STORMWATER MANAGEMENT PLAN

DELMORE, ŌREWA

Vineway Ltd

MCKENZIE & CO.

DOCUMENT CONTROL RECORD

PROJECT: DELMORE, ŌREWA

CLIENT: VINEWAY LTD

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

Revision	Date	Originator	Checker	Approver	Description
-	09/12/24	[redacted]	[redacted]		DRAFT
A	17/01/25	[redacted]			DRAFT
B	11/02/2025	[redacted]			DRAFT

Contents

Appendices

A STORMWATER MANAGEMENT TOOLBOX ASSESSMENT

B DRAWINGS

1. EXISTING SITE APPRAISAL

1.1 Summary of Data Sources and Dates

The following data sources have been used in preparing this stormwater management plan:

Table 1 - Summary of Data Sources

Existing Site Appraisal Item	Source and Date of Data Used
Topography	LiDAR, Auckland Council, 2016-2018 Mckenzie & Co Topographic Survey, November 2024.
Geotechnical	Riley Geotechnical Report, 2024.
Existing Stormwater Network	Auckland Council Geomaps, 2023
Existing Hydrological Features	Auckland Council Geomaps, 2023 Ōrewa West ICMP 2011 & 2014 Addendum
Stream, River, Coastal Erosion	Auckland Council Geomaps, 2023 Ōrewa West ICMP 2011 & 2014 Addendum
Flooding and Flow paths	Auckland Council Geomaps, 2023 Ōrewa West ICMP 2011 & 2014 Addendum
Coastal Inundation	Auckland Council Geomaps, 2023 Ōrewa West ICMP 2011 & 2014 Addendum
Ecological / Environmental Areas	Auckland Council AUP Maps, 2023
Cultural and Heritage Sites	Auckland Council AUP Maps, 2023
Contaminated Land	Auckland Council Geomaps, 2023

Note from Auckland Council Geomaps- Adopting official height standard NZVD2016

From 1 July 2024, Auckland Council adopts the official height standard for New Zealand called Vertical Datum 2016 (NZVD2016). The geographical datasets containing height information (e.g. Contours) will be updated to NZVD2016. From 1 July 2024, the GeoMaps Data Extract Tool will be generating the updated Contours in the new standard NZVD2016.

1.2 Location and General Information

Table 2 - Site Location and General Information

Existing Site Element

Site Address	53A, 53B & 55 Russell Road, 88, 130 & 132 Upper Ōrewa Rd. Location of the site is shown in Figure 1.
Legal Description	Lot 1 DP 336616 Lot 2 DP 497022 Lot 1 DP 497022 Lot 2 DP 418770 Lot 1 DP 153477 Lot 2 DP 153477
Current Land Use	The site is currently open pasture and is being used for farming. Refer to Figure 2. NZRLI capability is listed as predominantly Arable with moderate to severe limitations (ACGeomaps). It is zoned Future Urban, Refer to Figure 3.
Current Building Coverage	Existing building coverage on the site includes existing dwellings and ancillary buildings and accesses used for farming. Refer to Figure 2Error! Reference source not found.
Historical Land Use	A review of Retrolens historic aerial photographs shows that land has been used for farming (grazing) as far back as 1940.

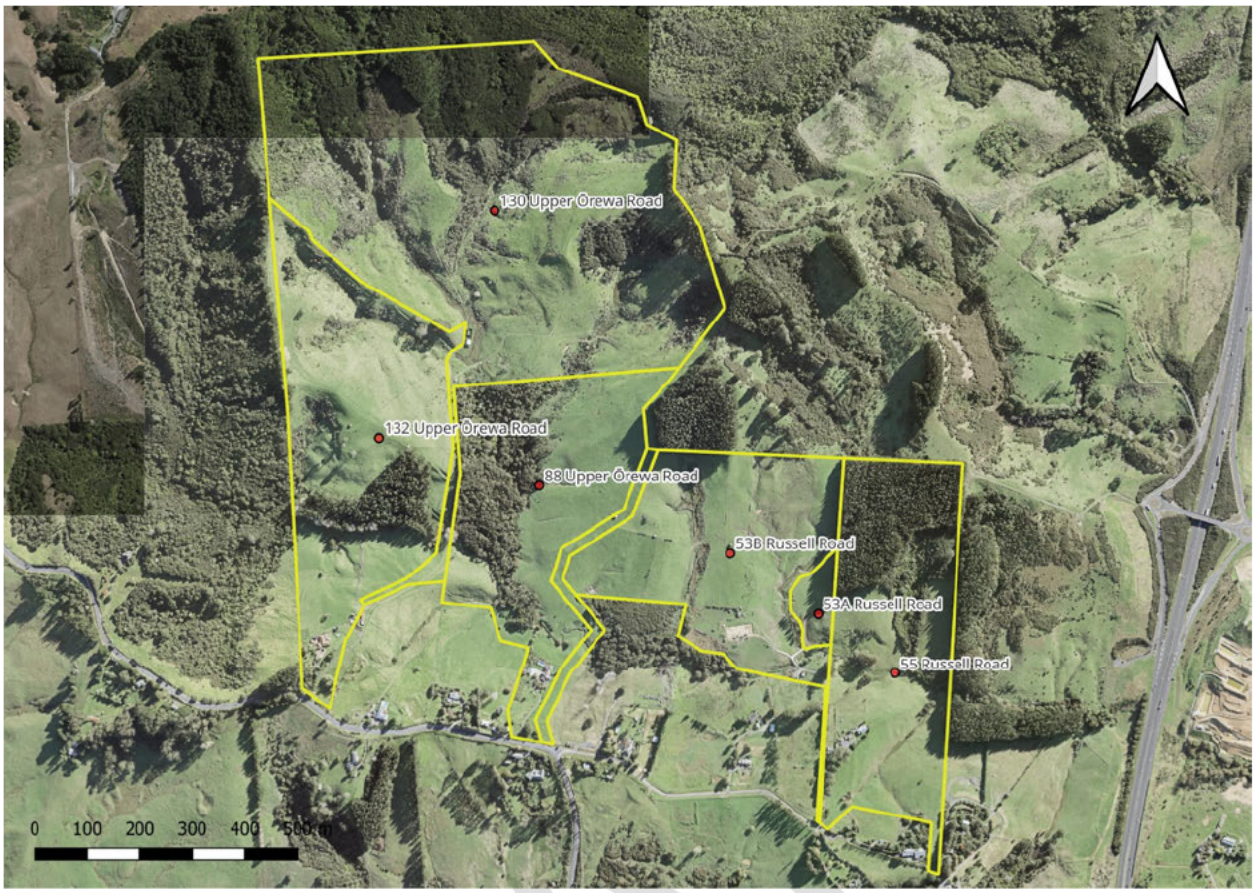


Figure 1 – Site Location and area covered by this SMP

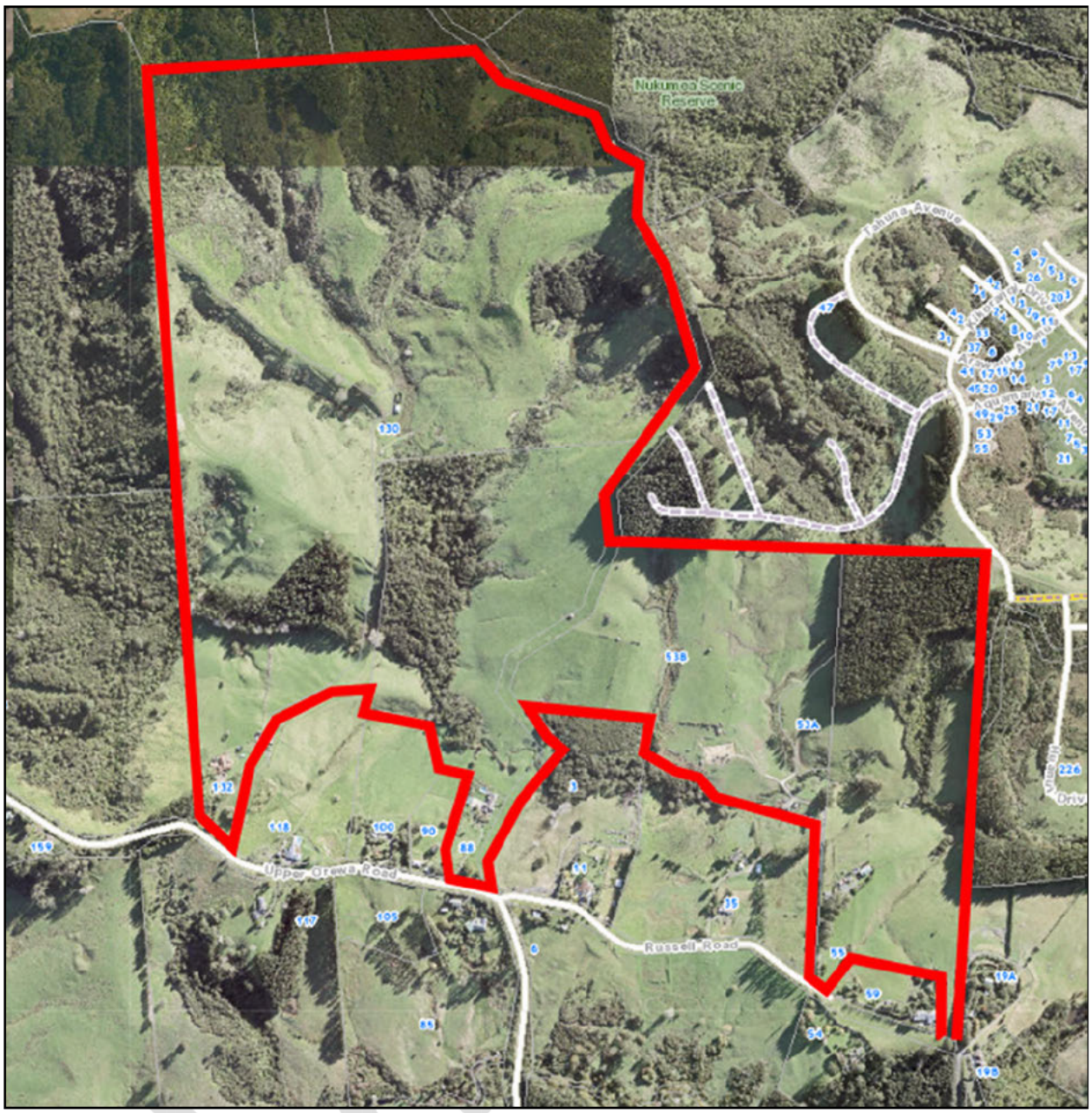


Figure 2 – Current Site Use and Building Coverage (Source – Auckland Council Geomaps)

