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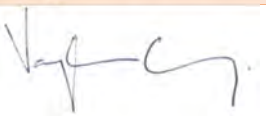
Hall Farm West - Ara Hills Private Plan Change Engineering Report

Hall Farm West - Ara Hills

Prepared for AVJennings Hobsonville Pty Ltd
July 2025

Document Quality Assurance Statement

Project Number	1403
Report Name	Hall Farm West - Ara Hills Private Plan Change Engineering Report
Revision No.	D
File Location	1403 - AVJ - Ara Hills\6.0 Reports and Letters\6.2 Infrastructure Report\250723 - Engineering Report REV D.docm

Action	Personnel	Sign	Date
Updated	Kevin Lee (Civil Engineer)		23/07/25
Approved	Vaughan Crang (Director)		23/07/25

Document Revision Status

Revision No.	Description	Section/Page	Author	Date
A	Initial Issue	All	CR	14/04/23
B	Updated Issue	All	NN	04/02/25
C	Updated Issue	All	NN	16/04/25
D	Updated issue	Section 5.3 and 8	KL	23/07/25

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1 Introduction

1.1 Overview

Crang Consulting Ltd has been commissioned by AVJennings Hobsonville Pty Ltd to assess and complete an engineering infrastructure report for a private plan change request by AVJennings Hobsonville Pty Ltd to the Auckland Unitary Plan Operative in Part (AUP). The private plan change seeks to rezone approximately 85ha to multiple different zonings to suit the proposed Hall Farm West or Ara Hills subdivision. The proposed zoning is primarily mixed house urban along with THAB, Commercial zones, and Open Space zones. The plan change further seeks to apply precinct provisions to enhance the existing environment and the unique surroundings of the site.

The proposed site currently has an approved resource consent (BUN20441333). This existing consent allows for a cap of 575 lots. This current private plan change application infrastructure report is assessing a new proposed cap of 900 lots.

It is important to note under the existing consent three stages have been constructed or actively in construction. These stages are specified as Stages 1, 2, and 3A. These three developments comprise of approximately 220 lots and 4 commercial lots. These lots are considered to be included within the proposed cap of 900 lots. Stage 1 has had its titles issued, Stage 3A-1 s224c issued 21st November 2023 and titles are expected by end of February 2023, Stage 3A-2 s224c is 90% processed and is on hold waiting completion of a wetland, and Stage 2 has recently begun construction. For this report, Stages 1, 2, and 3A are all considered to be existing and constructed as part of the original consent.

Excluding the Stage 1 subdivision, the Plan Change Area (PCA) comprises primarily of:

- 47 Ara Hills Drive, Upper Orewa, Lot 1001 DP 565605 and
- 226 Grand Drive, Orewa, Lot 1 DP 0931

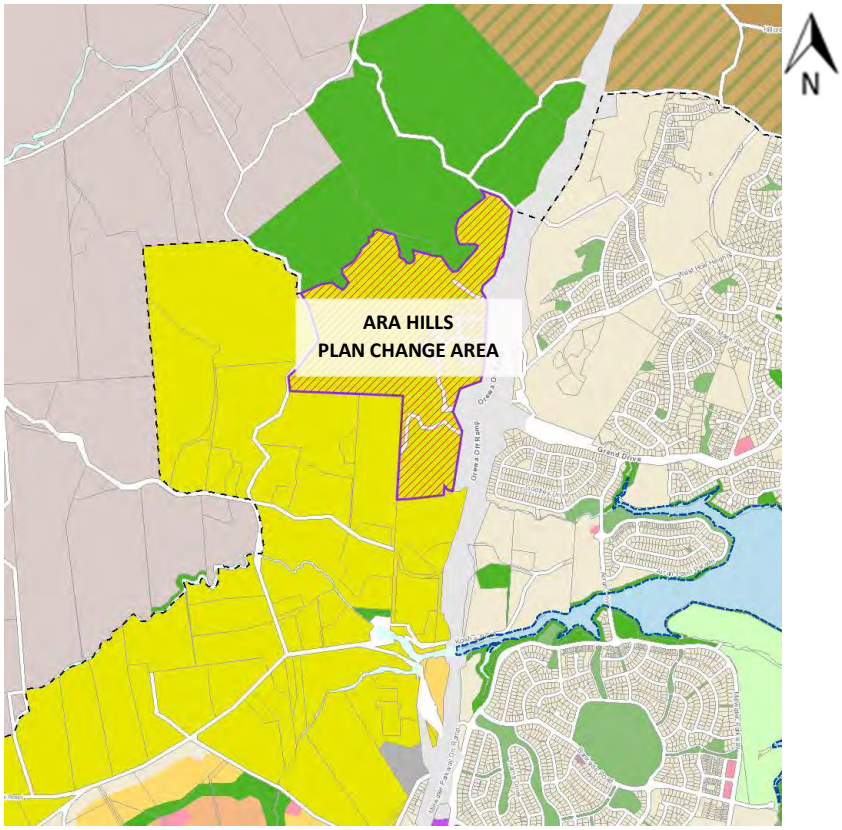

Figure 1-1: Site Location (Source: Auckland Council (AC) GIS)

1.2 Scope of Work

The scope of work associated with this engineering infrastructure report includes:

- The extent of earthworks that will be necessary to achieve compliant road gradients and accessways and stable building platforms if the plan change is approved.

- Proposed roading infrastructure with linkage from the Orewa SH1 intersection to the neighbouring properties for future potential development while utilising the existing roading infrastructure.

- Stormwater infrastructure requirements to provide quality and quantity mitigation for stream protection and flood plain analysis.

- Wastewater servicing requirements so that the development can be in compliance with Watercare's engineering requirements through the use of pump stations and gravity networks.

- How potable water servicing can be supplied throughout the development through a new Watercare reservoir located on the PCA.

1.3 Limitations

The report has been based off the information made available to Crang Consulting Ltd from the client, public sources and specific site investigation at the time of performing the assessment. Should further information become available regarding the site and the area around the site, Crang Consulting Ltd reserves the right to review the report with respect to the additional information.

2 Site Description

2.1 Existing PCA

The PCA is located directly off the Grand Drive extension over the motorway. The SH1 northbound off-ramp with a round-a-bout exit that directly services the Ara Hills subdivision. To the east of the PCA is the SH1 motorway, and directly across the motorway is newly developed urban areas zoned as mixed housing urban. To the south and west of the PCA is future urban zoning primary consisting of agricultural based activities (including cattle farming, glass houses, and market gardens). North of the PCA is the Nukumea Reserve. The Nukumea Reserve is considered to be an important ecological feature of Auckland and will control many of the precinct provisions of the plan change application to preserve the interface of the urban environment with the Reserve.

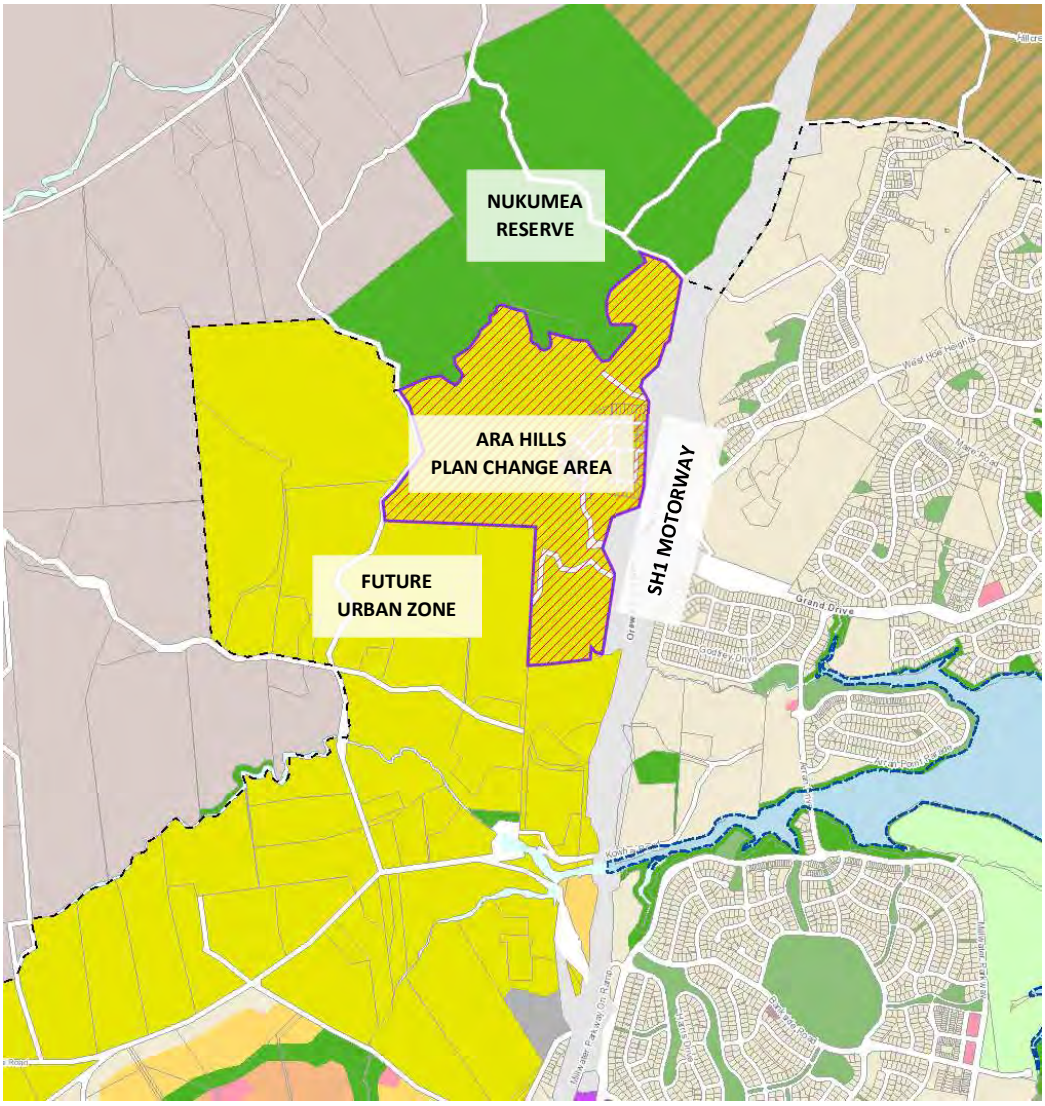

Figure 2-1: PCA (Source: AC GIS)

The PCA topography contains moderate to steep gradients with varying levels of ridges and gullies across the site. There are existing streams, wetlands, and native vegetation throughout the site as well as large areas of pasture. The Bioresearches ecology report is to be referred to for a full description of these and other existing watercourses on site. The ecology report has been included with the plan change request. The important features are proposed to retained, enhanced, and protected as much as possible.

3 Bulk Earthworks

3.1 Earthworks Description

Earthworks will be necessary to construct future public roads and private accessways to compliant gradients and provide for stable building platforms. A cut to fill balance is achievable. The earthworks design can adhere the following:

- Minimise the earthworks volumes as much as practical and stage the earthworks so that public road usage is not required.
- Preserve existing streams, wetlands, and native vegetation as much as practical.
- Provide compliant grades for public roads, accessways, driveways, and vehicle crossings and direct stormwater overland flows to suitable discharge locations.
- Provide stable building platforms through the use of engineered fill, retaining walls, MSE slopes, and other geotechnical treatments.

The final earthworks levels will be determined along with the geotechnical engineer's input at detailed design stage and will be subject to future resource consents when they differ from those consented. Earthworks is currently occurring on site with the construction of Stage 2.

Figure 3-1: Proposed Indicative Earthworks Plan

3.2 Timing of Works

It is expected that the earthworks will occur over the next five earthworks seasons in approximately 2023-2027. This timeframe is subject to obtaining the required resource consents and other

infrastructure approvals. Earthworks will occur ahead of civil works and minimise areas open and disturbed.

3.3 Erosion and Sediment Controls

Erosion and sediment controls will comply with the requirements of the Auckland Council GD05 "Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region". A combination of erosion and sediment control measures will be employed including:

- The construction of new sediment retention ponds dosed with flocculent to maximize sediment removal efficiencies.
- The construction of decanting earth bunds dosed with flocculent to maximize sediment removal efficiencies.
- The use of dirty water diversion bunds to intercept direct dirty water to the sediment ponds or earth bunds.
- The use of clean water diversion bunds to intercept and direct clean water away from the proposed area of works.
- The construction of topsoil bunds and silt fences for areas that are outside of the catchment of the sediment ponds or earth bunds.
- Installation of contour drains at the completion of each day's work.
- Progressive stabilization of the earthworks areas as they are completed.
- Provision of stabilized construction entrances to ensure that any vehicles leaving the site do not deposit earth on to the public roading network.
- Regular inspections of all sediment control devices to ensure all measures are functioning effectively and being maintained.

An Adaptive Environmental Management plan can be utilized to monitor treatment outcomes and allow corrective action to maximise treatment efficiencies. Regular site inspections by the Auckland Council monitoring officers, the civil engineer, and the contractor will further ensure high levels of sediment and erosion control proficiency.

3.4 Previously Consented Earthworks Extents

The original resource consent for Ara Hills reported a total volume of cut to fill earthworks of 1,153,000m^3 would be required. Preliminary cut to fill calculations indicate that a total of 777,300m^3 is required. This volume excludes Stages 1, 2, & 3A which are either completed or underway. The volumes of earthworks are therefore similar to the volume approved in the resource consent.

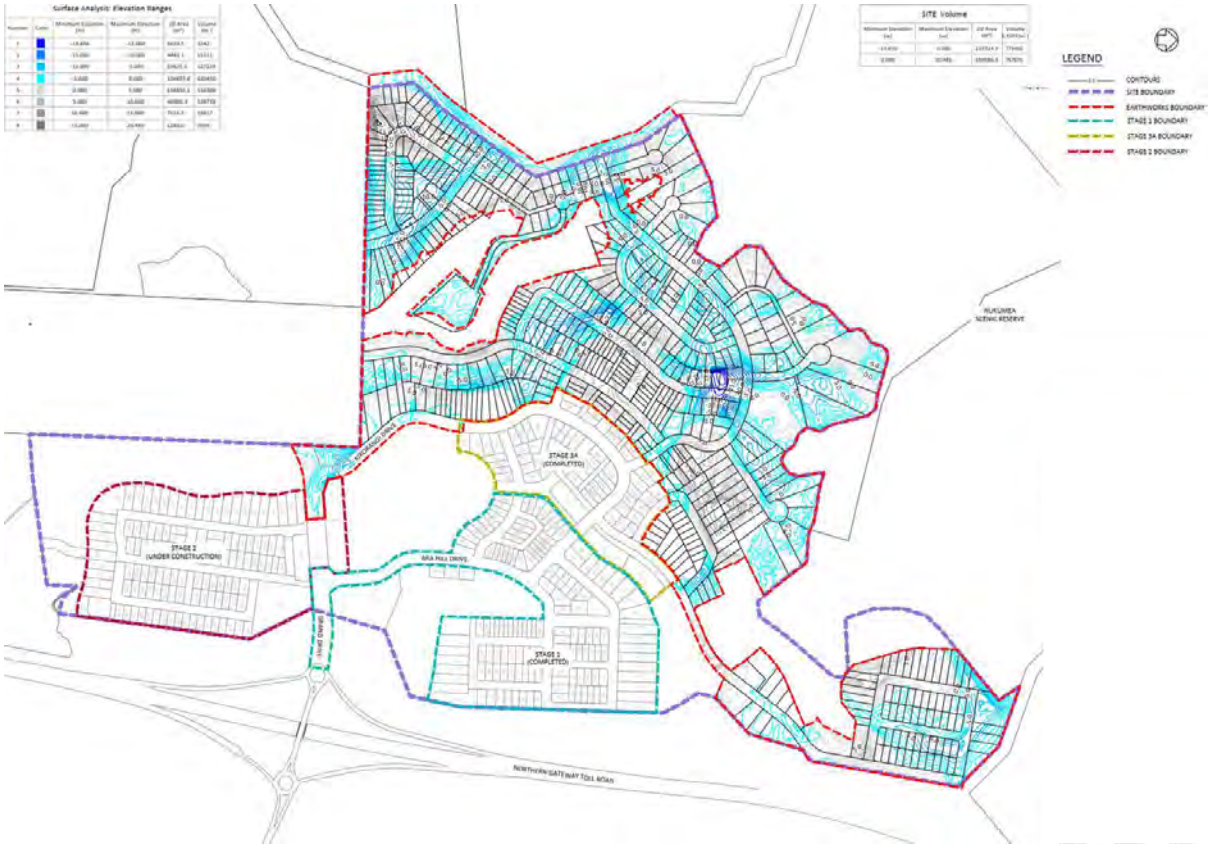

Figure 3-2**: Proposed Indicative Cut & Fill Plan**

4 Roading

4.1 Introduction

Flow Transportation Specialists has provided a complete Integrated Traffic Assessment Report for the Plan Change Area. The Traffic Assessment Report has been included with the plan change request.

The Supporting Growth Alliance of Auckland Transport and NZ Transport Agency is currently undergoing a review of future transportation projects that will affect the Plan Change Area. The most important feature of their review is the Grand Drive extension being an arterial road. The Ara Hills development has incorporated the future arterial road into its design and future proofed for any necessary transportation upgrades currently known.

4.2 Roading and Accessways

The roading network is proposed to be completed as each stage is built. This roading network will be compliant with the Auckland Transport TDM Standards. Public roads servicing over 200 lots are proposed for a maximum of 10% gradient; the public roads that service less than 200 lots are proposed to be a maximum of 12.5%. Any private accessways are proposed to be to Auckland Council's standards of a maximum of 20%. This is in line with the previous plan change and consent to minimise the amount of earthworks required to achieve these gradients.

Figure 4-1: Proposed Indicative Roading Plan

4.3 AT/NZTA Public Upgrades

The extension of Grand Drive to the neighbouring property will provide Auckland Transport with a 30m corridor for a future arterial road. This is part of the Supporting Growth projects. The development will provide this section of road to arterial roading standards and will be reviewed as part of the Engineering Plan Approval processes.

As part of the original consent conditions, the applicant was required to complete a shared path from Grand Drive to Aran Drive. The shared path has been designed and is currently being reviewed as part of the Engineering Plan Approval process. This will provide further infrastructure to the PCA by providing a connected footpath and cycleway link to the east over the motorway.

There are multiple existing paper roads included with the PCA. Most of these roads will be stopped and offset by the proposed vesting of public. One paper road that is proposed to be utilised is along the western boundary of the PCA. This paper road is along a suitable alignment for the future connection with Russell Road so it is considered an appropriate upgrade for the development and surrounding areas.

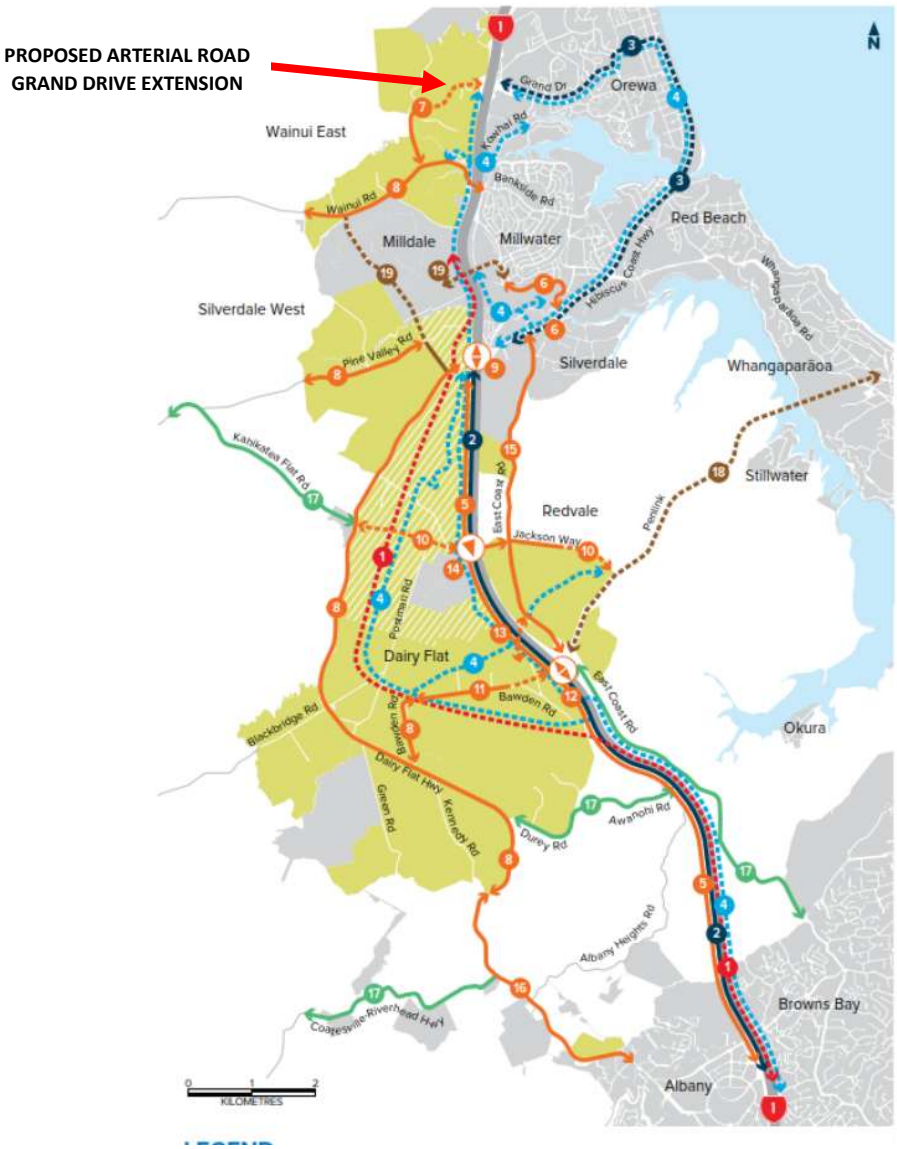

Figure 4-2: North Indicative Strategic Transport Network (Source: Supporting Growth Auckland)

5 Stormwater

5.1 Introduction

Airey Consultants completed a Stormwater Management Plan (SMP) for the earlier version of the private plan change which was accepted by Healthy Waters, final approval and falling under the region wide stormwater discharge consent will occur once the plan change becomes operative. With changes in catchments through earthworks and an increase in lot density, an addendum to the SMP by Crang Consulting has been completed. The addendum and accepted SMP is located in Appendix B. A summary of the SMP is below.

5.2 Existing Stormwater Features

The PCA is located across three catchments, each of which contain their own permanent stream. Culverts carry the flow from these catchments underneath the motorway and continue downstream into their receiving environment being the Orewa Estuary. These catchments are labelled as the Southern, Central, and Northern. This can be seen in Figure 5-1.

Figure 5-1: Existing Stormwater Features (Source: AC GIS)

The Southern catchment is the largest and extends into the Wainui rural area. The Central catchment is the smallest and is entirely located within the PCA. As part of the enabling earthworks of the current consent, a portion of the catchment was filled in to create compliant roading and building platforms. The Northern catchment extends into the Nukumea Scenic Reserve. This catchment and stream is the only stream that is proposed to be crossed to provide road access to parts of the PCA.

Bioresearches consultants' ecology report provides further descriptions of the streams and gulley networks and other ecological features associated with the PCA. The ecology report has been submitted as part of the plan change application.

There is an existing stormwater network of pipes, wetlands, and bioretention devices constructed as part of Stage 1, 2, and 3A. These devices are currently being constructed or have been vested to Auckland Council. There was no existing stormwater infrastructure within the PCA prior to the original resource consented development.

5.3 Flooding Analysis

A flooding analysis has been completed within the SMP. The analysis allows for the indicative scheme plan and final land form.

The SMP calculations assumed for three different design scenarios:

- 10-year ARI (2.1° climate change and full pipe capacity)
- 100-year ARI (3.8° Climate Change and culvert 50% blocked)
- 100-year ARI (3.8° Climate Change and culvert 100% blocked)

The results of the above are as per Table 1 below:

TABLE 1: DEVELOPED CONDITIONS FLOOD LEVEL (RL)

Catchment	Flood Level (RL)		
	10-year	100-year (50% blocked)	100-year (100% blocked)
Northern	19.8	24.02	28.8
Central	17.2	21.2	27.2
Southern	13.8	18.3	21.8

The analysis found that the motorway culverts have insufficient capacity for both the existing conditions and the developed conditions of the PCA. This in return creates a flood basin upstream of the culvert. For the plan change application, the existing conditions were assumed as if no development has occurred within the PCA.

The 100-year 100% blocked scenario provides a worst-case scenario and assesses the flood levels when the large diameter pipes are blocked at the start of the storm event. This scenario provides information on worst case levels but is not appropriate for setting finished floor levels.

The 100-year 50% blocked scenario provides a realistic and appropriately conservative limit for the maximum flood levels to determine minimum proposed building finished floor levels. This scenario is also compliant with the Auckland Council Stormwater Code of Practice for determining floodplain levels. A minimum freeboard of 500mm to finished floor levels to be provided on top of the floodplain levels. The minimum recommended finished floor levels for each catchment are as per Table 2 below:

TABLE 2: MINIMUM RECOMMENDED FINISHED FLOOR LEVELS

Catchment	100-year (50% blocked) Flood Level	Previously Consented Minimum Recommended Finished Floor Level	Minimum Recommended Finished Floor Level
Northern	24.0	24.0	24.5
Central	21.2	23.0	21.8
Southern	18.3	17.0	18.8

5.4 Overland Flow Path

Overland flow paths are proposed to be mostly within the road reserves. The steep gradients of the site allow for easier flow path management within the roading corridors. The exact flow path and discharge location of each stage will be confirmed at the time of resource consent.

The minimum recommended floor levels will be primarily controlled by the extent of flooding caused by the motorway culverts. Overland flows within the streams and roads will be considered during detailed design.

5.4 Proposed Works in or Adjacent to the Existing Watercourses

As part of this plan change application, no works are proposed to interact with the Central stream. These works have already occurred as part of the Stage 1, 2, and 3A works with the construction of an arch culvert over the Central stream.

The largest change in this plan change application when compared to the consented development is the Southern stream's western tributary crossing. The western tributary crossing in the original consented scheme plan is not considered to be the best option for the PCA and so has been avoided.

By utilising the western paper road, this application's indicative scheme plan allows for the proposed roading to continue north and above the two western tributaries. The western tributaries are bordered by existing native vegetation that is proposed to remain. There is an existing pocket of native vegetation that is to the northwest and another pocket directly north of the furthest tributary's extents. The pocket that is to the northwest of the stream is proposed to be removed as the only part of the existing native vegetation to be removed within the PCA.

The Northern stream is the only stream with an indicative road crossing proposed. The current consent conditions allow for an arch culvert over this stream. Upon site visits and preliminary analysis, the span of this stream is quite extensive as the stream actually splits into two where the crossing is proposed. Because of this, it is considered a bridge structure is the most optimal from geotechnical and structural perspective as well as the least intrusive on the existing environment. With this solution, it is considered the bed of the streams can remain in its natural state as well as not exacerbate any flooding hazards.

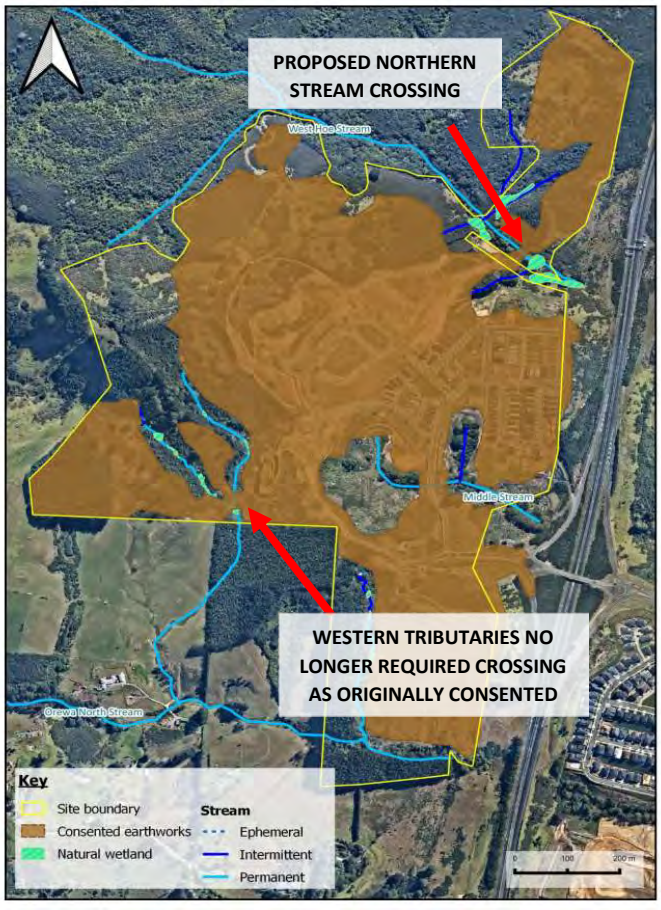

Figure 5-2: Key Freshwater Ecological Features (Source: Bioresearches)

5.5 Stormwater Mitigation

The current consent allows for water quality treatment according to GD01 standards which is 75% TSS removal and extended detention volume (EDV) for the first 34.5mm of rainfall over a 24-hour period. The EDV is utilised for stream protection.

The plan change application and the attached SMP proposes to adopt the PCA for SMAF 1 control. SMAF 1 provides more stringent stream protection than EDV and the proposed mitigation devices within public infrastructure consisting of wetlands and raingardens would provide the minimum requirements of stormwater quality treatment of 75% TSS removal as well as SMAF stream protection.

Runoff from private lots would utilise a stormwater tank that would provide SMAF 1 requirements. The tanks, wetlands, and bioretention devices combined would ensure the streams flows would match existing conditions and not cause further erosion concerns.

The PCA is proposed to be under SMAF 1 control, detention of the 2 year storm event is not considered to provide any further benefits for stream hydrology.

The 10-year detention is generally provided to ensure that existing downstream pipe reticulation is not subject to greater flows that for which is has design capacity. The only downstream infrastructure to the east of the motorway is the arch culvert below Grand Drive and a new culvert under Arran Drive are within coastal environments. The motorway culverts previously discussed provide attenuation of the development's flows. For this reason, attenuation of the 10-year storm event is not necessary as there are no downstream infrastructure issues.

100-year detention is generally provided for flood protection to ensure existing and proposed buildings are not subject to a greater risk of flooding as a result of the development. The motorway culverts provide attenuation upstream of the motorway. The peak flow discharge pre vs post conditions is considered to be similar and have no effect on downstream flooding hazards. The minor additional flooding caused upstream of the culverts due to the increased density and final landform will not affect neighbouring properties. The properties serviced off Russell Road are Future Urban Zoning with primarily agriculture uses. There are no upstream structures located within the extents of the floodplain. The NZTA land that is a steep batter and already subject to flooding. No attenuation of the 100-year storm event is therefore needed.

6 Wastewater

6.1 Introduction

The current consent allows for an infrastructure cap of 575 lots. This plan change application proposes to increase the number to an infrastructure cap of 900 lots. The wastewater infrastructure has been reassessed for the new cap.

6.2 Existing Wastewater

There is an existing network of wastewater gravity and pressure sewer with pump stations constructed as part of Stage 1, 2, and 3A utilising the current consent. There was no existing wastewater infrastructure within the PCA prior to the original consented development

Existing Watercare transmission infrastructure east of the motorway currently services the PCA to the Orewa Pump Station constructed as part of the Orewa West Structure Plan. A new wastewater pipe 315OD gravity line was drilled underneath the motorway to connect into this existing Watercare transmission infrastructure as part of the Stage 1 works. It is proposed to utilise this sewer and also construct a new sewer to the transmission network.

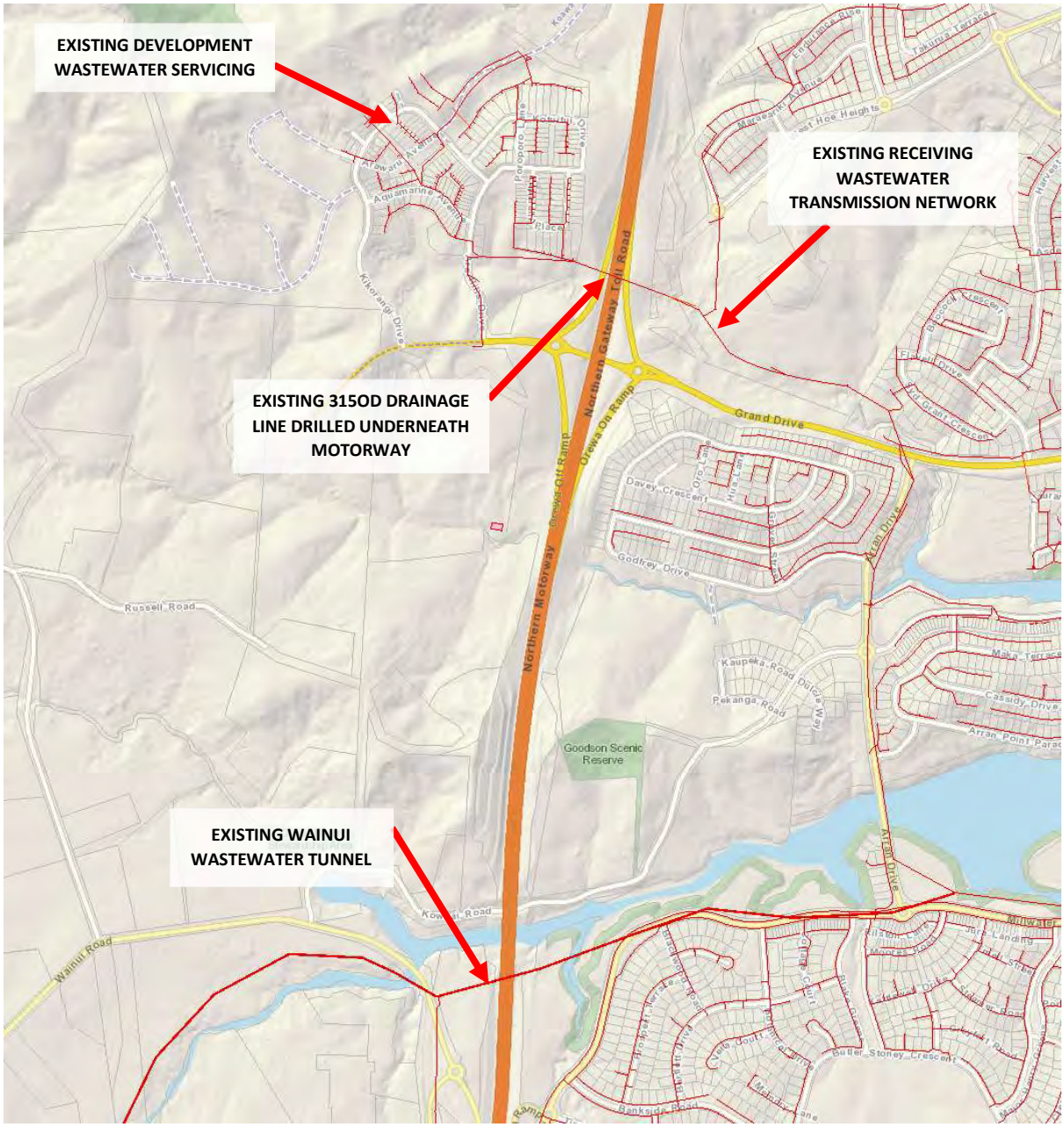

Figure 6-1: Existing Wastewater Network (Source: AC GIS)

6.3 Watercare Servicing

AV Jennings have an existing resource consent for 575 residential/ mixed use lots for the Ara Hills development (BUN20441333). This consent is currently being given effect to on site with 203lots created, and 148dwellings completed. There are still 372lots to be created. This consent currently lapses on the 7 August2027. Closer to this time we would recommend that AV Jennings seeks to formally extend the lapse date to provide additional time to complete works.

We have been working closely with Watercare Services Ltd ('WSL') to ensure that wastewater capacity is secured for this existing consent.

WSL have confirmed in principle *"that the balance of the development approved under the above resource consent and yet to connect to the public water and wastewater network would be granted approval to connect to the wastewater network. This confirmation is based on Watercare's current*

approach to honouring connections for approved resource consents in areas of capacity constraints." The full email is included in **Appendix C.**

The network wide capacity is currently limited by the capacity at the Army Bay Wastewater Treatment Plant. WSL has identified that upgrades to the plant will occur by 2031, but they are seeking to deliver an 'alternative upgrade' earlier. At present they have capacity to connect 4,000 homes though it is likely that the consented dwellings out number this capacity. So, it is antipcated that WSL will operate on a first come basis.

Option 1

The wastewater network to service the PCA will be a combined system of gravity and pressure sewer mains. Three pump stations will be provided at low points in the development to pump the wastewater flows to the gravity network which will eventually reach a drilled pipe underneath the motorway that connects to the existing Watercare transmission network. It is important to note two of the pump stations have already been constructed and the remaining pump station is consented based on the 575 lots of the approved resource consent. A portion of the large lots bordering the Nukumea Reserve will be serviced using private low pressure sewer mains instead of pump stations. The use of low pressure sewer mains is considered a better option when compared to adding more pump stations.

The only major public upgrades required for this option is a new drilled pipe underneath the motorway. The existing 315OD pipe currently servicing the PCA is considered to be insufficient for the infrastructure cap of 900 lots. The new pipe has been sized in Appendix D Wastewater Design Calculations.

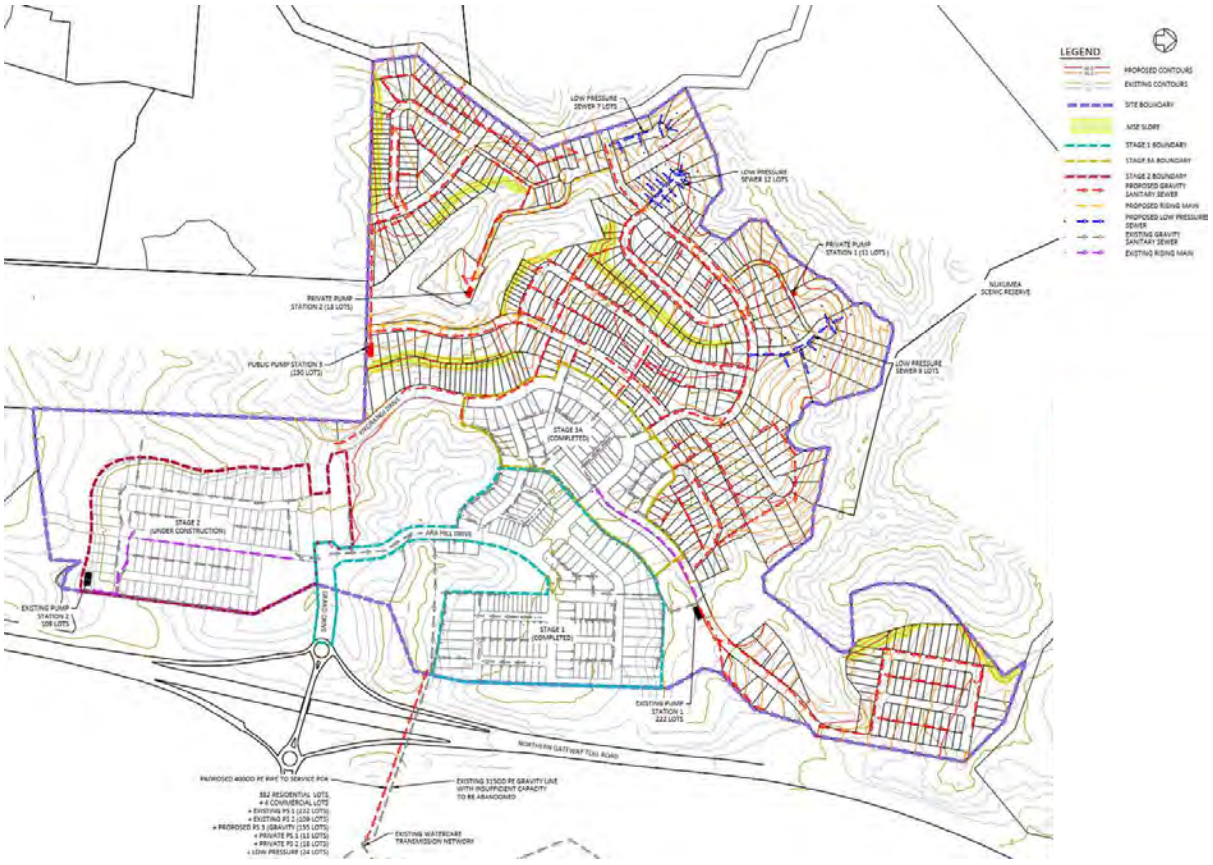

Figure 6-2: Proposed Indicative Wastewater Plan Option 1

Option 2

Watercare has also advised that at some stage they will be required to provide additional new infrastructure to allow growth to continue within this area based upon the proposed Future Urban Zone as shown in the Proposed Auckland Unitary Plan provisions.

As part of these plans, Watercare has planned for the entire PCA wastewater flows to flow south to the recently constructed Wainui Wastewater Tunnel constructed as part of the Milldale development. This will then eventually drain into the same transmission network as discussed in Option 1. Please refer to the Orewa West Wastewater Servicing Figure below.

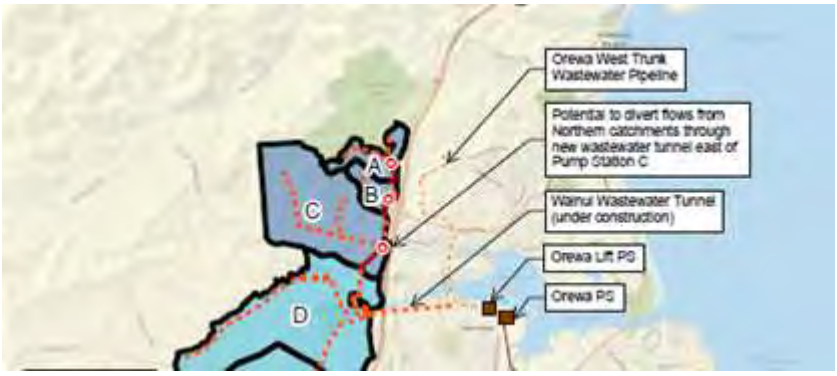

Figure 6-3: Orewa West Wastewater Servicing

Option 2 is considered a future project that will be completed by Watercare when the timing suits as it requires significant public wastewater infrastructure outside of the PCA and provides servicing to future urban areas that are not able to connect to at this time. This option also does not allow for the already constructed pipe drilled underneath the motorway as well as the consented 575 lots that this pipe will cater for.

The wastewater network to service the PCA for Option 2 is similar to Option 1, except the third pump station is removed and a gravity network as proposed in Watercare's future plans can be installed.

Figure 6-4: Proposed Indicative Wastewater Plan Option 2

WSL has completed a review of the servicing capacity associated with Option 1 and has confirmed that the existing infrastructure is adequate to accommodate the proposed cap of 900 HUE for the precinct. This assessment aligns with the position outlined in their correspondence dated 9 August.

WSL has indicated that, since the FDS does not specify the timing for the development of this future urban area, they would not oppose a plan change to rezone the land, provided that the precinct provisions include a requirement to assess the capacity of the bulk network at the time of the RC application. Additionally, WSL expects that any new development proposals within the rezoned area will be required to wait until the Army Bay Wastewater Treatment Plant (WWTP) upgrade, scheduled for completion by 2031, unless an alternative arrangement has been reached with WSL.

6.4 Discharge Consent

A wastewater overflow discharge consent was granted for the original plan change application as part of the development's current consent. The consent allows for three total public pump stations. This plan change application is in line with this same proposal.

In line with the consent, the pump stations will be to Watercare's requirements and conditions of discharge permit R/REG/2013/3743. Overflow points will be provided in the receiving manholes and a screen filter will be provided to prevent solids within the wastewater from overflowing to the land. The telemetry system of the pump station will alert Watercare of any potential issues prior to the overflows occurring. With the large amount of redundancies and conservatisms built into pump stations, the risk of overflow is very low.

7 Water and Utility Services

7.1 Introduction

The original plan change application and current consent has an infrastructure cap of 575 lots. This plan change application proposes to increase the number to an infrastructure cap of 900 lots. The water infrastructure has been reassessed for the new cap.

7.2 Existing Water

The PCA has existing water infrastructure on site constructed as part of the Stage 1, 2 and 3A works. The majority of the lines are to service the development as well as a 355OD line proposed for bulk supply of the PCA that will extend to a new water storage reservoir explained further below. There was no existing water infrastructure within the PCA prior to the original resource consented development.

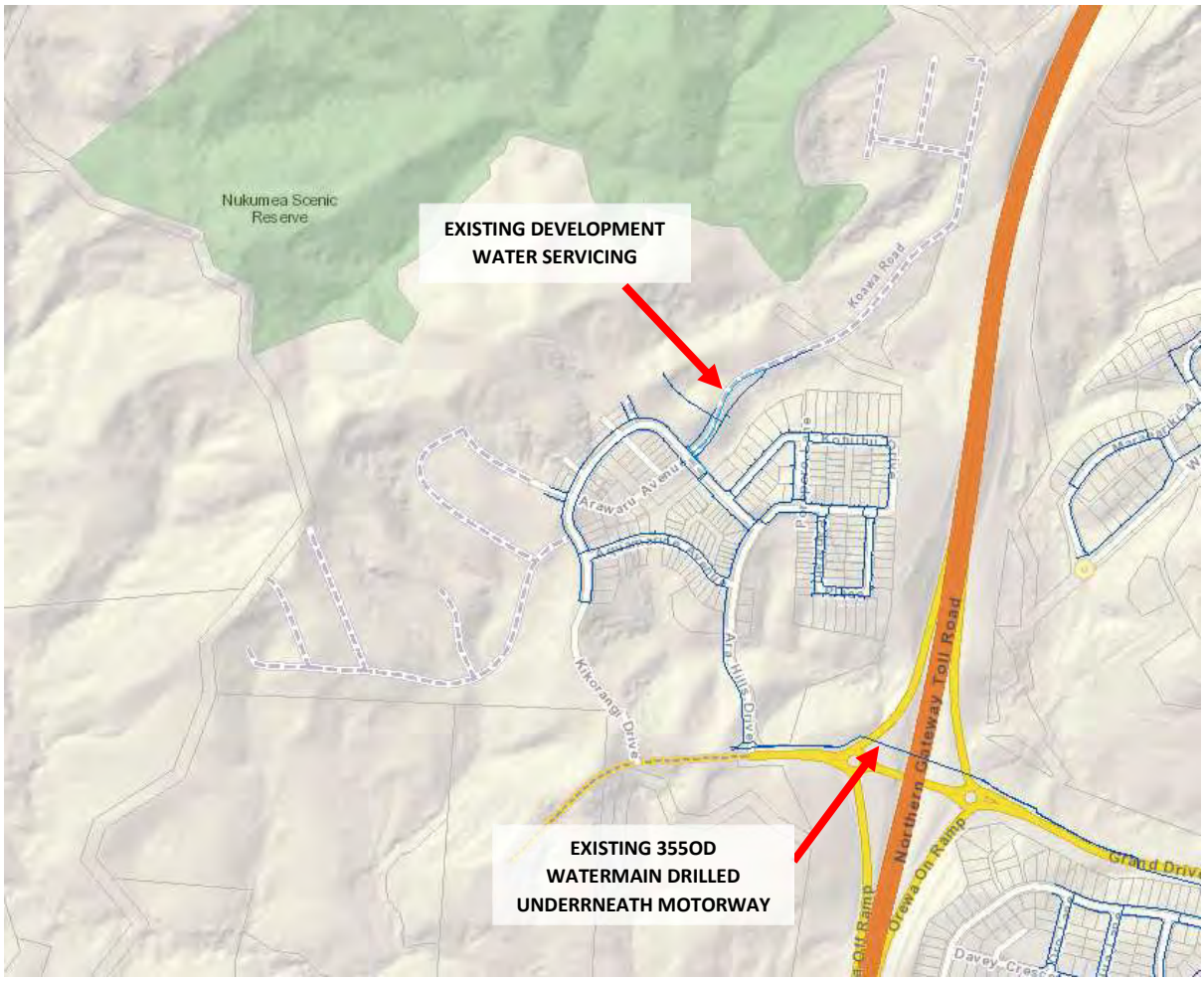

Figure 7-1: Existing Water Network (Source: AC GIS)

7.3 Watercare Servicing

Airey Consultants previously completed dynamic water modelling for the development. The analysis for this included there is sufficient water supply to Watercare's standards within the PCA for a portion of the development. This report was modelled for 800 lots and for the remaining areas not able to be serviced, a water storage reservoir was required to be constructed to provide adequate servicing to the PCA. Appendix E contains the Airey Consultants Water Supply Report.

Preliminary discussions with Watercare has resulted in the same conclusion that a water storage reservoir is required to be constructed within the PCA. The reservoir is proposed to constructed at the highest elevation of the PCA and service the PCA as well as the surrounding catchment.

There are two triggers which will cause the reservoir to be constructed. The first trigger is to ensure adequate servicing is provided in accordance with Watercare's standards for the PCA based on final landform and scheme plan. The second trigger is required once the PCA reaches 1,500 customers, or 500 constructed buildings. This is to provide resiliency to the water network for a 24hr period in extreme scenarios.

Further discussion will occur with Watercare to come to agreement on the reservoir location, size, and timing at resource consent stage.

Figure 7-2: Proposed Indicative Watermain Plan

7.4 Proposed Plan Change 78 – Water and Wastewater Servicing Constraints

Watercare has submitted on Proposed Plan Change 78 (the proposed intensification of Auckland). They have raised concerns with areas of insufficient water and wastewater servicing for the proposed intensification. A control is proposed to be placed over these areas requiring resource consent for any intensifications. The areas east of the motorway that are serviced by the same water and wastewater transmission networks of the PCA are proposed to be included within the control. We note that that resource consents will be required for any development with the PCA and will assess water and wastewater servicing as previously discussed.

7.5 Utility Services

There are existing telecom and power service cables constructed as part of Stage 1, 2, and 3A. These have capabilities of being upgraded to service the PCA and any other further future developments.

Vector and Chorus will need to be engaged to provide the designs which will ensure power and telecommunication infrastructure will be available.

This development does not propose the installation of a reticulated gas supply.

8 Orewa 4 Precinct

IXXX.1 Precinct Description

Subdivision and development are restricted until the land within the Precinct is able to connect to functioning bulk water supply and bulk wastewater infrastructure with sufficient capacity to service subdivision and development in the Precinct area.

