APPENDIX C
Geotechnical Report

3 PIGEON MOUNTAIN ROAD, HALFMOON BAY, AUCKLAND, PROPOSED RESIDENTIAL DEVELOPMENT

Geotechnical Investigation Report

Document Number:	J00538AA
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Prepared For:	HND HMB Ltd
Date of Issue:	12 July 2022

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1. Introduction

Total Ground Engineering Ltd have been engaged by HND HMB Ltd to carry out a Geotechnical Investigation for the proposed residential development at 3 Pigeon Mountain Road, Halfmoon Bay, Auckland. The location of the site is shown in Figure 1.

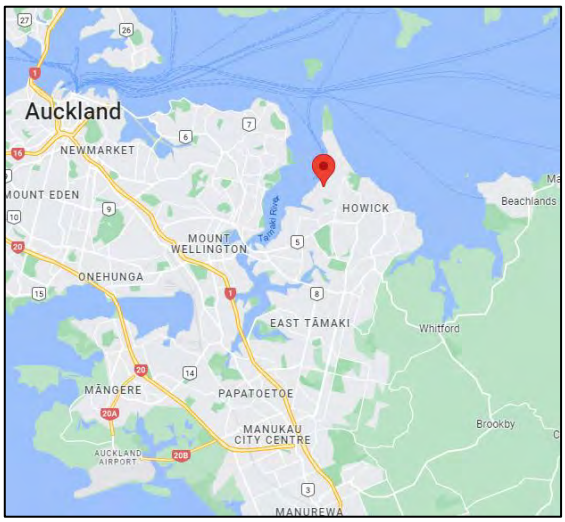


Figure 1, Locality Plan.

We understand that an approximate eighty townhouse residential development is proposed comprising two and/or three-storey light-weight timber structures. Minor earthworks are expected on the basis of a terraced development suited to the existing site topography.

Figure 2 shows a hand sketched scheme plan, extracted from (appendix A)

Figure 2, Hand sketched preliminary site plan.

This report has been prepared for HND HMB Ltd and presents the results of site investigations and engineering recommendations in support of resource consent applications to Auckland Council. Additional investigations and interpretation will be required for detailed design and Building Consent application.

2. Site Description

The site, legally described as Lot 1 DP 212125, is trapezoidal in shape covering an area of 1.4073 hectares. The site is located at the intersection of Compass Point Way and Pigeon Mountain Road and slopes gently to the north, away from Compass Point Way, toward Pigeon Mountain Road, at a gradient of approximately 1V:13H (approximate 4.4 degrees). Beyond the northern boundary, the slope steepens elevating the site approximately 3m above Pigeon Mountain Road.

The site is currently occupied by a school comprising five large school buildings located centrally with playgrounds, basketball court and carparking elsewhere with the remainder of ground coverage consisting of sports grounds. A sanitary sewer transects the site east to west, in the southern side of the site as shown in Figure 3.

Figure 3, Aerial view of site (Source, AC Geomaps)

3. Investigations

3.1 Previous Land Use

In order to help interpret the borelogs, we have investigated the land use history of the site from Auckland Council Geomaps. Figure 4 shows that the site was grassland without any buildings with the northern boundary being the edge of the foreshore. The land reclamation work for the half moon bay marina was completed before 1996. The reclamation filling extended onto the northern lower-lying portion of the site to construct Ara-Tai Road as clearly shown in Figure 5. The provided property files indicate the school development was completed in 2002 and as shown in Figure 6.

Figure 4, Aerial view of site in 1959 (Source, AC Geomaps)

Figure 5, Aerial view of site in 1996 (Source, AC Geomaps)

Figure 6, Aerial view of site in 2006 (Source, AC Geomaps)

3.2 Regional Geology

Reference has been made to the New Zealand Geology Web Map on the GNS website, http://data.gns.cri.nz/geology/, accessed on 10th June 2022 (refer Figure 7).

The maps indicate that the site is underlain by Tuff of the Auckland Volcanic Field (AVF, coloured purple in Figure 7). The AVF tuff comprises comminuted pre-volcanic materials with basaltic fragments, and unconsolidated ash and lapilli deposits. These volcanic materials can be spatially variable in terms of material types, often with abrupt end to ash deposits, with well sorted lapilli, tuff, ash and breccia at the margins.

The map indicates a geological boundary to the north of the site, mapped as East Coast Bays Formation (ECBF, coloured orange in Figure 7) of the Waitemata Group. The ECBF comprises alternating sandstone and mudstone with variable volcanic content and interbedded volcaniclastic grit beds.

The ECBF typically weathers at the surface forming stiff to very stiff silts and clays which can contain reactive clay mineralogy and be prone to shrinking and swelling due to varying moisture content conditions.

Figure 7, Snapshot of NZ Geological Map.

3.3 Fieldwork

Total Ground Engineering carried out a field investigation from 16 June to 21 June 2022 comprising the following:

- Eight hand augered boreholes and associated in-situ testing (i.e. shear vane and/or scala penetrometer testing), and;
- Scala penetrometer tests from the base of each borehole to refusal:
- Two soil samples collected for shrink-swell laboratory tests.
- Installed two standpipe piezometers and carried out groundwater monitoring.

The location of the hand augers and soil samples are shown in Figure 8 extracted from the *Test Location Plan* attached in Appendix B.

Soil conditions were logged by a TGE Engineering Geologist, in accordance with the New Zealand Geotechnical Society's, *Guideline for the Description of Soil and Rock for Engineering* Purposes (2005). The borelogs are attached in Appendix B.

In-situ shear vane tests were carried out at 0.5 m intervals to measure the undrained shear strength of fine-grained cohesive materials. Vane shear tests were carried out in accordance with the New Zealand Geotechnical Society Guideline for handheld shear vane test, (2001). Peak and remoulded shear strength values shown on field logs have been factored in terms of BS1377. The vane shear test results ranged between 53 kPa to 200+ kPa.

Dynamic Cone Penetrometer (Scala) testing was carried out at selected depths within the hand augured boreholes to determine soil density. Scala testing was carried out in accordance with NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer. The returning values ranging between 3 blows to 20+ blows per 100 mm penetration.

Detailed descriptions are given on the attached logs (Appendix B).

Figure 8, Investigation Plan.

4. Findings

4.1 Site Seismicity

For the purposes of deriving seismic loadings for the site in accordance with NZS 1170.5:2004 the site subsoil is considered Class C – Shallow soil site. This classification is based on depths of the residual soils inferred to be within the limits of Table 3.2 of the reference standard.

4.2 Geological Findings

Our investigations generally confirm the geology reported in the available literature. We have developed a geological cross section AA along the alignment shown in Figure 8.

Fill, associated with the marina reclamation, up to 4.0 m deep along the Pigeon Mountain Road boundary was encountered across the site. The composition and strength of the fill indicates that it can be considered as engineered fill.

AVF tuff was locally found in the southeast corner of the site (HA01, HA03 and HA04) and up to 2.5 m deep underlying the existing fill. The shear strength ranges from 100 kPa to 190+ kPa.

Puketoka formation, comprising stiff to very stiff silty clays and clayey silts, was encountered underlying the fill/AVF layer up to 5.0 m deep. This unit was not predicted by the geological maps. However, the engineering characteristics of the Puketoka Formation is similar to that of residually weathered ECBF.

The residual ECBF soils of sandy silt was only found in HA02 up to 5.0 m deep and not encountered in the rest of the investigation holes.

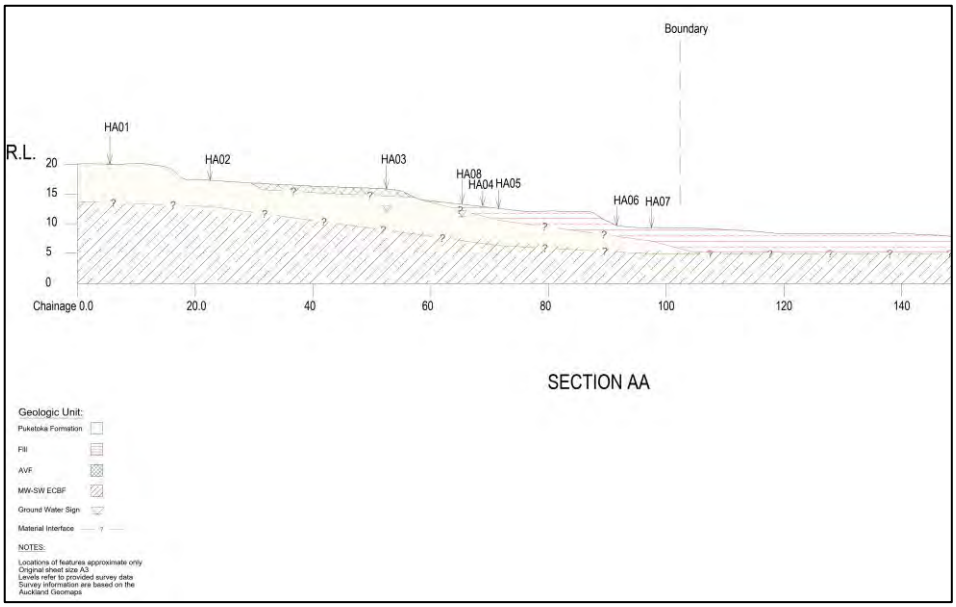


Figure 9. Geological Section AA.

Detailed investigation descriptions are given in the attached logs (Appendix B).

4.3 Groundwater

Groundwater was encountered at 3.0 m and 1.0 m deep at HA03 and HA08 respectively during the investigation and not encountered in the rest of the boreholes. It should be noted that groundwater levels/pressures can rise following periods of rainfall or fall during drier times.

Two standpipe piezometers, screened to 5 m depth were installed at HA02 and HA07. These are yet to be dipped.

4.4 Laboratory testing

Two samples at HA02 and HA07 were retrieved to carry out expansive soil tests by the testing laboratory to confirm the soil expansive soil class. The testing results are summarised in Table 1 and the detailed testing results are included in Appendix C. The interpretation of the test results is provided in Section 6.

Table 1. Expansive Soils Shrink-Swell Test Results.

Sample ID	Sample Depth (m)	Swelling Strain ε_{sw} (%)	Shrinkage Strain ε_{sh} (%)	Shrink-Swell Index I_{ss} (%)
SS01	0.8-1.0	4.0	13.9	8.8
SS02	0.4-0.6	0.7	4.8	2.8

5. Geohazard Evaluation

Section 106 of the Resource Management Act 1991, outlines hazards to be assessed by a Territorial Authority in considering a development application. Based on our desktop investigations and inspection of the site we make the following comments in regard to the geohazards.

5.1 Erosion

Council's Geomaps indicate only a small overland flow path from onsite runoff. Runoff from above the site is contained by Compass Point Way. Erosion is not considered a risk for the proposed development.

5.2 Falling debris

The land above is developed residential with no appreciable slope gradient so falling debris is not considered a risk.

5.3 Subsidence

The subsoils are engineered fill overlying puketoka formation and /or volcanic tuff with a bedrock of ECBF. Based on the fine-grained nature of the site soils, the age of the geological unit and the low seismic hazard of the Auckland region, the soils are not considered susceptible to liquefaction. The proposed structures are lightweight and there is no indication of deep filling required, so there is no significant risk of subsidence. However, as mentioned above, reactive clay minerals may cause seasonal shrink/swell which can be mitigated effectively during detailed design for building consent.

5.4 Slippage

The general site slope gradient is approximately 1V:13H, much gentler than the 1V:4H criteria for slope stability analysis suggested in *"Earthworks and Geotechnical Requirements" of the Auckland Council Code of Practice for Land Development & Subdivision.* On the basis of our site observations and review of the geomorphology evident from aerial photographs, there are no indicators of slope instability at the site or in the general area.

5.5 Inundation

According to the Auckland Council's Geomap, the site is not located within a floodplain or overland flow path, and inundation is not considered a risk.

6. Engineering Recommendations

6.1 Foundation Design

We understand the proposed structures will be a maximum of three-storeys high comprising lightweight timber frames and cladding. Shallow pad/slab foundations will generally be suitable, although piled foundations may be required for concentrated loads or bridging across pipelines.

The following geotechnical design parameters are provided for preliminary design to support financial planning and resource consent application. The geotechnical design parameters recommended below are provided in limit state format and should not be exceeded by factored limit state loads.

6.1.1 Shallow Foundations

We recommend the following design parameters for shallow pad foundations.

- Geotechnical Ultimate Bearing Capacity 300 kPa
- Partial strength factor 0.45
- Geotechnical Design Bearing Capacity 135 kPa

On the basis of our investigation and lab testing results, we consider the near surface residual soil to be extremely reactive and susceptible to moisture fluctuations and seasonal soil shrinkage and swelling (Class E, AS 2870:2011). Foundation design in expansive soil may be carried out in accordance with NZS3604 with reference to AS2870 for foundation design in expansive soils.

6.1.2 Piled Foundations

We recommend the following design parameters for piled foundations in combination with strength reduction factors for both static and seismic scenarios:

- Geotechnical Ultimate End-Bearing Capacity 600kPa
- Geotechnical Ultimate Skin Friction 80kPa
- Strength Reduction Factor 0.5(Static) /0.8 (Seismic)

Skin friction should be ignored for the upper 1.5m of the pile and the pile should be embedded at least three pile diameters in order to generate the end-bearing.

If deeper piles are required then end-bearing parameters could be increased to account for embedment into weathered ECBF rock. Further advice can be provided if required.

6.2 Retaining Walls

Although the detail architecture and civil design drawings are not provided at this stage, minor earthworks may be required to form the terraced building platforms with retained heights between terraces.

We envisage standard masonry retaining walls on pad foundations or timber soldier piled walls, to be subject to detailed design for building consent.

The following soil parameters may be assumed for retaining wall design:

- Unit Weight of the soil 18 kN/m^3
- Active earth pressure coefficient K_a 0.33
- At-rest earth pressure coefficient K_o 0.5
- Undrained shear strength (to calculate pole embedment) 70 kPa
- Coefficient of sliding resistance (i.e. tanδ) 0.36

Walls which are integral to structures should be designed for at-rest earth pressures and retaining walls which are independent of structures may be designed for active earth pressures. Retaining walls should also be designed accounting for surcharge loads and batter-slopes above or below the wall.

Appropriate load factors should be applied in accordance with the building code and a strength reduction factor of 0.5 should be applied to the passive resistance and 0.8 for sliding resistance. For gravity walls, bearing capacity can be determined as per recommendations in Section 6.1.1.

6.3 Pipe Bridging

Where structures are required to bridge across sewers, piled foundations should be designed in accordance with the design parameters provided in Section 6.1.2 and proportioned to isolate the sewer from the structure as required by the infrastructure owner.

6.4 Pavement Design

Based on the shear vane tests we recommend a CBR value of 5% for pavement design. The clays and silts may be sensitive to trafficking during construction and the construction methodology should account for this. It is recommended that topsoil and any existing fill should be stripped from the pavement footprint and scala penetrometer tests or Clegg hammer tests should be carried out to confirm CBR values when constructing the pavements.

6.5 Earthworks

We recommend that all earthworks are carried out in accordance with the following documents:

- New Zealand Standard Code of Practice for Earthworks for Residential Development, NZS4431.1989.
- Section 2 “Earthworks and Geotechnical Requirements” of the Auckland Council Code of Practice for Land Development & Subdivision (Version 1.6 dated 24 September 2013)

Fill should be appropriately monitored and tested during placement and compaction and its suitability for final residential development confirmed by a suitably qualified geotechnical engineer. Cuts and fills greater than 600mm depth should be assessed at the detailed design stage by a geotechnical engineer familiar with the contents of this report.

6.5.1 Filling

Investigations indicate the existing fill with variable depth across the site. Any unsuitable fill material should be removed after stripping the topsoil and replaced with clean, inorganic clays and silts or approved engineering fill. Fill testing should be carried out to verify compaction to engineer-certified standards.

Earthworks should be undertaken with conventional plant in accordance with the following subdivision and building development standards:

- NZS 4404 “*Land Development and Subdivision Engineering*”
- NZS 4431 “*Code* of *Practice for Earth Fill for Residential Development”*

We recommend that earthwork excavations are carried out during the dry months. However, excavations should be carried out with temporary drainage channels to intercept any groundwater ingress. These temporary drains should lead to sumps and a mechanism for sediment retention prior to discharging to the Council system. Appropriate permits will be necessary from the Council for such works.

Temporary excavations greater than 1.0m should be battered no steeper than 1H:1V, while excavations of less than 1.0m in height may generally be cut vertical. These recommendations are provided as guidelines only for situations where excavations are well clear of existing structures, boundaries, neighbouring retaining walls, or any other form of surcharge. In these instances, staged excavations, shallower batters, temporary retaining etc. may be required. However, it should be understood maintenance of temporary stability is the responsibility of the contractor.

All permanent cuts and fills at this site can be battered at 1V:4H. Once the batter slopes have reached their finished geometry, they should be stabilized with topsoil and/or root binding vegetation.

6.5.2 Hardfill compaction:

All fill should be placed on suitable subgrade, free of any topsoil or unsuitable materials. At this stage we recommend the use of hardfill (GAP65) as opposed to site-won silts and clays as it is more practical to compact effectively. The compaction of the hardfill should be undertaken using a heavy plate compactor or smooth-drum vibrating roller. Filling should be placed in layers not exceeding 200 mm lifts. Compaction specifications are provided in Table 2.

Table 2. Required CIV Values for hardfill compaction

Foundation Support	Equivalent Clegg Impact Value (CIV)	
	Minimum	Average
Foundation/ Footing/ Beams/ Slabs	15	20

7. Further Geotechnical Involvement

7.1 Detailed Design and Building Consent

A suitably qualified geotechnical engineer familiar with the findings of this reports should be engaged to review the final drawings of the proposed development, prior to submission to the Auckland Council for building consent. Further geotechnical investigation, analysis, design, or reporting may be warranted at this stage subject to the specifics of the proposal.

7.2 Construction Observations

A suitably qualified geotechnical engineer familiar with the findings of this report should be engaged to carry out observations during construction to confirm subsurface conditions are consistent with those described in this report.

8. Closure

For resource consent purposes our investigations and assessment of hazards confirms that the development is feasible and not exposed to any significant geohazards.

Shallow pad or deep foundations are suitable and should be designed in accordance with the recommendations contained in this report. Retaining walls should be specifically designed in accordance with the recommendations in this report and temporary support of excavations should be specifically designed to isolate neighbouring structures from the effects of the earthworks.

We trust this report meets your requirements. Please contact the undersigned if you have any questions.

Prepared by:

Jared Healey

Engineering Geologist

BSc(Geology), PGDipSci(Earth Science)

Total Ground Engineering

Reviewed and Authorised by:

Neil Jacka
Principal Geotechnical Engineer
BE(Hons), CMEngNZ, IntPE

Total Ground Engineering

Appendices

Appendix A.	Reference Information
Appendix B.	Investigation Location Plan & Borelogs
Appendix C	Laboratory Results

Limitations

This report has been prepared by Total Ground Engineering for our client's use in accordance with the proposed development plan and agreed scope of work. Any use or reliance by any other person, to which Total Ground Engineering has not given its prior written consent, is at that person's own risk.

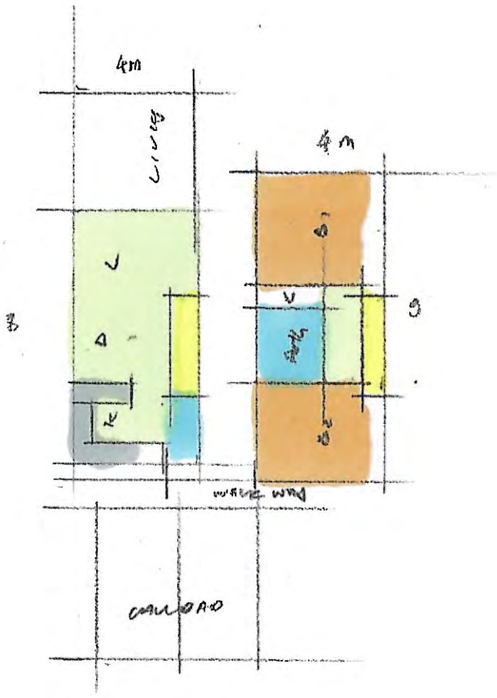
The findings, recommendations and comments presented in this report are based on common methods of site investigation. The site investigation has been undertaken at discrete locations and ground conditions away from these locations could vary.

Appendix A
Reference Information (Archi Scheme Sketches)

TYPE A	410 2STOREY - 2B 1 CARPAD 70SQM	19
TYPE B	415M 2STOREY - 3BED 2 CAR PAD 99SQM	28
TYPE C	415M 2STOREY 3BED 1 GARAGE + 1 CAR PARK	4
TYPE D	65M WIDE 4BED 2 STOREY 1 GARAGE + 1 CAR PAD 157SQM	22
TYPE E	6.5M ++ 4BED PLUS 2STOREY 4BED DOUBLE GARAGE 190	6
		79 units

10 40 8 × 4 = 32

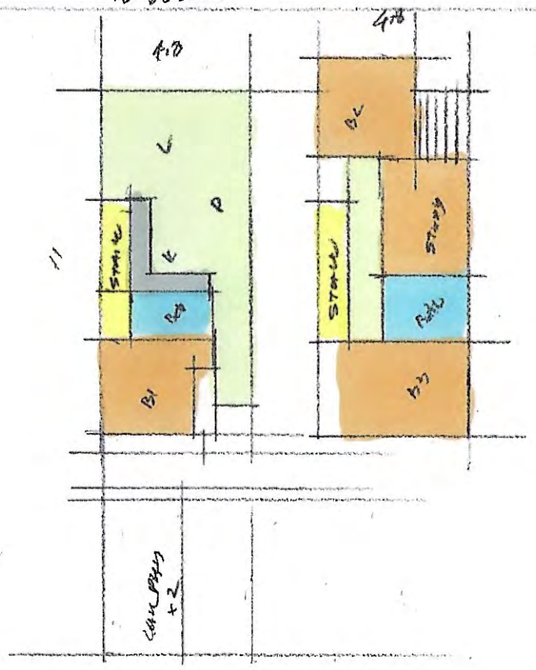
2STOREY OPTION



TYPE A 4.0 2 BED

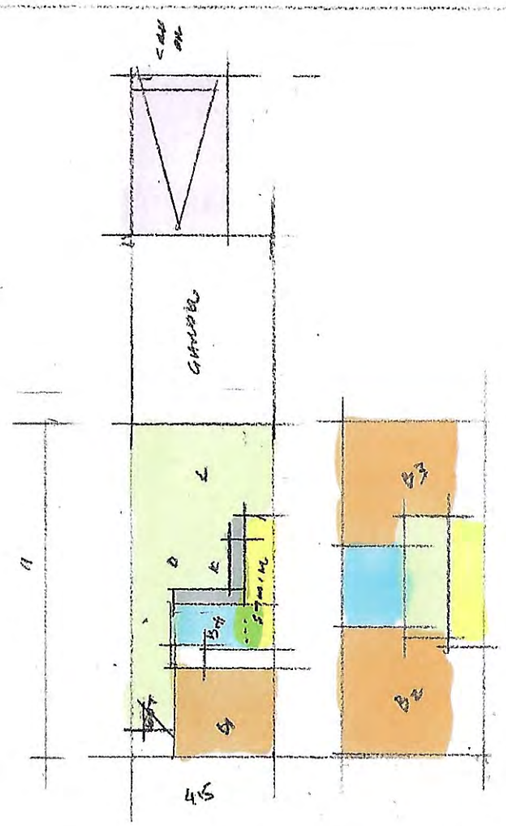
LO — 32
U1 — 36
≈ 68 SQM.