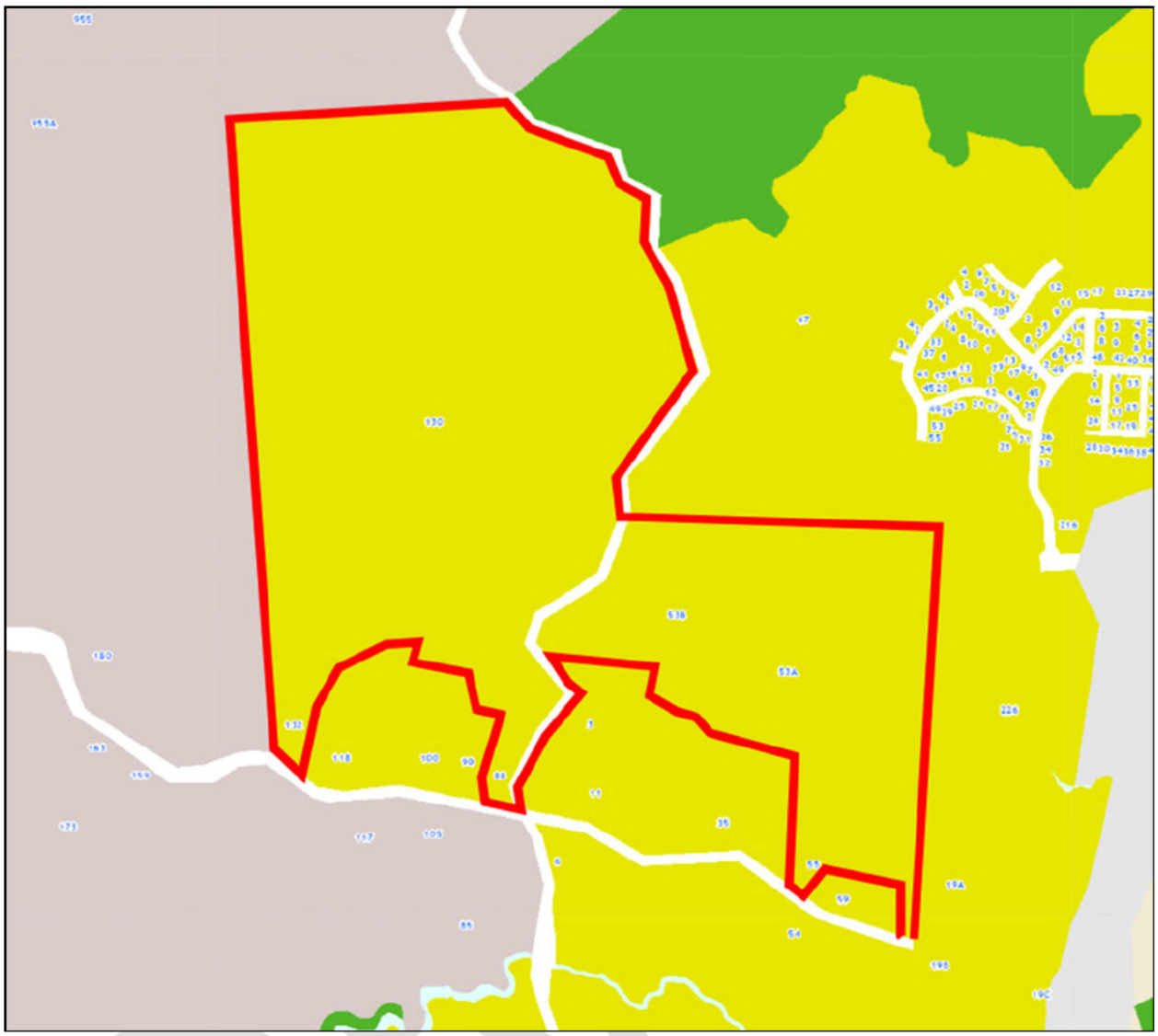


Figure 3 - Existing Land Use – Future Urban (Source - Auckland Council Geomaps)

1.3 Topography

The site is generally characterised by is well defined gullies, with an undulating series of steep sided hills with gullies which drain to well-defined streams.

The contour of the site generally grades towards the East.

Heights range from 95m RL to 10m RL. Ground slopes range from 1V:2H in the hillsides to slopes less than 5% at the lower gully areas. A major OLFP runs West to East through the southern part of the site.

Refer to Figure 4 for site topography plan and Figure 5 for the existing site slopes.

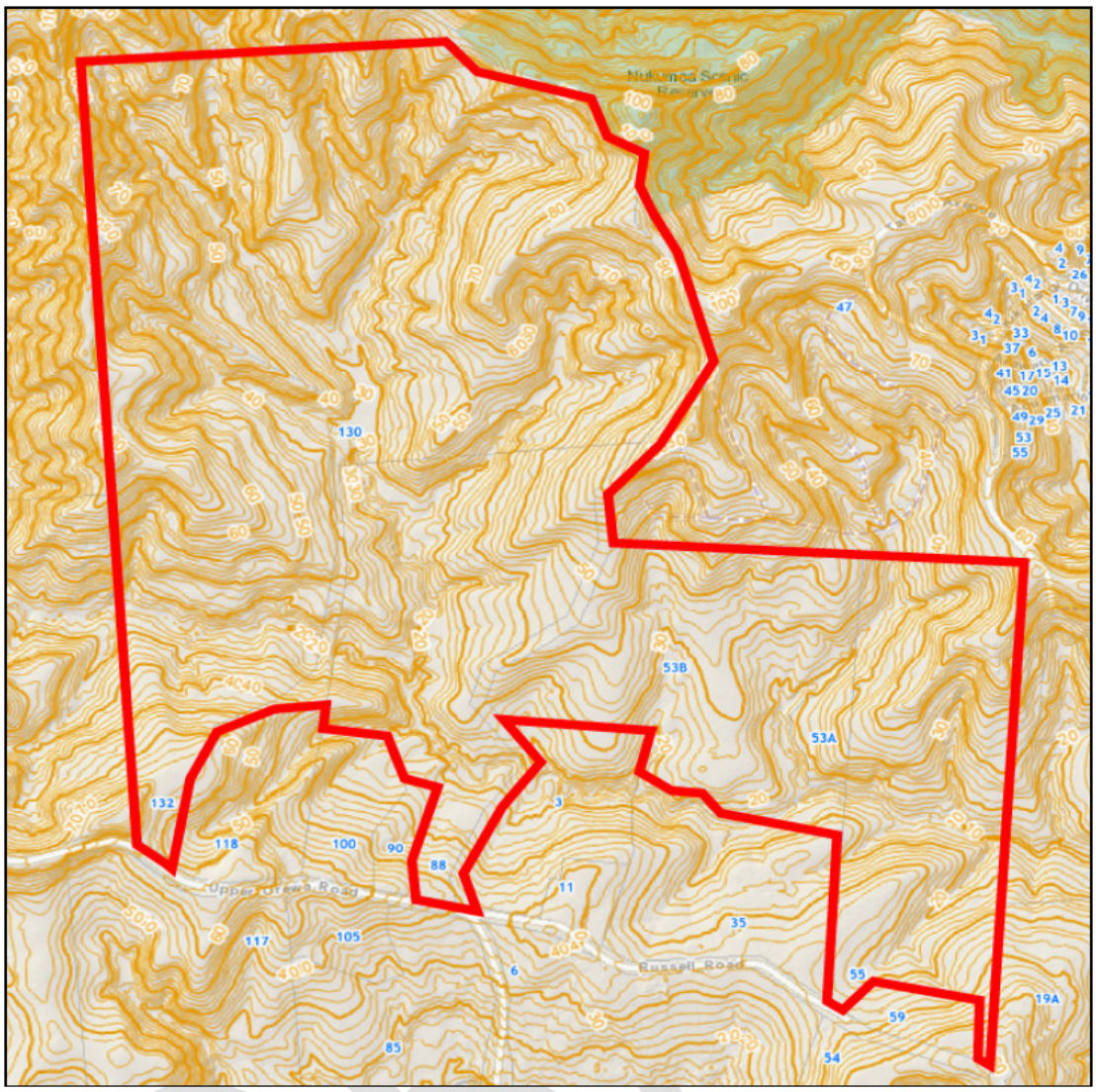


Figure 4 - Site Topography (Source - Auckland Council Geomaps)

