



Neil Construction Ltd
151,155-157 Brigham Creek Road & 69-71 Trig Road,
Whenuapai, Auckland

Stormwater Management Plan

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Executive Summary

The subject site has an irregular shape with an area of approximate 22.8 hectares which extend over several properties. These properties are located at 151, 155-157 Brigham Creek Road and 69-71 Trig Road in Whenuapai. The existing land has a moderate slope that falls from RL42m at the southern boundary to RL13m at the north-eastern corner, and to RL15m at the south-eastern corner.

The site is within Waiarohia Stream catchment. An unnamed stream which is fed by multiple overland flow paths, flows to north-eastern direction within the site and discharges to Waiarohia Stream. Separate minor overland flow paths within the south-eastern section of the subject site merge into a single overland flow path before discharging to Waiarohia Stream. An existing box culvert under Brigham Creek Road conveys the flow from Waiarohia Stream to Waiarohia Inlet.

The site is anticipated to be light industry zone in the future. The proposed development is to create 21 industrial lots and two balance lots (Lots 200 -300).

This Stormwater management plan is consistent with Schedule 4 of the Auckland Council Regional Stormwater Network Discharge Consent. The proposed stormwater management principles and works are detailed as following:

- Public stormwater pipes are designed to accommodate the runoff from 10% AEP storm event for the maximum probable development (MPD) scenario with climate change factor (as specified in section 4.2.10 of the Auckland Code of Practise for Land Development and Subdivision) considered. The MPD allows for the maximum impervious surface limits of the current zone or, if the land is zoned future urban in the AUP, the probable level of development arising from zone changes. The maximum impervious area is not limited in the light industry zone. The runoff from the south-eastern section of the subject site will be discharged to the existing gully at the north-eastern corner of proposed Lot 8 through a proposed outlet structure. The runoff from the remaining site, will be discharged to the unnamed stream through the proposed outlet structures. Given the difficulties in providing a stormwater network with a single outlet, and maintaining the existing sub-catchment of the stream, multiple outlet structures are proposed at a set back from the stream with riprap protection.
- There is no new flood risk being created or the exacerbation of the existing flood risk. There are no habitable floors in the downstream properties which are detrimentally affected by flooding due to the proposed development than those affected in the existing situation. The entry and exit points of the existing overland flow path are to be maintained. The roading and earthworks design incorporates the conveyance of overland flow. The MPD and climate change are considered in the flood risk assessment for 1 % AEP storm.
- The stream within the site is to be restored by removing the existing culverts and reinstating the stream bed, which will also be protected by 10m wide riparian planting either side of the stream. The outlet structures are set back from the stream with riprap protection to reduce any potential erosion.
- Bioretention (Raingardens) are proposed to provide the detention for the difference between the pre-development and post-development runoff volumes from the 95th percentile 24 hours rainfall. Due to low percolation rates the required retention for the impervious area in the road reserve will be compensated within the detention volume according to AUP Table E10.6.3.1.1 Hydrology mitigation requirements.

- Bioretention (Raingardens) are proposed within the road reserve to provide treatment.

Proposed Infrastructures include:

- Publicly stormwater reticulations.
- Publicly and privately owned stormwater treatment devices.
- Privately owned stormwater retention and detention tanks.

During the development of individual lots in future, the following stormwater management requirements shall apply to each lot:

- Private stormwater network shall be designed to convey the runoff from 10% AEP storm event with climate change factor (as specified in section 4.2.10 of the Auckland Code of Practise for Land Development and Subdivision) considered.
- Tanks or similar devices shall be used to provide retention of at least 5mm runoff depth for the impervious area and detention volume for the difference between the pre-development and post-development runoff volumes from the 95th percentile 24 hours rainfall minus the achieved retention volume.
- Treatment shall be provided wherever the impervious areas are over 1,000m² or the proposed carparks are over 30 carparks for each future lot. Gross Pollutant Traps (GPT) system shall be provided in the industrial lots.

The Auckland Council shall ensure that all the stormwater management measures in this report are referred to during the engineering and building consents processes.

1.0 Existing Site Appraisal

The site is located to the west of Waiarohia Stream with a box culvert under Brigham Creek Road to convey the flow from Waiarohia Stream to Waiarohia Inlet. One of the Waiarohia Stream tributaries (unnamed stream) crosses the site from the south-western side to the north-eastern side before discharging to the box culvert inlet.

There is no stormwater network in the area except for a number of circular culverts and the above box culvert along Brigham Creek Road. Stormwater management measures are required to collect, treat, and convey the stormwater from the proposed development to Waiarohia Stream or its tributaries.

