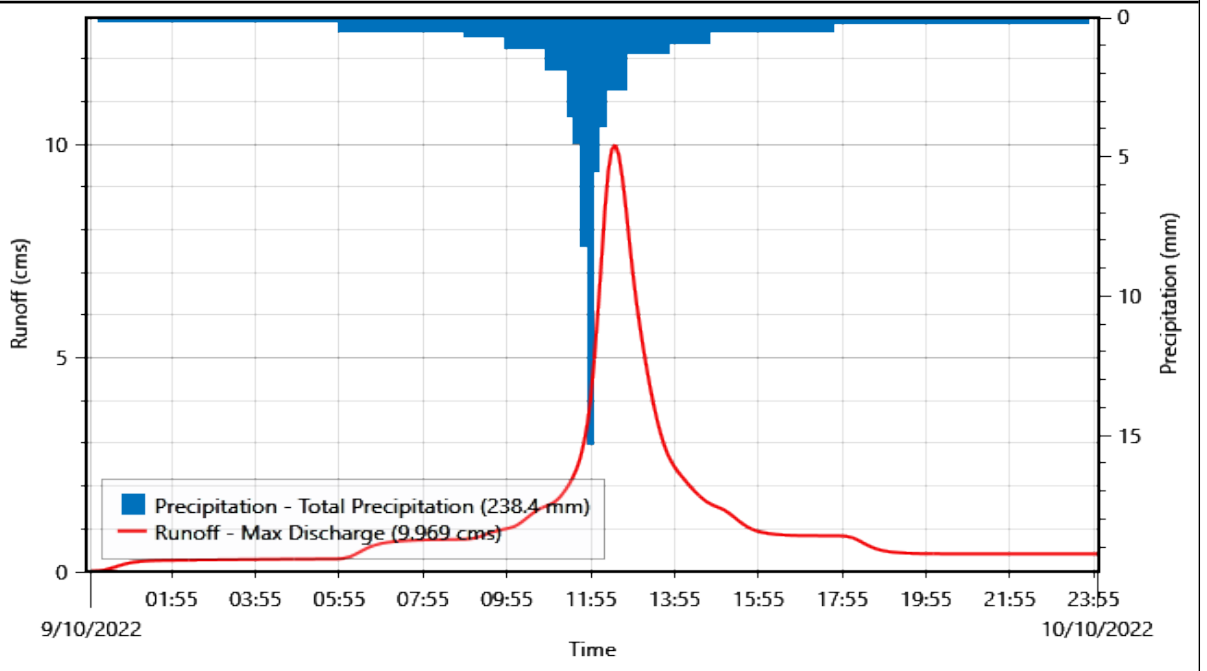
N2	Junction	2.179	2.179	
Outlet	Sink	13.924		

Routing Reaches

Reach ID	Peak Inflow (cms)	Peak Outflow (cms)	Attenuated Flow (cms)
R1	5.000	4.997	0.00
R2	2.179	2.153	0.03

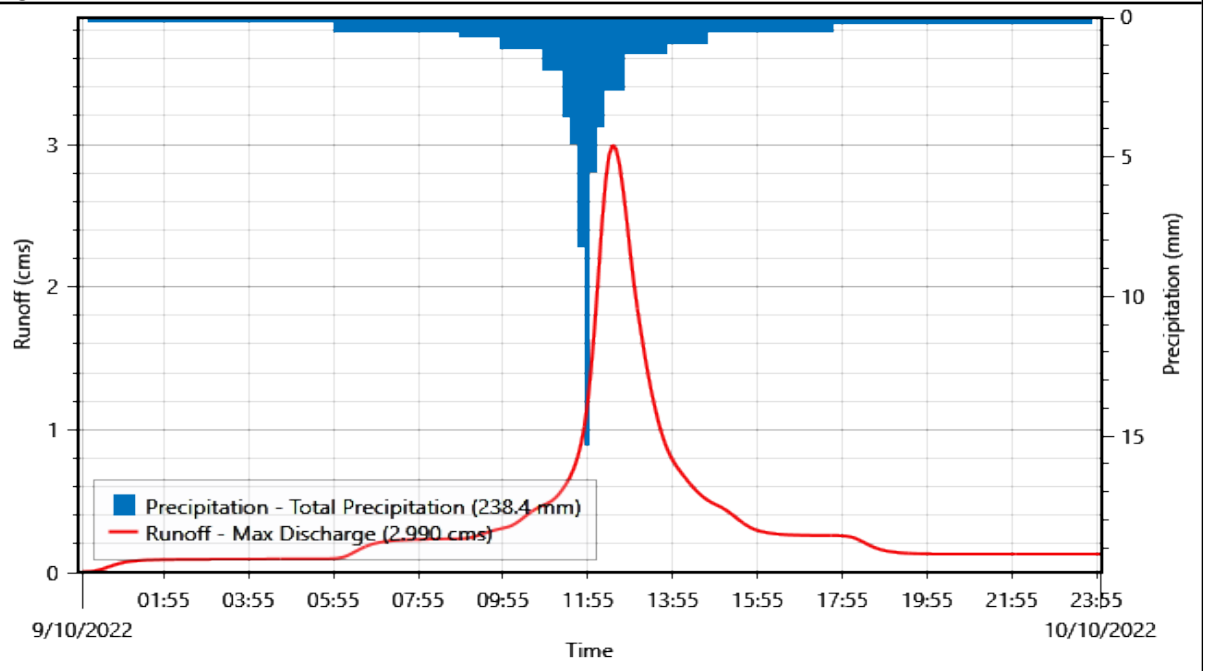
Sub-basins

Subbasin ID:	Villa			
Scenario:	**1% AEP**		**Depth**	**Volume**
Peak discharge:	9.97 cms	**Time of peak:**	09 Oct 2022, 12:30	
Drainage area:	42.675 ha	**Total rainfall:**	238.4 mm	101,758.936 m³
Initial abstraction:	4.8 mm	**Losses:**	5.5 mm	2,345.859 m³
Curve Number:	91	**Precip excess:**	232.9 mm	99,413.077 m³
Impervious surface:	80%	**Direct runoff:**	230.4 mm	98,342.86 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	34 minutes	**Total runoff:**	230.4 mm	98,342.86 m³



Subbasin ID:	Weddings-A			
Scenario:	**1% AEP**		**Depth**	**Volume**
Peak discharge:	2.99 cms	**Time of peak:**	09 Oct 2022, 12:30	
Drainage area:	13.154 ha	**Total rainfall:**	238.4 mm	31,352.624 m³
Initial abstraction:	6.7 mm	**Losses:**	3.7 mm	484.346 m³
Curve Number:	88	**Precip excess:**	234.7 mm	30,868.279 m³

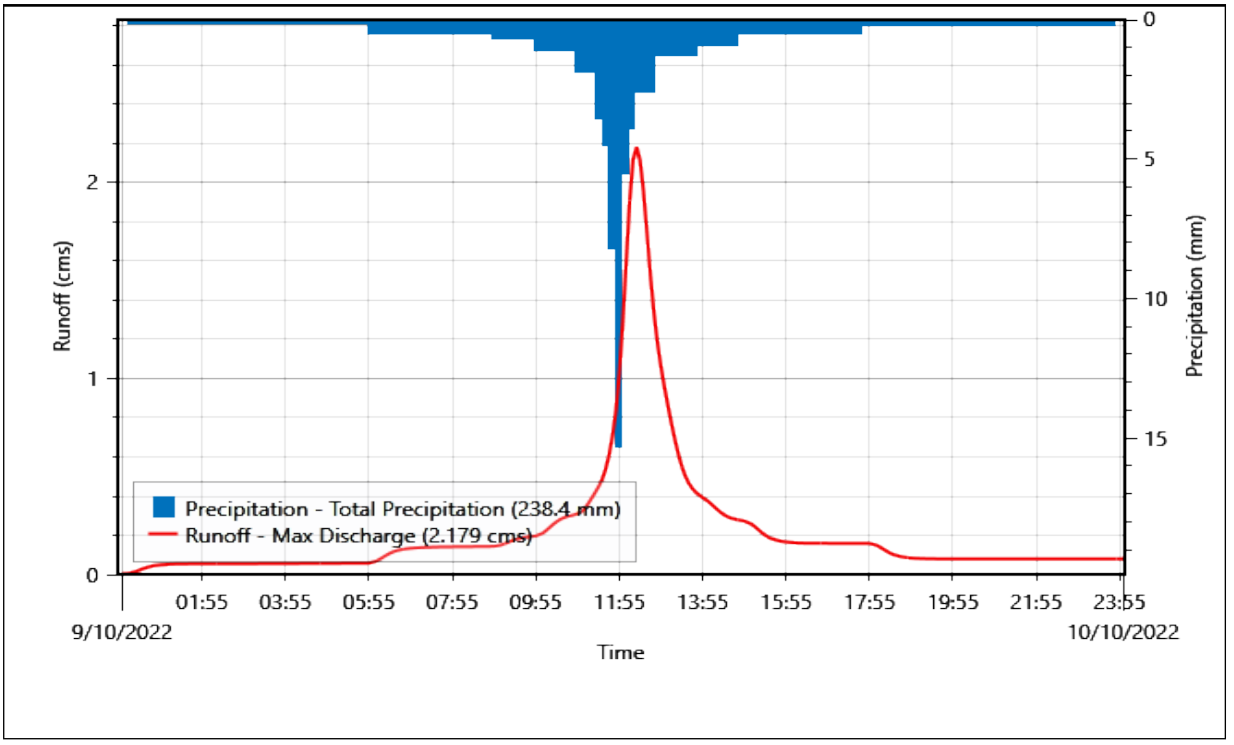
Impervious surface:	90%	**Direct runoff:**	232.1 mm	30,519.39 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	36 minutes	**Total runoff:**	232.1 mm	30,519.39 m³



Subbasin ID:	**Weddings-B**			
Scenario:	**1% AEP**		**Depth**	**Volume**
Peak discharge:	2.18 cms	**Time of peak:**	09 Oct 2022, 12:20	
Drainage area:	8.084 ha	**Total rainfall:**	238.4 mm	19,264.578 m³
Initial abstraction:	6.7 mm	**Losses:**	5.5 mm	446.408 m³
Curve Number:	88	**Precip excess:**	232.9 mm	18,818.170 m³
Impervious surface:	85%	**Direct runoff:**	231.0 mm	18,668.44 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	25 minutes	**Total runoff:**	231.0 mm	18,668.44 m³

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	Length (m)	Slope (m/m)	Velocity (m/s)	Description
4	6.146	0.09637	1.1533	Sheet Flow
2	65.380	0.07375	8.9680	Shallow Concentrated Flow
7	116.517	0.01651	4.2426	Shallow Concentrated Flow
24	437.417	0.00235	1.6001	Shallow Concentrated Flow
0	30.767	0.04420	7.8106	Channel Flow
38	**656.227**	**Total**	**Lag Time = 23 minutes**	



Scenario 02 -10% AEP

Sub-Basin Flow Summary

Subbasin ID	Drainage Area (ha)	Initial Abstraction (mm)	Curve Number	Impervious Surface (%)	Lag Time (minutes)	Peak Discharge (cms)
Villa	42.675	4.8	91	80	34	6.78
Weddings-A	13.154	6.7	88	90	36	2.04
Weddings-B	8.084	6.7	88	85	25	1.48