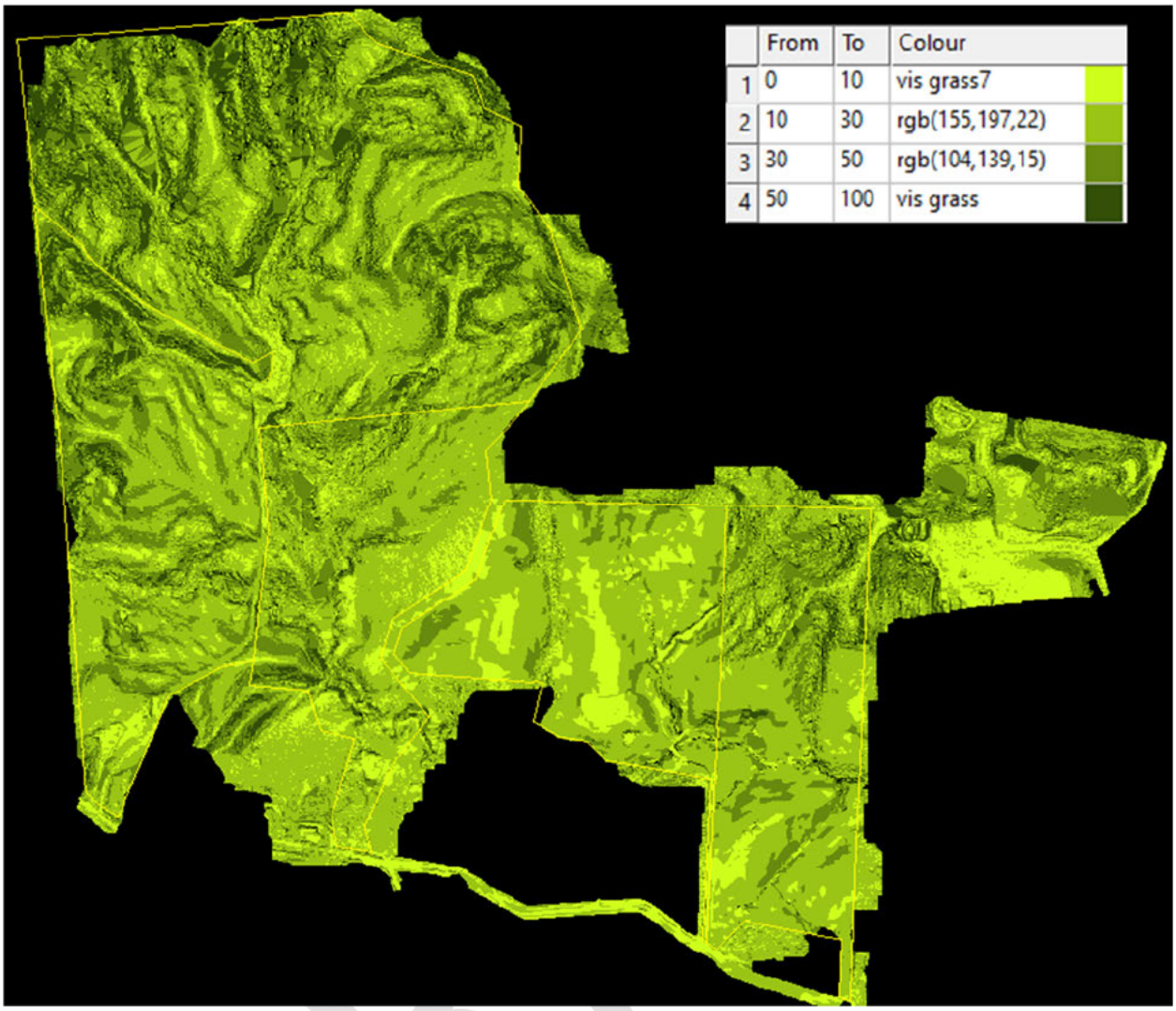


Figure 5 -Site Ground Slopes

1.4 Geotechnical

A geotechnical assessment has been undertaken by Riley Consultants[1]. A summary of the site geology is as follows – "findings from a review of the 1:250,000 GNS Online Geological Map, the site is underlain by the following geological units:

- Northland Allochthon (Hukerenui Mudstone) – underlying the central/eastern portions of the site (central part of 53B Russell Road).
- East Coast Bays Formations – underlying most of the site.
- Pakiri Formation – underlying the northern part of the site.

The Waitemata Group deposits, represented as East Coast Bays Formation (ECBF) and Pakiri Formation (PF) materials, are sedimentary materials. The most widespread geological unit is the Miocene-age Waitemata Group that underlies the materials of the Northland Allochthon where present. The ECBF is described as comprising alternating sandstone and mudstone with variable volcanic content and interbedded volcaniclastic grit. The regional dip of the ECBF within the site is inferred to be 30° to the north-west. The Pakiri Formation comprises alternating thick bedded, volcanic rich, graded sandstone, and siltstone. The materials of the Northland Allochthon are older materials that have been thrust over the younger ECBF and PF materials.

The Northland Allochthon (NA) materials, mapped as Hukerenui Mudstone. These materials are typically described as sheared mudstone and are often red, green and grey in colour. Tauranga Group Alluvium is also mapped as being present to the immediate south of the site. Based on site stratigraphy and our experience with neighbouring sites, we consider that alluvial materials are likely to be present in the vicinity of waterways and gully inverts within the lower lying parts of the site. Tauranga Group generally comprises silts and sands, with the potential for localised peat lenses. These materials have generally been subjected to pre-consolidation; however, they may contain localised areas of very soft ground.

Key recommendations in relation to stormwater management are contained in section 5.8 of the report, which notes that all stormwater discharges should be piped to suitable outfall locations, such as gully bases, ponds and creeks etc.

The report also notes that stormwater soakage into Northland Allochthon soils is not recommended due to potential effects on the underlying rock mass and local stability.

Figure 6 shows the GNS map of area.

[1] Geotechnical Report, Riley Consultants, 2025

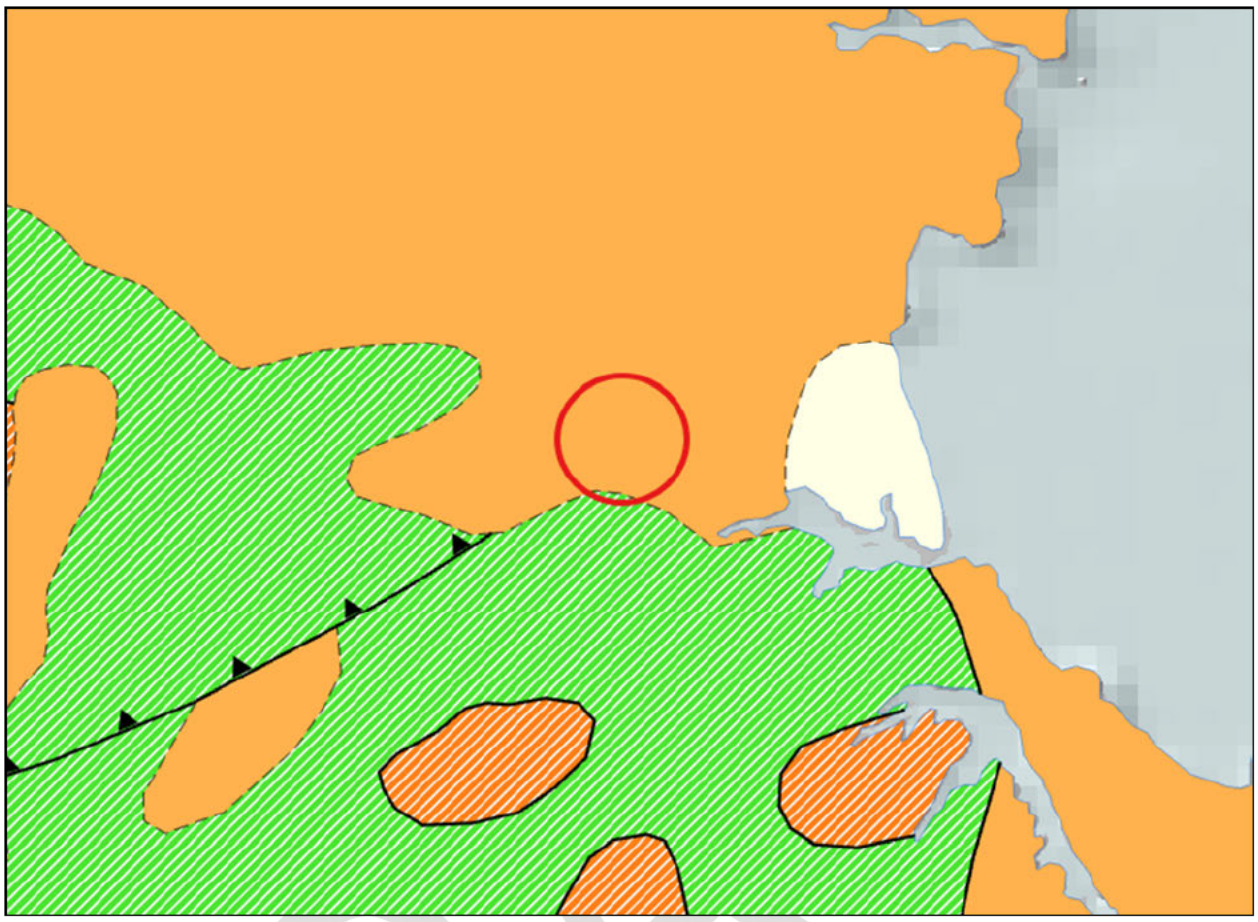


Figure 6 - GNS map of area

1.5 Existing Drainage Features and Stormwater Infrastructure

Auckland Council Geomaps (layer "Rivers and permanent streams") shows modelled overland flowpaths and streams inside the site boundaries (Refer Figure 7). All watercourses within the site have also been classified and mapped by Viridis Consultants[2], according to the definitions within the AUP-OP as either permanent, intermittent, ephemeral, or artificial drains.

No public stormwater infrastructure is contained within the site, however some private farm culverts crossing the streams in several locations are present. Several natural inland wetlands have also been documented. The stormwater within the site discharges to the existing streams and exits the subject site in the easterly direction.

[2] Delmore Fast Track Application – Ecology Report – Viridis 2025

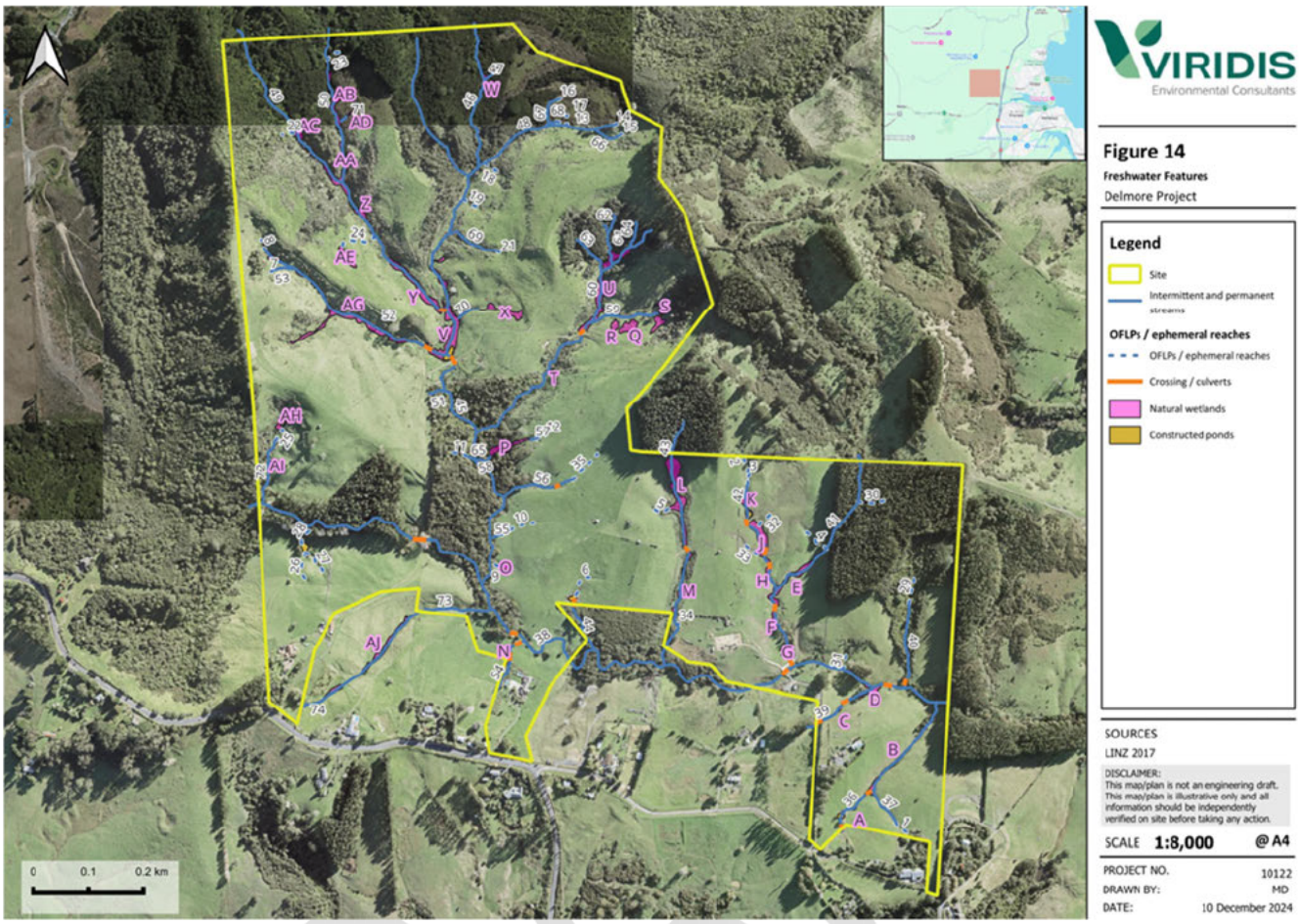


Figure 7 – Watercourses and natural wetlands mapped by Viridis

The site sits within a contributing catchment size of 266.86 ha (Refer Figure 8) (measured using the Digital Elevation Model 1m grid). Note the contributing catchment size is stated as 275 ha in the Ōrewa West ICMP 2011.