Investigations on the existing site was carried out and the data sources are summarised in the table below.

1.1 Summary of data sources and dates

Existing Site Appraisal Item	Source and date of data used
Topography	Topographic Survey by Neil Construction
Geotechnical / soil conditions	Due Diligence GIR 2020 for 71 Trig Road, Geotechnical Investigation Report and Further advice 2019-2020 by CMW with a final report in 2022.
Existing stormwater network	Survey by Neil Construction Ltd 2019-2021 Auckland Council GeoMaps data 2021
Existing hydrological features	Auckland Council GeoMaps data 2021
Stream, river, coastal erosion	Auckland Council GeoMaps Rivers and Streams layer 2021, Watercourse Classification Memo by Bioresearches
Flooding and flow paths	Auckland Council GeoMaps overland flow path layer 2021 Auckland Council GeoMaps floodplain layer 2021
Coastal Inundation	Auckland Council GeoMaps Coastal Inundation Layer, 2021
Ecological / environmental areas	Auckland Council GeoMaps Significant Ecological Area Layer, 2021, Watercourse Classification Memo by Bioresearches
Cultural and heritage sites	Archaeological Assessment 69 Trig Road, 149-151 Brigham Creek Road, 155-157 Brigham Creek Road, 71 Trig Road, by Clough & Associates Ltd 2019 - 2020
Contaminated land	Detailed Site Investigation by Geoscience Ltd 2020 and 2021

1.2 Location and General Information

Existing site element	
Site Address	151, 155-157 Brigham Creek Road & 69-71 Trig Road, Whenuapai
Legal description	Lot 2 DP 334953, Lot 2 DP 101583, Lot 3 DP 101583, Lot 4 DP 101583, Lot 5 DP 101583, Lot 2 DP 117365
Current Land Use	Rural land (Future Urban Zone on Geomap, Light industrial and residential Zone on proposed Plan Change 5 Zoning Map)
Current building coverage	Residential dwelling in 151 BCR

Existing site element	
Historical Land Use	1950 -1963 Pastoral Land use 1972-1980 Pastoral Land Use with Dairy shed 1988-2017 Horticulture

1.3 Topography

The combined site at 151, 155-157 Brigham Creek Road and 69-71 Trig Road in Whenuapai has an irregular shape with an area of 22.8 hectares.

The existing landscape has a moderate slope with the land falling from RL42m at the southern boundary to RL13m at the north-eastern corner, and to RL15m at the south-eastern corner. The ground slope varies between 2%-6% across the site.

An unnamed stream within the site, flows from the west to the north-east and discharges to Waiarohia Stream. A gully at the south-eastern corner of the site leads to Waiarohia Stream.



Figure 1: Site Location

1.4 Geotechnical

CMW Geosciences carried out a geotechnical investigation with a final report completed in 2022 for the resource consent application provided. The report is attached in Appendix B.

The topsoil was encountered in all tested locations and ranged from 100mm to 400mm in thickness. A non-engineered fill was encountered at the east-southern corner of the subject site with the fill depth ranging from 0.9m to 1.2m.

Groundwater was encountered within most of the boreholes with depths ranging from 2.2m to 4.0m from the existing ground level.

The soil type across the site is mainly clay or silty clay. Testing results suggest that the soils within the subject site have very low coefficients of permeability with the infiltration rates lower than 2mm/hr, which is not suitable to provide sufficient infiltration. The location of the boreholes is presented in Figure 2 below.



Figure 2: Geotechnical Test Locations

1.5 Existing Drainage Features and Stormwater Infrastructure

There is no existing public stormwater infrastructure within the site or adjacent properties. The site and surrounding properties are naturally draining to the existing gullies and the streams. However, there are few existing culverts under Brigham Creek Road which discharge to the subject site as shown in Figure 3.

A small portion of the runoff from the neighbouring properties to the south-west, naturally discharges to the subject site.



Figure 3: Existing Stormwater Network

1.6 Receiving Environment

The runoff from the subject site discharges to Waiarohia Stream, which is fed by several tributaries. The combined flow is conveyed through an existing box culvert under Brigham Creek Road before discharging to Waiarohia Inlet and Upper Waitemata Harbour.

Watercourse assessments were undertaken for 151, 155-157 Brigham Road and 69 Trig Road, 71 Trig Road by Bioresearches, the assessment memo is included in Appendix C.

As stated in the watercourse assessment memo by Bioresearches and shown on Auckland Council geomaps, there are several existing culverts within the site. An intermittent stream (W.C.2) enters an existing artificial online pond, then drains to a permanent stream (W.C.1) as shown in Figure 4.

