Birch
Planning
Surveying
Engineering
LAND DEVELOPMENT CONSULTANTS

HEC-HMS MODELLING REPORT

To:

AUCKLAND COUNCIL

On behalf of:

SR AND DS SMITH

70A & 70B Lisle Farm Drive, Pukekohe

DECEMBER 2024

BSL REF: 4553

REVISION D

REPORT PREPARED BY	REPORT REVIEWED BY	REPORT AUTHORISED BY
		
SKYWARD HANG CHARTERED PROFESSIONAL CIVIL ENGINEER	KELLY BOSGRA REGISTERED PROFESSIONAL SURVEYOR	SIR WILLIAM BIRCH PROJECT MANAGER DATE DECEMBER 2024:

BIRCH SURVEYORS LTD
2A Wesley Street, Pukekohe, Auckland
PO Box 475, Pukekohe 2340, New Zealand
Telephone: 64 9 237 1111 Facsimile: 64 9 238 0033
Website: www.birch.nz Email: applications@birch.nz

TABLE OF CONTENTS

1 INTRODUCTION

1.1 PURPOSE

The purpose of this report is to model the pre-development and post development stormwater runoff flows in the 10% and 1% Annual Exceedance Probability (AEP) storm events to support the Stormwater Management Report for the proposed Private Plan Change ('PPC') at 70A & B Lisle Farm Drive, Pukekohe and to design stormwater mitigation to ensure the requirements of the Auckland Unitary Plan (AUP) and the Stormwater Network Discharge Consent (NDC) are achieved.

The site is currently located within the Future Urban Zone under the AUP and is ***not*** subject to an existing Stormwater Management Plan (SMP). This means a SMP for the proposed development is require to inform how the development will meet the requirements of the Unitary Plan, schedule 2 of the NDC and will outline Best Practicable Option (BPO). This report is the technical document that supports the proposed SMP and confirms the following outcomes:

- Retention of the 5mm Storm Event (SMAF-1 equivalent retention).
- Detention with a drain down period of 24-hours for the difference between the pre-development and post-development runoff volumes from the 95th percentile, 24-hour rainfall event minus the achieved retention volume.
- Stormwater Treatment (subject to Stormwater Management Report)
- Flow rates from post development 10% AEP storm event with climate factor to not exceed pre-development 10% AEP storm event flow rate with climate factor.
- Flow rates from post development 1% AEP storm event with climate factor to not exceed pre-development 1% AEP storm event flow rate with climate factor.

This report confirms how the proposed PPC meets the Network Discharge Consent (NDC) requirements and outlines a site-specific stormwater management plan to ensure ongoing compliance with the proposed PPC. The aforementioned documents outline the stormwater management objectives, policies and mitigation methods of development within the site.

1.2 CATCHMENT

The subject site has complex topographical features, it generally slopes to the north, east, and south, with a broad main dividing ridgeline runs through the site from south-west to east. The detailed topographical features can be found in the Infrastructure Report and Geotechnical Desktop Assessment.

There is no existing stormwater connection that can be extended to service the entire subject site.

The Ecological Report identifies four areas for protection, comprising 3 wetlands and a permanent stream. These also form the receiving environment where treated stormwater will be discharged, refer to Figure 1.

Figure 1 Aerial Photos (derived from Geomap on September 2023)

1.3 STORMWATER MODELLING METHODOLOGY

Stormwater modelling has been undertaken in HEC-HMS version 4.11 in conjunction and in accordance with Auckland Council TP108 and as per Auckland Council Stormwater Code of Practice (CoP) recommendations.

The required Climate Change Factor for a 2.1°C increase in temperature in line with Auckland Council Stormwater Code of Practice Revision 3.0 and MfE Guidelines has been applied to the post-development rainfall depths. These factors being:

Frequent → Duration ↓	2 Years	5 Years	10 Years	50 Years	100 Years
24 Hour	+9%	+11.3%	+13.2%	+16.8%	+16.8%

As discussed with Healthy Waters, rainfall for 1% AEP with climate change (3.8°C increase) will be modelled for sensitivity check in line with Auckland Council Stormwater Code of Practice Revision 4.0 given the subject private plan change is for a long-term development.

Frequent → Duration ↓	2 Years	5 Years	10 Years	50 Years	100 Years
24 Hour	+27.4%	+29.6%	+30.8%	+31.2%	+32.7%

The stormwater modelling has established the anticipated pre-development flows for the 10% AEP and 1% AEP storm events and the expected post-development flows in the 10% and 1% AEP storm events with 3.8°C climate change factor. The latter flows are required to be mitigated to pre-development flowrates to ensure the future post-development runoff rate does not exceed the pre-development flowrate with the same rainfall increase under climate increase.

2 STORMWATER MODELLING

2.1 EXISTING SITE (PRE-DEVELOPMENT FOR ENTIRE SITE)

Currently the majority area of the subject site is covered by the grass and there are rural dwellings and the pavement located at the southern portion of the site. Due to the topographical constraints, the subject site is separated by eight sub-catchments, refer to Figure 2, and each sub-catchment area is summarized in the table below:

Table 1 Pre-development sub-catchments area

	Sub-catchment A	Sub-catchment B	Sub-catchment C	Sub-catchment D
Area (m²)	9,633	36,308	13,190	22,392
	Sub-catchment E	**Sub-catchment F**	**Sub-catchment G**	**Sub-catchment H**
Area (m²)	18,720	9,090	14,058	10,376

Eight sub-catchments are demonstrated to assess the pre-development scenario, which flow to four outlet points. Sub-catchment A flows towards the west, Sub-catchments B, C & D flows toward the north (existing SEA), Sub-catchments E & F flows towards the south east and Sub-catchment G & H flows toward the south west.

Figure 2 Pre-development sub-catchment plan

The non-highlighted area at the north east corner of the subject site is excluded from the stormwater assessment. The Ecological Report (refer to the appendix in the Infrastructure Report or Stormwater Management Report) and the current concept plan seeks to retain this area containing the existing

wetlands and vegetation, proposed plantings, and open space in its undeveloped state, and therefore stormwater devices are not required to be installed.

Using TP108 (Refer to **Appendix A**), the summarised peak flows for the pre-development scenarios with 3.8°C climate change factor for the 50%, 10% and 1% AEP storm events with climate change for eight catchments are shown in the table below. The HEC HMS pre-development peak flows for the four outlet points are also listed for comparison.

Table 2 Pre-development peak flows under 3.8°C CCF

Sub-catchment	Outlet Point	50% AEP Peak Flowrate (L/s)	10% AEP Peak Flowrate (L/s)	1% AEP Peak Flowrate (L/s)
A	West	**54**	**137**	**250**
HEC HMS Modelling Result		**51.7**	**144.7**	**290.8**
B	North	242	570	1,008
C		76	191	347
D		145	350	623
TP108 Total		**463**	**1,111**	**1,978**
HEC HMS Modelling Result		**450.9**	**1,192.8**	**2,322.6**
E	South East	132	309	542
F		57	139	249
TP108 Total		**189**	**448**	**791**
HEC HMS Modelling Result		**185.2**	**491.6**	**946.3**
G	South West	96	228	402
H		97	212	359
TP108 Total		**193**	**440**	**761**
HEC HMS Modelling Result		**184.1**	**465.7**	**872.8**

We note that the TP108 pre-development peak flows are slightly different than the modelled HEC HMS pre-development peak flows. The HEC HMS modelled results are used as the base flows to calculate the Stormwater Mitigation required.

Auckland Transport (AT) have reiterated that they do not want proprietary devices (detention tanks, pocket raingardens etc) within the road reserve. For this development, the water quality treatments are being provided by the communal proposed stormwater devices as Best Practice Option (BPO), with deep sump cesspits proposed within the Road Reserve, providing a level of pre-treatment.

To mitigate the stormwater runoff from the Road Reserve to pre-development levels, the communal stormwater devices are designed to achieve flow mitigation as well as water quality treatment.

To mitigate the stormwater runoff from each individual lot to pre-development levels, dual purpose stormwater tanks (retention and detention) will be required to achieve quality and quantity treatment. That conforms to the NDC requirements.

The calculations and parameters for the proposed mitigation are further described in Sections 2.2 and 2.3.

2.2 EXISTING SITE (PRE-DEVELOPMENT FOR EACH SUB-CATCHMENTS)

2.2.1 RUNOFF FACTOR

The entire site is generally covered by grass with the existing impervious area (dwellings and pavement) contained within Sub-catchment B & H. The area of each sub-catchment is summarized in Table 1.

The stormwater runoff modelling was undertaken in HEC-HMS v4.11 and in accordance with TP108:

Pervious Arcea SCS Hydrological Soil Group: Group B&C (refer to Soil-map Data) see CN below:

Table 3 Pervious Area CN for Grass

PRE	Sub-catchment A	Sub-catchment B	Sub-catchment C	Sub-catchment D
Combined CN	61	63	62	66
	Sub-catchment E	**Sub-catchment F**	**Sub-catchment G**	**Sub-catchment H**
Combined CN	69	66	68	74

Impervious Area Curve Number: 98 (Roof, driveway, or hardstand area)

2.2.2 HEC MODELLING REVIEW (PRE-DEVELOPMENT)

The pervious and impervious components of the sub-catchments were grouped at junctions and joined appropriately to simulate the existing catchment hydrology. The pre-development HEC-HMS hydrologic basin model schematic is given below:

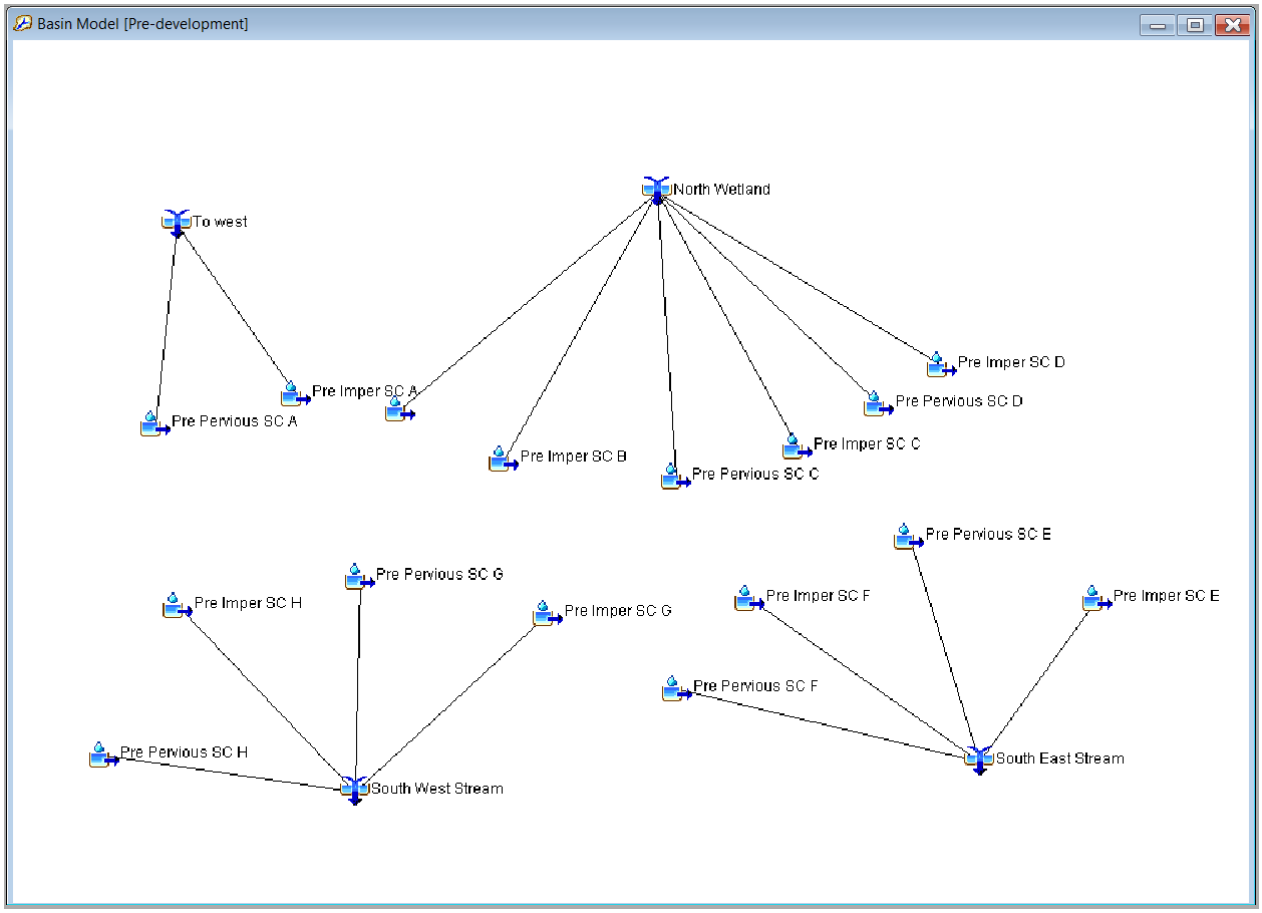


Figure 3 Pre-development HEC HMS hydrological design

50% AEP storm event (24-hour rainfall depth 89mm) peak flow:

Global Summary Results for Run "50% AEP Pre - CCF"

Project: Smith SW POND Simulation Run: 50% AEP Pre - CCF

Start of Run: 14Jun2024, 00:00
End of Run: 14Jun2024, 23:59
Compute Time: 14Nov2024, 14:14:08

Basin Model: Pre-development - CCF
Meteorologic Model: 50% AEP Post 3.8 CCF
Control Specifications: Post Development SH 3.8

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Pre Pervious SC A	0.0096	0.05166	14 June 2024, 12:13	0.24838
Pre Imper SC A	0.0000	0.00002	14 June 2024, 12:12	0.00008
Pre Pervious SC B	0.0333	0.18992	14 June 2024, 12:13	0.90861
Pre Imper SC B	0.0030	0.04822	14 June 2024, 12:12	0.25162
Pre Pervious SC C	0.0132	0.07294	14 June 2024, 12:13	0.34983
Pre Imper SC C	0.0000	0.00002	14 June 2024, 12:12	0.00008
Pre Pervious SC D	0.0224	0.13991	14 June 2024, 12:13	0.66421
Pre Imper SC D	0.0000	0.00002	14 June 2024, 12:12	0.00008
Pre Pervious SC E	0.0187	0.12814	14 June 2024, 12:13	0.60343
Pre Imper SC E	0.0000	0.00016	14 June 2024, 12:12	0.00079
Pre Pervious SC F	0.0091	0.05673	14 June 2024, 12:13	0.26934
Pre Imper SC F	0.0000	0.00016	14 June 2024, 12:12	0.00079
Pre Pervious SC G	0.0141	0.09335	14 June 2024, 12:13	0.44079
Pre Imper SC G	0.0000	0.00016	14 June 2024, 12:12	0.00084
Pre Pervious SC H	0.0094	0.07472	14 June 2024, 12:13	0.34695
Pre Imper SC H	0.0010	0.01587	14 June 2024, 12:12	0.07899
To west	0.0096	0.05168	14 June 2024, 12:13	0.24846
North Wetland	0.0719	0.45087	14 June 2024, 12:13	2.17443
South West Stream	0.0244	0.18406	14 June 2024, 12:13	0.86756
South East Stream	0.0278	0.18519	14 June 2024, 12:13	0.87435

10% AEP storm event (24-hour rainfall depth 157mm) peak flow:

Global Summary Results for Run "10% AEP Pre - CCF"

Project: Smith SW POND Simulation Run: 10% AEP Pre - CCF

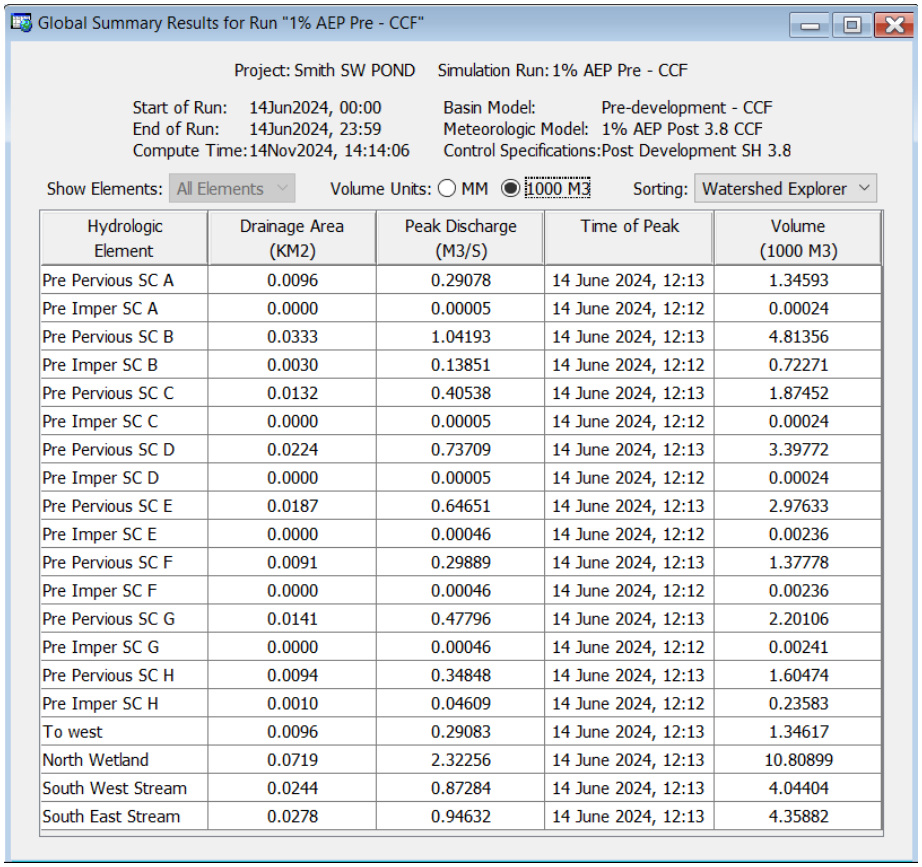
Start of Run: 14Jun2024, 00:00
End of Run: 14Jun2024, 23:59
Compute Time: 18Nov2024, 16:56:18