TYPE D — LO 31
U1 47
157 m²



TYPE B 4.0 3 BED

LO = 52.8
U1 = 53.0
≈ 105.6 SQM

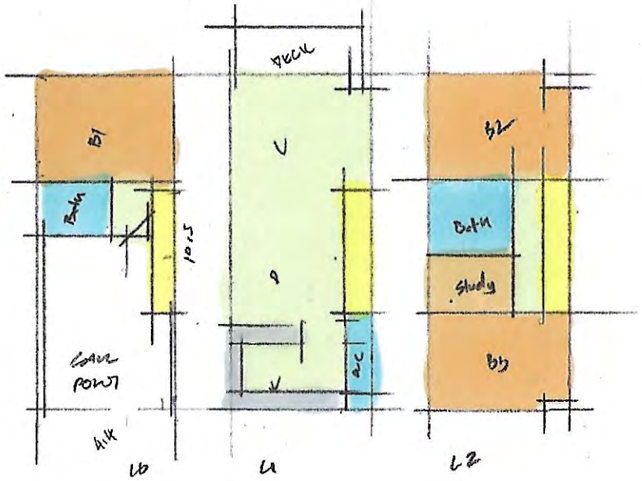


TYPE C — 3 BED LO 66
U1 49
114 SQM

TYPOLOGY FOR 2 STOREY
OPTION

TYPE A	15M WIDE 3 STOREY – BDRM + STUDY 1 CAR GARAGE	120 SQ M	15
TYPE B	5M WIDE 3 STOREY – 3BDRM + ISTUDY 1 GARAGE + 1 CARPARK	1140	27
TYPE C	6M WIDE 3 STOREY – 4 BDRM + FAMILY 1 GARAGE + 1 CARPARK	160	2
TYPE D	5.5M WIDE 3 STOREY 4BDRM + STUDY 1 CAR GARAGE + CARPARK	150	33
TYPE E	5.5++ WIDE 3 STOREY 4BDRM DOUBLE GARAGE	160	4
			81 units

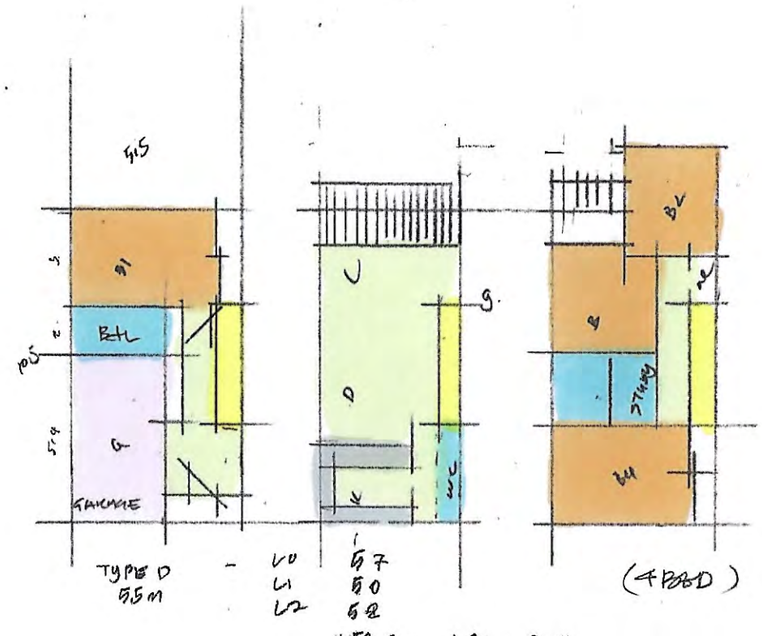
3 STOREY OPTION



TYPE A
4.4M

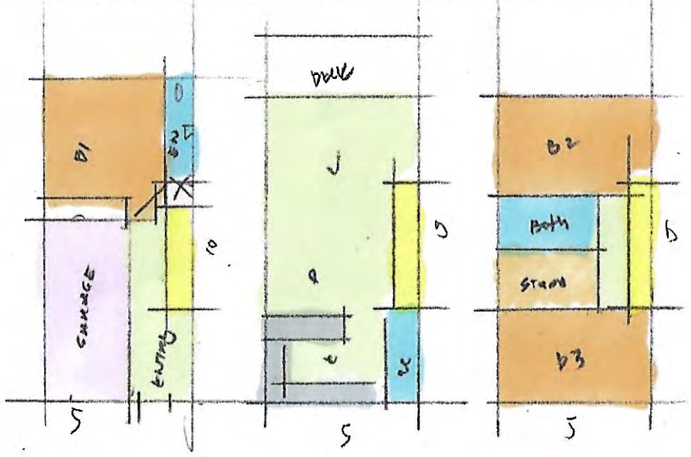
L0 44
L1 44
L2 40
128 SQM +8 SQM @

3 storey – 1 CAR GARAGE
– 3+1



TYPE D
5.5m

L0 57
L1 50
L2 52
159 SQM +8 SQM DECK



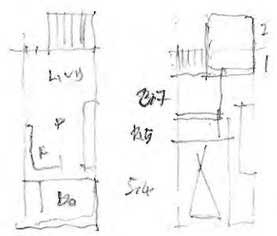
TYPE D
6m

L0 – 50
L1 45
L2 45
140 + 8 SQM

3 storey 1 GARAGE + 1 CAR PAD
3+1

3 STOREY TERRACE
HOUSE TYPOLOGY

TYPE A	11.5M WIDE 3 STOREY – BBED + STUDY 1 CAR GARAGE 120 SQM	14
TYPE B	5M WIDE 3 STOREY – BBED + STUDY 1 GARAGE + 1 CARPAD 140	25
TYPE C	5M WIDE 160 3 STOREY – 4 BED + FAMILY 1 GARAGE + 1 CARPAD	3
TYPE D	6M WIDE 160 3 STOREY 4BED + STUDY 1 CAR GARAGE + CARPAD	30
TYPE E	6M WIDE 180 3 STOREY 4BED DOUBLE GARAGE	5
		77 units



3
3
2
5.4
13.4

5X13.4=

LARGE 3 STOREY 4BED

Appendix B
Investigation Plan and Borelogs

TOTAL GROUND ENGINEERING

27C WAIPAREIRA AVENUE
HENDERSON

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njacka@tge.co.nz

PROJECT
3 PIGEON MOUNTAIN
HALF MOON BAY
AUCKLAND

DRAWING TITLE
INVESTIGATION PLAN

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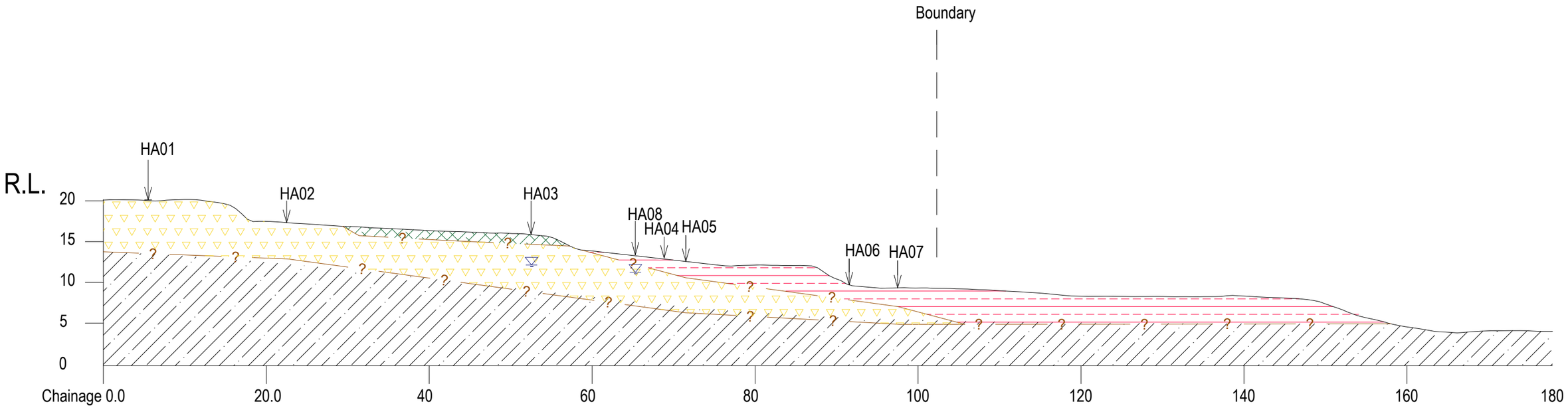

SECTION AA

Geologic Unit:

- Puketoka Formation
- Fill
- AVF
- MW-SW ECBF
- Ground Water Sign
- Material Interface —— ? ——

NOTES:

Locations of features approximate only
Original sheet size A3
Levels refer to provided survey data
Survey information are based on the Auckland Geomaps

TOTAL GROUND ENGINEERING

27C WAIPAREIRA AVENUE
HENDERSON

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PROJECT
3 PIGEON MOUNTAIN
HALF MOON BAY
AUCKLAND

DRAWING TITLE
GEOLOGICAL SECTION AA

Date:	JUL 2022
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TOTAL GROUND ENGINEERING

Client: HND HMB Ltd
Project: Geotechnical Investigation for Proposed Residential Development
Address: 3 Pigeon Mountain Road, Half Moon Bay, Auckland

Augerhole No. HA01
Sheet No. 1 of 1

Drill Type:	50mmØ Hand Auger	Project No:	J00538	Logged By:	JH
Drilled By:	JH	Coordinates:	NZTM2000 E1769285.17 N5916423.99	Shear Vane No:	2982
Date Started:	15-Jun-22	Ground Conditions:	Slightly sloping, Grass	Calibration Factor:	1.571
Date Finished:	15-Jun-22	Groundwater Level (m):	Not Encountered (15-Jun-22)	Calibration Date:	18-Sep-20

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005
FILL	0.5		SILT, minor fine to coarse sand, minor fine sub-angular gravel, brown and brownish orange intermixed, stiff, moist, non-plastic [FILL]
AUCKLAND VOLCANIC FIELD	1.0		SILT, minor to some clay, some fine to medium sand, brownish-orange with grey bands, very stiff, moist, slightly plastic [TUFF]
			no clay, hard, non-plastic
	1.5		trace clay, light grey with orange and black mottles
	2.0		
PUKETOKA FORMATION	2.5		Clayey SILT, trace fine sand, light grey with dark orange bands, very stiff, moist, moderately to highly plastic [PUKETOKA FORMATION]
	3.0		
	3.5		minor fine to medium sand
	4.0		
	4.5		
	5.0		End of Augerhole 5.0m [TARGET DEPTH]

Groundwater Level (m): Not Encountered

In-situ Field Testing

Shear Strength (kPa) — Peak: ● Remoulded: ○ — 0 50 100 150 200

Dynamic Cone (Scala) Penetrometer — Scala Blow Count / 100mm — 0

Depth (m)	Blow Count
0.5	Gravel Obstruction
1.0	192
1.5	198
2.0	UTP 200+
2.5	132
3.0	130
3.5	88
4.0	66
4.5	57
5.0	69

In-situ field testing in accordance with the following Standards:
Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer
Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

TOTAL GROUND ENGINEERING

Client: HND HMB Ltd
Project: Geotechnical Investigation for Proposed Residential Development
Address: 3 Pigeon Mountain Road, Half Moon Bay, Auckland

Augerhole No. HA02
Sheet No. 1 of 1

Drill Type:	50mmØ Hand Auger	Project No:	J00538	Logged By:	JH
Drilled By:	JH	Coordinates:	NZTM2000 E1769250.13 N5916486.75	Shear Vane No:	2982
Date Started:	16-Jun-22	Ground Conditions:	Near level, Grass	Calibration Factor:	1.571
Date Finished:	16-Jun-22	Groundwater Level (m):	Not Encountered (16-Jun-22)	Calibration Date:	18-Sep-20

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005
TOPSOIL/FILL	0.5		SILT, trace fine to coarse sand, minor clay, dark brown, stiff, moist, slightly plastic [TOPSOIL/FILL]
PUKETOKA FORMATION	1.0		Silty CLAY, trace fine sand, light grey with light orange streaks, stiff, moist, highly plastic [PUKETOKA FORMATION]
	1.5		SILT, some clay, some fine to medium sand, light grey with orange streaks, stiff, moist, slightly plastic
	2.0		minor clay
	2.5		orange with light grey bands
EAST COAST BAYS FORMATION	3.0		Fine to medium sandy SILT, light grey with orange bands, very stiff, moist, non to slightly plastic [EAST COAST BAYS FORMATION]
	3.5		grey
	4.0		
	4.5		
	5.0		SILT, some clay, trace fine sand, dark grey, hard, moist, slightly plastic
			End of Augerhole 5.0m [TARGET DEPTH]

Groundwater Level (m): Not Encountered

In-situ Field Testing

Shear Strength (kPa) — Peak: ● Remoulded: ○ — 0 50 100 150 200

Depth (m)	Shear Strength (kPa)
0.5	85
1.0	101
1.5	101
2.0	101
2.5	123
3.0	135
3.5	167
4.0	182
4.5	116
5.0	UTP 200+

Dynamic Cone (Scala) Penetrometer

Depth (m)	Blow Count	Scala Blow Count / 100mm
-0.1		0
-0.2		
-0.3		
-0.4		
-0.5		
-0.6		
-0.7		
-0.8		
-0.9		
-1.0		
-1.1		
-1.2		
-1.3		
-1.4		
-1.5		
-1.6		
-1.7		
-1.8		
-1.9		
-2.0		
-2.1		
-2.2		
-2.3		
-2.4		
-2.5		
-2.6		
-2.7		
-2.8		
-2.9		
-3.0		
-3.1		
-3.2		
-3.3		
-3.4		
-3.5		
-3.6		
-3.7		
-3.8		
-3.9		
-4.0		
-4.1		
-4.2		
-4.3		
-4.4		
-4.5		
-4.6		
-4.7		
-4.8		
-4.9		
-5.0		

In-situ field testing in accordance with the following Standards:
Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer
Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

TOTAL GROUND ENGINEERING

Client: HND HMB Ltd
Project: Geotechnical Investigation for Proposed Residential Development
Address: 3 Pigeon Mountain Road, Half Moon Bay, Auckland

Augerhole No. HA03
Sheet No. 1 of 1

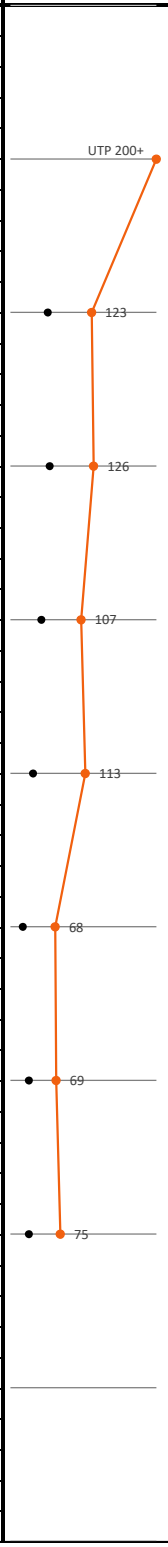
Drill Type:	50mmØ Hand Auger	Project No:	J00538	Logged By:	JH
Drilled By:	JH	Coordinates:	NZTM2000 E1769323.22 N5916452.24	Shear Vane No:	2982
Date Started:	15-Jun-22	Ground Conditions:	Near level, Grass	Calibration Factor:	1.571
Date Finished:	15-Jun-22	Groundwater Level (m):	3.0m (15-Jun-22)	Calibration Date:	18-Sep-20

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005
TS/FILL	0		SILT, minor fine sand, trace clay, brown, stiff, moist, non-plastic [TOPSOIL/FILL]
AUCKLAND VOLCANIC FIELD	0.5		SILT, some fine sand, trace clay, orange with grey bands, hard, dry, non-plastic [TUFF]
PUKETOKA FORMATION	1.0		Clayey SILT, minor fine to medium sand, light grey with orange streaks, very stiff, moist, slightly to moderately plastic [PUKETOKA FORMATION] trace decomposed organic mottles
	1.5		
	2.0		
	2.5		
	3.0		Fine to medium sandy SILT, minor clay, light grey with orange streaks, stiff, moist, moderately plastic
	3.5		
	4.0		Silty fine to medium SAND, light grey, loose, saturated
	4.5		
	5.0		End of Augerhole 5.0m [TARGET DEPTH]

Groundwater Level (m): GW = 3.0m (15-Jun-22)

In-situ Field Testing

Shear Strength (kPa) — Peak: / Remoulded: — 0 50 100 150 200



Dynamic Cone (Scala) Penetrometer

Depth (m)	Blow Count	Scala Blow Count / 100mm
-0.1 to -4.3		
-4.4	1	
-4.5	2	
-4.6	2	
-4.7	3	
-4.8	3	
-4.9	4	
-5.0		

In-situ field testing in accordance with the following Standards:
Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer
Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

TOTAL GROUND ENGINEERING

Client: HND HMB Ltd
Project: Geotechnical Investigation for Proposed Residential Development
Address: 3 Pigeon Mountain Road, Half Moon Bay, Auckland

Augerhole No. HA04
Sheet No. 1 of 1

Drill Type:	50mmØ Hand Auger	Project No:	J00538	Logged By:	JH
Drilled By:	JH	Coordinates:	NZTM2000 E1769362.55 N5916428.41	Shear Vane No:	2982
Date Started:	15-Jun-22	Ground Conditions:	Near level, Grass	Calibration Factor:	1.571
Date Finished:	15-Jun-22	Groundwater Level (m):	Not Encountered (15-Jun-22)	Calibration Date:	18-Sep-20

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005
FILL	0.0		SILT, minor clay, minor fine to coarse sand, trace fine sub-angular gravel, brown, grey and orange intermixed, stiff, moist, non to slightly plastic [FILL]
AUCKLAND VOLCANIC FIELD	1.0		SILT, trace clay, minor fine to coarse sand, greyish brown with light orange mottles, very stiff, dry, non-plastic [TUFF]
			dark orange and greyish orange intermixed
	2.0		some fine to medium sand
PUKETOKA FORMATION	2.5		Silty CLAY, trace fine sand, grey, very stiff, moist, highly plastic [PUKETOKA FORMATION]
			light whitish grey
	3.5		Clayey SILT, minor fine to medium sand, light whitish-grey with yellow streaks, very stiff, moist, moderately to highly plastic
	4.0		some fine to medium pumiceous sand
	5.0		End of Augerhole 5.0m [TARGET DEPTH]

Groundwater Level (m): Not Encountered

In-situ Field Testing

Shear Strength (kPa) — Peak: ● Remoulded: ○ — 0 50 100 150 200

Depth (m)	Shear Strength (kPa)
0.5	110
1.0	159
1.5	UTP 200+
2.0	107
2.5	110
3.0	110
3.5	107
4.0	91
4.5	96
5.0	91

Dynamic Cone (Scala) Penetrometer

Depth (m)	Blow Count	Scala Blow Count / 100mm
-0.1		0
-0.2		
-0.3		
-0.4		
-0.5		
-0.6		
-0.7		
-0.8		
-0.9		
-1.0		
-1.1		
-1.2		
-1.3		
-1.4		
-1.5		
-1.6		
-1.7		
-1.8		
-1.9		
-2.0		
-2.1		
-2.2		
-2.3		
-2.4		
-2.5		
-2.6		
-2.7		
-2.8		
-2.9		
-3.0		
-3.1		
-3.2		
-3.3		
-3.4		
-3.5		
-3.6		
-3.7		
-3.8		
-3.9		
-4.0		
-4.1		
-4.2		
-4.3		
-4.4		
-4.5		
-4.6		
-4.7		
-4.8		
-4.9		
-5.0		

In-situ field testing in accordance with the following Standards:
Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer
Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

TOTAL GROUND ENGINEERING

Client: HND HMB Ltd
Project: Geotechnical Investigation for Proposed Residential Development
Address: 3 Pigeon Mountain Road, Half Moon Bay, Auckland

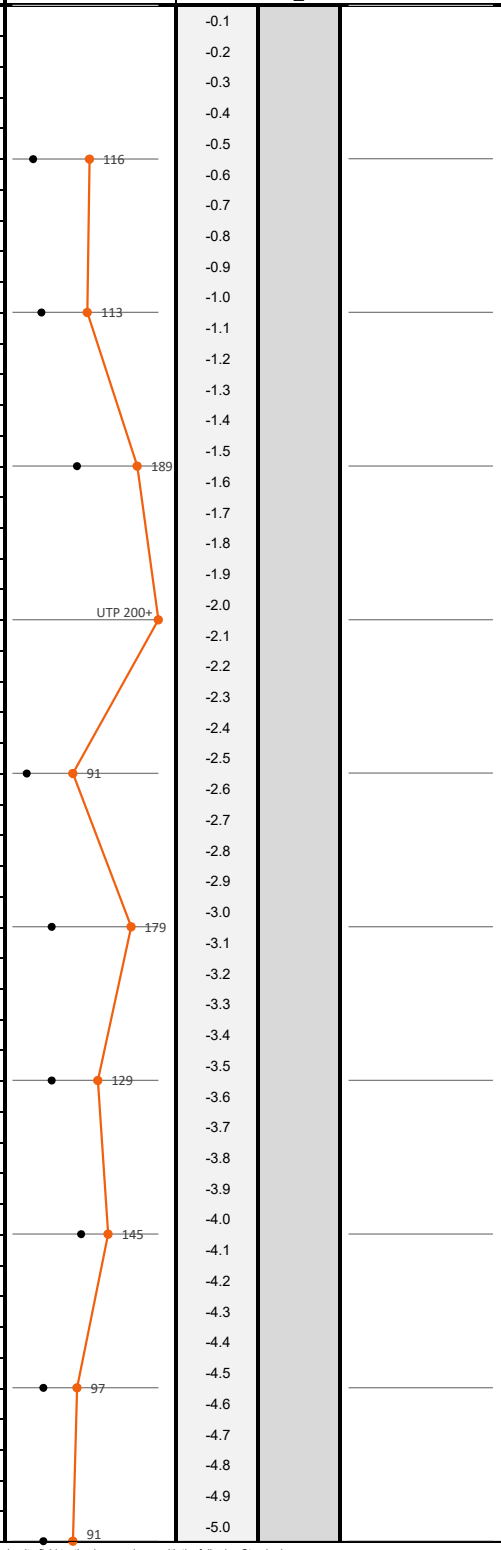
Augerhole No. HA05
Sheet No. 1 of 1

Drill Type:	50mmØ Hand Auger	Project No:	J00538	Logged By:	JH
Drilled By:	JH	Coordinates:	NZTM2000 E1769315.7 N5916485.41	Shear Vane No:	2982
Date Started:	16-Jun-22	Ground Conditions:	Near level, Grass	Calibration Factor:	1.571
Date Finished:	16-Jun-22	Groundwater Level (m):	Not Encountered (16-Jun-22)	Calibration Date:	18-Sep-20

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005
TS/F			SILT, trace clay, minor fine to coarse sand, brown, stiff, moist, non-plastic [TOPSOIL/FILL]
FILL	0.5		Clayey SILT, minor fine to coarse sand, trace fine to medium sub-angular gravel, light brown, grey and orange intermixed, stiff, moist, moderately plastic [FILL]
	1.0		
	1.5		SILT, some clay, minor fine to coarse sand, trace fine sub-angular gravel, brownish-orange and light grey intermixed, very stiff, moist, slightly to moderately plastic, trace rootlet inclusions
	2.0		no clay, no gravel, no rootlet inclusions, orange
	2.5		Silty CLAY, trace fine sand, light grey with orange streaks, stiff, wet, highly plastic light grey with black and dark orange mottles, trace rootlet inclusions
	3.0		
	3.5		Clayey SILT, minor fine to medium sand, bluish grey, grey and orange intermixed, stiff, moist, moderately plastic, trace rootlet inclusions
	4.0		
PUKETOKA FORMATION	4.5		Silty CLAY, minor fine to medium sand, light bluish grey with orange streaks, very stiff, wet, highly plastic [PUKETOKA FORMATION]
	5.0		End of Augerhole 5.0m [TARGET DEPTH]

Groundwater Level (m): Not Encountered

In-situ Field Testing



In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

Total Ground Engineering Ltd. 27C Waipareira Ave, Henderson, 0610
PO Box 27294, Glen Eden, 0604, Auckland, New Zealand
Phone: +64 9 216 7330
Website: www.totalgroundengineering.com

TOTAL GROUND ENGINEERING

Client: HND HMB Ltd
Project: Geotechnical Investigation for Proposed Residential Development
Address: 3 Pigeon Mountain Road, Half Moon Bay, Auckland

Augerhole No. HA06
Sheet No. 1 of 1

Drill Type:	50mmØ Hand Auger	Project No:	J00538	Logged By:	JH
Drilled By:	JH	Coordinates:	NZTM2000 E1769355.93 N5916465.98	Shear Vane No:	2982
Date Started:	16-Jun-22	Ground Conditions:	Sloping, Grass	Calibration Factor:	1.571
Date Finished:	16-Jun-22	Groundwater Level (m):	Not Encountered (16-Jun-22)	Calibration Date:	18-Sep-20

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005	Groundwater Level (m)	Depth (m)	In-situ Field Testing: Shear Strength (kPa) (Peak: / Remoulded:) 0 50 100 150 200	In-situ Field Testing: Dynamic Cone (Scala) Penetrometer Depth (m)	Blow Count	Scala Blow Count / 100mm 0
FILL			SILT, minor fine to medium angular gravel, trace clay, dark brown, stiff, moist, non-plastic [FILL]				-0.1		
							-0.2		
							-0.3		
							-0.4		
	0.5		End of Augerhole 0.4m		0.5		-0.5		
			[GRAVEL OBSTRUCTION]				-0.6		
							-0.7		
							-0.8		
							-0.9		
	1.0				1.0		-1.0		
							-1.1		
							-1.2		
							-1.3		
							-1.4		
	1.5				1.5		-1.5		
							-1.6		
							-1.7		
							-1.8		
							-1.9		
	2.0				2.0		-2.0		
							-2.1		
							-2.2		
							-2.3		
							-2.4		
	2.5				2.5		-2.5		
							-2.6		
							-2.7		
							-2.8		
							-2.9		
	3.0				3.0		-3.0		
							-3.1		
							-3.2		
							-3.3		
							-3.4		
	3.5				3.5		-3.5		
							-3.6		
							-3.7		
							-3.8		
							-3.9		
	4.0				4.0		-4.0		
							-4.1		
							-4.2		
							-4.3		
							-4.4		
	4.5				4.5		-4.5		
							-4.6		
							-4.7		
							-4.8		
							-4.9		
	5.0				5.0		-5.0		

In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

TOTAL GROUND ENGINEERING

Client: HND HMB Ltd
Project: Geotechnical Investigation for Proposed Residential Development
Address: 3 Pigeon Mountain Road, Half Moon Bay, Auckland

Augerhole No. HA07
Sheet No. 1 of 1

Drill Type:	50mmØ Hand Auger	Project No:	J00538	Logged By:	JH
Drilled By:	JH	Coordinates:	NZTM2000 E1769333.95 N5916508.07	Shear Vane No:	2982
Date Started:	16-Jun-22	Ground Conditions:	Near level, Grass	Calibration Factor:	1.571
Date Finished:	16-Jun-22	Groundwater Level (m):	Not Encountered (16-Jun-22)	Calibration Date:	18-Sep-20

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005
FILL	0.5		SILT, minor clay, some fine to coarse sand, trace fine sub-rounded gravel, brown, very stiff, moist, non-plastic [FILL]
	1.0		Clayey SILT, minor fine to coarse sand, trace fine sub-angular gravel, brownish grey, light grey and orange intermixed, very stiff, moist, moderately plastic
	1.5		
	2.0		
	2.5		
	3.0		
	3.5		orange with brownish-grey bands, trace rounded limonite gravel
PUKETOKA FORMATION	4.0		Fine to medium sandy SILT, some clay, light grey with minor decomposed silt inclusions as black bands, stiff, wet, slightly plastic
	4.5		trace medium angular basalt gravel
	5.0		End of Augerhole 5.0m [TARGET DEPTH]

Groundwater Level (m): Not Encountered

In-situ Field Testing

Depth (m)	Shear Strength (kPa) (Peak: / Remoulded:) 0 50 100 150 200	Dynamic Cone (Scala) Penetrometer: Depth (m)	Blow Count	Scala Blow Count / 100mm 0
0.5	145	-0.1 to -0.5		
1.0	110	-0.6 to -1.0		
1.5	140+	-1.1 to -1.5		
2.0	UTP 200+	-1.6 to -2.0		
2.5	148	-2.1 to -2.5		
3.0	110	-2.6 to -3.0		
3.5	132	-3.1 to -3.5		
4.0	85	-3.6 to -4.0		
4.5	85	-4.1 to -4.5		
5.0	115	-4.6 to -5.0		

In-situ field testing in accordance with the following Standards:
Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer
Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

Total Ground Engineering Ltd. 27C Waipareira Ave, Henderson, 0610
PO Box 27294, Glen Eden, 0604, Auckland, New Zealand
Phone: +64 9 216 7330
Website: www.totalgroundengineering.com

TOTAL GROUND ENGINEERING

Client: HND HMB Ltd
Project: Geotechnical Investigation for Proposed Residential Development
Address: 3 Pigeon Mountain Road, Half Moon Bay, Auckland

Augerhole No. HA08
Sheet No. 1 of 1

Drill Type:	50mmØ Hand Auger	Project No:	J00538	Logged By:	JH
Drilled By:	JH	Coordinates:	NZTM2000 E1769257.06 N5916543.39	Shear Vane No:	2982
Date Started:	16-Jun-22	Ground Conditions:	Slightly sloping, Grass	Calibration Factor:	1.571
Date Finished:	16-Jun-22	Groundwater Level (m):	1.0m (16-June-22)	Calibration Date:	18-Sep-20

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005
FILL	0.0		SILT, minor clay, trace fine to coarse sand, trace fine sub-angular gravel brownish-grey with orange mottles, stiff, moist, non-plastic [FILL]
	1.0		saturated
	1.5		some clay, orange with light grey bands, hard, saturated, slightly to moderately plastic, trace charcoal inclusions
	2.0		minor fine to coarse sand, trace fine angular gravel, brown, brownish orange and dark grey intermixed
PUKETOKA FORMATION	2.5		Silty CLAY, minor fine to medium sand, light grey with light orange streaks, trace fine sub-rounded limonite gravel, very stiff, saturated, highly plastic [PUKETOKA FORMATION]
	3.0		SILT, some clay, minor fine to coarse sand, trace fine sub-rounded gravel, grey, blue, brown and orange intermixed, very stiff, wet, moderately plastic
	3.5		Organic SILT, some clay, trace fine sand, black, stiff, saturated, moderately plastic [AMORPHOUS PEAT]
	4.0		Fine to coarse sandy SILT, minor silty clay bands, trace shell fragments to 20mm, trace fine to medium sub-rounded gravel, grey, brown, green and orange intermixed, stiff, saturated, slightly plastic [MARINE DIPOSITS]
	5.0		End of Augerhole 5.0m [TARGET DEPTH]

Groundwater Level (m): GW = 1.0m (16-June-22)

In-situ Field Testing

Shear Strength (kPa) — Peak: ● Remoulded: ◉ — 0 50 100 150 200

Depth (m)	Peak	Remoulded
0.5	119	
1.0	UTP 200+	
1.5	140+	
2.0	159	
2.5	135	
3.0	130	
3.5	53	
4.0	126	
4.5	75	
5.0	60	

Dynamic Cone (Scala) Penetrometer

Depth (m)	Blow Count	Scala Blow Count / 100mm
-0.1		
-0.2		
-0.3		
-0.4		
-0.5		
-0.6		
-0.7		
-0.8		
-0.9		
-1.0		
-1.1		
-1.2		
-1.3		
-1.4		
-1.5		
-1.6		
-1.7		
-1.8		
-1.9		
-2.0		
-2.1		
-2.2		
-2.3		
-2.4		
-2.5		
-2.6		
-2.7		
-2.8		
-2.9		
-3.0		
-3.1		
-3.2		
-3.3		
-3.4		
-3.5		
-3.6		
-3.7		
-3.8		
-3.9		
-4.0		
-4.1		
-4.2		
-4.3		
-4.4		
-4.5		
-4.6		
-4.7		
-4.8		
-4.9		
-5.0		

In-situ field testing in accordance with the following Standards:
Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer
Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

TOTAL GROUND ENGINEERING

Client: HND HMB Ltd
Project: Geotechnical Investigation for Proposed Residential Development
Address: 3 Pigeon Mountain Road, Half Moon Bay, Auckland

Scala Penetrometer Testing

Date tested: 16-June-2022 Tested By: JH

Test ID	HA01	Cont…	HA02	HA03	HA04	Cont…	HA05	HA07	Cont…	
Test from (m)	5.0	7.0	5.0	5.0	5.0	7.0	5.0	5.0	7.0	
Depth (m)	Blows/100mm penetration									
0.1	1	20	3	5	3	17	1	1	16	
0.2	1	20+	5	6	3	16	2	2	18	
0.3	1		8	6	4	16	4	2	20	
0.4	3		9	8	5	17	5	4	20+	
0.5	4		12	8	6	17	6	3		
0.6	4		17	8	7	18	7	4		
0.7	4		20	10	9	17	8	5		
0.8	4		20+	10	8	17	9	7		
0.9	6			9	9	20	10	6		
1.0	6			9	9	20+	13	4		
1.1	6			15	9		13	5		
1.2	8			14	10		15	9		
1.3	7			14	9		18	7		
1.4	8			15	11		23	11		
1.5	10			15	13		20+	12		
1.6	12			18	13			13		
1.7	13			19	14			13		
1.8	15			20	14			15		
1.9	14			20+	14			14		
2.0	14				14			12		
Test depth (m)	7.0	7.2	5.8	6.9	7.0	8.0	6.5	7.0	7.4	

In-situ field testing in accordance with Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Appendix C
Lab testing results

Babbage Geotechnical Laboratory
Level 4
68 Beach Road
Auckland 1010
Telephone
E-mail

P O Box 2027
New Zealand
64-9-367 4954
wec@babbage.co.nz

Please reply to: W.E. Campton

Total Ground Engineering Ltd.
PO Box 27294,
Glen Eden 0604

Job Number: 65048#L
BGL Registration Number: 2940
Checked by: WEC

Attention: **JARED HEALEY**

30th June 2022

SHRINK-SWELL INDEX TESTING

Dear Sir,

Re: 3 PIGEON MOUNTAIN ROAD, HALF MOON BAY

Report Number: 65048#L/SS 3 Pigeon Mountain Road

The following report presents the results of Shrink-swell Index testing at BGL of 54mm diameter undisturbed push-tube soil samples delivered to this laboratory on the 20th of June 2022. The test standards used were:

Water Content:	NZS4402:1986:Test 2.1
Shrink-swell Index:	AS1289:Test 7.1.1 - 2003

Sample Descriptions (*not part of BGL IANZ Accreditation*)

HA02 / SS01 / 0.80 – 1.00m: CLAY, very stiff, highly plastic, grey with brown streaks, moist.