The runoff from the subject site will discharge to the overland flow path and the watercourse W.C.2 and W.C.1.

The artificial channel (W.C.3) shown in figure 4 has been removed during the bulk earthworks under consents LUC60350837 and LUC60376543.

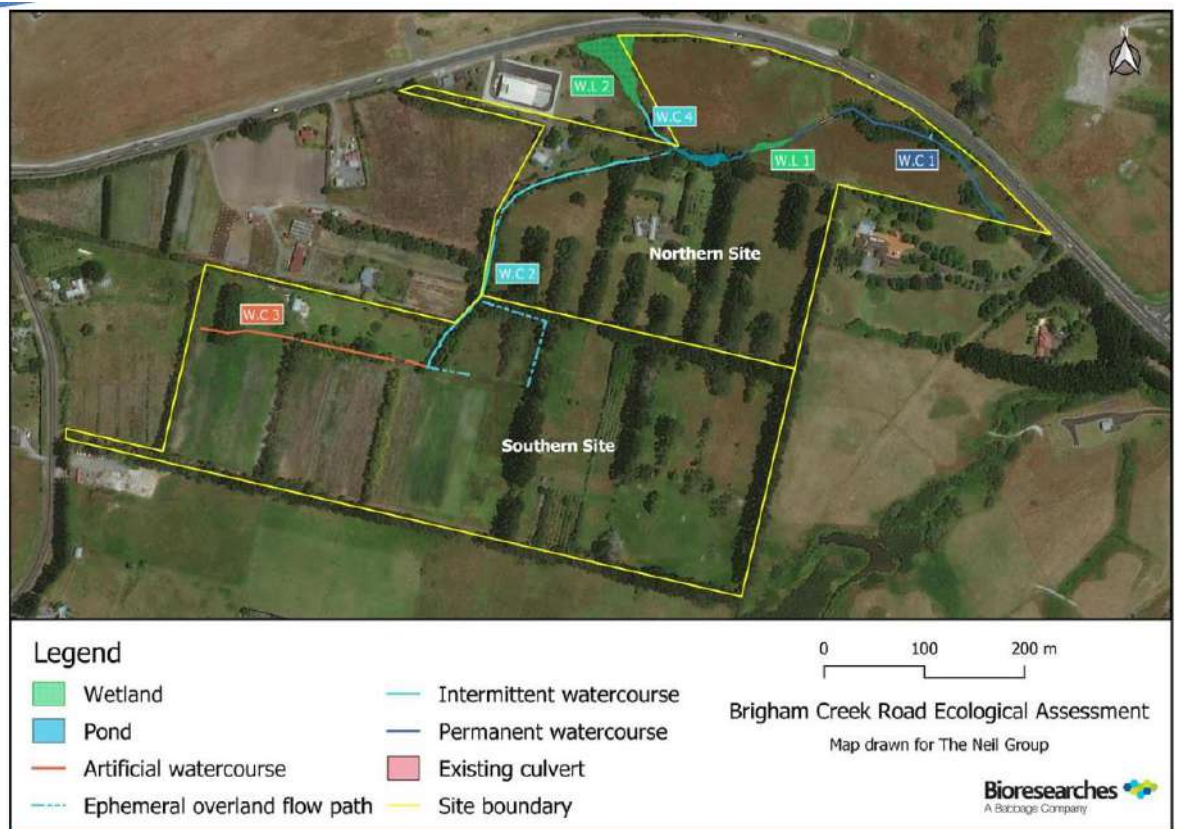


Figure 4: Watercourses in 151,155-157 Brigham Creek Road and 69 Trig Road

1.7 Existing Hydrological Features

An unnamed stream (shown as watercourse W.C.2 and W.C.1 in Figure 4) flows from the west to the north-east and discharges to Waiarohia Stream. Multiple overland flow paths discharge to the watercourses and Waiarohia Stream as shown on Auckland Council geomaps (Figure 5).

An artificial watercourse W.C.3 as shown in Figure 4 has been removed as part of the bulk earthworks construction under consents LUC60350837 and LUC60376543.

1.8 Flooding and Overland Flow paths

There are overland flow paths and floodplain with isolated flood prone areas within the site as shown in Figure 5. These overland flow paths cross the boundaries from 63 to 67 Trig Road (south), 141 and 153 Brigham Creek Road (north-west), and from Royal New Zealand Air Force base before merging with the unnamed stream within the subject site. The overland flow paths to the south-eastern side of the subject site discharge directly to Waiarohia Stream.

Two isolated flood prone areas are noticeable within the unnamed stream to the northern section. The Auckland Council geomaps identify one major floodplain within the unnamed stream that flows through the subject site to Waiarohia Stream. There are no buildings adjacent to the flood plains.