IXXX.2 Objectives

(2) Subdivision and development is coordinated with the provision of bulk and local water supply and wastewater infrastructure.

IXXX.3 Policies

(17) Avoid subdivision and development in advance of the provision of functioning bulk water supply and bulk wastewater infrastructure with sufficient capacity to service subdivision and development within the Precinct.

Table IXXX.4.1 All Zones

Activity			
		Activity status	**Standards to be complied with**
Use			
All zones			
(A2)	Use that does not comply with Standard IXXX.6.2.6 Bulk Water Supply and Wastewater Infrastructure	NC	
Development			
All zones			
(A5)	Development that does not comply with Standard IXXX.6.2.6 Bulk Water Supply and Wastewater Infrastructure	NC	
Subdivision			
All zones			
(A7)	Subdivision that is not in accordance with Standard IXXX.6.2.6 Bulk Water Supply and Wastewater Infrastructure	NC	

IXXX.5 Notification

(5) Any application for resource consent that infringes the following standard will be considered without public or limited notification to any person other than Watercare or the need to obtain the written approval from any other affected parties unless the Council decides that special circumstances exist under section 95A(9) of the Resource Management Act 1991:

a. Standard IXXX.6.2.6 Bulk Water Supply and Wastewater Infrastructure

IXXX.6.2.6 Bulk Water Supply and Wastewater Infrastructure

Purpose:

- To ensure subdivision and development within the Precinct is adequately serviced with bulk water and wastewater infrastructure.

(1) Bulk water supply and wastewater infrastructure with sufficient capacity for servicing the proposed development must be completed, commissioned and functioning prior to construction of any buildings or creation of any lots.

IXXX.6.3.1 Subdivision standards for the precinct

Purpose:

- To ensure subdivision and development within the Precinct is adequately serviced with bulk water and wastewater infrastructure.

9 Conclusions

This report assesses the existing servicing and future servicing upgrades required to rezone the PCA to the zoning proposed primarily being mixed house urban. This is summarised as follows:

- Earthworks can be undertaken to provide suitable roading and accessway gradients, stable building platforms, and achieve a cut to fill balance while providing the required sediment controls to protect the environment.

- Roading to access each possible lot as well as provide connectivity to neighbouring properties can be provided all in accordance with Auckland Transport standards and the Supporting Growth plans.

- Stormwater infrastructure can be provided to achieve quality and quantity management to protect receiving streams as well as avoiding flooding affects upstream and downstream of the motorway culverts. The works would comply with an approved stormwater management plan.

- The existing wastewater infrastructure previously constructed contains space capacity to service the PCA. New infrastructure can be provided to the transmission network to provide wastewater servicing to Watercare's standards and precinct provisions are included to ensure that the development aligns with the capacity in the wider network.

- The existing potable water infrastructure is sufficient to service a portion of the PCA. A new Watercare storage reservoir is required within the PCA.

It is considered that the existing infrastructure can be utilised or upgraded to service the PCA. New infrastructure is also proposed that will provide beneficial results to neighbouring properties.

APPENDIX A:

ENGINEERING DRAWINGS

CLIENT	AVJ HOBSONVILLE PTY LTD	PROJECT NO.	1403

PROJECT NAME	ARA HILLS - PRIVATE PLAN CHANGE	DAY	14	07	04	25
		MONTH	04	11	02	07
		YEAR	23	23	25	25

DRAWING NO.	DRAWING TITLE	DRAWING REVISION									
C150	SCHEME PLAN	A			B						
C200	OVERALL EARTHWORKS PLAN	A			B						
C210	OVERALL CUT & FILL PLAN	A			B						
C300	ROADING PLAN	A			B						
C400	STORMWATER PLAN	A			B						
C450	PRE-DEVELOPMENT STORMWATER CATCHMENT PLAN	A			B						
C451	POST-DEVELOPMENT STORMWATER CATCHMENT PLAN	A			B						
C452	POST-DEVELOPMENT FLOOD ANALYSIS PLAN	A	B	C	D						
C452-1	PRE AND POST DEVELOPMENT FLOOD ANALYSIS PLAN				A						
C453	PROPOSED STORMWATER DEVICE DETAIL PLAN SHEET 1				A						
C454	PROPOSED STORMWATER DEVICE DETAIL PLAN SHEET 2				A						
C500	WASTWATER OPTION 1	A			B						
C505	WASTWATER OPTION 2	A			B						
C600	WATERMAIN PLAN				B						

DISTRIBUTION	NUMBER OF COPIES									
AVJ HOBSONVILLE PTD LTD	1	1	1	1						
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REASON FOR ISSUE	Y	Y	Y	Y						
DRAWING SIZE	A3	A3	A3	A3						
MEDIA	PDF	PDF	PDF	PDF						

A = APPROVAL X = PRICING I = INFORMATION P = PRELIMINARY E = DXF/DWG C= CONSTRUCTION T = TENDER Y = CONSENT R = REQUESTED

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AVJ HOBSONVILLE PTY LTD
ARA HILLS - PRIVATE PLAN CHANGE

LOCALITY PLAN
SCALE A1 1:7500, A3 1:15000

PRIVATE PLAN CHANGE

LEGEND

- SITE BOUNDARY
- PEDESTRIAN WALKWAY
- ROADING/ACCESSWAYS
- STAGE 1 BOUNDARY
- STAGE 3A BOUNDARY
- STAGE 2 BOUNDARY

PRIVATE PLAN CHANGE

REVISION	CHANGES	CHECKED	DATE
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PROJECT

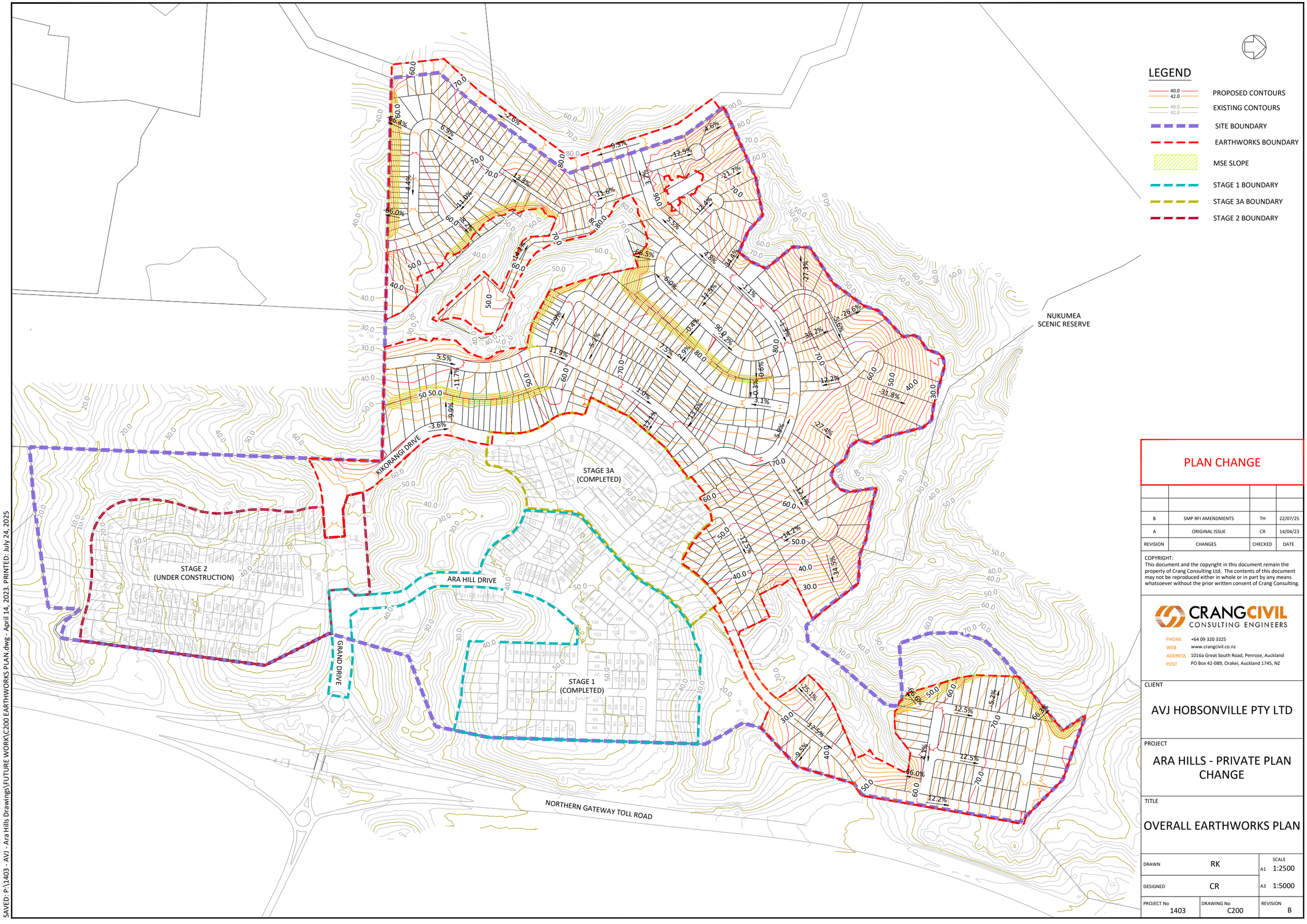
ARA HILLS - PRIVATE PLAN CHANGE

TITLE

SCHEME PLAN

DRAWN	RK	SCALE A1	1:2500
DESIGNED	CR	A3	1:5000
PROJECT No 1403	DRAWING No C150	REVISION B	

SAVED: P:\1403 - AVJ - Ara Hills Drawings\FUTURE WORK\C150 SCHEME PLAN.dwg - December 4, 2024, PRINTED: July 24, 2025



PLAN CHANGE

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PROJECT

ARA HILLS - PRIVATE PLAN CHANGE

TITLE

OVERALL EARTHWORKS PLAN

DRAWN	RK	SCALE A1	1:2500
DESIGNED	CR	A3	1:5000
PROJECT No 1403	DRAWING No C200	REVISION	B

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Surface Analysis: Elevation Ranges

Number	Color	Minimum Elevation (m)	Maximum Elevation (m)	2D Area (m²)	Volume (m³)
1		-19.696	-15.000	1639.5	3542
2		-15.000	-10.000	4482.1	15121
3		-10.000	-5.000	53625.5	127229
4		-5.000	0.000	156697.8	620450
5		0.000	5.000	138810.1	516308
6		5.000	10.000	40805.3	128719
7		10.000	15.000	7655.2	19817
8		15.000	20.466	1280.0	2698

SITE Volume

Minimum Elevation (m)	Maximum Elevation (m)	2D Area (m²)	Volume 1.15FF(m³)
-19.695	0.000	219714.9	773416
0.000	20.466	189686.3	767070

LEGEND

- CONTOURS
- SITE BOUNDARY
- EARTHWORKS BOUNDARY
- STAGE 1 BOUNDARY
- STAGE 3A BOUNDARY
- STAGE 2 BOUNDARY

KIKORANGI DRIVE

STAGE 3A (COMPLETED)

NUKUMEA SCENIC RESERVE

STAGE 2 (UNDER CONSTRUCTION)

ARA HILL DRIVE

GRAND DRIVE

STAGE 1 (COMPLETED)

NORTHERN GATEWAY TOLL ROAD

PRIVATE PLAN CHANGE

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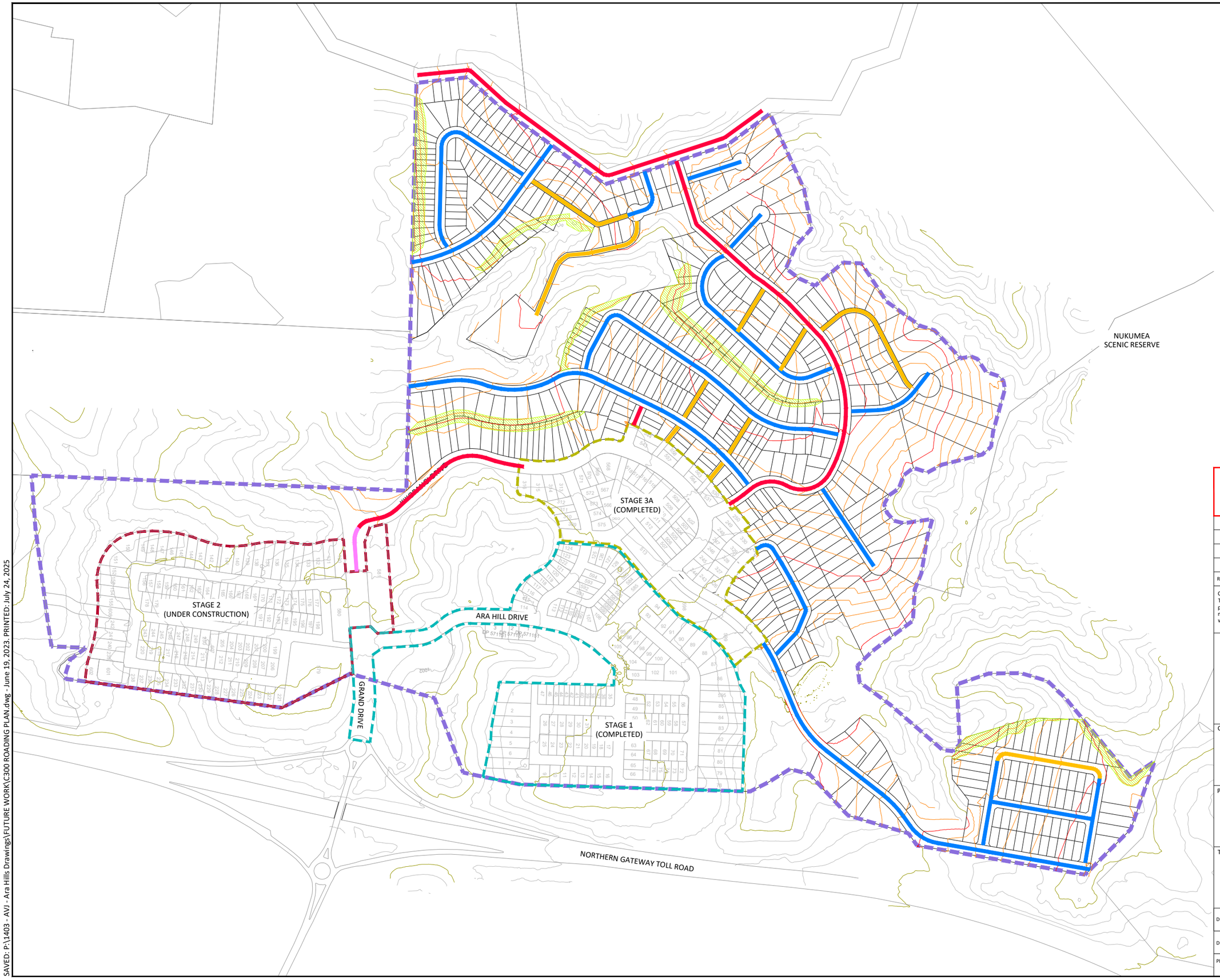
ARA HILLS - PRIVATE PLAN CHANGE

TITLE

OVERALL CUT-FILL PLAN

DRAWN	RK	SCALE A1 1:2500
DESIGNED	CR	A3 1:5000
PROJECT No 1403	DRAWING No C210	REVISION B

SAVED: P:\1403 - AVJ - Ara Hills Drawings\FUTURE WORK\C210 CUT-FILL PLAN.dwg - April 21, 2023. PRINTED: July 24, 2025



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ARA HILLS - PRIVATE PLAN CHANGE

TITLE

ROADING PLAN

DRAWN	RK	SCALE A1	1:2500
DESIGNED	CR	A3	1:5000
PROJECT No 1403	DRAWING No C300	REVISION	B

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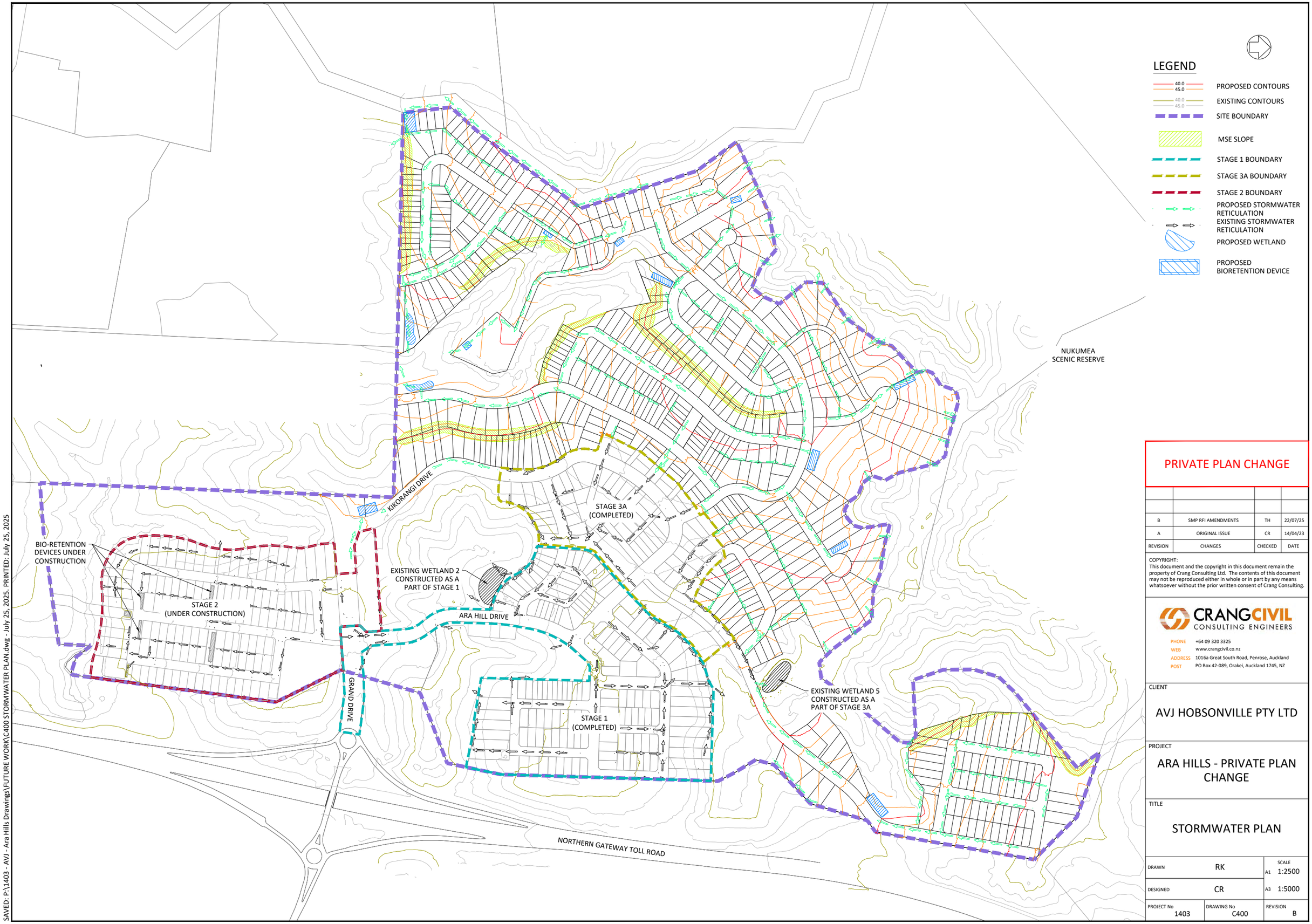

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PRIVATE PLAN CHANGE

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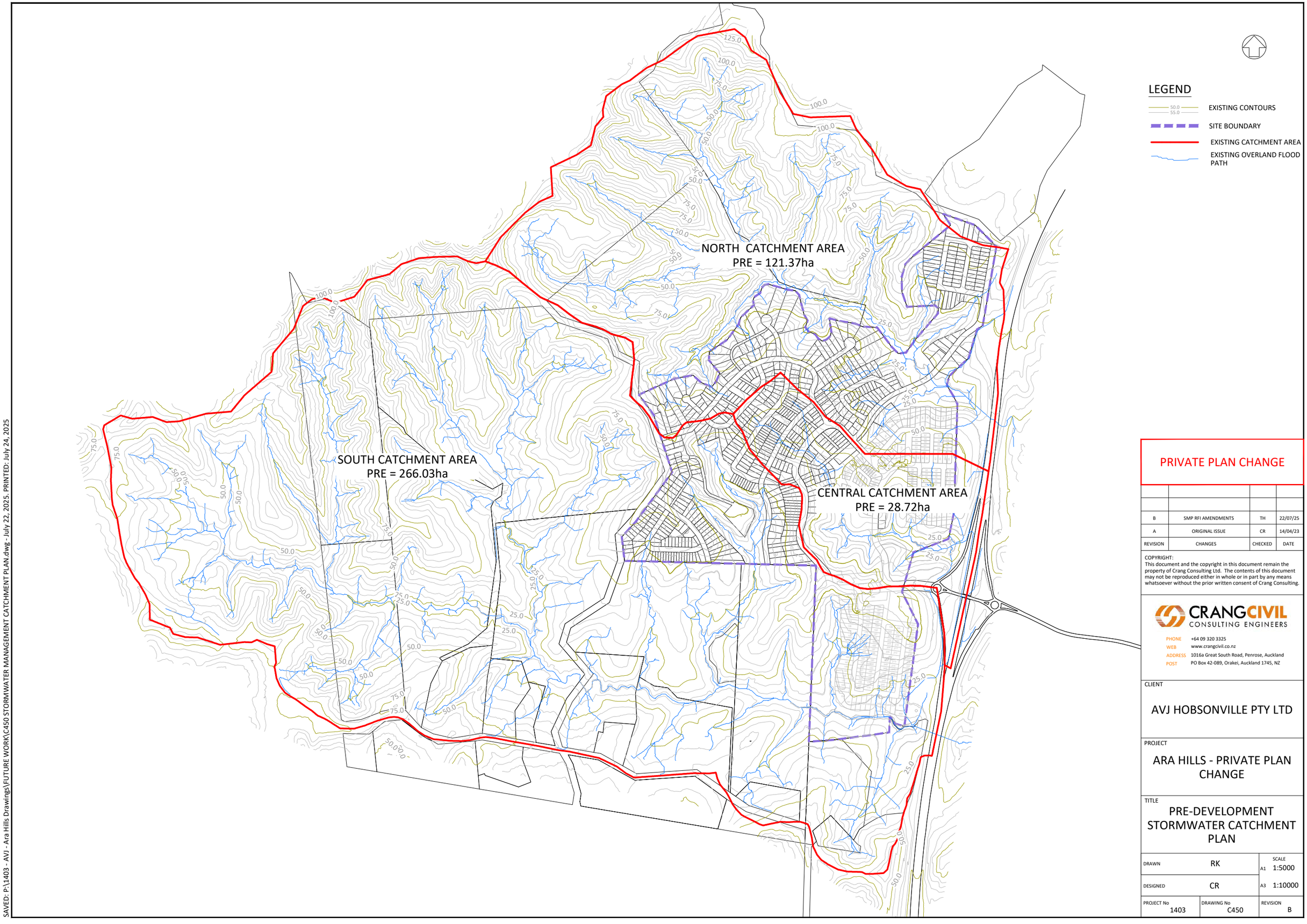
TITLE

STORMWATER PLAN

DRAWN	RK	SCALE A1	1:2500
DESIGNED	CR	A3	1:5000
PROJECT No 1403	DRAWING No C400	REVISION	B



LEGEND

- EXISTING CONTOURS (50.0 / 55.0)
- SITE BOUNDARY
- EXISTING CATCHMENT AREA
- EXISTING OVERLAND FLOOD PATH

PRIVATE PLAN CHANGE

REVISION	CHANGES	CHECKED	DATE
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TITLE
PRE-DEVELOPMENT STORMWATER CATCHMENT PLAN

DRAWN	RK	SCALE A1	1:5000
DESIGNED	CR	A3	1:10000
PROJECT No	1403	DRAWING No	C450
REVISION	B		

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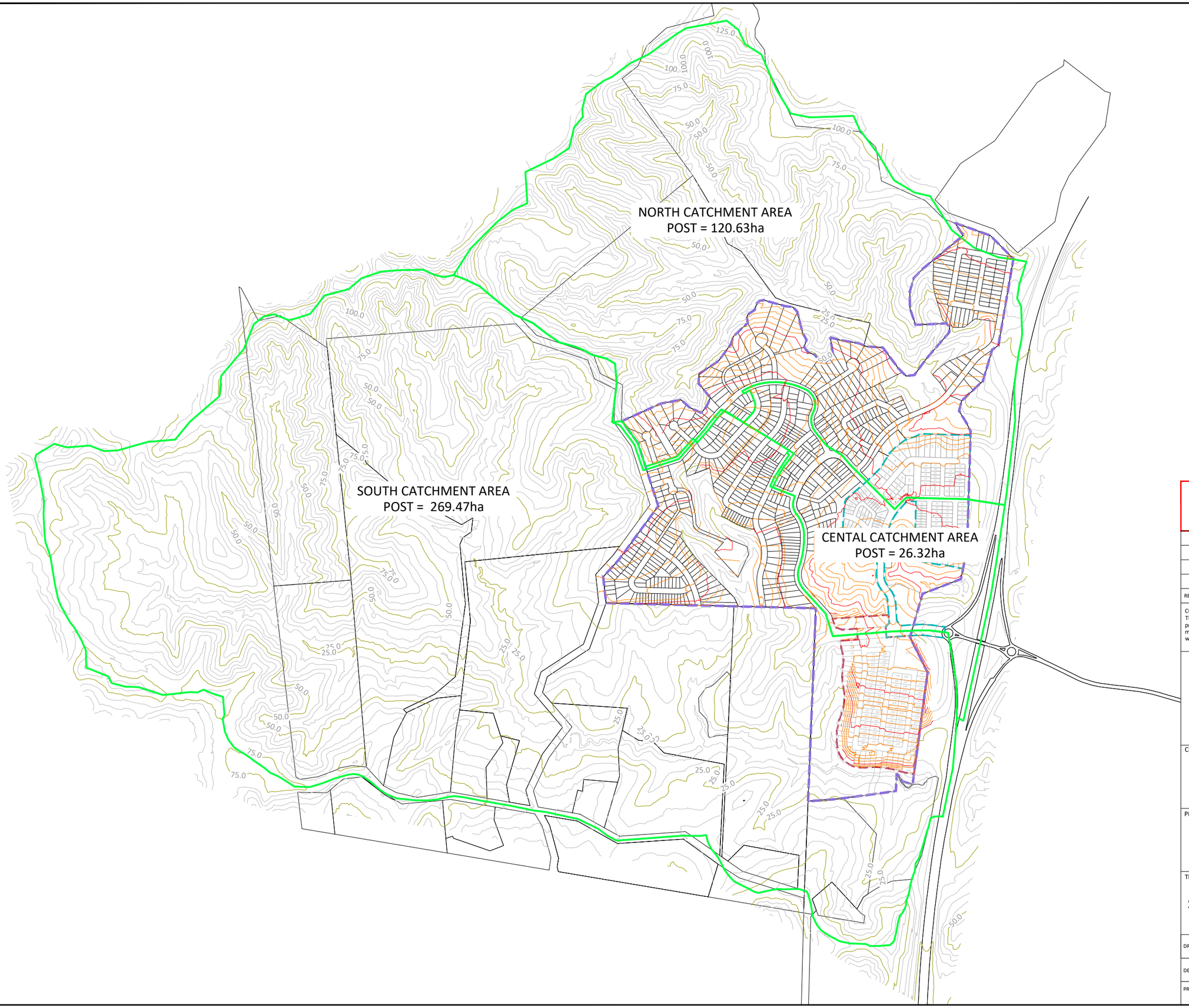

LEGEND

- PROPOSED CONTOURS
- EXISTING CONTOURS
- SITE BOUNDARY
- PROPOSED CATCHMENT AREA

PRIVATE PLAN CHANGE

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TITLE

POST-DEVELOPMENT STORMWATER CATCHMENT PLAN

DRAWN	RK	SCALE A1	1:5000
DESIGNED	CR	A3	1:10000
PROJECT No 1403	DRAWING No C451	REVISION B	

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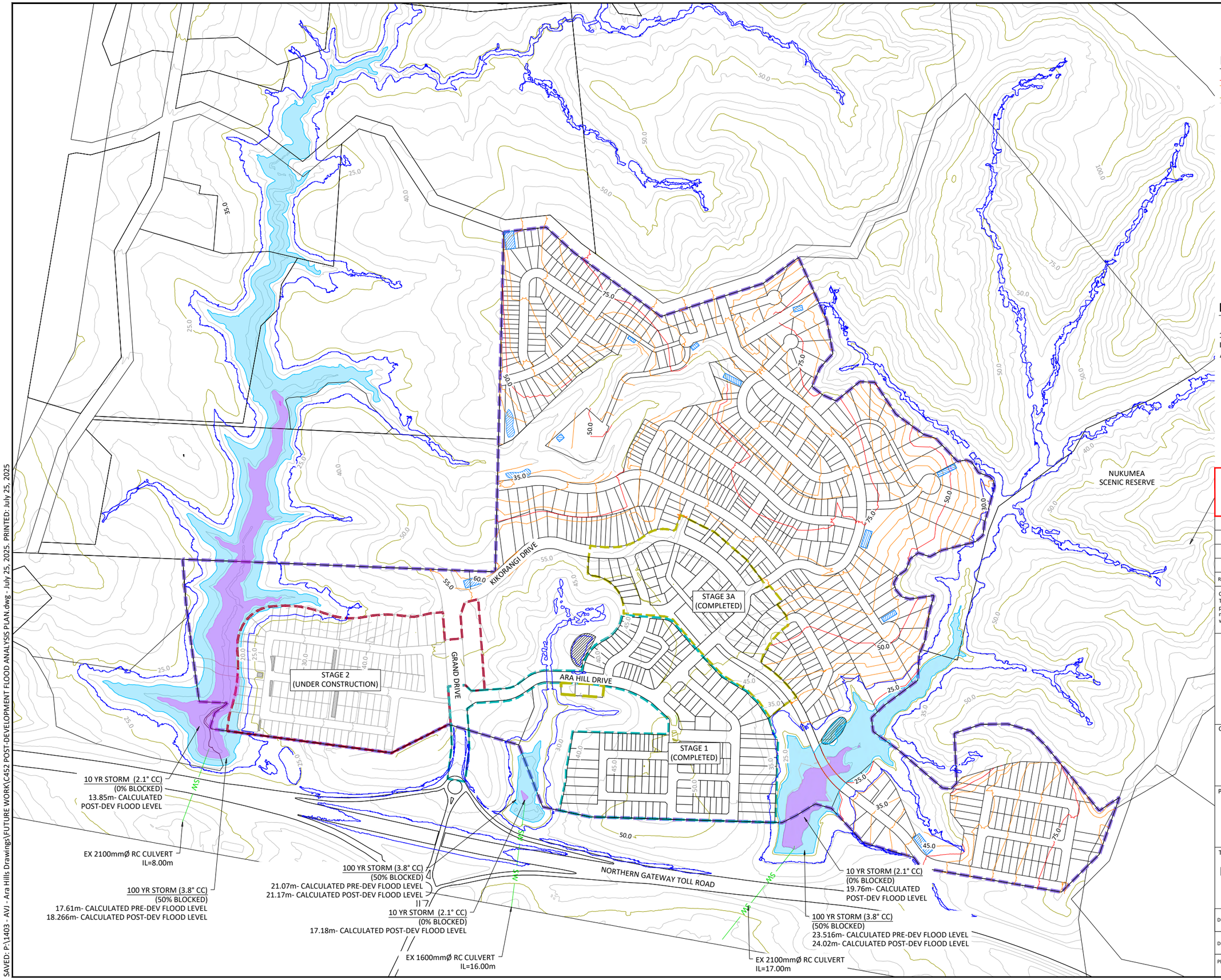

LEGEND

- PROPOSED CONTOURS (40.0 / 45.0)
- EXISTING CONTOURS (40.0 / 45.0)
- SITE BOUNDARY
- STAGE 1 BOUNDARY
- STAGE 3A BOUNDARY
- STAGE 2 BOUNDARY
- 10 YEAR - FLOOD LEVEL
- 100 YEAR (50% BLOCKAGE) FLOOD LEVEL
- 100 YEAR (100% BLOCKAGE) FLOOD LEVEL

NOTES

1. THE POST DEVELOPMENT FLOOD DEPTHS INCLUDE THE POTENTIAL FUTURE IMPERVIOUS AREAS.

PRIVATE PLAN CHANGE

REVISION	CHANGES	CHECKED	DATE
D	SMP RFI AMENDMENTS	TH	22/07/25
C	SMP RFI AMENDMENTS	NN	04/02/25
B	REV B	CR	07/11/23
A	ORIGINAL ISSUE	CR	14/04/23

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ARA HILLS - PRIVATE PLAN CHANGE

TITLE

POST-DEVELOPMENT FLOOD ANALYSIS PLAN

DRAWN	RK	SCALE A1	1:3000
DESIGNED	TH	A3	1:6000
PROJECT No 1403	DRAWING No C452	REVISION D	

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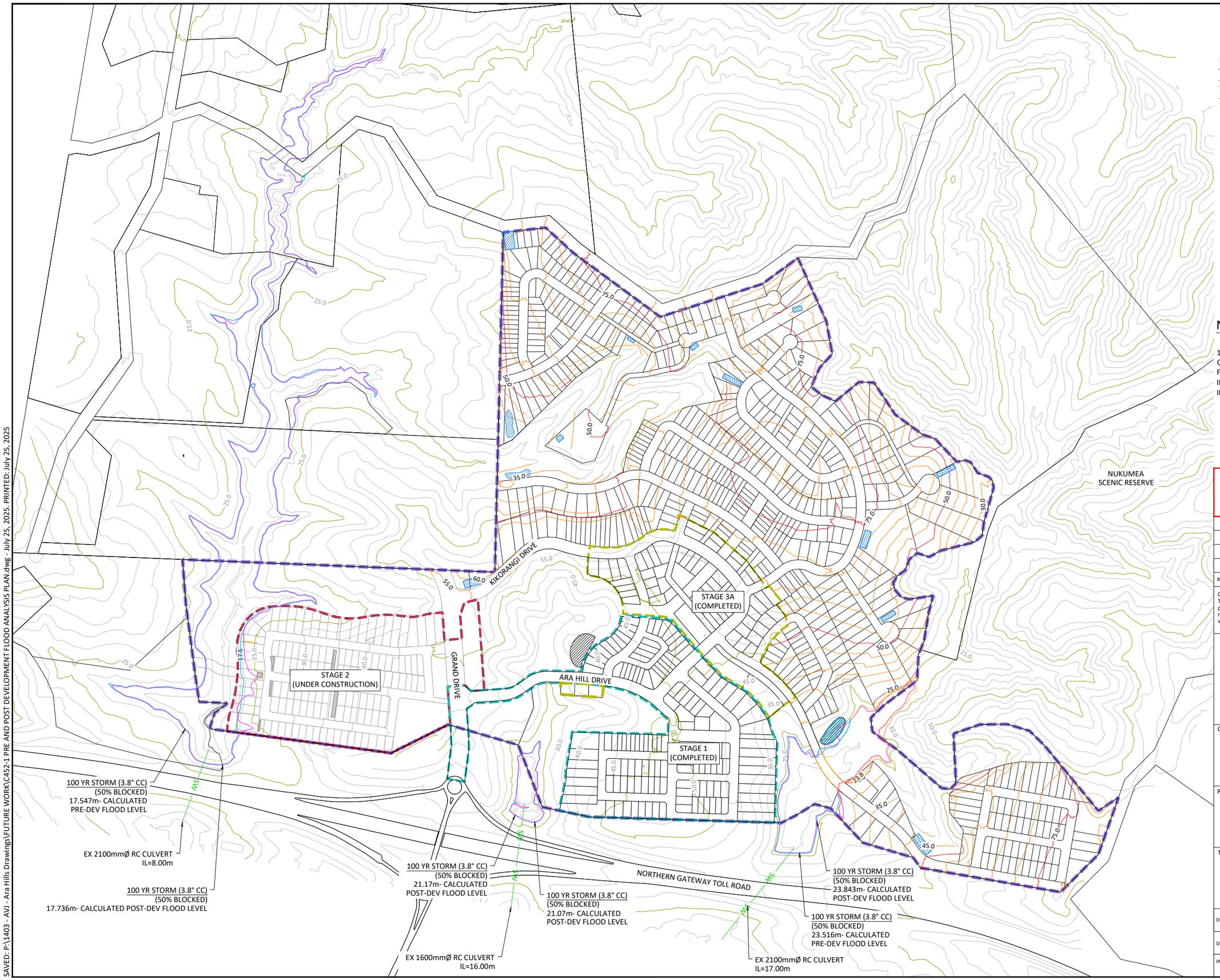

LEGEND

- PROPOSED CONTOURS
- EXISTING CONTOURS
- SITE BOUNDARY
- STAGE 1 BOUNDARY
- STAGE 3A BOUNDARY
- STAGE 2 BOUNDARY
- 100 YEAR (50% BLOCKAGE) PRE-DEV FLOOD LEVEL
- 100 YEAR (50% BLOCKAGE) POST-DEV FLOOD LEVEL

NOTES

1. THE POST-DEVELOPMENT FLOOD DEPTHS CONSIDERS ONLY THE PROPOSED DEVELOPMENT FOR THE ARA HILLS SITE. POTENTIAL FUTURE INCREASE IN IMPERVIOUS AREA HAS NOT BEEN INCLUDED IN THE ANALYSIS.

PRIVATE PLAN CHANGE

REVISION	CHANGES	CHECKED	DATE
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ARA HILLS - PRIVATE PLAN CHANGE

TITLE

PRE AND POST DEVELOPMENT FLOOD ANALYSIS PLAN

DRAWN	RK	SCALE A1	1:3000
DESIGNED	TH	SCALE A3	1:6000
PROJECT No	1403	DRAWING No	C452-1
REVISION	A		

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BD 01
CATCHMENT: 11,665m²
MITIGATION VOLUME: 229m³

BD 03
CATCHMENT: 1,617m²
MITIGATION VOLUME: 32m³

BD 02
CATCHMENT: 1,096m²
MITIGATION VOLUME: 22m³

BD 06
CATCHMENT:2,659m²
MITIGATION VOLUME:53m³

BD 04
CATCHMENT: 6,116m²
MITIGATION VOLUME: 120m³

WETLAND 6
CATCHMENT: 46,200m²
MITIGATION VOLUME: 577m³

BD 05
CATCHMENT: 1,833m²
MITIGATION VOLUME: 36m³

WETLAND 7
CATCHMENT: 48,784m²
MITIGATION VOLUME: 590m³

BD 11
CATCHMENT: 8,873m²
MITIGATION VOLUME: 174m³

EXISTING WETLAND 2
CATCHMENT

EXISTING WETLAND 2
TOTAL CATCHMENT: 14,500m²
EXISTING STAGE 3A CATCHMENT: 1,1200m²
PROPOSED CATCHMENT: 3,300m²

STAGE 2
UNDER CONSTRUCTION

STAGE 3A
COMPLETED

STAGE 1
COMPLETED

EXISTING WETLAND 5
CATCHMENT

BD 08
CATCHMENT: 8,137m²
MITIGATION VOLUME: 160m³

BD 09
CATCHMENT: 4,431m²
MITIGATION VOLUME:

EXISTING WETLAND 5
TOTAL CATCHMENT: 13,000m²
EXISTING STAGE 3A CATCHMENT: 2800m²
PROPOSED CATCHMENT: 10,200m²

LEGEND

- PROPOSED CONTOURS
- STAGE BOUNDARY
- BD 01 CATCHMENT
- BD 02 CATCHMENT
- BD 03 CATCHMENT
- BD 04 CATCHMENT
- BD 05 CATCHMENT
- BD 06 CATCHMENT
- BD 07 CATCHMENT
- BD 08 CATCHMENT
- BD 09 CATCHMENT
- BD 10 CATCHMENT
- BD 11 CATCHMENT
- WETLAND 6 CATCHMENT
- WETLAND 7 CATCHMENT
- EX. WETLAND 2 CATCHMENT
- EX. WETLAND 5 CATCHMENT
- PROPOSED STORMWATER RETICULATION
- EXISTING STORMWATER RETICULATION
- STORMWATER WETLAND
- BIORETENTION DEVICE

PRIVATE PLAN CHANGE

REVISION	CHANGES	CHECKED	DATE
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AVJ HOBSONVILLE PTY LTD

PROJECT
ARA HILLS - PRIVATE PLAN CHANGE

TITLE
PROPOSED STORMWATER DEVICES DETAIL PLAN SHEET 1

DRAWN	RK	SCALE A1	1:2000
DESIGNED	TH	A3	1:4000
PROJECT No 1403	DRAWING No C453	REVISION A	

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BD 02
CATCHMENT: 1,096m²
MITIGATION VOLUME: 22m³

BD 06
CATCHMENT:2,659m²
MITIGATION VOLUME:53m³

BD 04
CATCHMENT: 6,116m²
MITIGATION VOLUME: 120m³

WETLAND 6
CATCHMENT: 46,200m²
MITIGATION VOLUME: 577m³

BD 05
CATCHMENT: 1,833m²
MITIGATION VOLUME: 36m³

WETLAND 7
CATCHMENT: 48,784m²
MITIGATION VOLUME: 590m³

BD 07
CATCHMENT: 6,434m²
MITIGATION VOLUME: 127m³

BD 11
CATCHMENT: 8,873m²
ATION VOLUME: 174m³

BD 08
CATCHMENT: 8,137m²
MITIGATION VOLUME: 160m³

EXISTING WETLAND 2
CATCHMENT

STAGE 3A
COMPLETED

EXISTING WETLAND 2
TOTAL CATCHMENT: 14,500m²
EXISTING STAGE 3A CATCHMENT: 1,1200m²
PROPOSED CATCHMENT: 3,300m²

BD 09
CATCHMENT: 4,431m²
MITIGATION VOLUME: 87m³

EXISTING WETLAND 5
CATCHMENT

STAGE 1
COMPLETED

EXISTING WETLAND 5
TOTAL CATCHMENT: 13,000m²
EXISTING STAGE 3A CATCHMENT: 2800m²
PROPOSED CATCHMENT: 10,200m²

BD 10
CATCHMENT: 11,367m²
MITIGATION VOLUME: 233m³

LEGEND

- PROPOSED CONTOURS
- EXISTING STAGE BOUNDARY
- BD 01 CATCHMENT
- BD 02 CATCHMENT
- BD 03 CATCHMENT
- BD 04 CATCHMENT
- BD 05 CATCHMENT
- BD 06 CATCHMENT
- BD 07 CATCHMENT
- BD 08 CATCHMENT
- BD 09 CATCHMENT
- BD 10 CATCHMENT
- WETLAND 6 CATCHMENT
- WETLAND 7 CATCHMENT
- EX. WETLAND 2 CATCHMENT
- EX. WETLAND 5 CATCHMENT
- PROPOSED STORMWATER RETICULATION
- EXISTING STORMWATER RETICULATION
- STORMWATER WETLAND
- BIORETENTION DEVICE

PRIVATE PLAN CHANGE

REVISION	CHANGES	CHECKED	DATE
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CLIENT
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PROJECT
ARA HILLS - PRIVATE PLAN CHANGE

TITLE
PROPOSED STORMWATER DEVICES DETAIL PLAN SHEET 2

DRAWN	RK	SCALE A1	1:2000
DESIGNED	TH	A3	1:4000
PROJECT No 1403	DRAWING No C454	REVISION A	

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LOW PRESSURE SEWER 7 LOTS

LOW PRESSURE SEWER 12 LOTS

PRIVATE PUMP STATION 1 (11 LOTS)

NUKUMEA SCENIC RESERVE

PRIVATE PUMP STATION 2 (18 LOTS)

PUBLIC PUMP STATION 3 (150 LOTS)

LOW PRESSURE SEWER 9 LOTS

KIKORANGI DRIVE

STAGE 3A (COMPLETED)

STAGE 2 (UNDER CONSTRUCTION)

ARA HILL DRIVE

GRAND DRIVE

STAGE 1 (COMPLETED)

EXISTING PUMP STATION 2 125 LOTS

EXISTING PUMP STATION 1 222 LOTS

NORTHERN GATEWAY TOLL ROAD

PROPOSED 400OD PE PIPE TO SERVICE PCA

EXISTING 315OD PE GRAVITY LINE WITH INSUFFICIENT CAPACITY TO BE ABANDONED

382 RESIDENTIAL LOTS
+ 4 COMMERCIAL LOTS
+ EXISTING PS 1 (222 LOTS)
+ EXISTING PS 2 (109 LOTS)
+ PROPOSED PS 3 (GRAVITY (155 LOTS)
+ PRIVATE PS 1 (11 LOTS)
+ PRIVATE PS 2 (18 LOTS)
+ LOW PRESSURE (24 LOTS)

EXISTING WATERCARE TRANSMISSION NETWORK

LEGEND

- 40.0 / 45.0 — PROPOSED CONTOURS
- 40.0 / 45.0 — EXISTING CONTOURS
- SITE BOUNDARY
- MSE SLOPE
- STAGE 1 BOUNDARY
- STAGE 3A BOUNDARY
- STAGE 2 BOUNDARY
- PROPOSED GRAVITY SANITARY SEWER
- PROPOSED RISING MAIN
- PROPOSED LOW PRESSURE SEWER
- EXISTING GRAVITY SANITARY SEWER
- EXISTING RISING MAIN

PLAN CHANGE APPLICATION

REVISION	CHANGES	CHECKED	DATE
B	SMP RFI AMENDMENTS	TH	22/07/25
A	ORIGINAL ISSUE	CR	14/04/23

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CLIENT

AVJ HOBSONVILLE PTY LTD

PROJECT

ARA HILLS - PRIVATE PLAN CHANGE

TITLE

WASTEWATER PLAN OPTION 1

DRAWN	RK	SCALE A1 1:2500
DESIGNED	CR	A3 1:5000
PROJECT No 1403	DRAWING No C500	REVISION B

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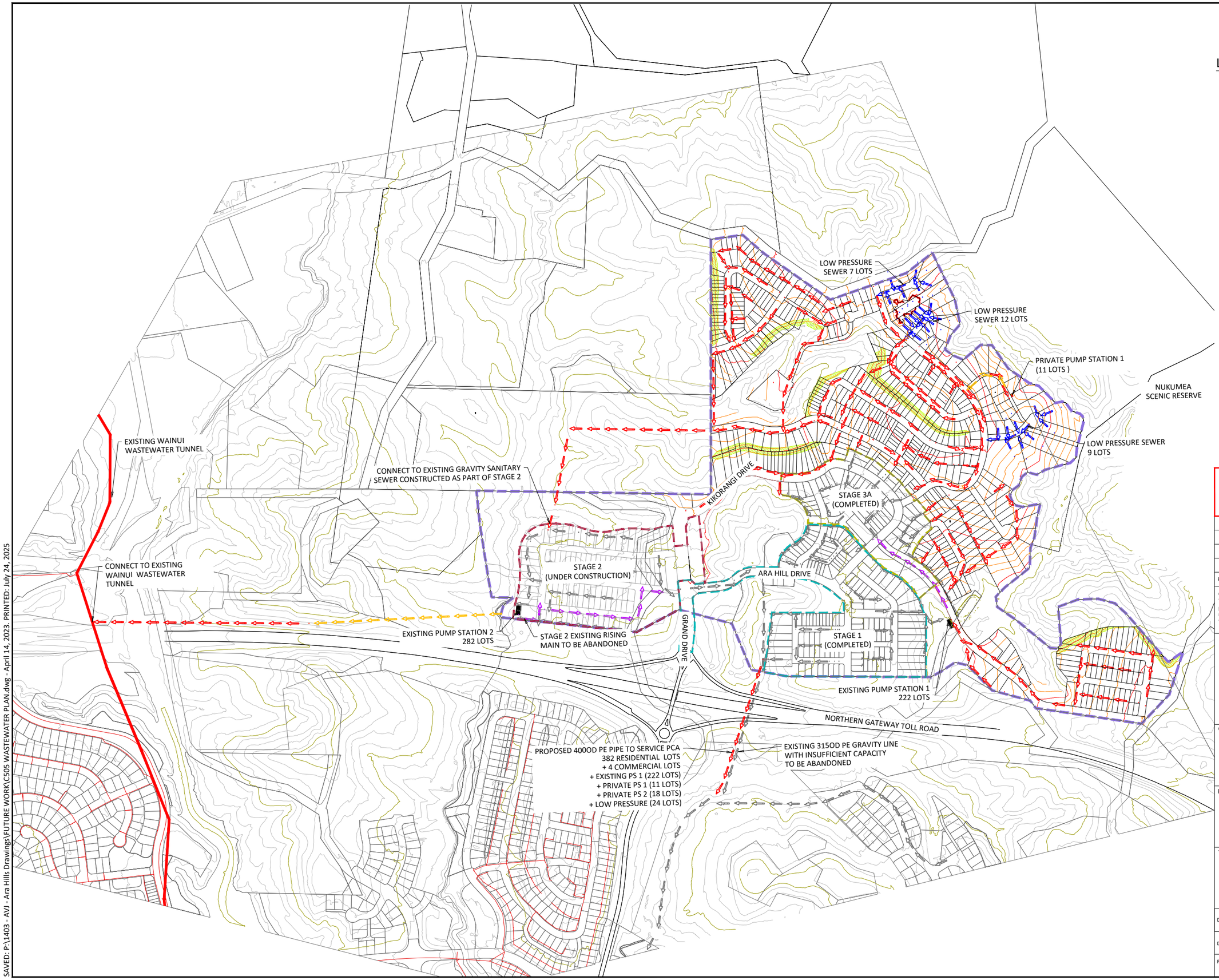

LEGEND

- PROPOSED CONTOURS (40.0 / 45.0)
- EXISTING CONTOURS (40.0 / 45.0)
- SITE BOUNDARY
- MSE SLOPE
- STAGE 1 BOUNDARY
- STAGE 3A BOUNDARY
- STAGE 2 BOUNDARY
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PLAN CHANGE APPLICATION

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PROJECT
ARA HILLS - PRIVATE PLAN CHANGE

TITLE
WASTEWATER PLAN OPTION 2

DRAWN	RK	SCALE A1 1:4000
DESIGNED	CR	A3 1:8000
PROJECT No 1403	DRAWING No C505	REVISION B

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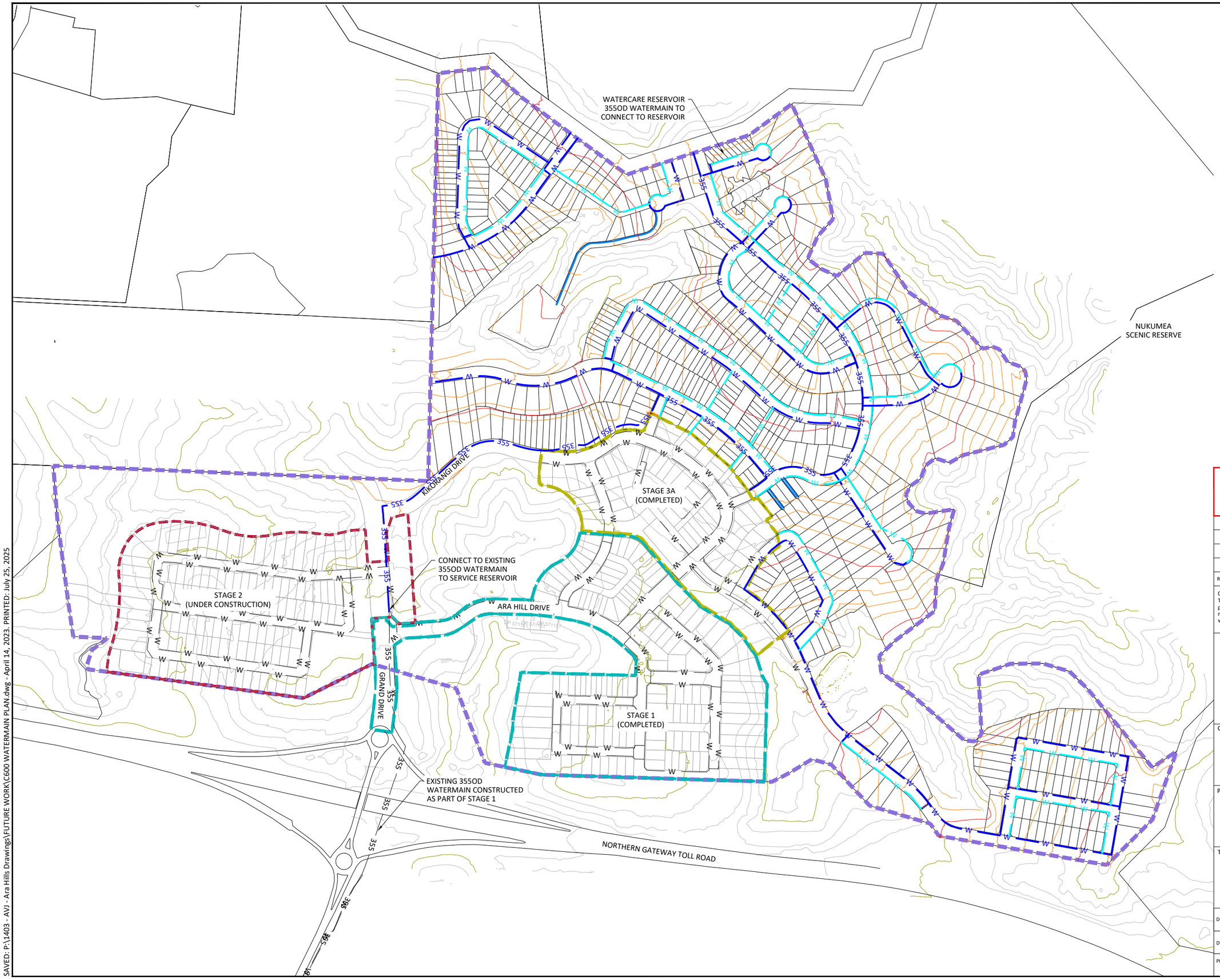

PRIVATE PLAN CHANGE

REVISION	CHANGES	CHECKED	DATE
B	SMP RFI AMENDMENTS	TH	22/07/25
A	ORIGINAL ISSUE	CR	14/04/23

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PROJECT

ARA HILLS - PRIVATE PLAN CHANGE

TITLE

WATERMAIN PLAN

DRAWN	RK	SCALE A1 1:2500
DESIGNED	CR	A3 1:5000
PROJECT No 1403	DRAWING No C600	REVISION B

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APPENDIX B:

STORMWATER MANAGEMENT PLAN

CRANGCIVIL
CONSULTING ENGINEERS

STORMWATER MANAGEMENT PLAN

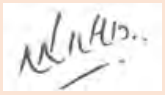
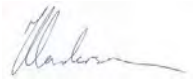
HALL FARM WEST – ARA HILLS

Prepared for:
AVJ Hobsonville Ltd

Date:
25 July 2025

Document Quality Assurance Statement

Project Number	1403
Report Name	Stormwater Management Plan – HALL FARM WEST - ARA HILLS
Revision No.	D
File Location	p:\1403 - avj - ara hills\6.0 reports and letters\6.3 stormwater report\stormwater management plan rev a draft.docm

Action	Personnel	Sign	Date
Prepared	Natalie Naidoo (Senior Civil Engineer)		25/07/2025
Approved	Tom Henderson (Director, CPEng)		25/07/2025

Document Revision Status

Revision No.	Description	Section/Page	Author	Date
A	Original Issue	All	CR	10/11/2023
B	Revised Issue - RFI	All	NN	8/04/2024
C	Revised Issue - RFI	All	NN	4/02/2025
D	Revised Issue - RFI	All	NN	25/07/2025

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Executive Summary

Crang Consulting Ltd has been commissioned by AVJ Hobsonville Pty Ltd to complete a stormwater management plan (SMP) for the Ara Hills Development in Orewa, Auckland. This report has been prepared in support of a private plan change to the Auckland Unitary Plan Operative in Part (AUP). The plan change seeks to rezone approximately 85 hectares from residential to multiple different zonings to suit the proposed Hall Farm West or Ara Hills subdivision. Precinct provisions are also proposed under the PPC application. The precinct provisions will provide a maximum cap of 900 lots within the Plan Change Area (PCA).