HA07 / SS02 / 0.40 – 0.60m: SILT, clayey, trace fine gravel, very stiff, moderately plastic, mottled light brown & dark brown, moist.

As per the reporting requirements of AS1289: Test 7.1.1 – 2003: the shrink-swell index value has been reported to the nearest 0.1, and water content is reported to the nearest 0.1%. Density & air voids results have been calculated based on the dimensions of the extruded samples. Density results are reported to the nearest 0.01t/m^3, and air voids are reported to the nearest whole number.

For calculating the air voids percentages a solid density of 2.65t/m^3 was assumed for these tests. Note that this assumed value is not part of the IANZ endorsement for this report. Please note that the test results relate only to the samples as-received, and relate only to the samples under test. Any crumbling of the shrinkage samples did not affect final water content readings.

Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report please contact the person authorising this report below at your convenience.

Yours faithfully,

Justin Franklin
Signatory (Assistant Laboratory Manager)
Babbage Geotechnical Laboratory

ACCREDITED TESTING LABORATORY
№ 126

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation. This report may not be reproduced except in full & with written approval from BGL.

Babbage Geotechnical Laboratory

SHRINK-SWELL TEST RESULTS

Site Location		3 Pigeon Mountain Road, Half Moon Bay	
BH Number / Sample Number		HA02 / SS01	HA07 / SS02
Depth (m)		0.80 – 1.00m	0.40 – 0.60m
SWELL TEST			
Initial Water Content	%	46.8	27.2
Initial Bulk Density*	t/m^3	1.74	1.94
Initial Dry Density*	t/m^3	1.19	1.53
Initial Air Voids*	%	0	1
Total Swell*	mm	1.0	0.2
Swelling Strain*	%	4.0	0.7
SHRINKAGE TEST			
Water Content*	%	46.1	27.2
Initial Bulk Density*	t/m^3	1.75	1.89
Initial Dry Density*	t/m^3	1.20	1.48
Initial Air Voids*	%	0	4
Total Shrinkage*	mm	15.1	5.2
Shrinkage Strain*	%	13.9	4.8
Cracking over the drying period		none / ~~slight / moderate / extreme~~	~~none / slight~~ / moderate / ~~extreme~~
Estimated Inert Inclusions (%)		0	5
SHRINK-SWELL INDEX			
SHRINK-SWELL INDEX		8.8	2.8

**These results are not part of AS1289: Test 7.1.1 – 2003 reporting requirements, and are provided for your information only.*

APPENDIX D
Development Plan (ASC)

Compass Point Way

Compass Point Way

SHAPE ARCHITECTS LTD
021 202 3393
han@shapearchitects.co.nz
www.shapearchitects.co.nz
Suite 105, 100 Parnell Road, Parnell

Project Name
3 Pigeon Mountain Road

Address
3 Pigeon Mountain Road, Auckland

Client
HND HMB Limited

Title
Proposed Site Plan

Drawing Number
A 1.02

Scale
1:300 AT A1

Project Number
207

Date
4/7/2026

Drawn By
HC

Issue Status
Resource Consent

N

Impervious Area

Item	Area
Building	5,485.91m^2
JOAL	1,456.86m^2
Carparks	0.00m^2
Driveway	177.26m^2
Footpath & Stairs	443.80m^2
Impermeable Pavers	842.00m^2
Total	8,405.83m^2

Area Legend

- Building
- JOAL
- Driveway
- Footpaths & Stairs
- Permeable Concrete
- Impermeable Pavers
- Landscape Area
- Decked Area (Category 1a,b,c)
- Paved Area (Category 1a,b,c)
- Concrete Pavers
- 1.4m^2 Bin Storage

Coverage Calculation

3 Pigeon Mountain Total Area:	14,070m^2	
Proposed Impervious Area:	8,405.83m^2	59.7%
Allowable Area:	8,442m^2	60%
Compliance	Yes	

SHAPE ARCHITECTS LTD
021 202 3393
han@shapearchitects.co.nz
www.shapearchitects.co.nz
Suite 105, 100 Parnell Road, Parnell

Project Name
3 Pigeon Mountain Road

Address
3 Pigeon Mountain Road, Auckland

Client
HND HMB Limited

Title
Impervious Area

Drawing Number
A 2.02

Scale
1:300 AT A1

Project Number
207

Date
4/7/2026

Drawn By
HC

Issue Status
Resource Consent

N

All drawings to be read in conjunction with engineers and consultants drawings & report.

Report any discrepancy between drawings and written specification to the architect prior to ordering materials or commencing construction.

Do not scale off drawings. Confirm original size and scale of drawing.

APPENDIX E

Stormwater Treatment Device Sizings, Drawings and Manual

JOAL 1,2,3

Jellyfish

JellyFish Project Details

Project Name	3 Pigeon Mountain Road	Project Number	
Project Address	JOAL 1,2,3	Local Council	Auckland
Location	Auckland	Author	yeewen ong

Catchment Details

Reference	Catchment Type	Runoff Coefficients (C)	Area, m^2 (A)	Product, m^2 (CxA)
	Hardstand/Road	0.95	2790	2650.5
Totals	-	0.95	2790	2650.5

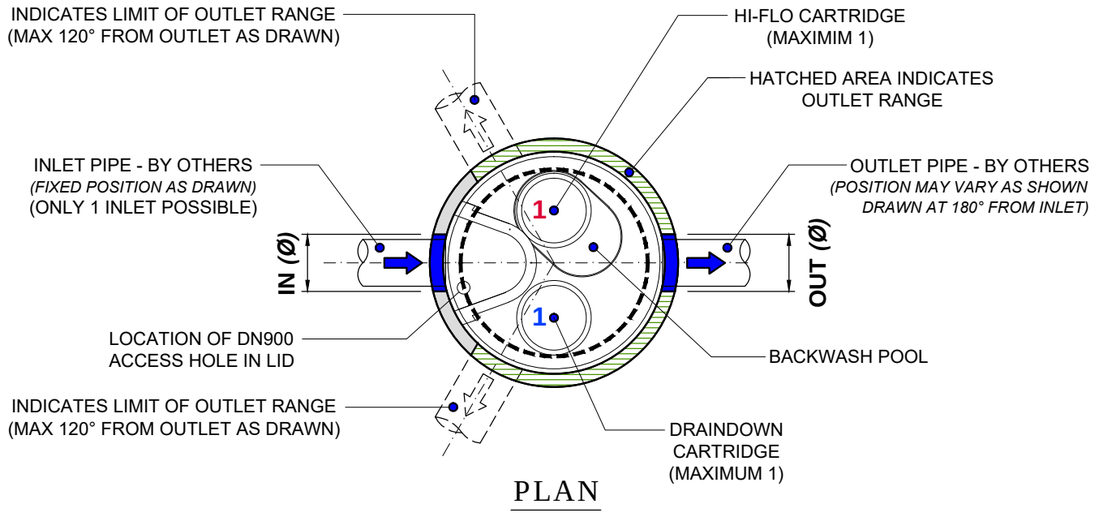
Rainfall Intensity (iwq): 10 mm/hr

*Note: The chosen rainfall intensity value is to treat 90% of annual rainfall (10mm/hr for Auckland region as per Auckland Council. 5mm/hr for Christchurch region as per Christchurch City Council, and 10mm/hr for other councils). If unsure, please contact Stormwater360

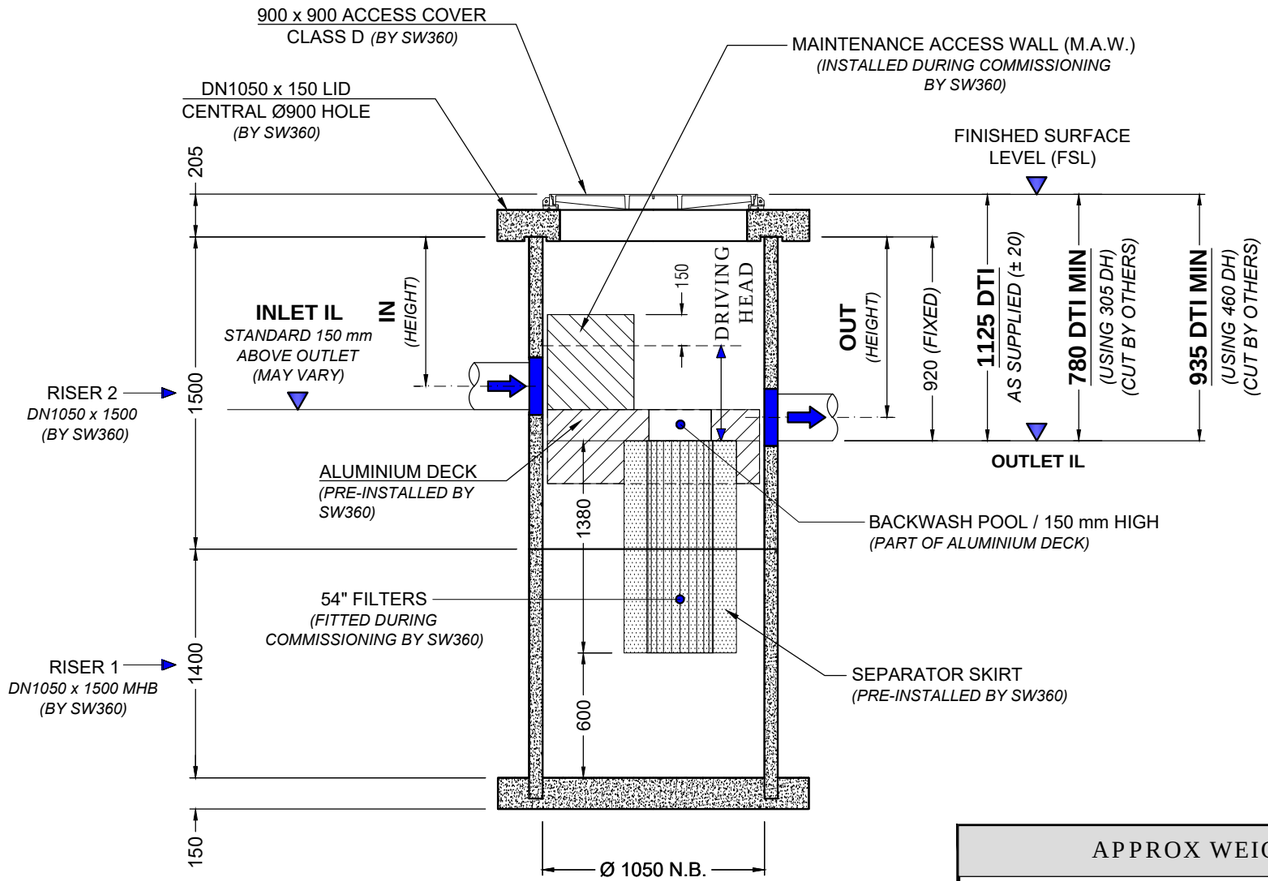
Output

Required treatable flow rate (Qwq)	7.36 L/s	Calculated using Rational method Qwq = C x iwq x A (L/s)
Jellyfish model required	JF1050-1-1 (54")	Please refer to drawing for footprint and size
No. of cart required (nCart)	2	Calculated - Qwq/Qcart (Rounded up to whole number)
Cartridge size/height	1.4m	For smaller cartridge, please contact sales@stormwater360.co.nz
Designed Head Loss	460mm	For lower hydraulic effect, please contact sales@stormwater360.co.nz
Design Jellyfish max treatment flow (Qcart)	7.5 L/s	Calculated using nCart x Qcart
Is QSF > Qwq?	Yes	

For any questions or further details please contact sales@stormwater360.co.nz



PLAN



ELEVATION

TO BE COMPLETED BY CUSTOMER / CONTRACTOR

COMPANY :		P.O. NUMBER :	
SITE ADDRESS :			
SITE CONTACT & PHONE :			
PREFERRED DELIVERY DATE *(TBC SW360)* :			
FILTER REFERENCE *(IF APPLICABLE)* :		LID LEVEL *(INPUT REQUIRED)* :	
INLET PIPE DATA *(DN225 RCRRJ-MAX)* : *(DN300 PVC-MAX)*	IL :	DIA :	MATERIAL :
OUTLET PIPE DATA *(DN225 RCRRJ-MAX)* : *(DN300 PVC-MAX)*	IL :	DIA :	MATERIAL :
OUTLET PIPE ORIENTATION : *(CIRCLE 180° OR INPUT REQUIREMENT)*	AS DRAWN : *180° FROM INLET*	CLOCKWISE FROM INLET : *(60° MIN)*	ANTICLOCKWISE FROM INLET : *(60° MIN)*
COMPLETED BY :	SIGNED :		DATE :

TO BE COMPLETED BY SW360

DRIVING HEAD (DH) *(CIRCLE REQUIREMENT OR INPUT CUSTOM VALUE)* :	305 mm	460 mm	CUSTOM DRIVING HEAD : *(INPUT DETAILS IF REQUIRED)*
DEPTH TO INVERT (DTI) CHECK : *(CALCULATE AND RECORD)* :	INLET / OUTLET IL CHECK : *(CALCULATE AND RECORD)* :		No. OF FILTERS :
ACCESS COVER : 900 x 900 WEBFORGE / CLASS D : *(SUPPLIED UNLESS STATED OTHERWISE)*		DETAILS OF OTHER : *(IF REQUIRED)*	
COMPLETED BY :		SIGNED :	DATE :

NOTES :

1. CONCRETE MANHOLE RISER UNITS FITTED WITH SWIFTLIFT ANCHOR POINTS (QTY 2). DO NOT EXCEED 60 DEGREE LIFT ANGLE. CONCRETE LID FITTED WITH SWIFTLIFT ANCHOR POINTS (QTY 4).
2. UNIT SUPPLIED WITH BOTH INLET AND OUTLET CORE DRILLED.
3. SEALING / GROUTING OF MANHOLE COMPONENTS AND PIPES BY CONTRACTOR. ENSURING LOCAL CODES AND REGULATIONS ARE COMPLIED WITH.
4. ANY RISERS REQUIRED TO INCREASE THE DEPTH TO INVERT (DTI) FROM THAT AS DRAWN TO BE SUPPLIED BY THE CONTRACTOR.
5. FOR A DTI EXCEEDING 5m PLEASE CONTACT **0800STORMWATER**.
6. BACKFILL, BEDDING AND BUOYANCY DESIGN BY ENGINEER OF RECORD.
7. CONCRETE MANHOLE RISERS ARE DESIGNED AND MANUFACTURED IN ACCORDANCE WITH AS/NZS 4058 : 2007
8. CONCRETE MANHOLE BASES ARE DESIGNED AND MANUFACTURED IN ACCORDANCE WITH NZS 3101 : 2006 AND NZS 3109 : 1997
9. CONCRETE LID DESIGNED AND MANUFACTURED TO HN-HO-72.
10. FILTERS AND MAINTENANCE ACCESS WALL (MAW) TO BE INSTALLED DURING COMMISSIONING BY STORMWATER360.
11. COMMISSIONING TO OCCUR ONLY WHEN CONSTRUCTION IS COMPLETE, AND SITE IS CLEAN.
12. CONTRACTOR TO ENSURE MANHOLE IS CLEAN FROM SITE RUN-OFF PRIOR TO COMMISSIONING.
13. CONTACT **0800STORMWATER** FOR COMMISSIONING OR ANY REQUIREMENTS OUTSIDE THIS DRAWING.

APPROX WEIGHTS

- RISER #1 *(BASED ON DN1050 x 1500)* : 1500 Kg
- RISER #2 *(DN1050 x 1500 INCL DECK)* : 920 Kg
- CONCRETE LID *(DN1050 x 150 THICK)* : 430 Kg

DATA FOR PRODUCTION ONLY (COMPLETED BY SW360)

OUT *(Ø) OUTLET CORE Ø*		*MAX Ø 350*	**OUT** *(HEIGHT) = 920 mm - 0.5 PIPE ID*		**IN** *(Ø) OUTLET CORE Ø*	*MAX Ø 350*	**IN** *(HEIGHT)* **= OUT** *(HEIGHT) - Δ INVERT*	

INLET TO OUTLET DISTANCE : *WRAP MEASUREMENT FROM C/L INLET TO C/L OUTLET*

$$= \frac{\text{(ANGLE) x (3.14 x RISER } OD\text{)}}{360}$$

COMPLETED BY :	SIGNED :	DATE :

Stormwater360 BETWEEN SKY AND SEA

0800 STORMWATER
sales@stormwater360.co.nz
www.stormwater360.co.nz

JELLYFISH® FILTER
STORMWATER MEMBRANE FILTER
DN1050 / 54" FILTERS 1 + 1 / OFFLINE / TRAFFICABLE
GENERAL ARRANGEMENT

SCALE : N.T.S. | DRG No : JF-MH-54-1050-T-OFF-20 | REV : 1 | DATE : 25.05.19

JOB NO :			REV	REVISION DETAIL	DATE
PROJECT :			0	APPROVED	25.05.19
			1	FORMULA REV	12.08.19
DRN :	R.P.	25.05.19			
CKD :	G.S.	25.05.19			

JELLYFISH®
Membrane Filtration

Highly effective high-flow sediment removal

The Jellyfish® Filter is a highly effective stormwater high-flow sediment removal device which uses membrane technology. The large surface area enables fine particle removal at high flows with low head.

The Jellyfish® Filter has a much smaller footprint than other BMP's, greater design flexibility and lower long-term maintenance cost.

JELLYFISH® FILTER FEATURES

- High surface area, high flow rate membrane filtration
- Highest design treatment flow rate per cartridge (up to 80 gpm (5 L/s))
- Low driving head (typically 18 inches or less (457 mm))
- Lightweight cartridges with passive backwash
- 3rd party verified field-performance per TARP protocol

JELLYFISH® FILTER BENEFITS

- Long-lasting and effective stormwater treatment
- Compact system with small footprint
- Fewer cartridges required
- Superior pollutant capture
- Easy maintenance and low life-cycle cost

www.stormwater360.co.nz

BETWEEN SKY AND SEA

FILTRATION

High Performance Membrane Filtration

- Pleated tentacles provide effective removal of fine sand and silt sized particles.
- Removes a high percentage of particulate-bound pollutants including nutrients, metals and hydrocarbons.
- High surface area membranes ensure long-lasting treatment.
- No Media required

Extended Filter Life

- During filtration, vibrational pulses dislodge sediment from the membrane surfaces.
- After every storm peak, filtered water back-washes membrane filtration tentacles.
- Sediment is continuously removed from the tentacles by gravity.
- Tentacles easily washed with low pressure hose.

PRETREATMENT

- Separation skirt traps oil, trash and debris outside the filtration zone.
- Sand size particles settle below the cartridges in the sump.

APPROVALS

- Approved for 80% removal TSS
- New Jersey Corporation for Advanced Technology (NJCAT) – Field Performance Verification per TARP Tier II Protocol
- New Jersey Department of Environmental Protection (NJDEP) – Certification
- Washington State Department of Ecology (TAPE - CULD)
- Maryland Department of the Environment (MDE)
- Ontario Ministry of Environment – New Environmental Technology Evaluation (NETE) – Certification
- Texas Commission on Environmental Quality (TCEQ)

CONTACT DETAILS

Stormwater360

FREEPHONE:
0800 STORMWATER
(0800 786769)

www.stormwater360.co.nz

Stormwater360®
BETWEEN SKY AND SEA

Stormwater360

Jellyfish®

Design, Operation and Maintenance Guidelines

DRAFT (for site-specific guidelines email maintenance@stormwater360.co.nz)

INTRODUCTION

This document, and the information within, are provided to be used only as a guide. This document is intended to provide general information for the operation and maintenance of the JellyFish device ("the product"). This document is not intended to be comprehensive health and safety guidelines for the operation and/or maintenance of the JellyFish device, which are the responsibility of the owner of the device. Users of this document are encouraged to consult professional advice before taking any course of action related to information, ideas or opinions expressed in this document. **Disclaimer** Information in this document is subject to change without notice and does not represent a commitment on the part of Stormwater360 New Zealand. Stormwater360 New Zealand makes no representations or warranties, implied or otherwise, that, amongst others, the information available from this document are free from errors or omissions. Nothing in this document should be construed as an expressed warranty or an implied warranty of Merchantability or fitness for any particular purpose.

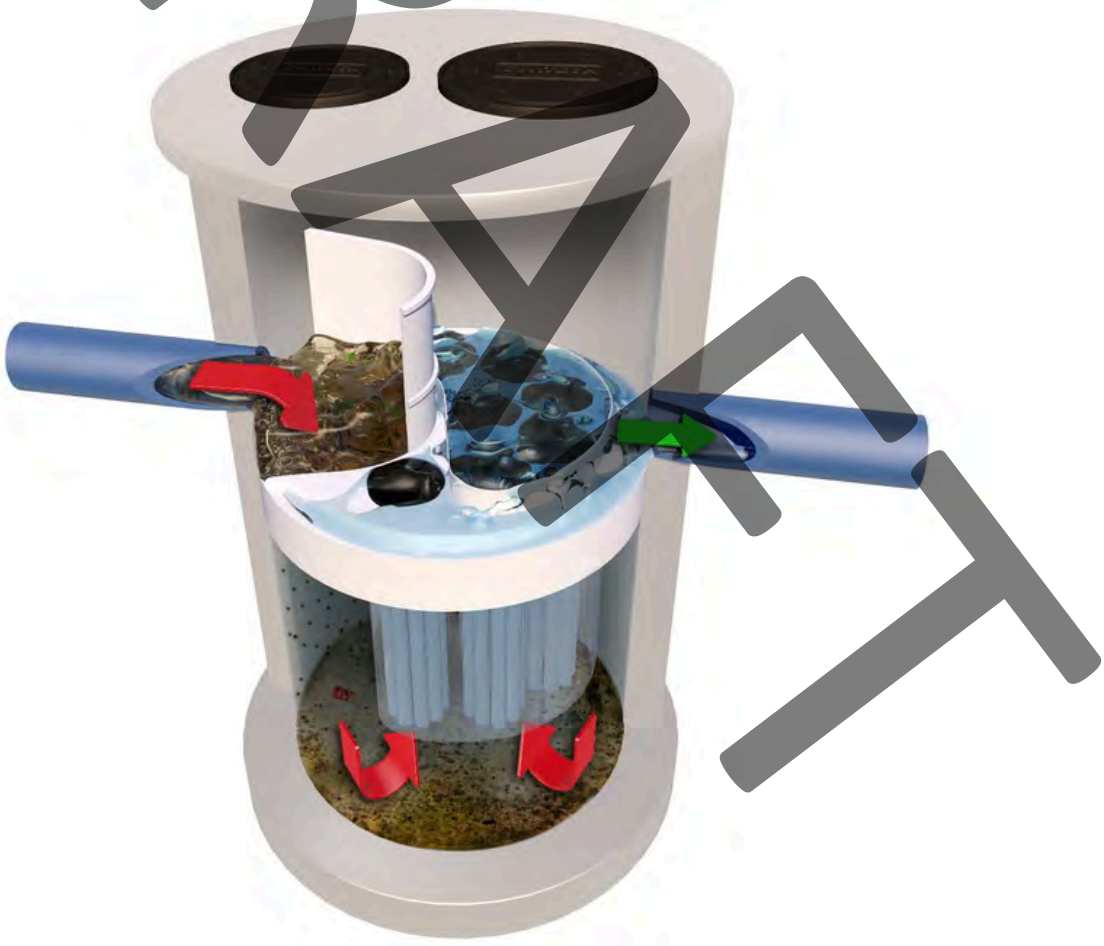


Table of Contents

SECTION A Site Specific Details

This section is to be filled out by the asset owner following installation of JellyFish devices. For assistance in filling out this form please contact our Maintenance Manager via 0800 STORMWATER. Please return completed forms via email to maintenance@stormwater360.co.nz.

Project Name:

Project Address:

Resource Consent Number:

Building Consent Number:

Consent/Site Owner:

Consent/Site Owner Address:

Table 1; Summary of Installed JellyFish

Jellyfish Reference #	Jellyfish Model	Number of Cartridges	Cartridge Height (mm)	DD Orifice Size (mm)	HF Orifice Size (mm)	Catchment Area (m^2)	Estimated Maintenance Frequency (Months)
#5892/JF	JF2300-7-2 (54")	9	1,372	35	70	8,000	12 Months

SECTION B Health and Safety

WARNINGS / CAUTION

1. When entering unit, personnel will need to be confined space trained.
2. **WATCH YOUR STEP** if standing on the Jellyfish Filter Deck at any time; Great care and safety must be taken while walking or maneuvering on the Jellyfish Filter Deck. Attentive care must be taken while standing on the Jellyfish Filter Deck at all times to prevent stepping onto a lid, into or through a cartridge hole or slipping on the deck.
3. The Jellyfish Filter Deck can be **SLIPPERY WHEN WET**
4. If the Top Slab, Covers or Hatches have not yet been installed, or are removed for any reason, great care must be taken to **NOT DROP ANYTHING ONTO THE JELLYFISH FILTER DECK.** The Jellyfish Filter Deck and Cartridge Receptacle Rings can be damaged under high impact loads. This type of activity voids all warranties. All damaged items to be replaced at owner's expense.
5. Maximum deck load 2 persons, total weight 102kg per person.