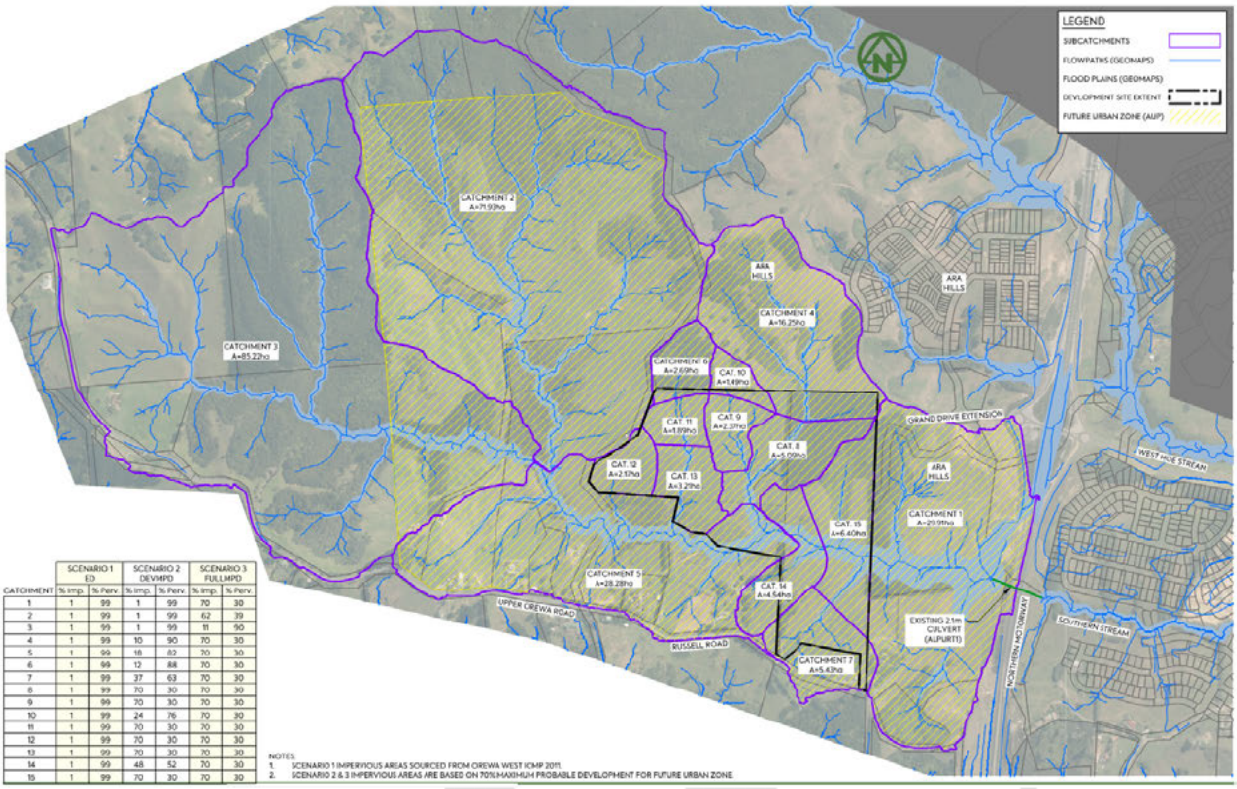
The contributing catchment is comprised of five subcatchments (refer Appendix # for catchment plan 470).

Two large subcatchments (catchment 2 and 3), 157ha located west/Northwest of the development site feed into Streams 31 & 38through the subject site.

The remaining catchments within northern portion of the subject site (catchments 8, 9, 11 12, part-of 6, 10, 14 and 15) drain south toward the main overland flow path running through the site, then discharges to the "main overland flow path" flowing in the easterly direction.

The site's southern boundary straddles several catchments and is bounded by Upper Ōrewa Road/Russel Road. Catchments 5, 7 and part of catchment 14 drain toward the "main overland flow path" which discharges to the east through the subject site.

The land cover throughout all subcatchments is predominantly pasture with occasional farm houses and a small number of small outbuildings. Three covenanted bush areas cover some stream areas. A pine plantation exists in the northeast area of the site, which will be required to be removed to enable the construction of the development. .



CATCHMENT	SCENARIO 1 ED % Imp.	SCENARIO 1 ED % Perv.	SCENARIO 2 DEVMPD % Imp.	SCENARIO 2 DEVMPD % Perv.	SCENARIO 3 FULLMPD % Imp.	SCENARIO 3 FULLMPD % Perv.
1	1	99	1	99	70	30
2	1	99	1	99	62	39
3	1	99	1	99	11	90
4	1	99	10	90	70	30
5	1	99	18	82	70	30
6	1	99	12	88	70	30
7	1	99	37	63	70	30
8	1	99	70	30	70	30
9	1	99	70	30	70	30
10	1	99	24	76	70	30
11	1	99	70	30	70	30
12	1	99	70	30	70	30
13	1	99	70	30	70	30
14	1	99	48	52	70	30
15	1	99	70	30	70	30

NOTES:
1. SCENARIO 1 IMPERVIOUS AREAS SOURCED FROM OREWA WEST ICMP 2011.
2. SCENARIO 2 & 3 IMPERVIOUS AREAS ARE BASED ON 70% MAXIMUM PROBABLE DEVELOPMENT FOR FUTURE URBAN ZONE

Figure 8 – Sub-catchment arrangement

1.6 Receiving Environment

Stream 31 (refer to Figure 7 above) flows through the site to the East, and eventually discharges under the northern motorway through a culvert, and out to the upper reaches of the Ōrewa Estuary. Refer Figure 9.

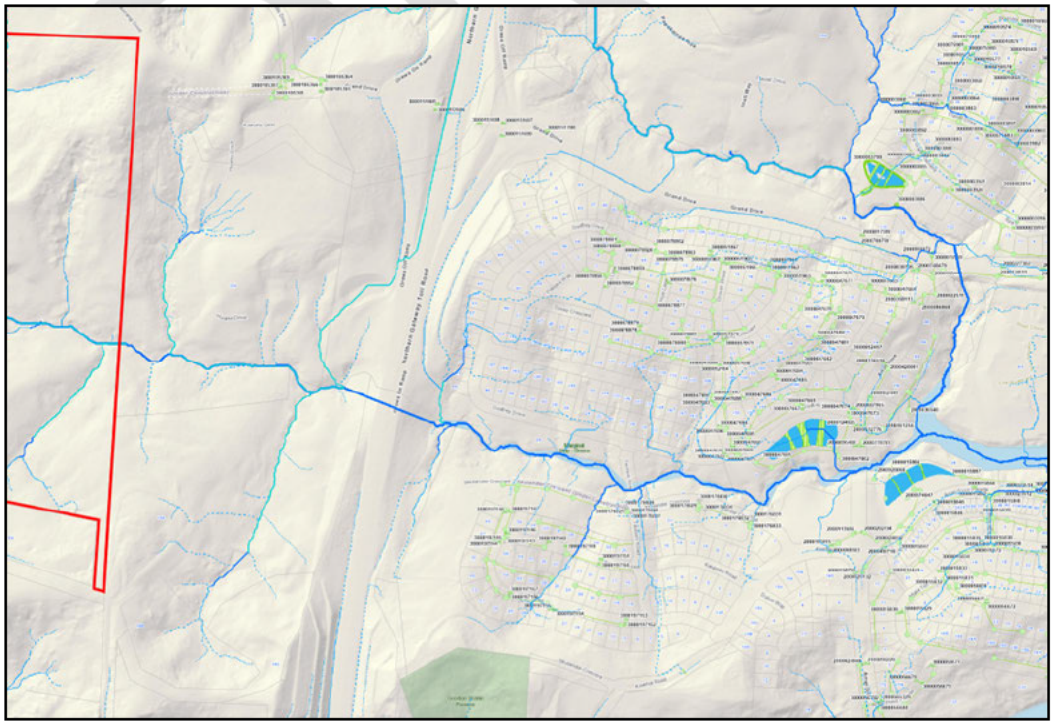


Figure 9 - Receiving environment

1.7 Existing Public Stormwater Infrastructure

Based on a review of Auckland Council GIS, there is no existing public stormwater infrastructure within the site.

1.8 Existing Hydrological Features

The streams and natural wetlands, are the main hydrological features with the SMP area.

1.9 Flooding and Flow paths

Auckland Council GIS shows the overland flow paths in the site, and a flood plain. Flood inundation is generally contained within the lower lying gulley features and natural inland wetlands across the site. This shows that all streams within the site act as well-defined overland flow paths, which drain all water in a flood event to the bottom of the catchment, where the water backs up against the motorway embankment, before discharging through a culvert to the coast.

The SMP area extent defined in in Figure 1 discharges to a single culvert which discharges under the Northern Motorway which creates a flood plain within the site. This flood plain is controlled by the headwater above the 2.1m diameter pipe.