The Ara Hills PCA is shown in Figure 1, which located on the western side of the Orewa Motorway interchange at the western end of Grand Drive. It encompasses the following properties:

- 47 Ara Hills Drive, Upper Orewa, Lot 1001 DP 565605
- 226 Grand Drive, Orewa, Lot 1 DP 0931

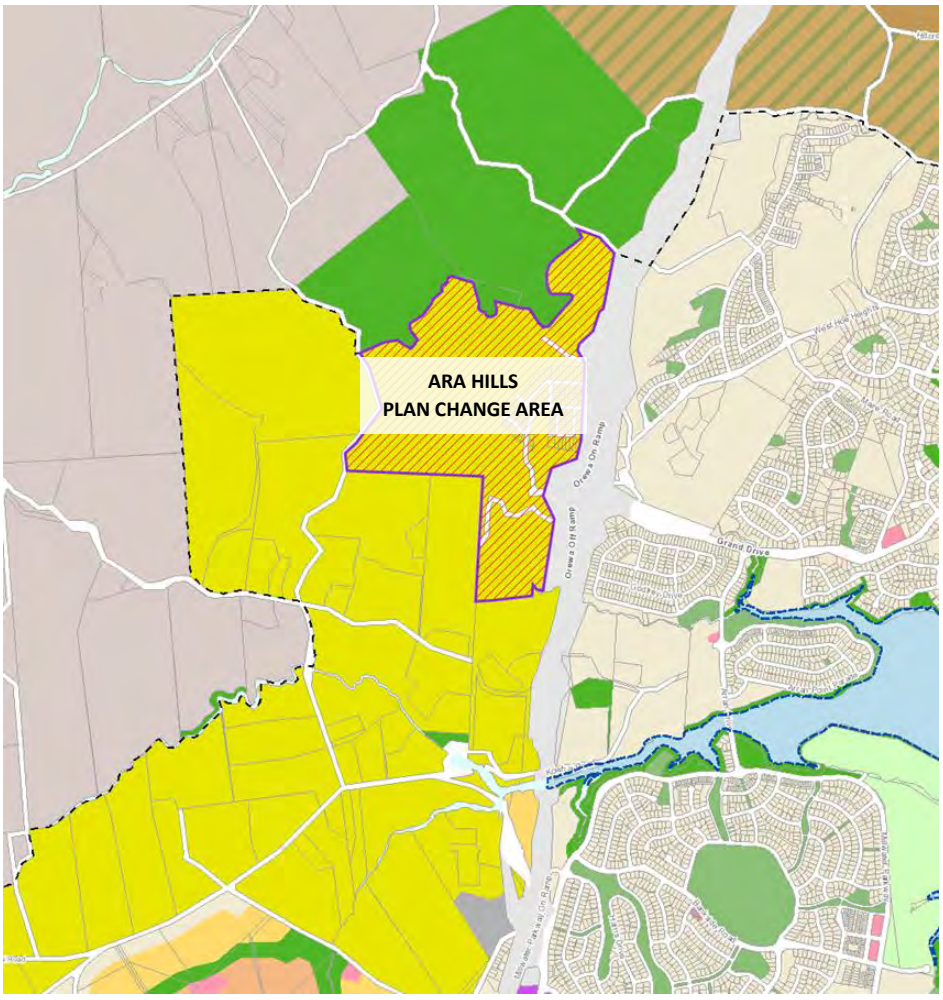

Figure 1 Site Location (Source: AC GIS)

The proposed site currently has an approved resource consent (BUN20441333). This existing consent allows for a cap of 575 lots. This SMP is assessing a new proposed cap of 900 lots, and will replace a current approved in principle SMP that was prepared by Airey Consultants Ltd.

It is important to note under the existing consent three stages have been constructed or actively in construction. These stages are specified as Stages 1, 2, 3A-1, and 3A-2. These three developments comprise of approximately 220 lots and 4 commercial lots. These lots are considered to be included

within the proposed precinct plan of 900 lots. Stages 1, 3A-1, and 3A-2 have had their titles issued. Stage 2 title release is expected to be complete by the end of the 2024 year. For this report, Stages 1, 2, 3A-1, and 3A-2 are all considered to be existing and constructed as part of the original consent.

This Stormwater Management Plan is going to establish a framework for the design and approval of new stormwater reticulation and treatment associated with development of the site.

This report has been based off the information made available to Crang Consulting Ltd from the client, public sources, and specific site investigation at the time of performing the assessment. Should further information become available regarding the site and the area around the site, Crang Consulting Ltd reserves the right to review the report with respect to the additional information.

1 Existing Site Appraisal

1.1 Location and General Information

The site is located approximately three kilometres from the Orewa beachfront. It has direct access off the SH1 northbound off-ramp with a roundabout exit directly servicing the Ara Hills subdivision. To the east of the development is the SH1 motorway and directly across the motorway is newly developed urban areas zoned as mixed housing urban. To the south and west is large lot zoning primary consisting of agriculturally based activities (including cattle farming, glass houses, and market gardens). North of the PCA is the Nukumea Reserve. The Nukumea Reserve is an important ecological feature of Auckland and will control many of the precinct provisions of the plan change application to preserve the interface of the urban environment with the Reserve.

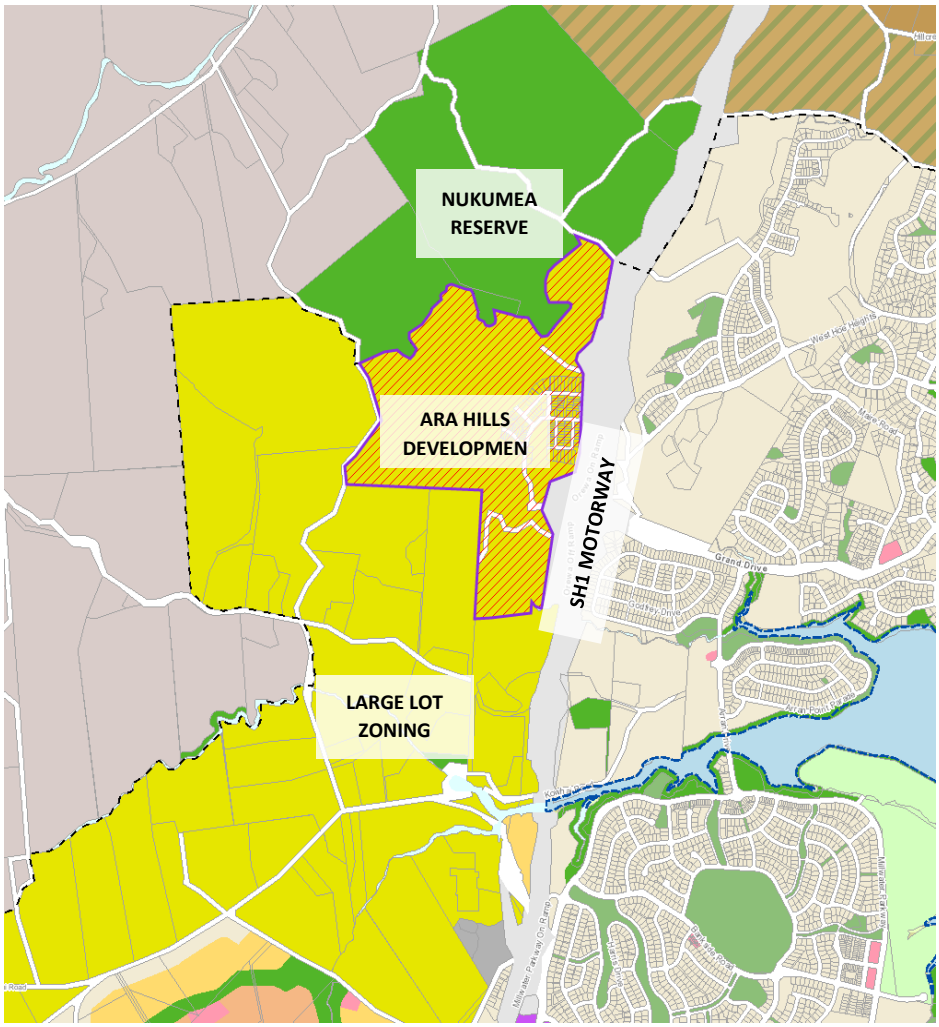

Figure 2 Existing PCA (Source: AC GIS)

1.2 Topography

The site's topography contains moderate to steep gradients with varying levels of ridges and incised gullies. To the north and northwest of the property, the PCA shares borders with a substantial expanse of Department of Conservation land, recognized as the Nukumea Scenic Reserve. On the western side, a prominent ridge acts as a natural boundary, creating a distinct separation between the property and the neighbouring rural zoned land, accessible via Upper Orewa Rd. Meanwhile, to the east, the motorway runs alongside the property. There are existing streams, wetlands, and native vegetation throughout the site as well as large areas of pasture. Three primary watercourses converge and channel their flows into the Orewa River Catchment.

1.3 Existing Stormwater Features and Pre-Development Flooding Analysis

The subject property is located across three distinct catchments and streams, each of which funnels its runoff through separate culverts constructed beneath the Northern Motorway (SH1). The northern catchment and stream contribute as a tributary to the West Hoe Stream and extends into the Nukumea Scenic Reserve, situated north of the PCA. The central gully and stream features a catchment entirely contained within the property boundaries, also feeding into the West Hoe Stream on the eastern side of the motorway. The southern catchment and stream are the largest and reaches into the Wainui rural area. These catchments are labelled as the Southern, Central, and Northern and can be seen in Figure 3.

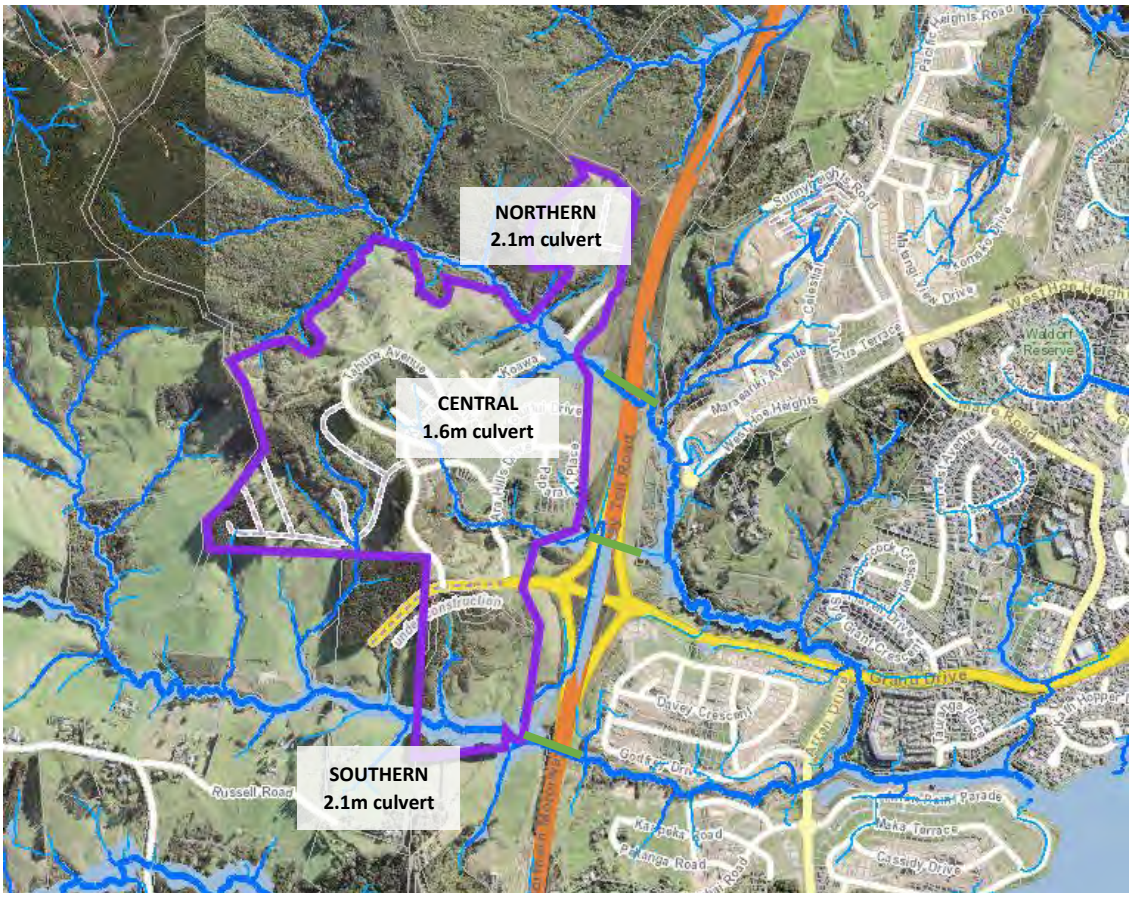

Figure 3 Existing Stormwater Features (Source: AC GIS)

1.4 Ecology

Bioresearches Consultants' ecology report provides descriptions of the PCA's ecology which can be provided on request. The ecology reports define the three catchment streams and their tributaries as well as wetlands located within the streams.

1.5 Receiving Environment

Culverts carry the flow from these catchments underneath the motorway and continue downstream into their receiving environment being the Orewa Estuary, and then into the Hauraki Gulf.

1.6 Existing Hydrological Features

Stormwater infrastructure has been constructed as part of the currently consented development. These include stormwater piped networks, bioretention devices, and new wetland treatment devices. An arch culvert has been constructed as part of the Stage 1 works over the existing Central stream upstream of the culvert to enable roading access to the property.

The only existing stormwater infrastructure downstream of the PCA and motorway culverts is an arch culvert below Grand Drive, through which the West Hoe Stream discharges, and a new bridge along Arran Drive. The Arran Drive bridge is within a tidal area, and the Grand Drive arch culvert is immediately above the tidal extent of the Orewa River.

Auckland Council has prepared the Orewa West Stormwater Integrated Catchment Management Plan (ICMP) (February 2011), which has been prepared to provide stormwater management controls for the proposed Orewa West development on the eastern side of the motorway. The ICMP does not include controls for the applicant land or other land on the western side of the motorway.

The ICMP identifies the three catchments within the applicant property as follows:

- The northern catchment is a tributary of the West Hoe Stream and has a catchment area of 130Ha.
- The central gully is also a tributary of the West Hoe Stream and has a catchment area of 27Ha.
- The southern catchment is identified as the Southern Stream and has a catchment area of 175Ha.

According to the ICMP, each of the three catchments has one existing culvert beneath SH1 motorway to discharge the stormwater flows. The details of the culverts are as follows:

- Northern culvert (West Hoe Stream) - 1800mm diameter
- Central culvert (West Hoe Stream) - 1600mm diameter
- Southern culvert (Southern Stream) - 2100mm diameter

Auckland Council has also prepared the Orewa West Catchment Rapid Flood Hazard Assessment. The purpose of this assessment was to be used as a precautionary assessment of areas at potential risk of flooding. This report revises the above Northern culvert to being 2100mm diameter and has been verified through as-builts.

The comprehensive detailed design of stormwater distribution and management will be conducted during the subdivision or land-use consent phase for specific portions of the phased development. Any proposed stormwater distribution and management should adhere to the overarching principles outlined in this Stormwater Management Plan.

2 Stormwater Reticulation

2.1 General

Although the stormwater reticulation and treatment system for each stage of the development will be designed in each stage's Resource Consent, fundamental design principles can be set for the entire site. The intention is that the future Resource Consent applications for specific stages would then be assessed against these principles. In general, the stormwater system will follow a treatment train approach, this is shown at a conceptual level in Figure 4.

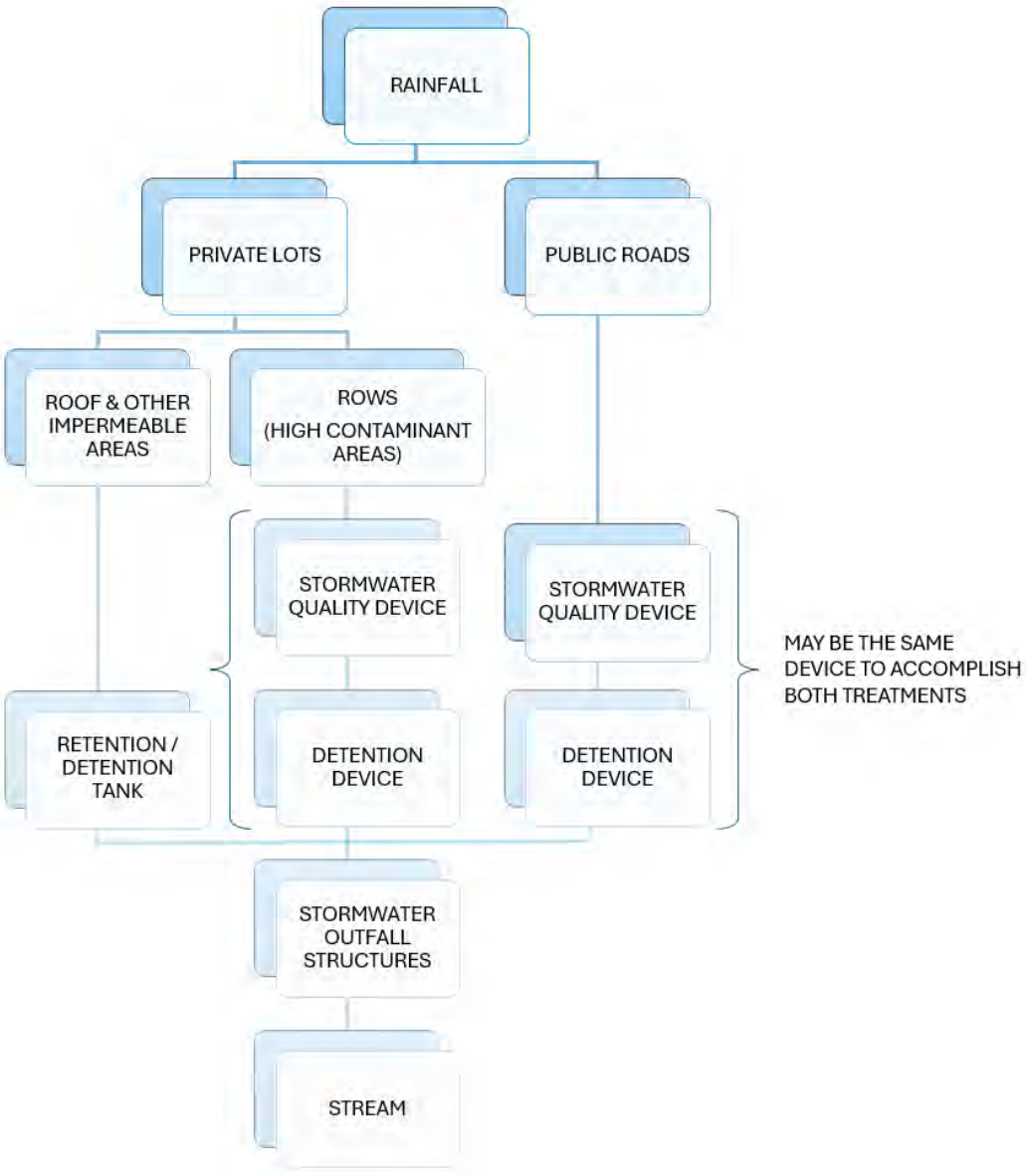

Figure 4 Stormwater Treatment Train

Stormwater conveyance between the stages of the treatment train will generally be accomplished by way of pipe systems. The use of grassed swales for stormwater conveyance should be investigated during the design process for each stage of development, however it is noted that the combination of topography and narrow road reserves probably renders swales reasonably impractical in most locations on the site.

2.2 Drainage Network

Due to the proposal to alter the zoning of the site to a higher density urban, a corresponding level of development is anticipated. The future development will be provided with piped stormwater networks, consisting of catchpits, manholes, and underground pipes in accordance with Auckland Council's Stormwater Code of Practice. In some locations grass-lined swales may be appropriate to provide stormwater conveyance, but we consider that in general a conventional piped stormwater system will be most suitable, particularly given the steep topography of the site. Stormwater reticulation should generally run along the road reserves or within the front or rear yards of the lots, with road catchpits and private property connections being connected to the public branches.

All stormwater networks within the site shall discharge to the existing stream network. There are three streams within the site and each of these streams crosses SH1 within a culvert, and then converges with the Orewa Estuary and the ultimate receiving environment of the Hauraki Gulf. Due to the steep topography of the site (particularly around the gullies through which the streams flow), the stormwater pipes discharging to the streams are likely to be very steep (15% gradient or more). Therefore, substantial erosion protection measures will be required. In general, this should take the form of concrete wingwalls and rip-rap aprons in accordance with Auckland Council TR2013-018 Hydraulic Energy Management: Inlet and Outlet Design for Treatment Devices (TR2013-018). Due to the steep gradients, there will likely be some stormwater outlets that exceed the limitations of standard rip-rap erosion protection (Froude number of 3 or more), and therefore an alternative outlet arrangement will be required. A stilling well/bubble up chamber is considered to be an appropriate erosion protection and energy reduction measure for the site. An example of such an outlet is shown in Figure 5.

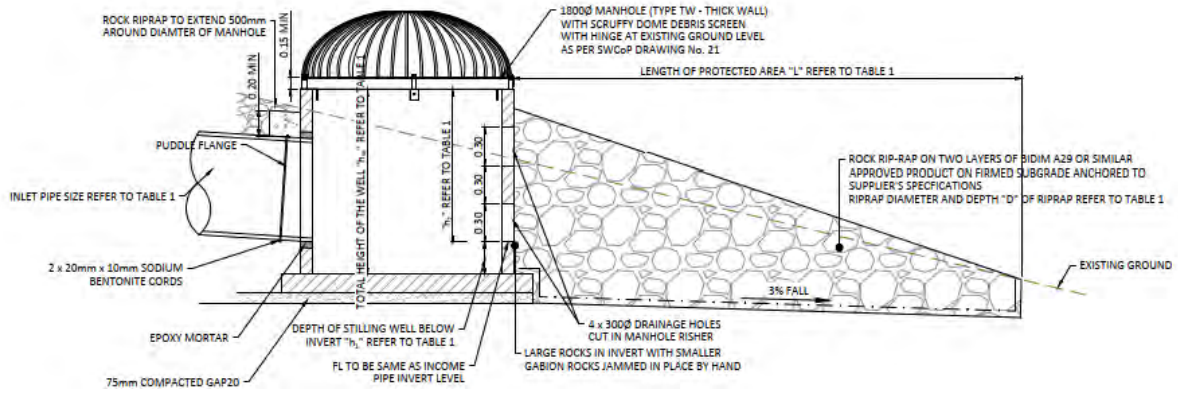

Figure 5 Stilling Well Detail

All lots within the development should discharge to a public stormwater conveyance system, rather than being provided with individual outlets. This will ensure that all outlets will be in public ownership and will therefore be maintained to ensure their continued operation for the duration of the design life. In cases where a row of large lots is located on the side of one of the gullies, a public pipe should be installed to collect the runoff from the lots and discharge via one outlet, rather than constructing individual level spreaders or dispersal tees for each lot. It is also preferred to spread out stormwater outlets through the length of the streams within the site to replicate existing flow patterns. Outfalls should be installed so that the pre-development stream flows are maintained post-development for the 95th percentile rain event best protecting the existing environment. The outlets are to be vested to Healthy Waters to ensure continual maintenance.

2.3 Overland Flowpath

It is anticipated that major drainage overland flow paths will primarily be provided along road corridors in accordance with Auckland Transport Design Manual. As some of the roads in the development are likely to be quite steep (>8% longitudinal gradient), specific design will need to be undertaken to ensure that overland flow travels from the road corridor to the discharge point (existing streams) without creating risks to vehicles, pedestrians, or neighbouring properties. This may require kerbs to be shaped at low points to provide routes for the water to exit the road carriageway and may also involve riprap or other forms of erosion protection being provided. Overland flow paths may be shaped (Vee or trapezoid cross-sections) through grassed reserve areas that will link the road reserve to land adjacent to the streams. The flow channels may need to be lined with rock or proprietary geotextiles to prevent erosion.

3 Stormwater Quantity Management

3.1 General Considerations

3.1.1 SMAF Zoning

The land immediately downstream of the motorway falls within Stormwater Management Area Control – Flow 1 (SMAF 1), as shown in Figure 6 below. This control seeks to protect and enhance Auckland's rivers, streams and aquatic biodiversity in urban areas. It has been previously agreed with Auckland Council that the SMAF 1 zone will apply to the site. SMAF 1 catchments are defined in the AUP as:

"Those catchments which discharge to sensitive or high value streams that have relatively low levels of existing impervious area. "

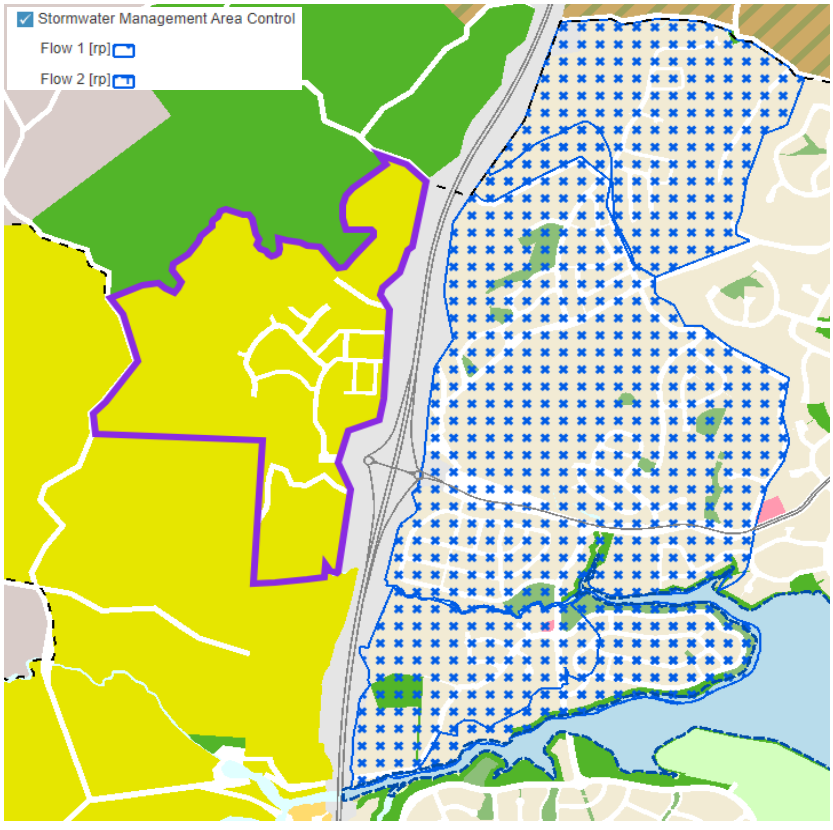

Figure 6 SMAF Extents

Analysis of historic aerial imagery prior to the motorway construction shows that the areas currently being developed east of the motorway were previously broadly like the subject site in terms of topography and land cover. The topography is generally undulating with steep gullies, while the vegetation is predominantly pasture with bush and trees concentrated in the gullies. Streams are generally narrow and highly incised, although the stream east of the motorway has been substantially modified as a result of the motorway construction works.

As the subject site has similar topography, pre-development landcover, and stream characteristics to the SMAF 1 areas on the eastern side of SH1, we consider that adopting SMAF 1 for the site is appropriate and consistent with the objectives and policies of the AUP. This has been previously agreed with Auckland Council.

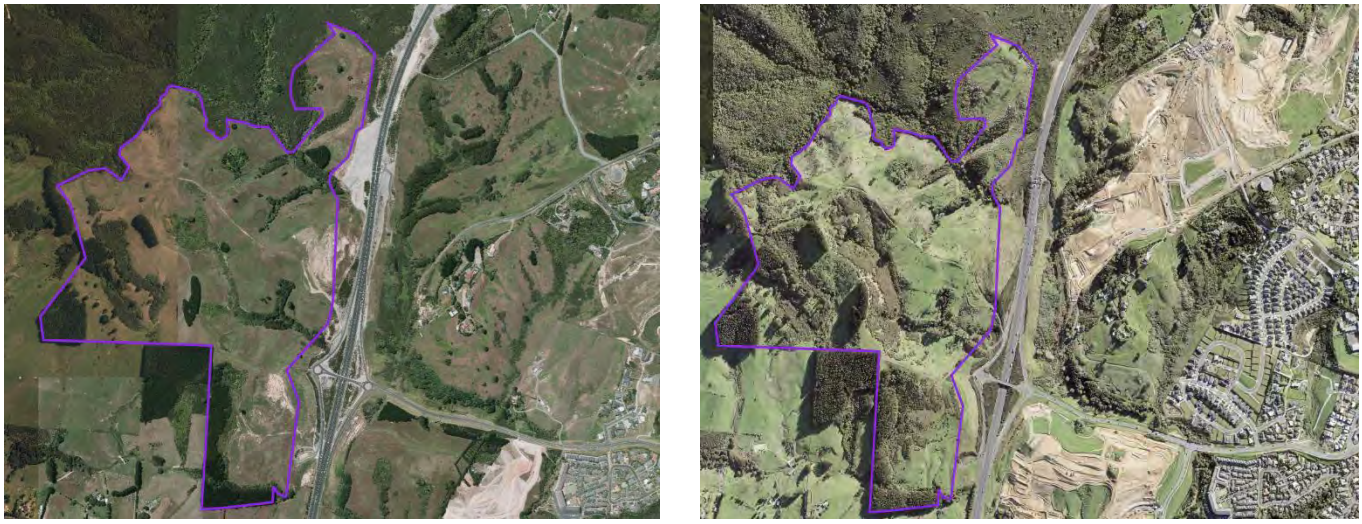

Figure 7 Historic Aerial Image 2010 vs 2017

3.1.2 Other Stormwater Quantity Considerations

The effects of the increased impervious area include a reduction in groundwater recharge, reduced stream flows during periods of dry weather, increased velocity of runoff during rainfall events, and increased volume of runoff during rainfall events.

Auckland Council GD01 Stormwater Management Devices in the Auckland Region (GD01) recommends three main solutions to provide mitigation for the effects of increased impervious area in relation to the quantity of stormwater.

1) Retention for stream protection and groundwater recharge

Stormwater retention is provided to ensure water volumes are not conveyed to the primary or secondary stormwater systems, therefore reducing the downstream volume during storm events. Retention is also provided to enable groundwater recharge.

2) Detention for stream protection

Detention of stormwater run-off for stream protection aims to maintain the receiving environment, as well as maintain or improve stream habitat. This is achieved by providing detention of the 95th percentile storm over 24 hours. Further mitigation can be provided by using stream protection measures such as riparian planting and the inclusion of wetlands.

3) Detention for flood management

Detention for flood management can be provided by designing stormwater management devices to provide detention for large storm events. These devices release the stored volumes over a longer period, to attenuate the increased run-off.

3.2 PCA Stormwater Mitigation Requirements

Each of the above-mentioned mitigation techniques is assessed below to investigate the suitability of options for the PCA.

1) Retention for stream protection, groundwater recharge, and reuse.

The site soils predominantly consist of low permeability clays with a maximum measured permeability of 0.036mm/hr (based on investigations by KGA Geotechnical in 2015), which is substantially less than the 2mm/hr minimum recommended by GD01 for bioretention devices designed to infiltrate to the underlying soils. Therefore, unlined infiltration/soakage devices such as bioretention, gravel trenches and soakage pits are not recommended to be utilised on the site.

Bioretention or similar devices should be lined with impermeable membranes to prevent potential stability issues and should be used solely for treatment and not provide any retention function. Due to both the topography and the geology of the site, existing stormwater runoff is generally via sheet flow into numerous overland flowpaths, and ephemeral, intermittent and permanent streams. As such, it is unlikely much groundwater recharge occurs within the PCA.

Regardless, it is recognised returning water to streams via groundwater is preferred. However, this is inappropriate for the PCA. In addition to the low permeability of the clay described above, the soils are also classified as moderately expansive soils in accordance with NZS 3604 timber-framed buildings. Introducing further moisture to these soils on an irregular basis (i.e., only when it rains) is therefore not recommended as this may lead to shrinking and swelling of the soils after the development works have been completed which can result in damage to pavements and structures. It is therefore not recommended that retention is provided for the public roads.

A more appropriate methodology for retaining stream baseflows would be to utilise stormwater reticulation to accomplish this. The stormwater reticulation should be designed to allow for flows to be collected and discharged back into the streams. This will ensure that the streams maintain a base flow that is similar to the existing runoff that they currently receive and that all of the developed catchment flows are not piped downstream of these gullies as occurs on typical subdivision designs.

Detailed design of subdivision stages should ensure that outfalls along the streams receive flows that approximately mimic the existing flows by dispersing discharge points intermittently along the watercourses. The number and location of outlets will largely be driven by topography, however ensuring that at least some runoff is returned to the head of the gullies by way of stormwater pipe networks should be a priority. These flows could be directly from a clean stormwater network or via an outfall from a treatment/detention device. This design principle will go some way to ensuring that baseflows within watercourses are maintained at a similar level to the pre-development condition.

Retention and reuse can be achieved for the PCA through the use of detention and retention tanks located within the private lots, providing mitigation of impervious areas. The retention portion of the tanks will be used as reuse within private lots for irrigation or non-potable water purposes. Retention tanks will be proposed in accordance with consent conditions, consent notices and will be reviewed and approved during the Resource & Building Consent stage.

2) Detention for stream protection

Detention of stormwater run-off for stream protection should be required to SMAF 1 standards as follows:

- provide detention (temporary storage) and a drain down period of 24 hours for the difference between the pre-development and post-development runoff volumes from the 95th percentile 24-hour rainfall event minus the 5 mm retention volume or any greater retention volume that is achieved, over the impervious area for which hydrology mitigation is required.

As discussed previously, retention is not proposed to be provided for impervious areas within the road reserve, but is required in all private lots. Detention device like wetland and bioretention devices etc. for stream protection must be provided for the 95th percentile 24-hour rainfall event for all catchments.

3) Detention for flood management

Section 7.2.2 Stormwater Management Options of the Orewa West Integrated Catchment Management Plan recommends that, "as there are no downstream flooding issues, attenuation of the 2-, 10- and 100-year ARI with 2.1℃ climate change flows is not proposed, except for the sub-catchments where there is existing infrastructure network". Section 2.2.8 of the ICMP notes that all three catchments within the site drain into sub-catchment 15 which has no stormwater infrastructure below the motorway embankments, other than the arch culvert below Grand Drive and the Arran Drive bridge. No attenuation within Catchment 15 is proposed by the ICMP. There would also be little purpose in providing attenuation of the 2-, 10- and 100-year ARI events from this development for the following reasons:

- The 2-year ARI detention requirement is typically for stream bank protection. The stormwater outlet details will ensure that appropriate erosion protection and energy dissipation are provided prior to discharge into the streams to minimise adverse effects on the downstream watercourses. In addition to this, the detention of the 95th percentile storm in accordance with SMAF 1 requirements will also ensure that adverse effects on downstream watercourses are minimised.
- The 10-year 2.1° climate change ARI detention requirement is typically to ensure that existing downstream pipe reticulation is not subject to greater flows than for which it has design capacity. The only downstream infrastructure is the arch culvert below Grand Drive, and the Arran Drive bridge which has been constructed in a tidal area and is not affected by any increase in flows. The development of this catchment in relation to the overall flows will have an insignificant effect on the flows/flooding levels downstream of the culverts beneath the State Highway. The existing culverts under SH1 are under capacity for the 10-year 2.1° climate change ARI storm event and above and therefore provide attenuation for the existing pre-development runoff from their upstream catchments during storm events equal to the 10-year 2.1° climate change ARI event and above.
- The 100-year 3.8° climate change ARI detention is for flood protection to ensure that existing downstream buildings are not subject to a greater risk of flooding as a result of upstream development. In the downstream catchment, there are no existing buildings within the Auckland Council GeoMaps floodplain overlay. Similarly, to the 10-year event, the existing culverts below the motorway provide flood attenuation for the existing land use and this will also be the case for the post-development scenario. Flood levels for the development have been modelled and used to determine that all proposed floor levels will be above the 100-

year flood level based upon 50% blockage of the culverts. This is considered to be a conservative approach for large-diameter culverts such as those beneath the motorway and is in accordance with Section 4.3.9.8 of the Auckland Council Stormwater Code of Practice. As the 100-year ARI storm event is throttled by the existing culverts, further attenuation by providing storage within constructed treatment devices would serve no purpose and is therefore unnecessary.

The details of the assessment for the 10- year and 100-year ARI events are assessed in Section 6.

3.3 Recommended Stormwater Quantity Requirements

Suggested stormwater quantity requirements are listed below, reference should also be made to the suggested precinct plan stormwater objectives, policy, and controls contained within the Private Plan Change Infrastructure Report prepared by Crang Civil Consultants. This may result in different devices being chosen for different stages based on the different constraints present.

- Stormwater management for all impervious areas per the AUP-OP SMAF1 requirements, being a 95th percentile storm. This includes retention and detention as follows:
    - Retention of the first 5mm. For this catchment, infiltration is not appropriate, therefore retention volumes shall be provided by non-potable water reuse only within private lots. Road catchments require the retention volume to be added to the detention volume.
    - Detention of the remaining 95th percentile storm shall be captured and released over 24 hours.

- Stormwater pipe networks will discharge into identified streams to replicate existing baseflows and mimic the natural catchment runoff as closely as is possible. This will be achieved by strategically locating multiple outlets along streams instead of one outlet at the lowest elevations of the development.

4 Stormwater Quality Management

4.1 General

Stormwater quality treatment will be required for all impervious surfaces within the public road reserves. Stormwater treatment will also be required for private accessways within private property, but this should be provided within the private property, not within the road reserve. It should be noted that the best treatment option for public roads will not necessarily be the best option for private roads, and vice versa.

Stormwater quality treatment devices like raingardens or similar approved are proposed in accordance with the stormwater device selection toolbox.

Roof materials are required to be constructed from low contaminant generating materials, hence stormwater quality treatment for roof runoff is not required.

4.2 Stream Quality

Land disturbance within 20m of watercourses is a significant contributor to sediment loads in waterways. Apart from stream crossing structures, no buildings or structures are anticipated to be undertaken within 20m of any of the permanent or intermittent streams within the site. The level of development near streams is in accordance with the previously approved resource consents (BUN20441333, LUC60010513-C), being primarily confined to the three stream crossing structures proposed (noting that these are all included in the previously consented development plans).

It should be noted that there is no change in the extent of riparian planting between the proposed Plan Change and the previously consented development (BUN20441333, LUC60010513-C). The consented planting extents are as follows:

- All streams will have a 10m riparian planting area with a precinct requirement in this regard.
- All streams have a riparian margin of at least 10 - 20m, the majority have a significantly larger margin than 20m.
- The length of retained streams is identical between the consented development and the Plan Change proposal. The Plan Change does not seek to remove any additional streams, but rather seeks provisions that go beyond the AUP requirements.

4.3 Wetland Quality

There are a few existing natural wetlands scatted through the alignment of the Northern and Southern stream tributaries. These are shown within the Bioresearches' Ecology Report. A minimum 10m setback of all works from the wetlands is proposed. As it is proposed for base flows to be maintained with the streams and the wetlands are located within the streams, net neutrality avoiding partial/complete drainage will be provided best protecting the site's freshwater features.

4.4 Water Temperature

Stream environments can be adversely affected by large fluctuations in water temperature which can occur as a result of stormwater runoff. Stormwater runoff from impervious areas in Auckland is substantially warmer (particularly during summer) than the temperature of the receiving environment. As part of the detailed design for Stage 1 of the development, previous consultants have liaised with Auckland Council's Healthy Waters unit to develop a stormwater strategy that mitigates the impacts of high stormwater temperature on the receiving environment. This strategy includes the following considerations:

- Concrete underground pipes – it has been demonstrated overseas that relatively short distances of underground concrete pipes can reduce the temperature of stormwater by

several degrees. The majority of stormwater pipes within the development are anticipated to be concrete, so a substantial amount of cooling of the stormwater will occur within the pipe networks.

- Bioretention devices – as discussed elsewhere in this report, bioretention devices are one of the potential options for providing stormwater quality treatment for the development. Raingardens are noted in GD01 as being an effective method for reducing stormwater temperatures.
- Stilling well outlet – the stormwater outlet detail shown in Figure 3 provides further cooling of the stormwater prior to discharge to the receiving environment. This is due to the fact that the 'first flush' stormwater (which is generally the warmest runoff) is held in the well prior to discharge, with the initial discharge being through the low-flow outlet underground. Discharge overland to the receiving environment only occurs once the stilling well is partially full, and the water sitting in the well will act to reduce the temperature of incoming water as well.
- Shading – as discussed previously, the bulk of the streams within the site will be planted or will retain the existing vegetation. The extensive vegetation will provide shading of the streams which will help to reduce the water temperature.

4.5 Stream Crossing

The preliminary development's scheme plan can be seen in the Engineering Drawings in Appendix A. This scheme plan proposes one new stream crossing of the Northern Stream. At the proposed crossing, the stream splits in two with a natural island between the two streams. Preliminary site visits with the geotechnical engineer provided a bridge structure may be the best option utilising this island for a support pylon for the bridge. Geotechnical investigations are still to be completed for design of this bridge. At Resource Consent stage, a Streamworks Consent will be requested for the works associated with this stream and all works will be approved with Auckland Council.

5 Stormwater Treatment Device Selection

5.1 Objectives and Selection Considerations

Stormwater treatment devices utilised within the development will need to accomplish the following objectives:

- AUP OP SMAF 1 requirements
- Provide retention of the first 5mm of rainfall (private lots only where the retention can be reused)
- Provide detention of the 95 percentile rainfall event, less any retention provided.
- Provide stormwater quality treatment, including impervious areas subject to vehicle traffic and roof areas.

There are a range of devices that are able to accomplish one or more of these objectives, Table 15 of Auckland Council's GD01 provides a good overview of this and is reproduced below.

Table 15: Estimated device effectiveness

	Quantity control					Quality control								
Key ● Effective ○ Partially effective - Not effective	1% AEP	Detention of 50% and 10% AEP	90th & 95th percentile detention	Groundwater recharge	Retention	Sediment	Gross pollutants	Heavy metals	Oils and grease	Nutrients	Organics	Hydrocarbons	Indicator bacteria	Temperature
Pervious pavement - unlined	-	-	●	○	●	●	-[b]	-[b]	-[b]	-[b]	-[b]	-[b]	-[b]	-[b]
Pervious pavement - lined	-	-	●	-	-	●	-[b]	-[b]	-[b]	-[b]	-[b]	-[b]	-[b]	-[b]
Living roof	-	-	●[a]	-	●	○	NA	○	NA	○	○	NA	○	●
Rainwater tank (no reuse)	-	○	●	-	-	●	NA	○	NA	○	○	NA	○	○
Rainwater tank (with reuse)	-	○	●	-	●	●	NA	○	NA	○	○	NA	○	○
Infiltration device	-	○	●[a]	●	●	-	-	-	-	-	-	-	-	●
Swale (lined)	-	-	-	-	-	●	○	○	○	○	○	○	○	●
Bioretention swale (unlined)	-	-	●	●	●	●	●	●	●	●	●	●	●	●
Rain garden	-	-	●	●	●	●	●	●	●	●	●	●	●	●
Stormwater tree pit[c]	-	-	○	○	●	●	●	●	●	●	●	●	●	●
Planter box	-	-	○	○	●	●	●	●	●	●	●	●	●	●
Constructed wetland	-[d]	●	●	-	○	●	●	●	●	●	●	●	○	○
Wet pond	●	●	●	-	-	●	●	○	○	○	○	○	○	-
Dry pond (detention basin)	●	●	●	-	-	-	-	-	-	-	-	-	-	●

Notes:

NB: Assumes sizing, construction and maintenance are compliant with this guideline's requirements

NA: Not applicable, does not treat this pollutant because it is generally not present in the drainage area

●[a]: Assumes retention of up to the 90th and 95th percentile events

-[b]: Assumes limited water quality treatment for active pervious paving systems. Passive pervious paving is assumed to have some treatment effectiveness if maintained correctly

[c]: Stormwater tree pits are different to street tree pits in that they are specifically designed for stormwater management and must be sized accordingly.

-[d] Wetlands designs should bypass large storm events to protect vegetation and ensure sediments are not resuspended

Figure 8 Estimated Device Effectiveness

As discussed, some of these devices are not suitable for use on the subject site (any device utilising infiltration) or are unlikely to be utilised due to the nature of the development. As such there is no need to consider all devices at this stage. We consider that site-specific stormwater treatment device selection toolboxes are an appropriate means by which the most appropriate options for the site can be laid out at this state and can serve as a starting point for device selection at the design phase of each stage of the development. Due to the different treatment objectives pertaining to different catchments, separate toolboxes have been prepared for private lots (excluding private accessways/ roads) and for vehicle-trafficked areas (including private accessways/ roads/carparks but excluding single dwelling driveways which do not require stormwater quality treatment).