Basin Model: Pre-development - CCF
Meteorologic Model: 10% AEP Post 3.8 CCF
Control Specifications: Post Development SH 3.8

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Pre Pervious SC A	0.0096	0.14467	14 June 2024, 12:13	0.67733
Pre Imper SC A	0.0000	0.00003	14 June 2024, 12:12	0.00015
Pre Pervious SC B	0.0333	0.52450	14 June 2024, 12:13	2.44629
Pre Imper SC B	0.0030	0.08777	14 June 2024, 12:12	0.45794
Pre Pervious SC C	0.0132	0.20286	14 June 2024, 12:13	0.94797
Pre Imper SC C	0.0000	0.00003	14 June 2024, 12:12	0.00015
Pre Pervious SC D	0.0224	0.37787	14 June 2024, 12:13	1.75279
Pre Imper SC D	0.0000	0.00003	14 June 2024, 12:12	0.00015
Pre Pervious SC E	0.0187	0.33780	14 June 2024, 12:13	1.55902
Pre Imper SC E	0.0000	0.00029	14 June 2024, 12:12	0.00148
Pre Pervious SC F	0.0091	0.15323	14 June 2024, 12:13	0.71076
Pre Imper SC F	0.0000	0.00029	14 June 2024, 12:12	0.00148
Pre Pervious SC G	0.0141	0.24813	14 June 2024, 12:13	1.14704
Pre Imper SC G	0.0000	0.00029	14 June 2024, 12:12	0.00153
Pre Pervious SC H	0.0094	0.18824	14 June 2024, 12:13	0.86283
Pre Imper SC H	0.0010	0.02913	14 June 2024, 12:12	0.14763
To west	0.0096	0.14470	14 June 2024, 12:13	0.67748
North Wetland	0.0719	1.19278	14 June 2024, 12:13	5.60530
South West Stream	0.0244	0.46570	14 June 2024, 12:13	2.15904
South East Stream	0.0278	0.49161	14 June 2024, 12:13	2.27274

1% AEP storm event (24-hour rainfall depth 239mm) peak flow:



Global Summary Results for Run "1% AEP Pre - CCF"

Project: Smith SW POND Simulation Run: 1% AEP Pre - CCF

Start of Run: 14Jun2024, 00:00 Basin Model: Pre-development - CCF
End of Run: 14Jun2024, 23:59 Meteorologic Model: 1% AEP Post 3.8 CCF
Compute Time: 14Nov2024, 14:14:06 Control Specifications: Post Development SH 3.8

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Pre Pervious SC A	0.0096	0.29078	14 June 2024, 12:13	1.34593
Pre Imper SC A	0.0000	0.00005	14 June 2024, 12:12	0.00024
Pre Pervious SC B	0.0333	1.04193	14 June 2024, 12:13	4.81356
Pre Imper SC B	0.0030	0.13851	14 June 2024, 12:12	0.72271
Pre Pervious SC C	0.0132	0.40538	14 June 2024, 12:13	1.87452
Pre Imper SC C	0.0000	0.00005	14 June 2024, 12:12	0.00024
Pre Pervious SC D	0.0224	0.73709	14 June 2024, 12:13	3.39772
Pre Imper SC D	0.0000	0.00005	14 June 2024, 12:12	0.00024
Pre Pervious SC E	0.0187	0.64651	14 June 2024, 12:13	2.97633
Pre Imper SC E	0.0000	0.00046	14 June 2024, 12:12	0.00236
Pre Pervious SC F	0.0091	0.29889	14 June 2024, 12:13	1.37778
Pre Imper SC F	0.0000	0.00046	14 June 2024, 12:12	0.00236
Pre Pervious SC G	0.0141	0.47796	14 June 2024, 12:13	2.20106
Pre Imper SC G	0.0000	0.00046	14 June 2024, 12:12	0.00241
Pre Pervious SC H	0.0094	0.34848	14 June 2024, 12:13	1.60474
Pre Imper SC H	0.0010	0.04609	14 June 2024, 12:12	0.23583
To west	0.0096	0.29083	14 June 2024, 12:13	1.34617
North Wetland	0.0719	2.32256	14 June 2024, 12:13	10.80899
South West Stream	0.0244	0.87284	14 June 2024, 12:13	4.04404
South East Stream	0.0278	0.94632	14 June 2024, 12:13	4.35882

Pre-development Peak Discharge Summary:

Table 4 Pre-development Peak Discharge Summary – HEC HMS under 3.8°C CCF

Outlet	50% AEP Peak Flowrate (L/s)	10% AEP Peak Flowrate (L/s)	1% AEP Peak Flowrate (L/s)
West	51.7	144.7	290.8
North	450.9	1,192.8	2,322.6
South East	185.2	491.6	946.3
South West	184.1	465.7	872.8

Refer to **Appendix A** for full calculations and outputs

2.3 PROPOSED DEVELOPMENT

2.3.1 POST-DEVELOPMENT SUB-CATCHMENTS PLAN

Based on the concept plan and preliminary earthwork recontouring, the post-development (for PPC development area only) Sub-catchments Plan is demonstrated as per Figure 4.

Figure 4 post-development sub-catchment plan

The non-highlighted area at the north east corner and the south edge of the PCA will be retained as wetlands and vegetation area with no development or improvements proposed in this area.

The non-highlighted area with brown outline is the indicative arterial road as advised by Supporting Growth, refer to the **Appendix H** in the Infrastructure Report.

The non-highlighted area at the south west corner of the PCA, being the proposed access point from Lisle Farm Drive, is #70 Lisle Farm Drive (Lot 1 DP 169148) and has a current zoning of Mixed Housing Suburban. Although it forms part of the greater site, this parcel is not subject to the re-zoning as it is already having a residential zone and can be developed following the Small Brownfield Development requirement in accordance with NDC Schedule 4, the existing stormwater pond located at the west of the PCA should include the appropriate mitigation for this area as per AUP Stormwater Guideline.

2.3.2 RUNOFF FACTOR AND MODEL SUMMARY

The proposed individual stormwater mitigation system is designed for each lot to attenuate the post-development impervious area and the proposed communal stormwater mitigation devices are designed for the post-development impervious area for the Road Reserve and portion for the non-controlled area, such as the impervious area from individual lot.

The proposed Plan Change Area ('PCA') is not located within any existing precinct zone, the proposed stormwater design should be carried out in accordance with NDC and the stormwater guidelines of AUP. The 5mm retention (SMAF-1 equivalent retention) is required but given the constraints of the steep slope and earthworking, soakage is not considered as a practical solution nor BPO and re-use will be required. Each lot will have an individual underground or aboveground dual purpose stormwater tank with appropriately designed orifices to provide flow attenuation for storm events up to and including the 10% AEP Storm Event. Inspection chambers, cesspits, channel grates and overflow pipes will also be required as part of the overall site drainage.

Maximum Portable Development ('MPD') was considered in this post-development assessment for the typical Mixed Housing Urban/Suburban residential lots under AUP, which is a maximum 60% impervious area with a minimum 40% pervious area. But given the lots within different sub-catchments have varies area, from minimum 400m² to 700m², the average lot size is utilised for each sub-catchment to assist the hydrological modelling. Also, the topographical steep site features limit the development possibility, the assumed roof area (connect to the stormwater tank), pervious area and the pavement area are different for each sub-catchment, details are summarised in the table below:

Table 5 post-development sub-catchments area and typical lots area

Post Sub-catchment	Total Area (m²)	Reserve Area (m²)	Total Lots Area (m²)	Each Lot Area (m²)
A	6,318	0	6,318	421 (15 Lots)
B	85,196	42,311	42,885	437 (98 Lots)
C	3,595	0	3,595	599 (6 Lots)
D	10,137	4,601	5,536	615 (9 Lots)
E	3,560	0	3,560	593 (6 Lots)
F	9,788	1,213	8,575	536 (16Lots)
G	13,270	1,023	12,247	490 (25 Lots)

The assumed roof area (combination of practical and MPD consideration), pervious area (grass or landscape) and the hardstand impervious area for each average lot for each sub-catchments are listed in the table below:

Table 6 post-development typical lots area and details

Post Development Sub-catchment	Average Lot Area (m²)	Average Roof Area (m²)	Maximum Roof Area (% of Lot)	Average Pervious Area (m²)	Average Hardstand Area (m²)	Impervious Site Coverage (% Of Lot)
A	421	169	40%	168	84	60%
B	437	175	40%	175	87	60%
C	599	240	40%	240	119	60%
D	615	246	40%	246	123	60%
E	593	237	40%	237	119	60%
F	536	215	40%	214	107	60%
G	490	196	40%	196	98	60%
Reserve	70% assumption to impervious area and 30% of pervious area					

The Road Reserve impervious area consists of the sealed road formation, footpath and vehicle entranceways, encompassing approximately 70% of the Road Reserve. The remaining 30% is pervious, consisting of grass or street landscape.

The stormwater runoff modelling was undertaken in HEC-HMS v4.11 and in accordance with TP108:

Impervious Area Curve Number: 98 (Roof, driveway and hardstand area)

Pervious Area Curve Number (for sub-catchment A): 61

(No bulk earthwork is proposed in sub-catchment A, CN number remains Class B)

Pervious Area Curve Number (for sub-catchments B to G): 74

Pervious Area Curve Number (for Stormwater Reserve B to G): remains as pre-development

(Grassed and landscape area, classified as Class C Soil Type after the earthwork construction)

Climate change factor has been applied to all post-development rainfall models as per section 1.2

We note that the actual impervious area for each lot will vary, and that the maximum impermeable area for each lot is 60%. We have assumed realistic 'nominal' building sizes and impervious areas that comply with the relevant planning rules. We note that any impervious area greater than 60% will need to be either replaced by porous/permeable paving or other approved methods subject to additional future Resource Consent. We also note that upon future building consent, calculations will be required to ensure the proposed mitigation is appropriate for the proposed site development. A consent notice will be proposed for each lot to ensure the proposed runoff collection devices are designed to capture 10% AEP rainfall event, further details to be confirmed at Resource Consent stage.

2.3.3 UNMITIGATED RESULT FOR 3.8 DEGREE CCF (POST-DEVELOPMENT)

The proposed bulk earthwork activity and recontouring will change the post-development sub-catchment area compared to the pre-development sub-catchment area which is summrised in the table below. Both the pre-development peak flow and the post-development unmitigated peak flow are calculated by using the rainfall depth with 3.8-degree climate change factor from each sub-catchments to four outlets.

Table 7 Unmitigated Peak Flow Summary and Catchment Areas

Outlet	Pre-catchment	Area (m²)	Post-catchment	Area (m²)	Pre Peak flow (L/s)		Un-mitigated Post Peak Flow (L/s)	
					10% AEP	1% AEP	10% AEP	1% AEP
To West	A	9,633	A	6,318	144.7	290.8	**148.6**	**250.9**
To North	B	36,308	B	85,196	1,192.8	2,322.6	**2,718.2**	**4,387.0**
	C	13,190	C	3,595				
	D	22,392	D	10,137				
To South East	E	18,720	E	3,560	465.7	872.8	**333.4**	**559.1**
	F	9,090	F	9,788				
To South West	G	14,058	G	13,270	491.6	946.3	**343.5**	**573.2**
	H	10,376						

The table above shows that all sub-catchments need to have the proper treatment to achieve the SMAF-1 equivalent retention and detention requirements, for the lots within post-catchment A, B, C and D which discharge towards the west and north also need the proper mitigation applied to attenuate the post-development peak flow to not exceed the pre-development peak flow under 10% AEP and 1% AEP rainfall events with 3.8°C Climate Change. For the lots within post-catchment E, F and G, no mitigation is required but the SMAF-1 equivalent retention and detention requirements need to be achieved.

2.3.4 HEC HMS Modelling Review (Post-development)

The pervious and impervious components, together with the proposed mitigation of the sub catchments are grouped at junctions and joined with reaches to simulate the post development catchment. The post-development HEC-HMS hydrologic basin model schematic is given below:

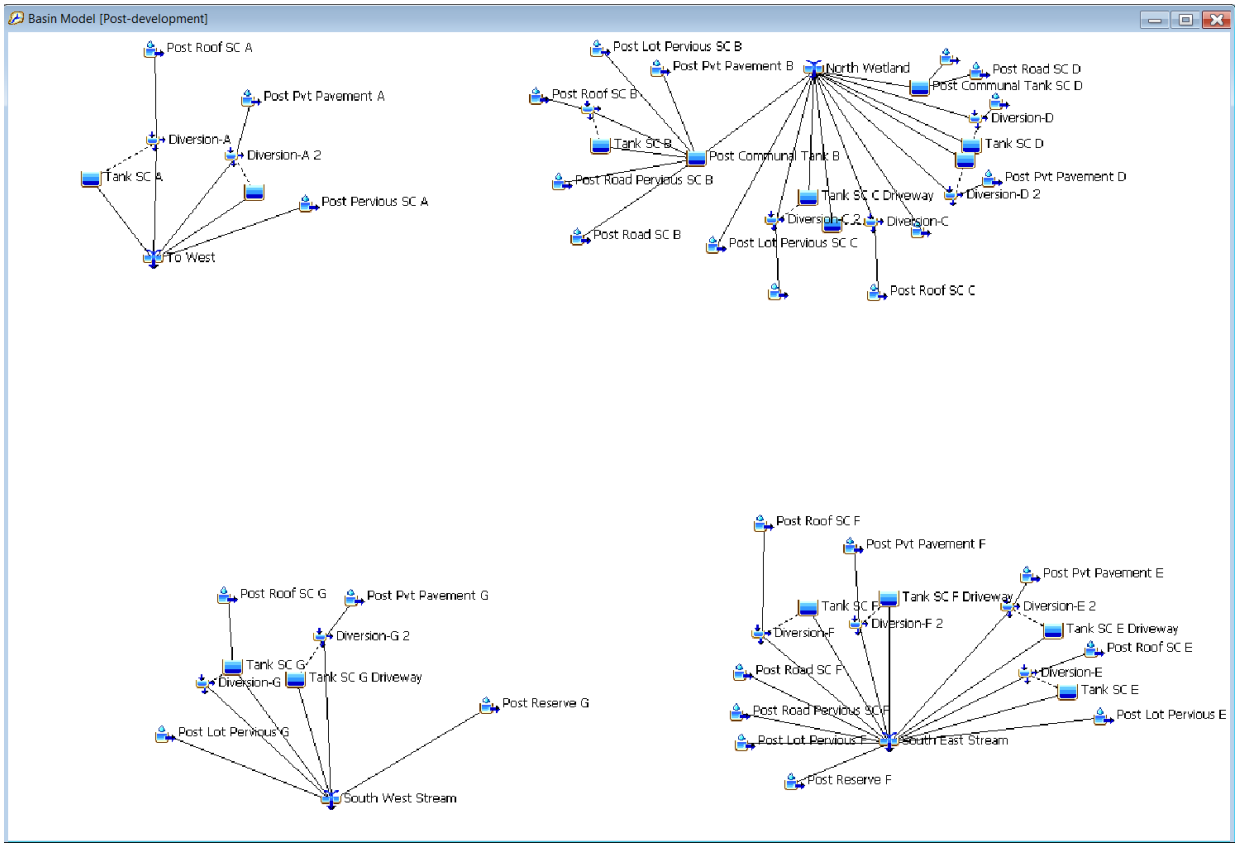


Figure 5 Post-development HEC HMS hydrological design

Individual Tank Details for Roof –1,000L & 4,000L:

To show efficacy of the proposed SW mitigation, for the post development scenario, to mitigate the runoff from the individual lots, each lot will require dual purpose retention/detention tanks. We have modelled tanks that are 2m tall, typical in dimensions with APD Stormlite Tank, Promax Slimline Tank or Bailey Slimline Tank for roof area. We have identified that sub-catchment A, B, C & D would need a tank size of ≈4,000L for SMAF-1 equivalent retention and detention and mitigation requirements, sub-

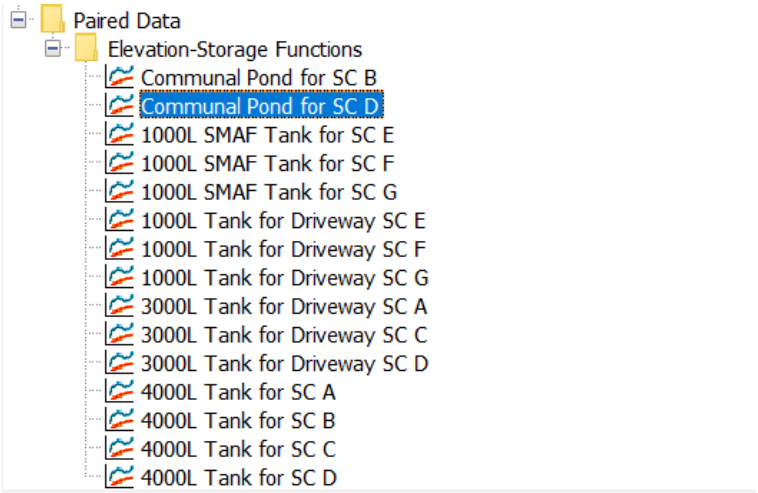


Figure 6 Tank function details for different catchments

catchment E, F and G would need a tank size of ≈1,000L for only SMAF-1 equivalent retention and detention requirements. We note that the actual size will depend on the level of development proposed for each site, and will be confirmed at Building Consent.