Based on the contours on the Auckland Council geomaps, the overland flow paths from the site can be split into two main sub-catchments. Those that discharge their flows to the unnamed stream to the west and north-west; and those flowing directly to Waiarohia Stream from the eastern boundary. These two catchments will

1.11 Cultural and Heritage Sites

Cultural and Heritage layer on Auckland Council Geomaps and the archaeological assessments provided by Clough & Associates Ltd in 2019 and 2020 show that there are no cultural or heritage sites within the subject site.

1.12 Contaminated Land

Bulk earthworks have been completed on the subject site, and Geosciences Ltd (GSL) have completed the site validation report.

2.0 Development Summary and Planning Context

2.1 Regulatory and Design Requirements

Requirement	Relevant regulatory/design to follow
Unitary Plan – SMAF hydrology mitigation	The SMAF 1 hydrological mitigation requirements are given in Table E10.6.3.1.1 in the AUP and are as follows: <ul style="list-style-type: none">• Retention (volume reduction) of at least 5 mm of runoff depth from impervious surfaces.• Detention (temporary storage) and a drain down period of 24 hours for the difference between the pre-development and post-development runoff volumes from impervious surfaces in the 95th percentile, 24hours rainfall event minus the achieved retention volume.• Schedule 4 of the Region wide NDC for Greenfields new and re-developed impervious surfaces.
Unitary Plan – Diversion and discharge	AUP E8.6.3.1 Diversion and discharge of stormwater runoff from impervious areas greater than 1000m ² and up to 5000m ² within an urban area (2) Stormwater management devices must be provided to reduce or remove contaminants from the impervious area to the maximum extent applying best practicable options
High Contaminant Generating Areas	AUP E9.6.1.3 as follows: Development of a new or redevelopment of an existing high contaminant generating car park greater than 1,000m ² and up to 5,000m ² <ol style="list-style-type: none">1) The development of a new or redevelopment of an existing high contaminant generating car park must not be located in an industrial or trade activity area.2) Stormwater management device(s) must meet the following standards: (a) the device or system must be sized and designed in accordance with GD01; or (b) where alternative devices are proposed, the device must demonstrate it is designed to achieve an equivalent level of contaminant or sediment removal performance to that GD01.3) Stormwater runoff from the impervious area used for the high contaminant generating car park is treated by stormwater management device(s) meeting Standard E9.6.1.3(2) above.4) Where the car park is more than 50 per cent of the total impervious area of the site, stormwater runoff from the

	<p>total impervious area on the site must be treated by stormwater management devices.</p> <p>AUP E9.6.2.2 as follows: Development of new high use road greater than 5000m²,</p> <ul style="list-style-type: none"> • stormwater runoff from the impervious area should be treated by stormwater management devices • Stormwater management devices must be sized and designed in accordance with GD01 or where alternative devices are proposed, the device must demonstrate it is designed to achieve an equivalent level of contaminant or sediment removal performance to that of GD01
Natural Hazards	N/A
Auckland Unitary Plan Precinct	NA
Existing Catchment Management Plan	N/A
Auckland Council Region wide Network Discharge Consent	<ul style="list-style-type: none"> • Minimise the stormwater related effects of development • Retain/restore natural hydrology as far as practicable • Minimise the generation and discharge of contaminants (including gross stormwater pollutants) • Enhance freshwater systems including streams and riparian margins - Minimise the location of engineered structures in streams

3.0 Mana Whenua Matters

3.1 Identification and Incorporation of Mana Whenua Values

A cultural impact assessment report for the proposed development was prepared by Te Kawarau Iwi. The assessment report indicates that the stream is the key cultural feature of the site requiring protection, other on-site cultural resources are in degraded state.

The proposed design is formulated in compliance with the recommendations in Auckland Council's Guidance Document GD01 and GD04 to incorporate Mana Whenua values.

- Provide hydrologic mitigation to reduce run off from extensive impervious areas.
- The stream is to be protected by land covenants. A riparian margin will be created with a 10m set back from the top bank of the stream and restored with native riparian planting 10m wide either side of stream.
- Provide treatment to the runoff from the roads.

4.0 Stakeholder Engagement and Consultation

Stakeholders	What is the reason for interest	What engagement has been completed	Feedback and response
Auckland Council including Healthy Waters, AT, Parks	All matters related to the Land-use and Resource Consent Application	Meetings	Stream to be protected/enhanced
Auckland Council – Healthy Waters	Guidance regarding requirements for stormwater treatment and detention requirements for the Resource Consent Application	Meetings	A site-specific stormwater management plan to be consistent with Whenuapai 3 Precinct Stormwater Management Plan September 2017. Best Practicable options are to be considered. On-site detention and retention are to be provided as per SMAF1 Controls requirement. Raingardens should be used on road reserves. Where applicable treatment device such as stormfilter and GPT system should be used. Provide flood modelling results to demonstrate that there is no increase in flood risk.