5.2 Selection Toolbox – Private Lots

Stormwater devices, preferably above ground or underground stormwater tanks, will be provided for private lots. The tanks will provide stormwater detention and retention as required. Runoff from all impervious areas will be collected in stormwater tanks and will be reused for each lot by means of irrigation, toilet flushing and other non-potable use.

As these tanks will be privately owned, it is the responsibility of the property owner to ensure their ongoing maintenance. The advantages and disadvantages of the rainwater tanks is discussed below; however the choice of device is at the discretion of the property owner and will be applied and approved at the time of Building Consent:

<u>Rainwater tanks</u>

Advantages

- Can provide retention and detention in a single device.
- Retention can be used for non-potable water supply (laundry, toilet flushing, outdoor taps) which may improve the property owner's awareness of and attitude towards maintenance.
- A wide range of shapes, sizes and configurations are available 'off the shelf' which makes tanks a cost-effective option appropriate for most sites.

Disadvantages

- If located above ground could be considered unsightly.
- Reuse of the water inside a house requires dual plumbing and likely a pump as well, this increases the cost and complexity of the system.

<u>Proprietary stormwater treatment devices</u>

Proprietary stormwater treatment devices are a possible option to treat private vehicle trafficked areas.

The advantages and disadvantages of proprietary treatment devices are detailed below:

Advantages

- Provides efficient water treatment for large areas generally exceeding the minimum required.
- Small in size and can be located underground where space is a constraint.
- Can be used in conjunction with other devices to provide a complete system.

Disadvantages

- Large up-front cost and requires third-party maintenance.

- Requires additional stormwater infrastructure to support the necessary requirements of the devices.

5.3 Selection Toolbox – Roading (public)

Devices chosen for roading will need to provide stormwater detention (of the full 95th percentile storm) and stormwater quality treatment but will not be required to provide retention. The reasons for this have been discussed previously. Devices used to provide treatment for public roads will need to be in public land (either road reserve, drainage reserve, or recreation reserve). Devices used to provide treatment for private roads will need to be located within the private road land. As noted previously, the best treatment option for public roads will not necessarily be the best treatment option for private roads and vice versa. Operational and maintenance considerations are important for these devices and there are additional considerations such as public safety that need to be taken into account for public roads in particular. The most suitable devices are discussed below:

<u>Bioretention (Swale or Raingardens)</u>

Advantages

- Can provide both stormwater quality and quantity treatment.
- Can be incorporated into landscape design to be aesthetically pleasing.

Disadvantages

- Require a sizeable amount of width which may render them impractical on many of the roads within the development.
- Bioretention swales are not suitable for slopes greater than around 5% as the number of check dams required becomes excessive.
- Maintenance can be difficult and expensive, particularly when located adjacent to road carriageways.
- The bioretention structure is quite deep (potentially >1m from surface level) which can lead to clashes with other services.

<u>Constructed Wetlands</u>

Advantages

- Can provide both stormwater quality and quantity treatment.
- Can be incorporated into landscape design to be aesthetically pleasing (more so for wetlands than ponds).
- Can treat large catchment areas making maintenance and asset management straightforward.

Disadvantages

- Require regular effective maintenance to maintain aesthetic values.
- Require large footprints of flat land.
- Have substantial safety risks for the public and require effective fencing and signage.
- Not suitable for land that may be subject to instability.

The designers of each stage of the development should refer to the toolbox in Table 1 below when determining which stormwater treatment devices represent the Best Practicable Option for public or private roading. Life costs as well as the safety of maintenance personnel (particularly for public roads) should also be included in the assessment.

In this project, existing wetland 2 and 5 constructed as a part of stage 3A. The proposed wetland 6,7 and bioretention device 01-11 will construct and provide treatment in the future stages.

TABLE 1 – SELECTION TOOLBOX - ROADING

	Detention	Quality	Footprint	Maintenance	Cost/complexity
Bioretention Devices	Yes	Yes	Moderate	High	Moderate
Raingarden	Yes	Yes	Moderate	High	Moderate
Constructed Wetland	Yes	Yes	High	Moderate	High

5.4 Proposed Devices

Appendix A contains the proposed preliminary engineering drawings for the PCA. Catchment areas for the treatment device sizing are presented on sheets C453 and C454, and are summarised on the table below. These are subject to change following resource consents and further detail when designing the stage and its stormwater devices.

A collection of bioretention devices and wetlands are proposed following the recommendations of this SMP. These devices are considered the best practical option (BPO), for the development per the preliminary scheme and final land form. The bioretention devices and wetlands have each been sized and appropriately placed to accommodate the necessary areas of the devices with additional considerations for sediment drying areas, forebays, vehicle maintenance access tracks, etc. Calculations showing compliancy with GD01 SMAF requirements can be found in Appendix B.

TABLE 2 – PROPOSED BIORETENTION DEVICES

Type of Device	Device No.	Contributing Catchment Area (m^2)	Min. Size of Device (m^3)
Bioretention	BD01	11,665	229
Bioretention	BD02	1,096	22
Bioretention	BD03	1,617	32
Bioretention	BD04	6,116	120
Bioretention	BD05	1,833	36
Bioretention	BD06	2,659	53
Bioretention	BD07	6,434	127
Bioretention	BD08	8,137	160
Bioretention	BD09	4,431	87
Bioretention	BD10	11,367	224
Bioretention	BD11	8,873	175
Wetland	Wetland 6	46,200	577
Wetland	Wetland 7	47,200	590

6 Flooding Considerations

6.1 Stream Flooding

The Auckland Council GeoMaps shows the streams, floodplains, flood prone areas and over land flow paths on the site, refer to Figure 9. It is noted the overland flows have not been updated per the developments of Stage 1, 3A-1 and Stage 3A-2. The flood plain extent indicates areas predicted to be covered by flood water as result of a 100-year ARI rainfall event and is derived from hydraulic modelling. The flood prone areas are topographical depressions. These areas occur naturally or are created by dammed gullies created by man-made features such as roads and railway embankments. The flood prone extent is the area water will pond up to in a 100-year ARI extreme rainfall event assuming the outlet to the topographical depression is blocked. Overland flow paths within the site need to be maintained or relocated and should generally utilise any future roading network and existing gullies and streams. No specific precinct rules need to be included as part of the PPC, as the existing AUP rules will be relevant and suitable for the subject site.

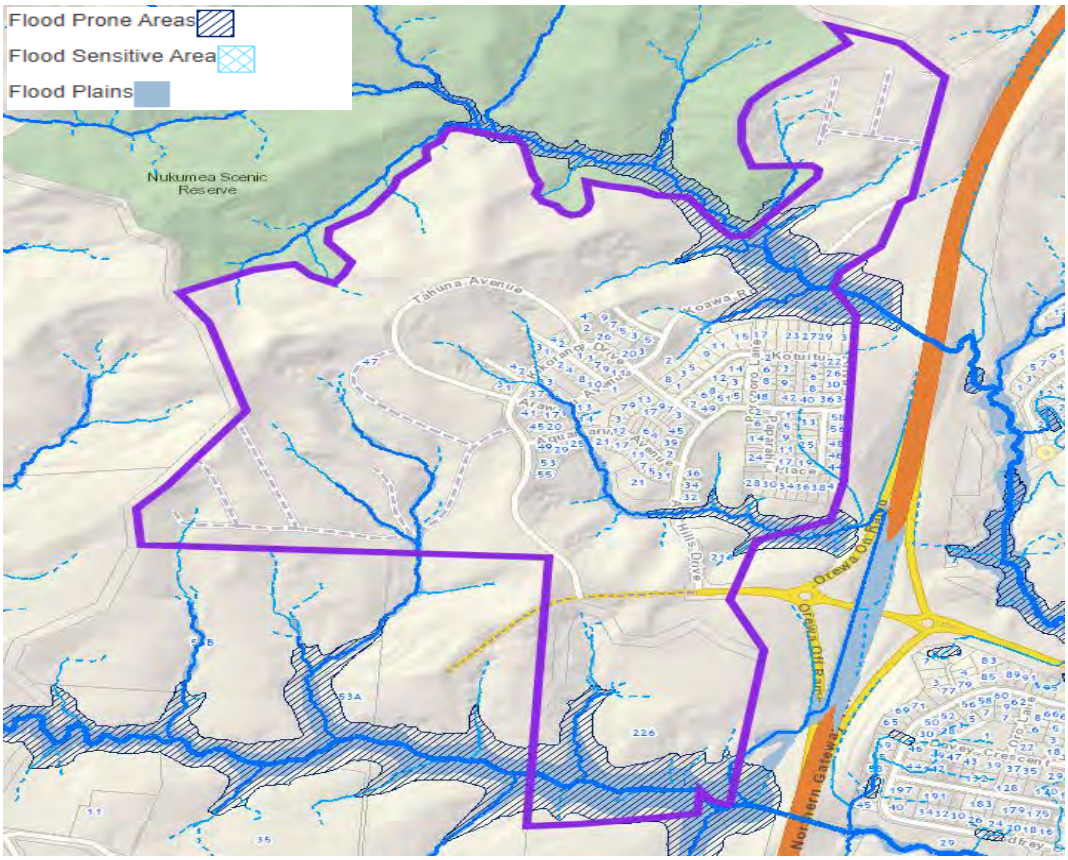

Figure 9 Flood-prone and flood-sensitive areas

6.2 Pre- and Post-Development Flooding Analysis

A HEC-HMS flooding analysis for the 10-year with 2.1℃ climate change, 100-year ARI with 2.1℃ climate change, and 100-year with 3.8℃ climate change has been completed for the development of the pre-development and post-development conditions. This has been checked against a HEC-RAS 2D model for the 100-year with 3.8℃ climate change, 100% blocked culvert analysis. Each analysis compares a 100% pervious pre-development scenario with a fully developed Ara Hills development with allowance for potential future development of the upstream catchments. While future

development does not relate to this site, it has been included so identification of the worst case flood levels are identified if the full catchment is developed.

In the assessment, the post-development scenario impervious areas are assumed to be 65% for private lots, and 80% for road corridors. Upstream catchments have significant areas of terrain that is steep and difficult to develop. We conservatively have assigned all upstream catchments with a future impervious area of 50%, which is greater than what could actually get constructed on that terrain. This percentage was selected to match council's flood model on GeoMaps.

The following scenarios have been modelled to provide peak flow and flood level for each catchment and culvert:

- 10-year ARI 2.1℃ climate change (full culvert capacity)
- 100-year ARI 2.1℃ climate change (culvert 50% blocked)
- 100-year ARI 3.8℃ climate change (culvert 50% blocked)
- 100-year ARI 3.8℃ climate change (culvert 100% blocked)
- 100-year ARI 3.8℃ climate change (culvert 50% blocked, with no future development upstream)

The extent of the flooding is shown in the Engineering Drawings in Appendix A and all calculations and results can be found in Appendix B.

The storm events used in the calculations are the 24-hour duration TP108 storm. All three culverts below the motorway are under capacity during all 100-year ARI events, including both the pre- and post-development scenarios. The 2.1℃ climate change is presented for the 10 year ARI event in line with the current Stormwater Code of Practice. The 2.1℃ climate change scenario is also presented for the 100 year ARI event, as this was the design requirement for previous approved versions of this Stormwater Management Plan. The 100-year ARI 3.8℃ climate change storm event has since been replaced as the design storm in Auckland Council's Stormwater Code of Practice, therefore these scenarios are also presented below.

6.2.1 10 & 100-year ARI 2.1℃ climate change

The results of the 10-year and 100-year ARI 2.1℃ climate change are shown on Tables 3 and 4 below:

TABLE 3: PRE- AND POST-DEVELOPMENT FLOOD LEVEL (RL) UPSTREAM OF MOTORWAY CULVERTS

	Flood Level (RL)					
	10-year 2.1℃ climate change			100-year 2.1℃ climate change (50% blocked)		
Catchment	Pre-Dev	Post-Dev	Previously Consented	Pre-Dev	Post-Dev	Previously Consented
Northern	19.0	19.8	20.4	22.8	23.3	23.4
Central	16.9	17.2	19.0	20.4	20.6	21.8
Southern	12.3	13.8	12.4	16.8	17.5	16.3

TABLE 4: PRE- AND POST-DEVELOPMENT PEAK FLOWS OUT OF MOTORWAY CULVERTS (m3/s)

	Peak Flow (m3/s)					
	10-year 2.1℃ climate change			100-year 2.1℃ climate change (50% blocked)		
Catchment	Pre-Dev	Post-Dev	Previously Consented	Pre-Dev	Post-Dev	Previously Consented
Northern	13.6	15.8	11.0*	11.4	11.9	8.2*
Central	4.8	5.9	5.9	5.8	5.9	5.5
Southern	19.7	23.0	17.5	14.7	15.2	12.8

*Note previous consent was based on an incorrect motorway culvert size

As discussed in Section 3, the 10-year detention is typically provided to ensure that existing downstream stormwater infrastructure is not subject to flows in excess of their design capacity. The only downstream infrastructure to the east of the motorway is the arch culvert below Grand Drive and the new Arran Drive Bridge for which the ICMP determines no additional attenuation is required. The motorway culverts previously discussed provide attenuation of the development's flows. For this reason, attenuation of the 10-year 2.1℃ climate change storm event is not necessary as there are no downstream infrastructure issues.

The 100-year 2.1℃ climate change ARI is the original design event for flooding hazards. The analysis found that the motorway culverts have insufficient capacity for both the existing conditions and the developed conditions of the site. This in return provides attenuation of the storm event and a flood basin upstream of the culvert.

6.2.2 100-year ARI 3.8℃ climate change (50% blocked)

Subsequent updates to the Auckland Council Stormwater Code of Practice require the secondary flow paths and flood extents to be assessed against the 100-year ARI 3.8℃ climate change event. The motorway culverts are all greater than 1.5m diameter, therefore they are to be considered 50% blocked.

The results of the 100-year ARI 3.8℃ climate change calculations, with culverts 50% blocked are shown on Table 5 below:

TABLE 5: 100-year 3.8° CLIMATE CHANGE FLOOD LEVEL (RL)

	Flood Level (RL)	
	100-year 3.8℃ climate change (50% blocked)	
Catchment	Pre-Dev	Post-Dev
Northern	23.5	24.0
Central	21.1	21.2
Southern	17.6	18.3

6.2.3 100-year ARI 3.8℃ climate change (100% blocked)

Auckland Council's Healthy Waters has requested that the absolute worst case scenario be modelled as a test case for flooding. The worst case would occur when a 100-year ARI 3.8℃ climate change

event occurs when the motorway culverts become 100% blocked. As this is the worst event, we have modelled this event in both HEC-HMS and HEC-RAS and provided a summary in Table 6 below.

TABLE 6: 100-year 3.8° CLIMATE CHANGE FLOOD LEVEL (RL)

	Flood Level (RL)			
	100-year 3.8℃ climate change (100% blocked)			
Catchment	Pre-Dev		Post-Dev	
Model	HEC-HMS (1D)	HEC-RAS (2D)	HEC-HMS (1D)	HEC-RAS (2D)
Northern	28.32	28.15	28.82	29.04
Central	27.16	25.40	27.22	25.87
Southern	21.19	20.84	21.80	21.72

The results from Table 6 above indicate that the HEC-HMS model and the HEC-RAS model result in very similar modelled flood water levels for the Northern and Southern catchments. The central catchment has significantly higher water levels in the HEC-HMS model. The difference is because the HEC-RAS model picks up all depressions in the catchment, and the Motorway includes a large depression, removing volume otherwise included in the HEC-HMS model. We recommend that model that results in the highest flood water elevation be adopted as the worst-case scenario.

6.2.4 100-year ARI 3.8℃ climate change (50% blocked, excluding upstream future development)

This scenario was assessed to check the effects the proposed Ara Hills development during the 100 year design storm event, including 3.8℃ Climate Change and culverts 50% blocked. Results are presented in Table 7.

TABLE 7: 100-year 3.8° CLIMATE CHANGE FLOOD LEVEL (RL)

	100-year 3.8℃ climate change (50% blocked, no upstream future development)			
	Flood Level (RL)		**Peak Flow (m3/s)**	
Catchment	Pre-Dev	Post-Dev	Pre-Dev	Post-Dev
Northern	23.52	23.84	12.13	12.44
Central	21.07	21.17	5.78	5.90
Southern	17.55	17.74	14.64	14.84

The increase in peak flow for the Ara Hills development during a 100-year 3.8℃ climate change storm event from the pre-development and post-development flows is considered to be negligible for all three catchments and motorway culverts.

The Central and Northern catchment combine into one stream prior to flowing through the Grand Drive arch culvert. The increase at the arch culvert due to the development is 0.4m3/s. This is a 2% increase which would have negligible effects. The Southern catchment peak flow increases by 0.2m3/s, but the receiving environment is considered to be tidal and downstream residential areas are significantly higher elevation than the stream extents. For this reason, no attenuation of the 100-year 3.8℃ climate change storm event downstream of the motorway culverts is required.

For the proposed development only (i.e. upstream future development not included) the Central and Northern catchment flood levels only increase within the Waka Kotahi land where the land is battered and is therefore considered to be acceptable and have no effect. For the Southern catchment, there are no existing structures or public roads within the extent of the floodplain and the land is rural with

primarily agricultural uses. For this reason, the increase in flood levels for the Southern catchment is considered to only have a minor effect. No attenuation of the 100-year storm event upstream of the motorway culverts is required.

6.3 Finished Floor Levels

In accordance with Auckland Council's Stormwater Code of Practice v4, all finished floor levels shall be 500mm above floodplain levels for the 100-year, 3.8℃ climate change storm event. The event shall assume a fully developed catchment, and 50% blocked culverts when culverts are greater than 1.5m diameter which is the case for this catchment.

The minimum recommended finished floor levels for all buildings or vulnerable activities that border the floodplain are per Table 8 below:

TABLE 8: 100-YEAR 3.8°C CLIMATE CHANGE FLOOD LEVEL (RL)

	Flood Level (RL)		
	100-year 3.8℃ climate change (50% blocked)		
Catchment	Pre-Dev	Post-Dev	Minimum Recommended Finished Floor Level
Northern	23.5	24.0	24.5
Central	21.1	21.2	21.8
Southern	17.6	18.3	18.8

Table 8 ponding levels are based on ponding at the motorway culverts. Where buildings or other vulnerable activities are located alongside streams, an assessment of the minimum finished floor level will need to be made for each individual lot.

The minimum finished floor levels in Table 8 are higher than in previous versions of this Stormwater Management Plan. Despite this, the lowest lot RL for all completed lots has an RL of 26.0, which is within the southern catchment. These lot levels are 7.2m above the latest minimum recommended floor level.

6.4 Increased Duration of Flooding

The increased duration of flooding has been assessed for each catchment for the 100-year ARI 2.1°CC climate change storm event. These results can be seen below in Figures 10-12:

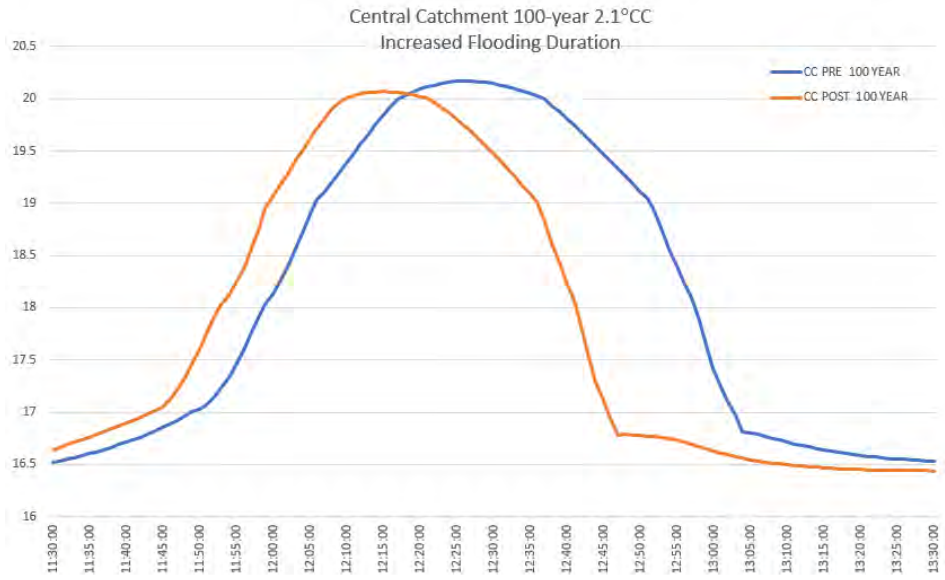

Figure 10 Central Catchment 100-year 2.1°CC Increased Flooding Duration

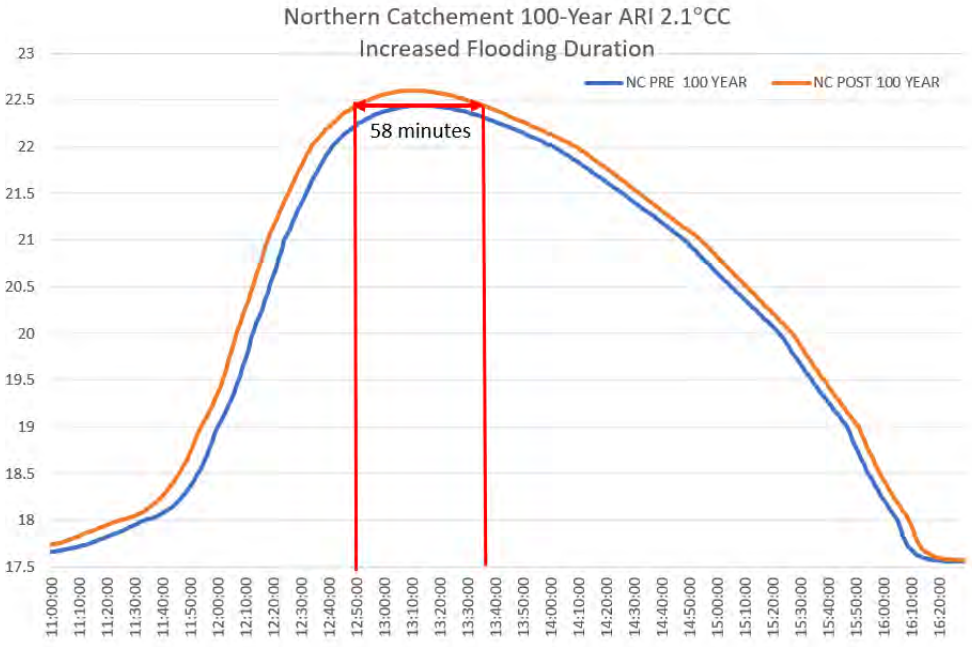

Figure 11 Northern Catchment 100-year 2.1°CC Increased Flooding Duration

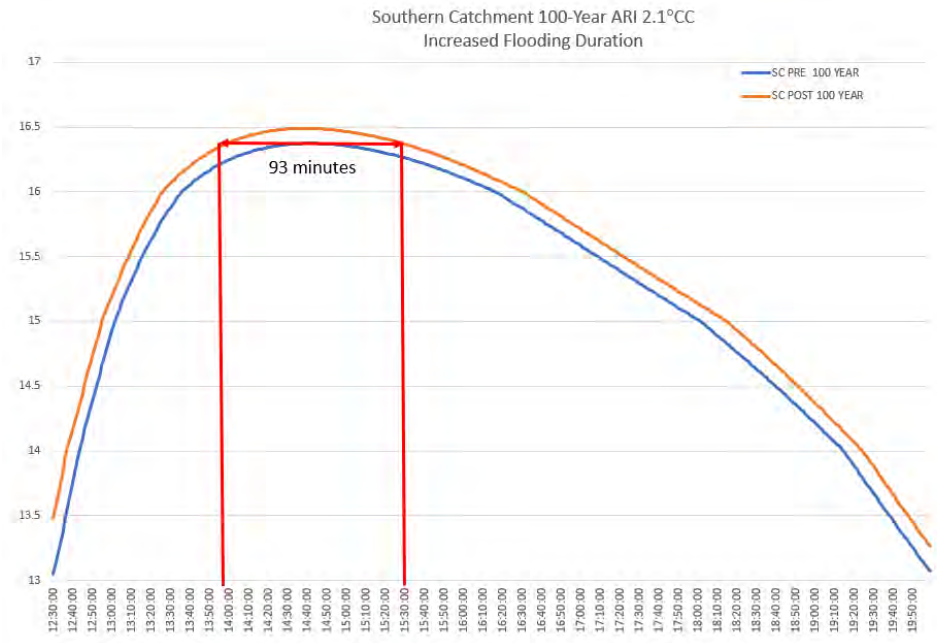

Figure 12 Southern Catchment 100-year 2.1°C Increased Flooding Duration

As previously discussed, the Central and Northern catchment's increased flooding caused by the development is considered acceptable due to only increasing flood levels within the Waka Kotahi battered land. The Central Catchment duration of flooding decreases due to the change in final landform. The Northern Catchment has an increase in the flooding duration over the pre-development peak flood level of 58 minutes. The increased duration is considered to be low-risk with minimal access points to the flooding areas.

The Southern Catchment also has an increase flooding duration over the pre-development peak flood level of 93 minutes. For this duration, there is an insignificant increase of flood level of only 100mm. As there are no upstream buildings within the proposed floodplain extents as well as the land use is primarily agricultural, the increased risk due to the additional flooding duration is considered to be minimal and acceptable.

6.5 Overland Flow Paths

Overland flow paths within the site will need to be maintained or relocated and should generally utilise any future roading network and existing gullies and streams. No specific precinct rules need to be included as part of the PPC, as the existing AUP rules will be relevant and suitable for the subject site.

6.6 Asset Ownership

All proposed private stormwater infrastructure will be privately owned and maintained by the respective property owners.

All proposed public stormwater infrastructure as approved under Engineering Plan Approval will be vested to Council or Auckland Transport. Any assets to be vested to Auckland Transport will be designed and constructed to Auckland Transport Standards and Guidelines. The following assets, but not limited to, will be vested to either Auckland Council or Auckland Transport. Vesting will be dependent on asset location and proposed use of asset:

- Stormwater Pipes
- Stormwater Manholes/Chambers
- Service Connections
- Catchpits
- Raingardens
- Ponds
- Detention Tanks
- Treatment Devices

7 Conclusions

This Stormwater Management Plan is to redefine the stormwater catchments with 2.1℃ and 3.8℃ climate change. The development is proposed to be rezoned to mixed use, mostly being mixed housing urban by a Private Plan Change.

While stormwater flows from the site will increase as a result of the development of the subject site, this report outlines the existing catchment characteristics and proposed stormwater mitigation requirements. The provision of stormwater treatment and detention for impervious areas is suggested to mitigate the likely effects of the future development of this site. Selection of stormwater devices should give consideration to the Best Practicable Option for the specific application, and should be in accordance with the selection toolboxes contained within this report.

The following summary of the SMP are the important features and design considerations:

- There are three existing catchments and streams that traverse through the site. Each stream has a culvert that conveys flows under and across the motorway and eventually into the Orewa Estuary.
- Stormwater runoff from the roading network is to discharge to stormwater quality and stormwater quantity devices. Runoff from the residential lots is to discharge to stormwater quantity devices prior to discharging to the reticulation and streams.
- A piped network will convey stormwater flows and discharge to the existing streams.
- Stormwater outlet structures will be designed to provide robust erosion protection measures.
- Overland flow paths will be designed to be along with road corridors with specific design to prevent risks to vehicles, pedestrians, and neighbouring properties.
- The site is proposed to be managed as a SMAF 1 Control to protect and enhance Auckland's rivers, streams, and aquatic biodiversity in urban areas. This is considered to be consistent with the objectives and policies of the AUP.
- Stormwater quantity management will be provided as following:
    - Stream protection is provided through SMAF1 Control
    - 10-year 2.1℃ climate change ARI detention will not be provided as downstream stormwater infrastructure will not become under capacity due to the increased flows of the development.
    - 100-year 3.8℃ climate change ARI detention will not be provided for flood protection to as there are no existing downstream buildings and other vulnerable activities subject to greater risk of flooding because of the development.
- Stormwater quality management will be provided as required:
    - Roading networks will be treated with a public device designed per GD01.
    - Private accessways and parking areas will be treated using a private device as per GD01 approved devices which will be designed and approved as part of the Building Consent application.
    - Roof materials selected shall be low contaminant generating materials, therefore roof runoff does not require quality management.
    - The selection toolbox as provided in GD01, as well as the SMP, is well-defined and a good guideline.

SMP APPENDIX A:

ENGINEERING DRAWINGS

CLIENT	AVJ HOBSONVILLE PTY LTD	PROJECT NO.	1403

PROJECT NAME	ARA HILLS - PRIVATE PLAN CHANGE	DAY	14	07	04	25
		MONTH	04	11	02	07
		YEAR	23	23	25	25

DRAWING NO.	DRAWING TITLE	DRAWING REVISION									
C150	SCHEME PLAN	A			B						
C200	OVERALL EARTHWORKS PLAN	A			B						
C210	OVERALL CUT & FILL PLAN	A			B						
C300	ROADING PLAN	A			B						
C400	STORMWATER PLAN	A			B						
C450	PRE-DEVELOPMENT STORMWATER CATCHMENT PLAN	A			B						
C451	POST-DEVELOPMENT STORMWATER CATCHMENT PLAN	A			B						
C452	POST-DEVELOPMENT FLOOD ANALYSIS PLAN	A	B	C	D						
C452-1	PRE AND POST DEVELOPMENT FLOOD ANALYSIS PLAN				A						
C453	PROPOSED STORMWATER DEVICE DETAIL PLAN SHEET 1				A						
C454	PROPOSED STORMWATER DEVICE DETAIL PLAN SHEET 2				A						
C500	WASTWATER OPTION 1	A			B						
C505	WASTWATER OPTION 2	A			B						
C600	WATERMAIN PLAN				B						

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AVJ HOBSONVILLE PTD LTD	1	1	1	1						
AUCKLAND COUNCIL	1	1	1	1						
REASON FOR ISSUE	Y	Y	Y	Y						
DRAWING SIZE	A3	A3	A3	A3						
MEDIA	PDF	PDF	PDF	PDF						

A = APPROVAL X = PRICING I = INFORMATION P = PRELIMINARY E = DXF/DWG C= CONSTRUCTION T = TENDER Y = CONSENT R = REQUESTED

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ARA HILLS - PRIVATE PLAN CHANGE

LOCALITY PLAN
SCALE A1 1:7500, A3 1:15000

PRIVATE PLAN CHANGE

LEGEND

- SITE BOUNDARY
- PEDESTRIAN WALKWAY
- ROADING/ACCESSWAYS
- STAGE 1 BOUNDARY
- STAGE 3A BOUNDARY
- STAGE 2 BOUNDARY

PRIVATE PLAN CHANGE

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PROJECT

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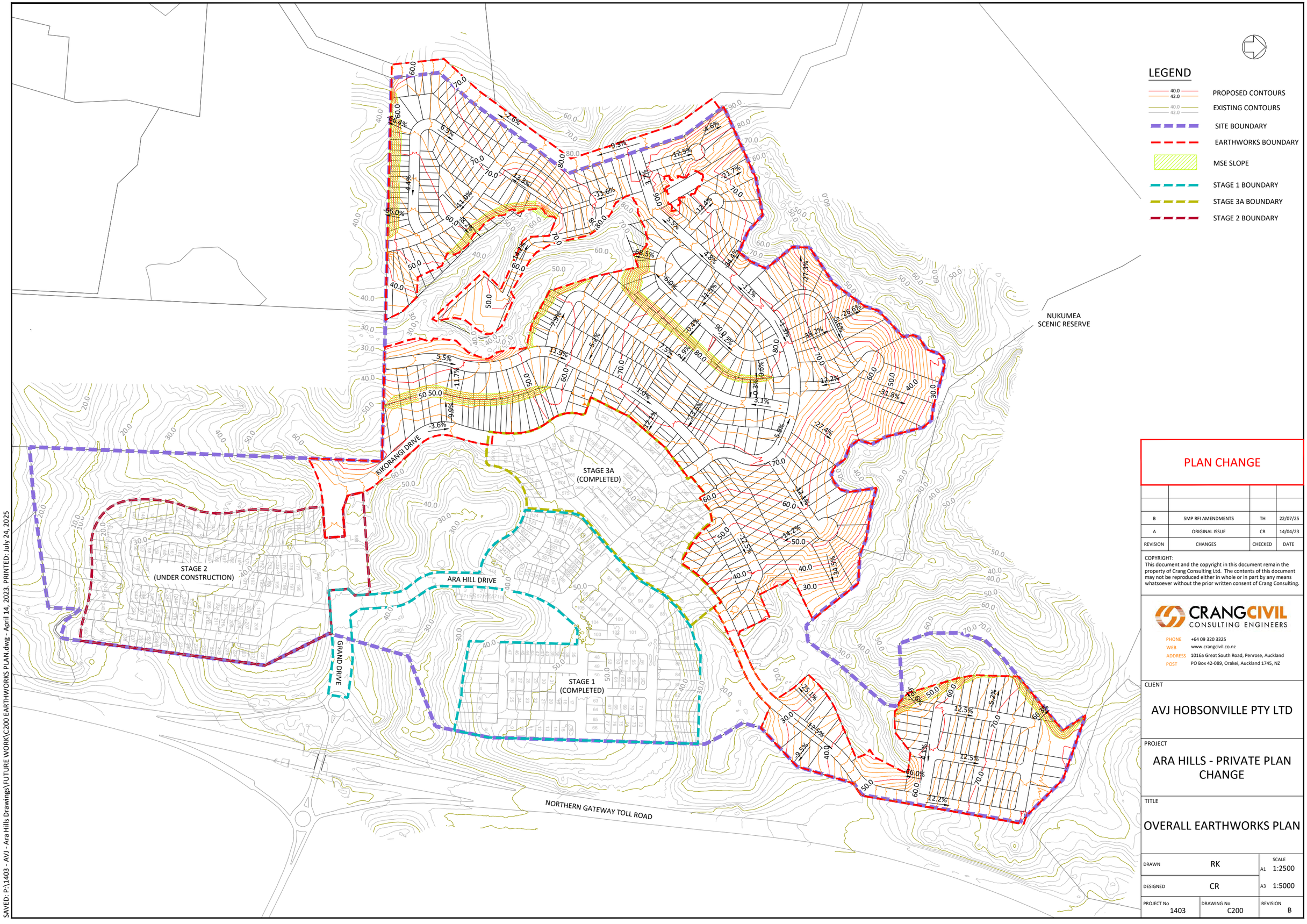
TITLE

SCHEME PLAN

DRAWN	RK	SCALE A1	1:2500
DESIGNED	CR	A3	1:5000
PROJECT No 1403	DRAWING No C150	REVISION B	

SAVED: P:\1403 - AVJ - Ara Hills Drawings\FUTURE WORK\C150 SCHEME PLAN.dwg - December 4, 2024, PRINTED: July 24, 2025



PLAN CHANGE

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ARA HILLS - PRIVATE PLAN CHANGE

TITLE

OVERALL EARTHWORKS PLAN

DRAWN	RK	SCALE A1	1:2500
DESIGNED	CR	A3	1:5000
PROJECT No 1403	DRAWING No C200	REVISION	B

SAVED: P:\1403 - AVJ - Ara Hills Drawings\FUTURE WORK\C200 EARTHWORKS PLAN.dwg - April 14, 2023. PRINTED: July 24, 2025

Surface Analysis: Elevation Ranges

Number	Color	Minimum Elevation (m)	Maximum Elevation (m)	2D Area (m²)	Volume (m³)
1		-19.696	-15.000	1639.5	3542
2		-15.000	-10.000	4482.1	15121
3		-10.000	-5.000	53625.5	127229
4		-5.000	0.000	156697.8	620450
5		0.000	5.000	138810.1	516308
6		5.000	10.000	40805.3	128719
7		10.000	15.000	7655.2	19817
8		15.000	20.466	1280.0	2698

SITE Volume

Minimum Elevation (m)	Maximum Elevation (m)	2D Area (m²)	Volume 1.15FF(m³)
-19.695	0.000	219714.9	773416
0.000	20.466	189686.3	767070

LEGEND

- CONTOURS
- SITE BOUNDARY
- EARTHWORKS BOUNDARY
- STAGE 1 BOUNDARY
- STAGE 3A BOUNDARY
- STAGE 2 BOUNDARY

KIKORANGI DRIVE

STAGE 3A (COMPLETED)

NUKUMEA SCENIC RESERVE

STAGE 2 (UNDER CONSTRUCTION)

ARA HILL DRIVE

GRAND DRIVE

STAGE 1 (COMPLETED)

NORTHERN GATEWAY TOLL ROAD

PRIVATE PLAN CHANGE

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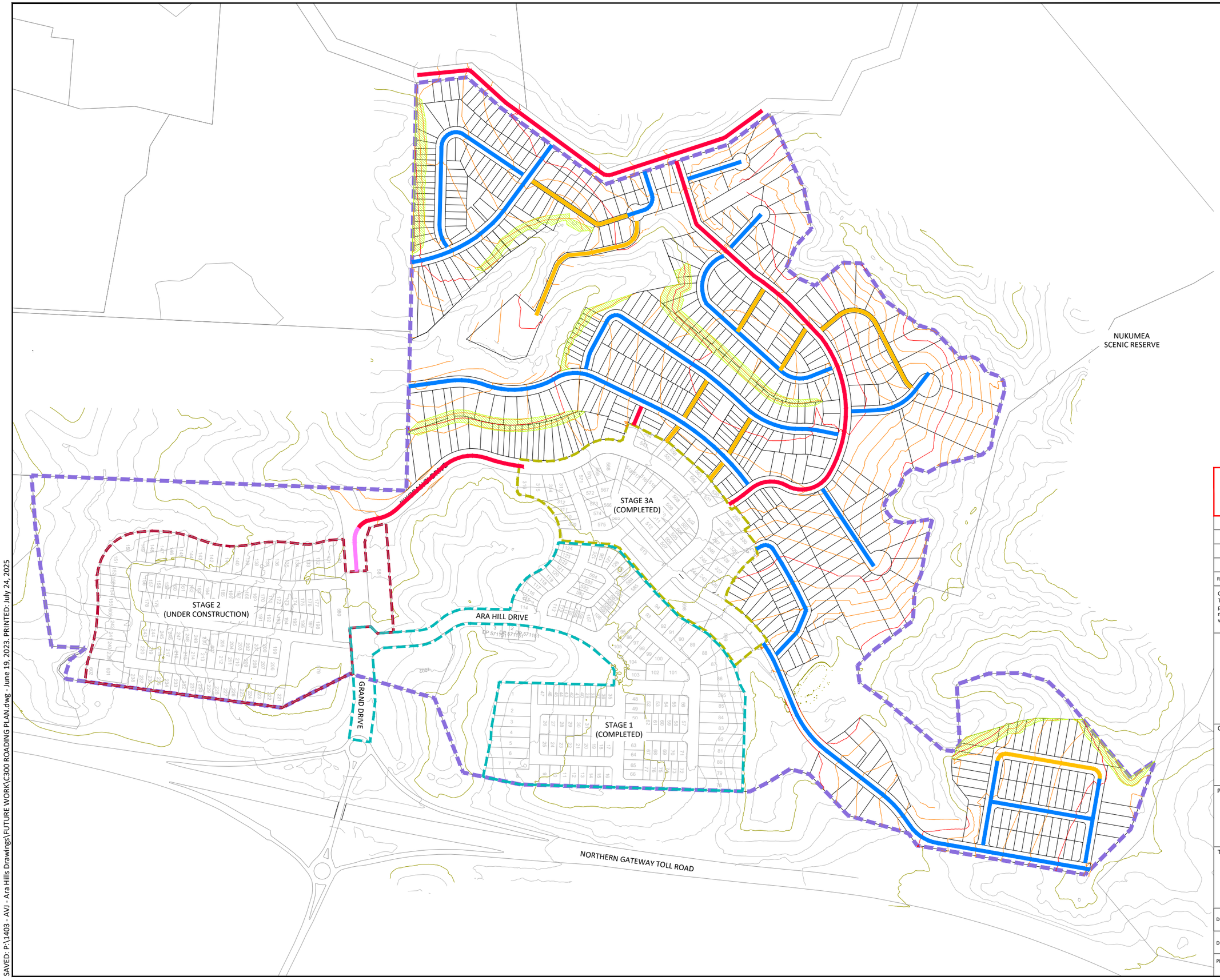
ARA HILLS - PRIVATE PLAN CHANGE

TITLE

OVERALL CUT-FILL PLAN

DRAWN	RK	SCALE A1 1:2500
DESIGNED	CR	A3 1:5000
PROJECT No 1403	DRAWING No C210	REVISION B

SAVED: P:\1403 - AVJ - Ara Hills Drawings\FUTURE WORK\C210 CUT-FILL PLAN.dwg - April 21, 2023. PRINTED: July 24, 2025



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ROADING PLAN

DRAWN	RK	SCALE A1	1:2500
DESIGNED	CR	A3	1:5000
PROJECT No 1403	DRAWING No C300	REVISION	B

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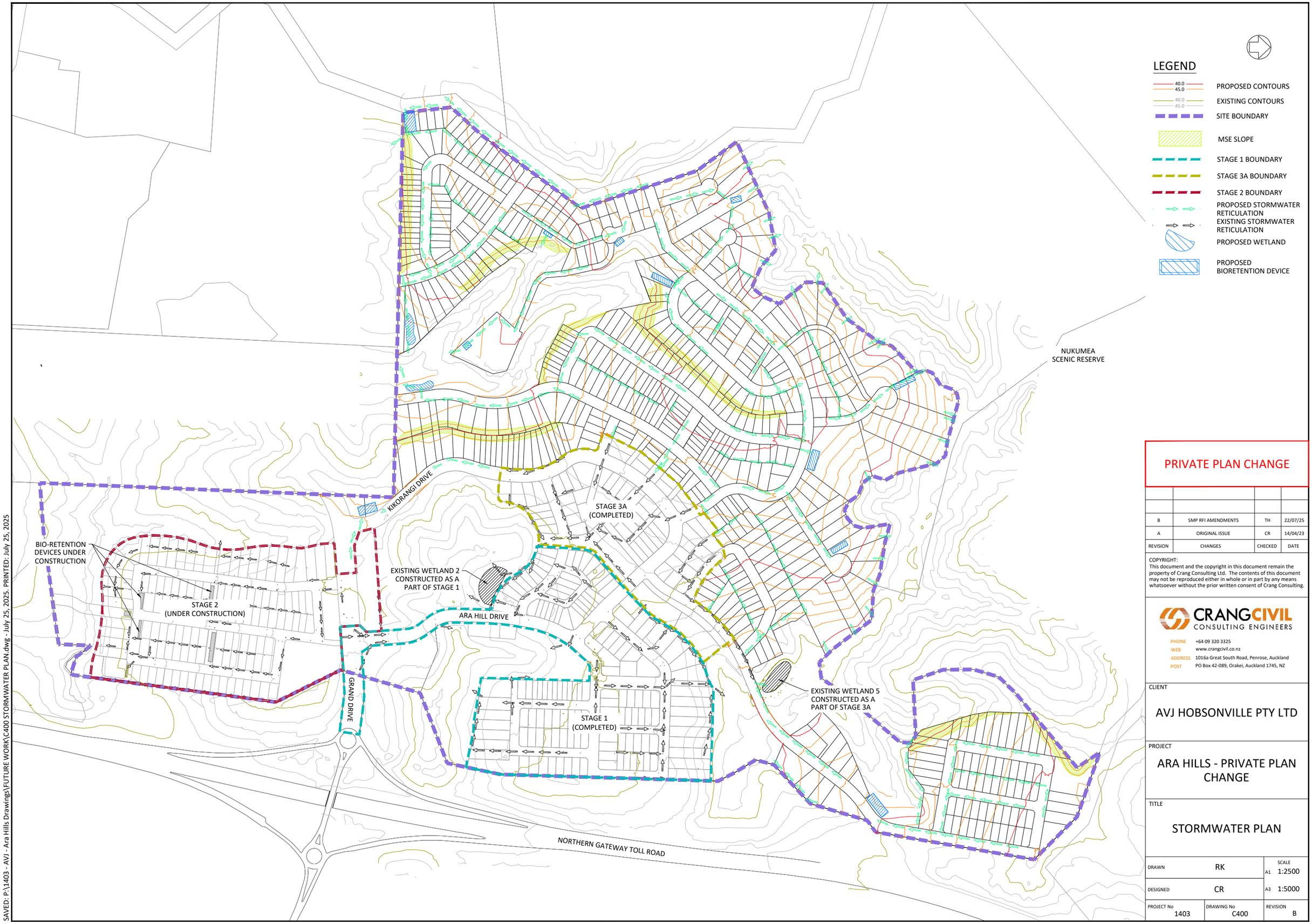

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PRIVATE PLAN CHANGE

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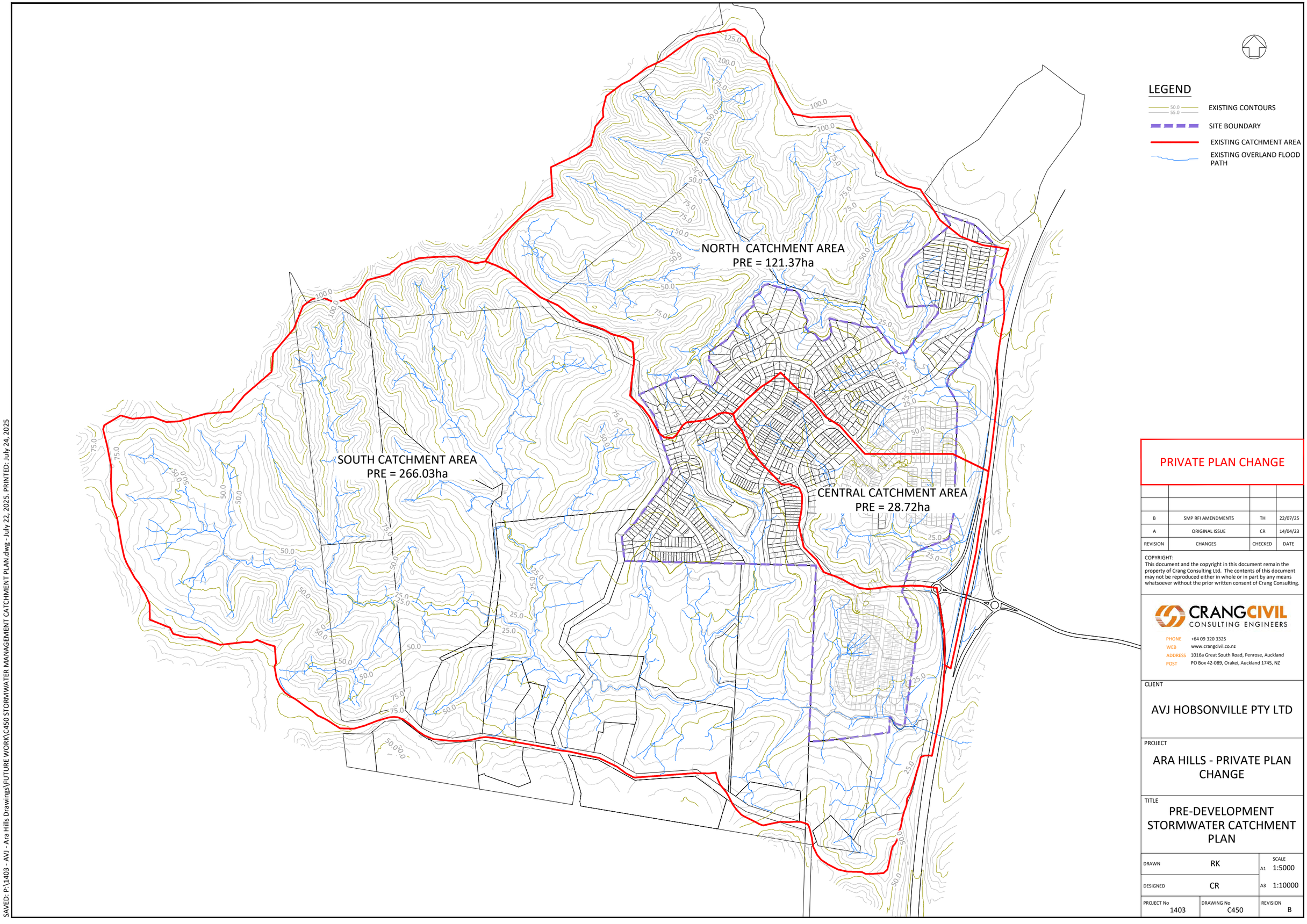
TITLE