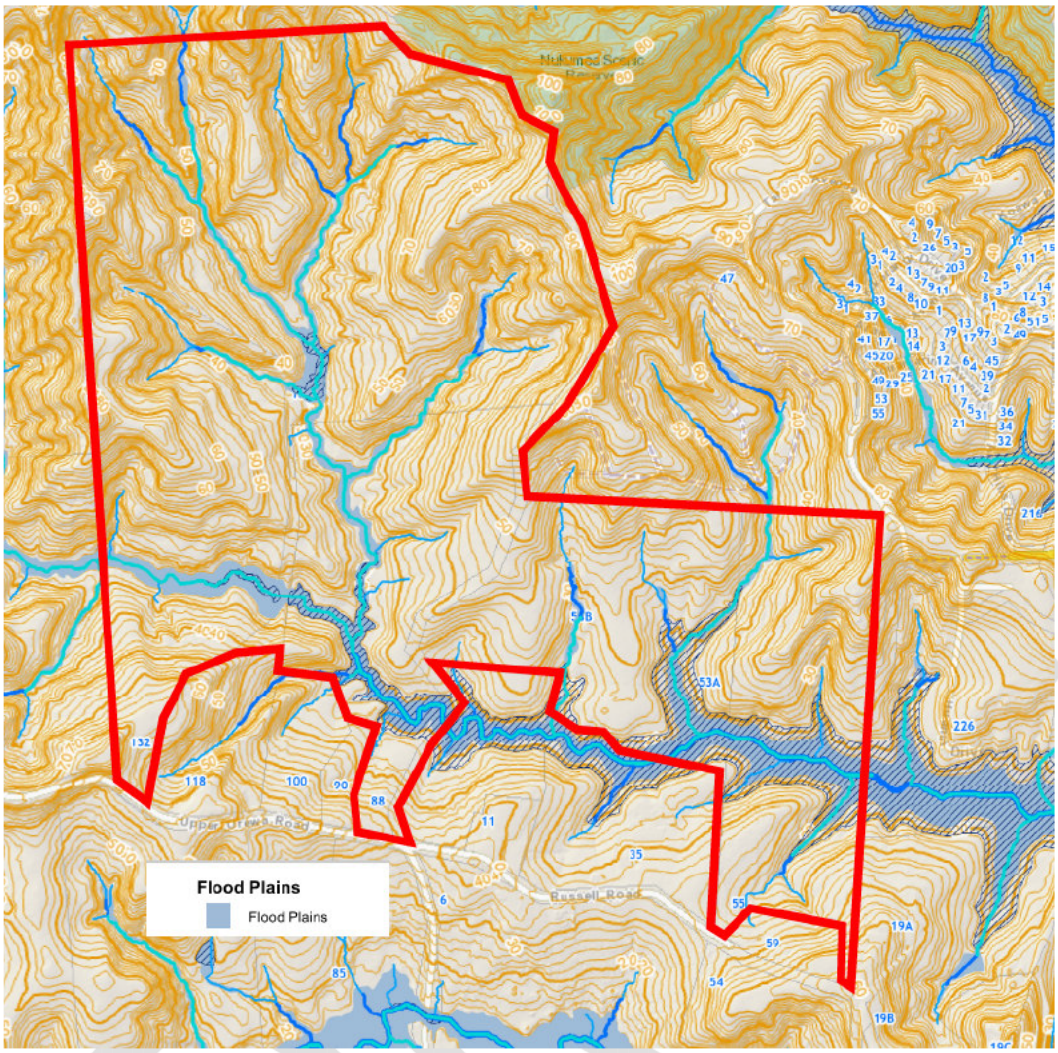


Figure 10– Indicative Overland Flow Paths and Flood Plains - Auckland Council Geomaps

A Flooding Assessment Report has been produced by McKenzie and Co to be read in conjunction with this SMP. This report predicts flooded widths for post development scenarios and states what anticipated effects the proposed development will have on the upstream and downstream neighbouring properties.

1.10 Coastal Inundation

The site's downstream boundary is located within approximately 1100 metres from the tidal effect area and at an elevation difference of 7 metres. A boundary condition for the extreme coastal inundation has been included with the flood model.

1.11 Biodiversity

Viridis[3] have identified various vegetation within the development site, which consists of pine plantation, native dominant vegetation, exotic dominant vegetation, and gorse scrub. These

[3] Viridis Environmental Consultants, 2025

areas are shown below in Figure 11 - Vegetation within the SMP areaFigure 11.

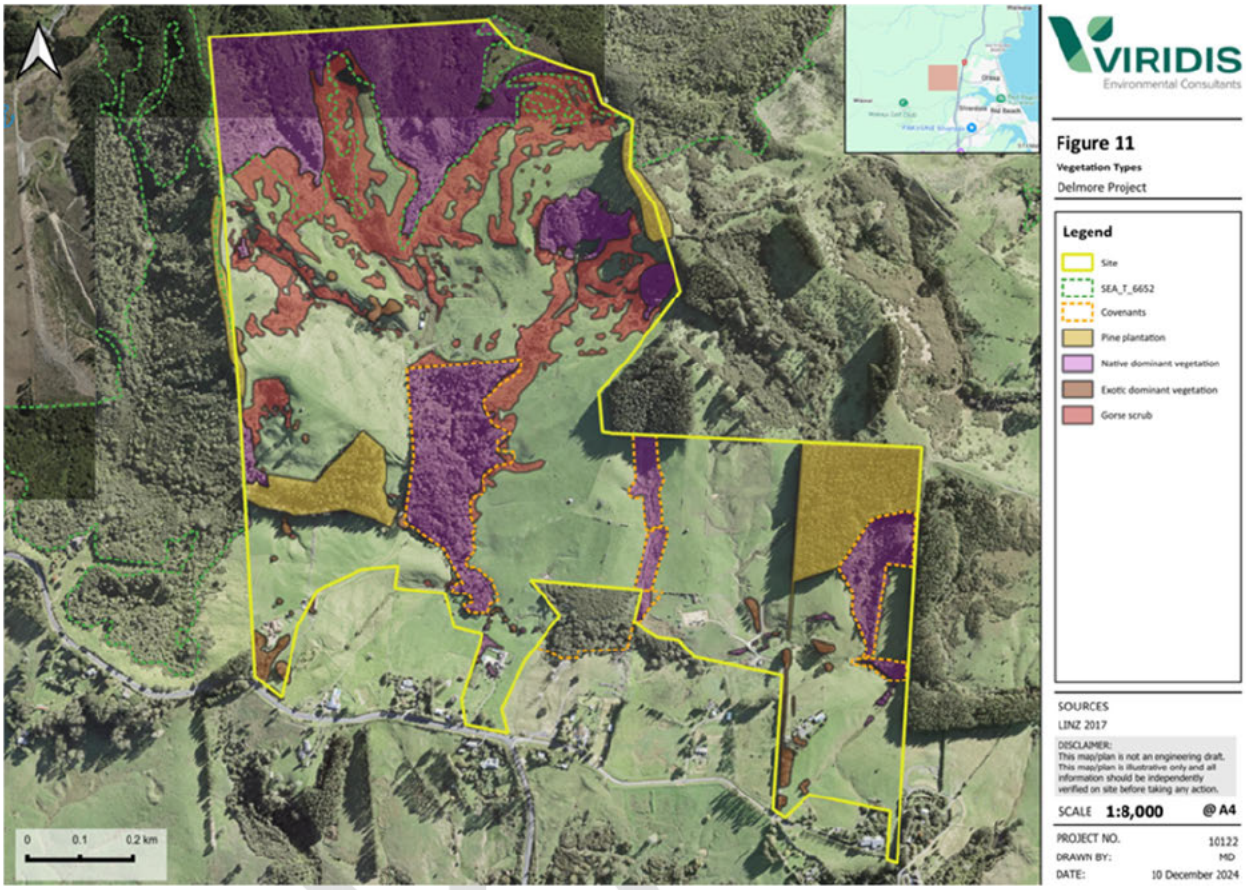


Figure 11 - Vegetation within the SMP area

Thirty-four natural inland wetlands were identified within the Site, as shown in Figure 7.

1.12 Cultural and Heritage Sites

An Archaeological assessment has been undertaken for this proposal[4]. The report identifies two archaeological sites recorded in the Project Area. Both sites will be able to be avoided by the proposed development, due to their location being out of the development footprint and upstream of the development..

1.13 Contaminated Land

A preliminary ground contamination advice memo[5] has been prepared by Williamson Water & Land Advisory Ltd (WWLA) dated 24th April 2024. Their assessment identified very limited potential for significant ground contamination. There are no confirmed HAIL activities on site. Dwellings and sheds are mostly modern construction (2000s onward) with one single garage having fibre cement cladding.

Regarding soil contamination management WWLA state "Localised soil contamination, which

[4] PROPOSED RESIDENTIAL DELMORE, ŌREWA, AUCKLAND: FAST TRACK ARCHAEOLOGICAL ASSESSMENT, Clough & Associates Ltd, December 2024

[5] Delmore Subdivision – Preliminary ground contamination advice for Fast-track Approval dated 24th April 2024 Ref. WWLA1147

may be present around existing structures, is best dealt with during demolition, for example, by a localised scrape of surficial soils. Such minor works can be dealt with under the demolition approval process and should not trigger the need for ground contamination specific consents. Following demolition and clearance of the existing structures it is expected that earthworks should largely be able to be managed through standard earthworks controls and procedures."

2. DEVELOPMENT SUMMARY AND PLANNING CONTEXT

This section provides a high-level summary of the proposed development, together with the specific planning and regulatory requirements.

2.1 Regulatory and Design Requirements

Based on the review of Auckland Council's regulatory and stormwater guidelines, site-specific stormwater management requirements have been identified. The relevant regulatory guidelines are listed in **Table 3** below, and a summary of the requirements is presented in the sections following.

Table 3 - Summary of Regulatory and Design Requirements

Requirement	Relevant Regulatory / Design to Follow
Stormwater Discharge Consent	Auckland Council Regionwide Stormwater Network discharge consent (NDC) Schedule 4 (Greenfields Development)
SMAF Hydrology mitigation	Not within SMAF overlay
High Contaminant Generating Areas (HCGA)	Auckland Unitary Plan Chapter E9
Natural Hazards	Auckland Unitary Plan Chapter E36
Natural Resources of the Regional Policy Statement	Auckland Unitary Plan Chapter B7
Stormwater Diversion and Discharge	Auckland Unitary Plan Chapter E8
AUP Precinct	Not applicable
Stormwater Management Devices Design	Auckland Council GD01
Application of Principles of Stormwater Management	Auckland Council GD04
Hydrology in the Auckland Region	Guidelines for Stormwater Runoff Modelling in the Auckland Region – Technical Publication 108 (1999). Former Auckland Regional Council.
Stormwater Management Approach	Auckland Unitary Plan stormwater management provisions: technical basis of contaminant and volume management requirements– Technical Report 2013/035 (2013). Auckland Council.
Design and Construction of Stormwater Infrastructure	Auckland Code of Practice: For Land Development and Subdivision (Chapter 4 - Stormwater V4) - NZ Building Code, E1 Surface Water.