Individual Tank Details for Driveway – 1,000L & 3,000L:

To show efficacy of the proposed SW mitigation, for the post development scenario, to mitigate the runoff from the individual lots' pavement or driveway area. We have modelled tanks that are in 1.0m diameter, typical in dimensions with APD Stormlite Tank, Promax or Bailey underground tanks. We have identified that sub-catchment A, C & D would need a tank size of ≈3,000L for SMAF-1 equivalent detention and mitigation requirements, sub-catchment E, F and G would need a tank size of ≈1,000L for only SMAF-1 equivalent detention requirements, the sub-catchment B will be treated by the designed communal stormwater pond. We note that the actual size will depend on the level of development proposed for each site, and will be confirmed at Building Consent.

Diversion Details:

The diversion effectively simulates the overflow from the roof gutters under the rainfall events greater than 10% AEP storm, because the gutters and downpipes are designed to capture the 10% AEP storm event as per Building Act E1/VM1, same to the drainage pipe system for the private driveway. The diversion flows are calculated based on the roof areas using Rational Formula with 120mm/hr of peak rainfall intensity, being the 10min 10% AEP runoff intensity with the climate change factor. The diversion flow for each post sub-catchments are shown below:

When the 10% AEP rainfall event mitigation is achieved with the controlled release, any overflow will be directed to the downstream devices via the public stormwater reticulation or overland flow paths.

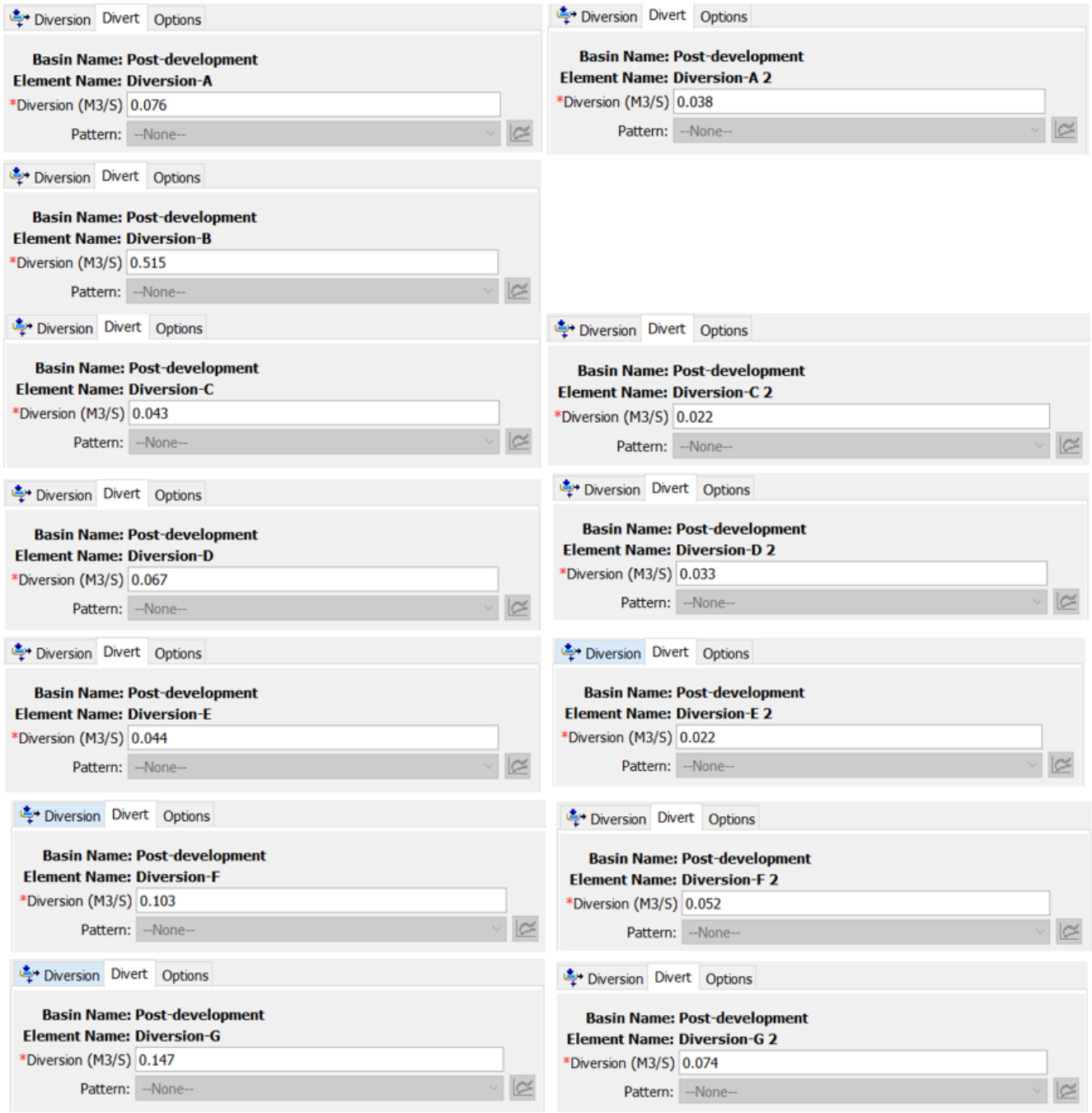


Figure 7 Diversion flow for all catchments, roof area and driveway area

Proposed Mitigation Details:

The PPC proposes a SMAF-1 overlay for the site. This requires at least a 5mm retention volume and the detention and release over 24hrs of the 95th percentile rainfall event less any retention provided. Notwithstanding the 24hr release, the minimum orifice size for any detention tank is 10mm. A secondary orifice to mitigate the 10% AEP rainfall runoff to pre-development rates is site specific and to be confirmed at Building Consent. A 150mm overflow pipe is also provided and all three outlets will discharge to the public stormwater network.

Orifice Details:

The table below lists the modelled orifice diameters for the proposed tanks within each sub-catchments to comply with the SMAF-1 and 10% AEP hydrology mitigation requirements;
(size of tanks and orifice to be confirmed at future Building Consent based on actual site development):

Table 8 Individual Stormwater Tank details for each post sub-catchment

Post Sub-catchment	Tank Size (L)	Primary Orifice Diameter (mm)	Secondary Orifice Diameter (mm)	Overflow (mm)
A	4,000	10	45	100
	3,000 (Driveway)	10	-	100
B	4,000	10	45	100
C	4,000	10	45	100
	3,000 (Driveway)	10	-	100
D	4,000	10	45	100
	3,000 (Driveway)	10	-	100
E	1,000	10	-	100
	1,000 (Driveway)	10	-	100
F	1,000	10	-	100
	1,000 (Driveway)	10	-	100
G	1,000	10	-	100
	1,000 (Driveway)	10	-	100

Communal Stormwater Device Details:

The overflow from all residential lots and the surface water from the road reserve, will be directed to the communal stormwater device for further mitigation before discharging to the receiving environment, ensuring the post-development peak flows are mitigated up to and including the 1% AEP rainfall event. Three communal stormwater devices are designed to discharge to four outlet points from the seven sub-catchments:

- Outlet 1 (To West)

Sub-catchment A contributes to this outlet. No communal stormwater device is required. All mitigation to be provided by on-site stormwater tanks for each lot.

- Outlet 2 (To North)

Post Sub-catchments B, C, and D contribute to this outlet. Each sub-catchment is designed to have a communal stormwater device to attenuate the post-development peak flow with the controlled outlets (orifices or weirs) in addition to the individual stormwater tank for each lot.

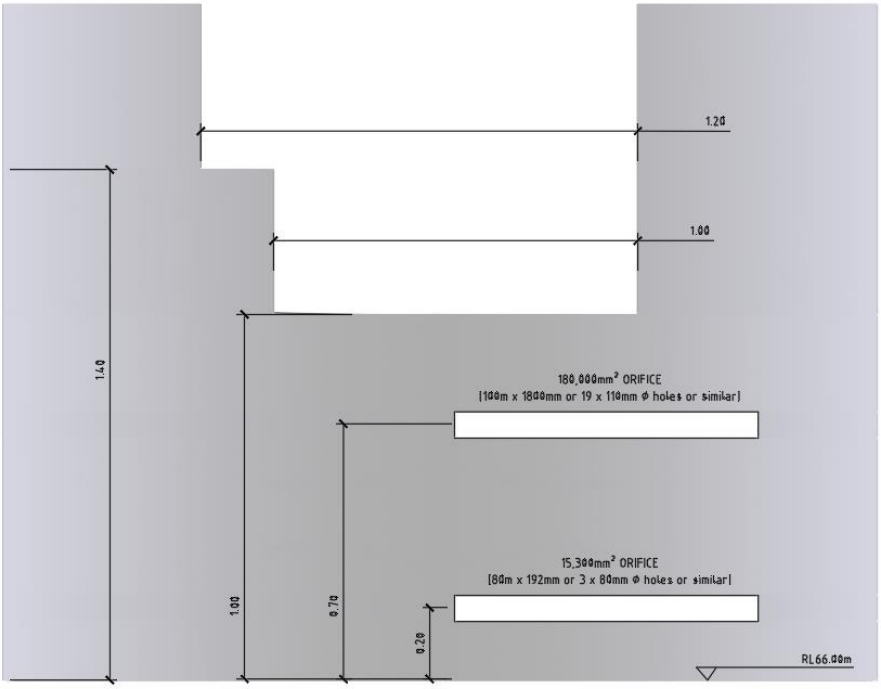
Communal Stormwater Device B:

- The size of device: 6,870m³ (typical open-top stormwater pond)

Paired Data | Table | Graph

Elevation (M)	Storage (1000 M3)
64.90	0.0000
65.90	0.7500
66.20	1.2900
67.00	3.7600
67.70	6.3300
67.85	6.9300
68.00	7.5500
68.15	7.6000

- Primary Outlet: 15,300mm² orifice centered at RL66.20m (SMAF and stream protection)
- Secondary Outlet: 180,000mm² orifice centered RL66.70m
- First Weir: (10% AEP rainfall event) 1,000mm wide, at RL67.0m
- Second Weir: (1% AEP rainfall event) 1,200mm wide, at RL67.45m
- Overflow: RL67.83m



Communal Stormwater Device D

- The size of device: 64m³ (for the proposed Road Reserve only)

Paired Data | Table | Graph

Elevation (M)	Storage (1000 M3)
70.00	0.0000
70.25	0.0125
70.50	0.0250
70.75	0.0375
71.28	0.0640
72.00	0.0650

- Primary Outlet: 15,708mm² Orifice, centered 100mm above the base of the device
- First Weir (10% AEP rainfall event): 100mm wide, centered 500mm above the base of the device
- Second Weir (1% AEP rainfall event): 150mm wide, 900mm above the base of the device
- Overflow: 1280mm from the bottom of the device

The type of the device to be detailed designed at Resource Consent stage.

- Outlet 3 (To South East)

Sub-catchments E & F contribute to this outlet. No communal stormwater device is required. All SMAF requirements and mitigation to be provided by on-site stormwater tanks for each lot.

- Outlet 4 (To South West)

Sub-catchment G contributes to this outlet. No communal stormwater device is required. All SMAF requirements and mitigation to be provided by on-site stormwater tanks for each lot.

2.3.5 HEC HMS Model Results

The Post Development assessment has been calculated for the 50% AEP, 10% AEP and the 1% AEP rainfall events with the proposed private and communal mitigation as detailed above. The post-development rainfall depths have been adjusted for 3.8°C Climate Change in accordance the upcoming 3.8°C Climate Change for sensitivity assessment in accordance with the future operative Auckland Council Stormwater Code of Practice Revision 4.0. The results for this scenario is summarised in the **Appendix A**.

2.3.6 Sensitivity Check Pre and Post Peak Flow Results (3.8°C CCF)

The 3.8°C climate change factor is required and listed in the upcoming Auckland Council Stormwater Code of Practice Version 4.0; the sensitivity check is provided in the assessment as requested by Healthy Waters.

Outlet	50% AEP Peak Flowrate (L/s)		10% AEP Peak Flowrate (L/s)		1% AEP Peak Flowrate (L/s)	
	Pre	Post	Pre	Post	Pre	Post
West	51.7	**49.7**	144.7	**141.8**	290.8	**251.8**
North	450.9	**443.1**	1,192.8	**1,190.7**	2,322.6	**2,307.5**
South East	185.2	**170.2**	491.6	**337.2**	946.3	**570.8**
South West	184.1	**164.3**	465.7	**330.9**	872.8	**556.1**

The table above compares the pre-and post- development flows under 3.8°C Climate Change scenario, confirming that the proposed mitigation ensures that the post-development peak flows during the 50% AEP, 10% AEP and the 1% AEP rainfall events do not exceed the pre-development peak flows under the same rainfall event with 3.8°C climate increase.

3 OVERLAND FLOW PATHS

Auckland Council has identified several Overland Flow Paths (OLFP) through and around the site, but none of these OLFPs will affect the proposed development concept in PCA, refer to the Figure 6 below:

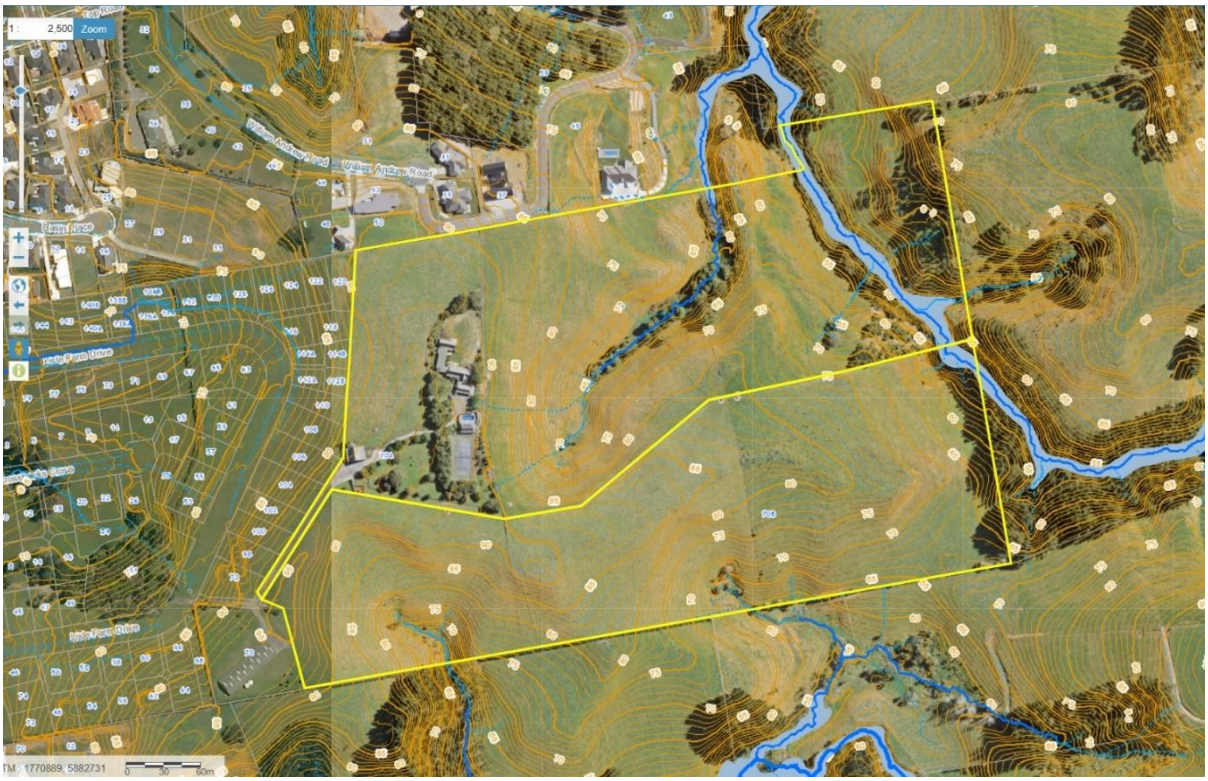


Figure 8 Existing Overland Flow Path Plan (derived from Geomap on September 2023)

The post-development overland flows are designed to be conveyed within the road reserve; and Manning's formula has been used to check the conveyance capacity of the road reserve. Post-development catchment B is the largest catchment which conveys flows to the outlet. The HEC HMS model anticipates the maximum inflow (peak flow will be conveyed within the road reserve) under 3.8°C Climate Change scenario is 3,819.1L/s.