STORMWATER PLAN

DRAWN	RK	SCALE A1	1:2500
DESIGNED	CR	A3	1:5000
PROJECT No 1403	DRAWING No C400	REVISION	B



LEGEND

- EXISTING CONTOURS (50.0 / 55.0)
- SITE BOUNDARY
- EXISTING CATCHMENT AREA
- EXISTING OVERLAND FLOOD PATH

PRIVATE PLAN CHANGE

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TITLE
PRE-DEVELOPMENT STORMWATER CATCHMENT PLAN

DRAWN	RK	SCALE A1	1:5000
DESIGNED	CR	A3	1:10000
PROJECT No	1403	DRAWING No	C450
REVISION	B		

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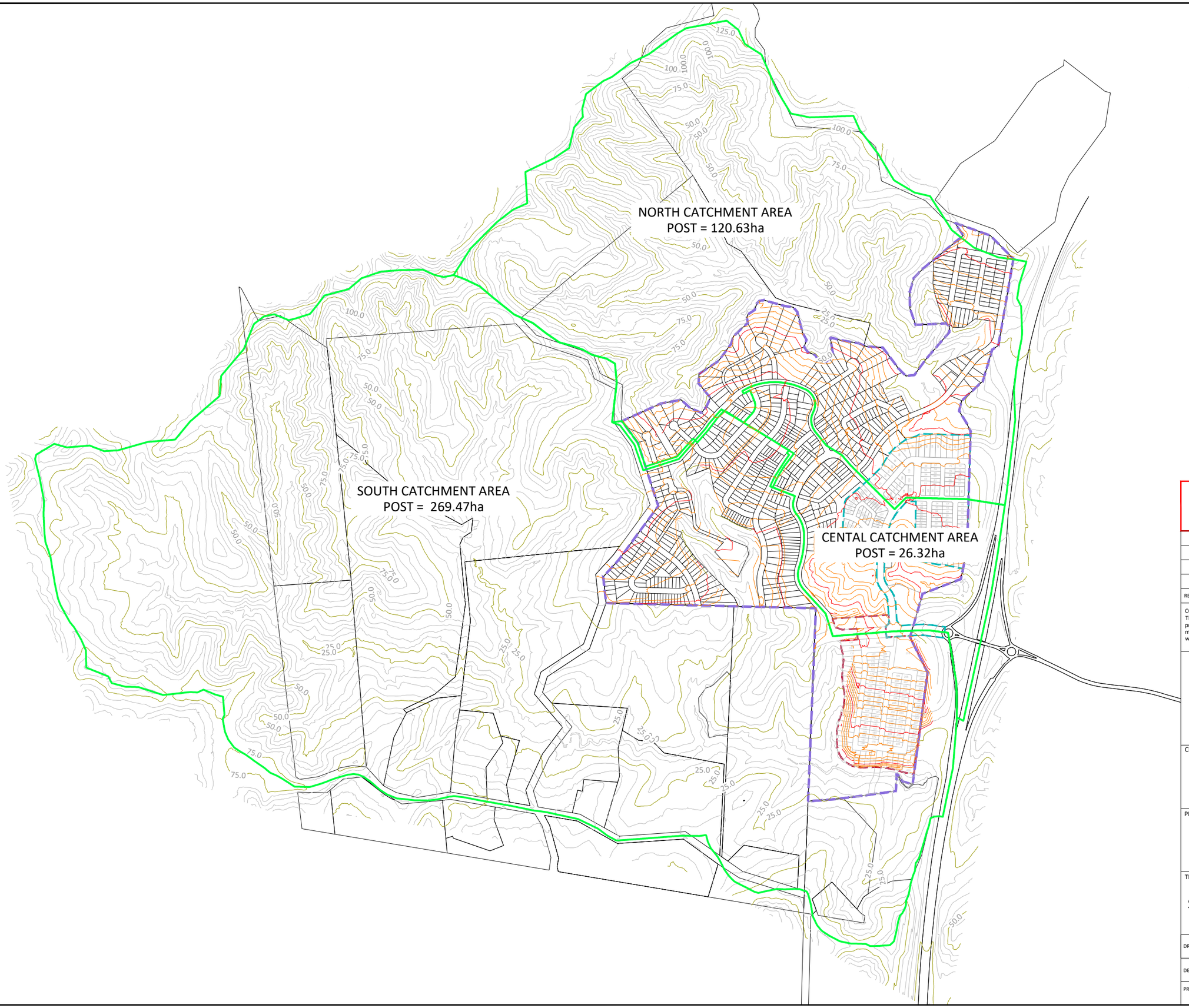

LEGEND

- PROPOSED CONTOURS
- EXISTING CONTOURS
- SITE BOUNDARY
- PROPOSED CATCHMENT AREA

PRIVATE PLAN CHANGE

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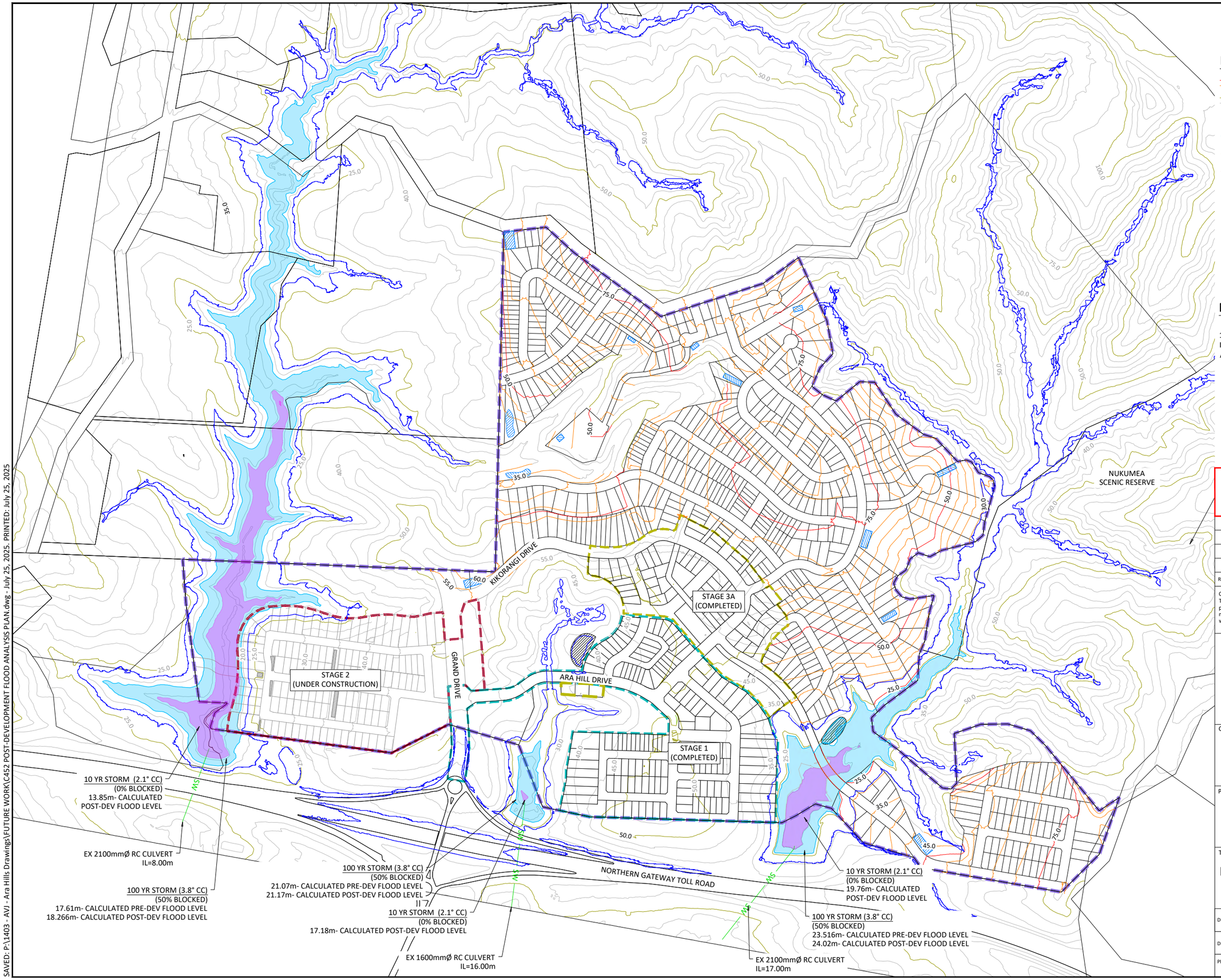
TITLE

POST-DEVELOPMENT STORMWATER CATCHMENT PLAN

DRAWN	RK	SCALE A1	1:5000
DESIGNED	CR	A3	1:10000
PROJECT No 1403	DRAWING No C451	REVISION B	

SAVED: P:\1403 - AVJ - Ara Hills Drawings\FUTURE WORK\C450 STORMWATER MANAGEMENT CATCHMENT PLAN.dwg - July 22, 2025. PRINTED: July 24, 2025



LEGEND

- PROPOSED CONTOURS (40.0 / 45.0)
- EXISTING CONTOURS (40.0 / 45.0)
- SITE BOUNDARY
- STAGE 1 BOUNDARY
- STAGE 3A BOUNDARY
- STAGE 2 BOUNDARY
- 10 YEAR - FLOOD LEVEL
- 100 YEAR (50% BLOCKAGE) FLOOD LEVEL
- 100 YEAR (100% BLOCKAGE) FLOOD LEVEL

NOTES

1. THE POST DEVELOPMENT FLOOD DEPTHS INCLUDE THE POTENTIAL FUTURE IMPERVIOUS AREAS.

PRIVATE PLAN CHANGE

REVISION	CHANGES	CHECKED	DATE
D	SMP RFI AMENDMENTS	TH	22/07/25
C	SMP RFI AMENDMENTS	NN	04/02/25
B	REV B	CR	07/11/23
A	ORIGINAL ISSUE	CR	14/04/23

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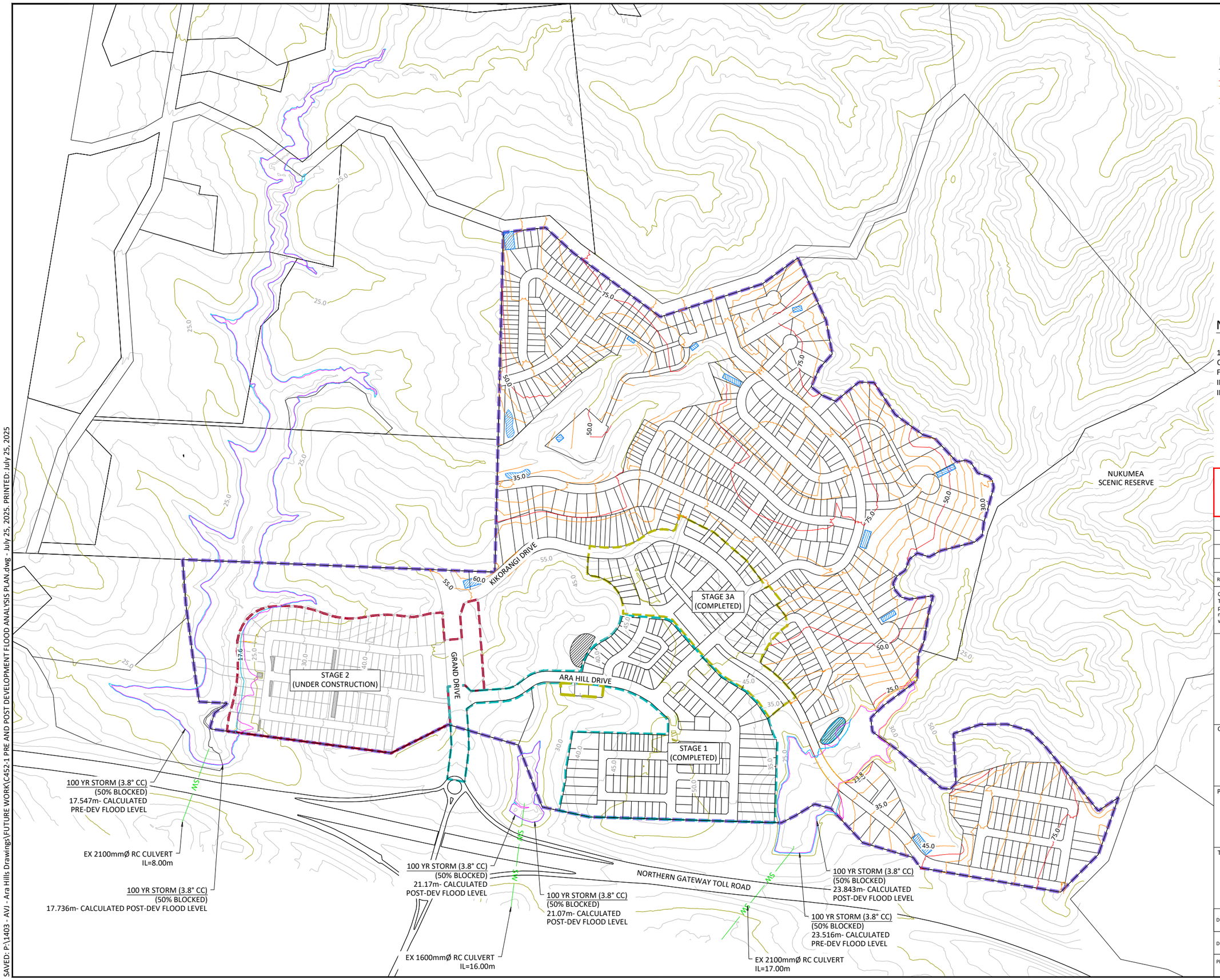
ARA HILLS - PRIVATE PLAN CHANGE

TITLE

POST-DEVELOPMENT FLOOD ANALYSIS PLAN

DRAWN	RK	SCALE A1	1:3000
DESIGNED	TH	A3	1:6000
PROJECT No 1403	DRAWING No C452	REVISION D	

SAVED: P:\1403 - AVJ - Ara Hills Drawings\FUTURE WORK\C452 POST-DEVELOPMENT FLOOD ANALYSIS PLAN.dwg - July 25, 2025 PRINTED: July 25, 2025



LEGEND

- PROPOSED CONTOURS
- EXISTING CONTOURS
- SITE BOUNDARY
- STAGE 1 BOUNDARY
- STAGE 3A BOUNDARY
- STAGE 2 BOUNDARY
- 100 YEAR (50% BLOCKAGE) PRE-DEV FLOOD LEVEL
- 100 YEAR (50% BLOCKAGE) POST-DEV FLOOD LEVEL

NOTES

1. THE POST-DEVELOPMENT FLOOD DEPTHS CONSIDERS ONLY THE PROPOSED DEVELOPMENT FOR THE ARA HILLS SITE. POTENTIAL FUTURE INCREASE IN IMPERVIOUS AREA HAS NOT BEEN INCLUDED IN THE ANALYSIS.

PRIVATE PLAN CHANGE

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ARA HILLS - PRIVATE PLAN CHANGE

TITLE

PRE AND POST DEVELOPMENT FLOOD ANALYSIS PLAN

DRAWN	RK	SCALE A1	1:3000
DESIGNED	TH	SCALE A3	1:6000
PROJECT No	1403	DRAWING No	C452-1
REVISION	A		

SAVED: P:\1403 - AVJ - Ara Hills Drawings\FUTURE WORK\C452-1 PRE AND POST DEVELOPMENT FLOOD ANALYSIS PLAN.dwg - July 25, 2025. PRINTED: July 25, 2025

BD 01
CATCHMENT: 11,665m²
MITIGATION VOLUME: 229m³

BD 03
CATCHMENT: 1,617m²
MITIGATION VOLUME: 32m³

BD 02
CATCHMENT: 1,096m²
MITIGATION VOLUME: 22m³

BD 06
CATCHMENT:2,659m²
MITIGATION VOLUME:53m³

BD 04
CATCHMENT: 6,116m²
MITIGATION VOLUME: 120m³

WETLAND 6
CATCHMENT: 46,200m²
MITIGATION VOLUME: 577m³

BD 05
CATCHMENT: 1,833m²
MITIGATION VOLUME: 36m³

WETLAND 7
CATCHMENT: 48,784m²
MITIGATION VOLUME: 590m³

BD 11
CATCHMENT: 8,873m²
MITIGATION VOLUME: 174m³

EXISTING WETLAND 2
CATCHMENT

EXISTING WETLAND 2
TOTAL CATCHMENT: 14,500m²
EXISTING STAGE 3A CATCHMENT: 1,1200m²
PROPOSED CATCHMENT: 3,300m²

STAGE 2
UNDER CONSTRUCTION

STAGE 3A
COMPLETED

STAGE 1
COMPLETED

EXISTING WETLAND 5
CATCHMENT

BD 08
CATCHMENT: 8,137m²
MITIGATION VOLUME: 160m³

BD 09
CATCHMENT: 4,431m²
MITIGATION VOLUME:

EXISTING WETLAND 5
TOTAL CATCHMENT: 13,000m²
EXISTING STAGE 3A CATCHMENT: 2800m²
PROPOSED CATCHMENT: 10,200m²

LEGEND

- PROPOSED CONTOURS
- STAGE BOUNDARY
- BD 01 CATCHMENT
- BD 02 CATCHMENT
- BD 03 CATCHMENT
- BD 04 CATCHMENT
- BD 05 CATCHMENT
- BD 06 CATCHMENT
- BD 07 CATCHMENT
- BD 08 CATCHMENT
- BD 09 CATCHMENT
- BD 10 CATCHMENT
- BD 11 CATCHMENT
- WETLAND 6 CATCHMENT
- WETLAND 7 CATCHMENT
- EX. WETLAND 2 CATCHMENT
- EX. WETLAND 5 CATCHMENT
- PROPOSED STORMWATER RETICULATION
- EXISTING STORMWATER RETICULATION
- STORMWATER WETLAND
- BIORETENTION DEVICE

PRIVATE PLAN CHANGE

REVISION	CHANGES	CHECKED	DATE
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PROJECT
ARA HILLS - PRIVATE PLAN CHANGE

TITLE
PROPOSED STORMWATER DEVICES DETAIL PLAN SHEET 1

DRAWN	RK	SCALE A1	1:2000
DESIGNED	TH	A3	1:4000
PROJECT No 1403	DRAWING No C453	REVISION A	

SAVED: P:\1403 - AVJ - Ara Hills Drawings\FUTURE WORK\C453 PROPOSED STORMWATER DEVICES CATCHMENT PLAN.dwg - July 24, 2025. PRINTED: July 25, 2025

BD 02
CATCHMENT: 1,096m²
MITIGATION VOLUME: 22m³

BD 06
CATCHMENT:2,659m²
MITIGATION VOLUME:53m³

BD 04
CATCHMENT: 6,116m²
MITIGATION VOLUME: 120m³

WETLAND 6
CATCHMENT: 46,200m²
MITIGATION VOLUME: 577m³

BD 05
CATCHMENT: 1,833m²
MITIGATION VOLUME: 36m³

WETLAND 7
CATCHMENT: 48,784m²
MITIGATION VOLUME: 590m³

BD 07
CATCHMENT: 6,434m²
MITIGATION VOLUME: 127m³

BD 11
CATCHMENT: 8,873m²
ATION VOLUME: 174m³

BD 08
CATCHMENT: 8,137m²
MITIGATION VOLUME: 160m³

EXISTING WETLAND 2
CATCHMENT

STAGE 3A
COMPLETED

EXISTING WETLAND 2
TOTAL CATCHMENT: 14,500m²
EXISTING STAGE 3A CATCHMENT: 1,1200m²
PROPOSED CATCHMENT: 3,300m²

BD 09
CATCHMENT: 4,431m²
MITIGATION VOLUME: 87m³

EXISTING WETLAND 5
CATCHMENT

STAGE 1
COMPLETED

EXISTING WETLAND 5
TOTAL CATCHMENT: 13,000m²
EXISTING STAGE 3A CATCHMENT: 2800m²
PROPOSED CATCHMENT: 10,200m²

BD 10
CATCHMENT: 11,367m²
MITIGATION VOLUME: 233m³

LEGEND

- PROPOSED CONTOURS
- EXISTING STAGE BOUNDARY
- BD 01 CATCHMENT
- BD 02 CATCHMENT
- BD 03 CATCHMENT
- BD 04 CATCHMENT
- BD 05 CATCHMENT
- BD 06 CATCHMENT
- BD 07 CATCHMENT
- BD 08 CATCHMENT
- BD 09 CATCHMENT
- BD 10 CATCHMENT
- WETLAND 6 CATCHMENT
- WETLAND 7 CATCHMENT
- EX. WETLAND 2 CATCHMENT
- EX. WETLAND 5 CATCHMENT
- PROPOSED STORMWATER RETICULATION
- EXISTING STORMWATER RETICULATION
- STORMWATER WETLAND
- BIORETENTION DEVICE

PRIVATE PLAN CHANGE

REVISION	CHANGES	CHECKED	DATE
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CLIENT
AVJ HOBSONVILLE PTY LTD

PROJECT
ARA HILLS - PRIVATE PLAN CHANGE

TITLE
PROPOSED STORMWATER DEVICES DETAIL PLAN SHEET 2

DRAWN	RK	SCALE A1	1:2000
DESIGNED	TH	A3	1:4000
PROJECT No 1403	DRAWING No C454	REVISION A	

SAVED: P:\1403 - AVJ - Ara Hills Drawings\FUTURE WORK\C453 PROPOSED STORMWATER DEVICES CATCHMENT PLAN.dwg - July 24, 2025. PRINTED: July 25, 2025

LOW PRESSURE SEWER 7 LOTS

LOW PRESSURE SEWER 12 LOTS

PRIVATE PUMP STATION 1 (11 LOTS)

NUKUMEA SCENIC RESERVE

PRIVATE PUMP STATION 2 (18 LOTS)

PUBLIC PUMP STATION 3 (150 LOTS)

LOW PRESSURE SEWER 9 LOTS

KIKORANGI DRIVE

STAGE 3A (COMPLETED)

STAGE 2 (UNDER CONSTRUCTION)

ARA HILL DRIVE

GRAND DRIVE

STAGE 1 (COMPLETED)

EXISTING PUMP STATION 2 125 LOTS

EXISTING PUMP STATION 1 222 LOTS

NORTHERN GATEWAY TOLL ROAD

PROPOSED 400OD PE PIPE TO SERVICE PCA

EXISTING 315OD PE GRAVITY LINE WITH INSUFFICIENT CAPACITY TO BE ABANDONED

382 RESIDENTIAL LOTS
+ 4 COMMERCIAL LOTS
+ EXISTING PS 1 (222 LOTS)
+ EXISTING PS 2 (109 LOTS)
+ PROPOSED PS 3 (GRAVITY (155 LOTS)
+ PRIVATE PS 1 (11 LOTS)
+ PRIVATE PS 2 (18 LOTS)
+ LOW PRESSURE (24 LOTS)

EXISTING WATERCARE TRANSMISSION NETWORK

LEGEND

- 40.0 / 45.0 — PROPOSED CONTOURS
- 40.0 / 45.0 — EXISTING CONTOURS
- SITE BOUNDARY
- MSE SLOPE
- STAGE 1 BOUNDARY
- STAGE 3A BOUNDARY
- STAGE 2 BOUNDARY
- PROPOSED GRAVITY SANITARY SEWER
- PROPOSED RISING MAIN
- PROPOSED LOW PRESSURE SEWER
- EXISTING GRAVITY SANITARY SEWER
- EXISTING RISING MAIN

PLAN CHANGE APPLICATION

REVISION	CHANGES	CHECKED	DATE
B	SMP RFI AMENDMENTS	TH	22/07/25
A	ORIGINAL ISSUE	CR	14/04/23

CRANGCIVIL CONSULTING ENGINEERS
PHONE +64 09 320 3325
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ADDRESS 1016a Great South Road, Penrose, Auckland
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CLIENT

AVJ HOBSONVILLE PTY LTD

PROJECT

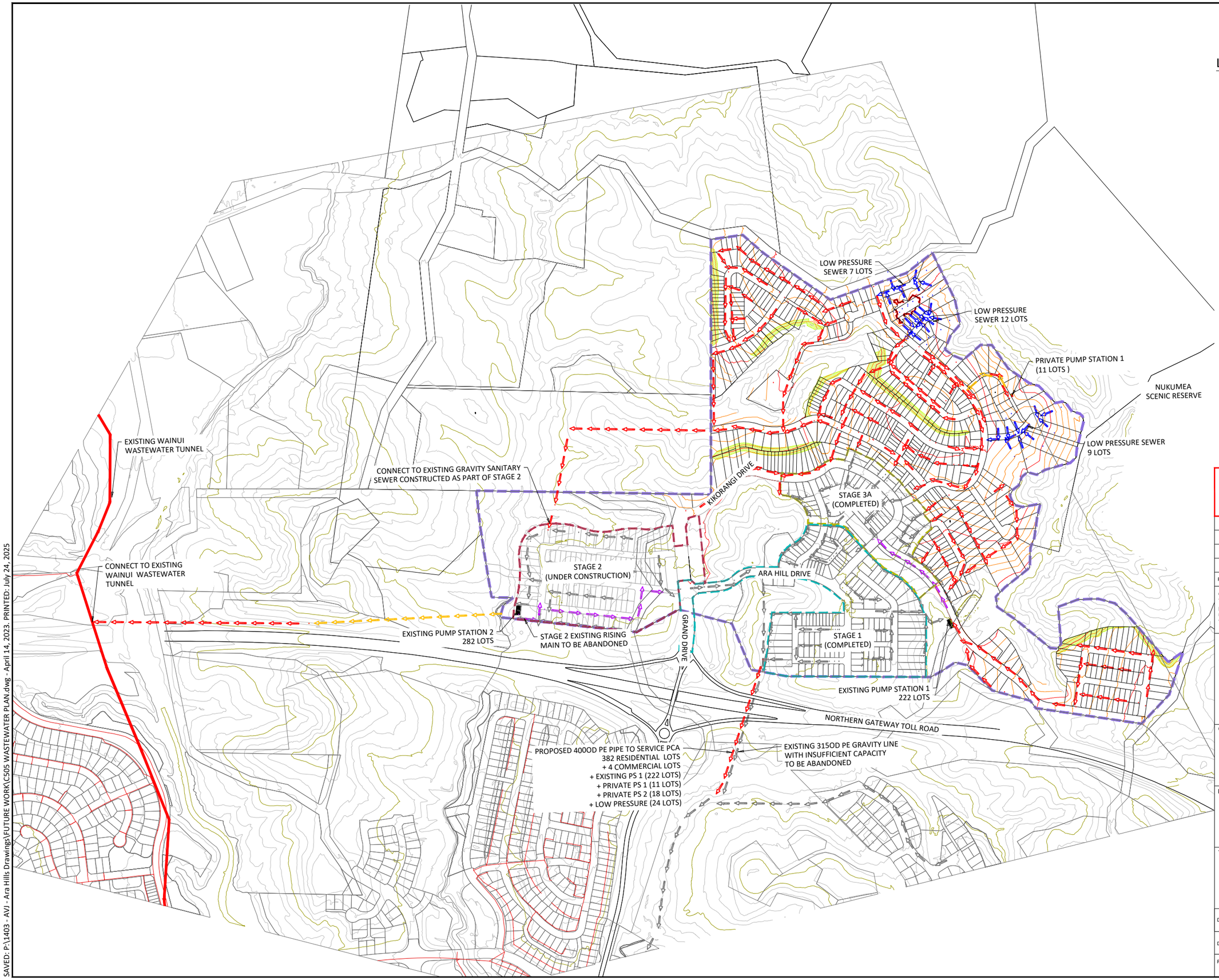
ARA HILLS - PRIVATE PLAN CHANGE

TITLE

WASTEWATER PLAN OPTION 1

DRAWN	RK	SCALE A1 1:2500
DESIGNED	CR	A3 1:5000
PROJECT No 1403	DRAWING No C500	REVISION B

SAVED: P:\1403 - AVJ - Ara Hills Drawings\FUTURE WORK\C500 WASTEWATER PLAN.dwg - April 14, 2023. PRINTED: July 24, 2025



LEGEND

- PROPOSED CONTOURS (40.0 / 45.0)
- EXISTING CONTOURS (40.0 / 45.0)
- SITE BOUNDARY
- MSE SLOPE
- STAGE 1 BOUNDARY
- STAGE 3A BOUNDARY
- STAGE 2 BOUNDARY
- PROPOSED GRAVITY SANITARY SEWER
- PROPOSED RISING MAIN
- PROPOSED LOW PRESSURE SEWER
- EXISTING GRAVITY SANITARY SEWER
- EXISTING RISING MAIN

PLAN CHANGE APPLICATION

REVISION	CHANGES	CHECKED	DATE
B	SMP RFI AMENDMENTS	TH	22/07/25
A	ORIGINAL ISSUE	CR	14/04/23

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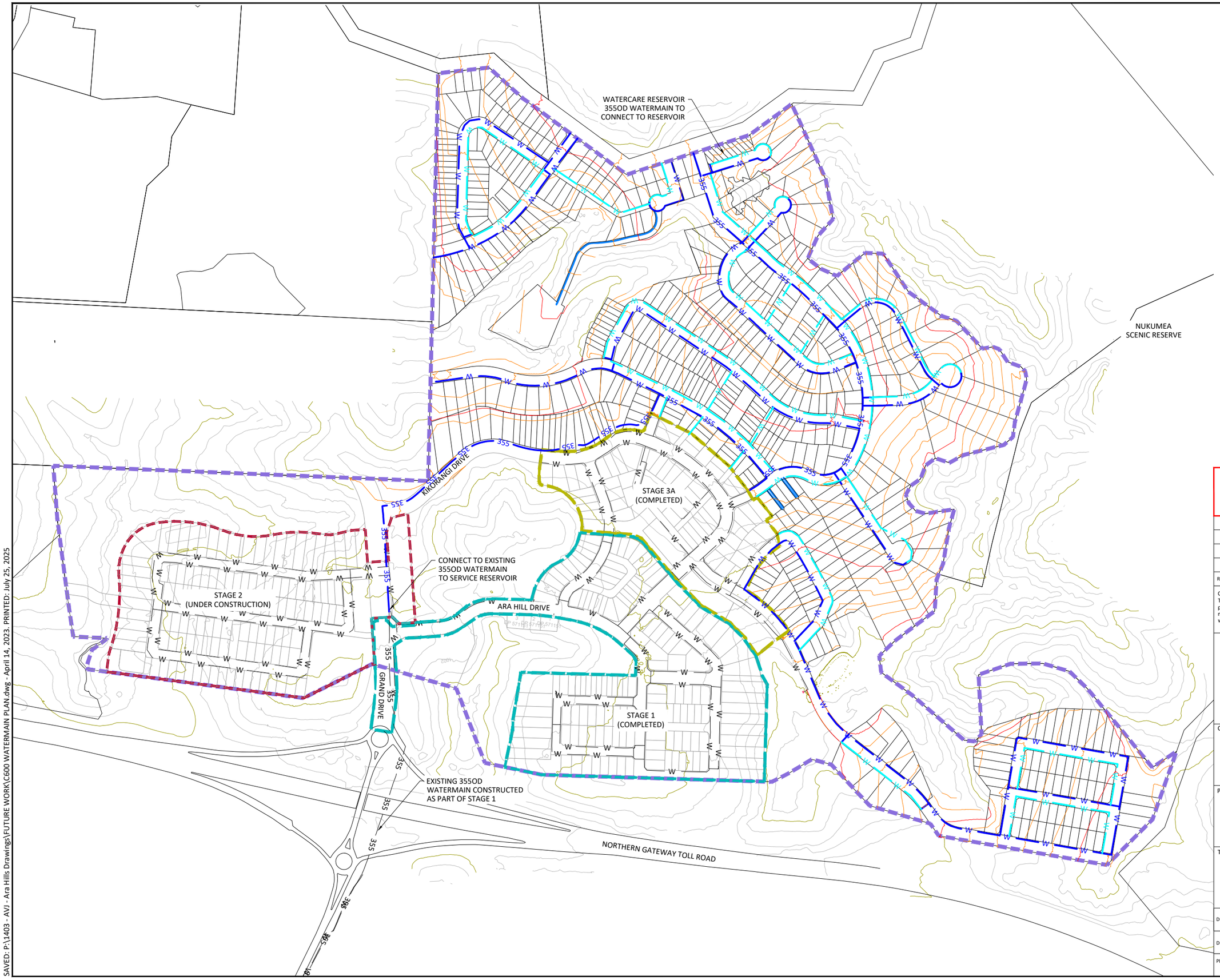
CLIENT
AVJ HOBSONVILLE PTY LTD

PROJECT
ARA HILLS - PRIVATE PLAN CHANGE

TITLE
WASTEWATER PLAN OPTION 2

DRAWN	RK	SCALE A1 1:4000
DESIGNED	CR	A3 1:8000
PROJECT No 1403	DRAWING No C505	REVISION B

SAVED: P:\1403 - AVJ - Ara Hills Drawings\FUTURE WORK\C505 WASTEWATER PLAN.dwg - April 14, 2023. PRINTED: July 24, 2025



PRIVATE PLAN CHANGE

REVISION	CHANGES	CHECKED	DATE
B	SMP RFI AMENDMENTS	TH	22/07/25
A	ORIGINAL ISSUE	CR	14/04/23

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CLIENT

AVJ HOBSONVILLE PTY LTD

PROJECT

ARA HILLS - PRIVATE PLAN CHANGE

TITLE

WATERMAIN PLAN

DRAWN	RK	SCALE A1 1:2500
DESIGNED	CR	A3 1:5000
PROJECT No 1403	DRAWING No C600	REVISION B

SAVED: P:\1403 - AVJ - Ara Hills Drawings\FUTURE WORK\C600 WATERMAIN PLAN.dwg - April 14, 2023. PRINTED: July 25, 2025

SMP APPENDIX B:

STORMWATER CALCULATIONS

TP 108 - NORTHERN CATCHMENT

CLIENT AVJ HOBSONVILLE PTY LTD
PROJECT ARA HILLS - PRIVATE PLAN CHANGE
JOB NO. 1403

CALCS BY RK
CHECKED BY TH
DATE 14/07/2025

CRANGCIVIL CONSULTING ENGINEERS

Pre Development

Catchment area: **121.37** ha

Cover	CN	Area (ha)	CN x Area
Grass Paddocks	74	25.37	1877.38
Bush Areas	70	96.00	6720.00
Impermeable Areas	98	0.00	0.00
	Total	121.37	8597.38

	10 year 2.1CC	100 year 2.1CC	100 year 3.8CC	100 year NOCC
CN	70.8	70.8	70.8	70.8
Ia (mm)	5.0	5.0	5.0	5.0
C	1	1	1	1
L (km)	1.65	1.65	1.65	1.65
S_c (m/m)	0.032	0.032	0.032	0.032
t_c (hrs)	0.76	0.76	0.76	0.76
t_p (hrs)	0.51	0.51	0.51	0.51
S (mm)	104.6	104.6	104.6	104.6
P_{24} (mm)	181	278	312	235
c*	0.45	0.56	0.59	0.52
q*	0.063	0.072	0.077	0.07
q_p (m^3/s)	13.840	24.293	29.158	19.965
Q_{24} (mm)	110.4	197.4	229.0	158.1
V_{24} (m^3)	133995	239571	277933	191900

Post Development (Developed area - Impervious)

Catchment area: **17.022** ha

Cover	CN	Area (ha)	CN x Area
Grass Paddocks	74	0.00	0.00
Bush Areas	70	0.00	0.00
Impermeable Areas	98	17.02	1668.16
	Total	17.02	1668.16

	10 year 2.1CC	100 year 2.1CC	100 year 3.8CC	100 year NOCC
CN	98.0	98.0	98.0	98.0
Ia (mm)	0.0	0.0	0.0	0.0
C	0.6	0.6	0.6	0.6
L (km)	0.45	0.45	0.45	0.45
S_c (m/m)	0.05	0.05	0.05	0.05
t_c (hrs)	0.17	0.17	0.17	0.17
t_p (hrs)	0.11	0.11	0.11	0.11
S (mm)	5.2	5.2	5.2	5.2
P_{24} (mm)	181	278	312	235
c*	0.95	0.96	0.97	0.96
q*	0.162	0.161	0.162	0.162
q_p (m^3/s)	4.991	7.619	8.604	6.480
Q_{24} (mm)	176.0	272.9	306.9	229.9
V_{24} (m^3)	29952	46455	52241	39138

Post Development (Open area - Pervious)

Catchment area: **19.76** ha

Cover	CN	Area (ha)	CN x Area
Grass Paddocks	74	15.99	1183.26
Bush Areas	70	3.77	263.90
Impermeable Areas	98	0.00	0.00
	Total	19.76	1447.16

	10 year 2.1C	100 year 2.1CC	100 year 3.8CC	100 year NOCC
CN	73.2	73.2	73.2	73.2
Ia (mm)	5.0	5.0	5.0	5.0
C	0.8	0.8	0.8	0.8
L (km)	0.45	0.45	0.45	0.45
S_c (m/m)	0.05	0.05	0.05	0.05
t_c (hrs)	0.22	0.22	0.22	0.22
t_p (hrs)	0.15	0.15	0.15	0.15
S (mm)	92.8	92.8	92.8	92.8
P_{24} (mm)	181	278	312	313
c*	0.48	0.59	0.62	0.62
q*	0.116	0.13	0.136	1.136
q_p (m^3/s)	4.149	7.141	8.385	70.260
Q_{24} (mm)	115.2	203.7	235.7	236.7
V_{24} (m^3)	22769	40257	3411370	46767

Post Development (Open area)

Catchment area: **83.848** ha

Cover	CN	Area (ha)	CN x Area	
Grass Paddocks	74	0.00	0.00	
Bush Areas	70	58.69	4108.55	*70%*
Impermeable Areas	98	25.15	2465.13	*30%*
	Total	83.85	6573.68	

	10 year 2.1CC	100 year 2.1CC	100 year 3.8CC	100 year NOCC
CN	78.4	78.4	78.4	78.4
Ia (mm)	3.5	3.5	3.5	3.5
C	0.8	0.8	0.8	0.8
L (km)	1.65	1.65	1.65	1.65
S_c (m/m)	0.032	0.032	0.032	0.032
t_c (hrs)	0.56	0.56	0.56	0.56
t_p (hrs)	0.37	0.37	0.37	0.37
S (mm)	70.0	70.0	70.0	70.0
P_{24} (mm)	181	278	312	235
c*	0.55	0.66	0.69	0.62
q*	0.095	0.095	0.095	0.094
q_p (m^3/s)	3.398	5.219	5.857	4.365
Q_{24} (mm)	127.3	218.7	251.5	177.8
V_{24} (m^3)	106746	183406	210844	149052

HEC-HMS RESULTS SUMMARY - NORTHERN CATCHMENT

CRANGCIVIL CONSULTING ENGINEERS

CLIENT AVJ HOBSONVILLE PTY LTD
PROJECT ARA HILLS - PRIVATE PLAN CHANGE
JOB NO. 1403
CALCS BY RK
CHECKED BY TH
DATE 22/07/2025

Storm Data

	Storm 1	Storm 2	Storm 3	Storm 4	Storm 5	
	10 2.1CC 0% Block	100 2.1CC 50% Block	100 3.8CC 50% Blcok	100 3.8CC 100% Block	100 3.8CC 50% Block Ara Hills Site Only	
Av Recurrence Int. **ARI** =						yr
24hr Rainfall Depth P_{24} =	181	278	312	312	312	mm

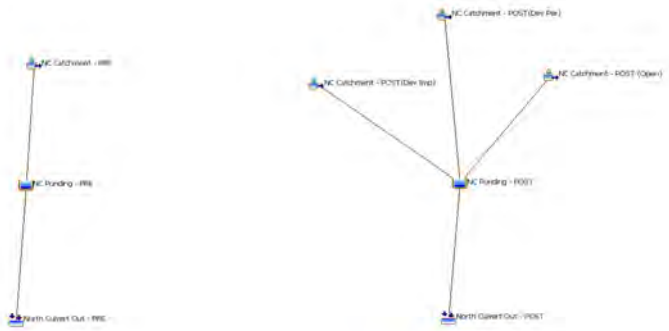
Storage Results

Av Recurrence Int. **ARI** =	10 2.1CC	100 2.1CC	100 3.8CC	100 NOCC	100 3.8CC 100% BLOCK	yr
Pre-Dev. Peak Elevation	19.045	22.758	23.516	28.322	23.516	m
Post-Dev. Peak Elevation	19.763	23.272	24.02	28.816	23.843	m
Pre-Dev. Peak Storage	4458	49108	67400	277809	67400	m^3
Post-Dev. Peak Storage	9005	60982	80776	309644	76001	m^3

Peak Flow Results

Av Recurrence Int. **ARI** =	10 2.1CC	100 2.1CC	100 3.8CC	100 NOCC	100 3.8CC 100% BLOCK	yr
Pre-Dev. Peak Flow q_{pre}	13.59	11.404	12.132	0	12.132	m^3/s
Post-Dev. Peak Flow q_{post}	15.758	11.904	12.6	0	12.437	m^3/s

Model Diagram



Summary Results for Reservoir "NC Ponding - PRE"

Project: Lot 900 10 yr Simulation Run: North Culvert 10yr
Reservoir: NC Ponding - PRE

Start of Run: 01Jan2000, 00:10
End of Run: 02Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE
Basin Model: North Culvert
Meteorologic Model: 10yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	15.111 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:27
Peak Discharge:	13.590 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 12:38
Inflow Volume:	108.789 (MM)	Peak Storage:	4.458 (1000 M3)
Discharge Volume:	108.719 (MM)	Peak Elevation:	19.045 (M)

Summary Results for Reservoir "NC Ponding - POST"

Project: ARA HILL 3.8CC Simulation Run: North Culvert 100yr
Reservoir: NC Ponding - POST

Start of Run: 01Jan2000, 00:10
End of Run: 03Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE
Basin Model: North Culvert
Meteorologic Model: 100yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	33.583 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:07
Peak Discharge:	11.904 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 13:00
Inflow Volume:	223.907 (MM)	Peak Storage:	60.982 (1000 M3)
Discharge Volume:	223.907 (MM)	Peak Elevation:	23.272 (M)

Summary Results for Reservoir "NC Ponding - PRE"

Project: ARA HILL 3.8CC Simulation Run: North Culvert 100yr
Reservoir: NC Ponding - PRE

Start of Run: 01Jan2000, 00:10
End of Run: 03Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE
Basin Model: North Culvert
Meteorologic Model: 100yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	32.950 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:26
Peak Discharge:	0.000 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 00:10
Inflow Volume:	228.895 (MM)	Peak Storage:	277.809 (1000 M3)
Discharge Volume:	0.000 (MM)	Peak Elevation:	28.322 (M)

Summary Results for Reservoir "NC Ponding - POST"

Project: ARA HILL 3.8CC Simulation Run: North Culvert 100yr
Reservoir: NC Ponding - POST

Start of Run: 01Jan2000, 00:10
End of Run: 03Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE
Basin Model: North Culvert
Meteorologic Model: 100yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	40.220 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:07
Peak Discharge:	0.000 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 00:10
Inflow Volume:	256.689 (MM)	Peak Storage:	309.644 (1000 M3)
Discharge Volume:	0.000 (MM)	Peak Elevation:	28.816 (M)

Summary Results for Reservoir "NC Ponding - POST"

Project: Lot 900 10 yr Simulation Run: North Culvert 10yr
Reservoir: NC Ponding - POST

Start of Run: 01Jan2000, 00:10
End of Run: 02Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE
Basin Model: North Culvert
Meteorologic Model: 10yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	19.830 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:06
Peak Discharge:	15.758 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 12:26
Inflow Volume:	131.214 (MM)	Peak Storage:	9.005 (1000 M3)
Discharge Volume:	131.138 (MM)	Peak Elevation:	19.763 (M)

Summary Results for Reservoir "NC Ponding - PRE"

Project: ARA HILL 3.8CC Simulation Run: North Culvert 100yr
Reservoir: NC Ponding - PRE

Start of Run: 01Jan2000, 00:10
End of Run: 03Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE
Basin Model: North Culvert
Meteorologic Model: 100yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	27.174 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:26
Peak Discharge:	11.404 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 13:16
Inflow Volume:	197.293 (MM)	Peak Storage:	49.108 (1000 M3)
Discharge Volume:	197.293 (MM)	Peak Elevation:	22.758 (M)

Summary Results for Reservoir "NC Ponding - PRE"

Project: ARA HILL 3.8CC Simulation Run: North Culvert 100yr
Reservoir: NC Ponding - PRE

Start of Run: 01Jan2000, 00:10
End of Run: 03Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE
Basin Model: North Culvert
Meteorologic Model: 100yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	32.950 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:26
Peak Discharge:	12.132 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 13:22
Inflow Volume:	228.895 (MM)	Peak Storage:	67.400 (1000 M3)
Discharge Volume:	228.895 (MM)	Peak Elevation:	23.516 (M)

Summary Results for Reservoir "NC Ponding - POST"

Project: ARA HILL 3.8CC Simulation Run: North Culvert 100yr
Reservoir: NC Ponding - POST

Start of Run: 01Jan2000, 00:10
End of Run: 03Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE
Basin Model: North Culvert
Meteorologic Model: 100yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	40.220 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:07
Peak Discharge:	12.600 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 13:04
Inflow Volume:	256.689 (MM)	Peak Storage:	80.776 (1000 M3)
Discharge Volume:	256.689 (MM)	Peak Elevation:	24.020 (M)

Summary Results for Reservoir "NC Ponding - POST"

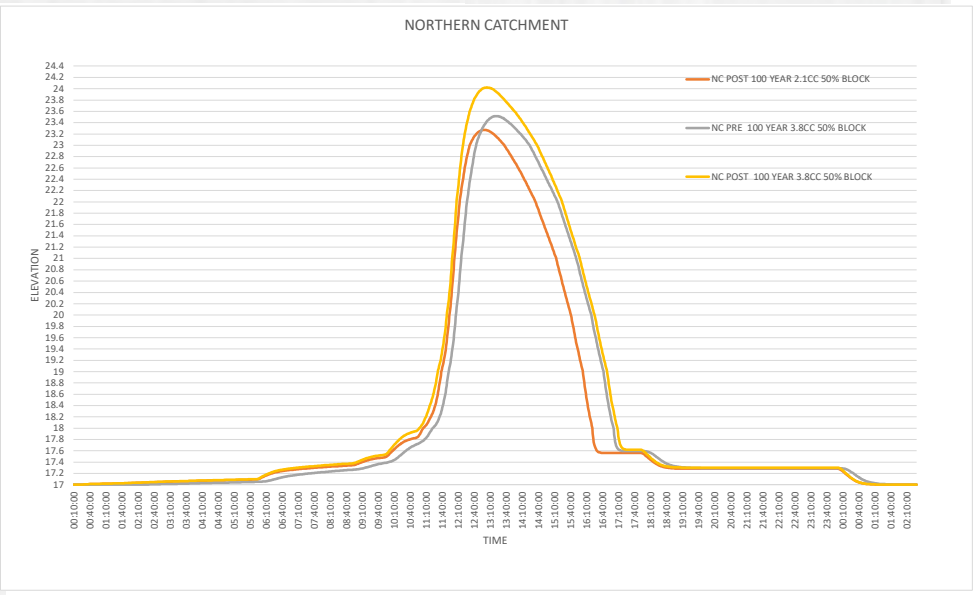
Project: ARA HILL 3.8CC Simulation Run: North Culvert 100yr 3.8 50%
Reservoir: NC Ponding - POST

Start of Run: 01Jan2000, 00:10
End of Run: 03Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE
Basin Model: North Culvert
Meteorologic Model: 100yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	37.745 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:06
Peak Discharge:	12.437 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 13:05
Inflow Volume:	247.234 (MM)	Peak Storage:	76.001 (1000 M3)
Discharge Volume:	247.234 (MM)	Peak Elevation:	23.843 (M)



TP 108 - CENTRAL CATCHMENT

CLIENT AVJ HOBSONVILLE PTY LTD
PROJECT ARA HILLS - PRIVATE PLAN CHANGE
JOB NO. 1403

CALCS BY RK
CHECKED BY TH
DATE 14/07/2025

CRANGCIVIL CONSULTING ENGINEERS

Pre Development

Catchment area: **28.72** ha

Cover	CN	Area (ha)	CN x Area
Grass Paddocks	74	18.72	1385.28
Bush Areas	70	10.00	700.00
Impermeable Areas	98	0.00	0.00
	Total	28.72	2085.28

	10 year 2.1CC	100 year 2.1CC	100 year 3.8CC	100 year NO CC
CN	72.6	72.6	72.6	72.6
Ia (mm)	5.0	5.0	5.0	5.0
C	1	1	1	1
L (km)	0.85	0.85	0.85	0.85
S_c (m/m)	0.045	0.045	0.045	0.045
t_c (hrs)	0.43	0.43	0.43	0.43
t_p (hrs)	0.29	0.29	0.29	0.29
S (mm)	95.8	95.8	95.8	95.8
P_{24} (mm)	181	278	312	235
c*	0.47	0.58	0.61	0.54
q*	0.089	0.1	0.105	0.095
q_p (m^3/s)	4.627	7.984	9.409	6.412
Q_{24} (mm)	114.0	202.1	234.0	162.4
V_{24} (m^3)	32728	58035	67196	46629

Post Development (Developed area - Impervious)

Catchment area: **9.802** ha

Cover	CN	Area (ha)	CN x Area
Grass Paddocks	74	0.00	0.00
Bush Areas	70	0.00	0.00
Impermeable Areas	98	9.80	960.60
	Total	9.80	960.60

	10 year 2.1CC	100 year 2.1CC	100 year 3.8CC	100 year NO CC
CN	98.0	98.0	98.0	98.0
Ia (mm)	0.0	0.0	0.0	0.0
C	0.6	0.6	0.6	0.6
L (km)	0.7	0.7	0.7	0.7
S_c (m/m)	0.045	0.045	0.045	0.045
t_c (hrs)	0.17	0.17	0.17	0.17
t_p (hrs)	0.11	0.11	0.11	0.11
S (mm)	5.2	5.2	5.2	5.2
P_{24} (mm)	181	278	312	235
c*	0.95	0.96	0.97	0.96
q*	0.162	0.163	0.163	0.163
q_p (m^3/s)	2.874	4.442	4.985	3.755
Q_{24} (mm)	176.0	272.9	306.9	229.9
V_{24} (m^3)	17248	26751	30082	22538

Post Development (Developed Area - Pervious)

Catchment area: **4.418** ha

Cover	CN	Area (ha)	CN x Area
Grass Paddocks	74	4.42	326.93
Bush Areas	70	0.00	0.00
Impermeable Areas	98	0.00	0.00
	Total	4.42	326.93

	10 year 2.1CC	100 year 2.1CC	100 year 3.8CC	100 year NO CC
CN	74.0	74.0	74.0	74.0
Ia (mm)	5.0	5.0	5.0	5.0
C	0.8	0.8	0.8	0.8
L (km)	0.7	0.7	0.7	0.7
S_c (m/m)	0.045	0.045	0.045	0.045
t_c (hrs)	0.30	0.30	0.30	0.30
t_p (hrs)	0.20	0.20	0.20	0.20
S (mm)	89.2	89.2	89.2	89.2
P_{24} (mm)	181	278	312	235
c*	0.49	0.60	0.63	0.56
q*	0.105	0.118	0.121	0.115
q_p (m^3/s)	0.840	1.449	1.668	1.194
Q_{24} (mm)	116.8	205.7	237.9	165.7
V_{24} (m^3)	5159	9090	10508	7321

Post Development (Open area)

Catchment area: **12.1** ha

Cover	CN	Area (ha)	CN x Area
Grass Paddocks	74	2.94	217.86
Bush Areas	70	9.16	640.92
Impermeable Areas	98	0.00	0.00
	Total	12.10	858.78