5.0 Proposed Development

5.1 Location and Area

The site extends over several properties being 151, 155-157 Brigham Creek Road & 69-71 Trig Road in Whenuapai, has a combined area of 224,459m². These properties are enclosed by Brigham Creek Road to the north, Trig Road to the west and Waiarohia Stream to the south-east.

5.2 Purpose of the Development

The proposal is to create 21 industrial lots and 2 balance lots. Four public roads are proposed to service the proposed development. One of these roads will intersect Brigham Creek Road at a proposed signalled traffic intersection to service the proposed development.

Brigham Creek Road carriageway will be widened at the proposed intersection. A separated cycleway with footpath will be constructed at northern side of Brigham Creek Road between Kauri Road intersection and the proposed intersection. Two new bridges are proposed at the stream crossing for Road 1 and private access way, to reduce the impact on the existing wetland.

5.3 Site Layout and Urban Form

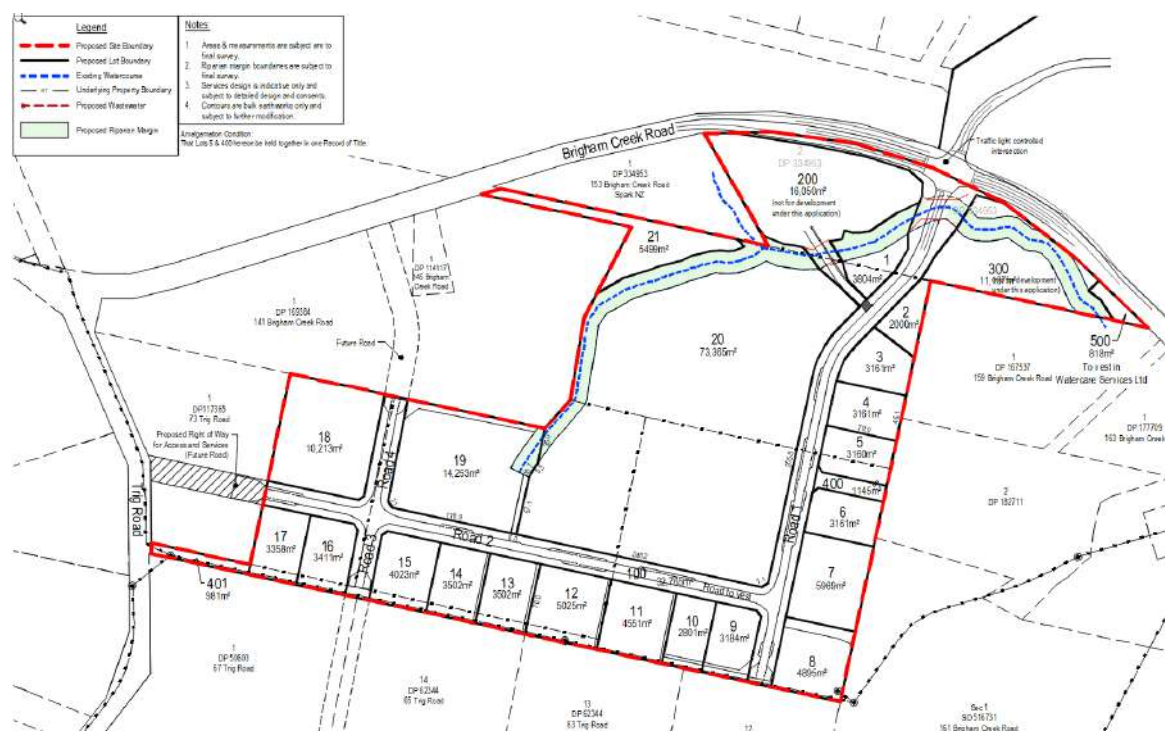


Figure 6: Proposed Development

5.4 Earthworks

Earthworks are proposed over an area of approximately 21.7 hectares exclusive the riparian margin. The earthworks are due to the proposed roads formation up to the subgrade levels and the lots formation. There are two bulk earthworks consent granted. These earthworks include the removal and disposal of the existing non-engineered fill. Sediment and erosion control are proposed in accordance with GD05, to mitigate the effects to the adjacent streams and downstream environment. Earthworks should be kept outside of the floodplain where possible.