Time-Series Results for Reservoir "Post Communal Tank B"

Project: Smith SW POND Simulation Run: 1% AEP Post 3.8 degree
Reservoir: Post Communal Tank B

Start ... 14Jun2024, 00:00 Basin Model: Post-develop
End ... 14Jun2024, 23:59 Meteorologic Model: 1% AEP Pos
Compute...DATA CHANGED, RECOMPUTE Control Specifications:Post Develop

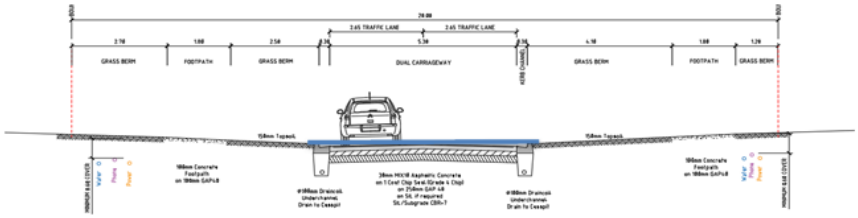
Date	Time	Inflow (M3/S)	Storage (1000 M3)	Elevation (M)	Outflow (M3/S)
14Jun2024	12:08	3.25993	5.54374	67.49	1.06037
14Jun2024	12:09	3.45796	5.67921	67.52	1.14197
14Jun2024	12:10	3.63203	5.82072	67.56	1.23090
14Jun2024	12:11	3.75889	5.96575	67.60	1.32558
14Jun2024	12:12	3.81908	6.11062	67.64	1.42349
14Jun2024	12:13	3.80918	6.25112	67.68	1.52145
14Jun2024	12:14	3.71207	6.38273	67.71	1.61266
14Jun2024	12:15	3.53404	6.50097	67.74	1.69220
14Jun2024	12:16	3.30491	6.60252	67.77	1.76178
14Jun2024	12:17	3.05438	6.68585	67.79	1.81974

Figure 9 Maximum inflow runoff rate under 3.8-degree climate change factor

The typical road cross section design has a 6.6m formation including kerb and channel. To convey a flow of 3,819.1L/s with a road grade of 4.0% as per roading design, the anticipated flow depth is 220mm in the channel, or 70mm above the top of kerb and above the crown of the road, refer to Figure 10 below. The overland flow width is approximately 11.26m.

Typical Overland Flow (peak flow from Sub-catchment B)

Q_{100} = 3819 l/s
Q_{100} = 3.819 m^3/s



Ignore Channel Flow for calculations as this is generally insignificant

Trapezoidal Channel:

(For Triangular Channel or V Drain set bottom width to 0)

side slope true LHS	1:h	1 :	z_L	
side slope true RHS	1:h	1 :	z_R	
bottom width	b		m	
Mannings coefficient	n	0.015		Asphalt
Channel Gradient	S	0.04	m/m	
gravity	g	9.81	m/s^2	
Flow Depth	d	0.22	m	
Area	A	1.289	m^2	d/2.(b+T)
wetted Perimeter	P	11.572	m^2	$b+d(sqr(1+z_L^2)+sqr(1+z_R^2)$
hydraulic Radius	R	0.11139	m^2	A/P
Velocity	V	3.086752	m/s	$(R^{2/3}S^{1/2})/n$
flow	Q	**3.978823**	m^3/s	VA
Froude number	Fr	2.102216	supercritical	$V/(gd)^{1/2}$
Floodway Safety		0.679085	m^2/s	d.V
For channel depth of		0.22	m	
Channel Width is	T	11.26	m	

Figure 10 Road flow capacity calculation by using Mannings' Formula

4 CONCLUSION

In summary, the proposed stormwater requirements for the development, consists of a dual-purpose retention/detention tank for every lot within post-catchment A, B, C and D to provide SMAF-1 retention and detention as well as attenuation for 10% AEP Storm Event to pre-development flowrates for the roof area, every lot within post-catchment E, F and G to provide SMAF-1 retention and detention only for the roof area. The proposed driveway area within post-catchment A, C and D to provide SMAF-1 extended detention as well as attenuation for 10% AEP storm event to pre-development flowrates, and the proposed driveway area within post-catchment E, F and G to provide SMAF-1 extended detention only, the communal stormwater pond for the post-catchment B to provide SMAF-1 retention and detention treatment for every lot within its catchment.

Sub-catchments A, C, D, E, F & G, the post-development runoff during rainfall events greater than the 10% AEP rainfall event will flow as overland sheet flow to the downstream receiving environment, as the change in catchment area and attenuation provided also ensures the 1% AEP storm events are mitigated to pre-development flowrates.

Post-catchment B, the post-development runoff during rainfall events greater than the 10% AEP rainfall event will flow via overland flow through via road reserve and then to the designed communal stormwater device for attenuation before discharging to the receiving environment. This is to ensure the flooding risks and impact to the downstream properties are not increased due to the development of the PPC.

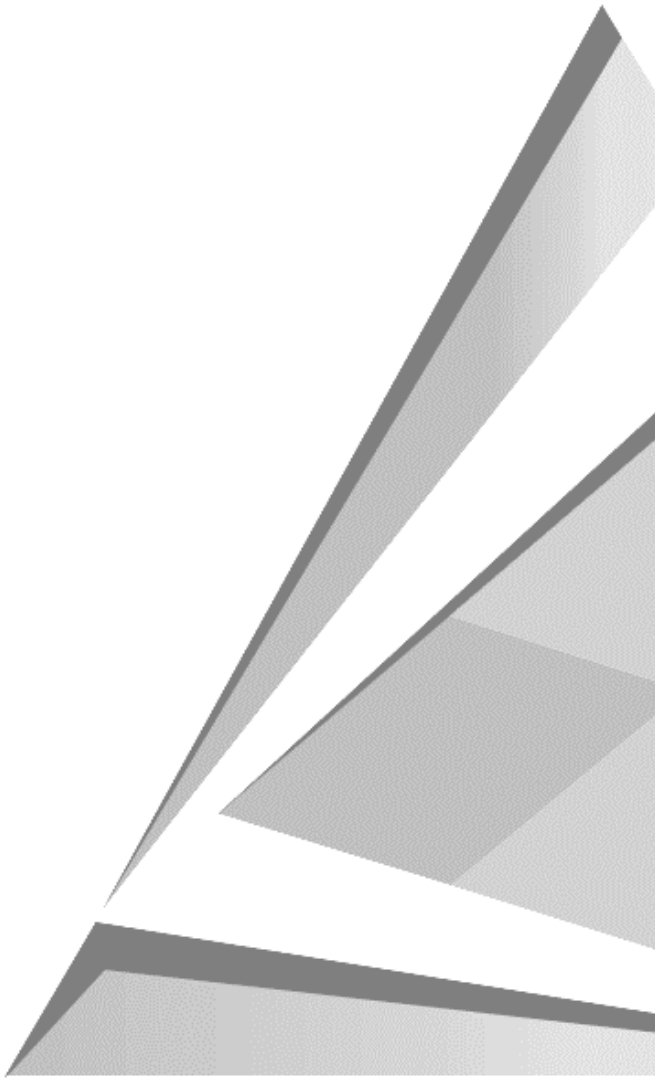
The required minimum volume of the communal stormwater device for post-catchment B is 6,870m³ and the communal stormwater device for the proposed Road Reserve within post-catchment D is 64m³, including the SMAF 1 requirements plus the mitigation, under 3.8°C Climate Change scenario. The impervious area for the private driveways and public roads is approximately 38,195m³ within the post-catchment B.

Communal Device	SMAF Retention and Detention Volume	Mitigation Volume for up to and including the 1% AEP Storm event	Minimum Requirement	Designed Total
Sub-catchment B	1,240m³	6,870m³	**6,867m³**	**6,870 m³**
Sub-catchment D	-	-	**61.9m³**	**64 m³**

For the 50% AEP, 10% AEP & 1% AEP rainfall events, the post-development peak flows to all four outlets from the sub-catchments are attenuated to not exceed the pre-development peak flows under both 2.1°C Climate Change scenario and 3.8°C Climate Change scenario:

Catchment Outlet	Flood Frequency	Pre-Development (3.8°C) Flow (l/s)	Post Development (3.8°C) Flow (L/s) Mitigated
	50% AEP	51.7	**49.7**
West	10% AEP	144.7	**141.8**
	1% AEP	290.8	**251.8**
	50% AEP	450.9	**443.1**
North	10% AEP	1,192.8	**1,190.7**
	1% AEP	2,322.6	**2,307.5**
	50% AEP	185.2	**170.2**
South East	10% AEP	491.6	**337.2**
	1% AEP	946.3	**556.1**
	50% AEP	184.1	**164.3**
South West	10% AEP	465.7	**330.9**
	1% AEP	872.8	**556.1**

APPENDIX A
HEC HMS RESULT

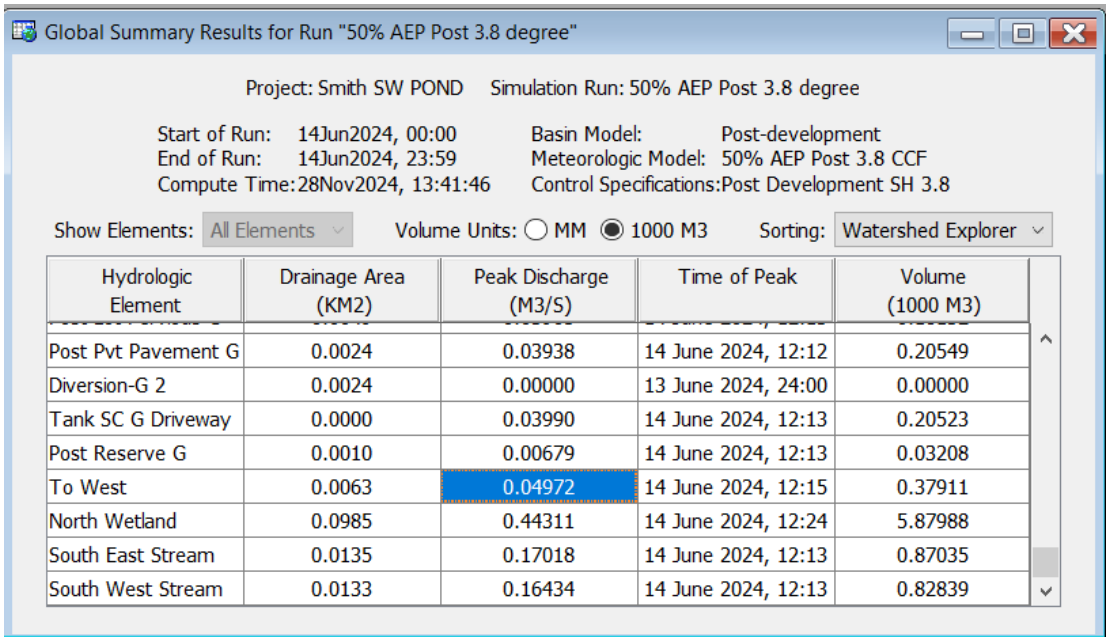


The peak flows under 50% AEP, 10% AEP & 1% AEP rainfall events for post-development with designed attenuation are shown below by using HEC HMS Modelling under 3.8-degree climate change scenario. As well as the water level for each communal devices under 1% AEP rainfall event.

Under 3.8°C Climate Change scenario

Outlet 1 (To West)

- The post-development peak flow under the 50% AEP rainfall event (3.8°C CCF)



Global Summary Results for Run "50% AEP Post 3.8 degree"

Project: Smith SW POND Simulation Run: 50% AEP Post 3.8 degree

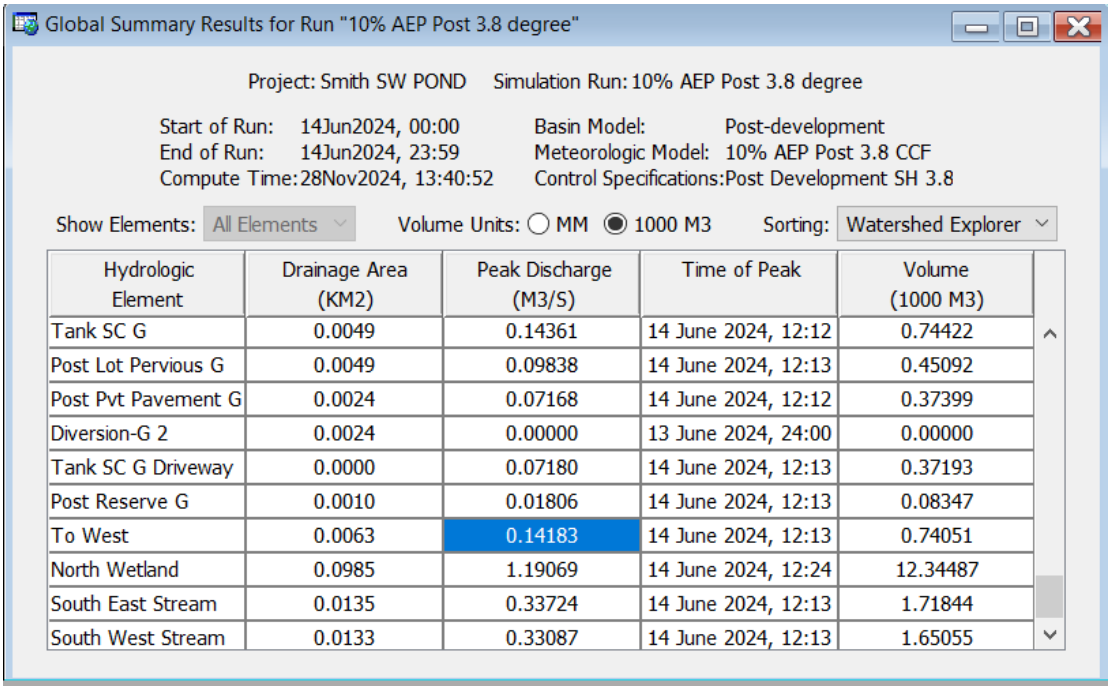
Start of Run: 14Jun2024, 00:00
End of Run: 14Jun2024, 23:59
Compute Time: 28Nov2024, 13:41:46

Basin Model: Post-development
Meteorologic Model: 50% AEP Post 3.8 CCF
Control Specifications: Post Development SH 3.8

Show Elements: All Elements | Volume Units: MM 1000 M3 | Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Post Pvt Pavement G	0.0024	0.03938	14 June 2024, 12:12	0.20549
Diversion-G 2	0.0024	0.00000	13 June 2024, 24:00	0.00000
Tank SC G Driveway	0.0000	0.03990	14 June 2024, 12:13	0.20523
Post Reserve G	0.0010	0.00679	14 June 2024, 12:13	0.03208
To West	0.0063	0.04972	14 June 2024, 12:15	0.37911
North Wetland	0.0985	0.44311	14 June 2024, 12:24	5.87988
South East Stream	0.0135	0.17018	14 June 2024, 12:13	0.87035
South West Stream	0.0133	0.16434	14 June 2024, 12:13	0.82839

- The post-development peak flow under the 10% AEP rainfall event (3.8°C CCF)



Global Summary Results for Run "10% AEP Post 3.8 degree"

Project: Smith SW POND Simulation Run: 10% AEP Post 3.8 degree

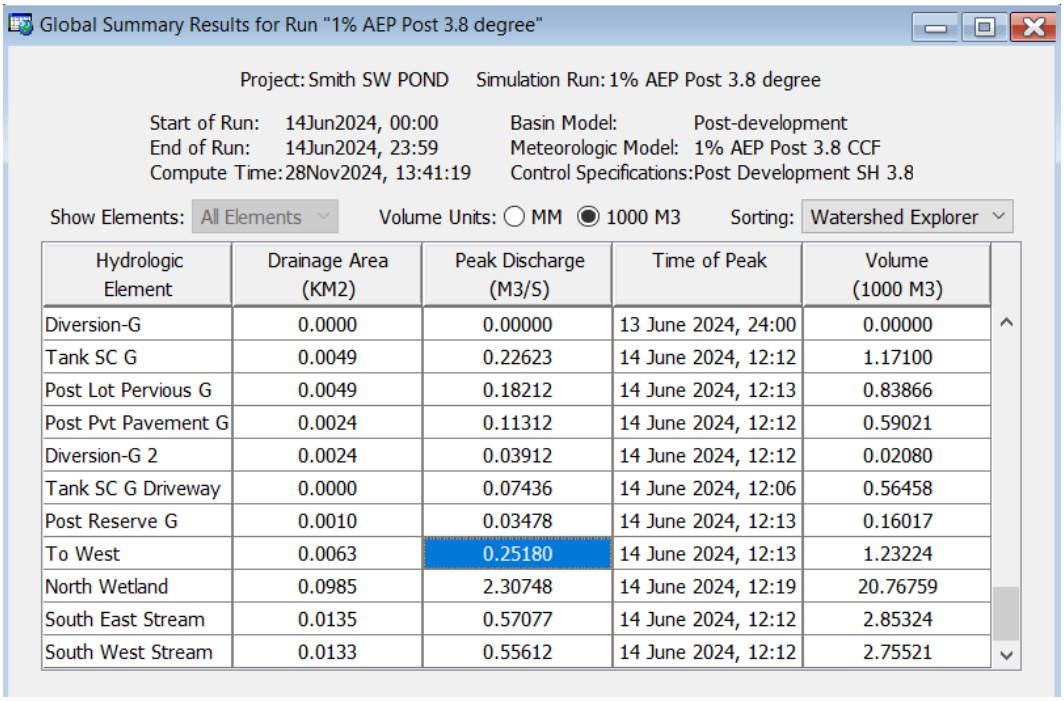
Start of Run: 14Jun2024, 00:00
End of Run: 14Jun2024, 23:59
Compute Time: 28Nov2024, 13:40:52