	10 year 2.1CC	100 year 2.1CC	100 year 3.8CC	100 year NO CC
CN	71.0	71.0	71.0	71.0
Ia (mm)	5.0	5.0	5.0	5.0
C	0.8	0.8	0.8	0.8
L (km)	0.7	0.7	0.7	0.7
S_c (m/m)	0.045	0.045	0.045	0.045
t_c (hrs)	0.31	0.31	0.31	0.31
t_p (hrs)	0.21	0.21	0.21	0.21
S (mm)	103.9	103.9	103.9	103.9
P_{24} (mm)	181	278	312	235
c*	0.45	0.56	0.59	0.52
q*	0.111	0.118	0.12	0.11
q_p (m^3/s)	0.888	1.449	1.654	1.142
Q_{24} (mm)	110.7	197.8	229.4	158.4
V_{24} (m^3)	4890	8737	10134	7000

HEC-HMS RESULTS SUMMARY - CENTRAL CATCHMENT

CRANGCIVIL CONSULTING ENGINEERS

CLIENT AVJ HOBSONVILLE PTY LTD
PROJECT ARA HILLS - PRIVATE PLAN CHANGE
JOB NO. 1403
CALCS BY RK
CHECKED BY TH
DATE 14/07/2025

Storm Data

	Storm 1	Storm 2	Storm 3	Storm 4	Storm 5	
Av Recurrence Int. **ARI** =	10 2.1CC 0% Block	100 2.1CC 50% Block	100 3.8CC 50% Block	100 3.8CC 100% Block	100 3.8CC 50% Block Ara Hills Site Only	yr
24hr Rainfall Depth P_{24} =	181	278	312	312	312	mm

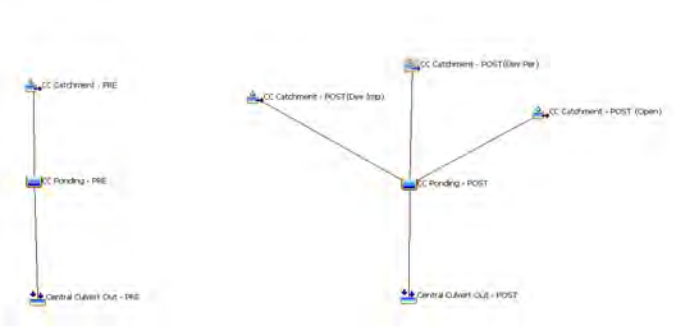
Storage Results

Av Recurrence Int. **ARI** =	10 2.1CC	100 2.1CC	100 3.8CC	100 3.8CC	100 3.8CC	yr
Pre-Dev. Peak Elevation	16.871	20.398	21.07	27.158	21.07	m
Post-Dev. Peak Elevation	17.179	20.58	21.169	27.224	21.169	m
Pre-Dev. Peak Storage	61	4010	6434	67190	6434	m^3
Post-Dev. Peak Storage	115	4634	6946	68335	6946	m^3

Peak Flow Results

Av Recurrence Int. **ARI** =	10 2.1CC	100 2.1CC	100 3.8CC	100 3.8CC	100 3.8CC	yr
Pre-Dev. Peak Flow q_{pre}	4.811	5.781	6.215	0	5.781	m^3/s
Post-Dev. Peak Flow q_{post}	5.931	5.9	6.273	0	5.9	m^3/s

Model Diagram



Summary Results for Reservoir "CC Ponding - PRE"

Project: Lot 900 10 yr Simulation Run: Central Culvert 10yr
Reservoir: CC Ponding - PRE

Start of Run: 01Jan2000, 00:10 Basin Model: Central Culvert
End of Run: 02Jan2000, 00:00 Meteorologic Model: 10yr
Compute Time:DATA CHANGED, RECOMPUTE Control Specifications:Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	4.811 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:13
Peak Discharge:	4.811 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 12:13
Inflow Volume:	113.042 (MM)	Peak Storage:	0.061 (1000 M3)
Discharge Volume:	113.034 (MM)	Peak Elevation:	16.871 (M)

Summary Results for Reservoir "CC Ponding - PRE"

Project: ARA HILL 3.8CC Simulation Run: Central Culvert 100yr
Reservoir: CC Ponding - PRE

Start of Run: 01Jan2000, 00:10 Basin Model: Central Culvert
End of Run: 03Jan2000, 00:00 Meteorologic Model: 100yr
Compute Time:DATA CHANGED, RECOMPUTE Control Specifications:Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	10.339 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:12
Peak Discharge:	6.215 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 12:31
Inflow Volume:	233.948 (MM)	Peak Storage:	6.434 (1000 M3)
Discharge Volume:	233.948 (MM)	Peak Elevation:	21.070 (M)

Summary Results for Reservoir "CC Ponding - POST"

Project: Lot 900 10 yr Simulation Run: Central Culvert 10yr
Reservoir: CC Ponding - POST

Start of Run: 01Jan2000, 00:10 Basin Model: Central Culvert
End of Run: 02Jan2000, 00:00 Meteorologic Model: 10yr
Compute Time:DATA CHANGED, RECOMPUTE Control Specifications:Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	6.031 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:04
Peak Discharge:	5.931 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 12:05
Inflow Volume:	135.491 (MM)	Peak Storage:	0.115 (1000 M3)
Discharge Volume:	135.482 (MM)	Peak Elevation:	17.179 (M)

Summary Results for Reservoir "CC Ponding - POST"

Project: ARA HILL 3.8CC Simulation Run: Central Culvert 100yr
Reservoir: CC Ponding - POST

Start of Run: 01Jan2000, 00:10 Basin Model: Central Culvert
End of Run: 03Jan2000, 00:00 Meteorologic Model: 100yr
Compute Time:DATA CHANGED, RECOMPUTE Control Specifications:Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	11.976 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:04
Peak Discharge:	6.273 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 12:21
Inflow Volume:	259.709 (MM)	Peak Storage:	6.946 (1000 M3)
Discharge Volume:	259.709 (MM)	Peak Elevation:	21.169 (M)

Summary Results for Reservoir "CC Ponding - PRE"

Project: ARA HILL 3.8CC Simulation Run: Central Culvert 100yr
Reservoir: CC Ponding - PRE

Start of Run: 01Jan2000, 00:10 Basin Model: Central Culvert
End of Run: 03Jan2000, 00:00 Meteorologic Model: 100yr
Compute Time:DATA CHANGED, RECOMPUTE Control Specifications:Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	9.543 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:12
Peak Discharge:	5.781 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 12:28
Inflow Volume:	202.051 (MM)	Peak Storage:	4.010 (1000 M3)
Discharge Volume:	202.051 (MM)	Peak Elevation:	20.398 (M)

Summary Results for Reservoir "CC Ponding - PRE"

Project: ARA HILL 3.8CC Simulation Run: Central Culvert 100yr
Reservoir: CC Ponding - PRE

Start of Run: 01Jan2000, 00:10 Basin Model: Central Culvert
End of Run: 03Jan2000, 00:00 Meteorologic Model: 100yr
Compute Time:DATA CHANGED, RECOMPUTE Control Specifications:Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	10.339 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:12
Peak Discharge:	0.000 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 00:10
Inflow Volume:	233.948 (MM)	Peak Storage:	67.190 (1000 M3)
Discharge Volume:	0.000 (MM)	Peak Elevation:	27.158 (M)

Summary Results for Reservoir "CC Ponding - POST"

Project: ARA HILL 3.8CC Simulation Run: Central Culvert 100yr
Reservoir: CC Ponding - POST

Start of Run: 01Jan2000, 00:10 Basin Model: Central Culvert
End of Run: 03Jan2000, 00:00 Meteorologic Model: 100yr
Compute Time:DATA CHANGED, RECOMPUTE Control Specifications:Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	10.021 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:04
Peak Discharge:	5.900 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 12:18
Inflow Volume:	227.116 (MM)	Peak Storage:	4.634 (1000 M3)
Discharge Volume:	227.116 (MM)	Peak Elevation:	20.580 (M)

Summary Results for Reservoir "CC Ponding - POST"

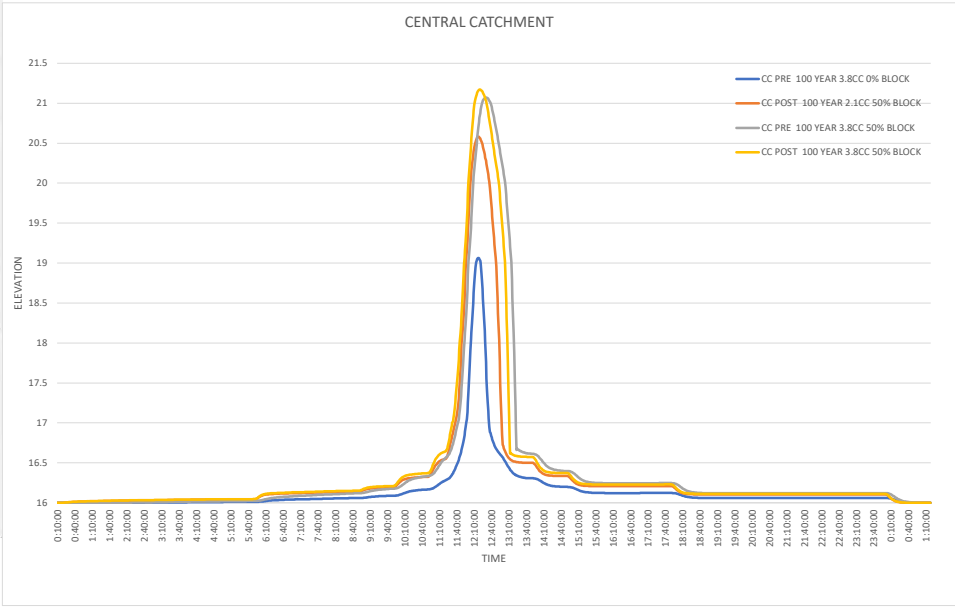
Project: ARA HILL 3.8CC Simulation Run: Central Culvert 100yr
Reservoir: CC Ponding - POST

Start of Run: 01Jan2000, 00:10 Basin Model: Central Culvert
End of Run: 03Jan2000, 00:00 Meteorologic Model: 100yr
Compute Time:DATA CHANGED, RECOMPUTE Control Specifications:Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	11.976 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:04
Peak Discharge:	0.000 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 00:10
Inflow Volume:	259.709 (MM)	Peak Storage:	68.355 (1000 M3)
Discharge Volume:	0.000 (MM)	Peak Elevation:	27.224 (M)



TP 108 - SOUTHERN CATCHMENT

CLIENT AVJ HOBSONVILLE PTY LTD
PROJECT ARA HILLS - PRIVATE PLAN CHANGE
JOB NO. 1403

CALCS BY RK
CHECKED BY TH
DATE 16/07/2025

CRANGCIVIL CONSULTING ENGINEERS

Pre Development

Catchment area: **266.03** ha

Cover	CN	Area (ha)	CN x Area
Grass Paddocks	74	155.07	11475.18
Bush Areas	70	109.00	7630.00
Impermeable Areas	98	1.96	192.08
	Total	266.03	19297.26

	10 year 2.1CC	100 year 2.1CC	100 year 3.8CC	100 year NOCC
CN	72.5	72.5	72.5	72.5
Ia (mm)	5.0	8.6	5.0	5.0
C	0.8	0.8	0.8	0.8
L (km)	2.88	2.88	2.88	2.88
S_c (m/m)	0.015	0.015	0.015	0.015
t_c (hrs)	1.08	1.08	1.08	1.08
t_p (hrs)	0.72	0.72	0.72	0.72
S (mm)	96.2	96.2	96.2	96.2
P_{24} (mm)	181	278	312	235
c*	0.47	0.58	0.61	0.54
q*	0.054	0.065	0.067	0.063
q_p (m^3/s)	26.002	48.072	55.611	39.386
Q_{24} (mm)	113.8	198.6	233.8	162.2
V_{24} (m^3)	302781	528226	622003	431562

Post Development (Developed area - Impervious)

Catchment area: **19.742** ha

Cover	CN	Area (ha)	CN x Area
Grass Paddocks	74	0.00	0.00
Bush Areas	70	0.00	0.00
Impermeable Areas	98	19.74	1934.52
	Total	19.74	1934.52

	10 year 2.1CC	100 year 2.1CC	100 year 3.8CC	100 year NOCC
CN	98.0	98.0	98.0	98.0
Ia (mm)	0.0	0.0	0.0	0.0
C	0.6	0.6	0.6	0.6
L (km)	0.425	0.425	0.425	0.425
S_c (m/m)	0.05	0.05	0.05	0.05
t_c (hrs)	0.17	0.17	0.17	0.17
t_p (hrs)	0.11	0.11	0.11	0.11
S (mm)	5.2	5.2	5.2	5.2
P_{24} (mm)	181	278	312	235
c*	0.95	0.96	0.97	0.96
q*	0.162	0.162	0.162	0.162
q_p (m^3/s)	5.788	8.890	9.977	7.515
Q_{24} (mm)	176.0	272.9	306.9	229.9
V_{24} (m^3)	34735	53873	60582	45388

Post Development (Developed Area - Pervious)

Catchment area: **9.156** ha

Cover	CN	Area (ha)	CN x Area
Grass Paddocks	74	9.16	677.54
Bush Areas	70	0.00	0.00
Impermeable Areas	98	0.00	0.00
	Total	9.16	677.54

	10 year 2.1CC	100 year 2.1CC	100 year 3.8CC	100 year NOCC
CN	74.0	74.0	74.0	74.0
Ia (mm)	5.0	5.0	5.0	5.0
C	0.8	0.8	0.8	0.8
L (km)	0.425	0.425	0.425	0.425
S_c (m/m)	0.05	0.05	0.05	0.05
t_c (hrs)	0.21	0.21	0.21	0.21
t_p (hrs)	0.14	0.14	0.14	0.14
S (mm)	89.2	89.2	89.2	89.2
P_{24} (mm)	181	278	312	313
c*	0.49	0.60	0.63	0.63
q*	0.115	0.13	0.131	1.131
q_p (m^3/s)	1.906	3.309	3.742	32.413
Q_{24} (mm)	116.8	205.7	237.9	238.8
V_{24} (m^3)	10693	18838	21778	21865

Post Development (Open area)

Catchment area: **131.5532** ha

Cover	CN	Area (ha)	CN x Area	
Grass Paddocks	74	65.78	4867.47	*50%*
Bush Areas	70	0.00	0.00	
Impermeable Areas	98	65.78	6446.11	*50%*
	Total	131.55	11313.58	

	10 year 2.1CC	100 year 2.1CC	100 year 3.8CC	100 year NOCC
CN	86.0	86.0	86.0	86.0
Ia (mm)	2.5	2.5	2.5	2.5
C	0.8	0.8	0.8	0.8
L (km)	2.88	2.88	2.88	2.88
S_c (m/m)	0.015	0.015	0.015	0.015
t_c (hrs)	0.93	0.93	0.93	0.93
t_p (hrs)	0.62	0.62	0.62	0.62
S (mm)	41.3	41.3	41.3	41.3
P_{24} (mm)	181	278	312	235
c*	0.68	0.77	0.79	0.74
q*	0.062	0.068	0.069	0.065
q_p (m^3/s)	1.027	1.731	1.971	1.399
Q_{24} (mm)	144.9	239.5	273.0	197.4
V_{24} (m^3)	190657	315132	359172	259679

Post Development (Proposed Delmore Development)

Catchment area: **109.1968** ha

Cover	CN	Area (ha)	CN x Area	
Grass Paddocks	74	54.60	4040.28	*50%*
Bush Areas	70	0.00	0.00	
Impermeable Areas	98	54.60	5350.64	*50%*
	Total	109.20	9390.92	

	10 year 2.1CC	100 year 2.1CC	100 year 3.8CC	100 year NOCC
CN	86.0	86.0	86.0	86.0
Ia (mm)	2.5	2.5	2.5	2.5
C	0.8	0.8	0.8	0.8
L (km)				
S_c (m/m)				
t_c (hrs)	0.17	0.17	0.17	0.17
t_p (hrs)	0.11	0.11	0.11	0.11
S (mm)	41.3	41.3	41.3	41.3
P_{24} (mm)	181	278	312	235
c*	0.68	0.77	0.79	0.74
q*	0.148	0.153	0.153	0.152
q_p (m^3/s)	2.453	3.894	4.371	3.271
Q_{24} (mm)	144.9	239.5	273.0	197.4
V_{24} (m^3)	158257	261578	298134	215548

HEC-HMS RESULTS SUMMARY - SOUTHERN CATCHMENT

CRANGCIVIL CONSULTING ENGINEERS

CLIENT AVJ HOBSONVILLE PTY LTD
PROJECT ARA HILLS - PRIVATE PLAN CHANGE
JOB NO. 1403

CALCS BY RK
CHECKED BY TH
DATE 22/07/2025

Storm Data

	Storm 1	Storm 2	Storm 3	Storm 4	Storm 5	
	10 2.1CC 0% Block	100 2.1CC 50% Block	100 3.8CC 50% Block	100 3.8CC 100% Block	100 3.8CC 50% Block Ara Hills Site Only	
Av Recurrence Int. **ARI** =						yr
24hr Rainfall Depth P_{24} =	181	278	312	312	312	mm

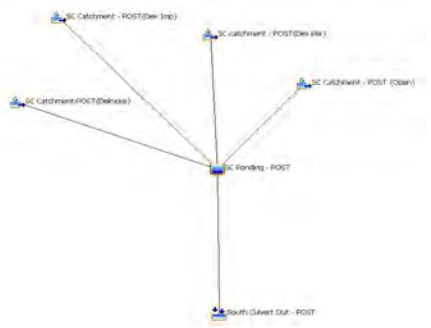
Storage Results

	10 2.1CC	100 2.1CC	100 3.8CC	100 3.8CC	100 3.8CC	
Av Recurrence Int. **ARI** =						yr
Pre-Dev. Peak Elevation	12.287	16.827	17.547	21.193	17.547	m
Post-Dev. Peak Elevation	13.851	17.527	18.266	21.802	17.736	m
Pre-Dev. Peak Storage	21600	177246	232897	640534	223014	m^3
Post-Dev. Peak Storage	50827	226915	287483	739672	242612	m^3

Peak Flow Results

	10 2.1CC	100 2.1CC	100 3.8CC	100 NOCC	100 3.8CC	
Av Recurrence Int. **ARI** =						yr
Pre-Dev. Peak Flow q_{pre}	19.669	14.127	14.736	0	14.635	m^3/s
Post-Dev. Peak Flow q_{post}	22.996	14.675	15.235	0	14.836	m^3/s

Model Diagram



Summary Results for Reservoir "SC Ponding - PRE"

Project: Lot 900 10 yr Simulation Run: South Culvert 10yr
Reservoir: SC Ponding - PRE

Start of Run: 01Jan2000, 00:10
End of Run: 02Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE
Basin Model: South Culvert
Meteorologic Model: 10yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	25.100 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:53
Peak Discharge:	19.669 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 13:24
Inflow Volume:	110.758 (MM)	Peak Storage:	21.600 (1000 M3)
Discharge Volume:	110.701 (MM)	Peak Elevation:	12.287 (M)

Summary Results for Reservoir "SC Ponding - POST"

Project: Lot 900 10 yr Simulation Run: South Culvert 10yr
Reservoir: SC Ponding - POST

Start of Run: 01Jan2000, 00:10
End of Run: 02Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE
Basin Model: South Culvert
Meteorologic Model: 10yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	50.124 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:03
Peak Discharge:	22.996 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 12:55
Inflow Volume:	145.018 (MM)	Peak Storage:	50.827 (1000 M3)
Discharge Volume:	144.955 (MM)	Peak Elevation:	13.851 (M)

Summary Results for Reservoir "SC Ponding - PRE"

Project: ARA HILL 3.8CC Simulation Run: South Culvert 100 yr
Reservoir: SC Ponding - PRE

Start of Run: 01Jan2000, 00:10
End of Run: 03Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE
Basin Model: South Culvert
Meteorologic Model: 100yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	46.210 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:52
Peak Discharge:	14.127 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 14:45
Inflow Volume:	208.549 (MM)	Peak Storage:	177.246 (1000 M3)
Discharge Volume:	208.549 (MM)	Peak Elevation:	16.827 (M)

Summary Results for Reservoir "SC Ponding - POST"

Project: ARA HILL 3.8CC Simulation Run: South Culvert 100 yr
Reservoir: SC Ponding - POST

Start of Run: 01Jan2000, 00:10
End of Run: 03Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE
Basin Model: South Culvert
Meteorologic Model: 100yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	81.495 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:03
Peak Discharge:	14.675 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 14:00
Inflow Volume:	240.842 (MM)	Peak Storage:	226.915 (1000 M3)
Discharge Volume:	240.842 (MM)	Peak Elevation:	17.527 (M)

Summary Results for Reservoir "SC Ponding - PRE"

Project: ARA HILL 3.8CC Simulation Run: South Culvert 100 yr
Reservoir: SC Ponding - PRE

Start of Run: 01Jan2000, 00:10
End of Run: 03Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE
Basin Model: South Culvert
Meteorologic Model: 100yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	61.342 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:40
Peak Discharge:	14.691 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 14:36
Inflow Volume:	233.669 (MM)	Peak Storage:	228.448 (1000 M3)
Discharge Volume:	233.669 (MM)	Peak Elevation:	17.547 (M)

Summary Results for Reservoir "SC Ponding - POST"

Project: ARA HILL 3.8CC Simulation Run: South Culvert 100 yr
Reservoir: SC Ponding - POST

Start of Run: 01Jan2000, 00:10
End of Run: 03Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE
Basin Model: South Culvert
Meteorologic Model: 100yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	96.678 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:03
Peak Discharge:	15.235 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 14:07
Inflow Volume:	274.310 (MM)	Peak Storage:	287.483 (1000 M3)
Discharge Volume:	274.310 (MM)	Peak Elevation:	18.266 (M)

Summary Results for Reservoir "SC Ponding - POST"

Project: ARA HILL 3.8CC Simulation Run: South Culvert 100 yr
Reservoir: SC Ponding - POST

Start of Run: 01Jan2000, 00:10
End of Run: 03Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE
Basin Model: South Culvert
Meteorologic Model: 100yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	60.288 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:39
Peak Discharge:	14.836 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 14:33
Inflow Volume:	242.911 (MM)	Peak Storage:	242.612 (1000 M3)
Discharge Volume:	242.911 (MM)	Peak Elevation:	17.736 (M)

Summary Results for Reservoir "SC Ponding - PRE"

Project: ARA HILL 3.8CC Simulation Run: South Culvert 100 yr
Reservoir: SC Ponding - PRE

Start of Run: 01Jan2000, 00:10
End of Run: 03Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE
Basin Model: South Culvert
Meteorologic Model: 100yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	55.603 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:52
Peak Discharge:	0.000 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 00:10
Inflow Volume:	240.775 (MM)	Peak Storage:	640.534 (1000 M3)
Discharge Volume:	0.000 (MM)	Peak Elevation:	21.193 (M)

Summary Results for Reservoir "SC Ponding - POST"

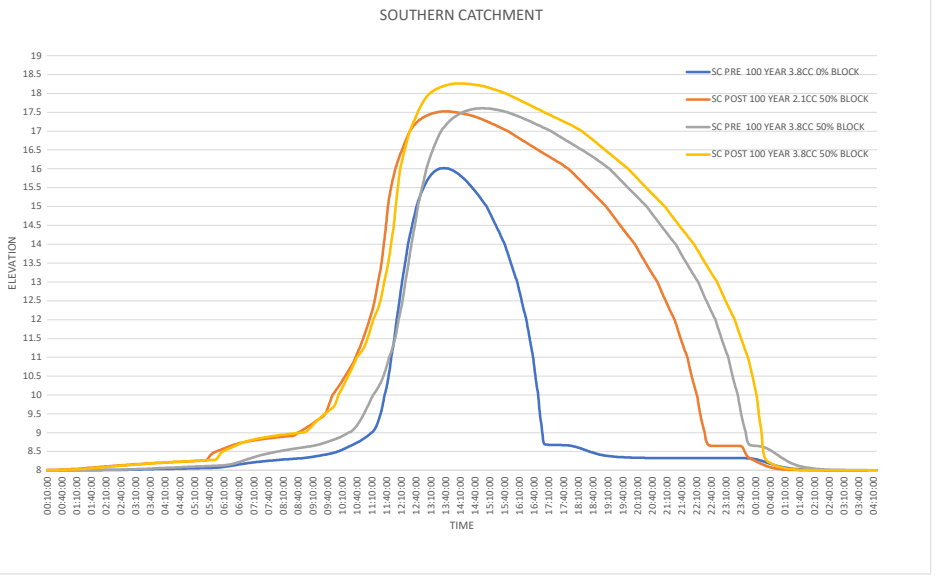
Project: ARA HILL 3.8CC Simulation Run: South Culvert 100 yr
Reservoir: SC Ponding - POST

Start of Run: 01Jan2000, 00:10
End of Run: 03Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE
Basin Model: South Culvert
Meteorologic Model: 100yr
Control Specifications: Control 1

Volume Units: MM 1000 M3

Computed Results

Peak Inflow:	96.678 (M3/S)	Date/Time of Peak Inflow:	01Jan2000, 12:03
Peak Discharge:	0.000 (M3/S)	Date/Time of Peak Discharge:	01Jan2000, 00:10
Inflow Volume:	274.310 (MM)	Peak Storage:	739.672 (1000 M3)
Discharge Volume:	0.000 (MM)	Peak Elevation:	21.802 (M)



HEC-HMS STORAGE-ELEVATION-DISCHARGE INPUTS

CRANGCIVIL CONSULTING ENGINEERS

CLIENT	AVJ HOBSONVILLE PTY LTD
PROJECT	ARA HILLS
JOB NO.	1403
CALCS BY	MD
CHECKED BY	CR
DATE	10/02/2023

CENTRAL

Orifice diameter (m)
1.6

Elevation (m)	Area (m^2)	Inc Volume (m3)	Volume ($1000m^3$)	Orifice outlet flow 50% (m^3/s)	Orifice outlet flow (m^3/s)
16	0	0	0.00	0.000	0.000
17	138	69	0.07	2.761	5.522
18	357	247.5	0.32	3.904	7.809
19	879	618	0.93	4.782	9.564
20	2542	1710.5	2.65	5.522	11.043
21	4314	3428	6.07	6.173	12.347
22	6013	5163.5	11.24	6.763	13.525
23	7677	6845	18.08	7.304	14.609
24	9446	8561.5	26.64	7.809	15.618
25	11367	10406.5	37.05	8.283	16.565
26	13567	12467	49.52	8.731	17.461
27	16176	14871.5	64.39	9.157	18.313
28	19198	17687	82.08	9.564	19.128
29	22547	20872.5	102.95	9.954	19.909

NORTH

Orifice diameter (m)
2.1

Elevation (m)	Area (m^2)	Inc Volume (m3)	Volume (1000m^3)	Orifice outlet flow 50% (m^3/s)	Orifice outlet flow (m^3/s)
17	229	0	0.00	0.000	0.000
18	1836	1032.5	1.03	4.756	9.512
19	4429	3132.5	4.17	6.726	13.452
20	8255	6342	10.51	8.238	16.475
21	11548	9901.5	20.41	9.512	19.024
22	16352	13950	34.36	10.635	21.269
23	22570	19461	53.82	11.650	23.299
24	30030	26300	80.12	12.583	25.166
25	36593	33311.5	113.43	13.452	26.904
26	43621	40107	153.54	14.268	28.536
27	51574	47597.5	201.14	15.040	30.079
28	60217	55895.5	257.03	15.774	31.548
29	68801	64509	321.54	16.475	32.950

SOUTH

Orifice diameter (m)
2.1

Elevation (m)	Area (m^2)	Inc Volume (m3)	Volume (1000m^3)	Orifice outlet flow 50% (m^3/s)	Orifice outlet flow (m^3/s)
8	355	0	0.00	0.000	0.000
9	1291	823	0.82	4.756	9.512
10	3599	2445	3.27	6.726	13.452
11	6563	5081	8.35	8.238	16.475
12	11490	9026.5	17.38	9.512	19.024
13	17895	14692.5	32.07	10.635	21.269
14	26202	22048.5	54.12	11.650	23.299
15	36933	31567.5	85.68	12.583	25.166
16	50237	43585	129.27	13.452	26.904
17	65843	58040	187.31	14.268	28.536
18	84473	75158	262.47	15.040	30.079
19	103920	94196.5	356.66	15.774	31.548
20	125495	114707.5	471.37	16.475	32.950
21	149766	137630.5	609.00	17.148	34.296
22	176421	163093.5	772.10	17.795	35.590
23	205261.5	190841.25	962.94	18.420	36.840

HEC-RAS Outputs

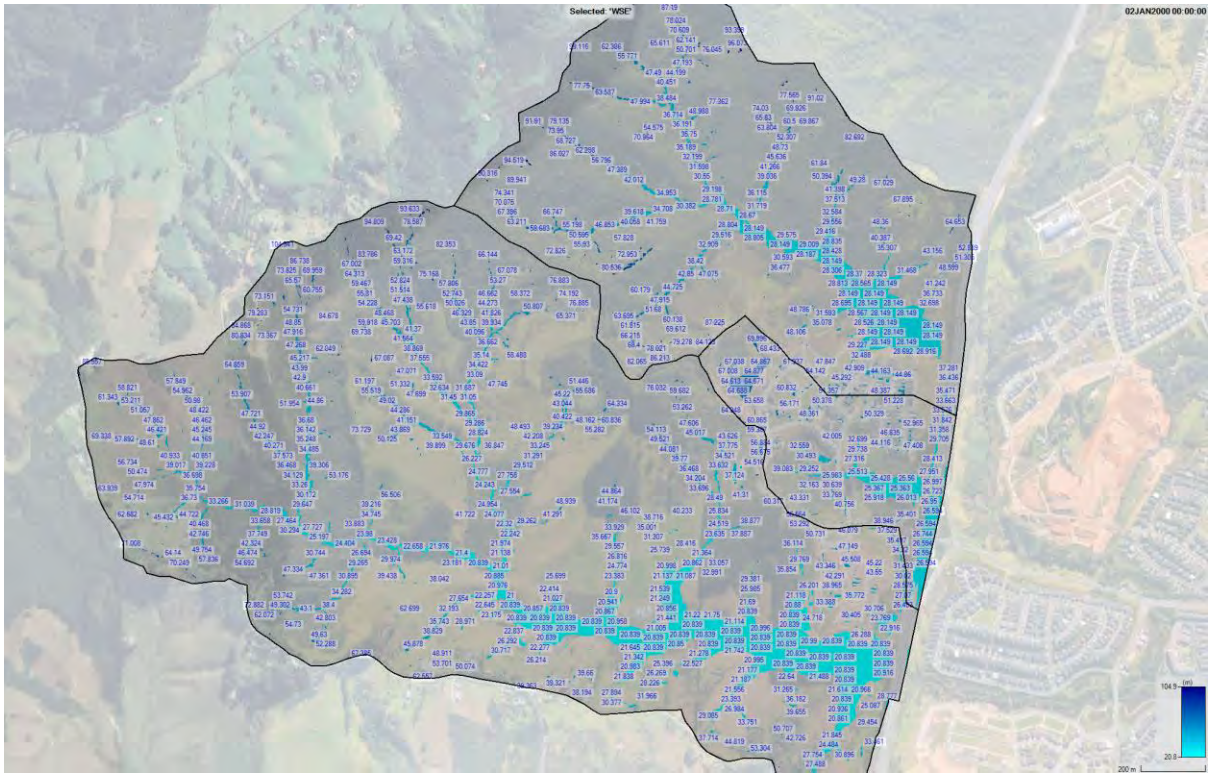


Figure 1PreDevelopment (End of 24hr Storm)

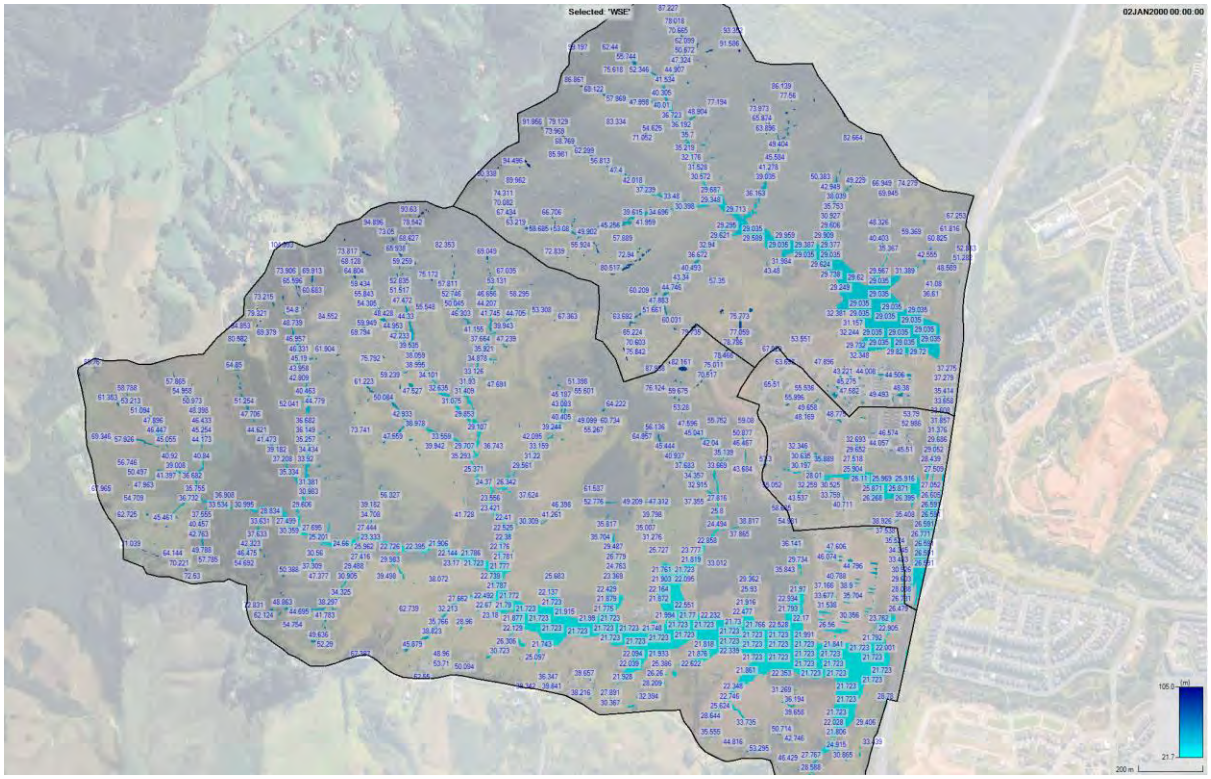


Figure 2 PostDevelopment (End of 24hr Storm)