Detail on Stormwater Management including WSD, Flood Risk Management, Freeboard allowance etc.	NZS4404 – Land development and Subdivision infrastructure. NZ Building Code, E1 Surface Water. Auckland Code of Practice: For Land Development and Subdivision (Chapter 4 – Stormwater V4) - November (2015). Auckland Council.

2.2 Stormwater Discharge Consent

This SMP relates to a Greenfields Development and falls under the Auckland Council Regionwide Stormwater Network discharge consent (NDC). Schedule 4 of the NDC outlines the stormwater management factors for Greenfields Developments. Under the NDC the performance requirements below must be achieved.

The stormwater management approach outlined in this SMP meets the NDC requirements.

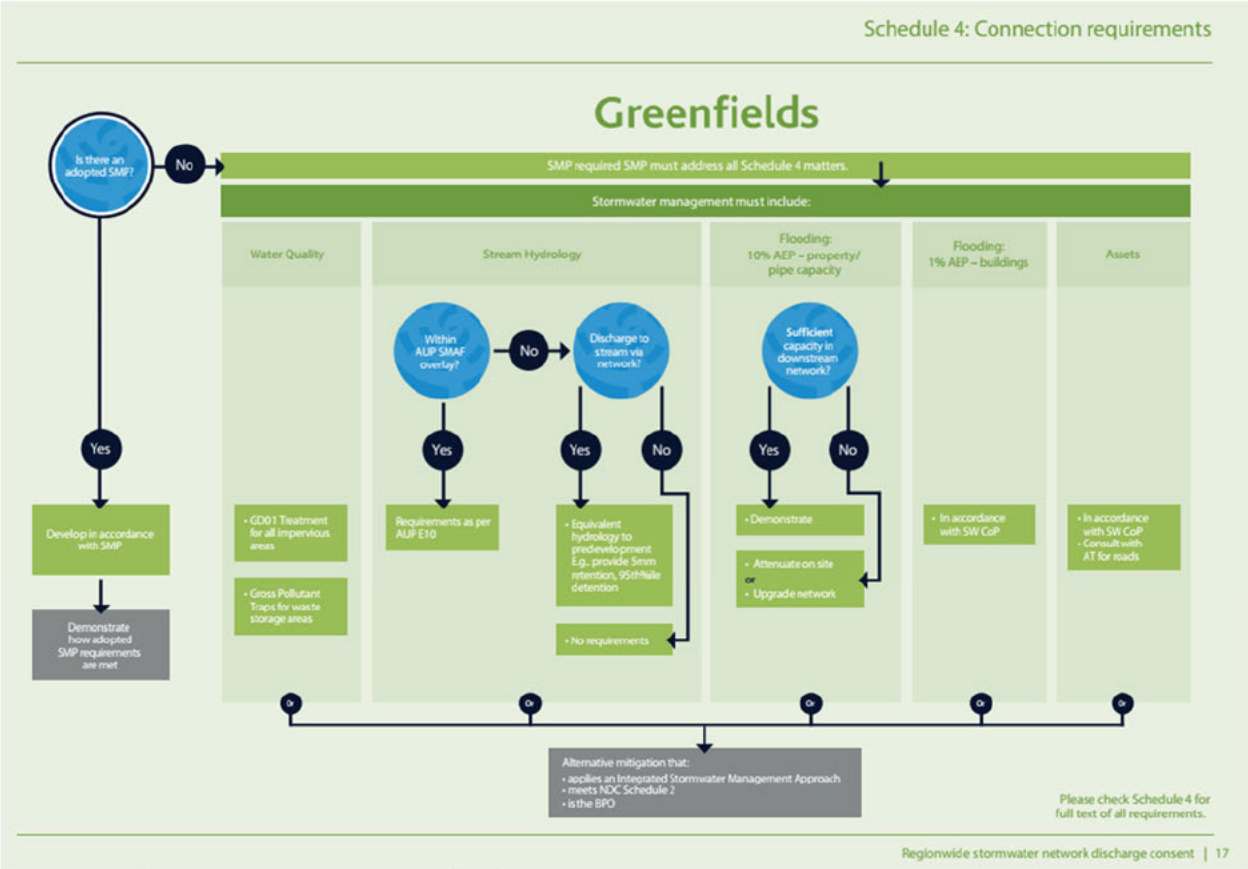


Figure 12 - Regionwide Stormwater Network Discharge Consent Schedule 4 Greenfield connection requirements (source - https://www.aucklanddesignmanual.co.nz/content/dam/adm/adm-website/developing-infrastructure/stormwater-network-discharge-consent-(ndc)/Healthy_Waters_NDC_Schedule_4-full_version.pdf.coredownload.pdf)

The following requirements apply to the site area covered by this SMP –

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

3. MANA WHENUA: TE AO MAORI AND MATAURANGA

Consultation with Iwi is currently being undertaken and key recommendations will be incorporated into the next issue of this SMP. The recommendations address cultural impacts, land preservation, water quality, and ecological conservation. By incorporating these recommendations, the stormwater management design will promote sustainable practices and cultural stewardship.

4. STAKEHOLDER ENGAGEMENT AND CONSULTATION

The following parties have been consulted during the preparation of the preparation of this SMP;

- Healthy Waters, Advice regarding their flood model characteristics.

5. PROPOSED DEVELOPMENT

5.1 Location and Area

The site for the proposal is located west of Ōrewa township in North Auckland Flat within a Future Urban Zone.

The site is located 370 metres west of State Highway 1 interchange with Grand Drive. Grand Drive is currently being constructed as an extension to serve the Ara Hills development currently under construction. This Grand Drive extension is proposed to continue west through the site and curve southward to end in a connection with Russell Road/Upper Ōrewa Road intersection. This is the main access into the site.

5.2 Purpose of the Development

The proposal is to develop the site into residential living. The current indicative masterplan is shown in Figure 13 below. The masterplan retains the current watercourses and does not alter the current flow path locations through the site. Residential areas will be located outside the flood plains. Roading layout is sympathetic to the current topology and maintains the watercourses. Several road crossings over the watercourses are required to facilitate the roading network. It is anticipated these road crossings will consist of box culverts to facilitate construction.

Figure 13 Indicative proposed Development Masterplan (Source: Vineway Ltd)

5.3 Earthworks

The site will be contoured to provide access and building platforms. Generally, the roads follow ridgelines, which will require these to be cut down and filled along the sides, with batters down to the streams to form building platforms. The extent of earthworks and the earthworks philosophy need to be carefully considered, planned and carried out for this development site due to the nature and value of the existing watercourses. It is expected earthworks will not be undertaken in the watercourses themselves. However some road crossings of the streams are proposed and these crossings will be in the form of box culverts. These will require some embankment earthworks to be carried out each side of the proposed culvert.

The alignment of flow paths will be retained however some minor adjustments could provide improved positive outcomes after consultation and with agreement of related stakeholders. Such adjustments could require minor earthworks in the watercourse bed and would be very carefully planned and managed during the design and works phases with monitoring during and after completion for adverse environmental effects. E.g. Any sediment migration, erosion. Any improvement work would be incorporated into the proposed planting/riparian improvement plan.

6. STORMWATER MANAGEMENT

6.1 Principles of Stormwater Management

6.1.1 Original Principles

This section outlines the stormwater management approach for the post-development outcome for the site. It aligns with the provisions of the AUP, and the objectives set out in schedule 4 of the NDC from greenfield developments. The purpose of this approach is to promote sustainable stormwater management and land development on the site. Additionally, it aims to safeguard, restore, and improve the receiving environment, such as watercourses.

The following standards and guidelines were adopted for the stormwater management approach:

- Auckland Unitary Plan Operative in Part
- Auckland Council Ōrewa West Integrated Catchment Management Plan February 2010
- Auckland Council Catchment Management Plan Update, Ōrewa West Catchment January 2014
- Stormwater Management Devices in the Auckland Region, Guideline Document 2017/001 (GD01) Dec 2017 Incorporating Amendment 2.
- Water Sensitive Design for Stormwater, March 2015, Guideline Document 2015/004 (GD04).
- The Auckland Council Code of Practice for Land Development and Subdivision, Stormwater (SWCoP v4).
- Guidelines for Stormwater Runoff Modelling in the Auckland Region, ARC Technical Publication No. 108 (ARC TP108), 1999.
- Network Discharge Consent (NDC)

The guiding water sensitive design principles as outlined in GD04, have been adopted and incorporated in the stormwater management approach for the development of the site. See key points and guiding principles below. **Table 4** shows the expected outcomes and performance standards consistent with the objectives and policies AUP.

Table 4 - Application of Stormwater Principles

Water Sensitive Design Principles	Applications
Protect and enhance the values and functions of the natural ecosystem	Adoption of the WSD Blue-Green infrastructure, and green corridor network. Riparian stream edge planting, and riprap have been used where practicable, to minimise impact of stormwater runoff and overland flow on the receiving downstream environment. Raingarden Bio-retention

	devices have been used for water quality and hydrological mitigation within the site to mitigate effects on receiving environments (streams).
Address stormwater effects as close to the source point as possible	Generation of contaminants will be prevented as far as practicable using inert building materials. Where contaminants are generated, i.e., roads, infrastructure will be provided to mimic natural physical, biological, and physical treatment processes as close to the source as practicable. Communal devices preferred.
Mimic natural systems and processes for stormwater management	Retain existing overland flow paths and add Riparian stream edge planting & revegetation planting, and riprap to protect the gully networks within the site.

6.1.2 Updated Principles

We envisage no updated principles for stormwater management and the development proposal will adopt the standards and principles in line with the Auckland Council regulatory and New Zealand Building Code requirements as discussed above.

6.2 Stormwater Management approach

6.2.1 General

An evaluation of stormwater management devices appropriate for this site, to produce a Best Practical Option (BPO) Toolbox, was undertaken and is presented in Appendix A.

The stormwater approach for the site, utilises the existing landform and stream network as far as practicable, by mimicking the existing catchments, and providing communal devices in the low points of the catchments. Where lots are directly adjacent to streams, treated stormwater discharges direct to the stream through a T bar energy dissipation device, to maintain stream flows and minimise flows entering the public system where possible. On site tanks will be provided for each lot for treatment and re-use.

A flow chat is shown below in Figure 14 for the approach to treating all impervious surfaces within the development. Further explanation of each element is shown below.