Basin Model: Post-development
Meteorologic Model: 10% AEP Post 3.8 CCF
Control Specifications: Post Development SH 3.8

Show Elements: All Elements | Volume Units: MM 1000 M3 | Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Tank SC G	0.0049	0.14361	14 June 2024, 12:12	0.74422
Post Lot Pervious G	0.0049	0.09838	14 June 2024, 12:13	0.45092
Post Pvt Pavement G	0.0024	0.07168	14 June 2024, 12:12	0.37399
Diversion-G 2	0.0024	0.00000	13 June 2024, 24:00	0.00000
Tank SC G Driveway	0.0000	0.07180	14 June 2024, 12:13	0.37193
Post Reserve G	0.0010	0.01806	14 June 2024, 12:13	0.08347
To West	0.0063	0.14183	14 June 2024, 12:13	0.74051
North Wetland	0.0985	1.19069	14 June 2024, 12:24	12.34487
South East Stream	0.0135	0.33724	14 June 2024, 12:13	1.71844
South West Stream	0.0133	0.33087	14 June 2024, 12:13	1.65055

- The post-development peak flow under the 1% AEP rainfall event (3.8°C CCF)



Global Summary Results for Run "1% AEP Post 3.8 degree"

Project: Smith SW POND Simulation Run: 1% AEP Post 3.8 degree

Start of Run: 14Jun2024, 00:00
End of Run: 14Jun2024, 23:59
Compute Time: 28Nov2024, 13:41:19

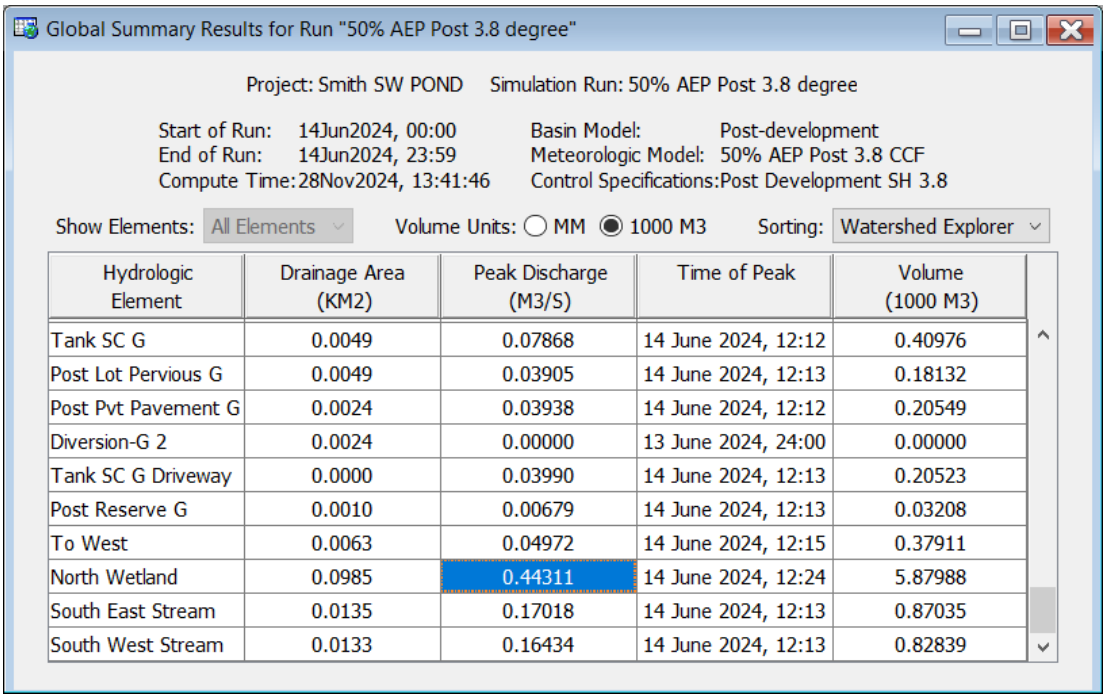
Basin Model: Post-development
Meteorologic Model: 1% AEP Post 3.8 CCF
Control Specifications: Post Development SH 3.8

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Diversion-G	0.0000	0.00000	13 June 2024, 24:00	0.00000
Tank SC G	0.0049	0.22623	14 June 2024, 12:12	1.17100
Post Lot Pervious G	0.0049	0.18212	14 June 2024, 12:13	0.83866
Post Pvt Pavement G	0.0024	0.11312	14 June 2024, 12:12	0.59021
Diversion-G 2	0.0024	0.03912	14 June 2024, 12:12	0.02080
Tank SC G Driveway	0.0000	0.07436	14 June 2024, 12:06	0.56458
Post Reserve G	0.0010	0.03478	14 June 2024, 12:13	0.16017
To West	0.0063	0.25180	14 June 2024, 12:13	1.23224
North Wetland	0.0985	2.30748	14 June 2024, 12:19	20.76759
South East Stream	0.0135	0.57077	14 June 2024, 12:12	2.85324
South West Stream	0.0133	0.55612	14 June 2024, 12:12	2.75521

Outlet 2 (To North)

- The post-development peak flow under the 50% AEP rainfall event (3.8°C CCF)



Global Summary Results for Run "50% AEP Post 3.8 degree"

Project: Smith SW POND Simulation Run: 50% AEP Post 3.8 degree

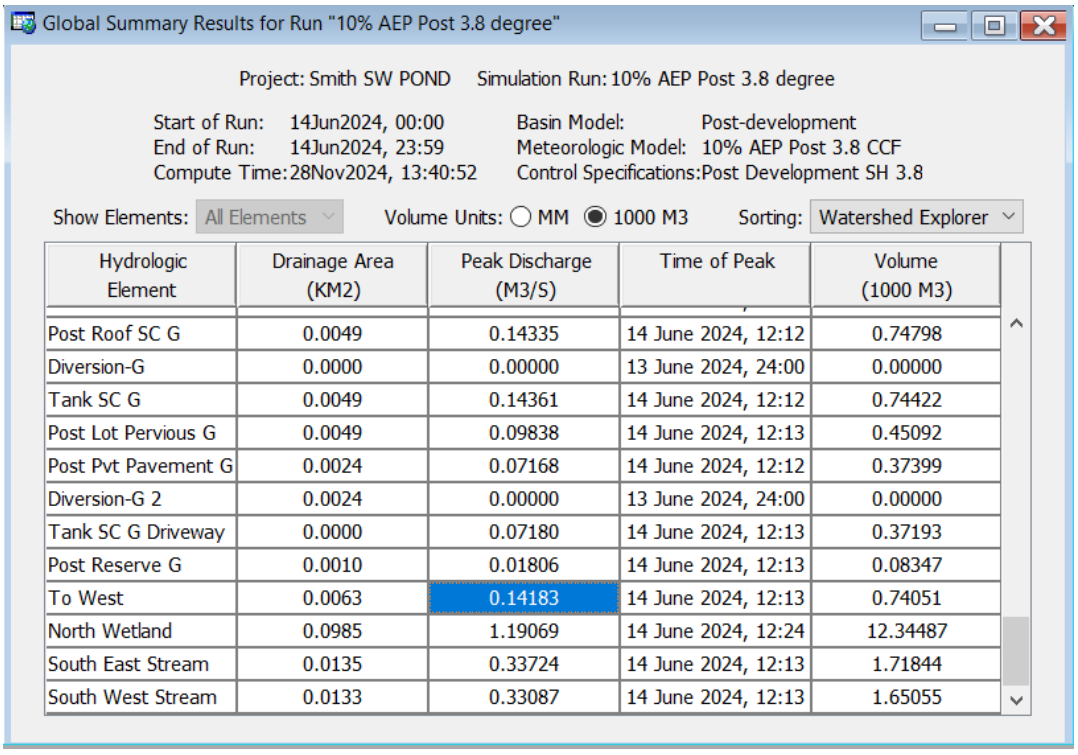
Start of Run: 14Jun2024, 00:00
End of Run: 14Jun2024, 23:59
Compute Time: 28Nov2024, 13:41:46

Basin Model: Post-development
Meteorologic Model: 50% AEP Post 3.8 CCF
Control Specifications: Post Development SH 3.8

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Tank SC G	0.0049	0.07868	14 June 2024, 12:12	0.40976
Post Lot Pervious G	0.0049	0.03905	14 June 2024, 12:13	0.18132
Post Pvt Pavement G	0.0024	0.03938	14 June 2024, 12:12	0.20549
Diversion-G 2	0.0024	0.00000	13 June 2024, 24:00	0.00000
Tank SC G Driveway	0.0000	0.03990	14 June 2024, 12:13	0.20523
Post Reserve G	0.0010	0.00679	14 June 2024, 12:13	0.03208
To West	0.0063	0.04972	14 June 2024, 12:15	0.37911
North Wetland	0.0985	0.44311	14 June 2024, 12:24	5.87988
South East Stream	0.0135	0.17018	14 June 2024, 12:13	0.87035
South West Stream	0.0133	0.16434	14 June 2024, 12:13	0.82839

- The post-development peak flow under the 10% AEP rainfall event (3.8°C CCF)



Global Summary Results for Run "10% AEP Post 3.8 degree"

Project: Smith SW POND Simulation Run: 10% AEP Post 3.8 degree

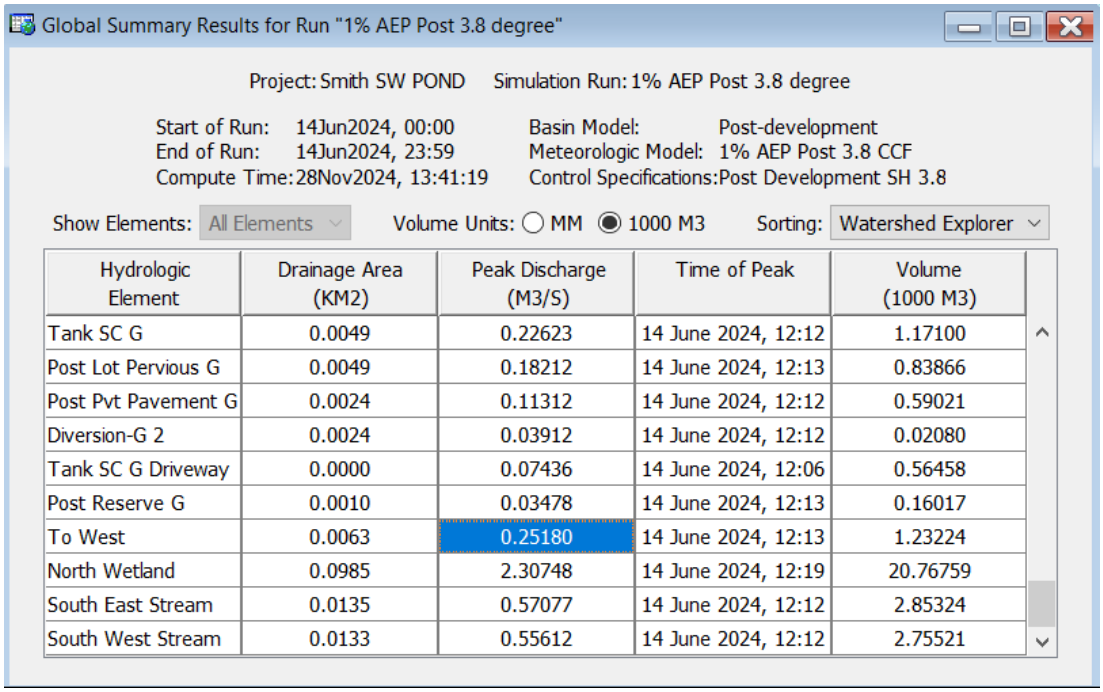
Start of Run: 14Jun2024, 00:00
End of Run: 14Jun2024, 23:59
Compute Time: 28Nov2024, 13:40:52

Basin Model: Post-development
Meteorologic Model: 10% AEP Post 3.8 CCF
Control Specifications: Post Development SH 3.8

Show Elements: All Elements | Volume Units: MM / 1000 M3 | Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Post Roof SC G	0.0049	0.14335	14 June 2024, 12:12	0.74798
Diversion-G	0.0000	0.00000	13 June 2024, 24:00	0.00000
Tank SC G	0.0049	0.14361	14 June 2024, 12:12	0.74422
Post Lot Pervious G	0.0049	0.09838	14 June 2024, 12:13	0.45092
Post Pvt Pavement G	0.0024	0.07168	14 June 2024, 12:12	0.37399
Diversion-G 2	0.0024	0.00000	13 June 2024, 24:00	0.00000
Tank SC G Driveway	0.0000	0.07180	14 June 2024, 12:13	0.37193
Post Reserve G	0.0010	0.01806	14 June 2024, 12:13	0.08347
To West	0.0063	0.14183	14 June 2024, 12:13	0.74051
North Wetland	0.0985	1.19069	14 June 2024, 12:24	12.34487
South East Stream	0.0135	0.33724	14 June 2024, 12:13	1.71844
South West Stream	0.0133	0.33087	14 June 2024, 12:13	1.65055

- The post-development peak flow under the 1% AEP rainfall event (3.8°C CCF)



Global Summary Results for Run "1% AEP Post 3.8 degree"

Project: Smith SW POND Simulation Run: 1% AEP Post 3.8 degree

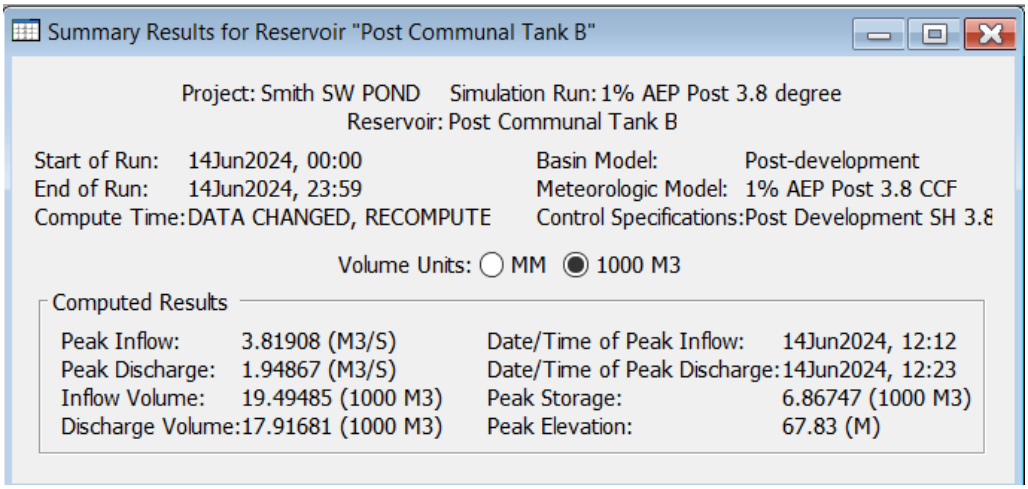
Start of Run: 14Jun2024, 00:00
End of Run: 14Jun2024, 23:59
Compute Time: 28Nov2024, 13:41:19

Basin Model: Post-development
Meteorologic Model: 1% AEP Post 3.8 CCF
Control Specifications: Post Development SH 3.8

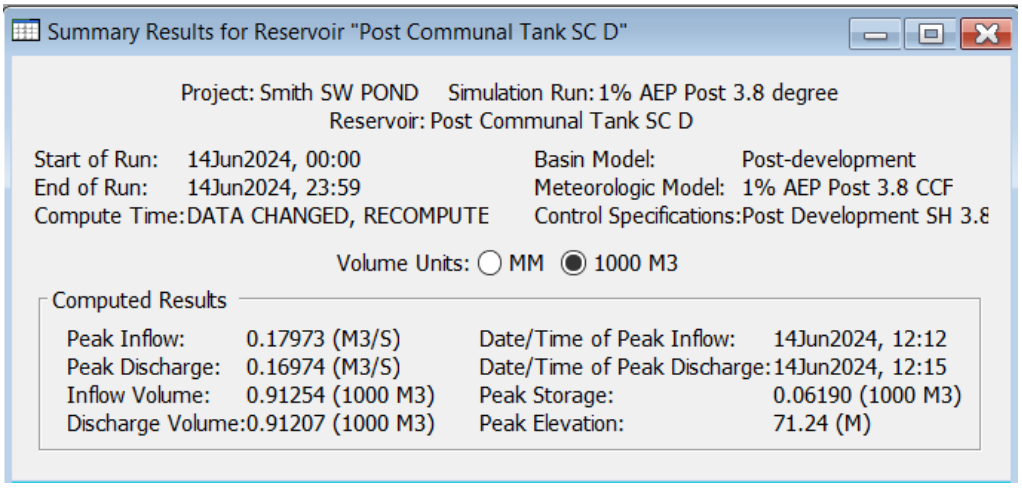
Show Elements: All Elements | Volume Units: MM / 1000 M3 | Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Tank SC G	0.0049	0.22623	14 June 2024, 12:12	1.17100
Post Lot Pervious G	0.0049	0.18212	14 June 2024, 12:13	0.83866
Post Pvt Pavement G	0.0024	0.11312	14 June 2024, 12:12	0.59021
Diversion-G 2	0.0024	0.03912	14 June 2024, 12:12	0.02080
Tank SC G Driveway	0.0000	0.07436	14 June 2024, 12:06	0.56458
Post Reserve G	0.0010	0.03478	14 June 2024, 12:13	0.16017
To West	0.0063	0.25180	14 June 2024, 12:13	1.23224
North Wetland	0.0985	2.30748	14 June 2024, 12:19	20.76759
South East Stream	0.0135	0.57077	14 June 2024, 12:12	2.85324
South West Stream	0.0133	0.55612	14 June 2024, 12:12	2.75521