The proposed earthworks plans are included in Appendix A.

6.0 Stormwater Management

6.1 Principles of Stormwater Management

6.1.1 Original Principles

The stormwater design principles adopted for the subject site are based on GD04 with reference to AUP chapter E1. More specifically, they include:

- Inter-disciplinary planning and design – Engineering design and planning were undertaken simultaneously, including specialised input from land surveyors, ecologists, geotechnical and contamination specialist so that one may inform the other, and to identify risks at the earliest opportunity.
- Protect and enhance the values and functions of natural ecosystems. The subject site was identified as being ideal and appropriate for the proposed density development. Riparian margins are created with 10m set back from the top of bank of the stream. The scale of earthworks operations is minimized.
- Address stormwater effects as close to source as possible – The runoff from impervious areas will be treated and mitigated prior to discharging to the receiving environment.
- Mimic natural Systems and processes for stormwater management – The restoration of the stream integrated with the proposed raingardens on the roads will promote the ecological values.

6.1.2 Updated Principles

Not Applicable within this SMP.

6.2 Proposed Stormwater Management

6.2.1 General

The stormwater management is consistent with Schedule 4 of the Auckland Council Regional Stormwater Network Discharge Consent.

- The primary stormwater networks are designed to accommodate the runoff from the 10% AEP storm event for the Maximum Probable Development (MPD) scenario with climate change accounted for. The MPD allows for the maximum impervious surface limits of the current zone or, if the land is zoned future urban in the AUP, the probable level of development arising from zone changes. The maximum impervious area is not limited in the light industrial zone.
- The stormwater mitigation requires to provide retention for 5mm runoff depth from the impervious areas and provide detention for the difference between the pre-development and post-development runoff volumes from the 95th percentile 24 hours rainfall event minus the retention volume.
- Treatment systems shall be provided to treat the runoff from the high use road or high contaminant carparks with impervious area over 1000m².

- The existing and proposed overland flow paths shall be managed to avoid any detrimental effects to the neighbouring properties and downstream environment. The locations of the overland flow path entry to and exit from the site are not altered.
- For the Enhancement of the stream, the works have been assessed by the ecologist from Bioresearches. Removal of existing culverts and reinstating the stream bed to restore the waterways are proposed to promote ecological and biodiversity values. Development will be set back 10m from the top of bank of the stream. Weeds and some trees on the stream bank will be removed, along with a man-made dam that is restricting flow. Riparian plantings are to be established 10m either side of the stream as per the Arborist report prepared by Tree3 and the landscaping design by Sola. The arborist report and landscaping designs are included within the AEE.

6.2.2 *Water Quality*

A variety of water quality options were considered for the development. Created Wetland ponds are not appropriate to provide treatment for this area due to the potential of bird-strike issues at the Whenuapai Airbase. Communal raingardens are not the best practical option due to the discharge levels and large batters or retaining walls required for their formation. Therefore, raingardens were selected to provide the required treatment of the runoff from the proposed roads and are considered the best practical option.

For the Brigham Creek Road widening adjacent the proposed intersection, raingardens are not a practicable option due to the area being heavily constrained with watercourses, steep batters, retaining walls, and existing underground services in this area. Installing proprietary stormwater filter systems in Brigham Creek Road is the best option for this area, however, such devices are generally not accepted by Council and Auckland Transport due to their regular and expensive maintenance requirements. Brigham Creek Road is not currently treated, and the best practical option is to forego treatment for the widened portion until the proposed upgrades to Brigham Creek Road are completed.

Riparian planting 10m either side of the stream will also provide the filtration of surface runoff to assist with the reduction of contaminants and sediment entering waterways.

Wherever the impervious areas exceed 1,000m² or if the proposed carparks exceed 30 carparks for each future lot, treatment shall be provided within the individual lots.

6.2.3 *Stream Hydrology*

The creation of impervious surfaces in a catchment increases the flow rate and volume of stormwater runoff. This change in hydrology, unless managed, can have a significant adverse effect on streams within the catchment, including accelerating river and stream erosion and bank instability, and creating hydrological conditions that do not support healthy aquatic ecosystems.

To mitigate the increased impervious surfaces created by the proposed roads, bioretention (raingardens) are proposed to provide the required detention for the difference between the pre-development and post-development runoff volumes from the 95th percentile 24 hours rainfall. According to the Memo provided by CMW Geosciences, the percolation rates from the test are below 2mm/hr. Therefore, the required retention for the impervious area in the road reserve shall be compensated within the proposed detention volume.