Nodes

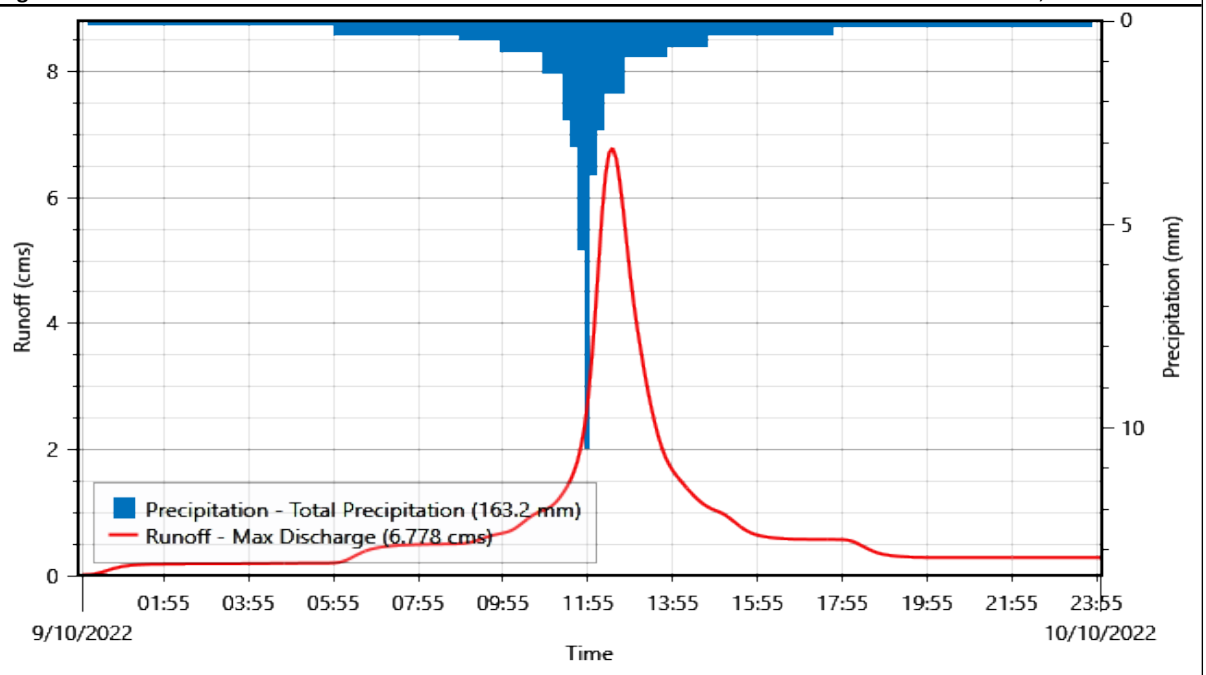
Element ID	Element Type	Peak Inflow (cms)	Peak Outflow (cms)	Peak Diverted Flow (cms)
N1	Junction	3.402	3.402	
N2	Junction	1.480	1.480	
Outlet	Sink	9.469		

Routing Reaches

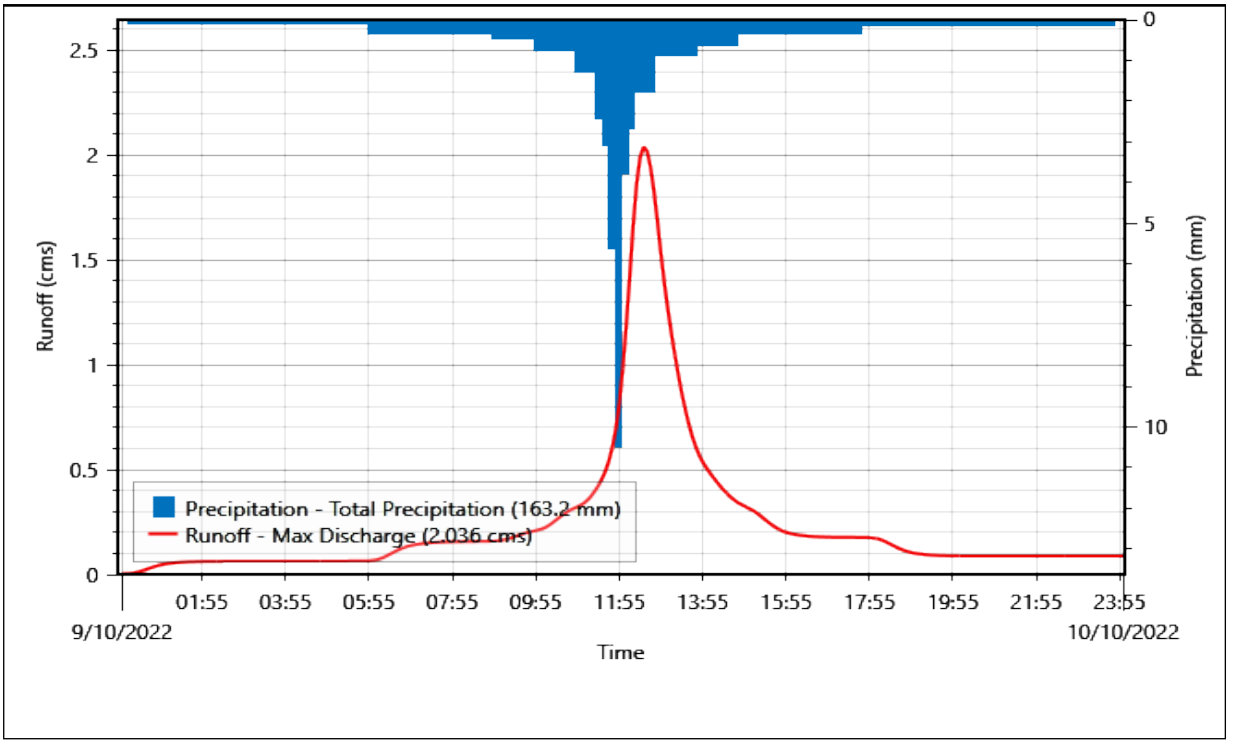
Reach ID	Peak Inflow (cms)	Peak Outflow (cms)	Attenuated Flow (cms)
R1	3.402	3.399	0.00
R2	1.480	1.462	0.02

Sub-basins

Subbasin ID:	Villa			
Scenario:	**10% AEP**		**Depth**	**Volume**
Peak discharge:	6.78 cms	**Time of peak:**	09 Oct 2022, 12:30	
Drainage area:	42.675 ha	**Total rainfall:**	163.2 mm	69,649.065 m³
Initial abstraction:	4.8 mm	**Losses:**	5.3 mm	2,260.508 m³
Curve Number:	91	**Precip excess:**	157.9 mm	67,388.557 m³
Impervious surface:	80%	**Direct runoff:**	156.2 mm	66,658.09 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	34 minutes	**Total runoff:**	156.2 mm	66,658.09 m³



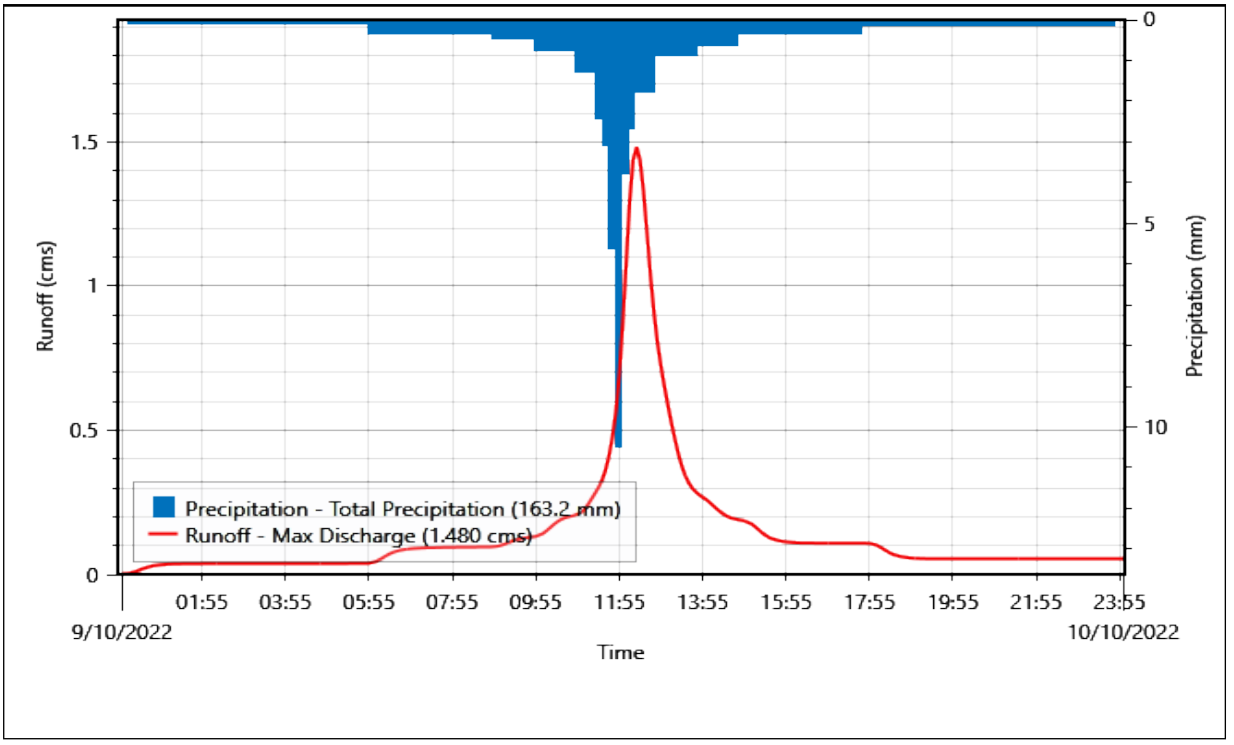
Subbasin ID:	Weddings-A			
Scenario:	**10% AEP**		**Depth**	**Volume**
Peak discharge:	2.04 cms	**Time of peak:**	09 Oct 2022, 12:30	
Drainage area:	13.154 ha	**Total rainfall:**	163.2 mm	21,459.354 m³
Initial abstraction:	6.7 mm	**Losses:**	3.5 mm	461.032 m³
Curve Number:	88	**Precip excess:**	159.7 mm	20,998.322 m³
Impervious surface:	90%	**Direct runoff:**	157.9 mm	20,760.13 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	36 minutes	**Total runoff:**	157.9 mm	20,760.13 m³



Subbasin ID:	Weddings-B			
Scenario:	**10% AEP**		**Depth**	**Volume**
Peak discharge:	1.48 cms	**Time of peak:**	09 Oct 2022, 12:20	
Drainage area:	8.084 ha	**Total rainfall:**	163.2 mm	13,185.671 m³
Initial abstraction:	6.7 mm	**Losses:**	5.3 mm	424.921 m³
Curve Number:	88	**Precip excess:**	157.9 mm	12,760.751 m³
Impervious surface:	85%	**Direct runoff:**	156.7 mm	12,658.61 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	25 minutes	**Total runoff:**	156.7 mm	12,658.61 m³

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	Length (m)	Slope (m/m)	Velocity (m/s)	Description
4	6.146	0.09637	1.1533	Sheet Flow
2	65.380	0.07375	8.9680	Shallow Concentrated Flow
7	116.517	0.01651	4.2426	Shallow Concentrated Flow
24	437.417	0.00235	1.6001	Shallow Concentrated Flow
0	30.767	0.04420	7.8106	Channel Flow
38	**656.227**	**Total**	**Lag Time = 23 minutes**	



Scenario 03 -1% AEP

Sub-Basin Flow Summary

Subbasin ID	Drainage Area (ha)	Initial Abstraction (mm)	Curve Number	Impervious Surface (%)	Lag Time (minutes)	Peak Discharge (cms)
Villa	42.675	4.8	91	80	34	9.97
Weddings-A	13.154	6.7	88	90	36	2.99
Weddings-B	8.084	6.7	88	85	25	2.18

Nodes

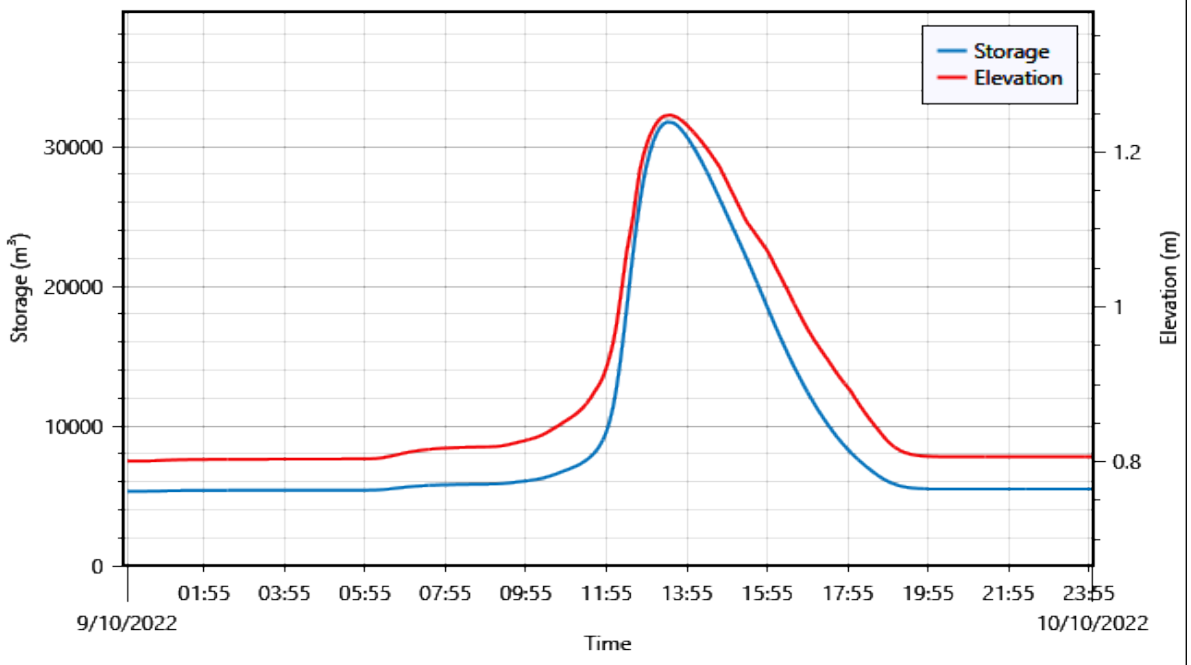
Element ID	Element Type	Peak Inflow (cms)	Peak Outflow (cms)	Peak Diverted Flow (cms)
N1	Junction	5.000	5.000	
N2	Junction	2.179	2.179	
Outlet	Sink	8.410		