Safety Notice

Jobsite safety is a topic and practice addressed comprehensively by others. The inclusions here are intended to be reminders to whole areas of Safety Practice that are the responsibility of the Owner(s), Manager(s) and Contractor(s). WorkSafe NZ, and Local Jurisdiction Safety Standards apply on any given site or project. The knowledge and applicability of those responsibilities is the Contractor's responsibility and outside the scope of Stormwater360.

Confined Space Entry

Secure all equipment and perform all training to meet applicable local and WorkSafe NZ regulations regarding confined space entry. It is the Contractor's or entry personnel's responsibility to proceed safely at all times.

Personal Safety Equipment

Contractor is responsible to provide and wear appropriate personal protection equipment as needed including, but not limited to safety boots, hard hat, reflective vest, protective eyewear, gloves and fall protection equipment as necessary. Make sure all equipment is **staffed with trained and/or certified personnel,** and all equipment is checked for proper operation and safety features prior to use.

Fall protection equipment (Tripod, Winch, Harness)	Hard hat
Eye protection	Gloves
Safety boots	Ventilation and respiratory protection/Gas detector
Ear protection	Maintenance and protection of traffic plan

SECTION C Operation

The Jellyfish® Filter is an engineered stormwater quality treatment technology that removes a high level and wide variety of stormwater pollutants. Each Jellyfish Filter cartridge consists of multiple membrane - encased filter elements ("filtration tentacles") attached to a cartridge head plate. The filtration tentacles provide a large filtration surface area, resulting in high flow and high pollutant removal capacity.

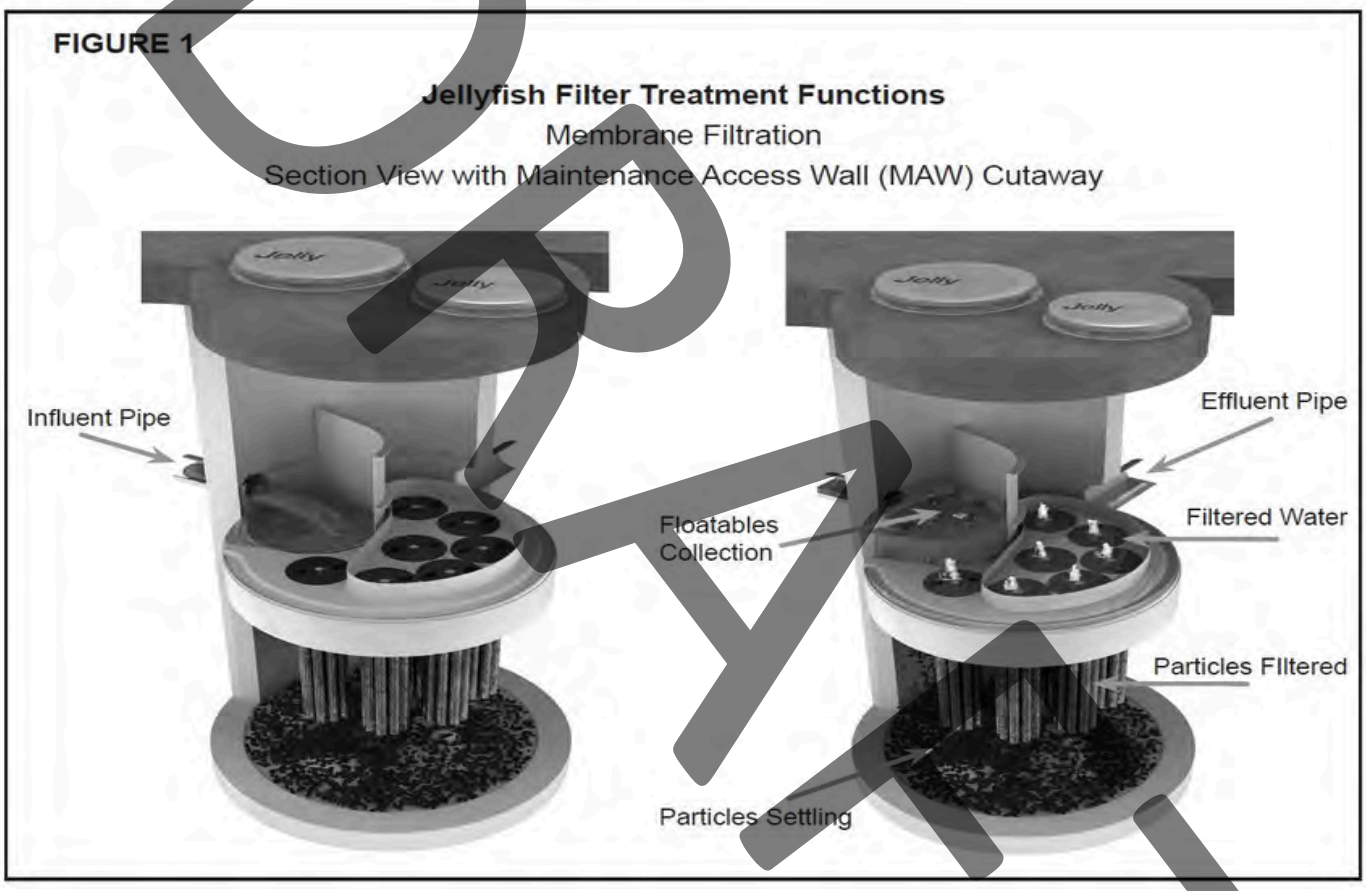
The Jellyfish Filter functions are depicted in Figure 1 below.

FIGURE 1

Jellyfish Filter Treatment Functions

Membrane Filtration

Section View with Maintenance Access Wall (MAW) Cutaway

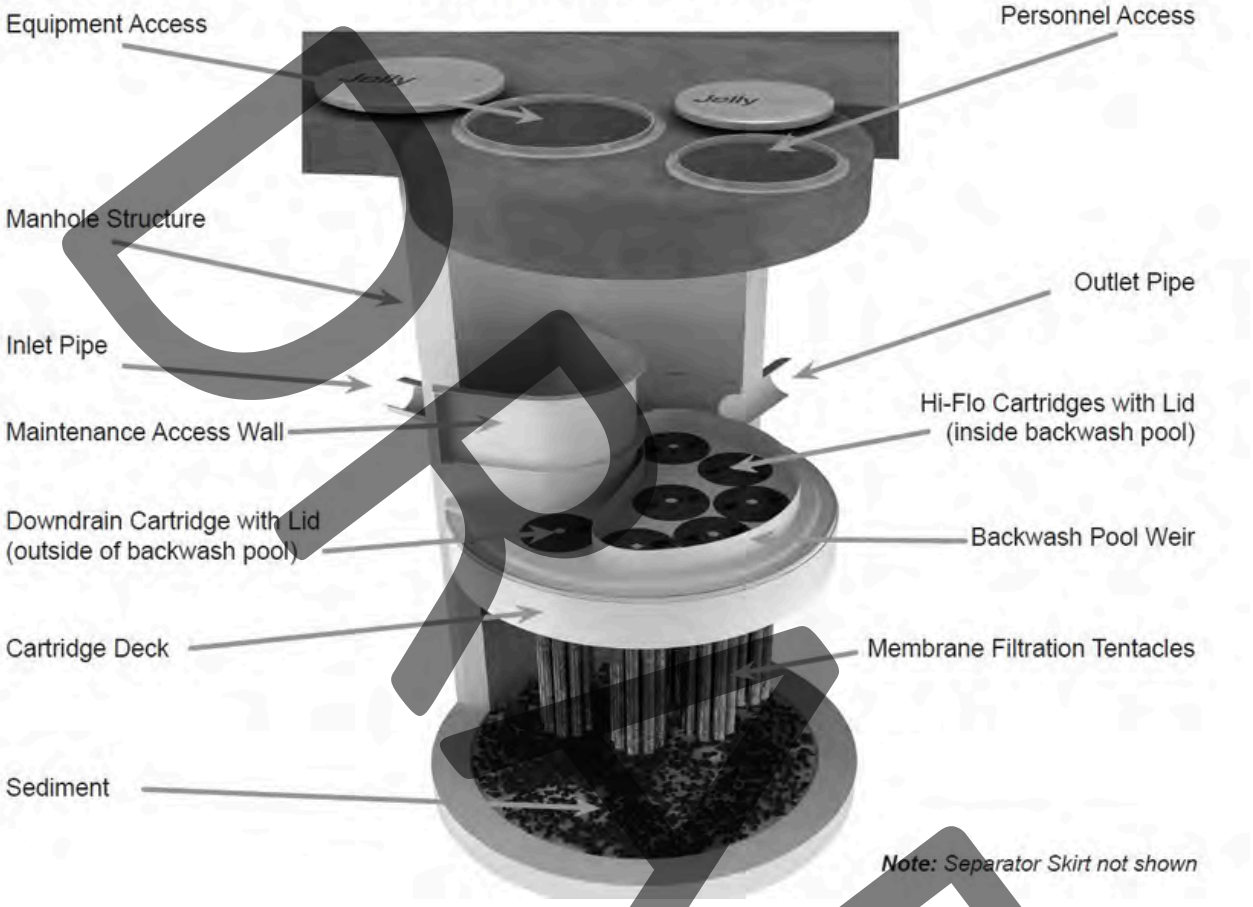


Jellyfish Filter cartridges are backwashed after each peak storm event, which removes accumulated sediment from the membranes. This backwash process extends the service life of the cartridges and increases the time between maintenance events.

For additional details on the operation and pollutant capabilities of the Jellyfish Filter please refer to additional details on our website at [www.stormwater360.co.nz.](http://www.stormwater360.co.nz)

The Jellyfish® Filter and components are depicted in Figure 2 below.

FIGURE 2 **Jellyfish Filter Components**



Tentacles are available in various lengths as depicted in Table 1 below.

Table 1 - Cartridge Lengths / Weights and Cartridge Lid Orifice Diameters

Cartridge Lengths	Dry Weight	Hi-Flo Orifice Diameter	Draindown Orifice Diameter
15 inches (381 mm)	10 lbs (4.5 kg)	35 mm	20 mm
27 inches (686 mm)	14.5 lbs (6.6 kg)	45 mm	25 mm
40 inches (1,016 mm)	19.5 lbs (8.9 kg)	55 mm	30 mm
54 inches (1,372 mm)	25 lbs (11.4 kg)	70 mm	35 mm

A Jellyfish membrane filtration cartridge is depicted in Figure 3 below.

FIGURE 3

Jellyfish Membrane Filtration Cartridge

Jellyfish Membrane Filtration Cartridge Assembly

The Jellyfish Filter utilizes multiple membrane filtration cartridges. Each cartridge consists of removable cylindrical filtration "tentacles" attached to a cartridge head plate. Each filtration tentacle has a threaded pipe nipple and a-ring. To attach, insert the top pipe nipples with the a-ring through the head plate holes and secure with locking nuts. Locking nuts to be hand tighten and checked with a wrench as shown below.

Jellyfish Membrane Filtration Cartridge Installation

After the upstream catchment and site have stabilized, Remove any accumulated sediment and debris from the Jellyfish Filter structure and upstream diversion structure (if applicable). Failure to address this step completely will reduce the time between required maintenance.

Cartridge Assembly

Descend to the cartridge deck (see Safety Notice and page 3).

Lower the Jellyfish membrane filtration cartridges into the cartridge receptacles within the cartridge deck. A filter cartridge should be placed into each of the draindown cartridge receptacles outside the backwash pool weir. It is possible dependent on the Jellyfish Filter model purchased that not all cartridge receptacles will be filled with a filter cartridge. In that case, a blank headplate and blank cartridge lid (has no orifice) would be installed.

Avoid snagging the cartridge membranes on the receptacle lip when inserting the Jellyfish membrane filtration cartridges into the cartridge receptacles. Use a gentle twisting or sideways motion to clear any potential snag. Do not force the tentacles down into the cartridge receptacle, as this may damage the membranes. Apply downward pressure on the cartridge head plate to seat the rim gasket (thick circular gasket surrounding the circumference of the head plate) into the cartridge receptacle.

Examine the cartridge lids to differentiate lids with a small orifice, a large orifice, and no orifice.

Lids with a **small orifice** are to be inserted into the draindown cartridge receptacles, outside of the backwash pool weir.

Lids with a **large orifice** are to be inserted into the **hi-flo cartridge receptacles** within the backwash pool weir.

Lids with **no orifice** (blank cartridge lids) and a blank headplate are to be inserted into unoccupied cartridge receptacles.

To install a cartridge lid, align the cartridge lid male threads with the cartridge receptacle female threads. Firmly twist the cartridge lid clockwise a minimum 110° to seat the filter cartridge snugly in place, with a proper watertight seal.

SECTION D Inspection and Maintenance

The primary purpose of the Jellyfish Filter is to capture and remove pollutants from stormwater runoff. As with any filtration system, captured pollutants must be removed to maintain the filter's maximum treatment performance. Regular inspection and maintenance are required to insure proper functioning of the system.

Maintenance frequencies and requirements are site specific and vary depending on pollutant loading. Maintenance activities may be required in the event of an upstream chemical spill or due to excessive sediment loading from site erosion or extreme runoff events. It is a good practice to inspect the system after major storm events.

Inspection activities are typically conducted from surface observations and include:

- Observe if standing water is present
- Observe if there is any physical damage to the deck or cartridge lids
- Observe the amount of debris in the Maintenance Access Wall (MAW)

Maintenance activities typically include:

- Removal of oil, floatable trash and debris
- Removal of collected sediments from manhole sump
- Rinsing and re-installing the filter cartridges
- Replace filter cartridge tentacles, as needed.

It is recommended that Jellyfish Filter inspection and maintenance be performed by professionally trained individuals, with experience in stormwater maintenance and disposal services. Maintenance procedures may require manned entry into the Jellyfish structure. Only professional maintenance service providers trained in confined space entry procedures should enter the vessel. Procedures, safety and damage prevention precautions, and other information, included in these guidelines, should be reviewed and observed prior to all inspection and maintenance activities.

D.1 - Inspection

D.1.1- Timing

Inspection of the Jellyfish Filter is key in determining the maintenance requirements for, and to develop a history of the site's pollutant loading characteristics. In general, inspections should be performed at the times indicated below; or per the approved project stormwater quality documents (if applicable), whichever is more frequent.

Post-construction inspection is required prior to putting the Jellyfish Filter into service. All construction debris or construction-related sediment within the device must be removed, and any damage to system components repaired.

A minimum of two inspections during the first year of operation to assess the sediment and floatable pollutant accumulation, and to ensure proper functioning of the system.

Inspection frequency in subsequent years is based on the inspection and maintenance plan developed in the first year of operation. Minimum frequency should be once per year. Inspection is recommended after each major storm event. Immediately after an upstream oil, fuel or other chemical spill.

D.1.2- Inspection Tools and Equipment

The following equipment and tools are typically required when performing a Jellyfish Filter inspection:

- Access cover lifting tool
- Sediment probe (clear hollow tube with check valve) Tape measure
- Flashlight
- Camera
- Inspection and maintenance log documentation
- Safety cones and caution tape
- Hard hat, safety shoes, safety glasses, and chemical-resistant gloves
- Confined Space Equipment

D.1.3- Inspection Procedure

The following procedure is recommended when performing inspections:

Provide traffic control measures as necessary.

Inspect the MAW for floatable pollutants such as trash, debris, and oil sheen.

Measure oil and sediment depth by lowering a sediment probe through the MAW opening until contact is made with the floor of the structure. Retrieve the probe, record sediment depth, and presences of any oil layers and repeat in multiple locations within the MAW opening. **Sediment depth of 12 inches (305mm) or greater indicates maintenance is required.**

Inspect cartridgelids. Missing or damaged cartridge lids to be replaced.

Inspect the MAW, cartridge deck, and backwash pool weir for cracks or broken components. If damaged, repair is required.

Dry weather inspections: Inspect the cartridge deck for standing water.

No standing water under normal operating condition.

Standing water **inside** the backwash pool, but not outside the filter backwash pool, this condition indicates that the cartridges need to be rinsed.

Standing water **outside** the backwash pool may indicate a backwater condition caused by high water elevation in the receiving water body, or possibly a blockage in downstream infrastructure.

The depth of sediment and oil can be measured from the surface by using a sediment probe or dipstick tube equipped with a ball check valve and inserted through the Jellyfish Filter's maintenance access wall opening. The large opening provides convenient access for inspection and vacuum removal of water and pollutants.

- **Wet weather inspections:** observe the rate and movement of water in the unit. Note the depth of water above deck elevation within the MAW
- **Less than 6 inches (150mm),** flow should be exiting the cartridge lids of each of the draindown cartridges (i.e. cartridges located outside the backwash pool).
- **Greater than 6 inches (150mm),** flow should be exiting the cartridge lids of each of the draindown cartridges and each of the hi-flo cartridges (i.e. cartridges located inside the backwash pool), and water should be overflowing the backwash pool weir.
- **18 inches (460mm) or greater** and relatively little flow is exiting the cartridge lids and outlet pipe, this condition indicates that the filter cartridges are occluded with sediment and need to be rinsed

D.2 - Maintenance D.2.1 -Maintenance Requirements

Required maintenance for Jellyfish Filter units is based upon results of the most recent inspection, historical maintenance records, or the site-specific water quality management plan; whichever is more frequent. In general, maintenance requires some combination of the following:

Sediment removal for depths reaching 12 inches (305mm) or greater, or within 3 years of the most recent sediment cleaning, whichever occurs sooner.

Floatable trash, debris, and oil must be removed.

Filter cartridges rinsed and re-installed as required by the most recent inspection results, or within 12 months of the most recent filter rinsing, whichever occurs first.

Replace filter cartridge if rinsing does not remove accumulated sediment from the tentacles, or if tentacles are damaged or missing. It is recommended that tentacles should remain in service no longer than 5 years before replacement.

Damaged or missing cartridge deck components must be repaired or replaced as indicated by results of the most recent inspection.

The unit must be cleaned out and filter cartridges inspected immediately after an upstream oil, fuel, or chemical spill. Filter cartridge tentacles should be replaced if damaged by the spill.

D.2.2- Maintenance Tools and Equipment

The following equipment and tools are typically required when performing Jellyfish Filter maintenance:

Vacuum truck
Ladder
Garden hose and low-pressure sprayer
Rope or cord to lift filter cartridges from the cartridge deck to the surface Adjustable pliers for removing filter cartridge tentacles from cartridge head plate Plastic tub or garbage can for collecting effluent from rinsed filter cartridge tentacles Access cover lifting tool
Sediment probe (clear hollow tube with check valve)
Tape measure Flashlight Camera
Inspection and maintenance log documentation
Safety cones and caution tape
Hard hats, safety shoes, safety glasses, chemical-resistant gloves, and hearing protection for service providers
Proper safety equipment for confined space entry
Replacement filter cartridge tentacles if required

D.2.3- Maintenance Procedure

The following procedures are recommended when maintaining the Jellyfish® Filter:

- Provide traffic control measures as necessary.
- Open all covers and hatches. Use ventilation equipment as required, according to confined space entry procedures.

Caution: Dropping objects onto the cartridge deck may cause damage. Perform **Inspection Procedure** prior to maintenance activity. To access the cartridge deck for filter cartridge service, descend the ladder and step directly onto the deck.

Caution: Do not step onto the maintenance access wall (MAVV) or backwash pool weir, as damage may result. Note that the cartridge deck may be slippery.

D.2.4- Filter Cartridge Rinsing Procedure

Remove a cartridge lid.

Remove the cartridge from the receptacle using the lifting loops in the cartridge head plate. **Caution:** Should a snag occur, do not force the cartridge upward as damage to the tentacles may result. Rotate the cartridge with a slight sideways motion to clear the snag and continue removing the cartridge.

Thread a rope or cord through the lifting loops and lift the filter cartridge from the cartridge deck to the top surface outside the structure.
Caution: Immediately replace and secure the lid on the exposed empty receptacle as a safety precaution. Never expose more than one empty cartridge receptacle.

Repeat the filter cartridge removal procedure until all of the cartridges are located at the top surface outside the structure.

Rinsing of dirty filter cartridge tentacles with a low-pressure garden hose sprayer and using a plastic garbage container to capture rinse water.

Disassemble the tentacles from each filter cartridge by rotating counter-clockwise. Remove the tentacles from the cartridge head plate.

Position a receptacle in a plastic tub or garbage can such that the rinse water is captured. Using a low-pressure garden hose sprayer, direct a wide-angle water spray at a downward 45° angle onto the tentacle membrane, sweeping from top to bottom along the length of the tentacle. Rinse until all sediment is removed from the membrane.

Caution: Do not use a high-pressure sprayer or focused stream of water on the membrane. Excessive water pressure may damage the membrane. Turn membrane upside down and pour out any residual rinsewater to ensure center of tentacle is clear of any sediment.

Remove rinse water from rinse tub or garbage can using a vacuum hose as needed.

Slip the o-ring over the tentacle nipple and reassemble onto the cartridge head plate; hand-tighten.

If rinsing is ineffective in removing sediment from the tentacles, or if tentacles are damaged, provisions must be made to replace the spent or damaged tentacles with new tentacles. Contact Stormwater360 to order replacement tentacles. Lower a rinsed filter cartridge to the cartridge deck. Remove the cartridge lid on a receptacle and carefully lower the filter cartridge into the receptacle until the head plate gasket is seated squarely on the lip of the receptacle.

Caution: Should a snag occur when lowering the cartridge into the receptacle, do not force the cartridge downward; damage may occur. Rotate the cartridge with a slight sideways motion to clear the snag and complete the installation.

Replace the cartridge lid on the exposed receptacle. Rinse away any accumulated grit from the receptacle threads if needed to get a proper fit. Align the cartridge lid male threads with the cartridge receptacle female threads. Firmly twist the cartridge lid clockwise a minimum 110° to seat the filter cartridge snugly in place, with a proper watertight seal.

Repeat cartridge installation until all cartridges are installed.

D.2.5- Vacuum Cleaning Procedure

Caution: Perform vacuum cleaning of the Jellyfish Filter only after filter cartridges have been removed from the system. Access the lower chamber for vacuum cleaning only through the maintenance access wall (MAW) opening, being careful not to damage the flexible plastic separator skirt that is attached to the underside of the deck. The separator skirt surrounds the filter cartridge zone and could be torn if contacted by the wand. Do not lower the vacuum wand through a cartridge receptacle, as damage to the receptacle will result.

To remove floatable trash, debris, and oil, lower the vacuum hose into the MAW opening and vacuum floatable pollutants off the surface of the water. Alternatively, floatable solids may be removed by a net or skimmer.

Using a vacuum hose, remove the water from the lower chamber to the sanitary sewer, if permitted by the local regulating authority, or into a separate containment tank.

Remove the sediment from the bottom of the unit through the MAW opening.

For larger diameter Jellyfish Filter manholes 2.3m, 3m, 3.6m diameter, complete sediment removal may be facilitated by removing a cartridge lid from an empty receptacle and inserting a jetting wand (not a vacuum wand) through the receptacle. Use the sprayer to rinse loosened sediment toward the vacuum hose in the MAW opening, being careful not to damage the receptacle.

After the unit is clean, re-fill the lower chamber with water if required by the local jurisdiction, and re-install filter cartridges.

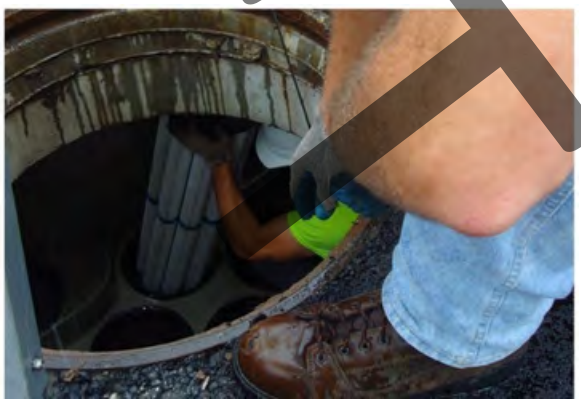
Dispose of sediment, floatable trash and debris, oil, spent tentacles, and water according to local regulatory requirements.

D.2.6- Chemical Spills

Caution: If a chemical spill has been captured by the Jellyfish Filter, do not attempt maintenance. Immediately contact the local hazard response agency.

A maintenance worker stationed on the surface uses a vacuum hose to evacuate water, sediment, and floatables from the Jellyfish Filter by inserting the vacuum wand through the maintenance access wall opening.

A view of a Jellyfish Filter cartridge deck from the surface showing all the cartridge lids intact and no standing water on the deck (left image), and inspection of the flexible separator skirt from inside the maintenance access wall opening (right image).



Assembly of a Jellyfish Filter cartridge (left) and installation of a filter cartridge into a cartridge receptacle in the deck (right).

D.3 - Disposal Procedures

Disposal requirements for recovered pollutants and spent filtration tentacles may vary depending on local guidelines. In most areas the sediment and spent filtration tentacles, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste.

Petroleum-based pollutants captured by the Jellyfish Filter, such as oil and fuels, should be removed and disposed of by a licensed waste management company.

Although the Jellyfish Filter captures virtually all free oil, a sheen may still be present at the MAW A rainbow or sheen can be visible at oil concentrations of less than 10 mg/L (ppm).

D.4 - Recommended Safety Procedures

Jobsite safety is a topic and a practice addressed comprehensively by others. The inclusions here are merely reminders to whole areas of Safety Practice that are the responsibility of the Owner(s), Manager(s) and Contractor(s). WorkSafe NZ, and Local Jurisdiction Safety Standards apply.