Within future lots, retention and detention volumes shall be provided in private stormwater devices such as tanks, bioretention (raingardens), filters or other appropriate devices during the development of individual lots in the future. The detention and retention volumes shall be calculated in accordance with GD01 and the Auckland Council Unitary Plan.

Stream works including removal of the existing culverts and reinstating the stream beds to restore the waterway and riparian planting to mitigate the adverse effects of runoff from the development are proposed.

6.2.4 Flooding 10% AEP event (Network capacity)

There is no existing public stormwater reticulation within the site.

New public stormwater networks are proposed to convey the 10% AEP flow from the development for the Maximum Probable Development (MPD) scenario. The climate change shall be accounted for in accordance with section 4.2.10 of the Auckland Code of Practise for Land Development and Subdivision.

The runoff from the south-eastern section of the subject site will be discharged to the gully at the north-eastern corner of the proposed Lot 8, through a proposed outlet structure. The runoff from remaining section will be discharged to the unnamed stream through the proposed outlet structures. Given the difficulties in providing a stormwater network with a single outlet, multiple outlet structures are proposed set back from the stream. Riprap protections are proposed to minimise the erosion.



Figure 7. Proposed Stormwater Layout

6.2.5 Flooding 1% AEP event (Habitable Floors)

A flood assessment has been undertaken to focus on the proposed development at Trig Road and Brigham Creek Road, the upgrade of Brigham Creek Road with future development at Kauri Road. The flood risk hazards were assessed for both pre-development and post-development situations using HEC RAS 2D

software. Future climate change (as specified in section 4.2.10 of the Auckland Code of Practise for Land Development and Subdivision) was considered in the model.

The impervious areas have been considered in the MPD scenario. This consideration allows to investigate the flooding effects on the proposed development and to the downstream environment.

The extent of the proposed and future developments has dictated the extent of the overland flow path catchment to be assessed. This resulted in a total catchment area of approximately 370ha being considered in the model.

The flood assessment has been undertaken for the predevelopment and the post-development situations based on the assumption of full capacity, 50% blockage and 100% blockage of the existing box culvert under Brigham Creek Road. The results indicate that there is an increase in flood level within Brigham Creek carriageway when the culvert is operating at half of its full capacity. The increase in flood levels is not only due to the proposed development but to the Maximum Probable Development (MPD) in the entire upstream catchment. Given that there are no affected habitable floors in the downstream properties and the proximity of the site to the coastal area, no mitigation of the 1% AEP is proposed. Any delay of peak discharge from the site would have a negative effect on the wider catchment peak flow as relates to the culvert. Due to the size of the box culvert, substantial blockage is considered unlikely.

The catchment plan and the flood assessment results are included in the flood and infrastructure report. The infrastructure report is attached in Appendix E. Flooding is discussed in section 7 in the infrastructure report.

6.2.6 Overland Flow Path and Floodplain Management

The entry points of the overland flow paths from 63, 65 and 67 Trig Road and the exits points will not be altered.

The proposed road corridors are designed to convey the 1% AEP minor overland flow for discharge to the existing exit points. Minor overland flow paths will be created through the lots to divert 1% AEP flow.

The HAC-RAS model results demonstrate that the extent of the 1% AEP floodplains for the post-development situation are contained within the stream banks, road reserves and the proposed overland flow paths. There are no detrimental effects to the neighbouring properties or downstream environment.

The future buildings shall be located outside of the floodplains and shall be provided with a minimum freeboard above the 1% AEP overland flow levels in accordance with the Auckland Council's Stormwater Code of Practice and the Building Code.

6.2.7 Development Staging

The current proposal is to create vacant lots. However, the proposed stormwater reticulations are designed to cater for the 10% AEP storm event flow from the development for the MPD scenario. Overland flow paths and flooding risk in the 1% AEP storm event are also assessed for MPD scenario. The climate change factor (as specified in section 4.2.10 of the Auckland Code of Practise for Land Development and Subdivision) has been accounted for in the stormwater assessment.

During the future development of the individual lots, private stormwater networks shall be designed to service the Lot.

Private stormwater devices for on-site retention and detention shall be provided during individual lot development. Stormwater devices such as tanks, bioretention (raingardens) or approved similar devices should be used. Retention volume shall be provided for at least 5mm of runoff depth from impervious surfaces with detention volumes being the difference between the pre-development and post-development runoff volumes from impervious surfaces in the 95th percentile, 24 hours rainfall event minus the achieved retention volume. Treatment shall be provided within the individual lots wherever the impervious areas are over 1,000m² or the proposed carparks are over 30 carparks for each future lot.