- The water level of Communal Device B under the 1% AEP rainfall event (3.8°C CCF)

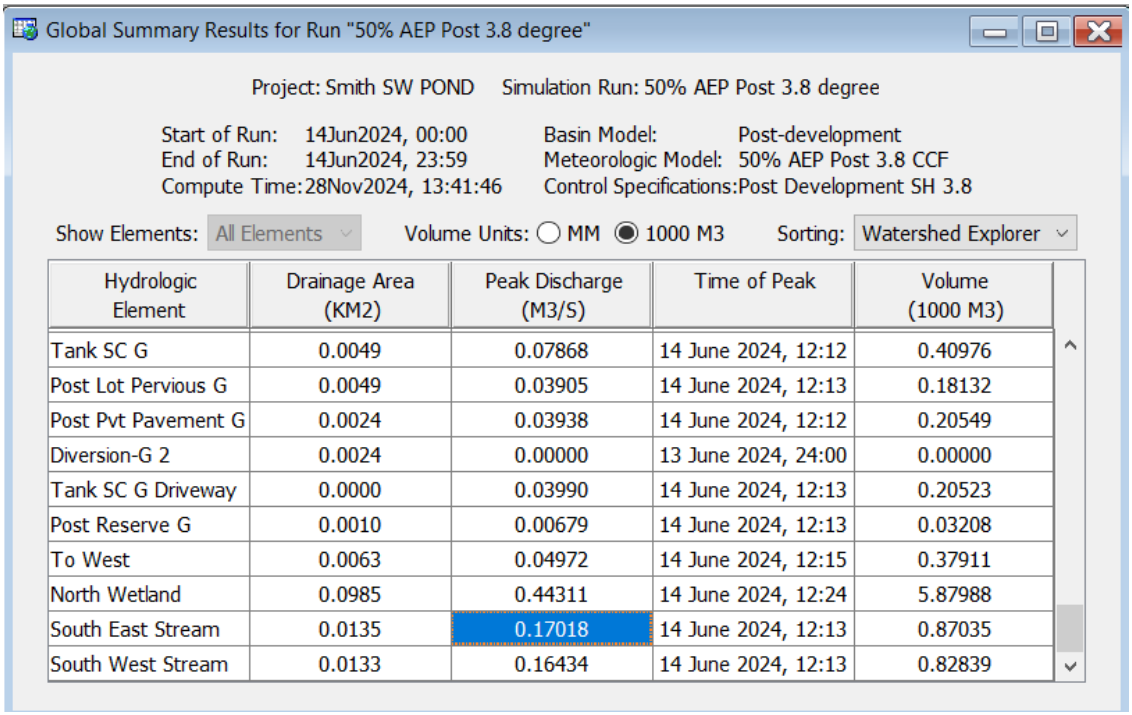


- The water level of Communal Device D under the 1% AEP rainfall event (3.8°C CCF)



Outlet 3 (To South East)

- The post-development peak flow under the 50% AEP rainfall event (3.8°C CCF)



Global Summary Results for Run "50% AEP Post 3.8 degree"

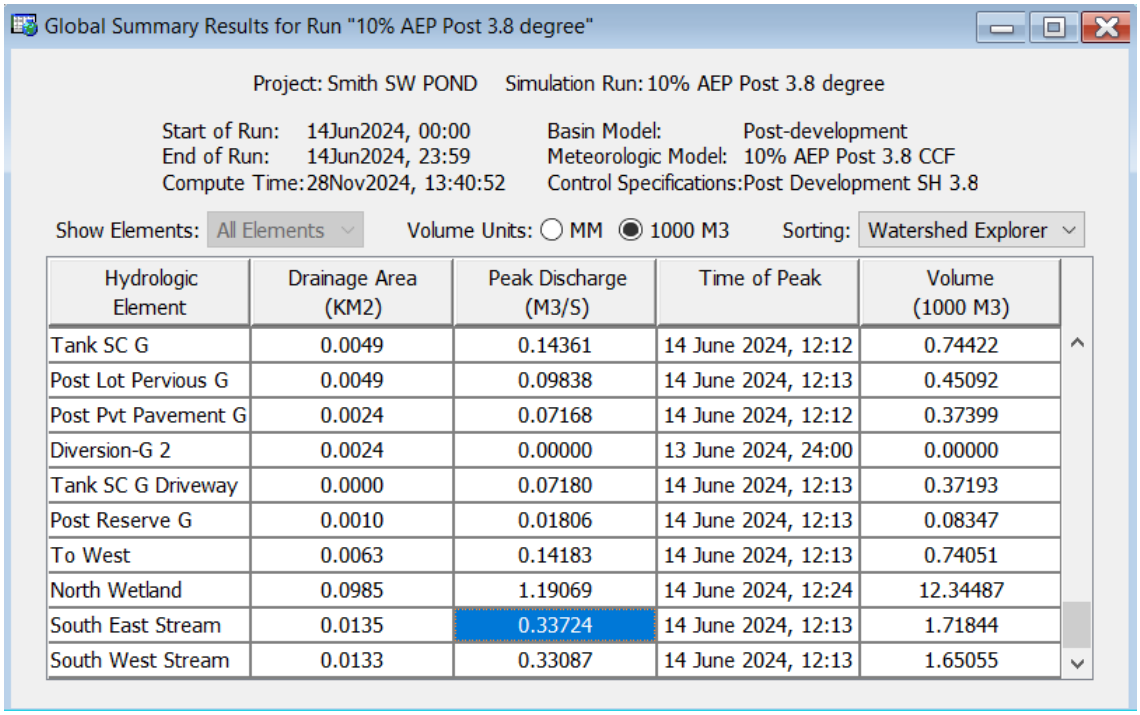
Project: Smith SW POND Simulation Run: 50% AEP Post 3.8 degree

Start of Run: 14Jun2024, 00:00 Basin Model: Post-development
End of Run: 14Jun2024, 23:59 Meteorologic Model: 50% AEP Post 3.8 CCF
Compute Time: 28Nov2024, 13:41:46 Control Specifications: Post Development SH 3.8

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Tank SC G	0.0049	0.07868	14 June 2024, 12:12	0.40976
Post Lot Pervious G	0.0049	0.03905	14 June 2024, 12:13	0.18132
Post Pvt Pavement G	0.0024	0.03938	14 June 2024, 12:12	0.20549
Diversion-G 2	0.0024	0.00000	13 June 2024, 24:00	0.00000
Tank SC G Driveway	0.0000	0.03990	14 June 2024, 12:13	0.20523
Post Reserve G	0.0010	0.00679	14 June 2024, 12:13	0.03208
To West	0.0063	0.04972	14 June 2024, 12:15	0.37911
North Wetland	0.0985	0.44311	14 June 2024, 12:24	5.87988
South East Stream	0.0135	0.17018	14 June 2024, 12:13	0.87035
South West Stream	0.0133	0.16434	14 June 2024, 12:13	0.82839

- The post-development peak flow under the 10% AEP rainfall event (3.8°C CCF)



Global Summary Results for Run "10% AEP Post 3.8 degree"

Project: Smith SW POND Simulation Run: 10% AEP Post 3.8 degree

Start of Run: 14Jun2024, 00:00 Basin Model: Post-development
End of Run: 14Jun2024, 23:59 Meteorologic Model: 10% AEP Post 3.8 CCF
Compute Time: 28Nov2024, 13:40:52 Control Specifications: Post Development SH 3.8

Show Elements: All Elements Volume Units: MM 1000 M3 Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Tank SC G	0.0049	0.14361	14 June 2024, 12:12	0.74422
Post Lot Pervious G	0.0049	0.09838	14 June 2024, 12:13	0.45092
Post Pvt Pavement G	0.0024	0.07168	14 June 2024, 12:12	0.37399
Diversion-G 2	0.0024	0.00000	13 June 2024, 24:00	0.00000
Tank SC G Driveway	0.0000	0.07180	14 June 2024, 12:13	0.37193
Post Reserve G	0.0010	0.01806	14 June 2024, 12:13	0.08347
To West	0.0063	0.14183	14 June 2024, 12:13	0.74051
North Wetland	0.0985	1.19069	14 June 2024, 12:24	12.34487
South East Stream	0.0135	0.33724	14 June 2024, 12:13	1.71844
South West Stream	0.0133	0.33087	14 June 2024, 12:13	1.65055

- The post-development peak flow under the 1% AEP rainfall event (3.8°C CCF)

Global Summary Results for Run "1% AEP Post 3.8 degree"

Project: Smith SW POND Simulation Run: 1% AEP Post 3.8 degree

Start of Run: 14Jun2024, 00:00
End of Run: 14Jun2024, 23:59
Compute Time: 28Nov2024, 13:41:19

Basin Model: Post-development
Meteorologic Model: 1% AEP Post 3.8 CCF
Control Specifications: Post Development SH 3.8

Show Elements: All Elements | Volume Units: MM / 1000 M3 | Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Tank SC G	0.0049	0.22623	14 June 2024, 12:12	1.17100
Post Lot Pervious G	0.0049	0.18212	14 June 2024, 12:13	0.83866
Post Pvt Pavement G	0.0024	0.11312	14 June 2024, 12:12	0.59021
Diversion-G 2	0.0024	0.03912	14 June 2024, 12:12	0.02080
Tank SC G Driveway	0.0000	0.07436	14 June 2024, 12:06	0.56458
Post Reserve G	0.0010	0.03478	14 June 2024, 12:13	0.16017
To West	0.0063	0.25180	14 June 2024, 12:13	1.23224
North Wetland	0.0985	2.30748	14 June 2024, 12:19	20.76759
South East Stream	0.0135	0.57077	14 June 2024, 12:12	2.85324
South West Stream	0.0133	0.55612	14 June 2024, 12:12	2.75521

Outlet 4 (To South West)

- The post-development peak flow under the 50% AEP rainfall event (3.8°C CCF)

Global Summary Results for Run "50% AEP Post 3.8 degree"

Project: Smith SW POND Simulation Run: 50% AEP Post 3.8 degree

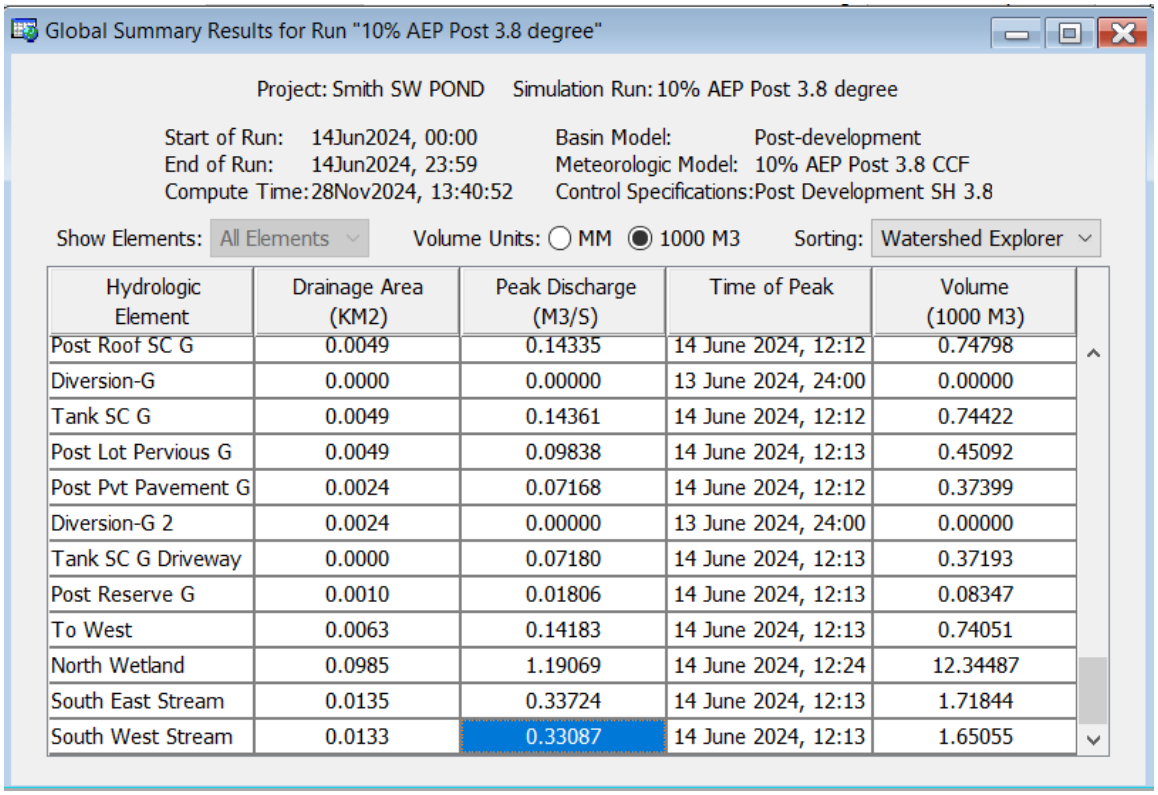
Start of Run: 14Jun2024, 00:00
End of Run: 14Jun2024, 23:59
Compute Time: 28Nov2024, 13:41:46

Basin Model: Post-development
Meteorologic Model: 50% AEP Post 3.8 CCF
Control Specifications: Post Development SH 3.8

Show Elements: All Elements | Volume Units: MM / 1000 M3 | Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Tank SC G	0.0049	0.07868	14 June 2024, 12:12	0.40976
Post Lot Pervious G	0.0049	0.03905	14 June 2024, 12:13	0.18132
Post Pvt Pavement G	0.0024	0.03938	14 June 2024, 12:12	0.20549
Diversion-G 2	0.0024	0.00000	13 June 2024, 24:00	0.00000
Tank SC G Driveway	0.0000	0.03990	14 June 2024, 12:13	0.20523
Post Reserve G	0.0010	0.00679	14 June 2024, 12:13	0.03208
To West	0.0063	0.04972	14 June 2024, 12:15	0.37911
North Wetland	0.0985	0.44311	14 June 2024, 12:24	5.87988
South East Stream	0.0135	0.17018	14 June 2024, 12:13	0.87035
South West Stream	0.0133	0.16434	14 June 2024, 12:13	0.82839

- The post-development peak flow under the 10% AEP rainfall event (3.8°C CCF)



Global Summary Results for Run "10% AEP Post 3.8 degree"

Project: Smith SW POND Simulation Run: 10% AEP Post 3.8 degree

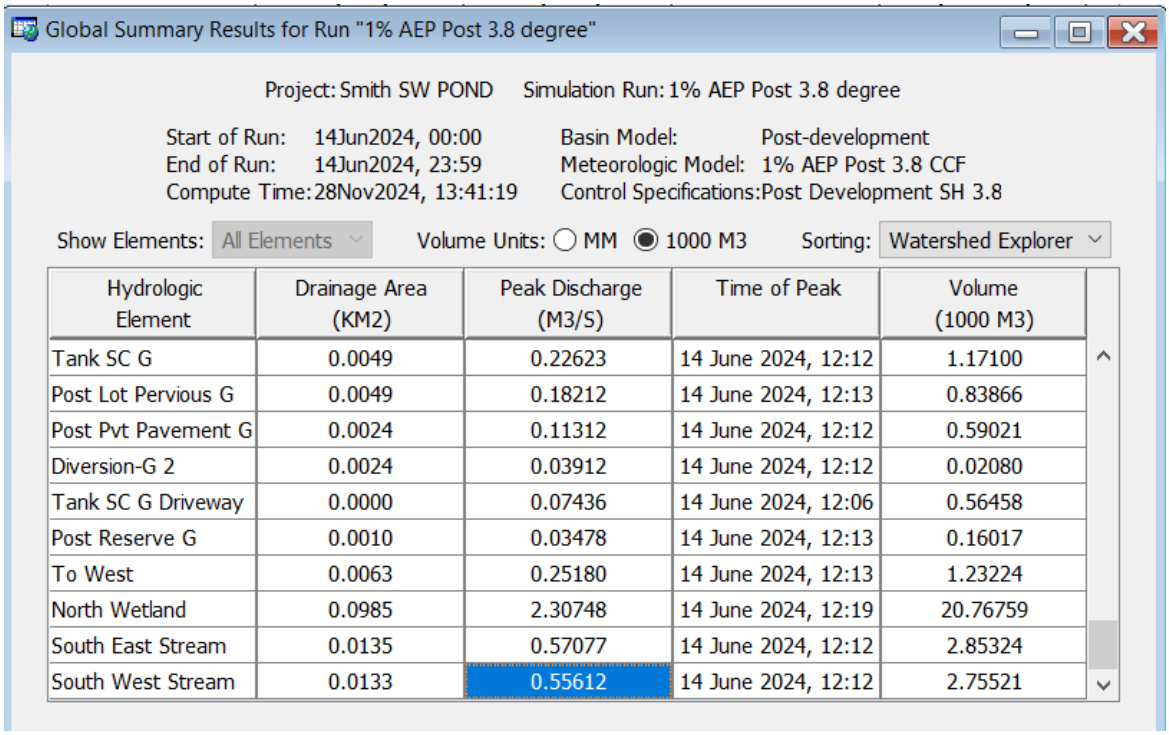
Start of Run: 14Jun2024, 00:00
End of Run: 14Jun2024, 23:59
Compute Time: 28Nov2024, 13:40:52