SECTION E Jellyfish Filter Replacement Parts

E.1 - Jellyfish Filter Replacement Parts

Jellyfish membrane filtration cartridges, cartridge components, cartridge lids, other replacement parts can be ordered by contacting Stormwater360 at:

0800 STORMWATER
+64 9 476 5586
info@stormwater360.co.nz

E.2 - Jellyfish Filter Replacement Parts List

Note: Jellyfish Cartridges and/or Filtration tentacles are available in the following lengths:

15 Inch (381 mm) 27 Inch (686 mm) 40 Inch (1,016 mm) 54 inch (1,372 mm)

Jellyfish Cartridge (specify length). Includes head plate with lifting loops, rim gasket, eleven (11) filtration tentacles, eleven (11) a-rings, and eleven (11) locking nuts

Standard Head plate

Blank head plate

Rim gasket (for head plate)

Locking nuts (for tentacles)

0-rings (for tentacles)

Cartridge lids are available with the following orifice sizes: 70mm, 55mm, 45mm, 35mm, 30mm, 25mm, 30mm, blank lid (no orifice)

Maintenance Access Wall (MAW) extension - 18-inch (457mm) segment

**Nothing in this catalogue should be construed as an expressed warranty or implied warranties, including the warranties of merchantability and of fitness for any particular purpose.*

JOAL 4

StormFilter

StormFilter Project Details

Project Name	3 Pigeon Mountain Road	Project Number	
Project Address	JOAL 4	Local Council	Auckland
Location	Auckland	Author	yeewen ong

Catchment Details

Reference	Catchment Type	Runoff Coefficients (C)	Area, m2 (A)	Product, m2 (CxA)
	Hardstand/Road	0.95	290	275.5
Totals	-	0.95	290	275.5

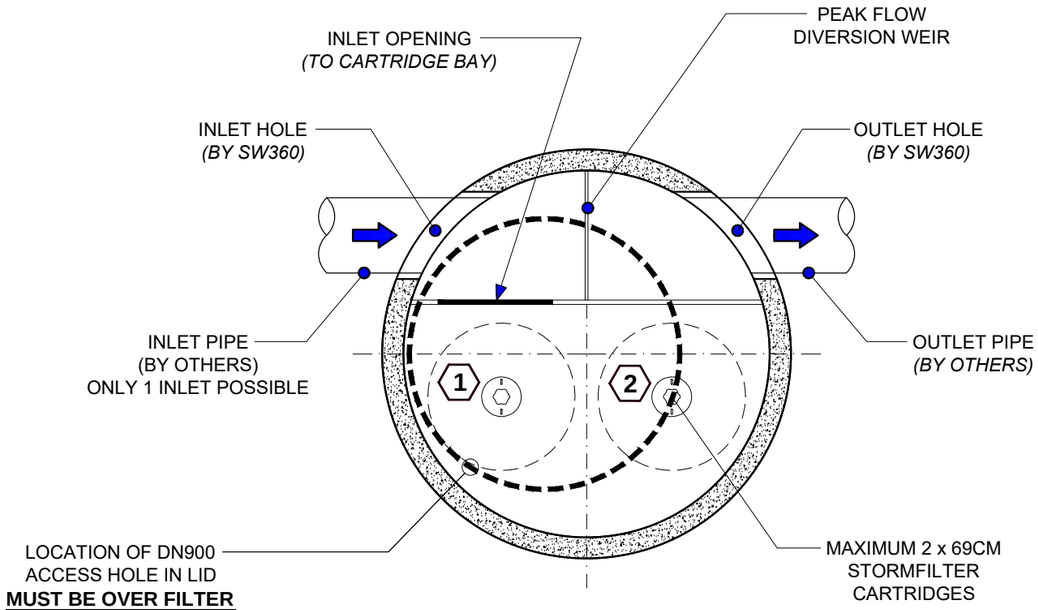
Rainfall Intensity (iwq): 10 mm/hr

*Note: The chosen rainfall intensity value is to treat 90% of annual rainfall (10mm/hr for Auckland region as per Auckland Council. 5mm/hr for Christchurch region as per Christchurch City Council, and 10mm/hr for other councils). If unsure, please contact Stormwater360

Output

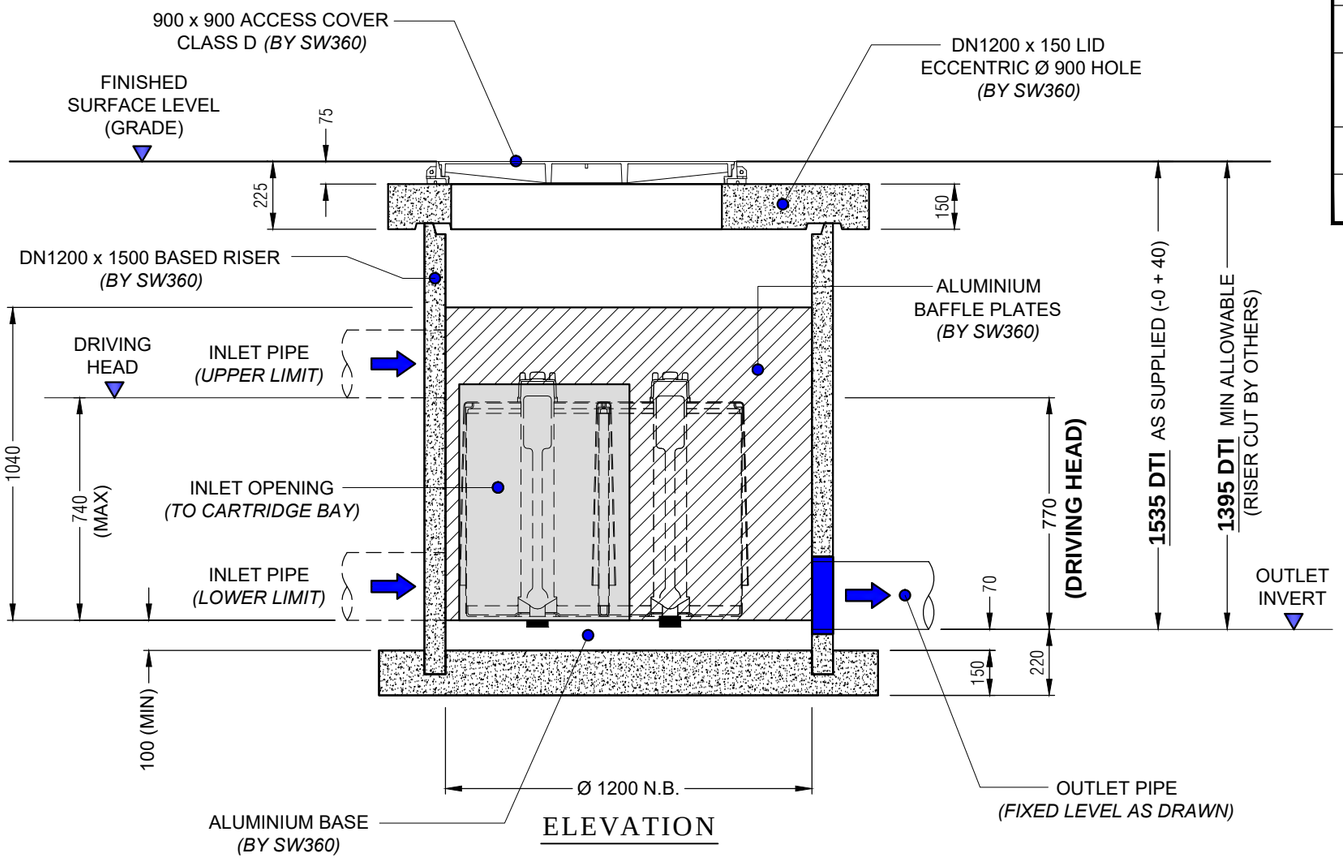
Required treatable flow rate (Qwq)	0.77 L/s	Calculated using Rational method Qwq = C x iwq x A (L/s)
StormFilter model required	SF-MH-69-1050-T-20	Please refer to drawing for footprint and size
Peak Diversion model required	SF-MHPD-69-1200-T-20	MHPD is an integrated Peak Diversion option for off-line configuration
No. of cart required (nCart)	1	Calculated - Qwq/Qcart (Rounded up to whole number)
Cartridge size/height	69cm	Recommended hydraulic effect is 770mm, for lower hydraulic effect option please contact Stormwater360
Media	Perlite	Other media options are available, please contact Stormwater360
Design treatment flow rate per cartridge (Qcart)	1.42 L/s	
Design StormFilter treatment flow (QSF)	1.42 L/s	Calculated - Qcart x nCart
Is QSF > Qwq?	Yes	

For any questions or further details please contact sales@stormwater360.co.nz



PLAN

(ACCESS COVER AND LID REMOVED)



ELEVATION

TO BE COMPLETED BY CUSTOMER / CONTRACTOR

COMPANY :		P.O. NUMBER :	
SITE ADDRESS :			
SITE CONTACT & PHONE :			
PREFERRED DELIVERY DATE (TBC SW360) :			
STORMFILTER REFERENCE (IF APPLICABLE) :			
INLET PIPE Ø : *DN225 RCRRJ - MAX* *DN300 PVC - MAX*	PIPE MATERIAL : *(PVC OR RCRRJ)*	CORE DRILL Ø :	INLET (IL) :
OUTLET PIPE Ø : *DN225 RCRRJ - MAX* *DN300 PVC - MAX*	PIPE MATERIAL : *(PVC OR RCRRJ)*	CORE DRILL Ø :	OUTLET (IL) :
LID LEVEL (RL) :	DTI :	ORIENTATION : 180° *(AS DRAWN)* / 90° / 135°	
COMPLETED BY :		SIGNED :	DATE :

TO BE COMPLETED BY SW360

SW360 PRODUCT CODE :				
MEDIA TYPE (CIRCLE ONE) :	PERLITE	ZPG	OTHER :	
CARTRIDGE QTY (STATE) :			PRE-INSTALLATION (Y/N) :	
SP FLOW RATE (CIRCLE ONE) :	FULL (Ø 27.6 ID) BLACK/MUSTARD	3 QTR (Ø 24.0 ID) WHITE/OPAL	HALF (Ø 19.7 ID) GREEN	OTHER :
ACCESS COVER (CIRCLE ONE) :	900 x 900 WEB-FORGE / CLASS D		OTHER :	
COMPLETED BY :	SIGNED :		DATE :	

NOTES

1. MANHOLE UNIT FITTED WITH 2 SWIFTLIFT ANCHOR POINTS. DO NOT EXCEED 60 DEGREE LIFT ANGLE. CONCRETE LID FITTED WITH 4 SWIFTLIFT ANCHOR POINTS.
2. UNIT SUPPLIED WITH INLET & OUTLET CORE DRILLED.
3. SEALING / GROUTING OF MANHOLE COMPONENTS AND PIPES BY CONTRACTOR. ENSURING LOCAL CODES AND REGULATIONS ARE COMPLIED WITH.
4. ANY RISERS REQUIRED TO INCREASE THE DEPTH TO INVERT (DTI) FROM THAT AS DRAWN TO BE SUPPLIED BY THE CONTRACTOR.
5. FOR A DTI EXCEEDING 5m PLEASE CONTACT **0800STORMWATER**.
6. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION RELATED EROSION RUNOFF.
7. BACKFILL, BEDDING AND BUOYANCY DESIGN BY ENGINEER OF RECORD
8. QTY OF CARTRIDGES BY ENGINEER OF RECORD.
9. CONCRETE MANHOLE RISERS ARE DESIGNED AND MANUFACTURED IN ACCORDANCE WITH AS/NZS 4058 : 2007
10. CONCRETE MANHOLE BASES ARE DESIGNED AND MANUFACTURED IN ACCORDANCE WITH NZS 3101 : 2006 & NZS 3109 : 1997
11. CONCRETE LID DESIGNED AND MANUFACTURED TO HN-HO-72
12. FOR REQUIREMENTS OUTSIDE OF DRAWING SPECIFICATIONS PLEASE CONTACT **0800STORMWATER**.

APPROX WEIGHTS

MANHOLE SECTION INCLUDING CARTRIDGES : **2050 Kg**
(AS DELIVERED, BASED ON QTY 2 ZPG CARTS)
LID WEIGHT : **520 Kg**

Stormwater360
BETWEEN SKY AND SEA

0800 STORMWATER
sales@stormwater360.co.nz
www.stormwater360.co.nz

STORMFILTER® PEAK DIVERSION
OFF - LINE CARTRIDGE FILTRATION SYSTEM
69cm CART / DN1200 x 1500 MH - TRAFFICABLE
GENERAL ARRANGEMENT

SCALE : N.T.S. | DRG No : SF-MHPD-69-1200-T-20 | REV : 0 | DATE : 22.05.19

JOB NO :			REV	REVISION DETAIL	DATE
PROJECT :			A	FOR APPROVAL	22.05.19
			0	APPROVED	23.05.19
DRN :	R.P.	22.05.19			
CKD :	G.S.	22.05.19			

STORMFILTER™

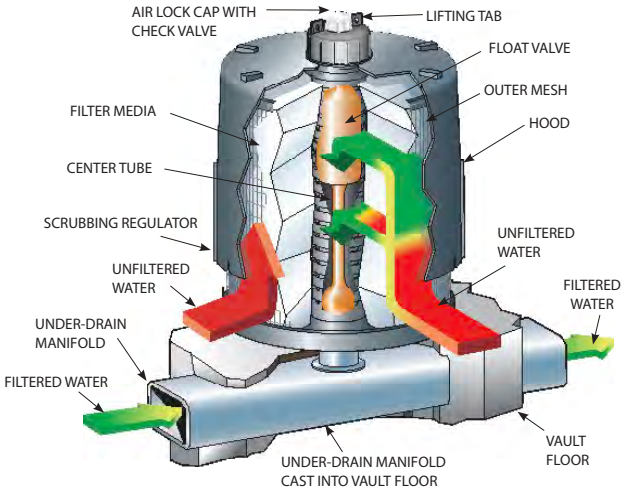
High efficiency / low maintenance stormwater filter.

SIPHON-ACTUATED FILTRATION The stormwater management StormFilter™ cleans stormwater through a patented passive filtration system, effectively removing pollutants to meet the most stringent regulatory requirements. Highly reliable, easy to install and maintain, and proven performance over time, StormFilter™ products are recognised as a versatile BMP for removing a variety of pollutants, such as sediments, oil and grease, metals, organics, and nutrients. These systems come in variable configurations to match local conditions and come with prolonged maintenance periods to ensure long-term performance and reduce operating costs.

HOW DOES IT WORK?

During a storm, runoff passes through the filtration media and starts filling the cartridge center tube. Air below the hood is purged through a one-way check valve as the water rises. When water reaches the top of the float, buoyant forces pull the float free and allow filtered water to drain.
After the storm, the water level in the structure starts falling. A hanging water column remains under the cartridge hood until the water level reaches the scrubbing regulators. Air then rushes through the regulators releasing water and creating air bubbles that agitate the surface of the filter media, causing accumulated sediment to drop to the vault floor. This patented surface-cleaning mechanism helps restore the filter's permeability between storm events.

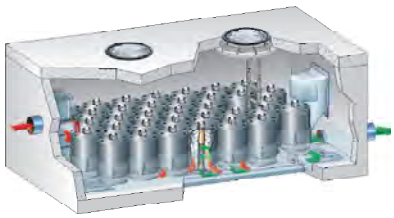
STORMFILTER™ CARTRIDGE



PROVEN PERFORMANCE

- First independently verified filter by Washington Department of Ecology, New Jersey Department of Environmental Protection and USEPA's Environmental Technology Verification program
- Approved and accepted by most regulatory bodies across New Zealand
- Over 16,800 x StormFilter's™ cartridges installed throughout New Zealand
- Continual innovation Design refined and perfected over two decades of research and experience

STORMFILTER™ VAULT



STORMFILTER BENEFITS

UNDERGROUND SYSTEMS MAXIMISE PROFITABILITY

- Save land space allowing denser developments reducing sprawl
- Add parking spaces and increase building size, increasing profitability
- Compact design reduces construction and installation costs by limiting excavation

RELIABLE LONGEVITY & LOWER MAINTENANCE COSTS

- Self cleaning hood prevents surface blinding, ensures use of all media and prolongs cartridge life
- 1-3 year maintenance cycles
- 20 years maintenance experience
- Minimal or no standing water. Lower disposal costs

CONTACT DETAILS

Stormwater360

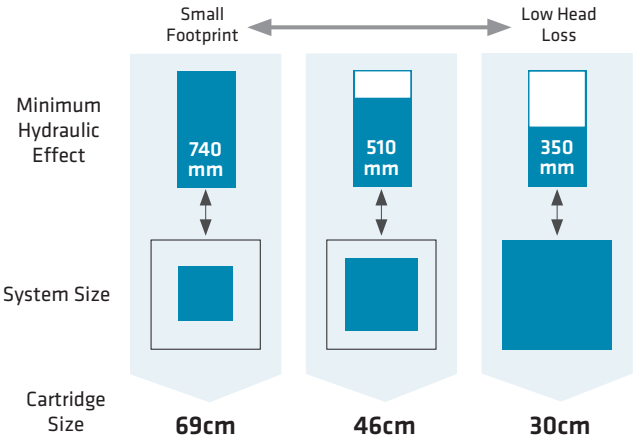
FREEPHONE:
0800 STORMWATER
(0800 786769)

www.stormwater360.co.nz

Stormwater360®
BETWEEN SKY AND SEA

SUPERIOR HYDRAULICS

Multiple cartridge heights gives design solutions for site restraints.



Other hydraulic benefits

- Hydraulic effect as low as 350mm head loss
- Zero surcharge of inlet pipe unlike upward flowing filters
- Can be designed for tail water e.g tidal conditions
- Online and offline configurations can limit hydraulic effects

MEDIA CHOICES

Our filtration products can be customised using different filter media to target site-specific pollutants. A combination of media is often recommended to maximise pollutant removal effectiveness.

Perlite is naturally occurring puffed volcanic ash. Effective for removing TSS, oil and grease.

ZPG™ is a multi-purpose media option approved for highly trafficked sites or sites with high metal loadings. ZPG is a mixture of Zeolite, Perlite and GAC (granular activated carbon). ZPG is ideal for removing soluble metals, TSS, oils and grease, organics and ammonium.

Zeolite is a naturally occurring mineral used to remove soluble metals, ammonium and some organics.

GAC (Granular Activated Carbon) has a micro-porous structure with an extensive surface area to provide high levels of adsorption. It is primarily used to remove oil and grease and organics such as PAHs and phthalates.

CONFIGURATION

Stormfilter's can be configured in any drainage structure. Please contact SW360 for a customised design.

PRECAST VAULT

- Treats medium sized sites
- Simple installation – arrives on-site fully assembled
- Plug and play solution

PRECAST MANHOLE

- Provides a low drop, point-of-entry configuration
- Uses drop from the curb inlet to the conveyance pipe to drive the passive filtration cartridges
- No crane required (Hi-AB lifting for most sizes)
- 1050-2400mm diameter sizes available

HIGH FLOW

- Treats flows from large sites
- Consists of large, precast components designed for easy assembly on-site
- Several configurations available, including: Panel Vault, Box Culvert, or Cast-In-Place

PEAK DIVERSION

- Combines off-line bypass and StormFilter™ pollutant removal into one structure
- Internal weir allows high peak flows with low hydraulic head losses
- Approved and accepted as offline configuration by councils around NZ
- Eliminates cost of additional structures to bypass peak flows
- Reduces the overall footprint of the treatment system

Stormwater360®
BETWEEN SKY AND SEA

StormFilter™

Operation & Maintenance Guidelines

DRAFT (for site-specific guidelines email maintenance@stormwater360.co.nz)

V4.4 2024

WWW.STORMWATER360.CO.NZ

0800 STORMWATER

INTRODUCTION

This document, and the information within, are provided to be used only as a guide. This document is intended to provide general information for the operation and maintenance of the StormFilter device ("the product"). This document is not intended to be comprehensive health and safety guidelines for the operation and/or maintenance of the StormFilter device, which are the responsibility of the owner of the device.

Users of this document are encouraged to consult professional advice before taking any course of action related to information, ideas or opinions expressed in this document.

Disclaimer

Information in this document is subject to change without notice and does not represent a commitment on the part of Stormwater360 New Zealand. Stormwater360 New Zealand makes no representations or warranties, implied or otherwise, that, amongst others, the information available from this document are free from errors or omissions.

Nothing in this document should be construed as an expressed warranty or an implied warranty of Merchantability or fitness for any particular purpose.

Table of Contents

SECTION A Site Specific Details

This section is to be filled out by the asset owner following installation of StormFilter devices. For assistance in filling out this form please contact our Maintenance Manager via 0800 STORMWATER. Please return completed forms via email to maintenance@stormwater360.co.nz.

Project Name:

Project Address:

Resource Consent Number:

Building Consent Number:

Consent/Site Owner:

Consent/Site Owner Address:

Table; Summary of Installed StormFilters ™

StormFilter Reference #	StormFilter Model	Number of Cartridges	Cartridge Height (cm)	Media Type	Restrictor Disc Size (mm)	Catchment Area (m^2)	Estimated Maintenance Frequency (Months)

SECTION B As Built Drawings

This section is to be filled out by the asset owner following installation of StormFilter devices. For assistance in filling out this form please contact our Maintenance Manager via 0800 STORMWATER. Please return completed forms via email to maintenance@stormwater360.co.nz.

The following as-built drawings are to be provided to Stormwater360 to include within this section;

As-Built Drawings	Supplied
Site Plan shown location of each StormFilter Device	YES / NO
Catchment Plan for each StormFilter	YES / NO
Long-section drawings of site pipe network	YES / NO
Product Drawing (To be supplied by SW360)	YES / NO

SECTION C Operation

The StormFilter™ is a passive, flow-through stormwater filtration system. It consists of vaults that house rechargeable cartridges filled with a variety of filter media. The filter systems are installed in-line with storm drains. The StormFilter works by passing stormwater through media-filled cartridges, which trap particulates and adsorb materials such as dissolved metals and hydrocarbons. After being filtered through the media, the treated stormwater flows into a collection pipe or discharges into an open channel drainage way. StormFilters are offered in three different configurations: cast-in-place, precast and linear. The precast and linear models utilize pre-manufactured vaults. The cast-in-place units are customized for larger flows and may be either covered or uncovered underground units.

C.1 Purpose

The StormFilter™ is a passive stormwater filtration system designed to improve the quality of stormwater runoff from the urban environment before it enters receiving waterways.

Through independent third-party studies, it has been demonstrated that the StormFilter is highly effective for treatment of first flush flows and design flows during the latter part of a storm. In general, the StormFilters efficiency is highest when pollutant concentrations are highest. The primary target pollutants for removal are sediments (TSS), soluble metals, phosphorus, nitrogen, and oil and grease.

C.2 Sizing

The StormFilter™ is typically sized to treat the peak flow of a water quality design storm as it passes through the filter. The peak flow is determined by calculations based on the contributing watershed hydrology and using a design storm magnitude. The design storm is usually based on the regulatory requirements set by the local stormwater management agency. The particular size of a StormFilter is determined by the number of filter cartridges (see Figure 1) required to treat the peak stormwater flow. As the StormFilter is available in different cartridge sizes, the peak design flow for each cartridge is a function of available filter area. Each cartridge is designed to treat a maximum of 1.4 Litres/second per square meter of filter area. Peak flows for the varying cartridge heights are as follows:

Table 1; Cartridge Model and Peak Flow

Cartridge Height	*Peak Design Flow*
69 cm	1.4 L/s 0.95 L/s
46 cm	0.63 L/s
30 cm (low drop)	

Alternative design methods are the solids-based or the detention design method. Solids-based designs utilize the known loading capacity of the StormFilter to size systems in accordance with a desired maintenance interval. The detention design method allows use of less cartridges than is required to treat the peak of the water quality design storm as additional detention is provided either upstream or in an oversized vault. The additional detention required is calculated by routing the water quality design storm through the chosen number of cartridges.

Because of the highly porous nature of the granular filter media, the flow through a newly installed cartridge is restricted using an orifice disc to ensure adequate pollutant-media contact time.

C.3 Basic Function

The StormFilter is designed to siphon stormwater runoff through a filter cartridge containing media. The variety of media available can be designed to act as a mechanical filter to remove sediments, as an ion exchanger to remove dissolved heavy metals, and as an absorber to remove oils and greases.

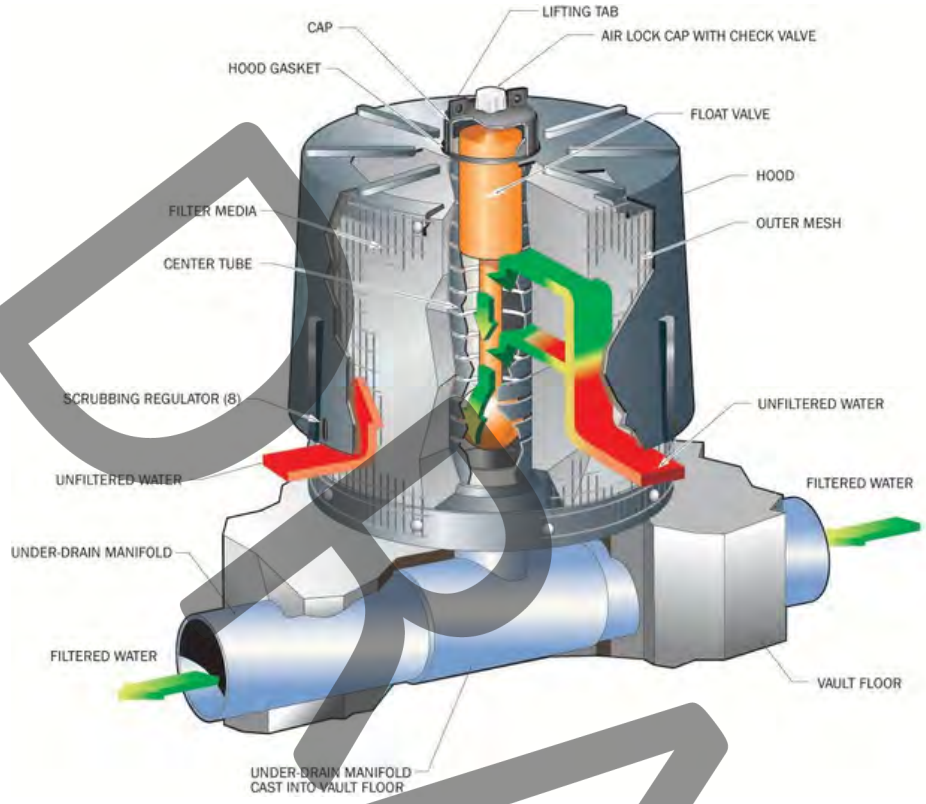


Figure 1: StormFilter Cartridge Detail

C.4 Priming System Function

The treated stormwater collects in the centre tube of the cartridge, which is equipped with a self-priming siphon system. Figure 1 illustrates this system. The key component of the system is the plastic float. The float consists of a ball located at the base leading up to a larger portion, which provides increased buoyancy. Initially the ball rests in a seat effectively closing off the port to the drainage manifold.

As a result, the filter fills the centre drainage tube until the water level has risen high enough to purge the air from the filter cartridges and displace the float. At this point the float pulls loose and allows the filtered water to drain out through the manifold. This effectively "primes" a siphon within the drainage tube and greatly increases the potential across the filter. The priming system increases StormFilters ability to be loaded with sediment. A related feature is the cartridge "hood". This hood maintains the siphon effect by preventing air from being drawn into the cartridge until the external water level drops below the bottom of the hood.

Cartridges are connected to the manifold with a plastic connector. Since some media used is potentially buoyant, a threaded connector affixed to the manifold with compression bolts is necessary to ensure the cartridge isn't lifted out of place. For the heavier leaf media, a slip connector is used.

The StormFilter is also equipped with flow spreaders that trap floating debris and surface films, even during overflow conditions. Depending on individual site characteristics, some systems are equipped with high and/or low flow bypasses. High flow bypasses are installed when the calculated peak storm event generates a flow that overcomes the overflow capacity of the system. This is especially important for precast systems. Low flow bypasses are sometimes installed to bypass continuous inflows caused by ground water seepage, which usually do not require treatment. All StormFilter units are designed with an internal overflow. The overflow operates when the inflow rate is greater than the infiltration capacity of the filter media.

END OF SECTION C

SECTION D Maintenance

The primary purpose of the StormFilter is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness. Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. To assist the owner with maintenance issues, Stormwater360 New Zealand (SW360) provides detailed Operation & Maintenance Guidelines with each unit.

SW360 can provide maintenance services completely, or in part. Available services include tracking of installed systems, advising the system's owner of maintenance needs, and notification of the regulatory agency once the system has been maintained. It is recommended that the StormFilter is inspected six months after installation of the cartridges to ensure its correct installation and that it is operating as designed.

Maintenance is usually performed in the dryer periods to rejuvenate the filter media and prepare the system for the next rainy period. Maintenance activities can also be required in the event of a chemical spill or excessive sediment loading due to site erosion or extreme storms. It is good practice to inspect the system after severe storm events.

D.1 Types of Maintenance Provided by Stormwater360

SW360 offers the following comprehensive maintenance services for StormFilter devices.