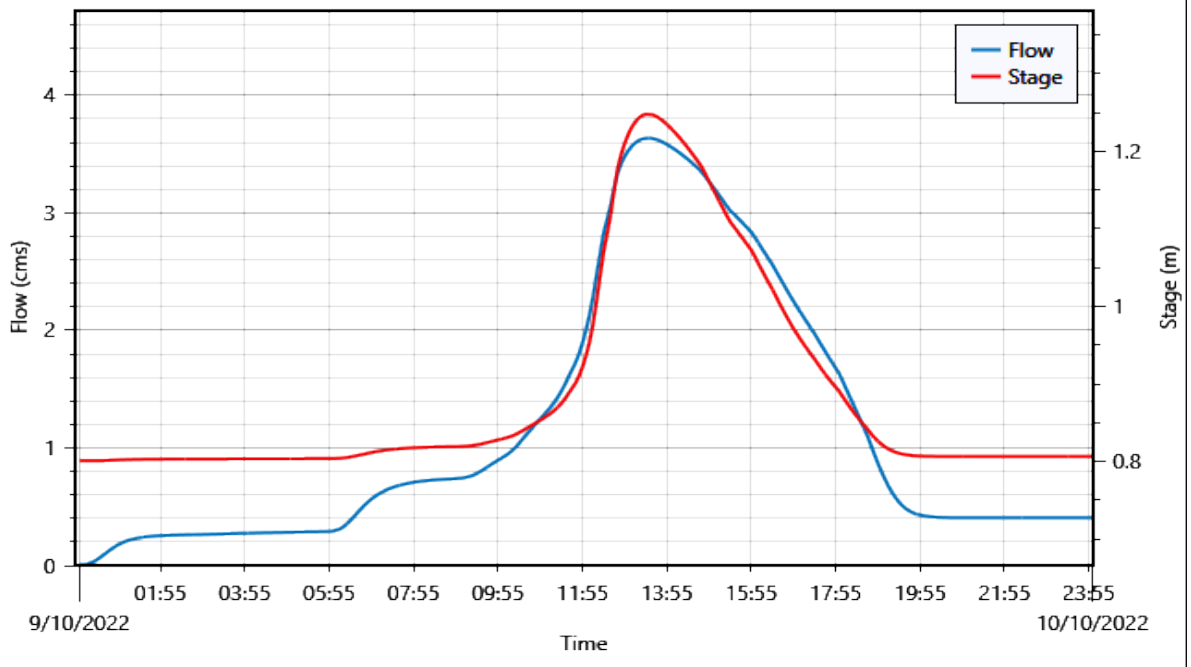
Routing Reaches

Reach ID	Peak Inflow (cms)	Peak Outflow (cms)	Attenuated Flow (cms)
R1	5.000	4.997	0.00
R2	2.179	2.153	0.03

Detention Storage

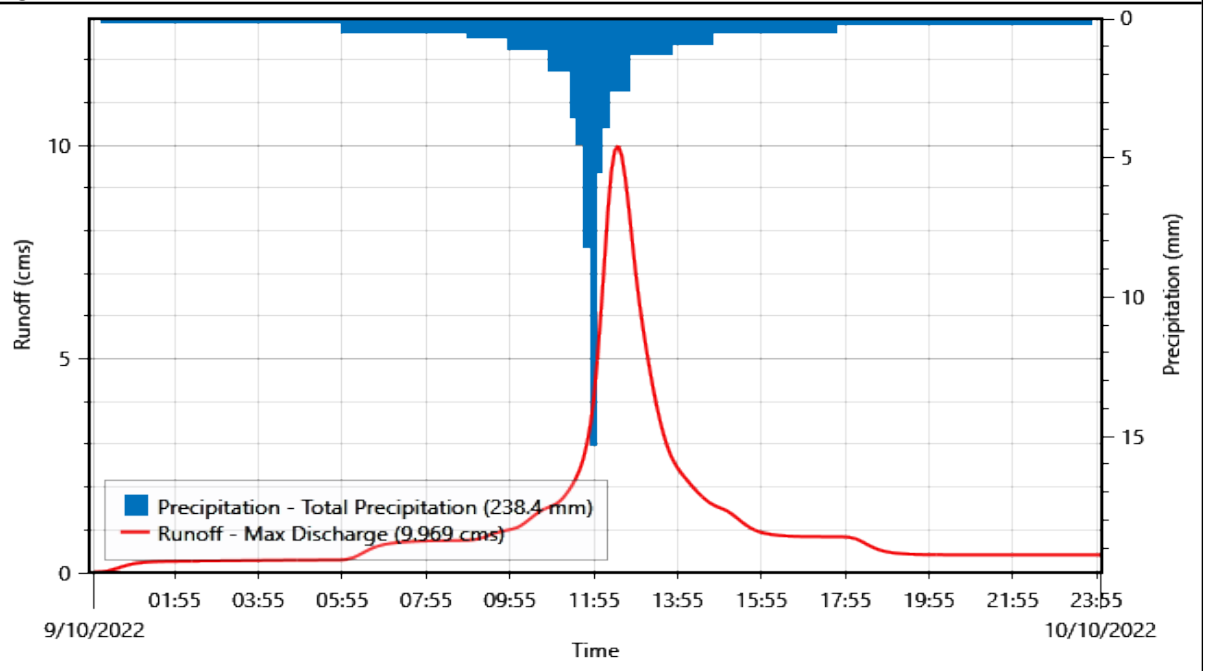
Storage Area ID:	**Pond**		
Scenario:	**1% AEP**		
Peak storage:	31,712.31 m³		
Peak elevation:	1.247 m	**Peak Volume**	**Time of Peak**
Peak inflow:	9.97 cms	98,342.86 m³	09Oct2022, 12:30
Peak outflow:	3.63 cms	98,191.87 m³	09Oct2022, 13:30



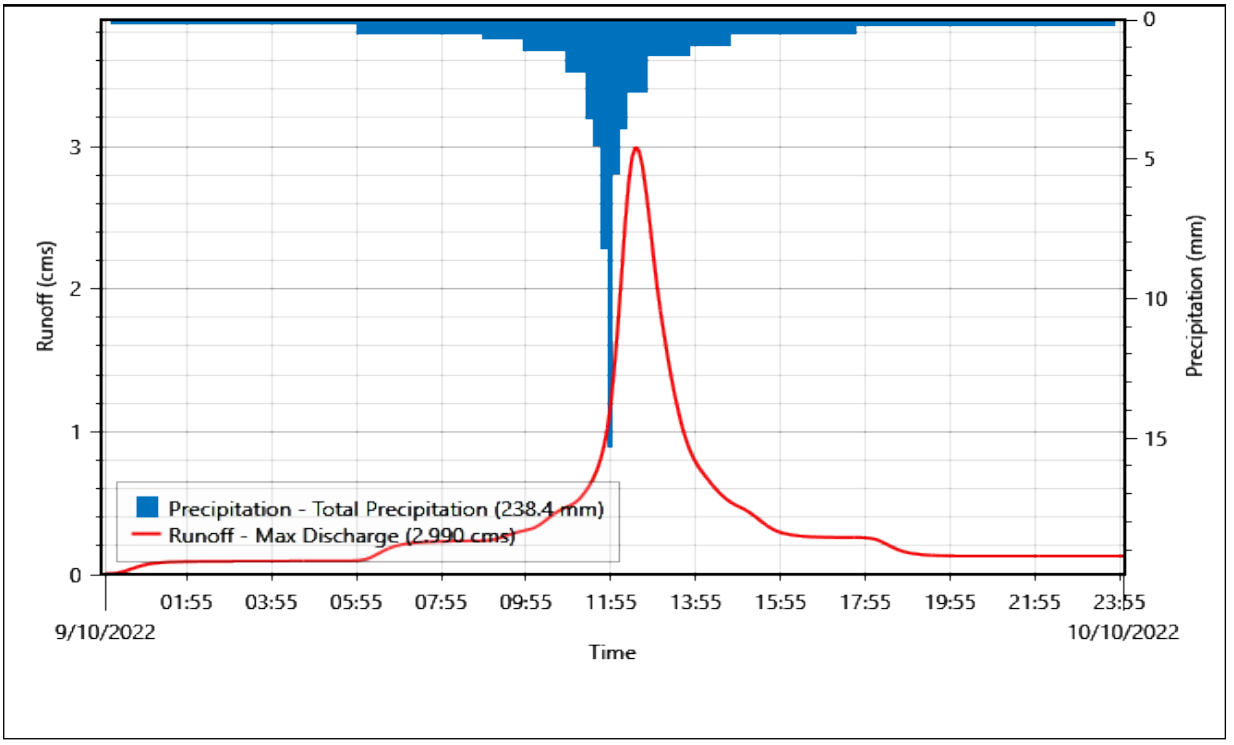


Sub-basins

Subbasin ID:	Villa			
Scenario:	**1% AEP**		**Depth**	**Volume**
Peak discharge:	9.97 cms	**Time of peak:**	09 Oct 2022, 12:30	
Drainage area:	42.675 ha	**Total rainfall:**	238.4 mm	101,758.936 m³
Initial abstraction:	4.8 mm	**Losses:**	5.5 mm	2,345.859 m³
Curve Number:	91	**Precip excess:**	232.9 mm	99,413.077 m³
Impervious surface:	80%	**Direct runoff:**	230.4 mm	98,342.86 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	34 minutes	**Total runoff:**	230.4 mm	98,342.86 m³



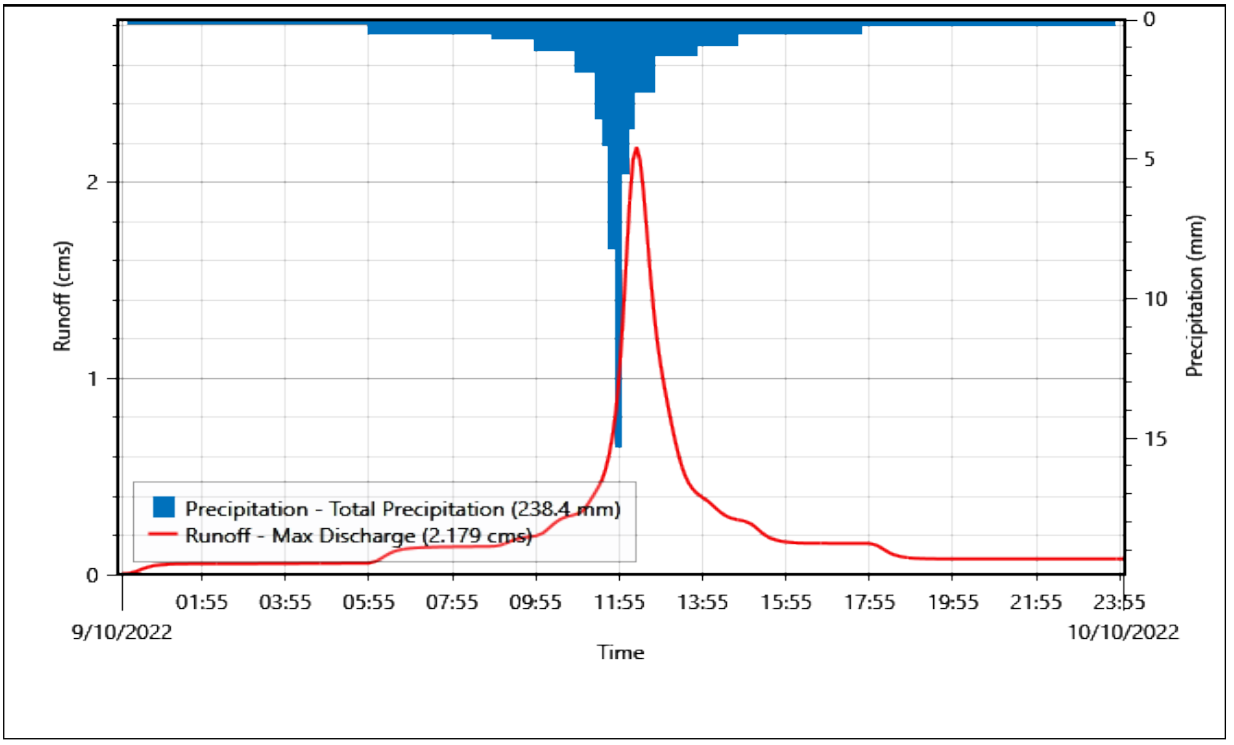
Subbasin ID:	Weddings-A			
Scenario:	**1% AEP**		**Depth**	**Volume**
Peak discharge:	2.99 cms	**Time of peak:**	09 Oct 2022, 12:30	
Drainage area:	13.154 ha	**Total rainfall:**	238.4 mm	31,352.624 m³
Initial abstraction:	6.7 mm	**Losses:**	3.7 mm	484.346 m³
Curve Number:	88	**Precip excess:**	234.7 mm	30,868.279 m³
Impervious surface:	90%	**Direct runoff:**	232.1 mm	30,519.39 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	36 minutes	**Total runoff:**	232.1 mm	30,519.39 m³