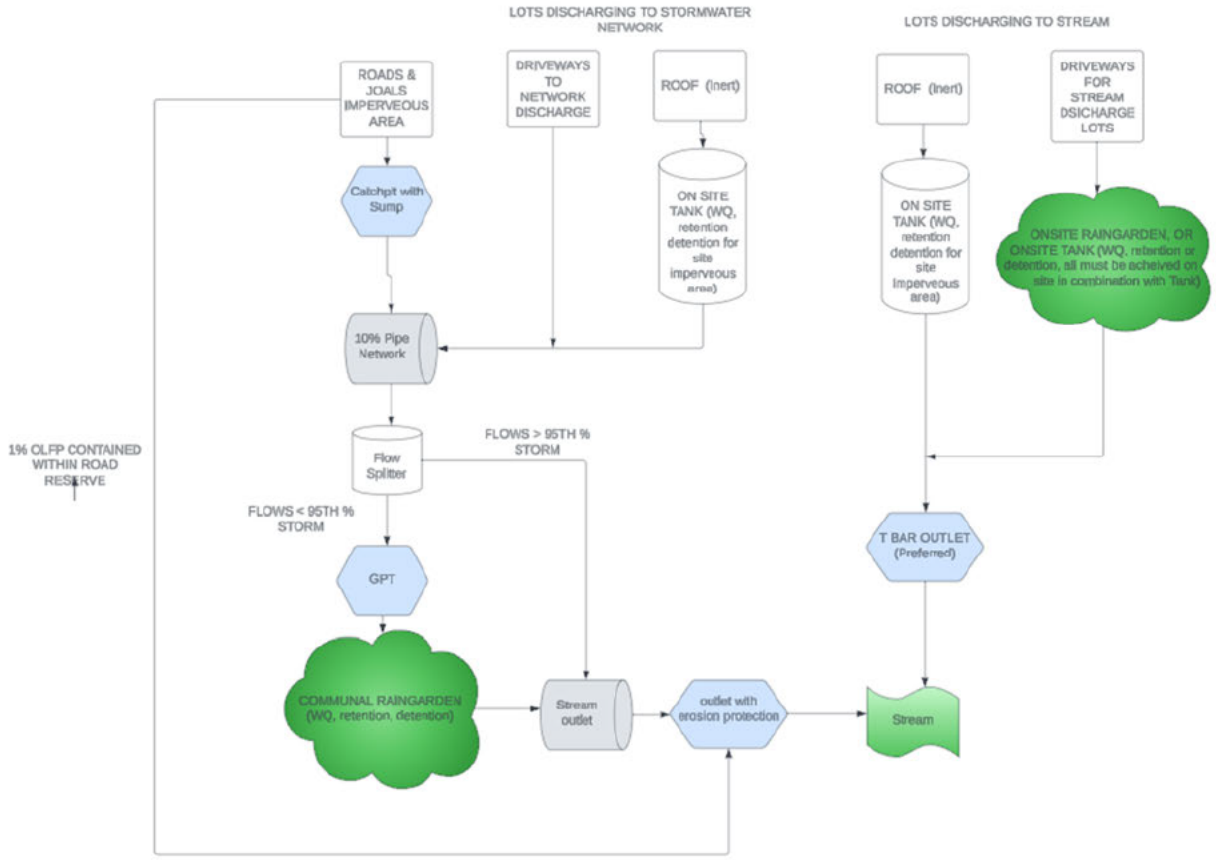


Figure 14 - Treatment Train flow chart for BPO

6.3 Water Quality

Water quality objectives are:

- To provide treatment of all impervious surfaces using a device designed in accordance with GD01 for the appropriate contaminants.
- 75% total suspended solid to be treated.
- Eliminate and if not possible minimise the generation and discharge of contaminants.
- Design a stormwater management system that provides a high level of water quality to protect the receiving environment.
- Preserve, protect, and enhance streams and floodplains which can also provide amenity and connectivity with communities.
- Provide at-source water quality treatment of runoff for contaminant generating impervious surfaces to target sediments and metals.

Table 5 - Contaminants of Concern, and Quality mitigation BPO for Various Impervious Surfaces

Impervious area	Contaminants of concern	BPO
Roofs,	Copper, Zinc	Inert Building materials
Driveways	Sediments, gross pollutants, metals, oils and grease, hydrocarbons, temperature	Catchpit with Sump, on-site Raingarden
Public roads	Sediments, gross pollutants, metals, oils and grease, hydrocarbons, temperature	Catchpit with Sump, Communal Raingarden
Private Joals	Sediments, gross pollutants, metals, oils and grease, hydrocarbons	Catchpit with Sump, Communal Raingarden

6.4 Stream Hydrology

The potential effects from development on stream hydrology will be mitigated through the provision of retention and detention within the private lots, and communal raingardens.

In addition, where possible, lots will discharge along the banks of the stream, instead of at the bottom of the catchment. The discharge will be through a T-bar system to spread the flow and minimise erosion risk. Outlets will be in accordance with Auckland Council Hydraulic Energy Management: Inlet and Outlet Design for Treatment Devices TR2013/18, HEC-14 or other equivalent guidelines.

The Raingardens designed to GD01 requirements will provide the water quality mitigation, retention and detention requirements suitable for the development proposal. Nominal Raingarden locations are shown on appended drawing 3725-400. They are communal devices to be vested to Auckland Council.

The Raingardens meet the required minimum water quality treatment described in section 6.2.1 above.

6.5 Flooding 10% AEP Event (Network Capacity)

A new pipe network will be provided within the SMP area, sized for the 10% AEP event, in accordance with SWCOP.

Attenuation of the 10% AEP event is not required as there are no downstream constraints or flood risk. Flood modelling has been undertaken by Mckenzie & Co[6] for the 10% AEP event with Climate change and Maximum Probable Development, for the pre and post development scenarios. This shows that there is no increased flood risk upstream or downstream from the development, in this event.

Outlets will be in accordance with Auckland Council Hydraulic Energy Management: Inlet and

[6] McKenzie & Co Flood Report 2025

Outlet Design for Treatment Devices TR2013/18, HEC-14 or other equivalent guidelines.

6.6 Flooding 1% AEP Event (Habitable Floors)

Attenuation of storms up to the 1% AEP is not included in this SMP as the Ōrewa West ICMP[7] states "*As there are no downstream flooding issues, attenuation of 2-, 10- and 100-year ARI flows is not proposed.*" Flooding is discussed further in the following sections 6.5 and 6.6.

Assessment of 1%AEP flooding is provided in the attached McKenzie and Co. Flood Assessment Report. Two properties are located directly downstream of the site. 19A Kowhai Road has a single dwelling at a floor level of approximately RL 50m, which is 30m higher than the MPD flood level.

A development directly east of the site is Ara Hills Stage 2. A review of proposed design contours on the Engineering Plan Approval drawings for that project reveal the design surface level at the lower lots is RL 26m. It is not clear if this is to Auckland Datum 1946 or NZVD 2016 (a difference of approximately 300mm exists between these datums). The AC Rapid Flood Model flood level at this location is 17.77m RL (1946 datum). This is a vertical height difference of approximately 8.2m. At this level difference it can be considered the development to which this SMP relates will not affect the existing downstream lots located in Ara Hills Stage 2.

Based on the ICMP recommendations, and the recent Mckenzie & Co Flood assessment, based on 3.8 Degree climate change, and MPD within the catchment, there is no downstream flood risk from the development.

Attenuation of the 1% AEP event is not required.

6.7 Overland Flowpath and Floodplain Management

All development is set outside of streams and overland flow paths. The Maximum Probable Development flood extent using post-development impervious coverage and 3.8° for climate change is shown on drawing 3725-4930 appended.

As the development is predominantly situated on ridges, most overland flowpaths are constrained to the stream alignments, and therefore do not affect the development. Where minor OFLPs do enter the site, these entry points are to be retained. All OLFPs from the development discharge to the stream network, through rip rap lined channels or other appropriate energy dissipating devices.

OLFPs are to be contained within the road reserves and JOAL boundaries. Lots are from the lot rear boundary to maintain freeboard above the OLFP's. Roads are used to convey secondary flow, from where flow is then conveyed to the streams.

All lots are located well above the flood plain at the bottom of the catchment, however a minimum finished floor level noted on the titles, for lots along the edge of the flood plain.

Outlets will be in accordance with Auckland Council Hydraulic Energy Management: Inlet and Outlet Design for Treatment should be Devices TR2013/18, HEC-14 or other equivalent guidelines.

[7] Ōrewa West ICMP 2011, section 7.2.2, page 50

6.8 Development Staging

The development is to be delivered in two stages, and 14 sub-stages, and each stage can be serviced with its own stormwater management device independently.

There are no downstream infrastructure constraints that require upgrading for this development.

6.9 Hydraulic Connectivity

Hydraulic connectivity mimics current natural physical pathways. Primary runoff from roofs and paving discharges to the pipe network which enter the Raingardens (on-lot tanks optional). Secondary flows runoff to the roads. There are no significant alterations to the natural flow paths. There are no disconnected impervious surfaces proposed.

6.10 Asset Ownership

Stormwater assets located within the public road and drainage reserves will be vested in Auckland Council at time of compliance.

On site tanks and T-bar discharges, will be owned and maintained by the private Lot owners.

6.11 Ongoing Maintenance Requirements

Vested assets will be maintained by Auckland Council. An operations and maintenance plan for each communal device will be provided at time of compliance.

The rainwater tanks are to be maintained by the owner. Consent notices can be put in place to ensure obligation of ongoing maintenance is ensured.

6.12 Implementation of Stormwater Network

Public stormwater network will be constructed and vested at each stage of development.

6.13 Dependencies

No stormwater infrastructure is proposed outside of the development site.

6.14 Risks

Potential risks to the stormwater management are listed below in Table 6. As specialist assessments are received the risks will be investigated and this table updated in a future issued of this SMP to confirm risk and provide the resultant level of risk to the stormwater management proposal. Resultant levels below are indicate awaiting further information. Mitigation and management options will be included also after further information is received.

Adjustment in location of the proposed large raingardens is expected to mitigate some of the risks identified.

Table 6 – Risk Register

Proposed Risk to Stormwater Management	Mitigation / Management	Further mitigation/ management to be used	When do risks need to be addressed	What is the Resultant level of Risk?
Infiltration ability	Use 2mm/day for design purposes	Testing at devices locations	Detailed Design	Low
Slope Stability	Geotechnical assessment		Resource Consent and Detailed Design phase	Moderate Moderate
High Groundwater levels	Geotechnical assessment (boreholes)		Resource Consent and Detailed Design phase	Low Low
Expansive soils	Geotechnical Assessment		Building Consent phase	Low
Erosion prone soils	Geotechnical Assessment		Resource Consent and Detailed Design phase	Moderate
Presence of fauna in close by watercourse	Ecology Assessment		Resource Consent phase	Low
Presence of natural wetlands, etc close to site	Environmental Assessment		Resource Consent phase	Moderate
Mana Whenua	Cultural Impact Assessment, consultation.		Resource Consent phase	Low

7. DEPARTURES FROM REGULATORY OR DESIGN CODES

The stormwater management approach for development meets the minimum regulatory or design codes standards and is considered the BPO approach. No departures are proposed.

8. CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WORK

This Stormwater Management Plan has been prepared to meet the requirements of Auckland Council's Regional Network Discharge Consent to enable stormwater discharges from an approximately 1250 lot development (and associated infrastructure) at the site. The supporting flood assessment is contained in a separate report. The management approach set out in this SMP is summarised below. –

Roads & Joals

Requirements

- WQ treatment for all impervious area
- retention/detention for impervious area

Proposed BPO

- Catchpits with Sumps
- Pipes for 10% conveyance
- Communal Raingardens for WQ and retention/detention
- Road OLFP for conveyance of 1% AEP with 3.8 degree climate change

Lots

Requirements

- WQ treatment for all impervious areas
- Retention/detention for impervious area

Proposed BPO

- Inert Building materials
- Rainwater Tanks
- On-site Raingarden to treat driveway runoff, for lots discharging to streams.
- T-bar discharge to streams where practical (Preferred), or Pipes for 10% conveyance to public system where not possible.
- Avoid the Floodplain, maintain freeboard above 1% AEP levels.

APPENDIX A – STORMWATER MANAGEMENT TOOLBOX ASSESSMENT

Hydrologic Requirements

The site is not located in a SMAF 1 or SMAF 2 area, as shown below in Figure 15.

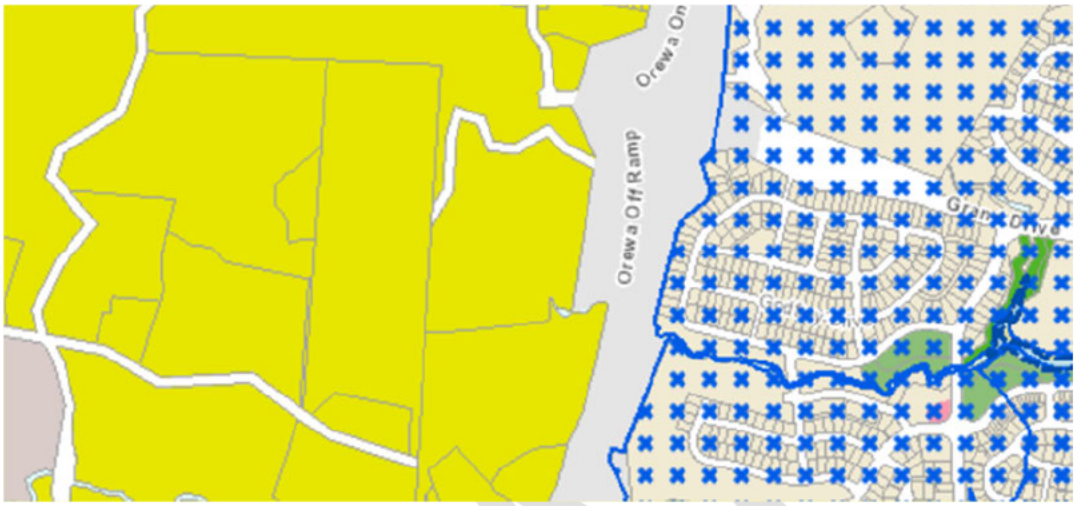


Figure 15 - Development site is outside SMAF area

As the proposed impervious area is greater than 1000m^2 the Unitary Plan states the discharge off the impervious area should be managed by a stormwater management device that reduces contaminants from the impervious area, provides retention (volume reduction) of a minimum of 5mm runoff depth off impervious areas and provide detention (temporary storage) with a drain down period of 24 hours for the difference between the pre-development and post-development runoff volumes of the 95th percentile, 24 hour rainfall event minus the retention volume off of impervious areas.

From GD01 Table 10 (Figure 16 below) the hydrologic mitigation requirements and the devices selected are highlighted in green boxes.

Table 10: Mitigation needed to support Auckland Unitary Plan requirements

Mitigation requirement (Auckland Unitary Plan)	Stormwater management requirement and aim	Devices providing this mitigation
Stormwater management - flow: SMAF 1 and 2: • Provide retention (volume reduction) of at least 5 mm runoff depth.	Retention: • To protect streams and recharge groundwater.	Rainwater tanks (with reuse) Bioretention devices (unlined) • Living roofs • Pervious paving (unlined) • Infiltration devices.
Stormwater management - flow: • SMAF 1: Provide detention and a drain-down period of 24 hours for the difference between the pre- and post-development runoff volumes from the 95th percentile, 24-hour rainfall event minus the 5 mm retention • SMAF 2: Provide detention and a drain-down period of 24-hours for the difference between the pre- and post-development runoff volumes from the 90th percentile, 24-hour rainfall event minus the 5 mm retention.	Detention: • To protect streams.	• Pervious pavements Bioretention devices • Wetlands • Ponds (dry and wet) • Rainwater tanks.
Stormwater diversion and discharge: • Provide detention of 10% AEP • Provide detention of 1% AEP.	Detention: • To manage and mitigate flood effects and flood risks, including effects on buildings and property.	• Rainwater tanks (no reuse) • Ponds • Wetlands.
Stormwater management – quality: Provide treatment of the water quality flow or volume.	Water quality mitigation: • To protect water quality.	Bioretention devices • Swales • Wetlands • Ponds (where specific design is agreed with Auckland Council).

Figure 16 - Mitigations requirements from GD01 Table 10

Hydrologic calculation requirements are proposed in green boxes from GD01 Table 11 (Figure 17 below).

Table 11: Suggested hydrological calculations

Hydrological calculation	Regulatory reference (Auckland Unitary Plan)	Mitigation aim	Preferred method	Calculation requirement	Wetlands	Ponds	Bioretention	Swales	Infiltration devices	Pervious paving	Living roofs	Rainwater tanks
Water quality flow (WQF)	E8 and E9	Water quality effects	Rational method	10 mm/hour			X[a]	X				
Water quality volume (WQV)	E8 and E9	Water quality effects	TP108[8]	90th percentile equivalent	X	X[b]	X					
Retention	E8 and E10	Effects on streams and aquatic biodiversity	TP108	5 mm runoff depth			X		X	X	X	X[d]
Detention	E8 and E10	Effects on streams and aquatic biodiversity	TP108	95th percentile 90th percentile	X	X	X			X		X
Large storms	E8	Flood effects	TP108	10% AEP	X	X		X[c]				X[f]
Extreme storms	E8	Flood effects	TP108	1% AEP	X[e]	X[e]						

Figure 17 - GD01 Table 11 hydrologic calculations

Due to raingarden Bioretention devices satisfying the above criteria for this site, they have been selected as the preferred device. They have been designed to be placed in locations where they can treat catchments, dictated largely by the catchment shape, but also to enable adequate access for maintenance of the Raingarden and outlet structures.

GD01 Figure 6 shows the 95th percentile 24-hour rainfall depth at the development site location as **38mm** which will be used for device sizing.

The site can be split into various catchment categories for determining the Best Practical Option (BPO) for the catchment. Below is a table with the different catchments, and the BPO identified for each, based on the toolbox.

Table 7 – Best practicable option for lots, roads, and joals

Sub catchment	BPO			
	Treatment	Detention/Retention	10% AEP conveyance	Outlet
Lots	Tank	Tank	T bar outlet to stream if possible, or public pipe if not.	To existing streams with rip-rap protection

Public Road	Raingarden	Raingarden	Pipe	To existing streams with rip-rap protection
Private Joals	Raingarden	Raingarden	Pipe	To existing streams with rip-rap protection

Lots

The residential lots will have optional private on-lot rain tanks. Tanks are sized for the retention and detention volume. It is proposed that each lot will have a T-bar discharge, where possible to discharge flows safely to the streams. This is to ensure that base flows in the streams are maintained. Where this is not possible, they will discharge into the public pipe network.

Public Roads

Public roads will be vested to Auckland Transport. Due to the steep road gradients above 8% swales are considered unsuitable. Pervious pavement, tree pits and roadside bioretention devices (Raingardens) are not desired by Auckland Transport due to O & M costs and are not proposed due to steep terrain. Wetlands cannot cater for retention, and as such communal raingardens are proposed as the most appropriate device selection.

Catchpits collect runoff which is piped to a common public network of trunk mains. The downstream end of the pipe network is directed to the Raingarden. The pipe outlet will have either a standard precast concrete wingwall or a bubble up manhole with scruffy dome for 10% AEP and low outlet pipe for storm flows lower than 10% AEP. Pre-treatment for Gross Pollutants before flow enters the Raingarden is not proposed.

The Raingarden provides retention volume of 5mm and 95th detention volume of post less pre and retention. Discharge is into an adjacent natural gully flow path with rock rip-rap outlet protection. These flow paths discharge to the main overland flow path that runs from west to east through the centre of the development site. An emergency spillway to GD01 is provided to the adjacent gully.

Raingardens will be designed to GD01.

Secondary storm flows run down roadways to sag locations. Short sections of new open conveyance channels could be required to provide the link to the existing gully locations. Velocity reduction measures will be employed e.g. check dams, natural baffles, etc. The shape and visual nature of these would be unobtrusive and marry with the aesthetic characteristics of the landform. Secondary flow paths will not be located on private property where possible.

Nominal locations of proposed Raingardens are shown on drawing 3725-400 appended. The number of Raingardens is desired to be minimised with their placement being logical to the layout of the roading and residential lots above and to the restrictions of topography and any nearby flooding effects. A minimal number of raingardens will reduce O & M costs for Auckland Council, so the raingardens are proposed at the base of their catchment. These devices will be in public reserve (recreation/stormwater).

Private Roads

Private JOALs follow the same principles as for the public roads. Grading, kerbs, channels and catchpits in the private roads collect surface runoff and discharge to the pipe network. From there the runoff is managed as above for public road runoff. Pervious pavement is not proposed due to the maintenance cost.

Riparian Margin

The riparian margin located at the edges of the main flow path and existing tributary gullies will be enhanced by planting. Extent of planting will be in accordance with recommendations of the watercourse assessment report.

Outlets

Outlets will be in accordance with Auckland Council Hydraulic Energy Management: Inlet and Outlet Design for Treatment Devices TR2013/18, HEC-14 or other equivalent guidelines.

Raingarden stability

If infiltration rate is less than 2mm per day and/or infiltration may influence slope stability, then they may be lined and retention volumes will be added to detention volumes. Should the geotechnical report raise this as a specific concern then raingardens may be lined to mitigate these risks in specific locations. This will be undertaken during detailed design.

APPENDIX B – DRAWINGS