- 360 Full-Service Pre-pay – SW360 will maintain your StormFilter device on a regular basis.
- Pay as you go – One-off or Long-Term contract options are available to have your StormFilter device maintained as requested.
- Cartridge Exchange – If you wish to maintain your own StormFilter device, SW360 offers a cartridge exchange program. Refurbished cartridges filled with the appropriate approved filter media are exchanged with emptied exhausted cartridges from your site. Further information on these maintenance services can be found on the SW360 website (http://www.stormwater360.co.nz/services/maintenance/). Please contact our maintenance team at maintenance@stormwater360.co.nz or 0800 STORMWATER to arrange maintenance services.

D.2 Health & Safety

All maintenance activities to be carried out on the device are recommended to be undertaken in accordance with appropriate health and safety guidelines, which are the responsibility of the asset/device owner. This device is considered to be a confined space. Entry into the device should be regarded as a ‘last resort’ to complete activities unable to be completed without entry. If entry is required, confined space entry procedures are recommended to be implemented in accordance with the health and safety guidelines mentioned above. Sources of ignition and smoking should not be permitted when undertaking inspections and maintenance due to the possibility of volatilised hydrocarbons and the associated explosion risk.

D.3 Maintenance Activities

Maintenance typically includes cartridge recharging and may involve disposal of materials that require consideration of regulatory guidelines. Depending on the particular unit configuration and equipment used, maintenance may require an understanding of Occupational Health and Safety (OH&S) rules. Table 3 summarizes the primary activities associated with StormFilter maintenance.

Table 2; StormFilter Maintenance Activity

Facility Component Requiring Maintenance	Maintenance Activity	When Maintenance Activity Is Required	Expected Facility Performance After Maintaining
StormFilter™ Cartridges and Containment Structure	Trash and Debris Removal	Floatable objects or other trash is present in the filter. Remove to avoid hindrance of filtration and eliminate unsightly debris and trash.	Permanent removal from storm system.
	Cartridge Replacement and Sediment Removal	Media has been contaminated by high levels of pollutants, such as after a spill.	New media is able to effectively treat stormwater.
Drainage System Piping	Flushing with Water	Drainage system is obstructed by debris or sediment.	Outflow is not restricted.

D.3.1 Timing

Two scheduled inspections/maintenance activities are recommended for the first three years to determine required maintenance frequency. Once site maintenance requirement and operation is established, one annual scheduled inspection is sufficient. During routine inspection, the maintenance requirement is determined and, if required, samples of the sediments and media are obtained. The next scheduled date is to perform maintenance activities (replacement of the filter cartridges and associated sediment removal). In addition to the scheduled activities, it is important to check the condition of the filter after major storms to check for damage caused by high flows and to check for high sediment accumulation, which may be caused by localised erosion in the drainage area. It may be necessary to adjust maintenance activity scheduling depending on the actual operating conditions encountered by the system.

D.3.2 Frequency

The primary factor controlling timing of maintenance for the StormFilter is sedimentation. A properly functioning system will remove solids from water by trapping these particulates within the porous structure of the media. The flow through the system will naturally decrease as more and more solids are trapped. Eventually the flow through a system will be low enough to require replacement of the cartridges. Sediment should be removed from upstream trapping devices on an as needed basis to prevent material from being resuspended and discharged to the system.

Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction should be inspected and maintained more often than those in fully established areas. The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after large storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual filter. It is recommended that the maintenance agency develop a database to properly manage StormFilter maintenance programs.

Prior to the development of the maintenance database, maintenance frequencies (Table 4) should be followed.

Frequencies should be updated as required. The recommended frequency for inspection is two times per year for the first three years for the system until maintenance requirement and operation is established, then one annual scheduled inspection is sufficient. Also, StormFilter units should be inspected after all major storms. Sediment removal on an annual basis is recommended until further knowledge is gained about a particular system.

Table 3; Maintenance Activity Frequency

	PRE-INSPECTION (Times / Year)	PREVENTATIVE MAINTENANCE (Months)	CORRECTIVE MAINTENANCE
StormFilter	• First 3 years – 2ea annual inspections are recommended. • Subsequent years 1ea annual inspection. • Major Storms – following rain events of 25mm over 24 hours.	Includes regularly scheduled inspections and activities to keep the device in good working order and prevent issues from arising. Refer to Table 1 SECTION A above for site Specific StormFilter Details	Includes emergency or non-routine activities requiring reactive action to be implemented to repair the device. As required as per the inspection report.

D.3.3 Crew Requirements

Table 5 lists the anticipated crew requirements for maintenance operations. Removal of water and sediments during major maintenance activities can be accomplished using either a pump and water truck or a vacuum truck. All applicable OH&S and disposal regulations should be followed. A general description of the maintenance activities follows.

Table 4; Anticipated Crew Requirements

	Inspection	Preventative Maintenance i.e. Scheduled Sediment Removal and Cartridge Replacement	Corrective Maintenance: 1 1 1 **3***
Labourer	1	1 1	
Skilled Worker	1	1	
Vacuum/Water Truck Operator		**3***	
Total	**2***		
Special Requirements	Knowledge of Proper StormFilter™ Operation and Function	Knowledge of Disposal Requirements Cartridge Removal and Installation Procedures	Case by Case Basis. Supported by SW360 Engineers

** This device is considered to be a confined space. Entry into the device should be regarded as a 'last resort' to complete activities unable to be completed without entry. If entry is required, confined space entry procedures are recommended to be implemented in accordance with the health and safety guidelines.*

D.4 Typical Equipment Required for Maintenance Activities

Typical equipment required for conducting maintenance is shown in

Table 6. Some of the materials listed are suggestions rather than requirements. It should be noted that there is more than one way to accomplish some tasks. Owners with available labour and equipment resources may desire to use alternative methods. However, it is advisable that guidance from Stormwater360 be obtained prior to using alternative techniques.

Table 5; Maintenance Equipment Requirements

Maintenance Equipment Required	
Pre- Maintenance Inspection	**Maintenance Cartridge Replacement**
Safety Equipment*: First aid, cones, barricades, flagging, flares, tape, vests, hard hats.	Safety Equipment*: First aid, cones, barricades, flagging, flares, tape, vests, hard hats.
Work Clothes: Rubber boots, overalls, and gloves.	Work Clothes: Rubber boots, overalls, and gloves.
Door Bolt, Wrench, proprietary lifters (e.g. Gatic) and Miscellaneous Tools.	Door Bolt, Wrench, Penta Socket and Miscellaneous Tools.
Tape Measure	Tape Measure
Flashlight	Flashlight
Record Keeping Forms	Record Keeping Forms Vacuum Truck Replacement
Trash/Debris Container	Cartridges Cartridge Hauling Truck Crane, Tripod and
	Hoist, or Other Lifting Device (150kg minimum
	capacity) Shovels
	Extra PVC or ABS cartridge connectors
	Spare Flow Restrictor disks
	Trash/Debris Container Vault Inlet Pipe
	Plug Dolly
	PVC Pipe Cutter
	Ladder
	Cartridge Installation and Removal Sling

*** Confined space equipment may be required for vault entry. This equipment must be used by personnel with the appropriate OH & S training. This equipment typically includes: Atmospheric testing devices, atmospheric purging and ventilating devices, and entry, exit, and rescue assisting devices.**

D.5 Methodology

D.5.1 Pre-Maintenance Inspection

The primary goal of the maintenance inspection is to assess the condition of the cartridges relative to the level of sediment loading. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, large amounts of sediments should be present and very little flow will be discharging from the drainage pipes. It is likely that the cartridges need to be replaced. Maintenance inspection will typically involve the steps below. However, if it appears that a spill of some type has occurred, the local hazard control agency and Stormwater360 should be notified immediately. **In the case of a spill, the worker should abort maintenance activities until the proper guidance has been obtained.**

D.5.1.1 Steps

1. **When confined space entry is required to access the StormFilter systems. Please ensure that appropriate Confined Space entry training and subsequent certification has been undertaken and valid, and work procedures are strictly adhered to. If you are unsure, do not enter the vault and contact Stormwater360 via 0800 STORMWATER.**
2. If the visit is during a storm, make the flow observations discussed above.
3. Close and fasten the access cover, remove safety equipment and barriers.
4. Make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system. Refer section D.5.1.2 for sample report.
5. Take notes about the external and internal condition.
6. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
7. Arrange for traffic management to be disestablished.
8. Review the condition reports from the previous maintenance visits and schedule for cartridge replacement if needed.
9. Pre-Maintenance inspection to be performed by a skilled worker familiar with StormFilter devices.
10. If device is located within a road carriageway, arrange for traffic management to be provided by a competent provider.
11. Set up safety equipment and barriers to isolate public from work zone and protect pedestrians from fall hazards presented by access cover.
12. Temporary (removable) ladders to be used for access into the StormFilter device.
13. Inspect the external condition of the device and take notes concerning defects/problems.
14. Open the access cover to the device and allow the vault to air out for 5-10 minutes.
15. Undertake a visual inspection from the top to check if there is sediment within vault and ponded water. Assess whether it is necessary and safe to enter the device. *note* entry to device is required to determine the quality of the cartridge media. *Confined space entry procedures are recommended to be implemented in accordance with your company's health and safety guidelines.*

STORMFILTER INSPECTION REPORT

SITE DETAILS

PROJECT NAME | JOB ID # | UNIT ID # | INSPECTION DATE (DD/MM/YYYY)

PROJECT ADDRESS | GPS CO-ORDINATES (LAT. , LONG.)

UNIT SIZE (eg. SF69-03-MH-1215-PER) | MEDIA TYPE | ACCESS COVER TYPE | UNIT DEPTH

UNIT OBSERVATIONS

LAST MAINTAINED (DD/MM/YY) | MONTHS IN SERVICE | INLETMANHOLES | OUTLET MANHOLES

FOREBAY

INLET PIPE(S) STATE | INLET PIPE SILT | FOREBAY WATER DEPTH | FOREBAY SILT DEPTH | FOREBAY SILT TYPE

INLET SKI JUMP STATE | INLET SPREADER STATE | INLET DISSIPATOR STATE | OTHER INLET PARTS

TREATMENT BAY

CARTRIDGES ON SPIGOT / OFF SPIGOT | CARTRIDGES SUBMERGED | CART MESH BLOCKED | MEDIA CLEAN / BLOCKED

TREATMENT BAY SEDIMENT TYPE | TREATMENT WATER DEPTH | TREATMENT BAY SILT DEPTH | OIL/GREASE

AIR RELIEF VALVES STATE | TOP CAP O-RING STATE | SOCK RUBBER BAND STATE

OUTLET BAY

OUTLET PIPE(S) STATE | BLOCKED? | OUTLET SPREADER STATE | OUTLET BAY SILT DEPTH | OTHER PARTS STATE?

UNIT SURROUNDS

OIL & GREASE | SOURCE | COMMENTS

SEDIMENT BUILD-UP | SOURCE | COMMENTS

SOIL EROSION | SOURCE | COMMENTS

RECOMMENDATIONS

CLEAN REQUIRED:

NEXT INSPECTION:

REPAIRS REQUIRED:

NOTES: Device had not been inspected or maintained since installation in 2008. This device has a large amount of sediment within the vault and is unable to operate as designed.

AUTHOR | TITLE | COMPANY | DATE

D.5.2 Cartridge Replacement

Filter cartridge replacement typically involves the steps below. However, if it appears that a spill of some type has occurred, the local hazard control agency and Stormwater360 should be notified immediately. **In the case of a spill, the worker should abort maintenance activities until the proper guidance has been obtained.** Depending on the configuration of the particular system, a worker may be required to enter the vault to perform some tasks. If vault entry is required, OH & S rules for general confined space entry must be strictly adhered to. Filter cartridge replacement should occur during dry weather and it may be necessary to plug the filter inlet pipe if base flows exist. Standing water present in the vault should be regarded as polluted and contained during this operation by temporarily capping the manifold connectors.

D.5.2.1 Steps (With Vacuum Truck)

1. Depending on the particular unit, one or two utility workers and a hauling truck operator will deliver the replacement cartridges to the site.
2. Information is available from Stormwater360 concerning how to obtain the replacement cartridges. If the device is located within a road carriageway, arrange for traffic management to be provided by a competent provider.
3. Set up safety equipment and barriers to isolate public from work zone and protect pedestrians from fall hazards presented by access cover.
4. Inspect the external condition of the device and take notes concerning defects/problems.
5. Open the access cover to the device and allow the vault to air out for 5-10 minutes.
6. Undertake a visual inspection from the top to check if there is sediment within vault and ponded water. Assess whether it is necessary and safe to enter the device. *note* entry to device is required to determine the quality of the cartridge media. *Confined space entry procedures are recommended to be implemented in accordance with your company's health and safety guidelines.*
7. **When confined space entry is required to access the StormFilter systems. Please ensure that appropriate Confined Space entry training and subsequent certification has been undertaken and valid, and work procedures are strictly adhered to. If you are unsure, do not enter the vault and contact Stormwater360 via 0800 STORMWATER.**
8. Make notes about the external and internal conditions.
9. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
10. Ensuring safe working procedures are met, off load the replacement cartridges (16-60kgs each) and set aside.
11. Temporary (removable) ladders to be used for access into the StormFilter device.
12. Remove the top cap (threaded), upper seal and float from the cartridge. Repeat procedure for every cartridge within StormFilter vault. Place items in a large plastic container to be lifted from the vault.
13. Move the Vacuum truck near the StormFilter vault on the downstream side. Be sure that the Vacuum truck is not too close to the vault so as the fumes will not enter the vault. Make sure that the last 500mm of the nozzle is approx. 100-125mm in outside diameter.
14. Feed vacuum nozzle into cartridge bay and start vacuum truck. Remove cartridge hood and place nozzle directly onto filter media. Completely remove media from each cartridge and repeat process for every cartridge in vault.

15. Once completed unthread cartridges from vault floor and place hood back on cartridges.

16. Using the appropriate lifting cap, attach the cable and remove the cartridge (up to 15kgs. each) from the vault. Personnel standing under suspended cartridges is strictly prohibited. Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the maintenance contractor.

17. Set the used cartridge aside or load onto the hauling truck.

18. Repeat steps 11 to 13 until all cartridges have been removed.

19. Remove deposited sediment from the floor of the vault and, if large amounts are present, from the forebay. This can be accomplished by using the Vacuum truck.

20. Once the sediments are removed, it is necessary to assess the condition of the vault, particularly the manifold and the connectors. These are either short sections of 2-inch schedule 50 PVC, threaded schedule 80 PVC, or ABS deck mount stubs that should protrude above the floor of the vault. If required, apply a light coating of FDA approved silicon grease to the outside of the exposed portion of the connectors. This ensures a watertight connection between the cartridge and the drainage pipe. Replace any damaged connectors.

21. Using the boom, crane, or tripod, lower and install the new cartridges (typically 16-17kgs. for 46cm perlite cartridges. 20-22kgs. For 69cm perlite cartridges). Once again, take care not to damage connections.

22. Close and fasten the access cover and remove safety equipment.

23. Make notes about the local drainage area relative to ongoing construction, erosion problems, or high loadings of other materials to the system.

24. Finally, dispose of the residual materials in accordance with applicable regulations. Make arrangements to return the used cartridges to Stormwater360.

D.5.2.2 Steps (Without Vacuum Truck)

1. Depending on the particular unit, one or two utility workers and a hauling truck operator will deliver the replacement cartridges to the site. Information concerning how to obtain the replacement cartridges is available from Stormwater360.

2. If the device is located within a road carriageway, arrange for traffic management to be provided by a competent provider.

3. Set up safety equipment and barriers to isolate the public from the work zone and protect pedestrians from fall hazards presented by access cover.

4. Inspect the external condition of the device and take notes concerning defects/problems.

5. Open the access cover to the device and allow the vault to air out for 5-10 minutes.

6. Undertake a visual inspection from the top to check if there is sediment within the vault and ponded water. Assess whether it is necessary and safe to enter the device. *note* entry to device is required to determine the quality of the cartridge media. *Confined space entry procedures are recommended to be implemented in accordance with your company's health and safety guidelines.*

7 **When confined space entry is required to access the StormFilter systems. Please ensure that appropriate Confined Space entry training and subsequent certification has been undertaken and valid, and work procedures are strictly adhered to. If you are unsure, do not enter the vault and contact Stormwater360 via 0800 STORMWATER.**

8. Make notes about the external and internal conditions.
9. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
10. Remove large loose debris and trash using a pole with a grapple or net on the end.
11. Ensuring safe working procedures are met, offload the replacement cartridges (16-60kgs each) and set aside.
12. Temporary (removable) ladders to be used for access into the StormFilter device.
13. Using the appropriate lifting cap, attach the cable from the boom, crane, or tripod to the cartridge being removed. Personnel standing under suspended cartridges is strictly prohibited. For more information contact Stormwater360. This activity may require that workers enter the vault* to remove the cartridges from the drainage system and place them under the vault opening for lifting. Note that cartridges require unscrewing from their threaded connectors. Take care not to damage the manifold connectors. This connector should remain installed in the manifold and capped if necessary. Note: * Confined space entry may be required on StormFilter systems. In this case, please ensure that appropriate Confined Space entry training and subsequent certification has been undertaken and valid, and work procedures are strictly adhered to. If you are unsure, do not enter the vault and contact Stormwater360 immediately.
14. Remove the cartridge (up to approx. 60kgs. each for 46cm Perlite/Zeolite mix saturated & occluded cartridges) from the vault. Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner unless maintenance activities are being performed by Stormwater360 and damage is not related to discharges to the system.
15. Set the used cartridge aside or load onto the hauling truck.
16. Continue steps 10 through 12 until all cartridges have been removed.
17. Remove deposited sediment from the floor of the vault and, if large amounts are present, from the forebay. This can usually be accomplished by shovelling the sediment into containers which, once full, are lifted mechanically from the vault and placed onto the hauling truck. In some cases of extreme sediment loading, especially if the sediment is saturated, a vacuum truck may be required.
18. Once the sediments are removed, it is necessary to assess the condition of the vault, particularly the manifold and the connectors. These are either short sections of 2-inch schedule 50 PVC, threaded schedule 80 PVC, or ABS deck mount stubs that should protrude above the floor of the vault. If required, apply a light coating of FDA approved silicon grease to the outside of the exposed portion of the connectors. This ensures a watertight connection between the cartridge and the drainage pipe. Replace any damaged connectors.
19. Using the boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.
20. Close and fasten the access cover and remove safety equipment.
21. Make notes about the local drainage area relative to ongoing construction, erosion problems, or high loadings of other materials to the system.
22. Finally, dispose of the residual materials in accordance with applicable regulations. Make arrangements to return the used cartridges to Stormwater360.

Vault Maintenance Data Sheet

Site Details

ID: 1097

Date: 19/01/2016 Location: 88 Carbine Road System Size: SF46-09-VF-421515-PER

System: Precast Linear Cast in Place (circle option) Personnel

Equipment Used: Road Cones, Truck Warning Lights, Gas Detector, Safety Harnesses, Winch and Pulley, Ear Muffs, Gloves, Steel Cap Gumboots, Disposable Overalls

System Observations

Media Month in service	94	Oil & Grease in Forebay	N/A
Forebay Sediment Depth	N/A	Vault Floor Sediment	150mm
Structural Damage	None	Flow from Pipes	Good
Carts Submerged	None	Submerged Depth	N/A

Drainage Area Report

Excessive Oil & Grease	No	Source	N/A
Sediment Build up	No	Source	N/A
Erosion of Landscaping	None	Source	N/A

Cartridge Replacement Activities (check off when completed & give description)

Remove Trash and Debris	Some litter removed	Replace Cartridges	9
Sediment Removed	±1000kg	Minor Structural Repairs	N/A

Sediment Disposal Methods: Council Approved Facility

Other Details

Items requiring further attention: None

Latitude Longitude

Comments: Device needs regular maintenance.

D.6 Related Maintenance Activities (Performed on an as-needed basis)

StormFilter™ units are often just one of many components in a more comprehensive stormwater drainage and treatment system. The entire system may include catch basins, detention vaults, sedimentation vaults and manholes, detention/retention ponds, swales, artificial wetlands, and other miscellaneous components. In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities. In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil and grease loading, and discharges of inappropriate materials.

D.7 Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in a manner that will not allow the material to affect surface or ground water. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily travelled roads. Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. It is not appropriate to discharge these materials back to the stormwater drainage system. Part of arranging for maintenance to occur should include coordination of disposal of solids (landfill coordination) and liquids (municipal vacuum truck decant facility, local wastewater treatment plant, on-site treatment and discharge). Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals. Disposal methods or reuse of the media contained in the cartridges will be determined by Stormwater360. If the material has been contaminated with any unusual substance, the cost of special handling and disposal will be the responsibility of the owner.

END OF SECTION D

SECTION E Available Resources

In addition to this O&M guideline, SW360 can supply the following resources upon request, where the asset/device owner does not have standard maintenance procedures/documents;

- Method Statements
  - MS-SF-0003; StormFilter Pre-Maintenance Inspection via Confined Space Entry o MS-SF-0006; StormFilter Cartridge Installation
  - StormFilter Inspection and Maintenance Procedures
- Confined Space Procedures
  - CSF 0029; Confined Space Entry Plan
- Product Drawings
- FAQs (Available from www.stormwater360.co.nz/faq)
- "How to" Videos (Available from www.youtube.com/user/stormwaterTV)

Further information and resources can be found on the SW360 website (http://www.stormwater360.co.nz/).

APPENDIX F

OLFP cross section report

3 Pigeon Mountain Road

1% AEP Flood Peak Flow Analysis

DATE: 25.03.2026

Runoff Coefficient - **C**	0.8	
Rainfall Intensity (100year) - **I**	184	mm/hour

Q = CIA X 2.78/1000

CATCHMENT	AREA (ha)	Q (m³/s)
1	0.1670	0.068
2	0.0730	0.030
3	0.5130	0.210
4	0.3290	0.135
5	0.0730	0.030
6	0.0790	0.032
7	0.1490	0.061

CROSS SECTION	CATCHMENT	AREA (ha)	Q (m³/s)
C	3	0.513	0.210
D	4	0.329	0.135

*OLF Path & Catchment plans refer to drawing 450

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Mar 25 2026

CROSS SECTION C-C

User-defined

Invert Elev (m)	= 7.0350
Slope (%)	= 10.0000
N-Value	= 0.030

Calculations

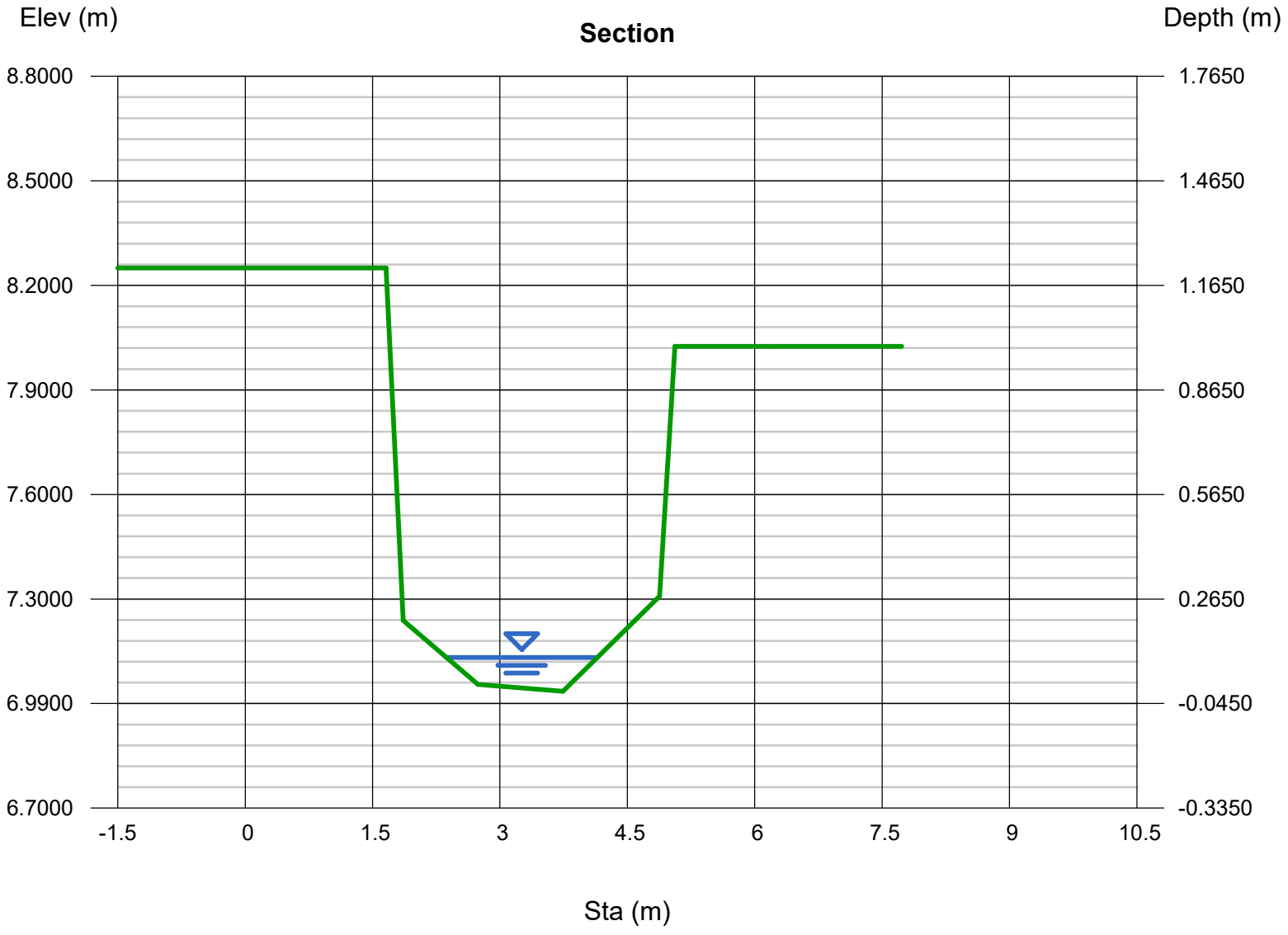
Compute by:	Known Q
Known Q (cms)	= 0.2100

Highlighted

Depth (m)	= 0.0975
Q (cms)	= 0.210
Area (sqm)	= 0.1219
Velocity (m/s)	= 1.7234
Wetted Perim (m)	= 1.7998
Crit Depth, Yc (m)	= 0.1463
Top Width (m)	= 1.7801
EGL (m)	= 0.2490

(Sta, El, n)-(Sta, El, n)...