Basin Model: Post-development
Meteorologic Model: 10% AEP Post 3.8 CCF
Control Specifications: Post Development SH 3.8

Show Elements: All Elements | Volume Units: MM / 1000 M3 | Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Post Roof SC G	0.0049	0.14335	14 June 2024, 12:12	0.74798
Diversion-G	0.0000	0.00000	13 June 2024, 24:00	0.00000
Tank SC G	0.0049	0.14361	14 June 2024, 12:12	0.74422
Post Lot Pervious G	0.0049	0.09838	14 June 2024, 12:13	0.45092
Post Pvt Pavement G	0.0024	0.07168	14 June 2024, 12:12	0.37399
Diversion-G 2	0.0024	0.00000	13 June 2024, 24:00	0.00000
Tank SC G Driveway	0.0000	0.07180	14 June 2024, 12:13	0.37193
Post Reserve G	0.0010	0.01806	14 June 2024, 12:13	0.08347
To West	0.0063	0.14183	14 June 2024, 12:13	0.74051
North Wetland	0.0985	1.19069	14 June 2024, 12:24	12.34487
South East Stream	0.0135	0.33724	14 June 2024, 12:13	1.71844
South West Stream	0.0133	0.33087	14 June 2024, 12:13	1.65055

- The post-development peak flow under the 1% AEP rainfall event (3.8°C CCF)



Global Summary Results for Run "1% AEP Post 3.8 degree"

Project: Smith SW POND Simulation Run: 1% AEP Post 3.8 degree

Start of Run: 14Jun2024, 00:00
End of Run: 14Jun2024, 23:59
Compute Time: 28Nov2024, 13:41:19

Basin Model: Post-development
Meteorologic Model: 1% AEP Post 3.8 CCF
Control Specifications: Post Development SH 3.8

Show Elements: All Elements | Volume Units: MM / 1000 M3 | Sorting: Watershed Explorer

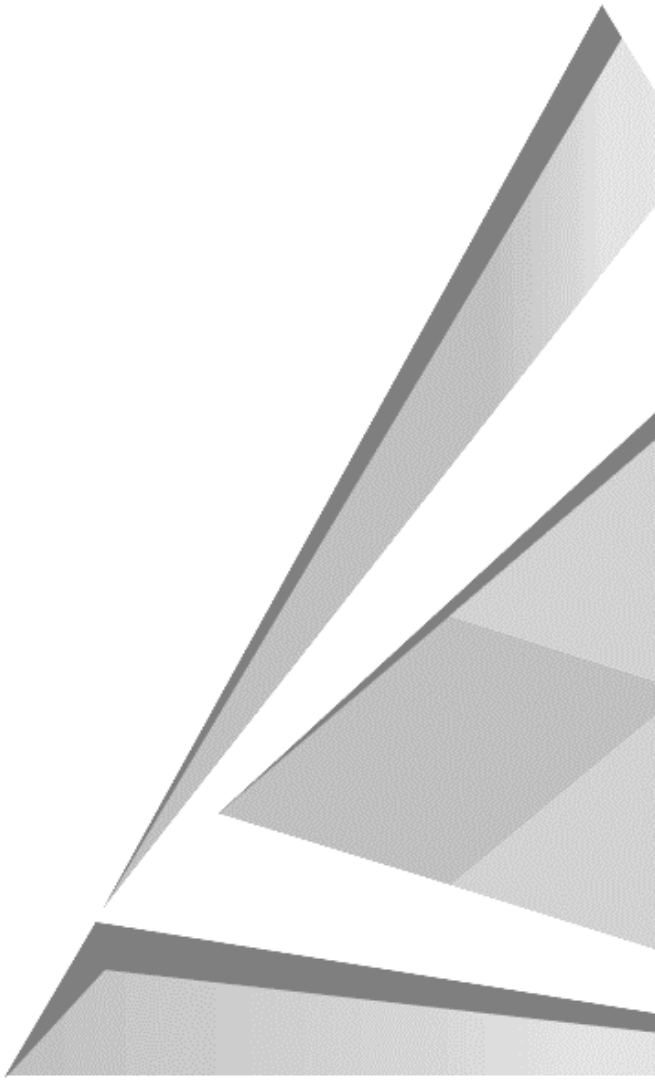
Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Tank SC G	0.0049	0.22623	14 June 2024, 12:12	1.17100
Post Lot Pervious G	0.0049	0.18212	14 June 2024, 12:13	0.83866
Post Pvt Pavement G	0.0024	0.11312	14 June 2024, 12:12	0.59021
Diversion-G 2	0.0024	0.03912	14 June 2024, 12:12	0.02080
Tank SC G Driveway	0.0000	0.07436	14 June 2024, 12:06	0.56458
Post Reserve G	0.0010	0.03478	14 June 2024, 12:13	0.16017
To West	0.0063	0.25180	14 June 2024, 12:13	1.23224
North Wetland	0.0985	2.30748	14 June 2024, 12:19	20.76759
South East Stream	0.0135	0.57077	14 June 2024, 12:12	2.85324
South West Stream	0.0133	0.55612	14 June 2024, 12:12	2.75521

APPENDIX B

STORMWATER CALCULATION

TP108 SPREADSHEET CALCULATIONS

SMAF VOLUME CALCULATION



2a Wesley Street
PO Box 475
Pukekohe 2340

BIRCH SURVEYORS LTD
Land Surveyors • Resource Consultants • Planners

ph: 09 237 1111
fax 09 238 0033

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Pre Development Pervious Area, Stormwater Catchment A

Hydrological Soil Group: Group_B

	CN	Area	Product
Grassed (Class B)	61	0.9633	58.7613
totals		0.9633	58.7613

% Impervious		0.00%	
CN weighted		61.0000	
Ia weighted		5.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.0670	km
Catchment Slope	(S_c)	0.0750	m/m
Runoff Factor		0.4388	
Time of Concentration	(t_c)	0.0805 hrs	4.8 min
Use	(t_c)	0.1667 min	10.0 min
Catchment Area		0.0096 km²	
CN		61.0000	
Storage	(S)	162.3934 mm	

Table 3.3 - Curve numbers for typical Auckland conditions

Land use	Group A Soil (volcanic granular loam)	Group B Soil (alluvial)	Group C Soil (mudstone/sandstone)
Bush, humid-climate, not-grazed	30	55	70
Pasture, lightly grazed, good grass cover	39	61	74
Urban lawns	39	61	74
Crops, straight rows, minimal vegetative cover	72	81	88
Sealed roads, roofs	98	98	98

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	5	34.50	89	130	157	184	210	239
c*			-0.0156	0.0701	0.1960	0.2691	0.3115	0.3484	0.3810	0.4134
q* from ARC		Approx	0.032	0.032	0.063	0.082	0.091	0.098	0.103	0.109
Peak Flowrate	(q_p)	cumecs	0.0015	0.0105	0.0542	0.1019	0.1369	0.1727	0.2088	0.2498
Peak Flowrate	(q_p)	l/s	2	11	54	102	137	173	209	250
24 hour Runoff Depth	(Q_{24})	mm	0.00	4.54	28.75	54.10	73.46	93.61	114.32	138.02
24 hour Runoff Volume	(V_{24})	cu mtr	0	44	277	521	708	902	1101	1330

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Pre Development Impervious Area, Stormwater Catchment A

Hydrological Soil Group: Group_B

	CN	Area	Product
Building	98	0.0000	
Drive & Paths	98	0.0000	
totals		0.0000	0.0000

% Impervious		100.00%	
CN weighted		0.0000	
Ia weighted		0.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.0670	km
Catchment Slope	(S_c)	0.0750	m/m
Runoff Factor		0.0000	
Time of Concentration	(t_c)	0.0000 hrs	0.0 min
Use	(t_c)	0.1667 min	10.0 min
Catchment Area		0.0000 km²	
CN		0.0000	
Storage	(S)	0.0000 mm	

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
c*			1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
q* from ARC		Approx	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169
Peak Flowrate	(q_p)	cumecs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Peak Flowrate	(q_p)	l/s	0	0	0	0	0	0	0	0
24 hour Runoff Depth	(Q_{24})	mm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24 hour Runoff Volume	(V_{24})	cu mtr	0	0	0	0	0	0	0	0

Existing Flows

			WQV $^1/_3$ 2yr	Ex. Det.	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
Peak Flowrate	(q_p)	cumecs	0.0015	0.0105	0.0542	0.1019	0.1369	0.1727	0.2088	0.2498
Peak Flowrate	(q_p)	l/s	2	11	54	102	137	173	209	250
24 hour Runoff Volume	(V_{24})	cu mtr	0	44	277	521	708	902	1101	1330

2a Wesley Street
PO Box 475
Pukekohe 2340

BIRCH SURVEYORS LTD
Land Surveyors • Resource Consultants • Planners

ph: 09 237 1111
fax 09 238 0033

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Post Development Pervious Area, Stormwater Catchment A

Hydrological Soil Group		Group_B		
		CN	Area	Product
Grassed		61	0.2718	16.5798
		totals	0.2718	16.5798
% Impervious			0.00%	
CN weighted			61.0000	
Ia weighted			5.0000	
Channelisation factor	(C)		1.0000	
Catchment Length	(l)		0.0500	km
Catchment Slope	(S_c)		0.0900	m/m
Runoff Factor			0.4388	
Time of Concentration	(t_c)		0.0628	hrs
Use	(t_c)		0.1667	min
Catchment Area			0.0027	km²
CN			61.0000	
Storage	(S)		162.3934	mm

				SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})		mm	5.0000	34.50	89	130	157	184	210	239
c*				-0.0156	0.0701	0.1960	0.2691	0.3115	0.3484	0.3810	0.4134
q* from ARC			Approx	0.032	0.032	0.063	0.082	0.091	0.098	0.103	0.109
Peak Flowrate	(q_p)		cumecs	0.0004	0.0030	0.0153	0.0287	0.0386	0.0487	0.0589	0.0705
Peak Flowrate	(q_p)		l/s	0	3	15	29	39	49	59	70
24 hour Runoff Depth	(Q_{24})		mm	0.00	4.54	28.75	54.10	73.46	93.61	114.32	138.02
24 hour Runoff Volume	(V_{24})		cu mtr	0	12	78	147	200	254	311	375

Table 3.3 - Curve numbers for typical Auckland conditions

Land use	Group A Soil (volcanic granular loam)	Group B Soil (alluvial)	Group C Soil (mudstone/sandstone)
Bush, humid-climate, not-grazed	30	55	70
Pasture, lightly grazed, good grass cover	39	61	74
Urban lawns	39	61	74
Crops, straight rows, minimal vegetative cover	72	81	88
Sealed roads, roofs	98	98	98

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Post Development Impervious Area, Stormwater Catchment A

Hydrological Soil Group		Group_B		
		CN	Area	Product
Buildings/Impervious		98	0.2700	26.4600
Road/Footpath		98	0.1050	10.2900
		totals	0.3750	36.7500
% Impervious			100.00%	
CN weighted			98.0000	
Ia weighted			0.0000	
Channelisation factor	(C)		1.0000	
Catchment Length	(l)		0.0500	km
Catchment Slope	(S_c)		0.0900	m/m
Runoff Factor			0.9608	
Time of Concentration	(t_c)		0.0408	hrs
Use	(t_c)		0.1667	min
Catchment Area			0.0038	km²
CN			98.0000	
Storage	(S)		5.1837	mm

				SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})		mm	5.0000	34.50	89	130	157	184	210	239
c*				0.3254	0.7689	0.8959	0.9259	0.9380	0.9466	0.9529	0.9584
q* from ARC			Approx	0.093	0.150	0.161	0.164	0.164	0.165	0.166	0.166
Peak Flowrate	(q_p)		cumecs	0.0017	0.0195	0.0539	0.0795	0.0968	0.1137	0.1304	0.1487
Peak Flowrate	(q_p)		l/s	2	19	54	79	97	114	130	149
24 hour Runoff Depth	(Q_{24})		mm	2.45	29.99	84.30	124.62	151.94	178.64	204.86	233.79
24 hour Runoff Volume	(V_{24})		cu mtr	9	112	316	467	570	670	768	877

Calculated Flows

			WQV $^1/_3$ 2yr	Ex. Det.	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
Peak Flowrate	(q_p)	cumecs	0.0022	0.0224	0.0692	0.1082	0.1354	0.1625	0.1893	0.2192
Peak Flowrate	(q_p)	l/s	2	22	69	108	135	162	189	219
24 hour Runoff Volume	(V_{24})	cu mtr	9	125	394	614	769	924	1079	1252

2a Wesley Street
PO Box 475
Pukekohe 2340

BIRCH SURVEYORS LTD
Land Surveyors • Resource Consultants • Planners

ph: 09 237 1111
fax 09 238 0033

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Pre Development Pervious Area, Stormwater Catchment B

Hydrological Soil Group		Group_C	(B&C)
	CN	Area	Product
Grassed	63	3.3308	209.8404
	totals	3.3308	209.8404

% Impervious		0.00%	
CN weighted		63.0000	
Ia weighted		5.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.1650	km
Catchment Slope	(S_c)	0.1500	m/m
Runoff Factor		0.4599	
Time of Concentration	(t_c)	0.1155	hrs
Use	(t_c)	0.1667	min
Catchment Area		0.0333	km²
CN		63.0000	
Storage	(S)	149.1746	mm

			6.9	min
			10.0	min

Table 3.3 - Curve numbers for typical Auckland conditions

Land use	Group A Soil (volcanic granular loam)	Group B Soil (alluvial)	Group C Soil (mudstone/sandstone)
Bush, humid-climate, not-grazed	30	55	70
Pasture, lightly grazed, good grass cover	39	61	74
Urban lawns	39	61	74
Crops, straight rows, minimal vegetative cover	72	81	88
Sealed roads, roofs	98	98	98

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	5	34.50	89	130	157	184	210	239
c*			-0.0170	0.0759	0.2098	0.2862	0.3300	0.3679	0.4012	0.4341
q* from ARC		Approx	0.032	0.032	0.067	0.085	0.094	0.101	0.107	0.112
Peak Flowrate	(q_p)	cumecs	0.0053	0.0364	0.1988	0.3683	0.4922	0.6182	0.7454	0.8890
Peak Flowrate	(q_p)	l/s	5	36	199	368	492	618	745	889
24 hour Runoff Depth	(Q_{24})	mm	0.00	4.87	30.38	56.71	76.68	97.38	118.59	142.78
24 hour Runoff Volume	(V_{24})	cu mtr	0	162	1012	1889	2554	3244	3950	4756

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Pre Development Impervious Area, Stormwater Catchment B

Hydrological Soil Group		Group_C	(B&C)
	CN	Area	Product
Building	98	0.1500	14.7000
Drive & Paths	98	0.1500	14.7000
	totals	0.3000	29.4000

% Impervious		100.00%	
CN weighted		98.0000	
Ia weighted		0.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.1650	km
Catchment Slope	(S_c)	0.1500	m/m
Runoff Factor		0.9608	
Time of Concentration	(t_c)	0.0770	hrs
Use	(t_c)	0.1667	min
Catchment Area		0.0030	km²
CN		98.0000	
Storage	(S)	5.1837	mm

			4.6	min						
			10.0	min						

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
c*			0.7415	0.7689	0.8959	0.9259	0.9380	0.9466	0.9529	0.9584
q* from ARC		Approx	0.148	0.150	0.161	0.164	0.164	0.165	0.166	0.166
Peak Flowrate	(q_p)	cumecs	0.0132	0.0156	0.0431	0.0636	0.0775	0.0910	0.1043	0.1190
Peak Flowrate	(q_p)	l/s	13	16	43	64	77	91	104	119
24 hour Runoff Depth	(Q_{24})	mm	25.32	29.99	84.30	124.62	151.94	178.64	204.86	233.79
24 hour Runoff Volume	(V_{24})	cu mtr	76	90	253	374	456	536	615	701

Existing Flows

			WQV $^1/_3$ 2yr	Ex. Det.	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
Peak Flowrate	(q_p)	cumecs	0.0185	0.0520	0.2420	0.4319	0.5697	0.7092	0.8497	1.0079
Peak Flowrate	(q_p)	l/s	18	52	242	432	570	709	850	1008
24 hour Runoff Volume	(V_{24})	cu mtr	76	252	1265	2263	3010	3779	4565	5457

2a Wesley Street
PO Box 475
Pukekohe 2340

BIRCH SURVEYORS LTD
Land Surveyors • Resource Consultants • Planners

ph: 09 237 1111
fax 09 238 0033

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Post Development Pervious Area, Stormwater Catchment B