HEC-RAS Outputs

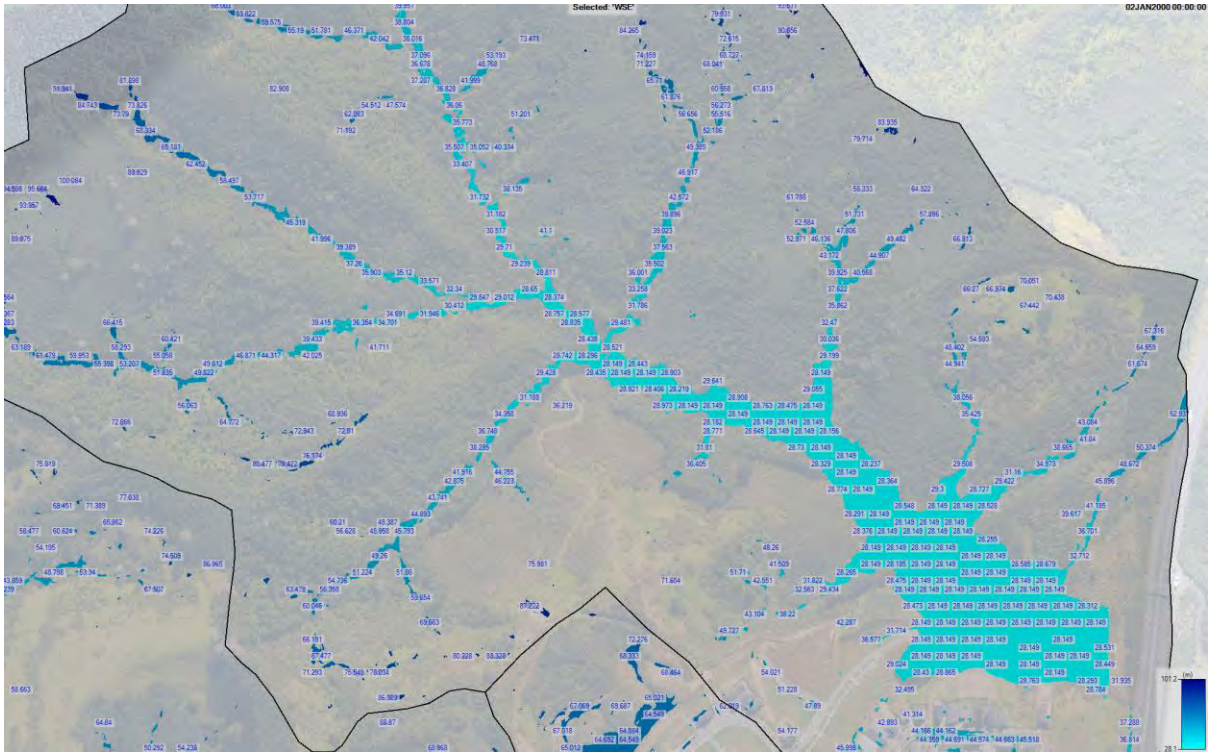


Figure 3 Northern Catchment Predevelopment

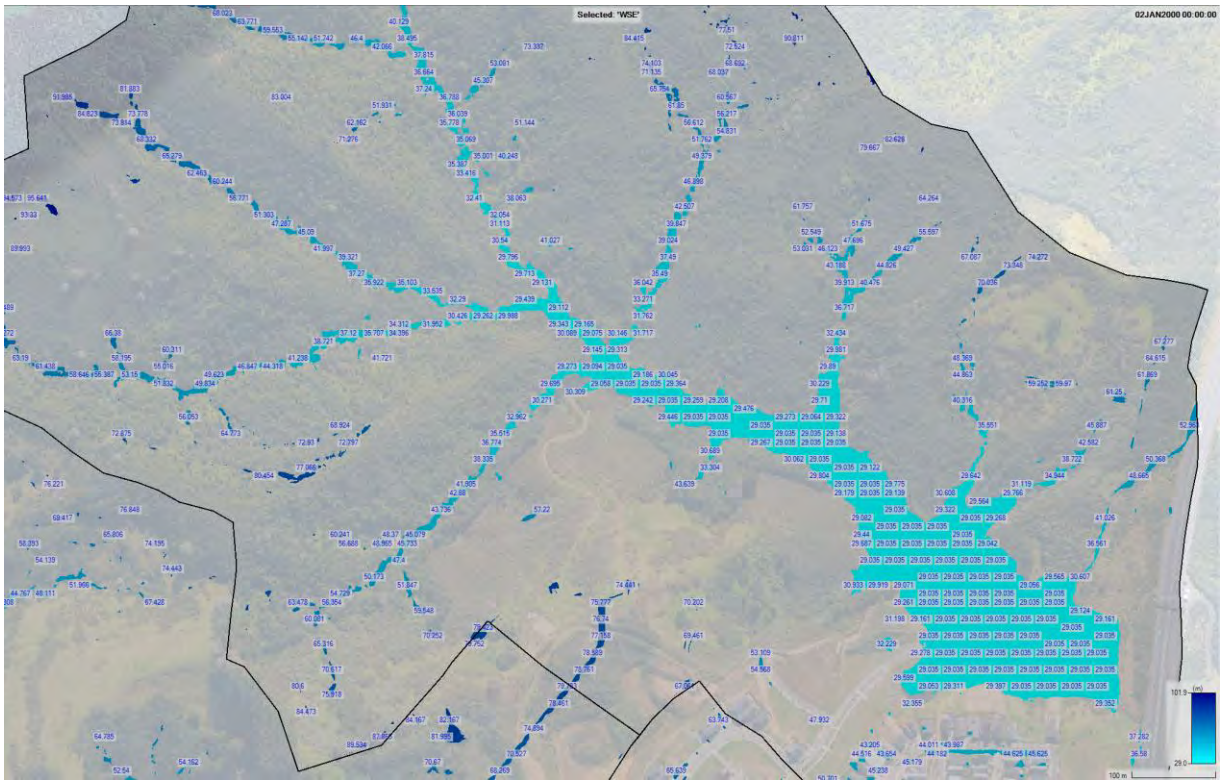


Figure 4 Northern Catchment Postdevelopment

HEC-RAS Outputs

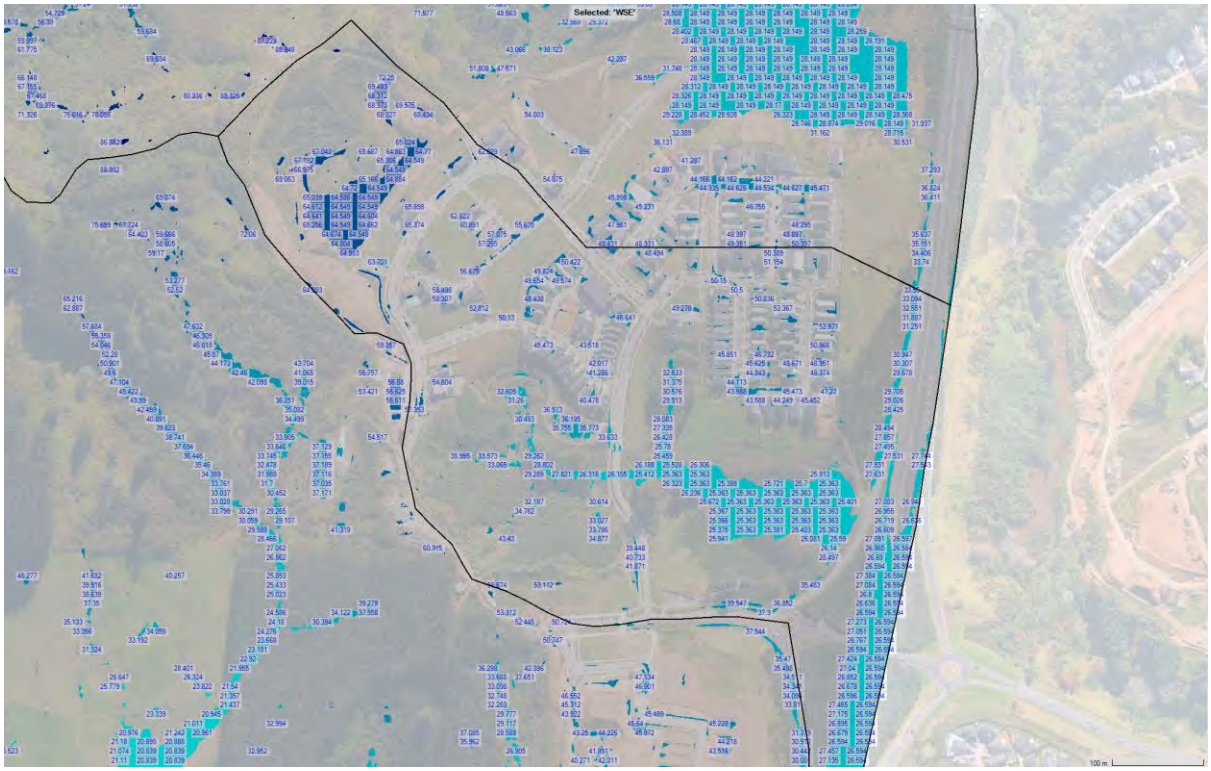


Figure 5 Central Catchment Predevelopment

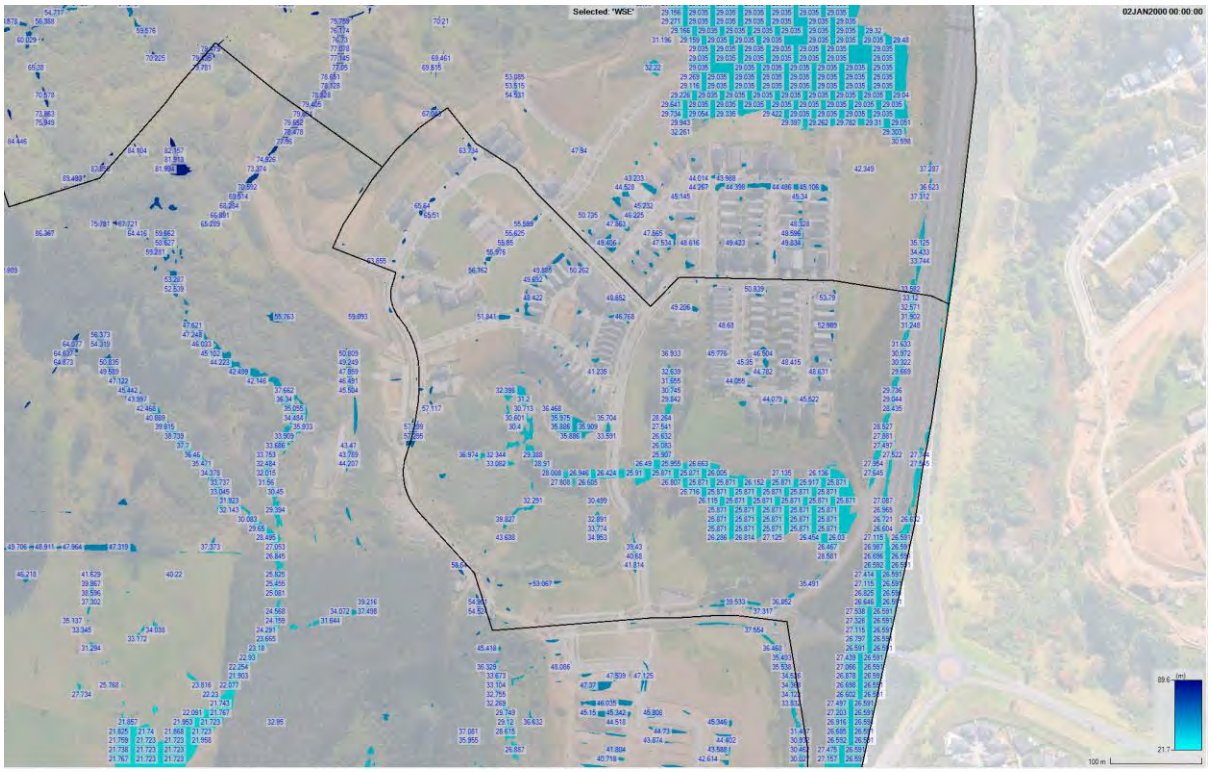


Figure 6 Central Catchment Postdevelopment

HEC-RAS Outputs

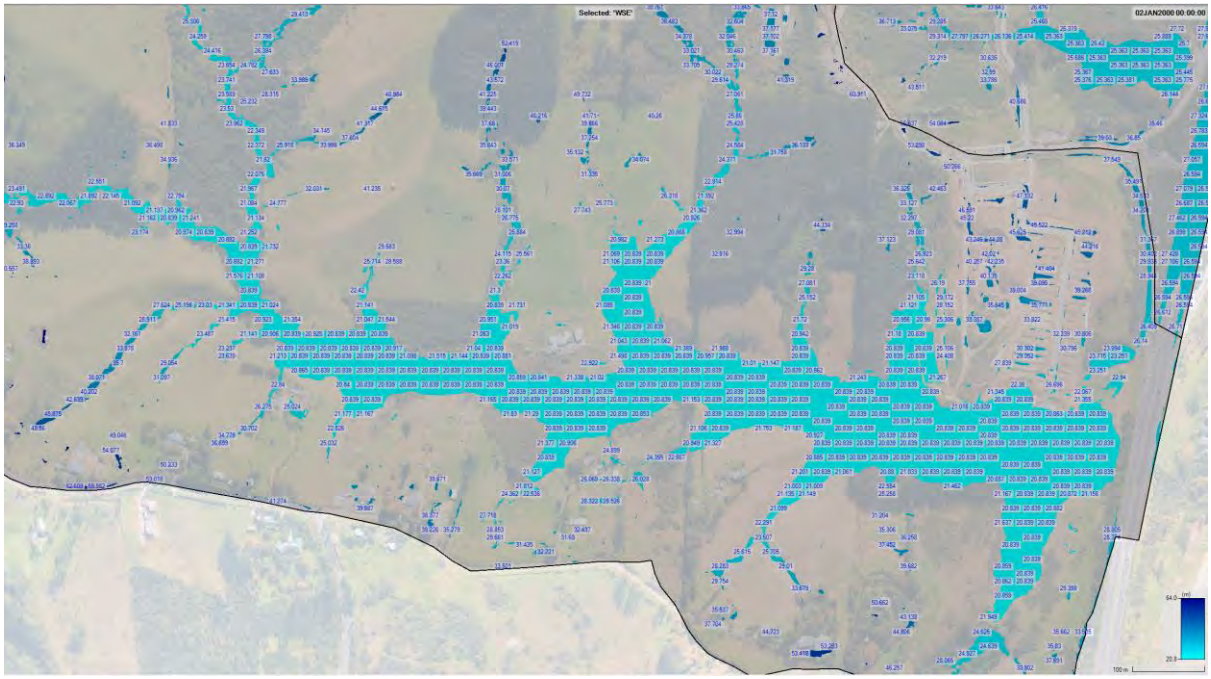


Figure 7 Southern Catchment PreDevelopment

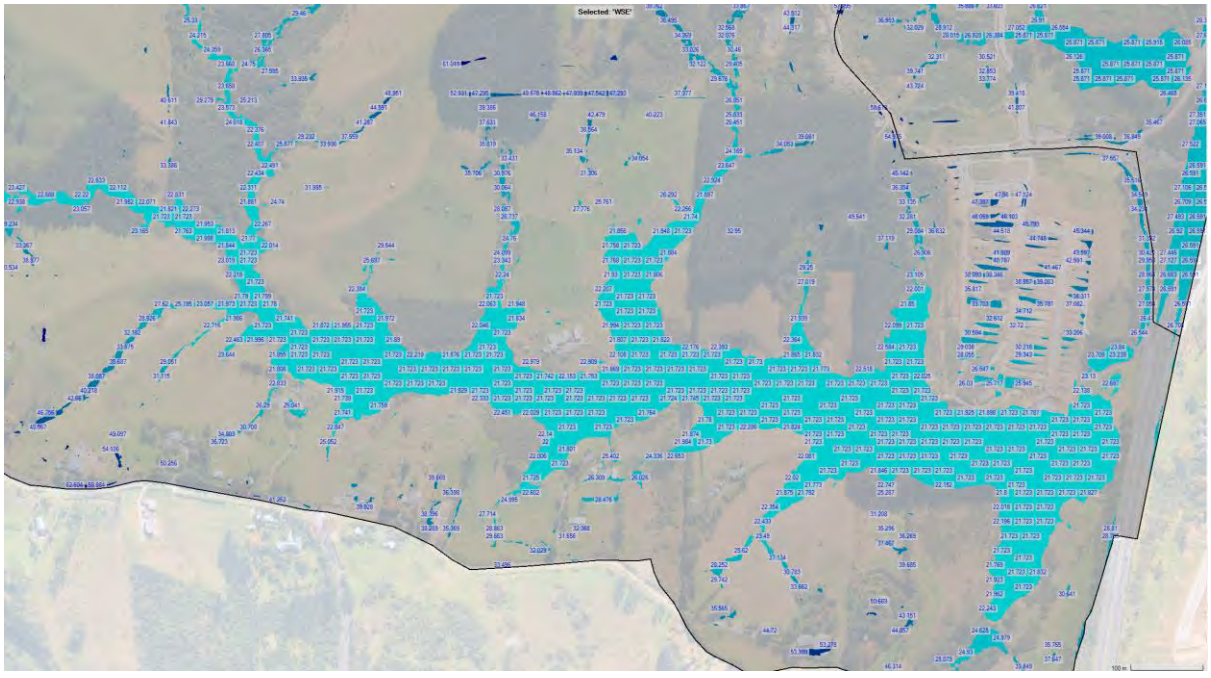


Figure 8 Southern Catchment PostDevelopment

HEC-RAS Outputs

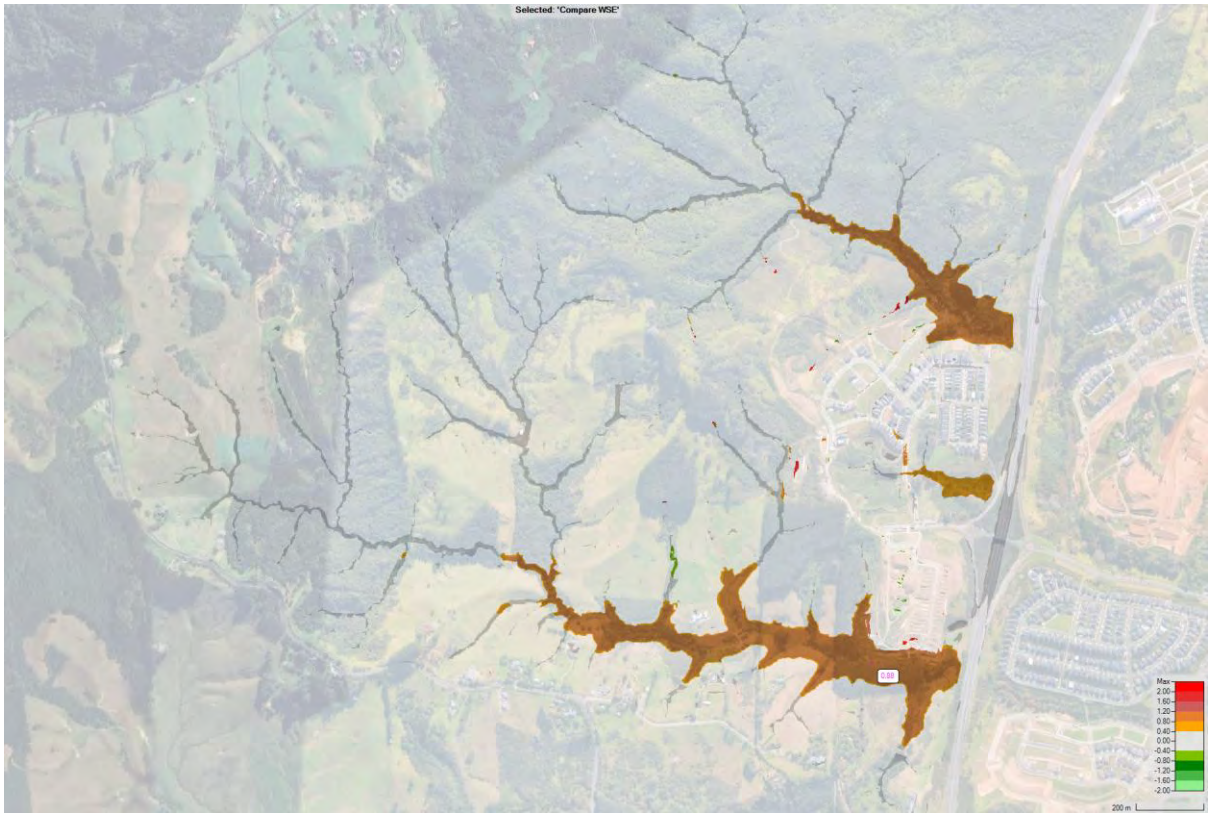


Figure 9 Comparison

HEC-RAS Outputs

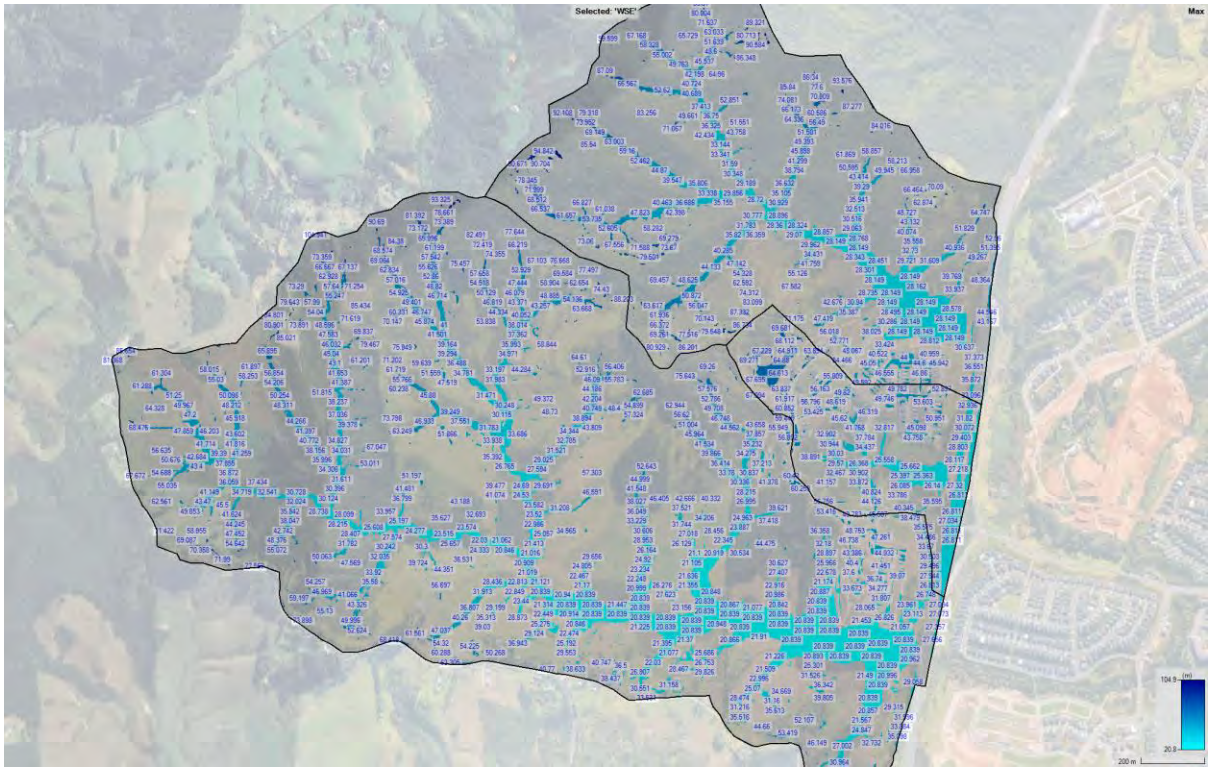


Figure 10 PreDevelopment (max)

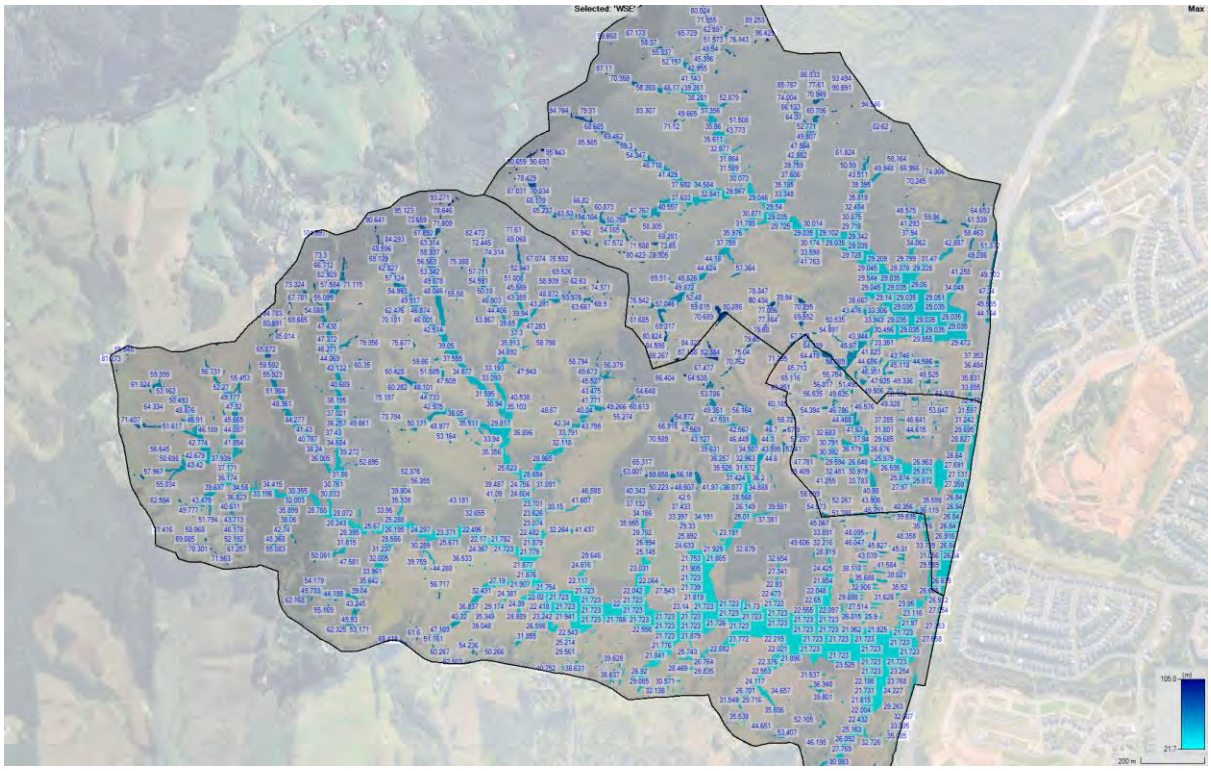


Figure 11 Post Development (max)

SMP APPENDIX C:

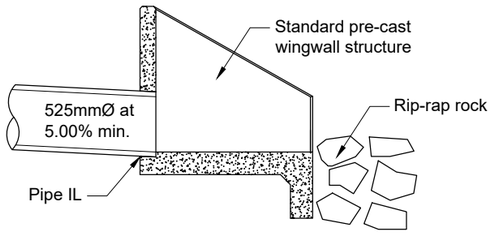
EXISTING WETLANDS DRAWING AND CALCULATION (AIREYS)

STORMWATER

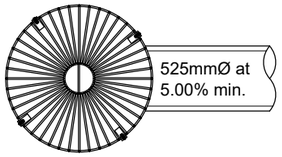
Wetland 2 Capacity:
Treated Area = 1.45 ha
EDV = 441m³
PWV(WQV) = 291m³
Total Volume = 732m³

Stage 3A Contribution:
Treated Area = 0.78 ha
EDV = 234m³
PWV(WQV) = 87m³
Total Volume = 321m³

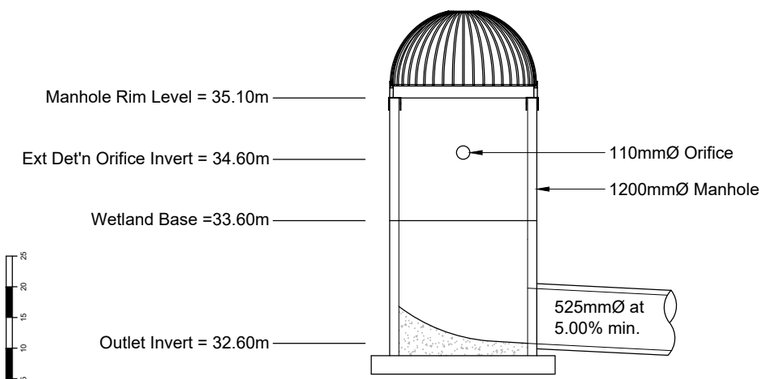
Future Treatment
Future Developed Area = 0.67ha
EDV = 207m³
PWV(WQV) = 204m³
Total Volume = 411m³



Pipe Outlet Section



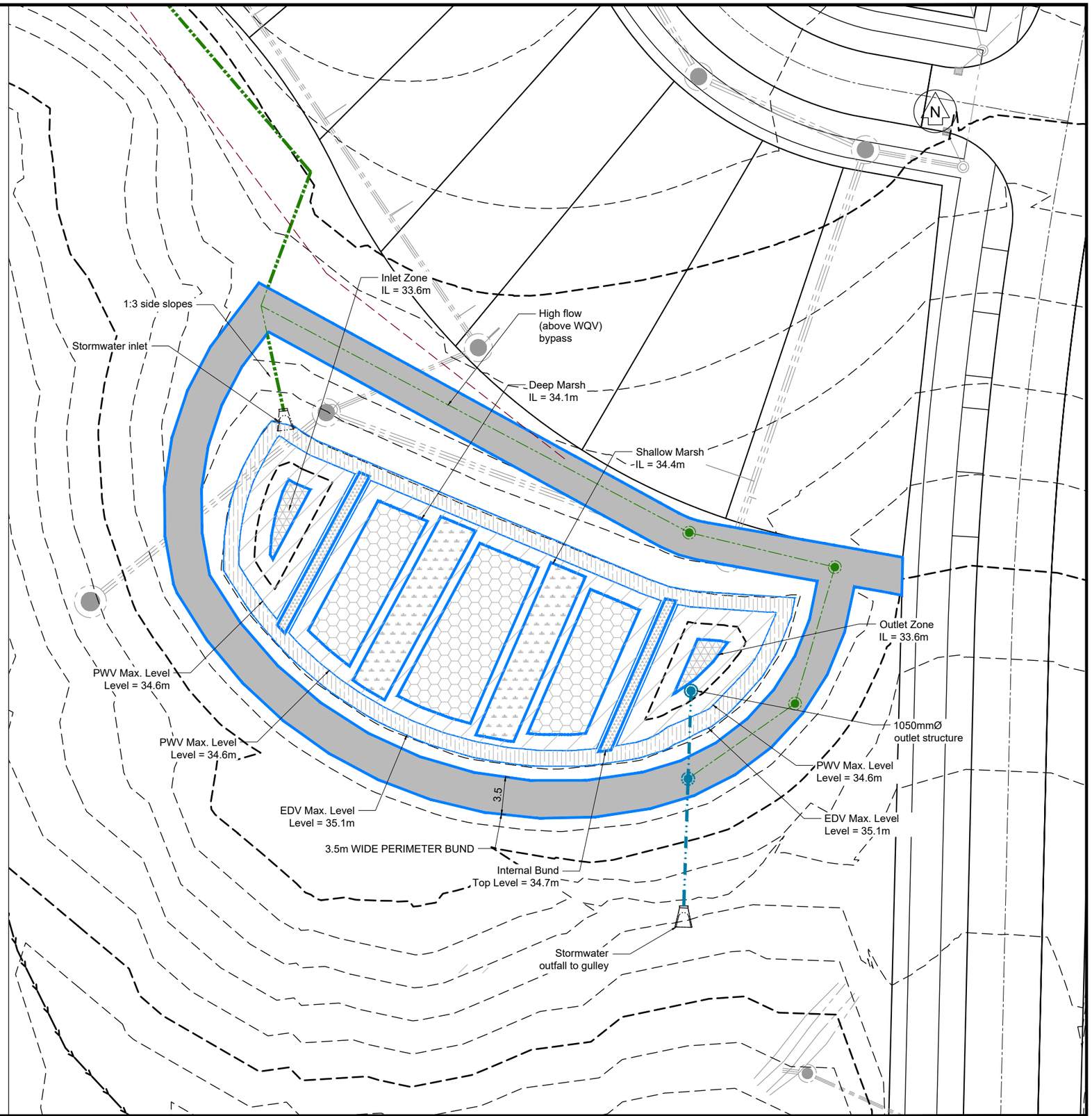
Plan



Elevation

Wetland 2 Outlet Details

Original Size:



No.	Revision Details (Current Revision Date : 25/06/2021)	Date
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----	----	----
----	----	----
B	ISSUE FOR S127	02/06/21
A	ISSUE FOR CONSENT	23/10/15

LEGEND:

- INLET/OUTLET ZONE
- INTERNAL BUND
- SHALLOW MARSH
- DEEP MARSH
- PWV EXTENT
- EDV EXTENT
- STORMWATER - UNTREATED
- STORMWATER - TREATED
- WASTEWATER
- EX. MH
- PROPOSED SWMH
- PROPOSED WWMH

Design	AJS
Survey	RECON LTD
Drawn	AJS
Checked	ML
Date	June 2021
Scale	1:200 (A1) 1:400 (A3)
CAD Filename	12516-01_S127 401.dwg

S127

Job Title.
AV JENNINGS
HALL FARM WEST OREWA
LOT 1 DP 310813 & LOT 3 DP327701
HIBISCUS COAST
AUCKLAND

AIREY CONSULTANTS LTD.
CONSULTING CIVIL & STRUCTURAL ENGINEERS
Takapuna, Pukekohe, Howick, Queenstown,Christchurch, Orewa
ACENZ

Drawing Title.
WETLAND 2 DETAILS

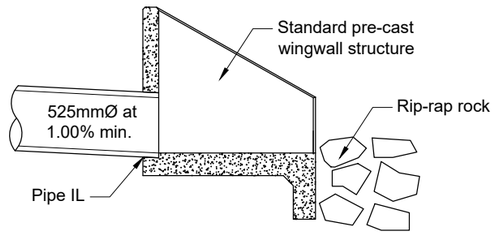
File No.	Rev.	Dwg. No.
12516-01-S127	B	402

STORMWATER

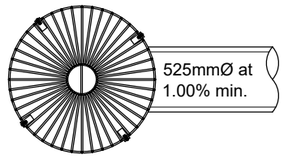
Wetland 5 Capacity:
Treated Area = 1.3 ha
EDV = 390m³
PWV(WQV) = 249m³
Total Volume = 639m³

Stage 3A Contribution:
Treated Area = 0.15 ha
EDV = 45m³
PWV(WQV) = 17m³
Total Volume = 62m³

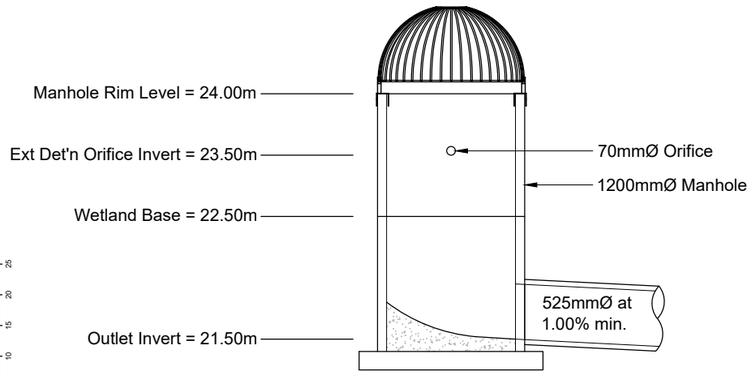
Future Treatment
Future Developed Area = 1.15 ha
EDV = 345m³
PWV(WQV) = 232m³
Total Volume = 577m³



Pipe Outlet Section

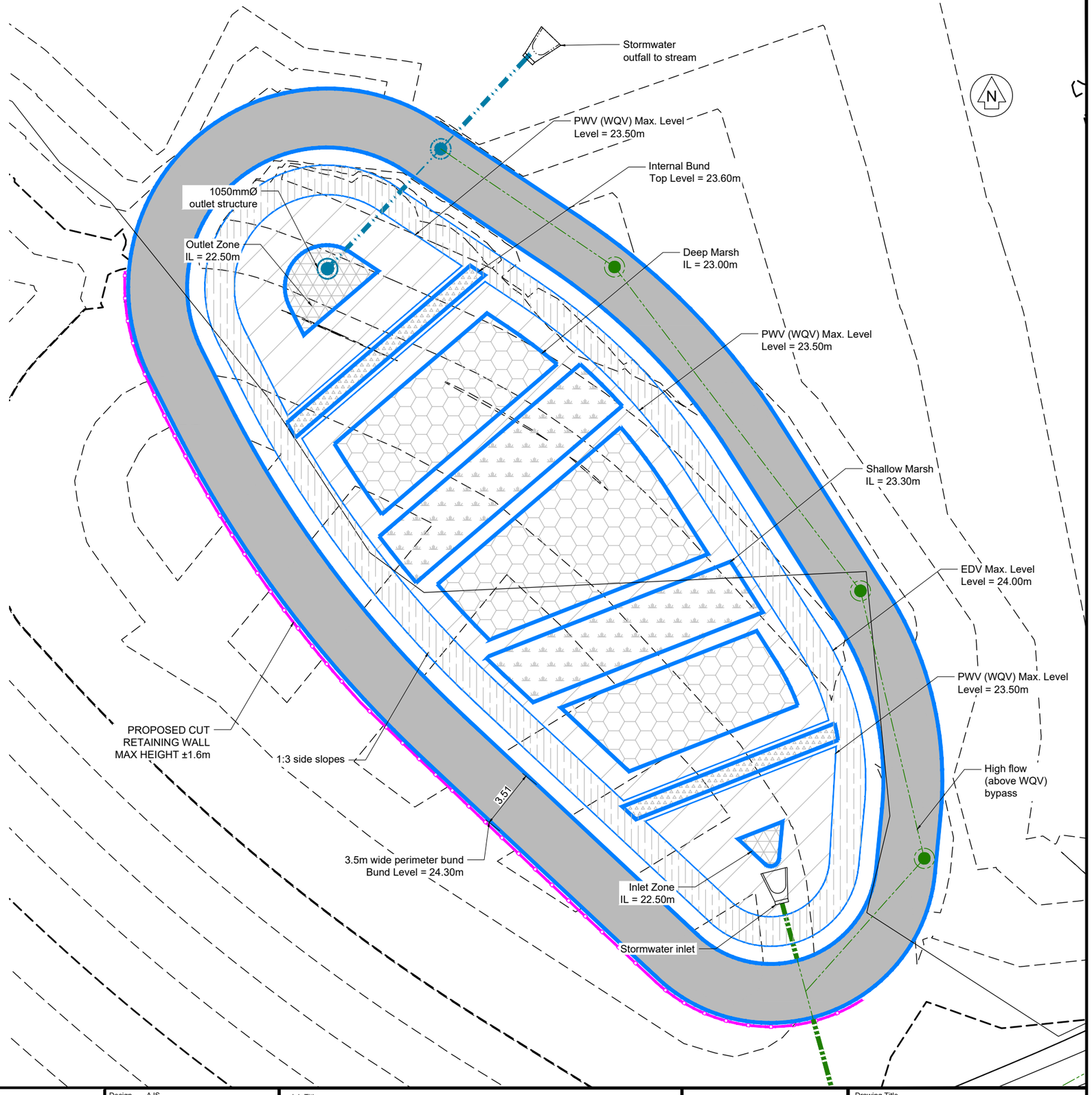


Plan



Elevation

Wetland 5 Outlet Details



Original Size: A1

No.	Revision Details (Current Revision Date : 25/06/2021)	Date
---	---	---
---	---	---
---	---	---
B	ISSUE FOR S127	02/06/21
A	ISSUE FOR CONSENT	23/10/15

LEGEND:

- INLET/OUTLET ZONE
- INTERNAL BUND
- SHALLOW MARSH
- DEEP MARSH
- EDV EXTENT
- EDV EXTENT
- STORMWATER - UNTREATED
- STORMWATER - TREATED
- RETAINING WALL
- EX. MH
- PROPOSED SWMH
- PROPOSED WWMH

Design	AJS
Survey	RECON LTD
Drawn	AJS
Checked	ML
Date	June 2021
Scale	1:125 (A1) 1:250 (A3)
CAD Filename	12516-01_S127 401.dwg

S127

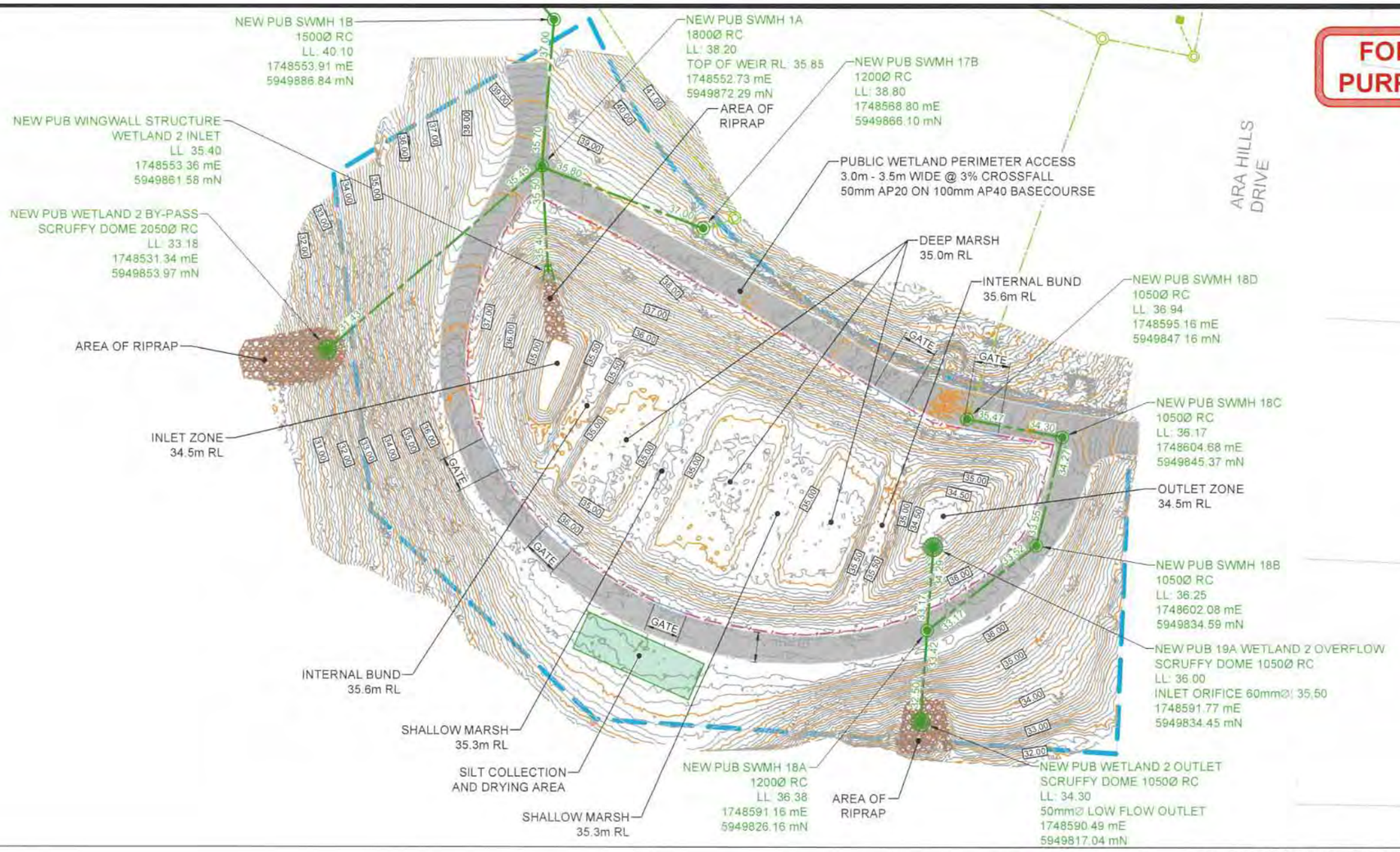
Job Title.
AV JENNINGS
HALL FARM WEST OREWA
LOT 1 DP 310813 & LOT 3 DP327701
HIBISCUS COAST
AUCKLAND

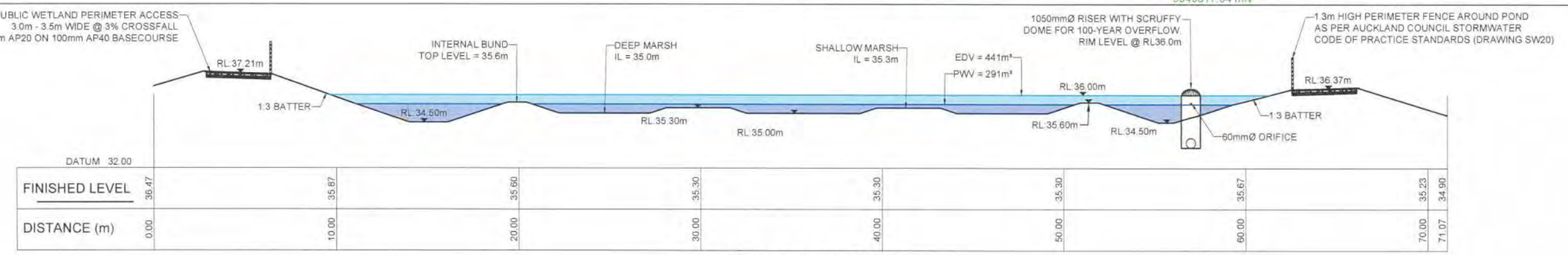
AIREY CONSULTANTS LTD.
CONSULTING CIVIL & STRUCTURAL ENGINEERS
Takapuna, Pukekohe, Howick, Queenstown,Christchurch, Orewa
ACENZ

Drawing Title.
WETLAND 5 DETAILS

File No.	Rev.	Dwg. No.
12516-01-S127	B	405

FOR AS-BUILT PURPOSES ONLY





FINISHED LEVEL	36.47	35.87	35.60	35.30	35.30	35.30	35.67	35.23	34.90
DISTANCE (m)	0.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	71.07

SECTION WETLAND 2

SCALE :1:250

I confirm that these As-Built Plans are an accurate record of the works undertaken and that:
* The **Coordinates** (X, Y) are in terms of NZTM on NZGD(2000), and are within ± 50mm.
* The **Levels** (Z) are in terms of the Auckland 1946 (MSL) LINZ datum (DOSLI datum), and are within ± 10mm.

Signed: .....
Chartered Professional Engineer

Date: 03/06/2022

Name: MITCH ROBERTS

Contact Phone: 09 486 4542

Email: MITCHELLR@AIREYS.CO.NZ

LEGEND:

- SCHEME BOUNDARY
- CONTOURS - MAJOR (0.5m)
- CONTOURS - MINOR (0.1m)
- WETLAND FENCE
- WETLAND ACCESS GATE
- WETLAND ACCESS
- AS-BUILT STORMWATER MAIN (PUBLIC)
- AS-BUILT STORMWATER MANHOLE (PUBLIC)
- EXISTING STORMWATER MAIN (PUBLIC)
- EXISTING STORMWATER MANHOLE (PUBLIC)
- LOT BOUNDARY
- LOT BOUNDARY (OUTSIDE SCHEME)

NOTES:

SURVEY DATA HAS BEEN COLLATED WITH INFORMATION PROVIDED BY SITE SURVEYS LTD

COORDINATES DATUM IS NZTM BASED ON NZGD (2000)

LEVELS ARE IN TERMS OF AUCKLAND 1946 (MSL) LINZ

Firm Name and Address

Airey
CIVIL STRUCTURAL AND FIRE ENGINEERS

Airey Consultants Ltd
19 Como Street, Takapuna
Auckland
Phone: (09) 486 4542
Email:

Project Name and Address
AVJ HOBSONVILLE PTY LTD
ARA HILLS - STAGE 3A
LOTS 1000 & 1001 DP556293
AND LOT 1 DP 310813
STATE HIGHWAY 1 -
UPPER OREWA

Council Ref#
SUB60035991-D

Project 12516/005	Sheet 700AB
Date 3/6/2022	Scale 1:500 (A3)
Drawing Title AS-BUILT WETLAND 2	

No.	Revision/Issue	Date
-	-	-
-	-	-
-	-	-
-	-	-

PLOT DATE: 6/3/2022 2:43 pm

FILE PATH: Z:\Jobs 10000-20000\12516 AV Jennings Ltd\005 Ara Hills, Stage 3\002 CAD\AB\12516-005-700AB.dwg

CRANGCIVIL
CONSULTING ENGINEERS

CLIENT	AVJ HOBSONVILLE PTY LTD	CALCS BY	RK
PROJECT	ARA HILLS - PRIVATE PLAN CHANGE	CHECKED BY	TH
JOB NO.	1403	DATE	17/07/2025

EX. WETLAND 5

Pre Development

Catchment area: **1.3** ha

Cover	CN	Area (ha)	CN x Area
Grass Paddocks	74	1.30	96.20
Bush Areas	70	0.00	0.00
Impermeable Areas	98	0.00	0.00
	Total	1.30	96.20
		95th %ile	
	CN	74.0	
	Ia (mm)	5.0	
	C	0.8	
	L (km)		
	S_c (m/m)		
	t_c (hrs)	0.17	
	t_p (hrs)	0.11	
	S (mm)	89.2	
	P_{24} (mm)	38	
	c*	0.14	
	q*	0.042	
	q_p (m^3/s)	0.021	
	Q_{24} (mm)	8.9	
	V_{24} (m^3)	116	

		95th %ile
$V_{24,\ pre}$ (m^3)		116
$q_{p,\ pre}$ (m^3/s)		0.021

Post Development

Catchment area: **1.3** ha

Cover	CN	Area (ha)	CN x Area
Urban lawns	74	0.00	0.00
	70	0.00	0.00
Impermeable Areas	98	1.30	127.40
	Total	1.30	127.40
		95th %ile	
	CN	98.0	
	Ia (mm)	0.0	
	C	0.6	
	L (km)	0.15	
	S_c (m/m)	0.080	
	t_c (hrs)	0.17	
	t_p (hrs)	0.11	
	S (mm)	5.2	
	P_{24} (mm)	38	
	c*	0.79	
	q*	0.16	
	q_p (m^3/s)	0.079	
	Q_{24} (mm)	33.4	
	V_{24} (m^3)	435	

	95th %ile
$V_{24,\ post}$ (m^3)	435
$q_{p,\ post}$ (m^3/s)	0.079

Mitigation Volume (Post-Pre)	319	m3

EX. WETLAND 2

Pre Development

Catchment area: **1.45** ha

Cover	CN	Area (ha)	CN x Area
Grass Paddocks	74	1.45	107.30
Bush Areas	70	0.00	0.00
Impermeable Areas	98	0.00	0.00
	Total	1.45	107.30
		95th %ile	
	CN	74.0	
	Ia (mm)	5.0	
	C	1	
	L (km)		
	S_c (m/m)		
	t_c (hrs)	0.17	
	t_p (hrs)	0.11	
	S (mm)	89.2	
	P_{24} (mm)	38	
	c*	0.14	
	q*	0.046	
	q_p (m^3/s)	0.025	
	Q_{24} (mm)	8.9	
	V_{24} (m^3)	129	

		95th %ile
$V_{24,\ pre}$ (m^3)		129
$q_{p,\ pre}$ (m^3/s)		0.025

Post Development

Catchment area: **1.45** ha

Cover	CN	Area (ha)	CN x Area
Urban lawns	74	0.00	0.00
Bush Areas	70	0.00	0.00
Impermeable Areas	98	1.45	142.10
	Total	1.45	142.10
		95th %ile	
	CN	98.0	
	Ia (mm)	0	
	C	0.6	
	L (km)	0.3	
	S_c (m/m)	0.08	
	t_c (hrs)	0.17	
	t_p (hrs)	0.11	
	S (mm)	5.2	
	P_{24} (mm)	38	
	c*	0.79	
	q*	0.16	
	q_p (m^3/s)	0.088	
	Q_{24} (mm)	33.4	
	V_{24} (m^3)	485	

	95th %ile
$V_{24,\ post}$ (m^3)	485
$q_{p,\ post}$ (m^3/s)	0.088

Mitigation Volume (Post-Pre)	356	m3

SMP APPENDIX D:

SMP HW RFI Comment Table

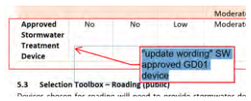
Ara Hill November 2023

Page/Section	Additional information required by Healthy Waters	Crang Civil Comments	Healthy Waters Comments May 2024	Crang Civil Comments April 2025	Healthy Waters Comments May 2025 Councils comment	Crang Civil Comments 25.07.2025
Consultation	Has there been consultation with Waka Kotahi, if so, what were their view on the flooding effects the proposed plan change will have on their assets.	AV Jennings are currently in consultation with Waka Kotahi. The client is awaiting feedback from Waka Kotahi.	Is there any update regarding this? Please include information about the consultation with Waka Kotahi in the SMP.	**The SMP proposal along with the ITA were sent to Waka Kotahi in May 2024 for consultation. Waka Kotahi did not raise any comments back on the SMP.**	No further questions.	Closed
Vesting	It is not clear in the SMP what assets will be vested to Healthy Waters and Auckland Transport. Has there been discussion with Auckland Transport if any assets are to be vested with them. The SMP needs to identify what assets will be vested, please include this information in the SMP.	Please refer to Section 6.6 of attached SMP. All vested stormwater assets will be per Engineering Plan Approval. Due to the extent of stormwater infrastructure and number of assets, it will be difficult to list each asset.	In Section 6.6 Asset Ownership please include some details such as what the public assets consist off, the number of assets is not required at this stage. If raingardens are proposed in the road corridor, has there been consultation with AT? Please include in the SMP.	**Please find list of assets included within Section 6.6** **Further detailed consultation will occur with AT during time of EPA submission. As with previous stages, the EPA is discussed with AT prior to approval.**	Please provide details on the raingarden, such as the estimated quantity/size of raingarden. Size / design calcs Catchment its treating, minimise no. of raingardens if possible (but sites contraints due to shape / contour) What are the water quality and hydrology mitigation for roads? Will impervious area will be treated? No retention provided within the roads? Road needs Retention /detention to meet SMAF1 requirements	For private lots only, Stormwater devices will be installed within each private lot, applied for as part of the building consent. The devices will either be above ground or underground rainwater tanks for detention/retention and a suitable treatment device for private high contaminant generating activities such as private ROWs. The tanks will provide retention and detention for all impervious areas on private lots. Water quality and detention for all impervious road areas will be provided by the Bioretention devices and Wetlands. Wherever the asset accepts flows from road runoff only, it will be an Auckland Transport Asset, however in most cases it is likely that private lots will discharge to the SW reticulation also, which will result in the asset being Auckland Council's asset. Ownership will be confirmed within Resource Consent applications.

						The catchments and proposed sizes of the raingardens are shown on drawing sheets C453 and C454, with detailed calculations in the appendix. Raingardens are designed for the 95th percentile storm. However, due to the low permeability of the underlying soil, retention will not be provided by the raingardens. Therefore, the raingardens have been sized to accommodate the full SMAF1 hydrological mitigation volume as detention, calculated as the difference between post-development and pre-development flows for the 95th percentile storm.
Section 2.2, Pg. 10	The report identified that several outfalls will be needed and will be spread out along the stream. Please provide further information on the number of outfalls required and how this is the best practical option, how are the number of outfalls optimised, and will the outfalls be vested to Healthy Waters? Please clarify in the SMP.	The outfalls being referred to are culverts. There are three existing culverts as mentioned in section 1.6 and appendix drawing C452. Outfall now changed to culvert.	The SMP references Appendix A, please provide comments or a summary table under Section 5.4 summarising Appendix A, and include estimated number/sizing of proposed stormwater management devices and area of the perspective upstream catchment area.	**Table Now included within Section 5.4**	Please clarify if all impervious area will be treated to meet GD01 Requirements, for example Figure 4 only shows roofs and roads, what about other hard surface areas. Please provide further details and update the SMP. Change wordings in the report to be consistent – i.e. all impervious areas Please discuss the proposed location of Wetland 3, 4 and 7 and effects of the steep slope location. How does the location of the Wetland 3, 4 and 7 affect the water quality treatment effectiveness? Review contours and see works	All impervious areas will be treated in accordance with GD01 requirements, wording now updated within report. And Figure 4 updated. The proposed location of Wetland 7 has been reviewed. The road presently batters down at a gradient of 1:3. A retaining wall will be incorporated into the design to support the wetland structure and maintain its water quality

						treatment effectiveness. These will also be lined to prevent water affecting the slope stability. The location of BD 04 has been updated to sit adjacent to the road reserve for better access and to be parallel to contours. Please refer to drawing sheet C453 and C454. The catchment for the BD 03 has been re-assessed and the size of the device has been reduced. It is now located closer to the road reserve on flatter land.
Section 3.2, Pg. 14	It was stated that "*… retention is not proposed to be provided for impervious areas with the road reserve but should be proposed where applicable within private lots."* Please provide further information, please include the total area of public road and the effects of the increase stormwater runoff. The increase in impervious area will result in large volume of water, with high flow rate, how will these effects be managed, please provide further information in the SMP? Please provide further information on *"where applicable"* means, what qualifies as applicable. The SMP needs to be clear on what is required for retention on private lots. Please amend the SMP accordingly.	In accordance with the approved resource consent conditions and associated S127 conditions, retention volume from impervious road areas will be accommodated within the lots by means of retention devices/tanks. Please refer to section Section 3.2, "where applicable" now removed.	As noted, the site soil has a maximum measured permeability of 0.036mm/hr. It is important reused is for internal non-portable water purposed rather than irrigation, how can this be guaranteed to occur on private lots? Can consent notices be used? Detention for stream protection is provided for the 95th percentile 24-hour rainfall event for all catchments, is this sufficient to protect the stream from further degradation. As stated in the SMP the zoning of the site is proposed to have a higher density, the streams are generally narrow and highly incised, the increase in impervious area will result in large volume of water, with high flow rate. The channel-forming flow in the Auckland region is	**Yes, consent notices can be used stating that the retention volume of water within private tanks is to be re-used for non potable purposes (eg. toilets, gardening etc.)** **Yes, we believe this will be sufficient. Calculation of the detention volumes are in accordance with GD01 and SMAF 1 requirements.** **Report updated to suite this requirement.**	The applicant replied that attenuation for the 50% AEP event is provided, however it is not clearly identified whether that 50% AEP event is proposed for hydrology detention in the SMP. Section 3.3 talks about stacked detention/retention, no details is provided, please clarify. Please note Section 3.3 reads as recommendation and not a requirement to manage effects, please clarify.	Wording is clarified in the report. No 50% AEP attenuation is required in the existing ICMP, GD01 or AUP. It was also not a requirement of the previously accepted SMP. Therefore we have not included it in the design. Stacked detention/retention was previously referring to how private lot detention subsequently flow through raingarden/wetland detention, stacking the detention flows. However, while this is the design intent, the wording is not helpful to the report, therefore it has been removed. Wording now updated within section 3.3

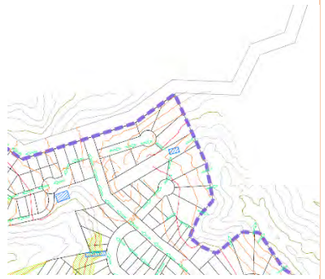
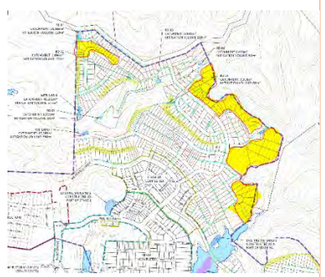
			about a 2.3 year ARI. The implementation of 2 year ARI attenuation alongside SMAF1 will help to manage the increased risk of stream erosion. Please include attenuation of a 50% AEP event to reduce the risk of stream erosion for the plan change area and downstream environment.		How is retention/detention managed for roads to meet SMAF requirements? It appears that retention is not proposed for road, nor proposed to be absorbed into detention volume, please clarify.	Raingardens and wetlands are designed for the SMAF1 requirements, being a 95th percentile storm. As discussed in report Section 3.2, due to the low permeability of the underlying soil, retention will not be provided by the raingardens. Therefore, the raingardens have been sized to accommodate the full hydrological mitigation volume as a detention volume, calculated as the difference between post-development and pre-development flows. The wetlands are also not designed to provide retention. Therefore, the wetlands will be designed to provide detention and a drain-down period of 24 hours for full retention/detention volume for the difference between the pre- and post-development runoff volumes from the 95th percentile storm.
Section 3.3, Pg. 16	The SMP required information to be included in the precinct provision, please clarify how this is incorporated into the precinct provision. It was stated that *"Reuse from retention tanks should be provide where possible"*, please clarify what *"where possible"* means. The SMP needs to be clear on what is required.	Wording revised, refer to Section 3.3, Page 16. Reuse from retention tanks should be provided for garden tap, toilet flushing or other non-potable water use.	How will internal reused be guaranteed? Can consent notices be used.	**Yes, consent notices can be used**	How will internal reuse be implemented? There is no provision in the precinct, and it is not clear in the SMP. The precinct and SMP needs to state clearly that there must be internal reuse given the soil condition of the plan change area.	Report wording is now updated to state that all lots must reuse water in accordance with SMAF 1 rules. The precinct rules have been satisfied with the Council Planner. Refer final precinct provisions.

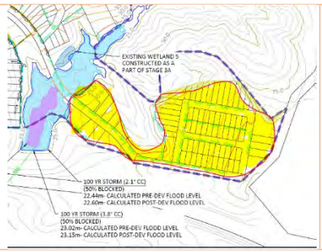
Section 5.2, Pg. 22	Please clarify in the SMP specifically what is required for privately own stormwater devices to ensure the desired outcomes of the SMP are implemented and achieved.	Please refer to Table 1 under section 5.2. Different device options are proposed and can be chosen based on the requirements of each lot.	Under Section 5.1, it states *Provide stormwater quality treatment (impervious areas subject to vehicle traffic only).* Please clarify does this include roofs? Section 5.2 roof material should not be made of any high contamination generating material. Please include in the SMP, and update the SMP where required.	**Yes, roof areas will be included. Although roof areas comprise of inert materials, water quality treatment will be provided. Report updated.**	Roof material remains unclear in the SMP, see Section 5.2, please update. For a green field development, roofs must be of low contaminate generating material. Noted the SMP is proposing tanks for roof runoff.	Section 5.2 updated. Reference to roof materials is now in Section 4.1
Table 1, Pg. 22	An assessment of stormwater treatment devices for private lots was carried out and some have been identified as not appropriate. Table 1 includes all the options assessed and does not identify what is not appropriate. For example Proprietary devices cannot achieve the required treatment standard and are not supported in the SWCoP, especially for greenfield developments. Please review Table 1 to make it clear what is required for stormwater management in private lots. The SMP needs to identify this clearly, please amend the SMP accordingly.	Noted. Please refer to updated Table 1 on Page 22.	Section 5.2 and 5.3 and Table 1 and Table 2 should only include options that are supported/BPO for the plan change area. The preferred option should be what is supported/BPO for the plan change area. For example, proprietary devices are not supported and should not be included as an option, also rain tanks within road corridor is not a supported option. Please include a column for Table 2 that clearly identifies the options that is supported/BPO for the plan change area. Section 5.3 and Table 2 – Please state that bioretention devices need to be lined as outline in the other sections in the SMP.	**Proprietary now removed. Table updated to suit BPO and devices applicable to the Plan Change Area.**	It is unclear what "Approved Stormwater Treatment Device", please only include GD01 devices, it is recommended this be removed from Table 1 and the relevant sections, only devices suitable for the area and meet GD01 requirements should be included.  What is the recommended option for Table 2? This has not been addressed in the updated SMP.  It should be noted in the SMP that any stormwater devices vested in Auckland Transport will need to meet Auckland Transport requirements.	Table removed and wording revised Table updated accordingly. Swales and ponds deleted. Wording added accordingly.

Section 5.4, Pg. 25	Proposed devices must be discussed in detailed. This section needs to include further details, along with sub catchment drawing, contributing catchment area and the proposed device sized. This section should also reference the drawing C452 and include relevant comments about the drawing C452. Please amend the SMP accordingly.	Noted. Section 5.4, Page 25 now updated.	Under Section 5.4 it needs to be clear that treatment need to be done as per GD01. Section 5.4 needs to also discuss Appendix A. Please update the SMP.	**Noted and updated Section 5.4**	The updated Section 5.4 does not include reference to C452 or any other subcatchment information for the proposed devices been provided/discussed in the text, please clarify and update the SMP.	The catchments for the proposed stormwater devices are shown on drawing sheets C453 and C454, and is now referenced in Section 5.4 of the report.
Section 6.2, Pg. 27	Calculations and models have been completed on peak flow and flood levels for each catchment and culvert with climate change, please also include information without climate change to better understand the effects of climate change.	Please refer to attached calculations.	Please review section Section 6.3 as it is unclear.	**Section now updated.**	Why is floor level based on 2.1 degree climate change? It is recommended that floor level is based on 3.8 degree climate change and 50% blockage scenario. Why is assessment focus and recommendations focus on 2.1 degree climate change and not 3.8 degree climate change? Flood risk assessment - the applicant has used 1D modelling assessment, which is only a high level assessment. Why was an assessment using a 2D modelling approach not used?	The floor levels have been updated in the SMP to account for 3.8-degree climate change scenario and 50% blockage condition. We have presented the 3.8 degree climate change scenario with 100% blockage also, to stress test the absolute worst situation. We have also retained the 2.1 degree climate change scenarios, as this report was previously submitted when the 2.1 degree scenario was the design requirement at the time. It has therefore been kept for reference. In addition to the 1D flood modelling, a 2D flood model has been completed as a comparison for the worst case scenario, being 3.8deg CC and 100% blockage. The results are discussed in the report.