Subbasin ID:	**Weddings-B**			
Scenario:	**1% AEP**		**Depth**	**Volume**
Peak discharge:	2.18 cms	**Time of peak:**	09 Oct 2022, 12:20	
Drainage area:	8.084 ha	**Total rainfall:**	238.4 mm	19,264.578 m³
Initial abstraction:	6.7 mm	**Losses:**	5.5 mm	446.408 m³
Curve Number:	88	**Precip excess:**	232.9 mm	18,818.170 m³
Impervious surface:	85%	**Direct runoff:**	231.0 mm	18,668.44 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	25 minutes	**Total runoff:**	231.0 mm	18,668.44 m³

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	Length (m)	Slope (m/m)	Velocity (m/s)	Description
4	6.146	0.09637	1.1533	Sheet Flow
2	65.380	0.07375	8.9680	Shallow Concentrated Flow
7	116.517	0.01651	4.2426	Shallow Concentrated Flow
24	437.417	0.00235	1.6001	Shallow Concentrated Flow
0	30.767	0.04420	7.8106	Channel Flow
38	**656.227**	**Total**	**Lag Time = 23 minutes**	



Scenario 03 -10% AEP

Sub-Basin Flow Summary

Subbasin ID	Drainage Area (ha)	Initial Abstraction (mm)	Curve Number	Impervious Surface (%)	Lag Time (minutes)	Peak Discharge (cms)
Villa	42.675	4.8	91	80	34	6.78
Weddings-A	13.154	6.7	88	90	36	2.04
Weddings-B	8.084	6.7	88	85	25	1.48

Nodes

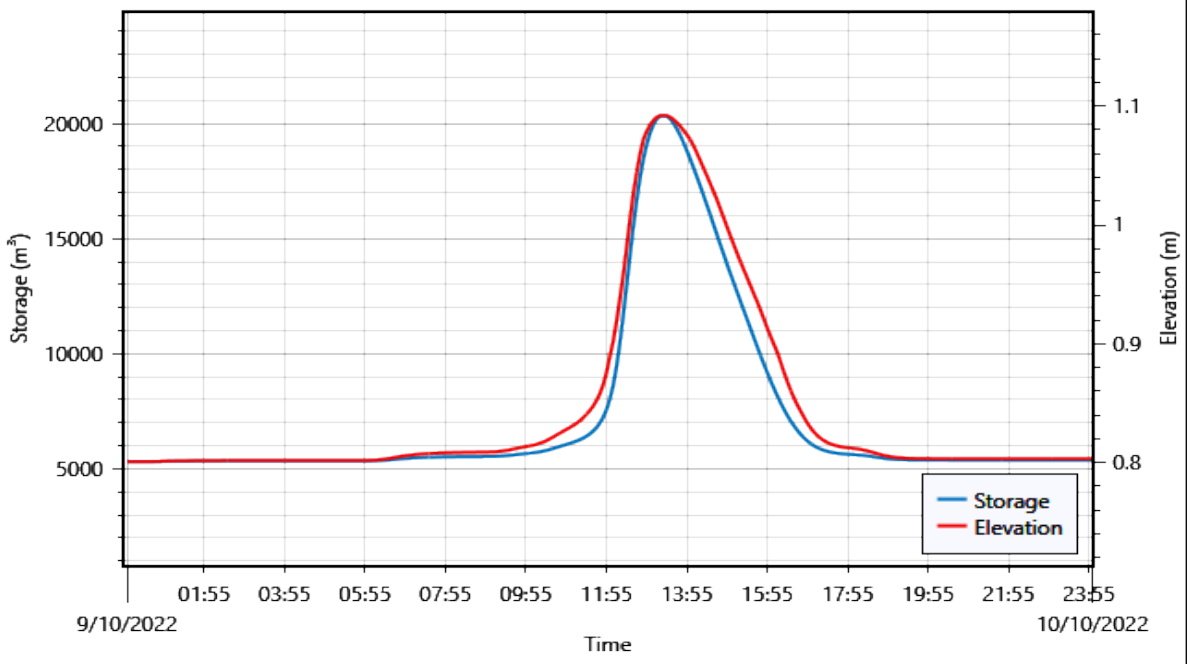
Element ID	Element Type	Peak Inflow (cms)	Peak Outflow (cms)	Peak Diverted Flow (cms)
N1	Junction	3.402	3.402	
N2	Junction	1.480	1.480	
Outlet	Sink	6.228		

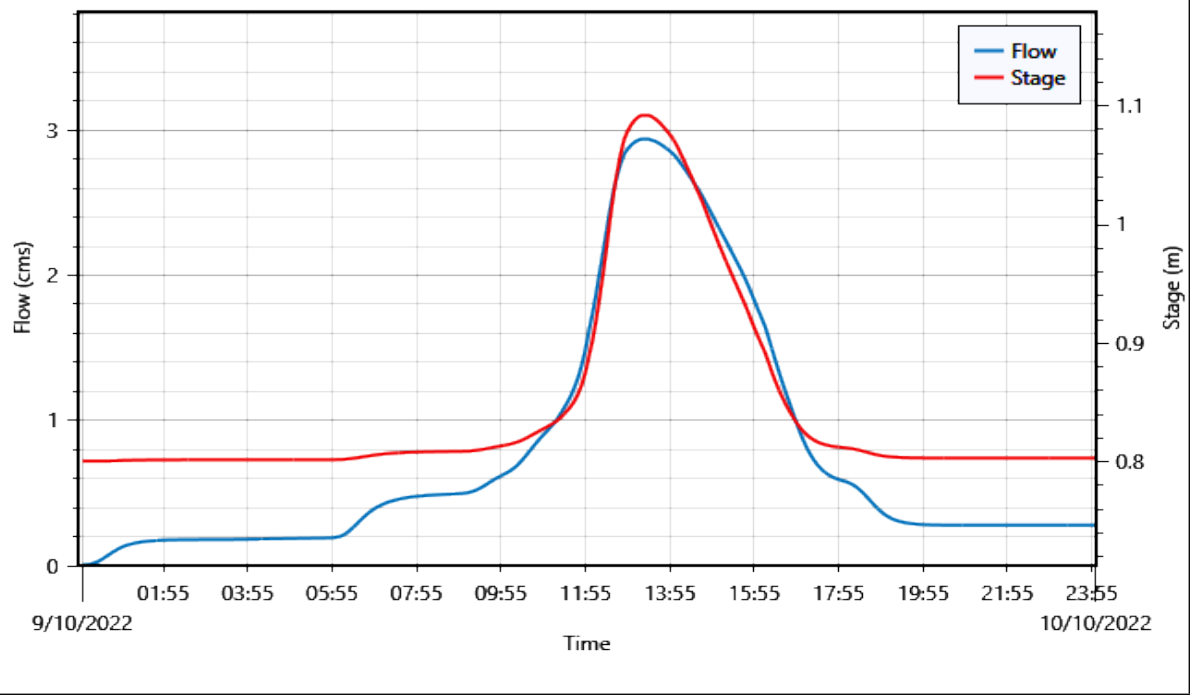
Routing Reaches

Reach ID	Peak Inflow (cms)	Peak Outflow (cms)	Attenuated Flow (cms)
R1	3.402	3.399	0.00
R2	1.480	1.462	0.02

Detention Storage

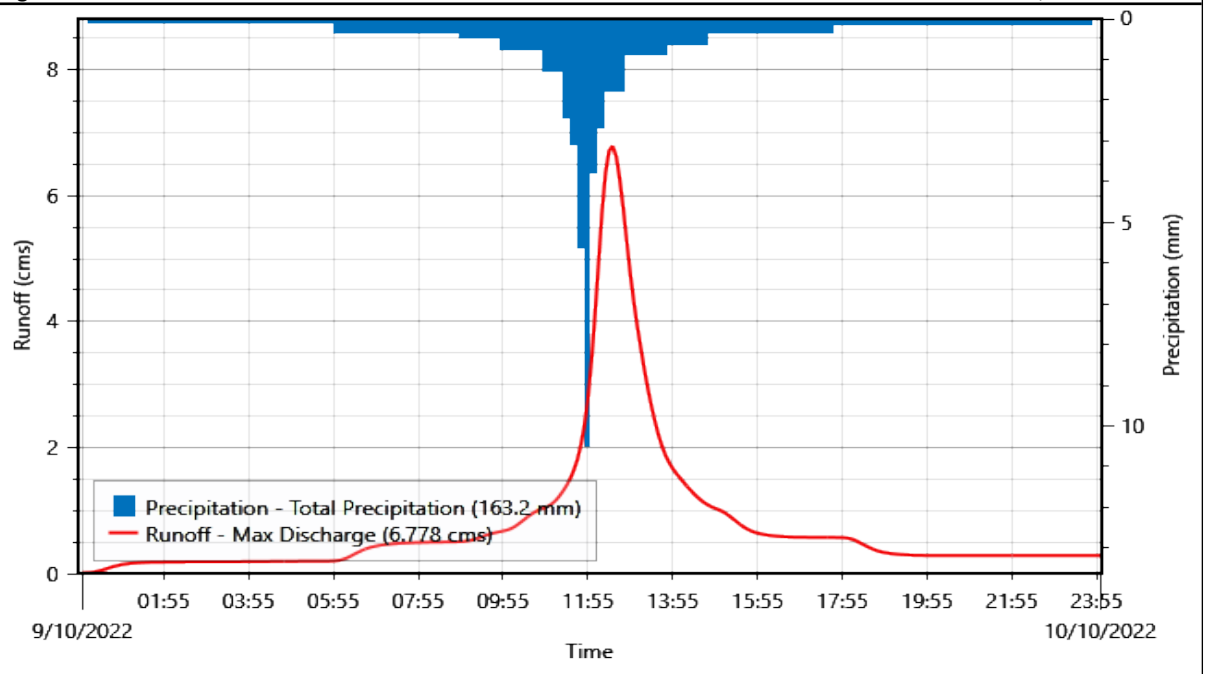
Storage Area ID:	**Pond**		
Scenario:	**10% AEP**		
Peak storage:	20,341.84 m³		
Peak elevation:	1.092 m	**Peak Volume**	**Time of Peak**
Peak inflow:	6.78 cms	66,658.09 m³	09Oct2022, 12:30
Peak outflow:	2.94 cms	66,588.42 m³	09Oct2022, 13:20