(0.0000, 8.2500)-(1.6600, 8.2500, 0.030)-(1.8600, 7.2380, 0.030)-(2.7400, 7.0550, 0.030)-(3.7400, 7.0350, 0.030)-(4.8800, 7.3080, 0.030)-(5.0600, 8.0250, 0.030)-(6.2300, 8.0250, 0.030)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Mar 26 2026

CROSS SECTION D-D

User-defined

Invert Elev (m)	= 8.2000
Slope (%)	= 3.0000
N-Value	= 0.020

Calculations

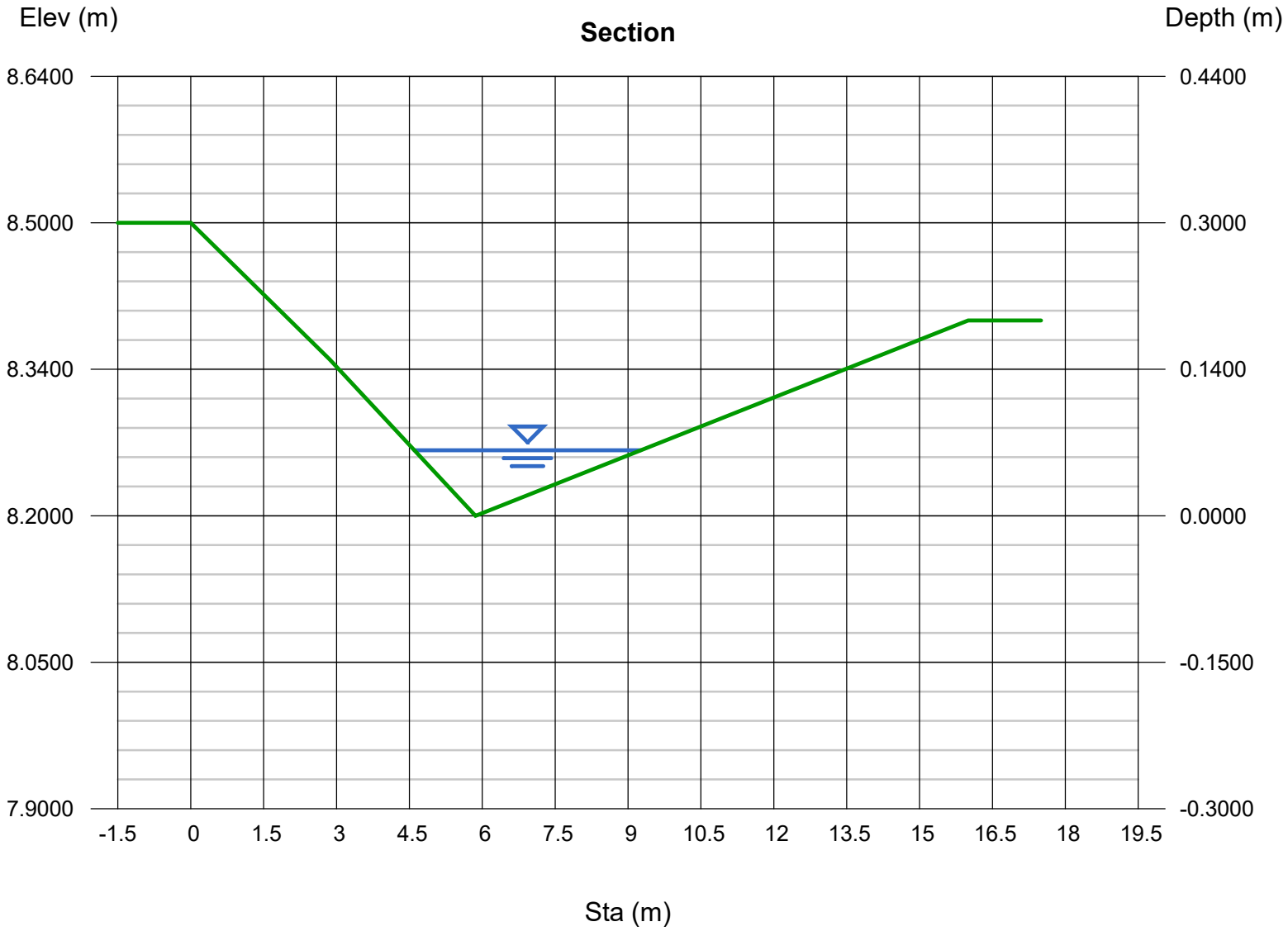
Compute by:	Known Q
Known Q (cms)	= 0.1350

Highlighted

Depth (m)	= 0.0671
Q (cms)	= 0.135
Area (sqm)	= 0.1561
Velocity (m/s)	= 0.8646
Wetted Perim (m)	= 4.6595
Crit Depth, Yc (m)	= 0.0792
Top Width (m)	= 4.6570
EGL (m)	= 0.1052

(Sta, El, n)-(Sta, El, n)...

(0.0000, 8.5000)-(2.8600, 8.3600, 0.020)-(5.8600, 8.2000, 0.020)-(16.0000, 8.4000, 0.020)



APPENDIX G

Stormwater Capacity Assessment

Proposed Stormwater Catchment
3 PIGEON MOUNTAIN ROAD
PROJECT ADDRESS: 3 Pigeon Mountain Road, Half Moon Bay

(For CONSENT) 25-03-26

Rev C

FACTORS

Tc mins	10
f years	10
i mm/hr	106
Pipe Coeff.(mm)	1.5

Runoff Coefficients	
Residential Lots	0.65
Public Roads	0.9
Concrete Joal	0.9
Concrete Walkway	0.9
Grass/Permeable Paver	0.3

PROJECT NO: FP326

Prepared by: JW

Checked by: SX

*(Note: catchment details refer to **stormwater catchment plan FP326-430**)*

CATCHMENT DETAIL

Catchment	Area (Ha)	Zoning
Catchment 1	0.1010	Residential lots
Catchment 2	0.1124	Residential lots
Catchment 3	0.0308	Concrete Joal
Catchment 4	0.0286	Concrete Joal
Catchment 5	0.1364	Residential lots
Catchment 6	0.1298	Residential lots
Catchment 7	0.0079	Concrete Walkway
Catchment 8	0.0083	Concrete Walkway
Catchment 9	0.0334	Concrete Joal
Catchment 10	0.0304	Concrete Joal
Catchment 11	0.0311	Concrete Joal
Catchment 12	0.0266	Concrete Joal
Catchment 12-1	0.0105	Grass/Permeable Paver
Catchment 13	0.0160	Concrete Joal

Catchment	Area (Ha)	Zoning
Catchment 14	0.0341	Concrete Joal
Catchment 14-1	0.0435	Grass/Permeable Paver
Catchment 15	0.0242	Concrete Joal
Catchment 15-1	0.0133	Grass/Permeable Paver
Catchment 16	0.0911	Residential lots
Catchment 17	0.1008	Residential lots
Catchment 18	0.0769	Residential lots
Catchment 19	0.0440	Residential lots
Catchment 20	0.0362	Residential lots
Catchment 21	0.1063	Residential lots
Catchment 22	0.0450	Residential lots
Catchment 23	0.0556	Residential lots
Catchment 24	0.0438	Residential lots

PIPE LINE	CATCHMENT	AREA (ha)	COEFF.	INTENSITY (mm/hr)	EQUIVALENT Increment	AREA Sum	FLOW (l/s)	DIA (mm)	GRADE (%)	CAPACITY (l/s)	VELOCITY (m/s)	CAPACITY Check
PROPOSED PUBLIC STORMWATER LINES												
PROPOSED PUBLIC LINE 3												
3/4 - 3/3	***Catchment 1***	0.1010	0.65	106	0.0657	0.0657	**19.3**	225	5.00	**107**	2.6	
	Catchment 5	0.1364	0.65	106	0.0887	0.1543	**45.3**	225	5.00	**107**	2.6	yes
3/3 - 3/2	***Catchment 1***	0.1010	0.65	106	0.0657	0.0657	**19.3**	225	5.00	**107**	2.6	
	Catchment 5	0.1364	0.65	106	0.0887	0.1543	**45.3**	225	5.00	**107**	2.6	yes
3/2 - 3/1	***Catchment 1***	0.1010	0.65	106	0.0657	0.0657	**19.3**	300	1.00	**102**	1.4	
	Catchment 5	0.1364	0.65	106	0.0887	0.1543	**45.3**	300	1.00	**102**	1.4	
	Catchment 21	0.1063	0.65	106	0.0691	0.2234	**65.6**	300	1.00	**102**	1.4	
	Catchment 23	0.0556	0.65	106	0.0361	0.2595	**76.2**	300	1.00	**102**	1.4	yes
3/1 - 1/4	***Catchment 1***	0.1010	0.65	106	0.0657	0.0657	**19.3**	300	5.00	**229**	3.1	
	Catchment 5	0.1364	0.65	106	0.0887	0.1543	**45.3**	300	5.00	**229**	3.1	
	Catchment 21	0.1063	0.65	106	0.0691	0.2234	**65.6**	300	5.00	**229**	3.1	
	Catchment 23	0.0556	0.65	106	0.0361	0.2595	**76.2**	300	5.00	**229**	3.1	yes
PROPOSED PUBLIC LINE 2												
2/4 - 2/3	***Catchment 2***	0.1124	0.65	106	0.0731	0.0731	**21.4**	225	8.00	**135**	3.3	
	Catchment 6	0.1298	0.65	106	0.0844	0.1574	**46.2**	225	8.00	**135**	3.3	yes
2/3 - 2/2	***Catchment 2***	0.1124	0.65	106	0.0731	0.0731	**21.4**	225	5.00	**107**	2.6	
	Catchment 4	0.0286	0.65	106	0.0186	0.0917	**26.9**	225	5.00	**107**	2.6	
	Catchment 6	0.1298	0.90	106	0.1168	0.2085	**61.2**	225	5.00	**107**	2.6	yes
2/2 - 2/1	***Catchment 2***	0.1124	0.65	106	0.0731	0.0731	**21.4**	225	5.00	**107**	2.6	
	Catchment 4	0.0286	0.65	106	0.0186	0.0917	**26.9**	225	5.00	**107**	2.6	
	Catchment 6	0.1298	0.90	106	0.1168	0.2085	**61.2**	225	5.00	**107**	2.6	
	Catchment 8	0.0083	0.90	106	0.0075	0.2159	**63.4**	225	5.00	**107**	2.6	yes
2/1 - EXMH 2000323535	***Catchment 2***	0.1124	0.65	106	0.0731	0.0731	**21.4**	225	2.00	**67**	1.6	
	Catchment 4	0.0286	0.65	106	0.0186	0.0917	**26.9**	225	2.00	**67**	1.6	
	Catchment 6	0.1298	0.90	106	0.1168	0.2085	**61.2**	225	2.00	**67**	1.6	
	Catchment 8	0.0083	0.90	106	0.0075	0.2159	**63.4**	225	2.00	**67**	1.6	yes

PROPOSED PUBLIC LINE 1												
1/6 - 1/5	***Catchment 16***	0.0911	0.65	106	0.0592	0.0592	**17.4**	225	1.00	**48**	1.2	
	Catchment 24	0.0438	0.65	106	0.0285	0.0877	**25.7**	225	1.00	**48**	1.2	**yes**
1/5 - 1/4	***Catchment 3***	0.0308	0.65	106	0.0200	0.0200	**5.9**	450	0.60	**232**	1.4	
	Catchment 7	0.0079	0.65	106	0.0051	0.0252	**7.4**	450	0.60	**232**	1.4	
	Catchment 9	0.0334	0.65	106	0.0217	0.0469	**13.8**	450	0.60	**232**	1.4	
	Catchment 10	0.0304	0.65	106	0.0198	0.0666	**19.6**	450	0.60	**232**	1.4	
	Catchment 11	0.0311	0.90	106	0.0280	0.0946	**27.8**	450	0.60	**232**	1.4	
	Catchment 12	0.0266	0.90	106	0.0239	0.1186	**34.8**	450	0.60	**232**	1.4	
	Catchment 12-1	0.0105	0.30	106	0.0032	0.1217	**35.7**	450	0.60	**232**	1.4	
	Catchment 13	0.0160	0.90	106	0.0144	0.1361	**39.9**	450	0.60	**232**	1.4	
	Catchment 14	0.0341	0.90	106	0.0307	0.1668	**49.0**	450	0.60	**232**	1.4	
	Catchment 14-1	0.0435	0.30	106	0.0131	0.1798	**52.8**	450	0.60	**232**	1.4	
	Catchment 15	0.0242	0.90	106	0.0218	0.2016	**59.2**	450	0.60	**232**	1.4	
	Catchment 15-1	0.0133	0.30	106	0.0040	0.2056	**60.4**	450	0.60	**232**	1.4	
	Catchment 16	0.0911	0.90	106	0.0820	0.2876	**84.4**	450	0.60	**232**	1.4	
	Catchment 17	0.1008	0.90	106	0.0907	0.3783	**111.0**	450	0.60	**232**	1.4	
	Catchment 18	0.0769	0.90	106	0.0692	0.4475	**131.4**	450	0.60	**232**	1.4	
	Catchment 22	0.0450	0.90	106	0.0405	0.4880	**143.2**	450	0.60	**232**	1.4	**yes**
1/4 - 1/3	***Catchment 1***	0.1010	0.65	106	0.0657	0.0657	**19.3**	450	0.80	**268**	1.6	
	Catchment 3	0.0308	0.65	106	0.0200	0.0857	**25.1**	450	0.80	**268**	1.6	
	Catchment 5	0.1364	0.65	106	0.0887	0.1743	**51.2**	450	0.80	**268**	1.6	
	Catchment 7	0.0079	0.65	106	0.0051	0.1795	**52.7**	450	0.80	**268**	1.6	
	Catchment 9	0.0334	0.65	106	0.0217	0.2012	**59.0**	450	0.80	**268**	1.6	
	Catchment 10	0.0304	0.65	106	0.0198	0.2209	**64.8**	450	0.80	**268**	1.6	
	Catchment 11	0.0311	0.90	106	0.0280	0.2489	**73.1**	450	0.80	**268**	1.6	
	Catchment 12	0.0266	0.90	106	0.0239	0.2729	**80.1**	450	0.80	**268**	1.6	
	Catchment 12-1	0.0105	0.30	106	0.0032	0.2760	**81.0**	450	0.80	**268**	1.6	
	Catchment 13	0.0160	0.90	106	0.0144	0.2904	**85.2**	450	0.80	**268**	1.6	
	Catchment 14	0.0341	0.90	106	0.0307	0.3211	**94.2**	450	0.80	**268**	1.6	
	Catchment 14-1	0.0435	0.30	106	0.0131	0.3342	**98.1**	450	0.80	**268**	1.6	
	Catchment 15	0.0242	0.90	106	0.0218	0.3559	**104.5**	450	0.80	**268**	1.6	
	Catchment 15-1	0.0133	0.30	106	0.0040	0.3599	**105.6**	450	0.80	**268**	1.6	
	Catchment 16	0.0911	0.90	106	0.0820	0.4419	**129.7**	450	0.80	**268**	1.6	
	Catchment 17	0.1008	0.90	106	0.0907	0.5326	**156.3**	450	0.80	**268**	1.6	
	Catchment 18	0.0769	0.90	106	0.0692	0.6018	**176.7**	450	0.80	**268**	1.6	
	Catchment 19	0.0440	0.90	106	0.0396	0.6414	**188.3**	450	0.80	**268**	1.6	
	Catchment 21	0.1063	0.90	106	0.0957	0.7371	**216.4**	450	0.80	**268**	1.6	
	Catchment 22	0.0450	0.90	106	0.0405	0.7776	**228.2**	450	0.80	**268**	1.6	
	Catchment 23	0.0556	0.90	106	0.0500	0.8277	**242.9**	450	0.80	**268**	1.6	**yes**
1/3 - 1/2	***Catchment 1***	0.1010	0.65	106	0.0657	0.0657	**19.3**	450	1.00	**299**	1.8	
	Catchment 3	0.0308	0.65	106	0.0200	0.0857	**25.1**	450	1.00	**299**	1.8	
	Catchment 5	0.1364	0.65	106	0.0887	0.1743	**51.2**	450	1.00	**299**	1.8	

	Catchment 7	0.0079	0.65	106	0.0051	0.1795	**52.7**	450	1.00	**299**	1.8	
	Catchment 9	0.0334	0.65	106	0.0217	0.2012	**59.0**	450	1.00	**299**	1.8	
	Catchment 10	0.0304	0.65	106	0.0198	0.2209	**64.8**	450	1.00	**299**	1.8	
	Catchment 11	0.0311	0.90	106	0.0280	0.2489	**73.1**	450	1.00	**299**	1.8	
	Catchment 12	0.0266	0.90	106	0.0239	0.2729	**80.1**	450	1.00	**299**	1.8	
	Catchment 12-1	0.0105	0.30	106	0.0032	0.2760	**81.0**	450	1.00	**299**	1.8	
	Catchment 13	0.0160	0.90	106	0.0144	0.2904	**85.2**	450	1.00	**299**	1.8	
	Catchment 14	0.0341	0.90	106	0.0307	0.3211	**94.2**	450	1.00	**299**	1.8	
	Catchment 14-1	0.0435	0.30	106	0.0131	0.3342	**98.1**	450	1.00	**299**	1.8	
	Catchment 15	0.0242	0.90	106	0.0218	0.3559	**104.5**	450	1.00	**299**	1.8	
	Catchment 15-1	0.0133	0.30	106	0.0040	0.3599	**105.6**	450	1.00	**299**	1.8	
	Catchment 16	0.0911	0.90	106	0.0820	0.4419	**129.7**	450	1.00	**299**	1.8	
	Catchment 17	0.1008	0.90	106	0.0907	0.5326	**156.3**	450	1.00	**299**	1.8	
	Catchment 18	0.0769	0.90	106	0.0692	0.6018	**176.7**	450	1.00	**299**	1.8	
	Catchment 19	0.0440	0.90	106	0.0396	0.6414	**188.3**	450	1.00	**299**	1.8	
	Catchment 20	0.0362	0.90	106	0.0326	0.6740	**197.8**	450	1.00	**299**	1.8	
	Catchment 21	0.1063	0.90	106	0.0957	0.7697	**225.9**	450	1.00	**299**	1.8	
	Catchment 22	0.0450	0.90	106	0.0405	0.8102	**237.8**	450	1.00	**299**	1.8	
	Catchment 23	0.0556	0.90	106	0.0500	0.8602	**252.5**	450	1.00	**299**	1.8	**yes**

1/2 - 1/1	***Catchment 1***	0.1010	0.65	106	0.0657	0.0657	**19.3**	450	2.00	**424**	2.6	
	Catchment 3	0.0308	0.65	106	0.0200	0.0857	**25.1**	450	2.00	**424**	2.6	
	Catchment 5	0.1364	0.65	106	0.0887	0.1743	**51.2**	450	2.00	**424**	2.6	
	Catchment 7	0.0079	0.65	106	0.0051	0.1795	**52.7**	450	2.00	**424**	2.6	
	Catchment 9	0.0334	0.65	106	0.0217	0.2012	**59.0**	450	2.00	**424**	2.6	
	Catchment 10	0.0304	0.65	106	0.0198	0.2209	**64.8**	450	2.00	**424**	2.6	
	Catchment 11	0.0311	0.90	106	0.0280	0.2489	**73.1**	450	2.00	**424**	2.6	
	Catchment 12	0.0266	0.90	106	0.0239	0.2729	**80.1**	450	2.00	**424**	2.6	
	Catchment 12-1	0.0105	0.30	106	0.0032	0.2760	**81.0**	450	2.00	**424**	2.6	
	Catchment 13	0.0160	0.90	106	0.0144	0.2904	**85.2**	450	2.00	**424**	2.6	
	Catchment 14	0.0341	0.90	106	0.0307	0.3211	**94.2**	450	2.00	**424**	2.6	
	Catchment 14-1	0.0435	0.30	106	0.0131	0.3342	**98.1**	450	2.00	**424**	2.6	
	Catchment 15	0.0242	0.90	106	0.0218	0.3559	**104.5**	450	2.00	**424**	2.6	
	Catchment 15-1	0.0133	0.30	106	0.0040	0.3599	**105.6**	450	2.00	**424**	2.6	
	Catchment 16	0.0911	0.90	106	0.0820	0.4419	**129.7**	450	2.00	**424**	2.6	
	Catchment 17	0.1008	0.90	106	0.0907	0.5326	**156.3**	450	2.00	**424**	2.6	
	Catchment 18	0.0769	0.90	106	0.0692	0.6018	**176.7**	450	2.00	**424**	2.6	
	Catchment 19	0.0440	0.90	106	0.0396	0.6414	**188.3**	450	2.00	**424**	2.6	
	Catchment 20	0.0362	0.90	106	0.0326	0.6740	**197.8**	450	2.00	**424**	2.6	
	Catchment 21	0.1063	0.90	106	0.0957	0.7697	**225.9**	450	2.00	**424**	2.6	
	Catchment 22	0.0450	0.90	106	0.0405	0.8102	**237.8**	450	2.00	**424**	2.6	
	Catchment 23	0.0556	0.90	106	0.0500	0.8602	**252.5**	450	2.00	**424**	2.6	**yes**

1/1 - EXMH 2000234285	***Catchment 1***	0.1010	0.65	106	0.0657	0.0657	**19.3**	450	18.00	**1271**	7.8	
	Catchment 3	0.0308	0.65	106	0.0200	0.0857	**25.1**	450	18.00	**1271**	7.8	
	Catchment 5	0.1364	0.65	106	0.0887	0.1743	**51.2**	450	18.00	**1271**	7.8	
	Catchment 7	0.0079	0.65	106	0.0051	0.1795	**52.7**	450	18.00	**1271**	7.8	
	Catchment 9	0.0334	0.65	106	0.0217	0.2012	**59.0**	450	18.00	**1271**	7.8	
	Catchment 10	0.0304	0.65	106	0.0198	0.2209	**64.8**	450	18.00	**1271**	7.8	
	Catchment 11	0.0311	0.90	106	0.0280	0.2489	**73.1**	450	18.00	**1271**	7.8	
	Catchment 12	0.0266	0.90	106	0.0239	0.2729	**80.1**	450	18.00	**1271**	7.8	
	Catchment 12-1	0.0105	0.30	106	0.0032	0.2760	**81.0**	450	18.00	**1271**	7.8	
	Catchment 13	0.0160	0.90	106	0.0144	0.2904	**85.2**	450	18.00	**1271**	7.8	
	Catchment 14	0.0341	0.90	106	0.0307	0.3211	**94.2**	450	18.00	**1271**	7.8	
	Catchment 14-1	0.0435	0.30	106	0.0131	0.3342	**98.1**	450	18.00	**1271**	7.8	
	Catchment 15	0.0242	0.90	106	0.0218	0.3559	**104.5**	450	18.00	**1271**	7.8	
	Catchment 15-1	0.0133	0.30	106	0.0040	0.3599	**105.6**	450	18.00	**1271**	7.8	
	Catchment 16	0.0911	0.90	106	0.0820	0.4419	**129.7**	450	18.00	**1271**	7.8	
	Catchment 17	0.1008	0.90	106	0.0907	0.5326	**156.3**	450	18.00	**1271**	7.8	
	Catchment 18	0.0769	0.90	106	0.0692	0.6018	**176.7**	450	18.00	**1271**	7.8	
	Catchment 19	0.0440	0.90	106	0.0396	0.6414	**188.3**	450	18.00	**1271**	7.8	
	Catchment 20	0.0362	0.90	106	0.0326	0.6740	**197.8**	450	18.00	**1271**	7.8	
	Catchment 21	0.1063	0.90	106	0.0957	0.7697	**225.9**	450	18.00	**1271**	7.8	
	Catchment 22	0.0450	0.90	106	0.0405	0.8102	**237.8**	450	18.00	**1271**	7.8	
	Catchment 23	0.0556	0.90	106	0.0500	0.8602	**252.5**	450	18.00	**1271**	7.8	**yes**
PROPOSED PUBLIC CONN TO FILTER												
PVT FILTER 2 - 2/3	***Catchment 4***	0.0286	0.90	106	0.0257	0.0257	**7.6**	225	7.00	**126**	3.1	**yes**
PVT FILTER 1 - 1/5	***Catchment 3***	0.0308	0.90	106	0.0277	0.0277	**8.1**	300	1.00	**102**	1.4	
	Catchment 9	0.0334	0.90	106	0.0301	0.0578	**17.0**	300	1.00	**102**	1.4	
	Catchment 10	0.0304	0.90	106	0.0274	0.0851	**25.0**	300	1.00	**102**	1.4	
	Catchment 11	0.0311	0.90	106	0.0280	0.1131	**33.2**	300	1.00	**102**	1.4	
	Catchment 12	0.0266	0.90	106	0.0239	0.1371	**40.2**	300	1.00	**102**	1.4	
	Catchment 12-1	0.0105	0.30	106	0.0032	0.1402	**41.2**	300	1.00	**102**	1.4	
	Catchment 13	0.0160	0.90	106	0.0144	0.1546	**45.4**	300	1.00	**102**	1.4	
	Catchment 14	0.0341	0.90	106	0.0307	0.1853	**54.4**	300	1.00	**102**	1.4	
	Catchment 14-1	0.0435	0.30	106	0.0131	0.1984	**58.2**	300	1.00	**102**	1.4	
	Catchment 15	0.0242	0.90	106	0.0218	0.2201	**64.6**	300	1.00	**102**	1.4	
	Catchment 15-1	0.0133	0.30	106	0.0040	0.2241	**65.8**	300	1.00	**102**	1.4	**yes**

PROPOSED PRIVATE STORMWATER LINES												
PROPOSED PRIVATE LINE 5												
5/3 - 5/2	***Catchment 12***	0.0266	0.90	106	0.0239	0.0239	**7.0**	225	3.50	**89**	2.2	
	Catchment 12-1	0.0105	0.30	106	0.0032	0.0271	**8.0**	225	3.50	**89**	2.2	
	Catchment 13	0.0160	0.90	106	0.0144	0.0415	**12.2**	225	3.50	**89**	2.2	**yes**
5/2 - 5/1	***Catchment 12***	0.0266	0.90	106	0.0239	0.0239	**7.0**	225	0.50	**34**	0.8	
	Catchment 12-1	0.0105	0.90	106	0.0095	0.0334	**9.8**	225	0.50	**34**	0.8	
	Catchment 13	0.0160	0.90	106	0.0144	0.0478	**14.0**	225	0.50	**34**	0.8	
	Catchment 14	0.0341	0.90	106	0.0307	0.0785	**23.0**	225	0.50	**34**	0.8	
	Catchment 14-1	0.0435	0.30	106	0.0131	0.0915	**26.9**	225	0.50	**34**	0.8	**yes**
5/1 - PVT FILTER 1	***Catchment 3***	0.0308	0.90	106	0.0277	0.0277	**8.1**	300	1.00	**102**	1.4	
	Catchment 9	0.0334	0.90	106	0.0301	0.0578	**17.0**	300	1.00	**102**	1.4	
	Catchment 10	0.0304	0.90	106	0.0274	0.0851	**25.0**	300	1.00	**102**	1.4	
	Catchment 11	0.0311	0.90	106	0.0280	0.1131	**33.2**	300	2.00	**145**	2.0	
	Catchment 12	0.0266	0.90	106	0.0239	0.1371	**40.2**	300	2.00	**145**	2.0	
	Catchment 12-1	0.0105	0.30	106	0.0032	0.1402	**41.2**	300	2.00	**145**	2.0	
	Catchment 13	0.0160	0.90	106	0.0144	0.1546	**45.4**	300	2.00	**145**	2.0	
	Catchment 14	0.0341	0.90	106	0.0307	0.1853	**54.4**	300	2.00	**145**	2.0	
	Catchment 14-1	0.0435	0.30	106	0.0131	0.1984	**58.2**	300	2.00	**145**	2.0	
	Catchment 15	0.0242	0.90	106	0.0218	0.2201	**64.6**	300	2.00	**145**	2.0	
	Catchment 15-1	0.0133	0.30	106	0.0040	0.2241	**65.8**	300	2.00	**145**	2.0	**yes**

PROPOSED PRIVATE LINE 4												
4/3 - 4/2	***Catchment 3***	0.0308	0.90	106	0.0277	0.0277	**8.1**	150	7.00	**43**	2.4	**yes**
4/2 - 4/1	***Catchment 3***	0.0308	0.90	106	0.0277	0.0277	**8.1**	150	7.00	**43**	2.4	
	Catchment 9	0.0334	0.90	106	0.0301	0.0578	**17.0**	150	7.00	**43**	2.4	
	Catchment 11	0.0311	0.90	106	0.0280	0.0858	**25.2**	150	7.00	**43**	2.4	**yes**
4/1 - 5/1	***Catchment 3***	0.0308	0.90	106	0.0277	0.0277	**8.1**	225	2.00	**67**	1.6	
	Catchment 9	0.0334	0.90	106	0.0301	0.0578	**17.0**	225	2.00	**67**	1.6	
	Catchment 10	0.0304	0.90	106	0.0274	0.0851	**25.0**	225	2.00	**67**	1.6	
	Catchment 11	0.0311	0.90	106	0.0280	0.1131	**33.2**	225	2.00	**67**	1.6	
	Catchment 15	0.0242	0.90	106	0.0218	0.1349	**39.6**	225	2.00	**67**	1.6	
	Catchment 15-1	0.0133	0.30	106	0.0040	0.1389	**40.8**	225	2.00	**67**	1.6	**yes**