6.3 Hydraulic Connectivity

Public stormwater reticulations are proposed to convey the 10% AEP runoff from the development. The runoff from the impervious areas of proposed roads shall be collected by the cesspits after treatment in the raingardens before discharging to the public stormwater network.

The public stormwater network will discharge to the unnamed stream or to the gully at the north-eastern corner of proposed Lot 8. Outlet structures with riprap protection are proposed at each stormwater network discharge point. Private stormwater pipes shall be designed to collect the runoff from the future development of individual lots. On site mitigation and treatment shall be provided before discharging to the public stormwater network.

The entry and exit points are not altered. The catchments are retained as in the pre-development situation.

6.4 Asset Ownership

- Public stormwater reticulation is to be vested in Auckland Council. This includes stormwater pipes, manholes and outlet structures.
- Cesspits, raingardens, treatment devices in road reserves are to be vested in Auckland Transport.

6.5 Ongoing Maintenance Requirements

Draft Operation and Maintenance plans for stormwater devices and planting respectively are included in Appendix D. Maintenance of raingardens will transfer to Auckland Council and AT on completion. Maintenance of the planting within the riparian margin will be the responsibility of the relevant private Lot owners.

6.6 Implementation of Stormwater Network

Sediment and Erosion controls will be installed prior to the earthworks commencement and will be monitored and maintained during construction.

During the stage of subdividing the sites into 21 industrial lots and 2 balance lots, the proposed overland flow paths will be formed to manage the overland flow. The proposed stormwater networks will be installed to convey the 10% AEP flow. The proposed raingardens will be installed to provide the mitigation and treatment for the runoff from the impervious areas of the proposed roads. The surface will be mulched and topsoiled after the earthworks in the proposed lots.

The proposed stream works will be completed during the subdivision stage. The removal of the existing culverts and reinstating the stream bed will improve the watercourse. The riparian planting will not only provide banks stability but also to reduce the sediment entering the waterway and to mitigate adverse effects of stormwater runoff from the developed area.

During future development in the individual lots, private stormwater reticulation shall be installed to service the development. Private stormwater devices will be installed to provide the required mitigation and treatment.

6.7 Dependencies

Not Applicable within this SMP.

6.8 Risks

What is the risk to the proposed stormwater management?	How can this be mitigated/managed?	What other management/mitigation could be used?	When does this risk need to be address?	What is the resultant level of risk?
Infiltration	On-site testing		During the design	Low
Flow paths on Geomaps do not match the on-site topography	Complete site-specific topographic survey		During the design phase	Low
Streams and watercourses on the site are different to Geo Maps	Undertake site investigation and watercourses classification assessment		During the plan and design phase	Low
Raingardens are not installed properly	Construction monitoring		During the construction phase	Medium
Stormwater devices are not implemented correctly on lots	Implementation of a Consent Notice on the Record of Title referencing the Stormwater Mitigation requirements		During the planning and completion phase	Low

7.0 Departures from Regulatory or Design Codes

Not Applicable within this SMP.

8.0 Conclusions and Recommendations for Future Work

8.1 Conclusions

The design for this development was undertaken through a consultative process with Auckland Council and client representatives to create a product that is a suitable and appropriate end use for the site. The existing hydrology as well as the downstream environment are considered in the design.

The entry and exit points of the existing overland flow paths are maintained. The roading and earthworks design incorporates the conveyance of overland flow within the site. The flood assessment for both pre-development and post-development suggest an increase in flood levels at the existing box culvert with reduced levels at downstream. The increase is mainly due to the future MPD in the catchment and does not present a significant flood risk. No adverse effects are caused to the neighbouring and downstream habitable floors. The overland flow within the site is contained within the proposed roads and the unnamed stream channel.

The unnamed stream within the site will be enhanced by riparian planting and the removal of the existing culverts and artificial pond, and reinstating the stream bed.

New public drainage reticulation is proposed to accommodate runoff from the 10% AEP post development in MPD scenario.

Bioretention (Raingardens) will be installed to provide the required detention and treatment.

8.2 Recommendations

The stormwater principles recommended for the future development in individual lots are summarised below.

Tanks, raingardens, or similar stormwater devices shall be installed to provide the detention volume for the difference between the pre-development and post-development runoff volumes from the 95th percentile 24 hours.

Retention volumes for 5mm runoff depth from the impervious area shall be provided in the tanks or other devices for water-reuse.

Wherever the impervious areas are over 1,000m² or the proposed carparks are over 30 carparks for each future lot, treatment shall be provided by the private devices such as raingardens or stormfilter with GPT system or similar within the individual lots.

We recommend that Auckland Council implement a Consent Notice on each lot to ensure that required mitigation and treatment detailed in this report are provided.