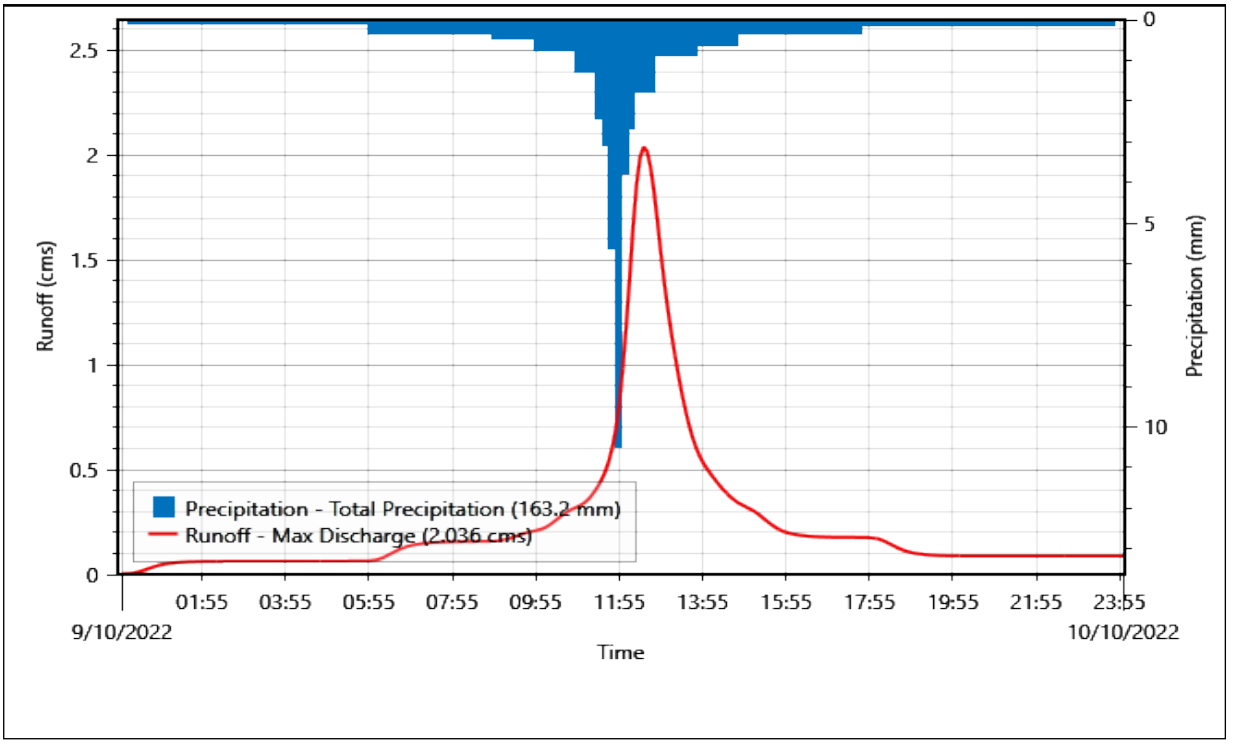


Sub-basins

Subbasin ID:	Villa			
Scenario:	**10% AEP**		**Depth**	**Volume**
Peak discharge:	6.78 cms	**Time of peak:**	09 Oct 2022, 12:30	
Drainage area:	42.675 ha	**Total rainfall:**	163.2 mm	69,649.065 m³
Initial abstraction:	4.8 mm	**Losses:**	5.3 mm	2,260.508 m³
Curve Number:	91	**Precip excess:**	157.9 mm	67,388.557 m³
Impervious surface:	80%	**Direct runoff:**	156.2 mm	66,658.09 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	34 minutes	**Total runoff:**	156.2 mm	66,658.09 m³



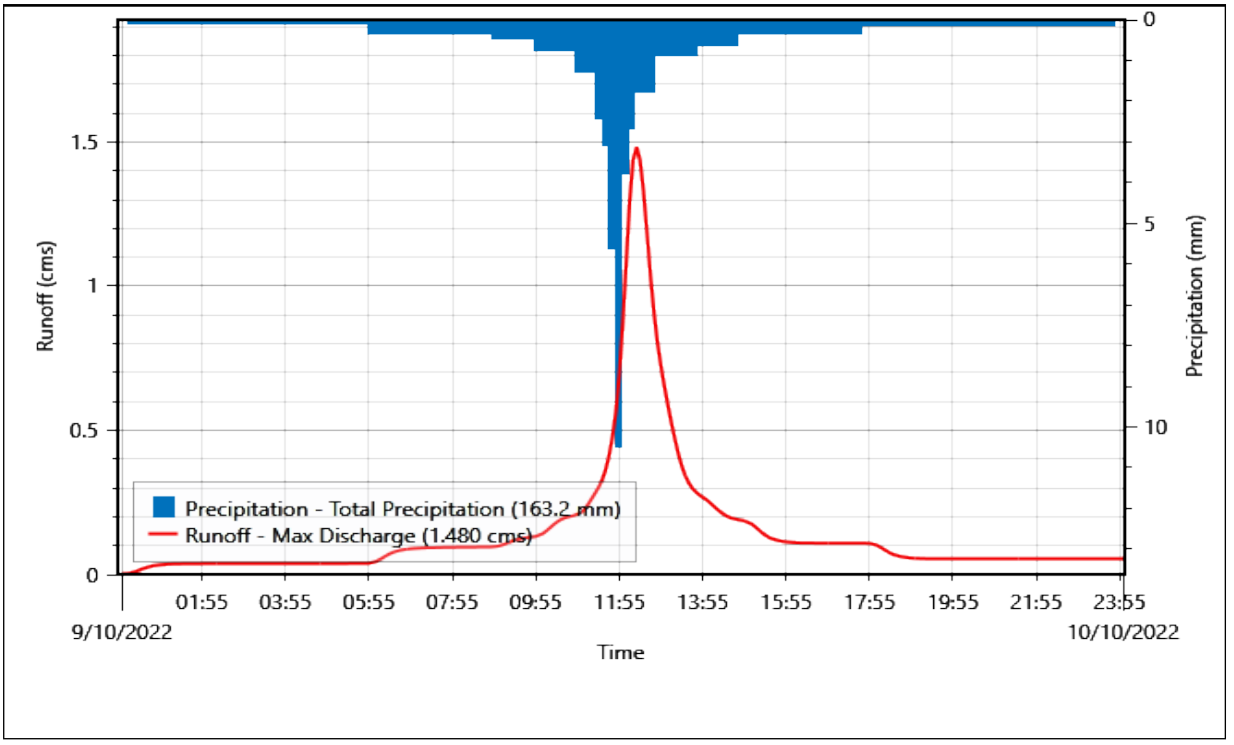
Subbasin ID:	Weddings-A			
Scenario:	**10% AEP**		**Depth**	**Volume**
Peak discharge:	2.04 cms	**Time of peak:**	09 Oct 2022, 12:30	
Drainage area:	13.154 ha	**Total rainfall:**	163.2 mm	21,459.354 m³
Initial abstraction:	6.7 mm	**Losses:**	3.5 mm	461.032 m³
Curve Number:	88	**Precip excess:**	159.7 mm	20,998.322 m³
Impervious surface:	90%	**Direct runoff:**	157.9 mm	20,760.13 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	36 minutes	**Total runoff:**	157.9 mm	20,760.13 m³



Subbasin ID:	Weddings-B			
Scenario:	**10% AEP**		**Depth**	**Volume**
Peak discharge:	1.48 cms	**Time of peak:**	09 Oct 2022, 12:20	
Drainage area:	8.084 ha	**Total rainfall:**	163.2 mm	13,185.671 m³
Initial abstraction:	6.7 mm	**Losses:**	5.3 mm	424.921 m³
Curve Number:	88	**Precip excess:**	157.9 mm	12,760.751 m³
Impervious surface:	85%	**Direct runoff:**	156.7 mm	12,658.61 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	25 minutes	**Total runoff:**	156.7 mm	12,658.61 m³

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	Length (m)	Slope (m/m)	Velocity (m/s)	Description
4	6.146	0.09637	1.1533	Sheet Flow
2	65.380	0.07375	8.9680	Shallow Concentrated Flow
7	116.517	0.01651	4.2426	Shallow Concentrated Flow
24	437.417	0.00235	1.6001	Shallow Concentrated Flow
0	30.767	0.04420	7.8106	Channel Flow
38	**656.227**	**Total**	**Lag Time = 23 minutes**	



Scenario 04 -1% AEP

Sub-Basin Flow Summary

Subbasin ID	Drainage Area (ha)	Initial Abstraction (mm)	Curve Number	Impervious Surface (%)	Lag Time (minutes)	Peak Discharge (cms)
Villa	42.675	4.8	91	80	34	9.97
Weddings-A	13.154	6.7	88	90	36	2.99
Weddings-B	8.084	6.7	88	85	25	2.18

Nodes

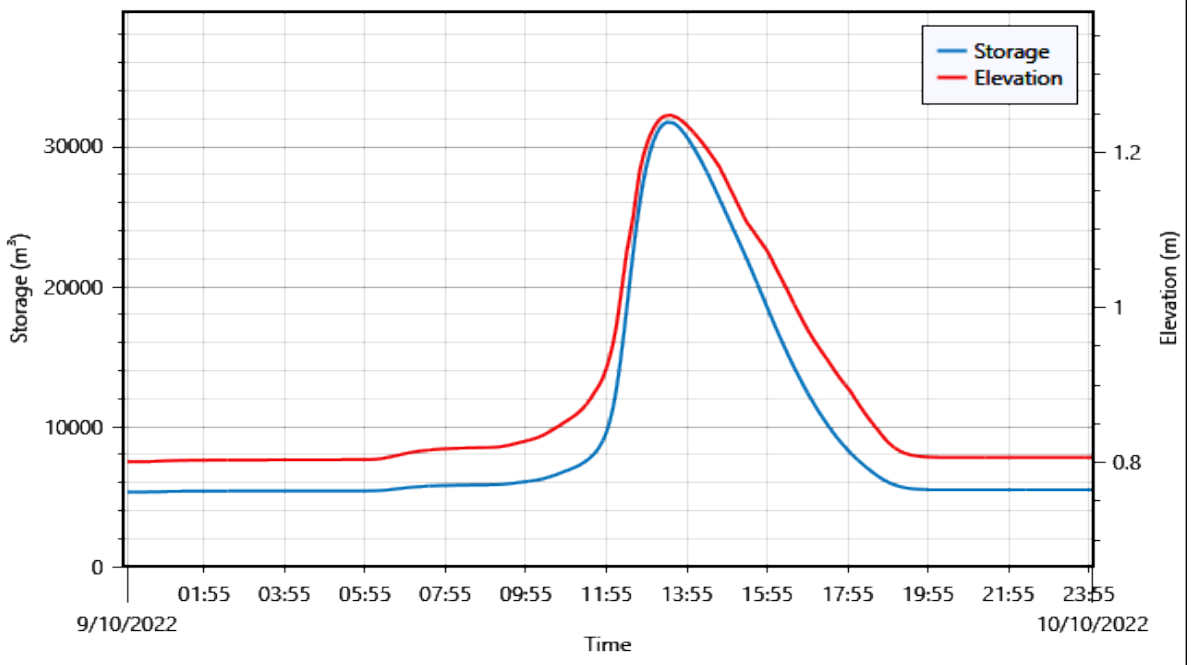
Element ID	Element Type	Peak Inflow (cms)	Peak Outflow (cms)	Peak Diverted Flow (cms)
Montgomerie Outlet	Sink	4.997		
N1	Junction	5.000	5.000	
N2	Junction	2.179	2.179	
Oruarangi Outlet	Sink	3.631		

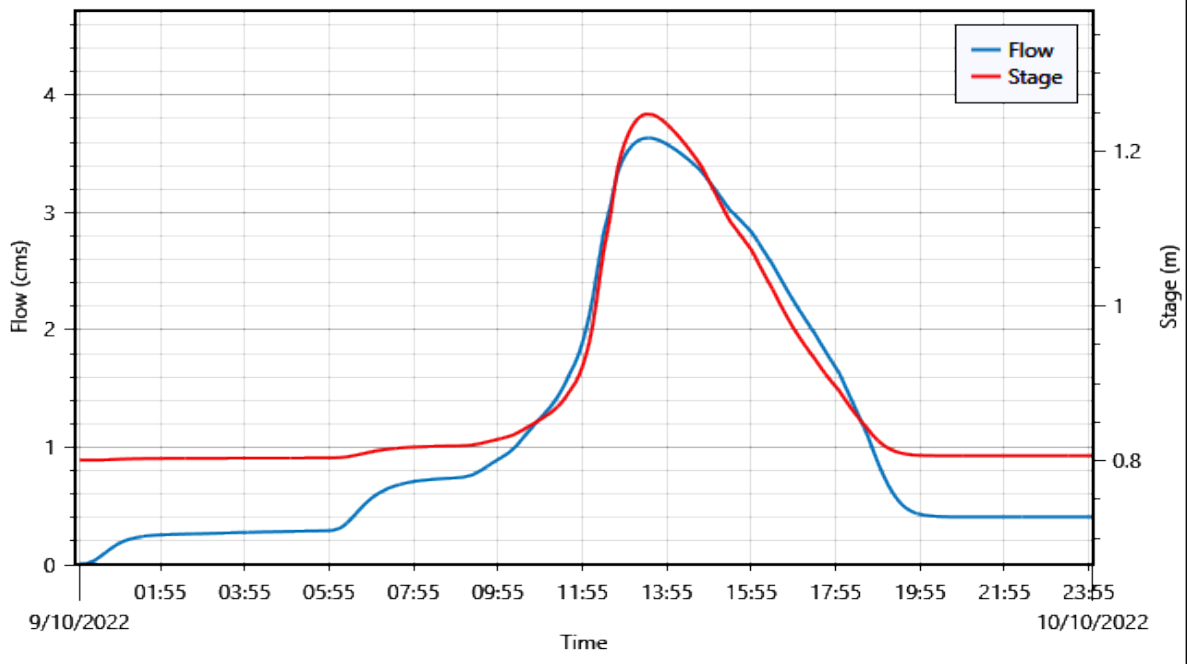
Routing Reaches

Reach ID	Peak Inflow (cms)	Peak Outflow (cms)	Attenuated Flow (cms)
R1	5.000	4.997	0.00
R2	2.179	2.153	0.03