PIPE LINE	CATCHMENT	AREA (ha)	COEFF.	INTENSITY (mm/hr)	EQUIVALENT Increment	AREA Sum	FLOW (l/s)	DIA (mm)	GRADE (%)	CAPACITY (l/s)	VELOCITY (m/s)	CAPACITY Check
EXSITING LINES												
EXMH 2000323535 - EXSW downstream	***Catchment 2***	0.1124	0.65	106	0.0731	0.0731	**21.4**	300	1.10	**107**	1.5	
	Catchment 4	0.0286	0.65	106	0.0186	0.0917	**26.9**	300	1.10	**107**	1.5	
	Catchment 6	0.1298	0.90	106	0.1168	0.2085	**61.2**	300	1.10	**107**	1.5	
	Catchment 8	0.0083	0.90	106	0.0075	0.2159	**63.4**	300	1.10	**107**	1.5	**yes**
EXMH 2000234285 - EXSW downstream	***Catchment 1***	0.1010	0.65	106	0.0657	0.0657	**19.3**	450	18.00	**1271**	7.8	
	Catchment 3	0.0308	0.65	106	0.0200	0.0857	**25.1**	450	18.00	**1271**	7.8	
	Catchment 5	0.1364	0.65	106	0.0887	0.1743	**51.2**	450	18.00	**1271**	7.8	
	Catchment 7	0.0079	0.65	106	0.0051	0.1795	**52.7**	450	18.00	**1271**	7.8	
	Catchment 9	0.0334	0.65	106	0.0217	0.2012	**59.0**	450	18.00	**1271**	7.8	
	Catchment 10	0.0304	0.65	106	0.0198	0.2209	**64.8**	450	18.00	**1271**	7.8	
	Catchment 11	0.0311	0.90	106	0.0280	0.2489	**73.1**	450	18.00	**1271**	7.8	
	Catchment 12	0.0266	0.90	106	0.0239	0.2729	**80.1**	450	18.00	**1271**	7.8	
	Catchment 12-1	0.0105	0.30	106	0.0032	0.2760	**81.0**	450	18.00	**1271**	7.8	
	Catchment 13	0.0160	0.90	106	0.0144	0.2904	**85.2**	450	18.00	**1271**	7.8	
	Catchment 14	0.0341	0.90	106	0.0307	0.3211	**94.2**	450	18.00	**1271**	7.8	
	Catchment 14-1	0.0435	0.30	106	0.0131	0.3342	**98.1**	450	18.00	**1271**	7.8	
	Catchment 15	0.0242	0.90	106	0.0218	0.3559	**104.5**	450	18.00	**1271**	7.8	
	Catchment 15-1	0.0133	0.30	106	0.0040	0.3599	**105.6**	450	18.00	**1271**	7.8	
	Catchment 16	0.0911	0.90	106	0.0820	0.4419	**129.7**	450	18.00	**1271**	7.8	
	Catchment 17	0.1008	0.90	106	0.0907	0.5326	**156.3**	450	18.00	**1271**	7.8	
	Catchment 18	0.0769	0.90	106	0.0692	0.6018	**176.7**	450	18.00	**1271**	7.8	
	Catchment 19	0.0440	0.90	106	0.0396	0.6414	**188.3**	450	18.00	**1271**	7.8	
	Catchment 20	0.0362	0.90	106	0.0326	0.6740	**197.8**	450	18.00	**1271**	7.8	
	Catchment 21	0.1063	0.90	106	0.0957	0.7697	**225.9**	450	18.00	**1271**	7.8	
	Catchment 22	0.0450	0.90	106	0.0405	0.8102	**237.8**	450	18.00	**1271**	7.8	
	Catchment 23	0.0556	0.90	106	0.0500	0.8602	**252.5**	450	18.00	**1271**	7.8	**yes**
*ASSUMPTION: Existing pipe gradient assumed to be 1% due to insufficient data available												

LEGEND:

- EXISTING STORMWATER
- PROPOSED PUBLIC STORMWATER
- PROPOSED PRIVATE STORMWATER
- PROPOSED PRIVATE STORMWATER FILTER
- PROPOSED PRIVATE STANDARD CATCHPIT
- PROPOSED PRIVATE DOUBLE CATCHPIT
- PROPOSED PRIVATE FIELD CATCHPIT
- CATCHMENT BOUNDARY

RAR TAI ROAD

EX SWMH
2000234285
LL=8.16 TOPO
IL=4.32 TOPO

EX SWMH
LL=3.76 TOPO
DTI=1.37 GIS
IL=2.39 CALC

EX Ø300 SW
@1.1%

EX SWMH
2000323535
LL=3.73 TOPO
DTI=0.9 CCTV
IL=-2.83 CALC

PIGEON MOUNTAIN ROAD

COMPASS POINT WAY

CATCHMENT 20
0.0362ha

CATCHMENT 19
0.0440ha

CATCHMENT 18
0.0769ha

CATCHMENT 17
0.1008ha

CATCHMENT 14
0.0341ha

CATCHMENT 13
0.0160ha

CATCHMENT 21
0.1063ha

CATCHMENT
12-1
0.0105ha

CATCHMENT 22
0.0450ha

CATCHMENT
14-1
0.0435ha

CATCHMENT
15-1
0.0133ha

CATCHMENT
12-1
0.0266ha

CATCHMENT 24
0.0298ha

CATCHMENT 15
0.0242ha

CATCHMENT 16
0.0911ha

CATCHMENT 23
0.0556ha

CATCHMENT 11
0.0311ha

CATCHMENT 10
0.0304ha

CATCHMENT 7
0.0079ha

CATCHMENT 8
0.0083ha

CATCHMENT 5
0.1364ha

CATCHMENT 9
0.0334ha

CATCHMENT 6
0.1298ha

CATCHMENT 3
0.0308ha

CATCHMENT 4
0.0286ha

CATCHMENT 1
0.1010ha

CATCHMENT 2
0.1124ha

1-1 1-2 1-3 1-4 1-5 1-6
2-1 2-2 2-3 2-4
3-1 3-2 3-3 3-4
4-1 4-2 4-3
5-1 5-2 5-3
CP1 CP2 CP3 CP4 CP5 CP6 CP7
DCP1 DCP2
PVT FILTER 1
PVT FILTER 2
FCP1 FCP2
JOAL 3

EIGHTY6 CIVIL ENGINEERING
86 MANUKAU ROAD EPSOM AUCKLAND 1023
www.eighty6.co.nz

REF	DESCRIPTION	BY	DATE
C	S92	JW	23.03.26
B	S92	AS	09.02.26
A	RESOURCE CONSENT	JW	28.02.25

PROJECT:

3 PIGEON MOUNTAIN ROAD
HALF MOON BAY

DESCRIPTION:

STORMWATER
CATCHMENT PLAN

DESIGNED: JW	DATE: 17.02.25	SIGNATURE:	PLOT BY:
DRAWN: JW	DATE: 17.02.25	SIGNATURE:	PLOT DATE:
CHECKED: SX	DATE: 28.02.25	SIGNATURE:	SURVEY BY:
APPROVED: SX	DATE: 28.02.25	SIGNATURE:	SURVEY DATE:

ISSUE STATUS: RESOURCE CONSENT

PROJECT No:	SCALES:	REV:
FP326	1:300-A1 1:600-A3	C

DRAWING No:

FP326-430

APPENDIX H

Stormwater Tank Design Memo

Technical Memo

STORMWATER 10-YEAR PEAK FLOW MITIGATION

3 Pigeon Mountain Road, Half Moon Bay

(Project ref: FP436)

Prepared by: Yee Wen
Reviewed by: Simon Xie

Version: C
Date: 25.03.2026

1.0 INTRODUCTION

This technical memorandum is produced to support the resource application for development at 3 Pigeon Mountain Road, Half Moon Bay.

This memo specifies the proposed methods of mitigating the effects on stormwater discharge from the development in compliance with Auckland Council requirements.

2.0 SITE COVERAGE

The site has a total area of 14073m^2. The site coverage at pre- and post- development scenarios are summarised in Table 1. Further details can be found in the site information included in Attachment 1.

The pre-development site coverage area is based on the topographic survey conducted by Envivo Surveyor. The post development site coverage area has been referenced from the Architectural plans prepared by SHAPE Architects (18.03.2026).

Pre development

	Overall
Site area	14073.00
Roof	2862.60
Concrete	2769.80
Grass	8440.60
Permeable paver	0.00
Impervious	5632.40
Pervious	8440.60

Post development

	Overall
Site area	14073.00
Roof	5486.00
Concrete	2920.00
Grass	5667.00
Permeable paver	0.00
Impervious	8406.00
Pervious	5667.00

3.0 STORMWATER NETWORK

The proposed development will discharge the runoff to the existing stormwater network through a new stormwater extension.

Given the deteriorated condition of the downstream public stormwater network, on-lot detention rain tanks are proposed for each individual lot to mitigate peak flows during a 10% AEP storm event. This approach ensures that post-development peak discharges do not exceed pre-development levels. By limiting peak flows, the proposal reduces the risk of adverse effects on the public stormwater infrastructure identified by Council.

4.0 STORMWATER MITIGATION

4.1 STORMWATER 10% AEP PEAK FLOW RATE

DESIGN PARAMETERS

The stormwater assessment is based on the Stormwater Code of Practice Version 4 and account for a 17% climate change factor (2.1 degree) for a 10-year storm event.

- TP108 rainfall depth (10-year) = 130mm
- Rainfall depth (adjusted for climate change) = 152.10mm
- Rainfall intensity = 105.7mm/hr

Runoff coefficient used for peak flow analysis

- Permeable area (grass/ landscape) = 0.3
- Impermeable roof or driveway = 0.9

PEAK FLOW RATE ANALYSIS

AUTODESK Storm and Sanitary Analysis (2024) (SSA) model is used to analyse the peak flow rates and runoff volumes from the site for both pre-development and post-development at 10-year stormwater event. Figure 1 illustrates the SSA simulations for the pre- and post-development models for 10-year events. The analysis assumes no stormwater tank is present in either scenario.

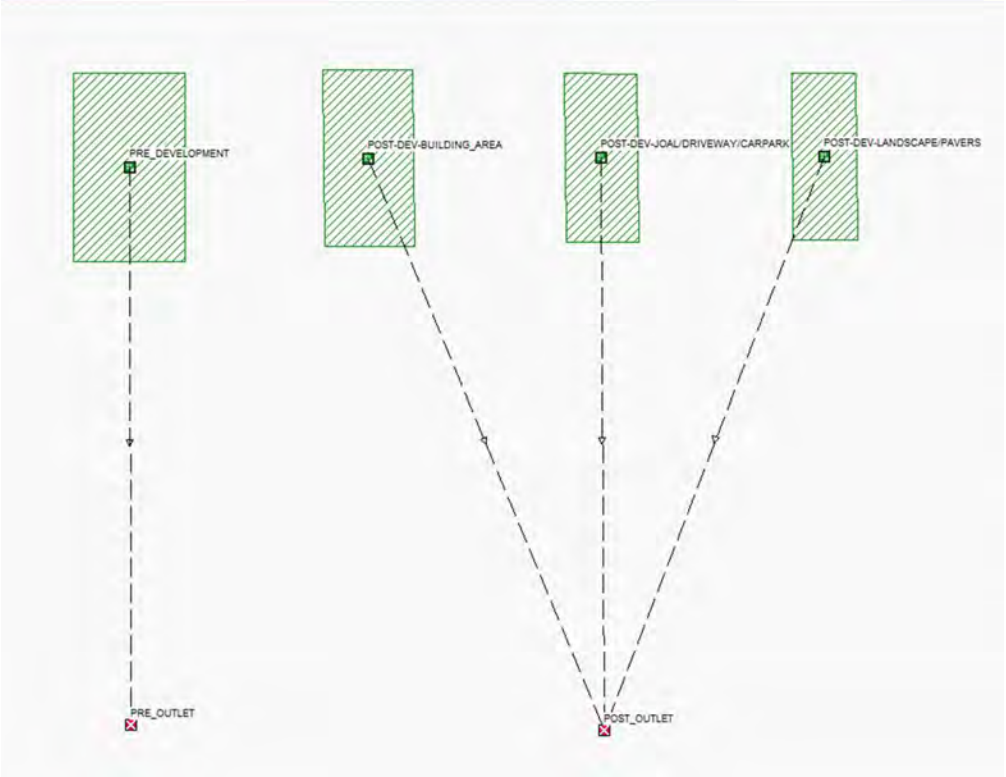


Figure 1: SSA model

Under existing site conditions, the pre-development 10% AEP peak flow is 221.90l/s. Post development, as impervious areas increase, the peak flow rises to 270.55l/s. A summary of SSA results is provide in Table 1. SSA analysis output is provided in attachment 1.

Table 1: Summary of Site Coverage			
	Area	**Peak Flow Rate**	**Stormwater Mitigation for 10-year peak flow**
	(m2)	**(l/s)**	
Pre-development			
	14073.0	221.90	None
Post-development			
Building Area	5486.0	144.17	None
JOALs or other impervious area	2920.0	76.74	None
Landscape Area or other permeable area	5667.0	49.64	None
Total	14073.0	270.55	

5.0 POST DEVELOPMENT STORMWATER MITIGATION

5.1 POST DEVELOPMENT FLOW

To ensure the overall 10% AEP peak flow does not exceed the pre-development rate of 221.90l/s, the discharge from the private lots must be limited.

It is proposed that on-lot stormwater detention tanks to be installed for the building roof areas. The remaining runoff, including private accessways and landscape/ permeable areas, will discharge directly to the public network without attenuation.

The allowable flow for the 62 private lots is calculated as:
Allowable flow = 221.9L/s – 76.74L/s - 49.64L/s = 95.52L/s
Allowable flow per lot = 95.52L/s / 62 Lots = 1.54 L/s per lot

Roof runoff from dwelling areas (Lots 1–62) will be collected into on-lot stormwater detention tanks. Runoff from landscaping, pavers, and concrete driveways is expected to bypass the detention tanks and discharge directly into the stormwater network.

With the implementation of on-lot stormwater tanks, the post-development peak flow will be equal to or less than the pre-development peak flow of 221.90 L/s for the 10-year ARI event.

5.2 IMPLEMENTATION

Each private lot shall be provided with stormwater detention device with a controlled orifice (or stormwater device providing similar function) for roof area to achieve the required discharge limit. Outlet controls shall be designed to prevent exceedance of the allowable discharge under a 10% AEP event.
A detailed calculation shall be provided at Building Consent stage to demonstrate how the stormwater from individual lots will be mitigated via the stormwater detention tank.

5 CONCLUSIONS AND RECOMMENDATIONS

The stormwater assessment demonstrates that the proposed development can be managed to ensure compliance with Council requirements. SSA modelling indicates that post-development impervious areas increase peak flows from 221.90l/s to 270.55l/s for a 10-year storm event.

To mitigate this, on-lot stormwater detention tanks are proposed for all dwelling roof areas, while runoff from landscape areas, pavers and private accessways will discharge directly to the public network. With the implementation of this measure, the post development peak flow from the site can be limited to equal or below the pre-development peak flow of 221.90l/s, ensuring no adverse effects on the downstream stormwater network.

Each private lot shall be provided with stormwater detention device with outlet controls designed to meet the allowable discharge limit (1.54l/s per lot) under a 10% AEP event. Detailed calculations and design shall be provided at Building Consent stage to confirm the proposed mitigation achieves the required flow control.

6 LIMITATIONS

This technical memo is for the use by client for 3 Pigeon Mountain Road, Half Moon Bay, for the objectives described herein. Conclusions and recommendations within this technical memo were based on desktop investigations using data collected from Auckland Council GeoMaps, Topographical survey plan and Healthy Waters.

The author accepts no responsibility for the content of this memo if it is used by any other party or for any other objective. Any use of or reliance on the information contained in this report for decisions made by third parties is the responsibility of these third parties. The author accepts no responsibility for damage incurred by third parties resulting from the use of or reliance on this report, or if the report is used by any party for purposes other than the objectives described herein. This report has been prepared for the project described to us and its extent is limited to the scope of work agreed between the client and the author. No responsibility is accepted by the author for the accuracy of information provided by third parties and/or the use of any part of this report in any other context or for any other purposes.

Attachment 1

SSA Peak Flow Analysis Report

Site Information for Rain Tank Design

3 Pigeon Mountain Road, Half Moon Bay

PROJECT ADDRESS: 3 Pigeon Mountain Road, Half Moon Bay

Project Number FP326

Prepared by: YW
Checked by: SX

Total Site Area: 14073.00 m²

Pre development

	Overall
Site area	14073.00
Roof	2862.60
Concrete	2769.80
Grass	8440.60
Permeable paver	0.00
Impervious	5632.40
Pervious	8440.60

Post development

	Overall
Site area	14073.00
Roof	5486.00
Concrete	2920.00
Grass	5667.00
Permeable paver	0.00
Impervious	8406.00
Pervious	5667.00

Project Description

File Name	3 Pigeon SSA.SPF

Project Options

Flow Units	LPS
Elevation Type	Elevation
Hydrology Method	Rational
Time of Concentration (TOC) Method	User-Defined
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	0
Subbasins	4
Nodes	2
Junctions	0
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Rainfall Intensity	106 mm/hr

Subbasin Summary

SN	Subbasin ID	Area (m²)	Weighted Runoff Coefficient	Total Rainfall (mm)	Total Runoff (mm)	Total Runoff Volume (ha-mm)	Peak Runoff (lps)	Time of Concentration (days hh:mm:ss)
1	POST-DEV-BUILDING_AREA	5486.00	0.9000	17.67	15.90	8.72	144.17	0 00:10:00
2	POST-DEV-JOAL/DRIVEWAY/CARPARK	2920.00	0.9000	17.67	15.90	4.64	76.74	0 00:10:00
3	POST-DEV-LANDSCAPE/PAVERS	5667.00	0.3000	17.67	5.30	3.00	49.64	0 00:10:00
4	PRE_DEVELOPMENT	14073.00	0.5400	17.67	9.54	13.43	221.90	0 00:10:00

Subbasin Hydrology

Subbasin : POST-DEV-BUILDING_AREA

Input Data

Area (m²)	5486
Weighted Runoff Coefficient	0.9

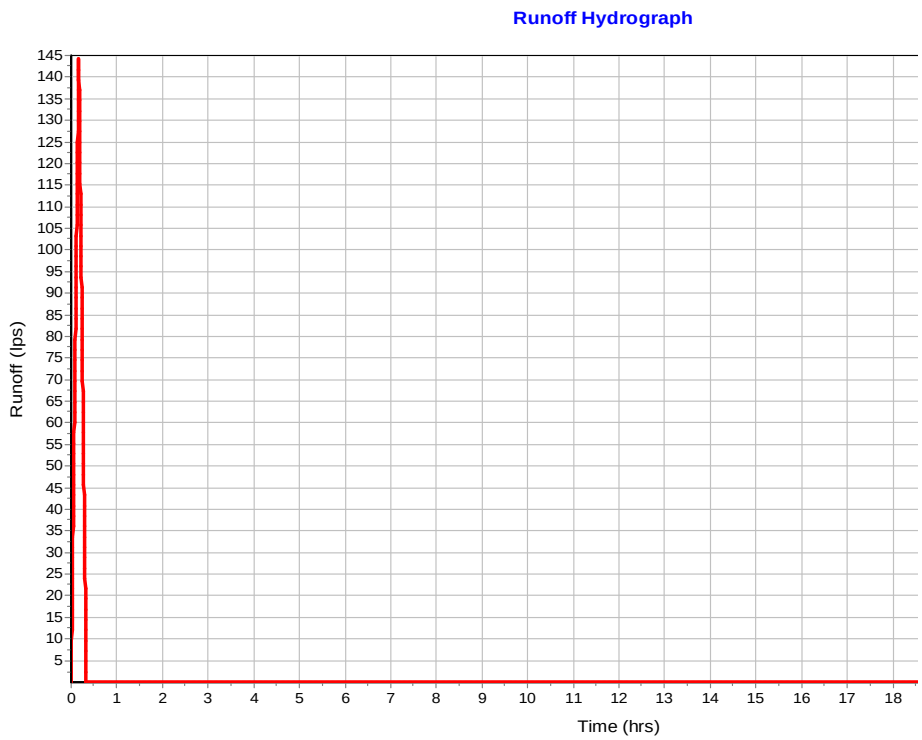
Runoff Coefficient

Soil/Surface Description	Area (m²)	Soil Group	Runoff Coeff.
ROOF	5486	-	0.9
Composite Area & Weighted Runoff Coeff.	5486		0.9

Subbasin Runoff Results

Total Rainfall (mm)	17.67
Total Runoff (mm)	15.9
Peak Runoff (lps)	144.17
Rainfall Intensity	106
Weighted Runoff Coefficient	0.9
Time of Concentration (days hh:mm:ss)	0 00:10:00

Subbasin : POST-DEV-BUILDING_AREA



Subbasin : POST-DEV-JOAL/DRIVEWAY/CARPARK

Input Data

Area (m²)	2920
Weighted Runoff Coefficient	0.9

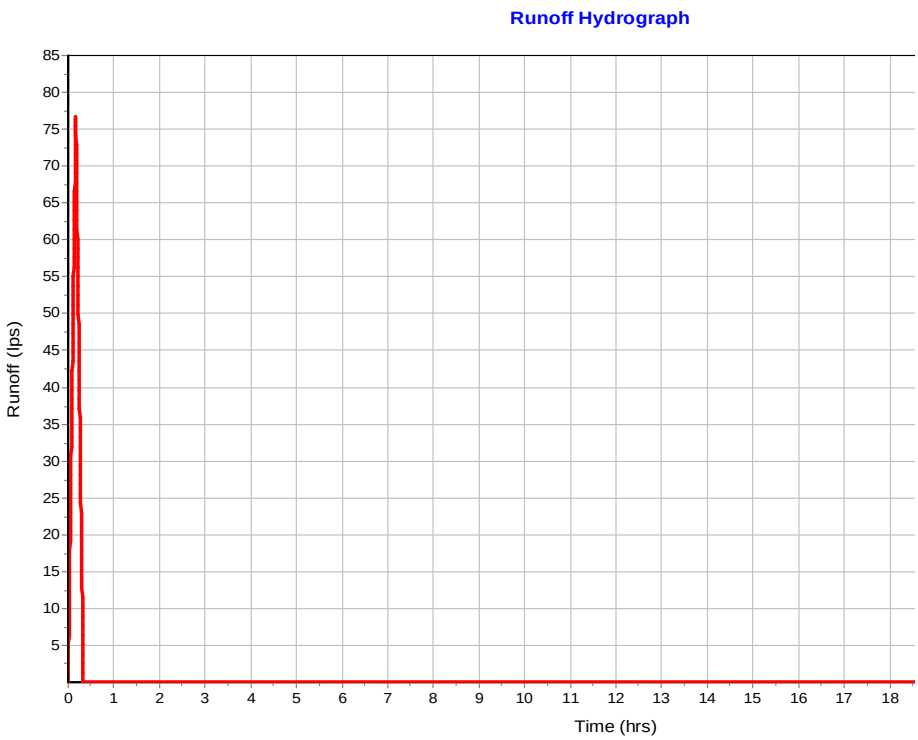
Runoff Coefficient

Soil/Surface Description	Area (m²)	Soil Group	Runoff Coeff.
Driveway/carparks	2920	-	0.9
Composite Area & Weighted Runoff Coeff.	2920		0.9

Subbasin Runoff Results

Total Rainfall (mm)	17.67
Total Runoff (mm)	15.9
Peak Runoff (lps)	76.74
Rainfall Intensity	106
Weighted Runoff Coefficient	0.9
Time of Concentration (days hh:mm:ss)	0 00:10:00

Subbasin : POST-DEV-JOAL/DRIVEWAY/CARPARK



Subbasin : POST-DEV-LANDSCAPE/PERMEABLEPAVERS

Input Data

Area (m²)	5667
Weighted Runoff Coefficient	0.3

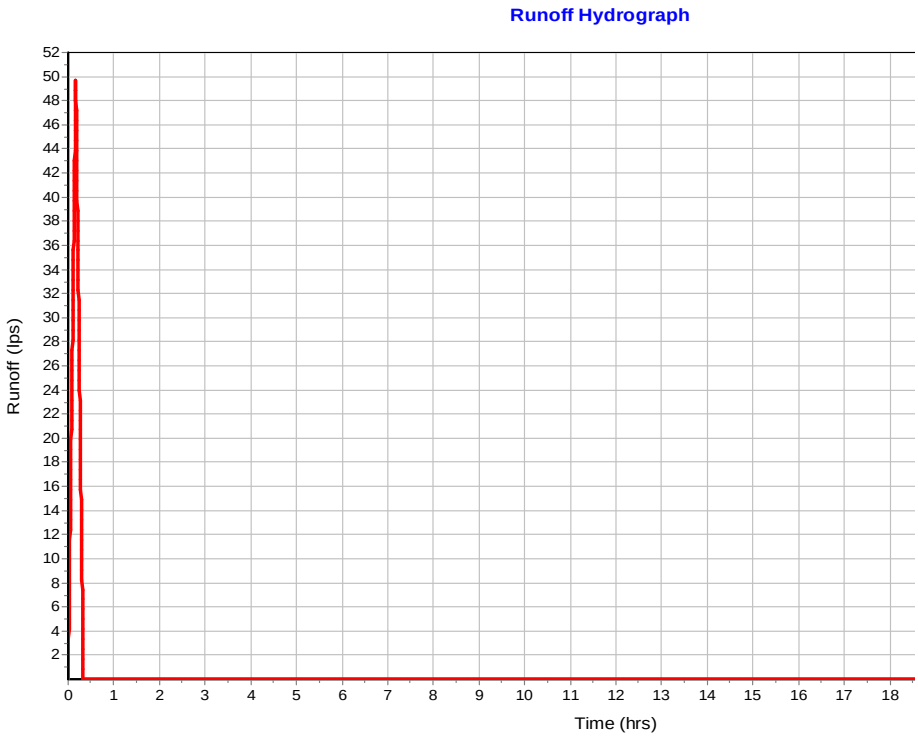
Runoff Coefficient

Soil/Surface Description	Area (m²)	Soil Group	Runoff Coeff.
-	5667	-	0.3
Composite Area & Weighted Runoff Coeff.	5667		0.3

Subbasin Runoff Results

Total Rainfall (mm)	17.67
Total Runoff (mm)	5.3
Peak Runoff (lps)	49.64
Rainfall Intensity	106
Weighted Runoff Coefficient	0.3
Time of Concentration (days hh:mm:ss)	0 00:10:00

Subbasin : POST-DEV-LANDSCAPE/PAVERS



Subbasin : PRE_DEVELOPMENT

Input Data

Area (m²)	14073
Weighted Runoff Coefficient	0.54

Runoff Coefficient

Soil/Surface Description	Area (m²)	Soil Group	Runoff Coeff.
PERMEABLEAREA	8440.6	-	0.3
IMPERMEABLEAREA	5632.4	-	0.9
Composite Area & Weighted Runoff Coeff.	14073		0.54

Subbasin Runoff Results

Total Rainfall (mm)	17.67
Total Runoff (mm)	9.54
Peak Runoff (lps)	221.9
Rainfall Intensity	106
Weighted Runoff Coefficient	0.54
Time of Concentration (days hh:mm:ss)	0 00:10:00

Subbasin : PRE_DEVELOPMENT