					The applicant has used 50% blockage and 100yr 2.1 degree climate change for floor level sitting. Why was a 100yr 3.8 degree climate change scenario for the 100% blockage assessment to identify peak water level not used? The 100yr 3.8 degree climate change scenario would future proof the site, what would the difference be between 3.8 degree climate change and 2.1 degree climate change? It is recommended at 3.8 degree is used. Why is the recommended floor levels in the SMP significantly lower than previously consented levels?	Minimum Floor levels are updated. These have been set for the 100yr 3.8deg CC with 50% blockage per the current SWCoP. It also allows for future upstream development. Modelling has been revised and is now based off 3.8deg CC. Although the 2.1deg CC event has also been kept for reference to the earlier approved SMP. Calculations have been updated. This is no longer the case.
Section 6.4, Pg. 30	The report states that there will be increase flood levels within Waka Kotahi battered land. Has there been discussion with Waka Kotahi about the effects of the plan change? Please provide further information. Healthy Waters cannot assess or make decision on Waka Kotahi's behalf. Healthy Waters do not accept an increase in flood risk. The assessment has provided information on the modelled results for the increment, however, the risk cannot be assess based on the increment only. It is	AV Jennings are currently in consultation with Waka Kotahi. The client is awaiting feedback from Waka Kotahi.	As previously discussed, the Central and Northern catchments flooding due to the development is considered acceptable due to only increasing flood levels within the Waka Kotahi battered land. The Central Catchment duration of flooding decreases due to the change in final landform. The Northern Catchment has an increase in the flooding duration over the pre-development peak flood level of 58 minutes. The increased duration is considered to be low-risk with minimal access points to the	**The SMP proposal along with the ITA were sent to Waka Kotahi in May 2024 for consultation. Waka Kotahi did not raise any comments back on the SMP.**	No further questions. It is noted that the flood risk on Waka Kotahi's land has not been addressed. As stated before Healthy Waters cannot assess or make decision on Waka Kotahi's behalf.	This is still in consultation with Waka Kotahi.

	necessary to understand if the risk change pre and post development i.e. what was the peak water level along the SH1 pre and post development, it would be best to understand through the scenarios without climate change. Please provide further information in the SMP to allow understanding of the risk. Hazard assessment needs to be assessed for the water depth for each scenario identified in Section 6.4. Please update the SMP accordingly.		flooding areas. Is this within limits acceptable by Waka Kotahi? If mitigation is needed, please include in the SMP. Please include updated information from consultation with Waka Kotahi. Healthy Waters cannot assess or make decision on Waka Kotahi's behalf.			
			In Appendix A, please clarify what MSE slope means. Please provide further information and justification on the location of the bioretention devices in areas marks MSE slope, such as the location of BD02 and BD04 in diagram C452. In diagram C452, please note some bioretention devices do not have a label and are located in private lots, please see diagrams below and clarify. Is Wetland 6 in a private lot?	**MSE is Mechanically Stabilized Earth Wall Slope.** **BD02 has been moved further away from the MSE slope. Please refer to drawing sheet C452. The MSE slope will terminate at the rain garden BD04, with retaining walls to be constructed on either side of the rain garden to provide support for the MSE slope.** **BD07 now updated.** **Wetland 6 will be a drainage reserve.**	How come not all impervious area have detention and water quality treatment? Such as the area bounded by orange outline. 	- Based on the land contour and future proposed dwelling locations, runoff from these lots will discharge into the adjacent watercourse which follows the natural contours - On site detention/retention to SMAF1 requirements will be provided within each lot, as is required for all lots in this catchment. - On site water quality treatment will also be provided by use of proprietary devices for high contaminant generating activities. Existing Wetlands 2 and 5 have sufficient capacity to accommodate additional flows while maintaining water quality and SMAF 1

			  Please check proposed boundary lines of diagrams. Please confirm if all proposed stormwater wetlands are located above the 10% AEP flood plain? Please clarify whether the areas highlighted yellow in the diagrams below will have any stormwater treatment devices? 	**Boundary lines have been assessed.** **Wetland areas will be located above the 10% AEP floodplain.** **Part of the below highlighted areas are being treated by BD01, Wetland No. 5, BD06 and BD07**	There is an area that is proposed to be discharged into the existing (Stage 1) wetland, please provide information to demonstrate the existing wetland will be able to meet GD01 for water quality and SMAF 1 detention. Will a storm water pipe going along the bridge be used to discharge the stormwater into Wetland 5?	detention requirements in accordance with GD01. This is supported by the calculations provided and the plan prepared by Aireys as a part of S127, with asbuilts also attached. The associated catchment areas for these wetlands are shown on Crang Civil drawing sheets C453 and C454. Yes, a stormwater pipe will be installed at the bridge which will discharge into the existing wetland.

				**This area is being treated by Wetland No. 5**		

APPENDIX C:

WATERCARE CORRESPONDENCE

From: Amber Taylor <Amber.Taylor2@water.co.nz>
Sent: Tuesday, 20 August 2024 2:29 pm
To: Ila Daniels
Cc: Katelyn Orton; Dave Paul; Monica De Magalhaes; Michael Campbell; Lars Fog
Subject: RE: Ara Hills - RC and PPC

Kia ora Ila,

Further to my email below, we have reviewed the existing resource consent BUN20441333 held by AV Jennings that approves the creation of 575 lots in the Future Urban Zone (site address: Hall Farm, State Highway 1, Upper Orewa; see location map below). This RC was approved in August 2017.

As discussed, Watercare operates on a first come first served basis in relation to providing connections to the water and wastewater networks. Watercare's peer reviews for capacity assessments and resource consents are therefore only valid for two years. Subsequent EPA approvals are made on the basis that construction must commence within 2 years of the EPA approval provided by Watercare.

Having considered the existing resource consent approval and the continued staged implementation of that consent over time by AV Jennings, Watercare confirms that the balance of the development approved under the above resource consent and yet to connect to the public water and wastewater network would be granted approval to connect to the wastewater network. This confirmation is based on Watercare's current approach to honouring connections for approved resource consents in areas of capacity constraints.

Watercare are continuing work to better understand the remaining capacity at the Army Bay wastewater treatment plant and possible options for mitigating and managing this to meet our current wastewater discharge consent conditions and requirements.

As we progress this work and become clearer on the issues and options, Watercare may be required to take action to preserve the integrity of our networks and ensure compliance with our consents. This could include refusing connections to the network under the Water Supply and Wastewater Network Bylaw, including for development with an existing and valid resource consent.

Ngā mihi,

Amber Taylor
Development Planning Lead | Major Developments
Kaihautū Mataamua Whakamahere Whanaketanga | Ngā Hanganga Matua

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Mon Tue Wed Thu Fri

Office Home

From: Amber Taylor
Sent: Friday, August 9, 2024 4:47 PM
To: Ila Daniels <ila@campbellbrown.co.nz>
Cc: Katelyn Orton <korton@avjennings.co.nz>; Dave Paul <Dave.Paul@aucklandcouncil.govt.nz>; Monica De Magalhaes <mdemagalhaes@avjennings.co.nz>; Michael Campbell <michael@campbellbrown.co.nz>; Lars Fog <Lars.Fog@water.co.nz>
Subject: Ara Hills - RC and PPC

Kia ora Ila,

In following up from the meeting early last week please see below and attached.

Existing Resource Consent
In relation to the existing RC and the remaining 253 lots that have not yet been lodged for EPA, I will need some further time to confirm our position on this. I will aim to come back to you within the next 1-2 weeks. Feedback from water planning confirms that the EPA will need to include the developer delivered water network reservoir.
Question: When do you expect to be ready to lodge the EPA by?

Plan Change
As discussed, I consider the Plan Change to be a separate matter to the existing RC and whether the full extent of development approved under the RC can be serviced immediately or by the future Army Bay WWTP upgrade.
Any new development proposals/subdivision consents from the Plan Change area would not be able to connect to the public wastewater network until the Army Bay WWTP Stage 1 upgrade is completed and commissioned (currently anticipated in 2031).
Please see attached a set of provisions that Watercare are recommending for plan change precincts where either the bulk infrastructure is not yet in place, or the existing bulk infrastructure is at capacity.
We have since reviewed the capacity of the proposed wastewater network servicing option 1 and consider that there is capacity for the full 900 DUE anticipated to be developed within the plan change area. This assessment is as of today's date and will need to be reassessed at the resource consent stage.
Given the FDS is silent on the timing of the development of this future urban area, we would not oppose a plan change to rezone the land subject to precinct provisions that require consideration of the capacity of the bulk network at the time of RC application, and upon the clear expectation that new development proposals from the plan change area would be required to wait for the WWTP upgrade due 2031.

Ngā mihi,

Amber Taylor
Development Planning Lead | Major Developments
Kaihautū Mataamua Whakamahere Whanaketanga | Ngā Hanganga Matua

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4th April 2024

Dave Paul
Auckland Council
Dave.Paul@aucklandcouncil.govt.nz

Dear Dave,

Re: Ara Hills (Hall Farm) Private Plan Change

Thank you for sharing the lodged application for the Ara Hills (Hall Farm) Private Plan Change. We have reviewed the relevant documents and provide the following feedback.

Future Development Strategy 2023

Auckland Council's Future Development Strategy (FDS) identifies the plan change area as a Resource Consent Area, recognising that development could occur under the granted resource consent. The FDS does not include a date on when the expected live urban zoning, that may enable development over and above what has already been granted resource consent, is expected to occur. But given the timeframes for the surrounding future urban areas and infrastructure pre-requisites this is likely to be post 2050+. Watercare do not anticipate providing extra infrastructure for connection of this area until that time.

Wastewater servicing:

Wastewater Headworks

The plan change area will be serviced by the Army Bay Wastewater Treatment Plan (WWTP).

In recent years, growth within the Army Bay WWTP catchment area has progressed at a higher rate than was otherwise anticipated by Council's population projections and Watercare's wastewater planning for the catchment.

Based on the recent trend of increase in dry weather inflow to the WWTP, the existing WWTP is expected to reach its maximum capacity around 2028. When this occurs, all applications to connect new development to the wastewater network may be refused until the Stage 1 upgrade (currently anticipated to be completed by 2031) is completed.

Therefore, if the plan change is successful and applications to connect to Watercare's network are made after the WWTP reaches maximum capacity, but before the 2031 upgrade, development from the Plan Change area will be delayed.

On the other hand, if the Plan Change is successful and applications to connect to Watercare's network are made prior to the WWTP reaching capacity, then there will be an increased risk of other development occurring in the existing urban area being delayed.

Watercare notes that in servicing the existing urban area, applications to connect to its networks are approved on a first come first served basis.

Wastewater Networks

The applicant has proposed two separate options for the wastewater servicing of the 900 DUE[1] in the proposed plan change area. Watercare's comments on each option are outlined below. Of the two options, Watercare prefers Option 2 as this aligns with the long term wastewater servicing plan for the Ara Hills area.

Option 1:

Under this option the plan change area is serviced via a new 400mm PE pipe drilled under the motorway and connecting into the existing 450 PE pipe to the east of the motorway.

In section 6.3 of the Infrastructure Report the applicant states that in 2018 Watercare advised that the network east of the motorway had capacity for 800 DUE from this development. In the intervening years (2018 to 2024) there has been substantial development both north and south of Grand Drive, which will have used a significant proportion of the available capacity.

The applicant will need to establish the current capacity of the transmission system from the motorway crossing to the Orewa pumping station.

The Future Development Strategy for the future urban zone does not put a date on when the expected development will happen, but it is likely to be post 2050+. Watercare do not anticipate providing extra infrastructure for connection of this area until that time. Should further upgrades be required to service the proposed 900 DUE in the plan change area through this option, then an appropriate funding agreement should be established between the applicant and Watercare.

It should be noted that the wastewater demand calculations as submitted in the Infrastructure Report are not considered by Watercare to be correct.

Option 2:

Under this option the plan change area is serviced via a rising main and a gravity sewer connecting into the Milldale Branch Sewer tunnel prior to crossing the motorway. Watercare considers that there is sufficient capacity in the Milldale Branch Sewer tunnel for the 900 DUE proposed by the plan change.

The Future Development Strategy for the future urban zone does not put a date on when the expected development will happen, but it is likely to be post 2050+. Watercare do not anticipate providing infrastructure for connection of this area until that time. As a result of this the applicant would have to enter into an appropriate funding agreement to provide the network connection from the plan change area to the Milldale Branch Sewer.

[1] A Development Unit Equivalent (DUE) is the unit of demand used to calculate IGCs. For water supply, one DUE is 220 kilolitres of water use per year. For wastewater, one DUE is 209 kilolitres of wastewater discharge per year.

As stated above Watercare do not consider the wastewater demand calculations for the plan change area to be correct.

Water servicing:

Headworks

The plan change area will be serviced by the metropolitan water network which has sufficient capacity to service the plan change.

Networks

The bulk water network has sufficient capacity for the proposed 900 DUEs.

As mentioned in the plan change Infrastructure Report, the Applicant is required to construct a water reservoir within the plan change area to cater development in excess of 500 DUEs. This reservoir and the water supply to the reservoir shall be provided by the Applicant. Agreement shall be obtained from Watercare on the reservoir location, size and timing of providing the reservoir prior to further development proceeding.

Yours faithfully,

Amber Taylor

Development Planning Lead

Major Developments

Watercare Services Limited

APPENDIX D:

ENGINEERING DESIGN CALCULATIONS

CRANGCIVIL CONSULTING ENGINEERS

PROJECT : ARA HILLS STAGE 2
Job No. 1403

CLIENT: AVJ HOBSONVILLE PTY LTD
PROJECT: ARA HILLS - PRIVATE PLAN CHANGE
JOB NO.: 1403

Calculations By: RK Date: 22/07/25
Checked by: TH Date: 22/07/25

RAINGARDEN DESIGN

Catchment & Raingarden	Catchment Area (m^2)	Pervious Area (m^2)	Impervious Area (m2)		CN	Ia	Area km^2	Storage	24 - Rain	Depth	Volume	Pre - Post Volume	Mitigation Volume	Minimum infiltration, Ponding, Media				Design for Detention									
														Ponding (m^2)	Media (m^2)	Infiltration (m^2)		Length Ponding	Width Ponding	Height Ponding	Void Ponding	Length Media	Width Media	Height Media	Void Media	Length Drainage	Width Drainage	Height Drainage	Void Media
BD01	11,665	2333	9,332	Pre-development	74	5	0.009332	89.24	38.00	8.91	83.13	228.91	228.91	466.60	396.61	326.62		29.5	16	0.2	1	28.3	14.8	0.5	0.3	27.3	13.8	0.6	0.35
				Post-development	98	0	0.009332	5.18	38.00	33.44	312.05			Comply	Comply	Comply		$V_{(ponding)}$	94.40			$V_{(media)}$	62.83			$V_{(drainage)}$	79.12		
														YES	YES	YES		472	418.84	376.74		$V_{(detention)}$	236.34	Greater than Required Detention			YES		
BD 02	1,096	219	877	Pre-development	74	5	0.000877	89.24	38.00	8.91	7.81	21.51	21.51	43.84	37.26	30.69		13.5	5	0.2	1	12.3	3.8	0.5	0.3	11.3	2.8	0.6	0.35
				Post-development	98	0	0.000877	5.18	38.00	33.44	29.32			Comply	Comply	Comply		$V_{(ponding)}$	13.50			$V_{(media)}$	7.01			$V_{(drainage)}$	6.64		
														YES	YES	YES		67.5	46.74	31.64		$V_{(detention)}$	27.16	Greater than Required Detention			YES		
BD 03	1,617	323	1,294	Pre-development	74	5	0.001294	89.24	38.00	8.91	11.52	31.73	31.73	64.68	54.98	45.28		13	6.5	0.2	1	11.8	5.3	0.5	0.3	10.8	4.3	0.6	0.35
				Post-development	98	0	0.001294	5.18	38.00	33.44	43.26			Comply	Comply	Comply		$V_{(ponding)}$	16.90			$V_{(media)}$	9.38			$V_{(drainage)}$	9.75		
														YES	YES	YES		84.5	62.54	46.44		$V_{(detention)}$	36.03	Greater than Required Detention			YES		
BD 04	6,116	1223	4,893	Pre-development	74	5	0.004893	89.24	38.00	8.91	43.59	120.02	120.02	244.64	207.94	171.25		32.5	8	0.2	1	31.3	6.8	0.5	0.3	30.3	5.8	0.6	0.35
				Post-development	98	0	0.004893	5.18	38.00	33.44	163.61			Comply	Comply	Comply		$V_{(ponding)}$	52.00			$V_{(media)}$	31.93			$V_{(drainage)}$	36.91		
														YES	YES	YES		260	212.84	175.74		$V_{(detention)}$	120.83	Greater than Required Detention			YES		
BD 05	1,833	367	1,466	Pre-development	74	5	0.001466	89.24	38.00	8.91	13.06	35.97	35.97	73.32	62.32	51.32		10.5	8.5	0.2	1	9.3	7.3	0.5	0.3	8.3	6.3	0.6	0.35
				Post-development	98	0	0.001466	5.18	38.00	33.44	49.03			Comply	Comply	Comply		$V_{(ponding)}$	17.85			$V_{(media)}$	10.18			$V_{(drainage)}$	10.98		
														YES	YES	YES		89.25	67.89	52.29		$V_{(detention)}$	39.01	Greater than Required Detention			YES		
BD 06	2,659	532	2,127	Pre-development	74	5	0.002127	89.24	38.00	8.91	18.95	52.18	52.18	106.36	90.41	74.45		15.5	8	0.2	1	14.3	6.8	0.5	0.3	13.3	5.8	0.6	0.35
				Post-development	98	0	0.002127	5.18	38.00	33.44	71.13			Comply	Comply	Comply		$V_{(ponding)}$	24.80			$V_{(media)}$	14.59			$V_{(drainage)}$	16.20		
														YES	YES	YES		124	97.24	77.14		$V_{(detention)}$	55.59	Greater than Required Detention			YES		
BD 07	6,434	1287	5,147	Pre-development	74	5	0.005147	89.24	38.00	8.91	45.85	126.26	126.26	257.36	218.76	180.15		33.5	8	0.2	1	32.3	6.8	0.5	0.3	31.3	5.8	0.6	0.35
				Post-development	98	0	0.005147	5.18	38.00	33.44	172.11			Comply	Comply	Comply		$V_{(ponding)}$	53.60			$V_{(media)}$	32.95			$V_{(drainage)}$	38.12		
														YES	YES	YES		268	219.64	181.54		$V_{(detention)}$	124.67	Greater than Required Detention			NO		
BD 08	8,137	1627	6,510	Pre-development	74	5	0.006510	89.24	38.00	8.91	57.99	159.68	159.68	325.48	276.66	227.84		30	11	0.2	1	28.8	9.8	0.5	0.3	27.8	8.8	0.6	0.35
				Post-development	98	0	0.006510	5.18	38.00	33.44	217.67			Comply	Comply	Comply		$V_{(ponding)}$	66.00			$V_{(media)}$	42.34			$V_{(drainage)}$	51.37		
														YES	YES	YES		330	282.24	244.64		$V_{(detention)}$	159.71	Greater than Required Detention			YES		
BD 09	4,431	886	3,545	Pre-development	74	5	0.003545	89.24	38.00	8.91	31.58	86.95	86.95	177.24	150.65	124.07		26	7.5	0.2	1	24.8	6.3	0.5	0.3	23.8	5.3	0.6	0.35
				Post-development	98	0	0.003545	5.18	38.00	33.44	118.53			Comply	Comply	Comply		$V_{(ponding)}$	39.00			$V_{(media)}$	23.44			$V_{(drainage)}$	26.49		
														YES	YES	YES		195	156.24	126.14		$V_{(detention)}$	88.93	Greater than Required Detention			YES		
BD 10	11,367	2273	9,094	Pre-development	74	5	0.009094	89.24	38.00	8.91	81.01	223.07	223.07	454.68	386.48	318.28		36.5	12.5	0.2	1	35.3	11.3	0.5	0.3	34.3	10.3	0.6	0.35
				Post-development	98	0	0.009094	5.18	38.00	33.44	304.08			Comply	Comply	Comply		$V_{(ponding)}$	91.25			$V_{(media)}$	59.83			$V_{(drainage)}$	74.19		
														YES	YES	YES		456.25	398.89	353.29		$V_{(detention)}$	225.27	Greater than Required Detention			YES		
BD 11	8,873	1775	7,098	Pre-development	74	5	0.007098	89.24	38.00	8.91	63.24	174.12	174.12	354.92	301.68	248.44		27.5	13	0.2	1	26.3	11.8	0.5	0.3	25.3	10.8	0.6	0.35
				Post-development	98	0	0.007098	5.18	38.00	33.44	237.36			Comply	Comply	Comply		$V_{(ponding)}$	71.50			$V_{(media)}$	46.55			$V_{(drainage)}$	57.38		
														YES	YES	YES		357.5	310.34	273.24		$V_{(detention)}$	175.43	Greater than Required Detention			YES		

CRANGCIVIL
CONSULTING ENGINEERS

CLIENT	AVJ HOBSONVILLE PTY LTD	CALCS BY	TS
PROJECT	ARA HILLS - PRIVATE PLAN CHANGE	CHECKED BY	CR
JOB NO.	1403	DATE	14/04/2023

WETLAND 6

Pre Development

Catchment area: **4.62** ha

Cover	CN	Area (ha)	CN x Area
Grass Paddocks	74	4.62	341.88
Bush Areas	70	0.00	0.00
Impermeable Areas	98	0.00	0.00
	Total	4.62	341.88
		95th %ile	
	CN	74.0	
	Ia (mm)	5.0	
	C	1	
	L (km)	0.42	
	S_c (m/m)	0.110	
	t_c (hrs)	0.21	
	t_p (hrs)	0.14	
	S (mm)	89.2	
	P_{24} (mm)	38	
	c*	0.14	
	q*	0.041	
	q_p (m^3/s)	0.072	
	Q_{24} (mm)	8.9	
	V_{24} (m^3)	412	

	95th %ile
$V_{24, pre}$ (m^3)	412
$q_{p, pre}$ (m^3/s)	0.072

Post Development

Catchment area: **4.62** ha

Cover	CN	Area (ha)	CN x Area	
Urban lawns	74	1.62	119.66	*35%*
	70	0.00	0.00	
Impermeable Areas	98	3.00	294.29	*65%*
	Total	4.62	413.95	
		95th %ile		
	CN	89.6		
	Ia (mm)	0.0		
	C	0.6		
	L (km)	0.34		
	S_c (m/m)	0.110		
	t_c (hrs)	0.17		
	t_p (hrs)	0.11		
	S (mm)	29.5		
	P_{24} (mm)	38		
	c*	0.39		
	q*	0.1		
	q_p (m^3/s)	0.176		
	Q_{24} (mm)	21.4		
	V_{24} (m^3)	989		

	95th %ile
$V_{24, post}$ (m^3)	989
$q_{p, post}$ (m^3/s)	0.176

Mitigation Volume (Post-Pre)	577	m3
PWA	192	m2

WETLAND 7

Pre Development

Catchment area: **4.72** ha

Cover	CN	Area (ha)	CN x Area
Grass Paddocks	74	4.72	349.28
Bush Areas	70	0.00	0.00
Impermeable Areas	98	0.00	0.00
	Total	4.72	349.28
		95th %ile	
	CN	74.0	
	Ia (mm)	5.0	
	C	1	
	L (km)	1.65	
	S_c (m/m)	0.187	
	t_c (hrs)	0.43	
	t_p (hrs)	0.29	
	S (mm)	89.2	
	P_{24} (mm)	38	
	c*	0.14	
	q*	0.04	
	q_p (m^3/s)	0.072	
	Q_{24} (mm)	8.9	
	V_{24} (m^3)	420	

	95th %ile
$V_{24, pre}$ (m^3)	420
$q_{p, pre}$ (m^3/s)	0.072

Post Development

Catchment area: **4.72** ha

Cover	CN	Area (ha)	CN x Area	
Urban lawns	74	1.65	122.25	*35%*
Bush Areas	70	0.00	0.00	
Impermeable Areas	98	3.07	300.66	*65%*
	Total	4.72	422.91	
		95th %ile		
	CN	89.6		
	Ia (mm)	0		
	C	0.6		
	L (km)	0.55		
	S_c (m/m)	0.098		
	t_c (hrs)	0.17		
	t_p (hrs)	0.11		
	S (mm)	29.5		
	P_{24} (mm)	38		
	c*	0.39		
	q*	0.1		
	q_p (m^3/s)	0.179		
	Q_{24} (mm)	21.4		
	V_{24} (m^3)	1010		

	95th %ile
$V_{24, post}$ (m^3)	1010
$q_{p, post}$ (m^3/s)	0.179

Mitigation Volume (Post-Pre)	590	m3
PWA	197	m2

APPENDIX E:

AIREY CONSULTANTS WATER SUPPLY REPORT

M E M O R A N D U M

TO: Carolyn Powles

CC: Teresa Scott

FROM: Jing Qi

RE: HALL FARM WEST, OREWA – WATER SUPPLY

DATE: January 2019

This memorandum report summarizes the findings after analysing the current design for the proposed Orewa Hall Farm West development's network pressures and flows.

The memorandum describes the EPANET water supply network modelling, the results and findings.

DESIGN CRITERIA

Water supply demands and design criteria taken from the *Watercare Services Limited Water and Wastewater Code of Practice for Land Development and Subdivision 2015, Section 6 – Water Supply are listed as below:*

Section 6.3.5.6 Minimum water demand states:

The minimum peak domestic demand shall be specified by Watercare, or:
(a) ***Daily consumption*** *of 250 L/p/day;*
(b) Peaking factor of up to 5;
(c) Firefighting demands as specified in SNZ PAS 4509;
(d) The network shall be designed to maintain appropriate nominated pressures for both peak demand (average daily demand in L/s x peaking factor) and firefighting demand scenarios.

Section 6.3.5.3 Peak flows states:

Peak Day Demand *(over a 12-month period) = Average Day Demand x PF:*
(a) PF = 1.5 for populations over 10,000;
(b) PF = 2 for populations below 2,000.

Peak Hourly Demand *= Average Hourly Demand (on peak day) x PF (over a 24-hour period):*
(a) PF = 2 for populations over 10,000;
(b) PF = 5 for populations below 2,000.

Section 6.3.5.10 **Design pressure** states:

(a) Unless otherwise specified by Watercare, the design pressure shall be between 250kPa and 800kPa (25 m to 80 m).

Section 6.3.5.4 **Head losses** states:

The head loss through the local network pipes and fittings at the design flow rate shall be less than:
(a) 5 m/km for DN ≤150;
(b) 3 m/km for DN >150.

The Hall Farm West Orewa development is assumed mostly residential and unless stated otherwise, an assumption of 4 persons per lot has been made for population totals.

All pipes are to be PE100 SDR13.6. Hazen Williams Coefficient has been selected as 140 for all the proposed pipes.

Firefighting Water supply classification for the proposed development is FW2 according to *New Zealand Fire Service Firefighting Water Supplies Code of Practice, SNZ PAS 4509: 2008*. To meet the requirement, 12.5 l/s of water flow should be available within a distance of 135m and another 12.5 l/s of water flow should be available within a distance of 270m. Maximum number of fire hydrants to provide flow is 2 and residual pressure should remain above 10m at all times. These criteria have all been taken into consideration during modelling process.

SCENARIOS MODELLED

Four Scenarios were modelled in this analysis:

Scenario1:

Scenario one proposes to use an existing 300mm J-Route pipeline at the intersection of Grand Drive and Arran Drive to service the entire new development. A Previous assessment on the local Orewa network has been carried out by Water Planning team from Hal Consulting. Taking into account both the current and proposed demand, the 300mm pipe at the point of connection delivers an HGL of between 85m to 95m. 85m head has been used in the model at the connection point.

Scenario 2:

For Scenario two, the existing 300mm J-Route pipeline will still service southern part of the proposed development. Eastern part will include a booster delivers 20m head at a flow rate of 30 l/s to increase pressure. There will also be a rising main to pump water from the south to a proposed reservoir at northern side of the proposed development on the hill at 115m elevation. The reservoir will service the northern side through gravity.

Scenario 3:

Similar to scenario one, this option also proposes to use the same existing 300mm J-Route pipeline at the intersection of Grand Drive and Arran Drive to service the entire new development.
Apart from the confirmed proposed 575 lots in scenario one, there might be another 275 lots to be added to the development in the future. In total, there will be 800 lots.
Scenario three analyses the feasibility of connecting the total 800 lots into the same existing 300mm pipe across the bridge. As the location for those 275 future lots are not confirmed. A total peak flow rate for 275 lots has been added to a node within the network, which has the lowest pressure. This is a conservative analysis.

Scenario 4:

Similar to scenario two, this option still uses the same existing 300mm J-Route pipeline to service southern part of the proposed development. It will include the same booster and reservoir to service eastern side and northern side as scenario two.
Apart from the confirmed proposed 575 lots in scenario two, there might be another 275 lots to be added to the development in the future. The location of the future 275 lots has not been confirmed. As the network was divide into three parts, a total peak flow rate for 275 lots has been added to each of the three parts to make sure the proposed network has the capacity to service a total 800 lots regardless the location for the future lots. Scenario four analyses the feasibility of connecting the total 800 lots into the same proposed network as scenario two.

MODEL SETUP

The proposed development was analysed with four Scenarios. Water demand is summarized below.

Table 1 Demand Summary for Scenario One and Scenario Two

Development	Number of Lots	Persons	Average Day Demand (m^3/day)	Peak Day Demand (m^3/day)	Peak Hourly Demand (L/s)
Proposed Development	575	2300	575	1150	66.55

Table 2 Demand Summary for Scenario Three and Scenario Four

Development	Number of Lots	Persons	Average Day Demand (m^3/day)	Peak Day Demand (m^3/day)	Peak Hourly Demand (L/s)
Proposed Development	800	3200	800	1600	92.59

The elevation for each lot was obtained from the designed finished ground level information. The water supply network was assumed to be 1m below ground level at each lot.

Firefighting flow and pressure have been tested against relevant standard listed above. For scenario one and scenario three, locations with lowest pressure have been chosen to test fire flow (shown on the Figure 1 below). Scenario two and scenario four are divided into 3 separate networks, a few trial at different locations with low pressure have been carried out to test firefighting pressure and flow. The fire flows has been taken as 12.5L/s from the SNZ PAS 4509:2008 New Zealand Fire Service Firefighting Water Supplies Code of Practice.

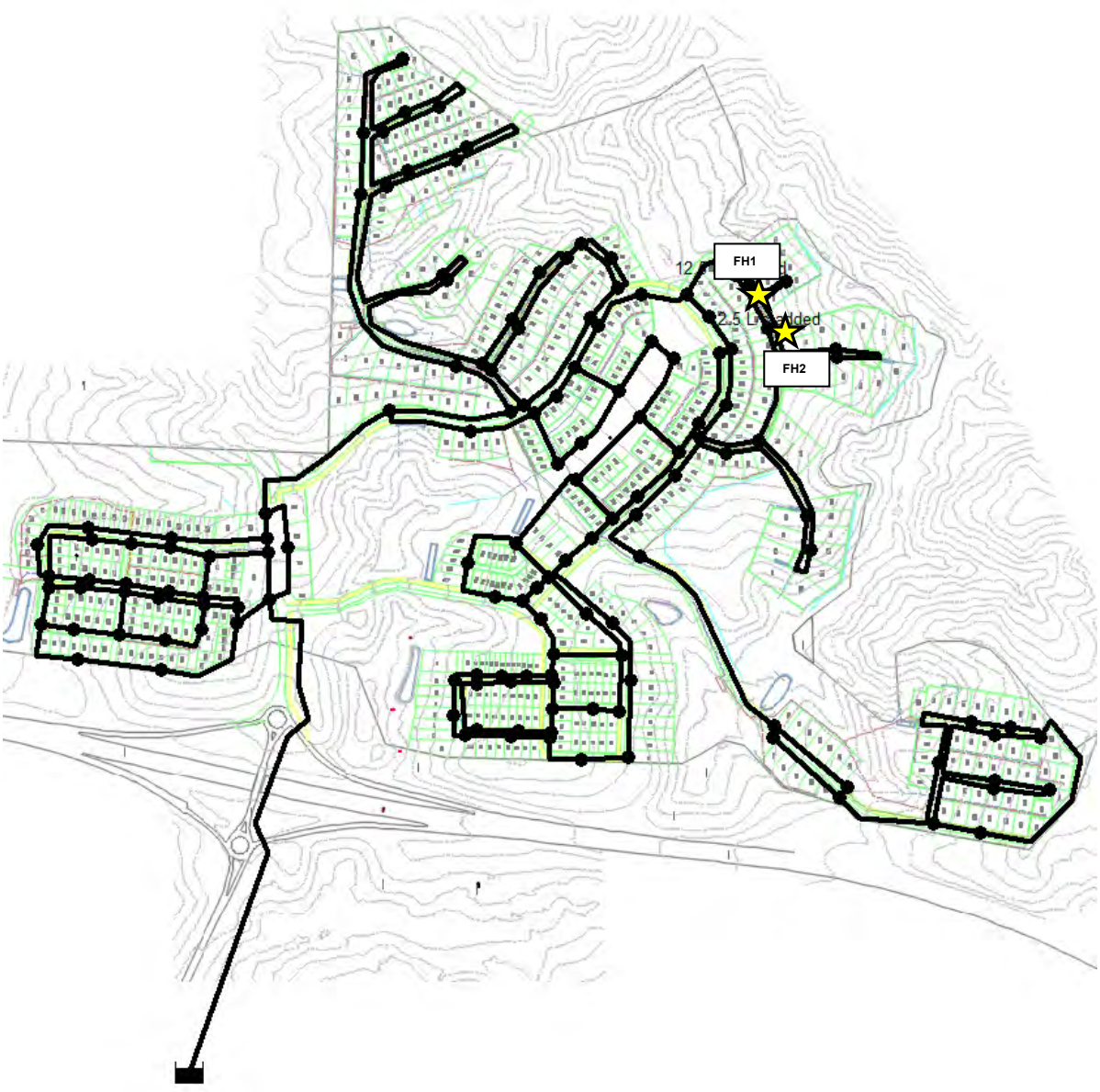

Figure 1 Fire Hydrant Location

RESULTS

Scenario 1 – Entire site Connects to 300mm J-Route pipeline across bridge, 575 Lots

Junction Pressure

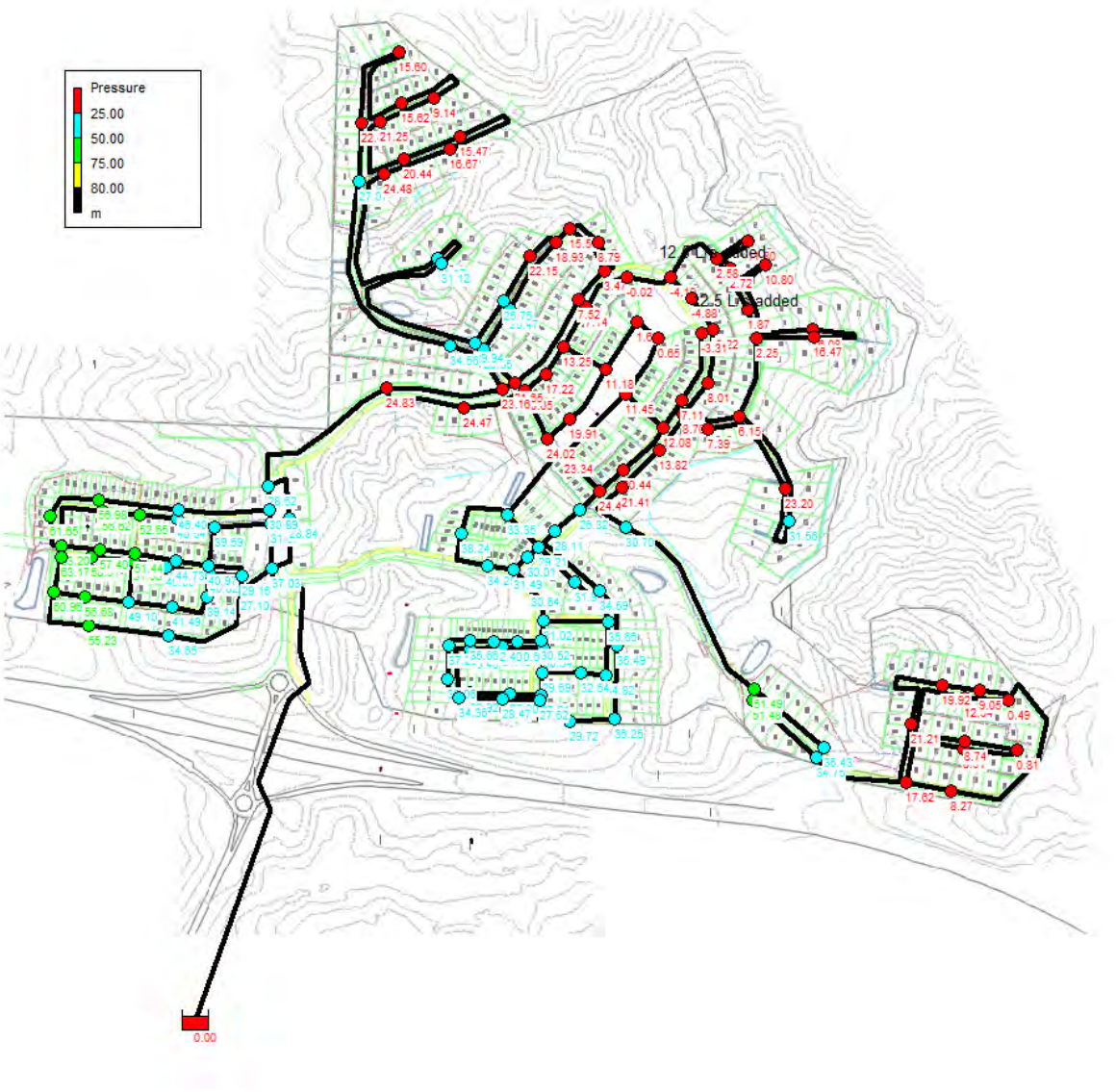

Figure 2 Scenario 1 Pressure at Nodes

Nodes in red are the ones below 25m pressure at nodes. There is not node with pressure higher than 80m.

Result shows large areas within eastern and northern side of the proposed development do not have adequate water pressure.

Pipe Results

Figure 3 Scenario 1 Unit Headloss

Pipes in purple are the ones with unit headlosses more than 3m/km. There is no pipe with a unit headloss more than 5m/km. Unit headlosses for this scenario meets relevant Council requirements listed above.

Scenario 2 – Only South part connects to 300mm J-Route pipeline across bridge, 575 Lots

Junction Pressure

Figure 4 Scenario 2 Pressure at Nodes

All proposed nodes have adequate pressure for this scenario, which is between 25m and 80m. Fire hydrant have also been added to a few locations as different trial runs within the area and all the trials have residual pressure more than 10m.

Pipe Results

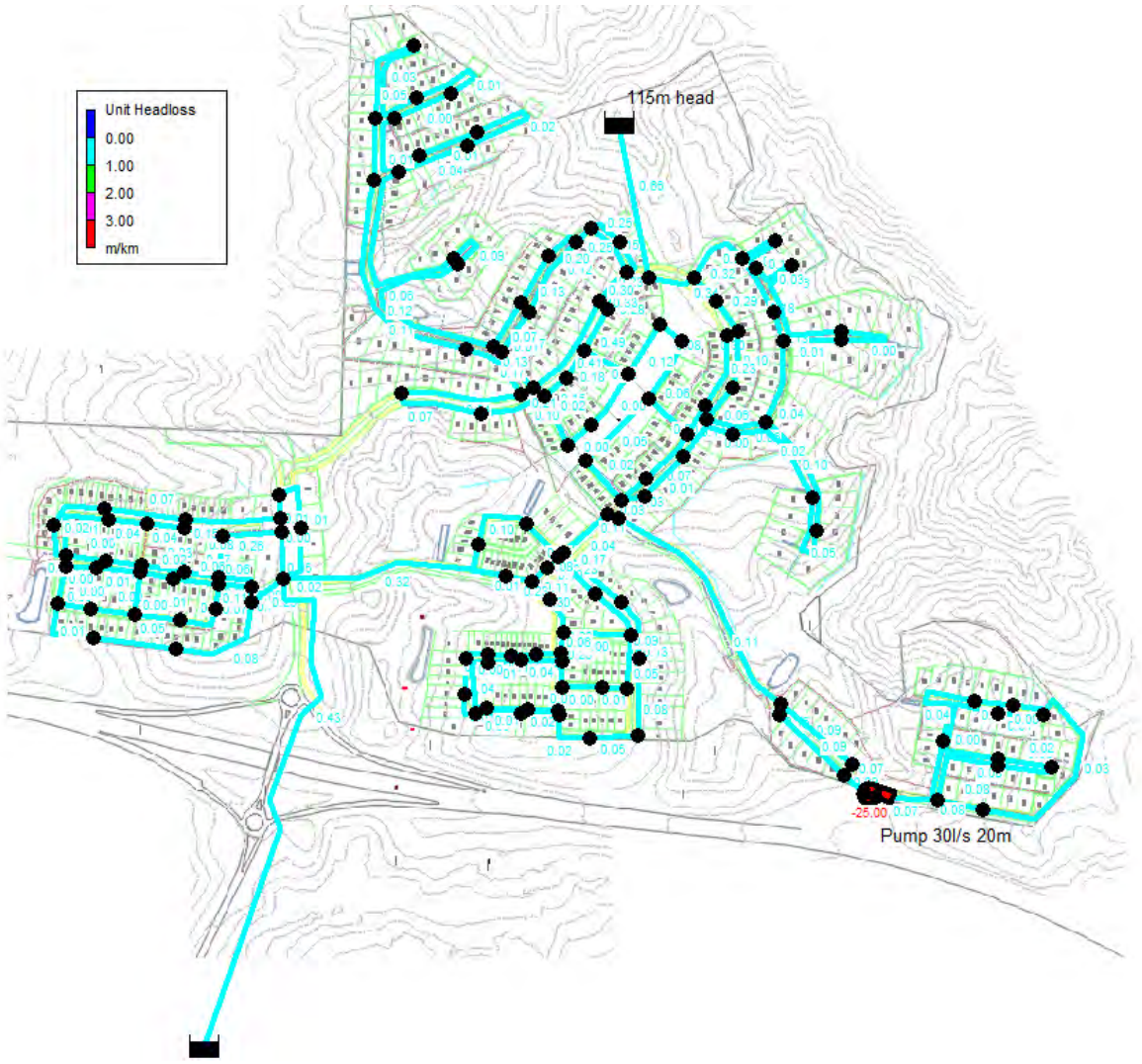

Figure 5 Scenario 2 Unit Headloss

Pipe unit headlosses for this scenario are all below 1 m/km, which meet relevant Council requirements listed above.

Junction Pressure

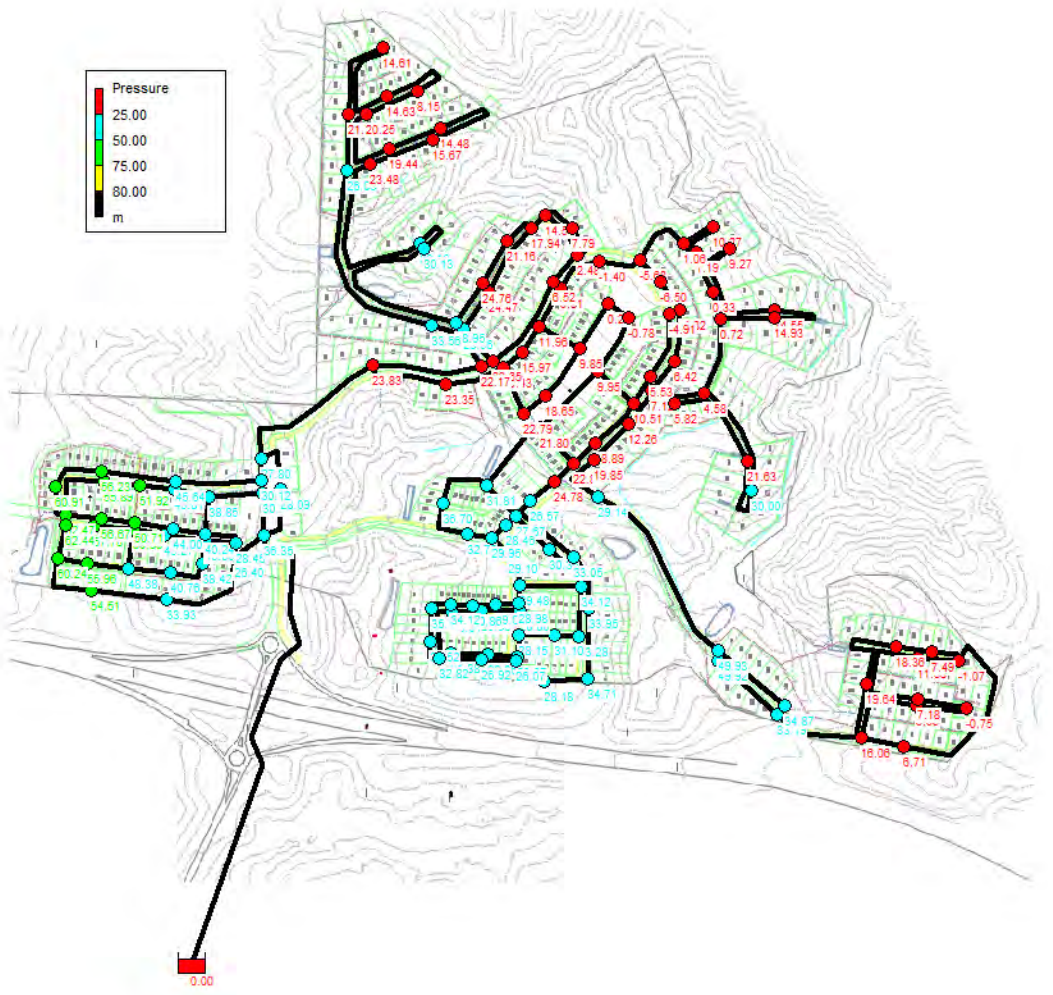

Figure 6 Scenario 3 Pressure at Nodes

Nodes in red are the ones below 25m pressure at nodes. There is not node with pressure higher than 80m.

Similar to scenario one, large areas within eastern and northern side of the proposed development do not have adequate water pressure.

Pipe Results

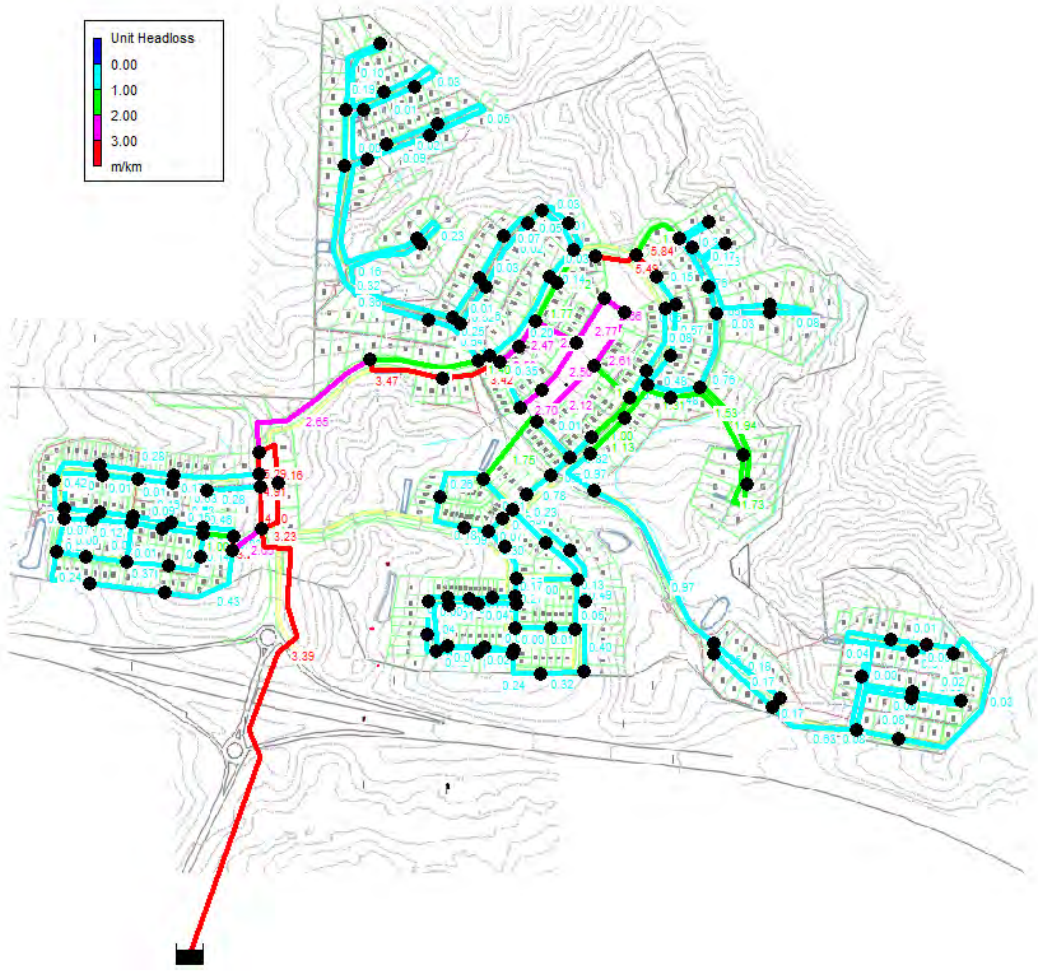

Figure 7 Scenario 3 Unit Headloss

Pipes in red are the ones with unit headlosses more than 3m/km. There is no pipe with a unit headloss more than 5m/km. Unit headlosses for this scenario meet relevant Council requirements listed above.

Scenario 4 – Only South part connects to 300mm J-Route pipeline across bridge, 800 Lots

Junction Pressure

Figure 8 Scenario 4 Pressure at Nodes

All proposed nodes have adequate pressure for this scenario, which is between 25m and 80m. Fire hydrant have also been added to a few locations as different trial runs within the area and all the trials have residual pressure more than 10m.

Pipe Results

Figure 9 Scenario 4 Unit Headloss

Pipe unit headlosses for this scenario meet relevant Council requirements listed above. As the proposed 225 future lots total flow have been added in the nodes with lowest pressures, the location was assumed. Some of the local network may needs to be upgraded based on real location of the future 225 lots to reduce pipe unit headloss.

CONCLUSIONS

The existing 300mm J-Route pipeline at the intersection of Grand Drive and Arran can provide adequate operating pressures with acceptable pipe headloss to southern part of the proposed development. Eastern and northern part of the proposed development willl have pressures lower than Council requirement. This would need to be improved by adding a booster at the eastern part and a proposed reservoir on the hill at northern side. The proposed network can also provide required pressure for future 225 lots. Part of the local network may need to be upgraded to reduce pipe unit headloss based on the real location of the future lots.