Detention Storage

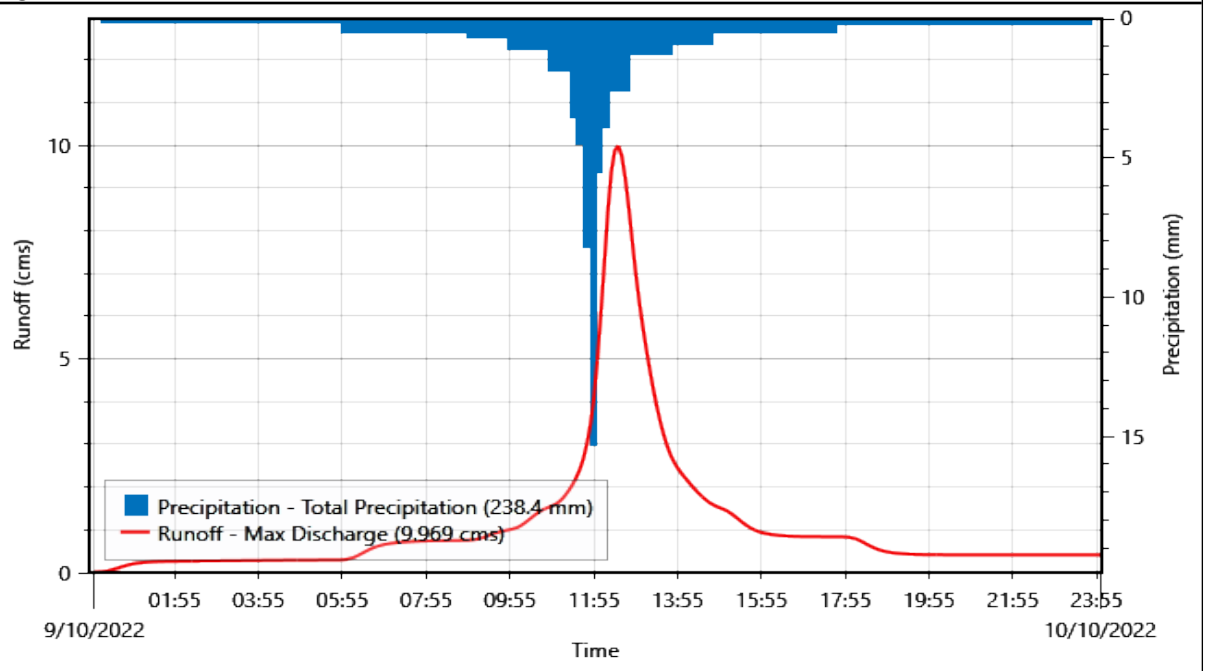
Storage Area ID:	**Pond**		
Scenario:	**1% AEP**		
Peak storage:	31,712.22 m³		
Peak elevation:	1.247 m	**Peak Volume**	**Time of Peak**
Peak inflow:	9.97 cms	98,342.86 m³	09Oct2022, 12:30
Peak outflow:	3.63 cms	98,191.87 m³	09Oct2022, 13:30



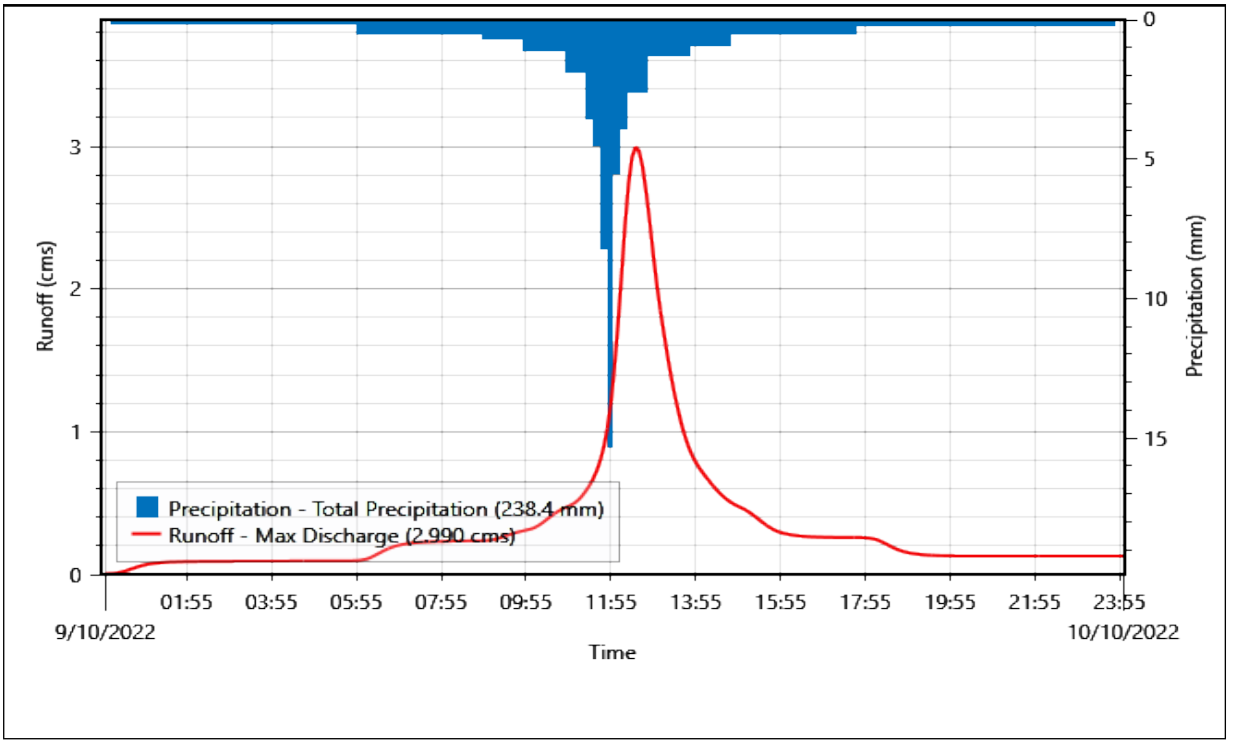


Sub-basins

Subbasin ID:	Villa			
Scenario:	**1% AEP**		**Depth**	**Volume**
Peak discharge:	9.97 cms	**Time of peak:**	09 Oct 2022, 12:30	
Drainage area:	42.675 ha	**Total rainfall:**	238.4 mm	101,758.936 m³
Initial abstraction:	4.8 mm	**Losses:**	5.5 mm	2,345.859 m³
Curve Number:	91	**Precip excess:**	232.9 mm	99,413.077 m³
Impervious surface:	80%	**Direct runoff:**	230.4 mm	98,342.86 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	34 minutes	**Total runoff:**	230.4 mm	98,342.86 m³



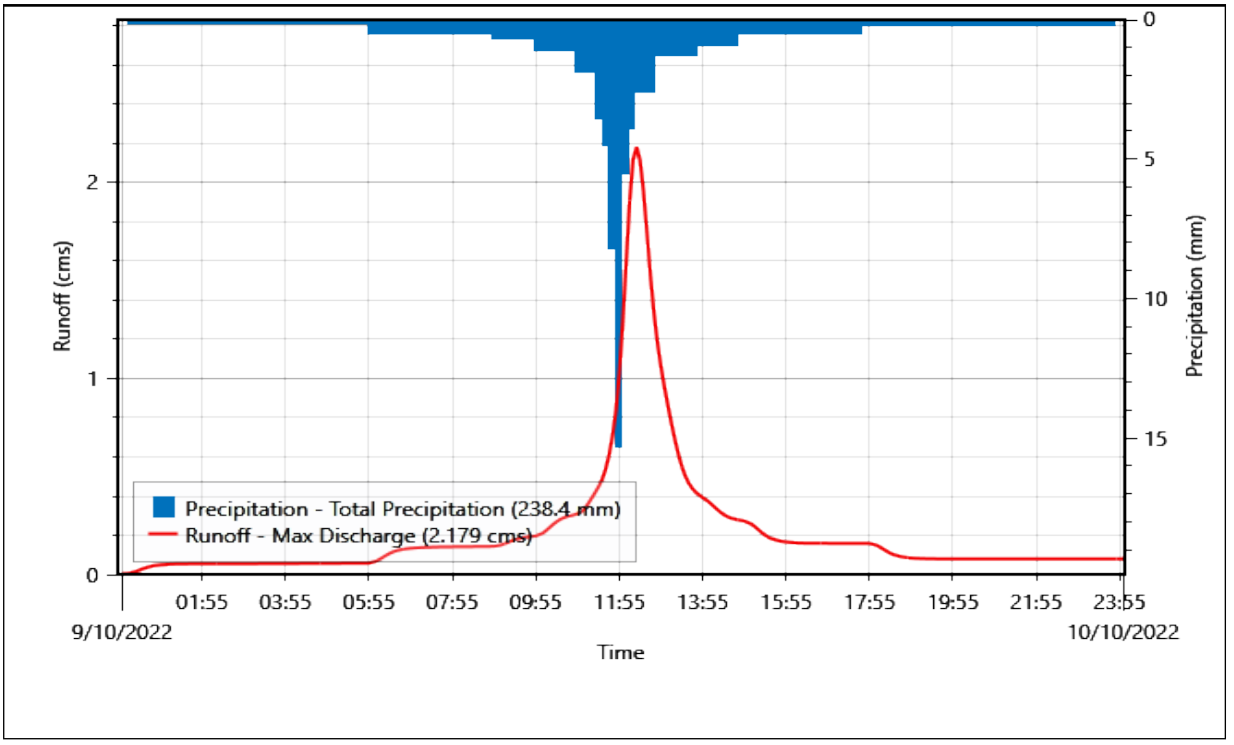
Subbasin ID:	Weddings-A			
Scenario:	**1% AEP**		**Depth**	**Volume**
Peak discharge:	2.99 cms	**Time of peak:**	09 Oct 2022, 12:30	
Drainage area:	13.154 ha	**Total rainfall:**	238.4 mm	31,352.624 m³
Initial abstraction:	6.7 mm	**Losses:**	3.7 mm	484.346 m³
Curve Number:	88	**Precip excess:**	234.7 mm	30,868.279 m³
Impervious surface:	90%	**Direct runoff:**	232.1 mm	30,519.39 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	36 minutes	**Total runoff:**	232.1 mm	30,519.39 m³



Subbasin ID:	**Weddings-B**			
Scenario:	**1% AEP**		**Depth**	**Volume**
Peak discharge:	2.18 cms	**Time of peak:**	09 Oct 2022, 12:20	
Drainage area:	8.084 ha	**Total rainfall:**	238.4 mm	19,264.578 m³
Initial abstraction:	6.7 mm	**Losses:**	5.5 mm	446.408 m³
Curve Number:	88	**Precip excess:**	232.9 mm	18,818.170 m³
Impervious surface:	85%	**Direct runoff:**	231.0 mm	18,668.44 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	25 minutes	**Total runoff:**	231.0 mm	18,668.44 m³

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	Length (m)	Slope (m/m)	Velocity (m/s)	Description
4	6.146	0.09637	1.1533	Sheet Flow
2	65.380	0.07375	8.9680	Shallow Concentrated Flow
7	116.517	0.01651	4.2426	Shallow Concentrated Flow
24	437.417	0.00235	1.6001	Shallow Concentrated Flow
0	30.767	0.04420	7.8106	Channel Flow
38	**656.227**	**Total**	**Lag Time = 23 minutes**	



Scenario 04 -10% AEP

Sub-Basin Flow Summary

Subbasin ID	Drainage Area (ha)	Initial Abstraction (mm)	Curve Number	Impervious Surface (%)	Lag Time (minutes)	Peak Discharge (cms)
Villa	42.675	4.8	91	80	34	6.78
Weddings-A	13.154	6.7	88	90	36	2.04
Weddings-B	8.084	6.7	88	85	25	1.48

Nodes

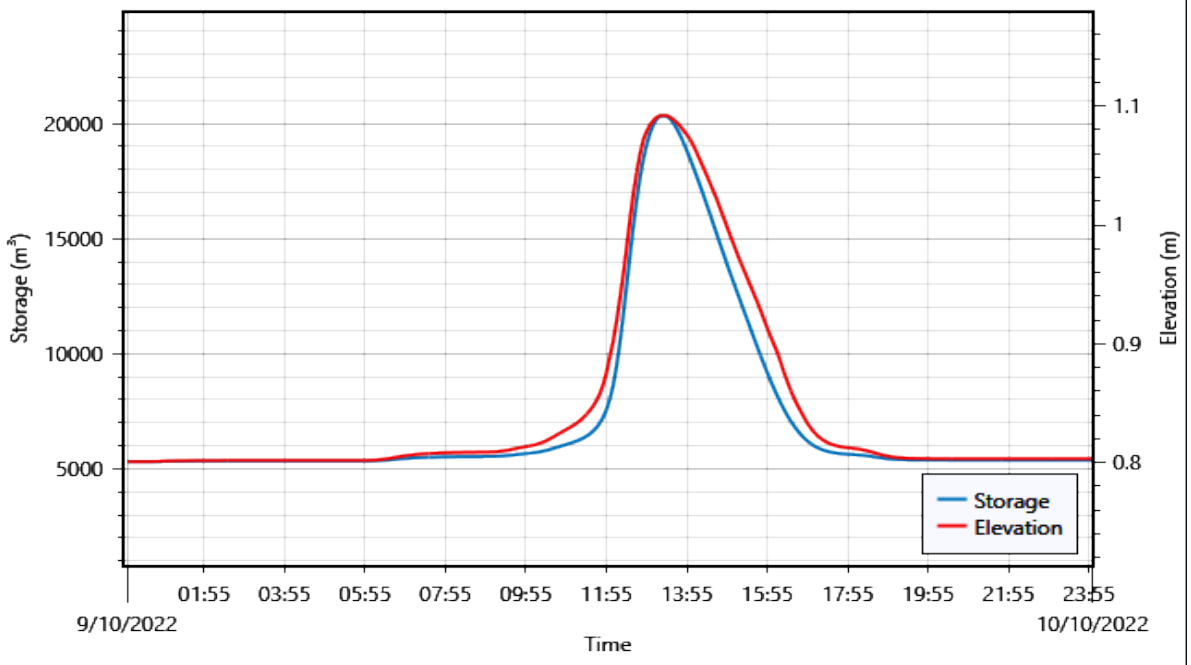
Element ID	Element Type	Peak Inflow (cms)	Peak Outflow (cms)	Peak Diverted Flow (cms)
Montgomerie Outlet	Sink	3.399		
N1	Junction	3.402	3.402	
N2	Junction	1.480	1.480	
Oruarangi Outlet	Sink	2.935		

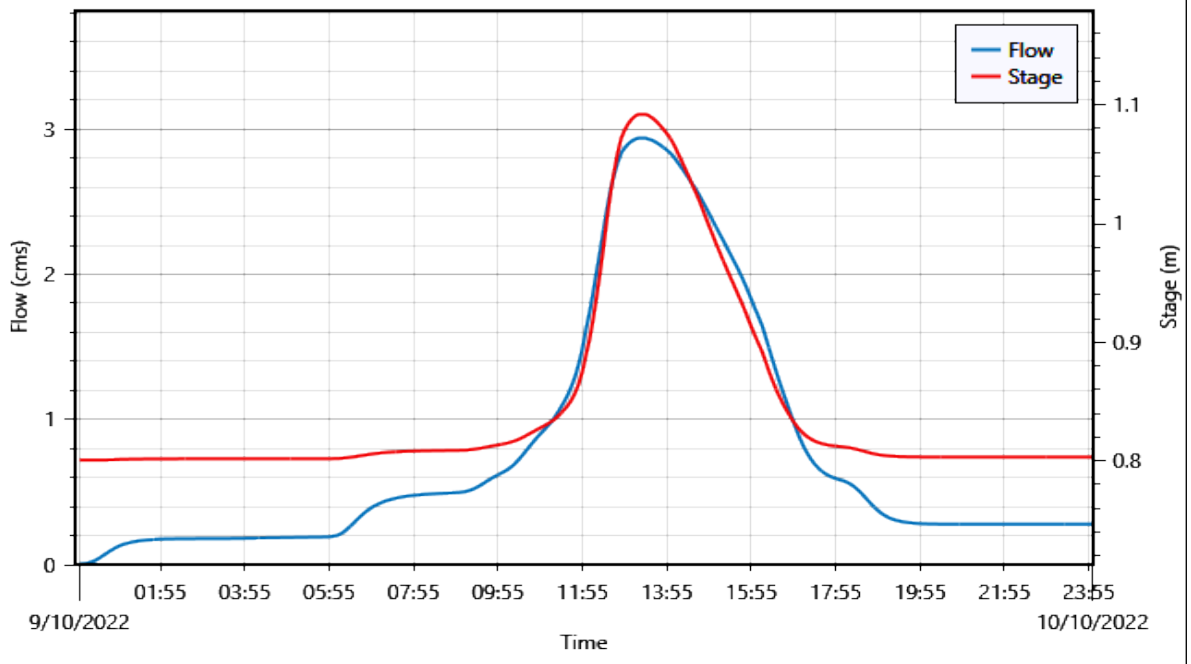
Routing Reaches

Reach ID	Peak Inflow (cms)	Peak Outflow (cms)	Attenuated Flow (cms)
R1	3.402	3.399	0.00
R2	1.480	1.462	0.02

Detention Storage

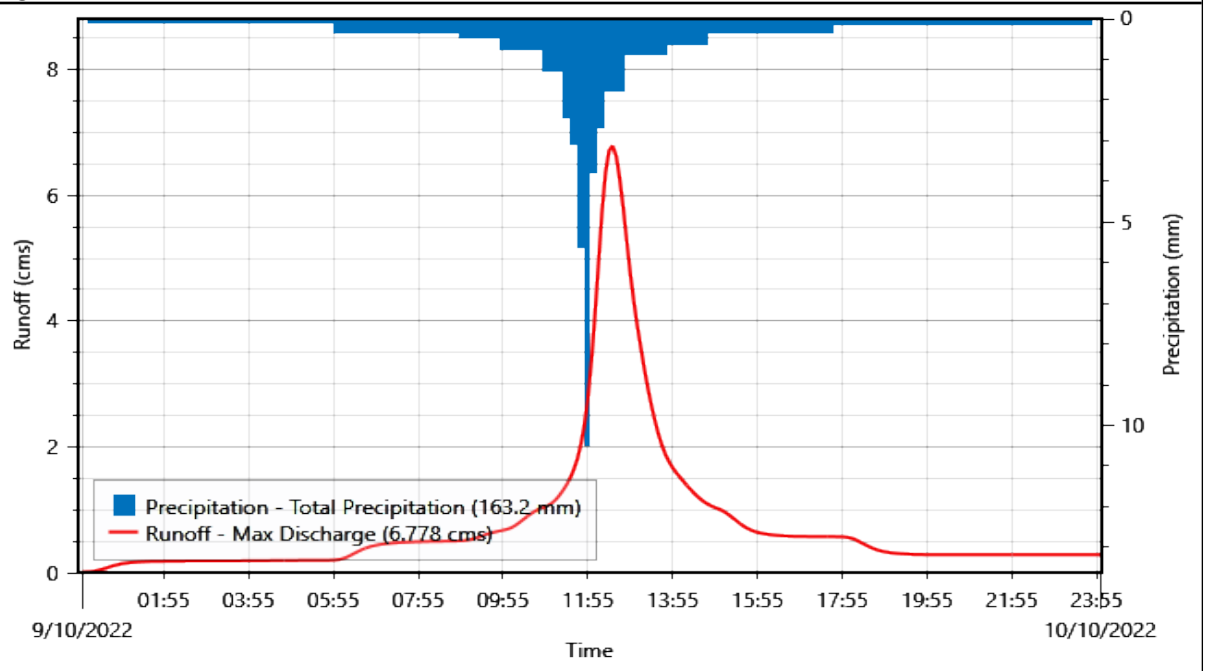
Storage Area ID:	**Pond**		
Scenario:	**10% AEP**		
Peak storage:	20,341.78 m³		
Peak elevation:	1.092 m	**Peak Volume**	**Time of Peak**
Peak inflow:	6.78 cms	66,658.09 m³	09Oct2022, 12:30
Peak outflow:	2.94 cms	66,588.42 m³	09Oct2022, 13:20



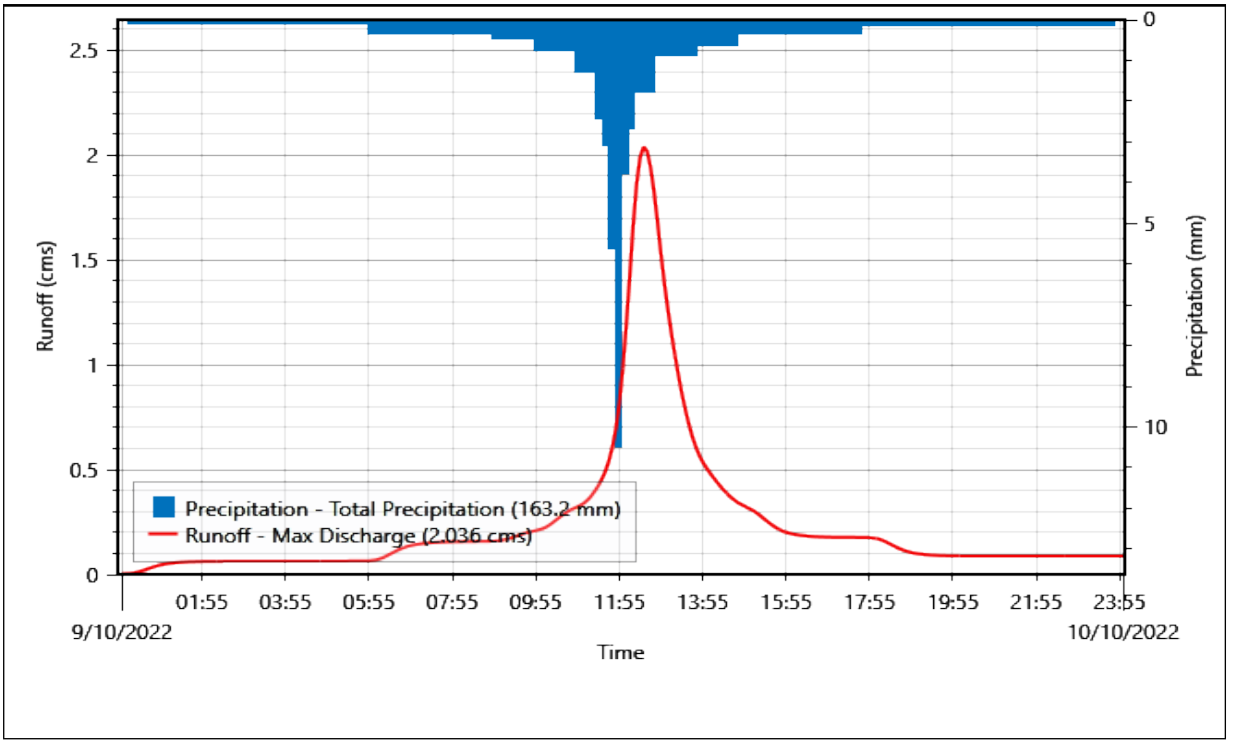


Sub-basins

Subbasin ID:	Villa			
Scenario:	**10% AEP**		**Depth**	**Volume**
Peak discharge:	6.78 cms	**Time of peak:**	09 Oct 2022, 12:30	
Drainage area:	42.675 ha	**Total rainfall:**	163.2 mm	69,649.065 m³
Initial abstraction:	4.8 mm	**Losses:**	5.3 mm	2,260.508 m³
Curve Number:	91	**Precip excess:**	157.9 mm	67,388.557 m³
Impervious surface:	80%	**Direct runoff:**	156.2 mm	66,658.09 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	34 minutes	**Total runoff:**	156.2 mm	66,658.09 m³



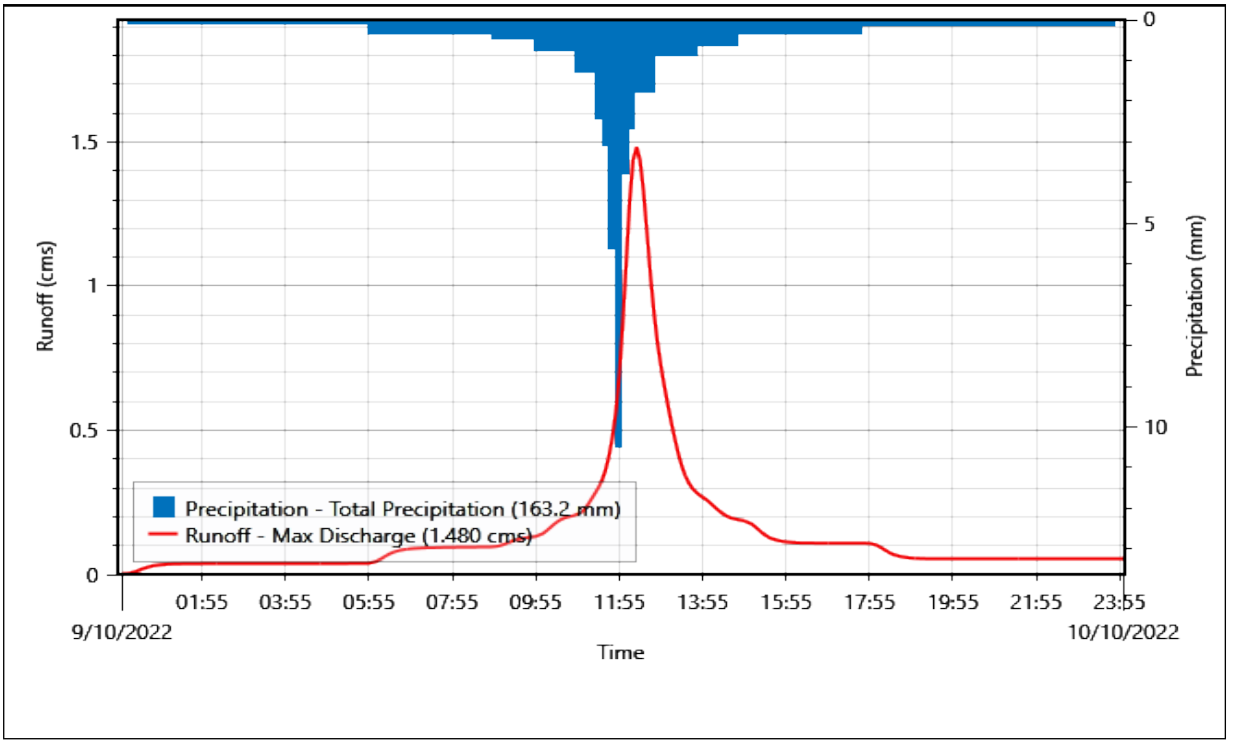
Subbasin ID:	Weddings-A			
Scenario:	**10% AEP**		**Depth**	**Volume**
Peak discharge:	2.04 cms	**Time of peak:**	09 Oct 2022, 12:30	
Drainage area:	13.154 ha	**Total rainfall:**	163.2 mm	21,459.354 m³
Initial abstraction:	6.7 mm	**Losses:**	3.5 mm	461.032 m³
Curve Number:	88	**Precip excess:**	159.7 mm	20,998.322 m³
Impervious surface:	90%	**Direct runoff:**	157.9 mm	20,760.13 m³
Peaking factor:	484	**Baseflow:**	0.0 mm	0.00 m³
Lag time:	36 minutes	**Total runoff:**	157.9 mm	20,760.13 m³



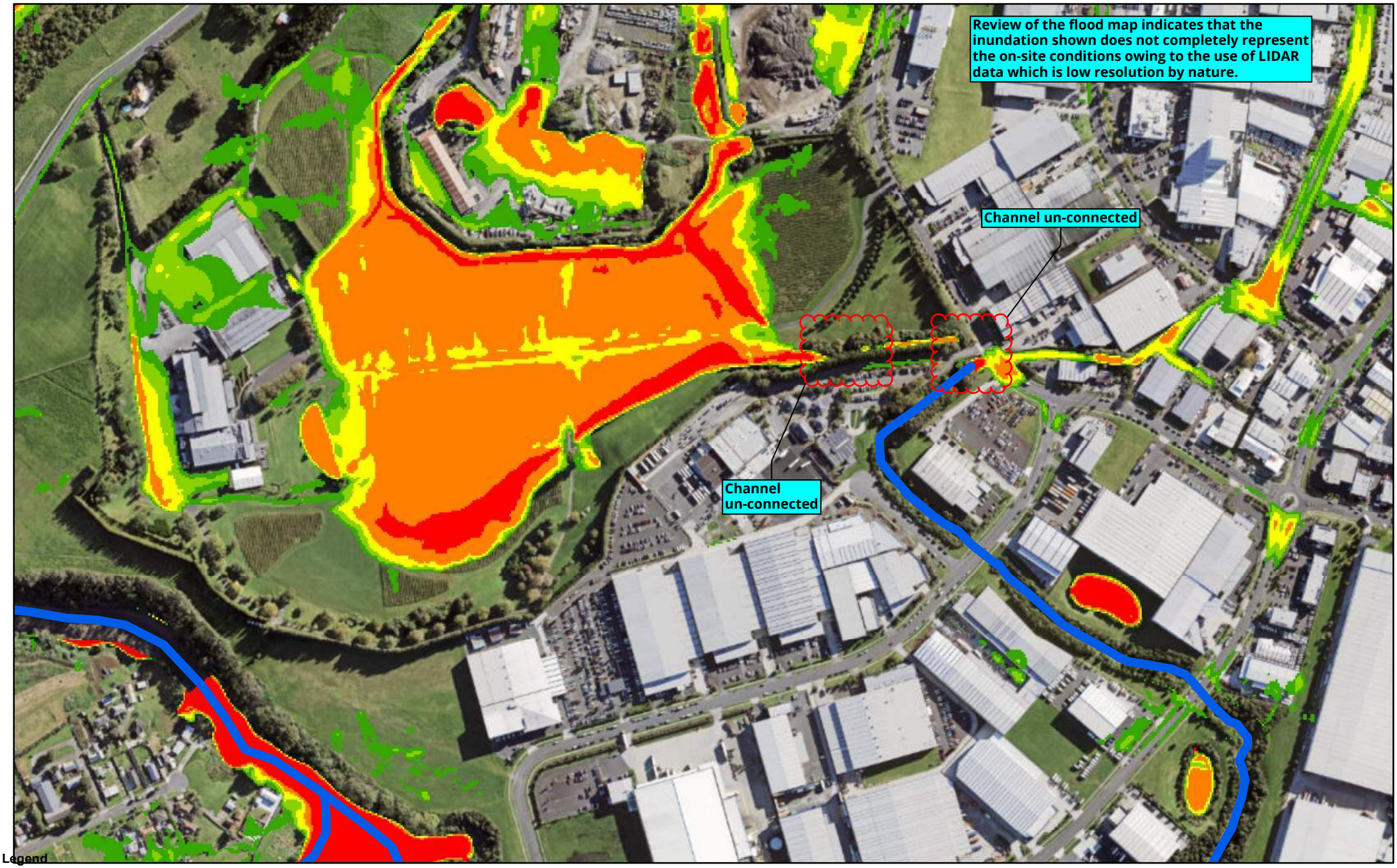
Subbasin ID:	Weddings-B			
Scenario:	10% AEP		Depth	Volume
Peak discharge:	1.48 cms	Time of peak:	09 Oct 2022, 12:20	
Drainage area:	8.084 ha	Total rainfall:	163.2 mm	13,185.671 m³
Initial abstraction:	6.7 mm	Losses:	5.3 mm	424.921 m³
Curve Number:	88	Precip excess:	157.9 mm	12,760.751 m³
Impervious surface:	85%	Direct runoff:	156.7 mm	12,658.61 m³
Peaking factor:	484	Baseflow:	0.0 mm	0.00 m³
Lag time:	25 minutes	Total runoff:	156.7 mm	12,658.61 m³

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	Length (m)	Slope (m/m)	Velocity (m/s)	Description
4	6.146	0.09637	1.1533	Sheet Flow
2	65.380	0.07375	8.9680	Shallow Concentrated Flow
7	116.517	0.01651	4.2426	Shallow Concentrated Flow
24	437.417	0.00235	1.6001	Shallow Concentrated Flow
0	30.767	0.04420	7.8106	Channel Flow
38	**656.227**	**Total**	**Lag Time = 23 minutes**	


Runoff (cms)
Precipitation (mm)
1.5
1
0.5
0
5
10
Precipitation - Total Precipitation (163.2 mm)
Runoff - Max Discharge (1.480 cms)
01:55
03:55
05:55
07:55
09:55
11:55
13:55
15:55
17:55
19:55
21:55
23:55
9/10/2022
10/10/2022
Time

Appendix G – Existing Flood Maps



Legend

Ihumatao_20200202_100yrMPD_MaxH.asc

<VALUE>

- 0.05 - 0.15
- 0.15 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1.0 - 8.7

MB_HydraulicModel_1D

Source: Healthy Waters - Auckland Council

Ihumatao Catchment Flooding Modelling

0 35 70 140 210 280 Meters

N

Appendix H – Villa Catchment - Outlet Options

PRELIMINARY DESIGN

INDICATIVE MASTERPLAN. SUBJECT TO DESIGN DEVELOPMENT

UPSTREAM DIVERSION

UPSTREAM DIVERSION PEAK FLOW Q100 = 5.17m^3/s

PEAK FLOW Q100 = 3.63m^3/s

TREATMENT CHANNEL

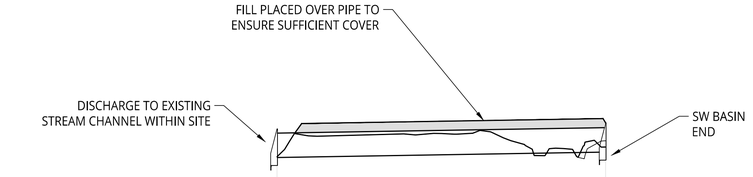
APPROXIMATE LOW POINT ON THE ROAD

MONTGOMERIE OUTLET PEAK FLOW Q100 = 8.53m^3/s

HIGH FLOW CONVEYANCE

ORUARANGI CREEK

MONTGOMERIE OUTLET OPTION
POND OUTLET IL = 4.59m
TOP WATER LEVEL RL= 8.65m
STORAGE VOLUME Q100 = 32,550m^3
STORAGE VOLUME REQUIRED = 31,715m^3



DEPTH TO INVERT	1.9	1.9
	4.24	4.59
	6.11	6.46
		DN1600 0.33%
	OUTLET	107.3 INLET

OUTLET TO INTERNAL STREAM
LONGITUDINAL SECTION BETWEEN CH: 0.00 AND 107.25

SCALE: VERTICAL - 1:200 @ A1; 1:400 @ A3
HORIZONTAL - 1:!1000 @ A1; 1:2000 @ A3

SERTUS civil engineering

SKETCH NO:	SK#017: MONTGOMERIE OUTLET
SCALE:	1:1500 @ A1 / 1:3000 @ A3
DATE:	12/11/2023
BY:	DR

PRELIMINARY DESIGN

INDICATIVE MASTERPLAN. SUBJECT TO DESIGN DEVELOPMENT

UPSTREAM DIVERSION

UPSTREAM DIVERSION
PEAK FLOW Q100 = 5.17m^3/s

APPROXIMATE LOW POINT ON THE ROAD

ORUARANGI OUTLET OPTION
POND OUTLET IL = 4.48m
TOP WATER LEVEL RL= 7.90m
STORAGE VOLUME Q100 = 31,840m^3
STORAGE VOLUME REQUIRED = 31,715m^3

TREATMENT CHANNEL

MONTGOMERIE OUTLET
PEAK FLOW Q100 = 5.00m^3/s

POND OUTLET TO CONNECT TO ORUARANGI CREEK OUTFALL

PEAK FLOW Q100 = 3.63m^3/s

HIGH FLOW CONVEYANCE

INLET
LID LEVEL:6.15
SW INV OUT:4.48

SWMH 1-01
LID LEVEL:17.23
NE INV IN:3.99
SW INV OUT:3.94

OUTLET
LID LEVEL:5.67
NE INV IN:3.80

DN 1600 CLASS 2 @ 0.33%
149.1m
41.9m

ORUARANGI CREEK

SITE NOT OWNED BY [illegible] A MARIA 12,610m²

SITE NOT OWNED (VME CORE) 76234 m²

RESERVE 25,911m²

4m embankment zone

4m OFP/ retaining zone

EMBANKMENT

R.o.W-A1 2205 m²

OLF exit

PIPED SECTION

Existing Gate - Egress

MONTGOMERIE ROAD

BUILDING A1
BUILDING A2
BUILDING A3
BUILDING A4
BUILDING A5
BUILDING A6
BUILDING A7
BUILDING HV3

YARD A7 2470 m²
YARD A1a
YARD 5288 m²

ROAD 1

BOTTOM OF BANK

Existing Building

LANDSCAPING

SERTUS civil engineering

SKETCH NO:	SK#016: ORUARANGI OUTLET
SCALE:	1:1500 @ A1 / 1:3000 @ A3
DATE:	12/11/2023
BY:	DR

POTENTIAL RETAINING WALL ON HIGH SIDE OF ACCESSWAY. RESULTS IN LOWERING OF MANHOLE BY ≈ 3.0m

MINIMUM COVER

SW BASIN TREATMENT CHANNEL

DEPTH TO INVERT	1.9		13.3			1.7
	3.80		3.94	3.99		4.48
	5.67		17.23			6.15
		DN1600 0.33%		DN1600 0.33%		
	OUTLET	41.9	SWMH 1-01	149.1		INLET

ORUARANGI OUTLET
LONGITUDINAL SECTION BETWEEN CH: 0.00 AND 199.17

SCALE: VERTICAL - 1:200 @ A1; 1:400 @ A3
HORIZONTAL - 1:!1000 @ A1; 1:2000 @ A3