Hydrological Soil Group		Group_C	
	CN	Area	Product
Grassed	74	2.4200	179.0800
totals		2.4200	179.0800

% Impervious		0.00%	
CN weighted		74.0000	
Ia weighted		5.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.4100	km
Catchment Slope	(S_c)	0.0550	m/m
Runoff Factor		0.5873	
Time of Concentration	(t_c)	0.2486 hrs	14.9 min
Use	(t_c)	0.2486 min	14.9 min
Catchment Area		0.0242	km²
CN		74.0000	
Storage	(S)	89.2432	mm

Table 3.3 - Curve numbers for typical Auckland conditions

Land use	Group A Soil (volcanic granular loam)	Group B Soil (alluvial)	Group C Soil (mudstone/sandstone)
Bush, humid-climate, not-grazed	30	55	70
Pasture, lightly grazed, good grass cover	39	61	74
Urban lawns	39	61	74
Crops, straight rows, minimal vegetative cover	72	81	88
Sealed roads, roofs	98	98	98

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	5.0000	34.50	89	130	157	184	210	239
c*			-0.0288	0.1207	0.3074	0.4012	0.4516	0.4932	0.5283	0.5618
q* from ARC		Approx	0.028	0.034	0.079	0.094	0.101	0.106	0.110	0.114
Peak Flowrate	(q_p)	cumecs	0.0034	0.0284	0.1709	0.2951	0.3832	0.4713	0.5592	0.6575
Peak Flowrate	(q_p)	l/s	3	28	171	295	383	471	559	657
24 hour Runoff Depth	(Q_{24})	mm	0.00	7.33	40.88	72.60	95.74	119.16	142.75	169.27
24 hour Runoff Volume	(V_{24})	cu mtr	0	177	989	1757	2317	2884	3455	4096

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Post Development Impervious Area, Stormwater Catchment B

Hydrological Soil Group		Group_C	
	CN	Area	Product
Buildings/Impervious	98	1.3300	130.3400
Road/Footpath	98	2.7500	269.5000
totals		4.0800	399.8400

% Impervious		100.00%	
CN weighted		98.0000	
Ia weighted		0.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.4100	km
Catchment Slope	(S_c)	0.0550	m/m
Runoff Factor		0.9608	
Time of Concentration	(t_c)	0.1897 hrs	11.4 min
Use	(t_c)	0.1897 min	11.4 min
Catchment Area		0.0408	km²
CN		98.0000	
Storage	(S)	5.1837	mm

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	5.0000	34.50	89	130	157	184	210	239
c*			0.3254	0.7689	0.8959	0.9259	0.9380	0.9466	0.9529	0.9584
q* from ARC		Approx	0.090	0.145	0.155	0.157	0.158	0.159	0.159	0.160
Peak Flowrate	(q_p)	cumecs	0.0183	0.2038	0.5645	0.8320	1.0134	1.1905	1.3645	1.5565
Peak Flowrate	(q_p)	l/s	18	204	564	832	1013	1191	1365	1556
24 hour Runoff Depth	(Q_{24})	mm	2.45	29.99	84.30	124.62	151.94	178.64	204.86	233.79
24 hour Runoff Volume	(V_{24})	cu mtr	100	1224	3439	5084	6199	7288	8358	9538

Calculated Flows

			WQV $^1/_3$ 2yr	Ex. Det.	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
Peak Flowrate	(q_p)	cumecs	0.0217	0.2321	0.7354	1.1271	1.3966	1.6618	1.9238	2.2140
Peak Flowrate	(q_p)	l/s	22	232	735	1127	1397	1662	1924	2214
24 hour Runoff Volume	(V_{24})	cu mtr	100	1401	4429	6841	8516	10172	11813	13635

2a Wesley Street
PO Box 475
Pukekohe 2340

BIRCH SURVEYORS LTD
Land Surveyors • Resource Consultants • Planners

ph: 09 237 1111
fax 09 238 0033

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Pre Development Pervious Area, Stormwater Catchment C

Hydrological Soil Group		Group_C	(B&C)
	CN	Area	Product
Grassed	62	1.3190	81.7780
	totals	1.3190	81.7780

% Impervious		0.00%	
CN weighted		62.0000	
Ia weighted		5.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.1350	km
Catchment Slope	(S_c)	0.1630	m/m
Runoff Factor		0.4493	
Time of Concentration	(t_c)	0.0999	hrs
Use	(t_c)	0.1667	min
Catchment Area		0.0132	km²
CN		62.0000	
Storage	(S)	155.6774	mm

		6.0	min
		10.0	min

Table 3.3 - Curve numbers for typical Auckland conditions

Land use	Group A Soil (volcanic granular loam)	Group B Soil (alluvial)	Group C Soil (mudstone/sandstone)
Bush, humid-climate, not-grazed	30	55	70
Pasture, lightly grazed, good grass cover	39	61	74
Urban lawns	39	61	74
Crops, straight rows, minimal vegetative cover	72	81	88
Sealed roads, roofs	98	98	98

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	5	34.50	89	130	157	184	210	239
c*			-0.0163	0.0729	0.2028	0.2775	0.3207	0.3581	0.3910	0.4236
q* from ARC		Approx	0.032	0.032	0.065	0.083	0.092	0.099	0.105	0.110
Peak Flowrate	(q_p)	cumecs	0.0021	0.0144	0.0765	0.1426	0.1912	0.2406	0.2906	0.3470
Peak Flowrate	(q_p)	l/s	2	14	76	143	191	241	291	347
24 hour Runoff Depth	(Q_{24})	mm	0.00	4.70	29.56	55.39	75.06	95.49	116.45	140.40
24 hour Runoff Volume	(V_{24})	cu mtr	0	62	390	731	990	1259	1536	1852

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Pre Development Impervious Area, Stormwater Catchment C

Hydrological Soil Group		Group_C	(B&C)
	CN	Area	Product
Building	98	0.0000	
Drive & Paths	98	0.0000	
	totals	0.0000	0.0000

% Impervious		100.00%	
CN weighted		0.0000	
Ia weighted		0.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.1350	km
Catchment Slope	(S_c)	0.1630	m/m
Runoff Factor		0.0000	
Time of Concentration	(t_c)	0.0000	hrs
Use	(t_c)	0.1667	min
Catchment Area		0.0000	km²
CN		0.0000	
Storage	(S)	0.0000	mm

			0.0	min
			10.0	min

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
c*			1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
q* from ARC		Approx	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169
Peak Flowrate	(q_p)	cumecs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Peak Flowrate	(q_p)	l/s	0	0	0	0	0	0	0	0
24 hour Runoff Depth	(Q_{24})	mm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24 hour Runoff Volume	(V_{24})	cu mtr	0	0	0	0	0	0	0	0

Existing Flows

			WQV $^1/_3$ 2yr	Ex. Det.	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
Peak Flowrate	(q_p)	cumecs	0.0021	0.0144	0.0765	0.1426	0.1912	0.2406	0.2906	0.3470
Peak Flowrate	(q_p)	l/s	2	14	76	143	191	241	291	347
24 hour Runoff Volume	(V_{24})	cu mtr	0	62	390	731	990	1259	1536	1852

2a Wesley Street
PO Box 475
Pukekohe 2340

BIRCH SURVEYORS LTD
Land Surveyors • Resource Consultants • Planners

ph: 09 237 1111
fax 09 238 0033

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Post Development Pervious Area, Stormwater Catchment C

Hydrological Soil Group: Group_C

	CN	Area	Product
Grassed	74	0.6800	50.3200
totals		0.6800	50.3200

% Impervious		0.00%	
CN weighted		74.0000	
Ia weighted		5.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.0920	km
Catchment Slope	(S_c)	0.2280	m/m
Runoff Factor		0.5873	
Time of Concentration	(t_c)	0.0605	hrs
		3.6	min
Use	(t_c)	0.1667	min
		10.0	min
Catchment Area		0.0068	km²
CN		74.0000	
Storage	(S)	89.2432	mm

Table 3.3 - Curve numbers for typical Auckland conditions

Land use	Group A Soil (volcanic granular loam)	Group B Soil (alluvial)	Group C Soil (mudstone/sandstone)
Bush, humid-climate, not-grazed	30	55	70
Pasture, lightly grazed, good grass cover	39	61	74
Urban lawns	39	61	74
Crops, straight rows, minimal vegetative cover	72	81	88
Sealed roads, roofs	98	98	98

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	5.0000	34.50	89	130	157	184	210	239
c*			-0.0288	0.1207	0.3074	0.4012	0.4516	0.4932	0.5283	0.5618
q* from ARC		Approx	0.032	0.038	0.090	0.107	0.114	0.120	0.125	0.129
Peak Flowrate	(q_p)	cumecs	0.0011	0.0090	0.0544	0.0940	0.1220	0.1501	0.1781	0.2094
Peak Flowrate	(q_p)	l/s	1	9	54	94	122	150	178	209
24 hour Runoff Depth	(Q_{24})	mm	0.00	7.33	40.88	72.60	95.74	119.16	142.75	169.27
24 hour Runoff Volume	(V_{24})	cu mtr	0	50	278	494	651	810	971	1151

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Post Development Impervious Area, Stormwater Catchment C

Hydrological Soil Group: Group_C

	CN	Area	Product
Buildings/Impervious	98	0.4600	45.0800
Road/Footpath	98	0.2300	22.5400
totals		0.6900	67.6200

% Impervious		100.00%	
CN weighted		98.0000	
Ia weighted		0.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.0920	km
Catchment Slope	(S_c)	0.2280	m/m
Runoff Factor		0.9608	
Time of Concentration	(t_c)	0.0462	hrs
		2.8	min
Use	(t_c)	0.1667	min
		10.0	min
Catchment Area		0.0069	km²
CN		98.0000	
Storage	(S)	5.1837	mm

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	5.0000	34.50	89	130	157	184	210	239
c*			0.3254	0.7689	0.8959	0.9259	0.9380	0.9466	0.9529	0.9584
q* from ARC		Approx	0.093	0.150	0.161	0.164	0.164	0.165	0.166	0.166
Peak Flowrate	(q_p)	cumecs	0.0032	0.0358	0.0992	0.1463	0.1781	0.2093	0.2399	0.2736
Peak Flowrate	(q_p)	l/s	3	36	99	146	178	209	240	274
24 hour Runoff Depth	(Q_{24})	mm	2.45	29.99	84.30	124.62	151.94	178.64	204.86	233.79
24 hour Runoff Volume	(V_{24})	cu mtr	17	207	582	860	1048	1233	1414	1613

Calculated Flows

			WQV $^1/_3$ 2yr	Ex. Det.	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
Peak Flowrate	(q_p)	cumecs	0.0043	0.0448	0.1536	0.2402	0.3002	0.3594	0.4180	0.4830
Peak Flowrate	(q_p)	l/s	4	45	154	240	300	359	418	483
24 hour Runoff Volume	(V_{24})	cu mtr	17	257	860	1354	1699	2043	2384	2764

2a Wesley Street
PO Box 475
Pukekohe 2340

BIRCH SURVEYORS LTD
Land Surveyors • Resource Consultants • Planners

ph: 09 237 1111
fax 09 238 0033

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Pre Development Pervious Area, Stormwater Catchment D

Hydrological Soil Group		Group_C	(B&C)
	CN	Area	Product
Grassed	66	2.2392	147.7872
	totals	2.2392	147.7872

% Impervious		0.00%	
CN weighted		66.0000	
Ia weighted		5.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.1950	km
Catchment Slope	(S_c)	0.1490	m/m
Runoff Factor		0.4925	
Time of Concentration	(t_c)	0.1244	hrs 7.5 min
Use	(t_c)	0.1667	min 10.0 min
Catchment Area		0.0224	km²
CN		66.0000	
Storage	(S)	130.8485	mm

Table 3.3 - Curve numbers for typical Auckland conditions

Land use	Group A Soil (volcanic granular loam)	Group B Soil (alluvial)	Group C Soil (mudstone/sandstone)
Bush, humid-climate, not-grazed	30	55	70
Pasture, lightly grazed, good grass cover	39	61	74
Urban lawns	39	61	74
Crops, straight rows, minimal vegetative cover	72	81	88
Sealed roads, roofs	98	98	98

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	5	34.50	89	130	157	184	210	239
c*			-0.0195	0.0856	0.2323	0.3137	0.3596	0.3989	0.4331	0.4665
q* from ARC		Approx	0.032	0.032	0.073	0.091	0.100	0.106	0.112	0.116
Peak Flowrate	(q_p)	cumecs	0.0035	0.0245	0.1455	0.2640	0.3500	0.4370	0.5245	0.6230
Peak Flowrate	(q_p)	l/s	4	24	145	264	350	437	524	623
24 hour Runoff Depth	(Q_{24})	mm	0.00	5.43	32.97	60.78	81.65	103.15	125.06	149.96
24 hour Runoff Volume	(V_{24})	cu mtr	0	122	738	1361	1828	2310	2800	3358

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Pre Development Impervious Area, Stormwater Catchment D

Hydrological Soil Group		Group_C	(B&C)
	CN	Area	Product
Building	98	0.0000	
Drive & Paths	98	0.0000	
	totals	0.0000	0.0000

% Impervious		100.00%	
CN weighted		0.0000	
Ia weighted		0.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.1950	km
Catchment Slope	(S_c)	0.1490	m/m
Runoff Factor		0.0000	
Time of Concentration	(t_c)	0.0000	hrs 0.0 min
Use	(t_c)	0.1667	min 10.0 min
Catchment Area		0.0000	km²
CN		0.0000	
Storage	(S)	0.0000	mm

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
c*			1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
q* from ARC		Approx	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169
Peak Flowrate	(q_p)	cumecs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Peak Flowrate	(q_p)	l/s	0	0	0	0	0	0	0	0
24 hour Runoff Depth	(Q_{24})	mm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24 hour Runoff Volume	(V_{24})	cu mtr	0	0	0	0	0	0	0	0

Existing Flows

			WQV $^1/_3$ 2yr	Ex. Det.	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
Peak Flowrate	(q_p)	cumecs	0.0035	0.0245	0.1455	0.2640	0.3500	0.4370	0.5245	0.6230
Peak Flowrate	(q_p)	l/s	4	24	145	264	350	437	524	623
24 hour Runoff Volume	(V_{24})	cu mtr	0	122	738	1361	1828	2310	2800	3358

2a Wesley Street
PO Box 475
Pukekohe 2340

BIRCH SURVEYORS LTD
Land Surveyors • Resource Consultants • Planners

ph: 09 237 1111
fax 09 238 0033

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Post Development Pervious Area, Stormwater Catchment D

Hydrological Soil Group		Group_C	
	CN	Area	Product
Grassed	74	0.6900	51.0600
totals		0.6900	51.0600

% Impervious		0.00%	
CN weighted		74.0000	
Ia weighted		5.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.0850	km
Catchment Slope	(S_c)	0.1170	m/m
Runoff Factor		0.5873	
Time of Concentration	(t_c)	0.0702	hrs
Use	(t_c)	0.1667	min
Catchment Area		0.0069	km²
CN		74.0000	
Storage	(S)	89.2432	mm

				SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})		mm	5.0000	34.50	89	130	157	184	210	239
c*				-0.0288	0.1207	0.3074	0.4012	0.4516	0.4932	0.5283	0.5618
q* from ARC			Approx	0.032	0.038	0.090	0.107	0.114	0.120	0.125	0.129
Peak Flowrate	(q_p)		cumecs	0.0011	0.0092	0.0552	0.0953	0.1238	0.1523	0.1807	0.2124
Peak Flowrate	(q_p)		l/s	1	9	55	95	124	152	181	212
24 hour Runoff Depth	(Q_{24})		mm	0.00	7.33	40.88	72.60	95.74	119.16	142.75	169.27
24 hour Runoff Volume	(V_{24})		cu mtr	0	51	282	501	661	822	985	1168

Table 3.3 - Curve numbers for typical Auckland conditions

Land use	Group A Soil (volcanic granular loam)	Group B Soil (alluvial)	Group C Soil (mudstone/sandstone)
Bush, humid-climate, not-grazed	30	55	70
Pasture, lightly grazed, good grass cover	39	61	74
Urban lawns	39	61	74
Crops, straight rows, minimal vegetative cover	72	81	88
Sealed roads, roofs	98	98	98

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Post Development Impervious Area, Stormwater Catchment D

Hydrological Soil Group		Group_C	
	CN	Area	Product
Buildings/Impervious	98	0.4400	43.1200
Road/Footpath	98	0.3500	34.3000
totals		0.7900	77.4200

% Impervious		100.00%	
CN weighted		98.0000	
Ia weighted		0.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.0850	km
Catchment Slope	(S_c)	0.1170	m/m
Runoff Factor		0.9608	
Time of Concentration	(t_c)	0.0535	hrs
Use	(t_c)	0.1667	min
Catchment Area		0.0079	km²
CN		98.0000	
Storage	(S)	5.1837	mm

				SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})		mm	5.0000	34.50	89	130	157	184	210	239
c*				0.3254	0.7689	0.8959	0.9259	0.9380	0.9466	0.9529	0.9584
q* from ARC			Approx	0.093	0.150	0.161	0.164	0.164	0.165	0.166	0.166
Peak Flowrate	(q_p)		cumecs	0.0037	0.0410	0.1136	0.1675	0.2040	0.2396	0.2746	0.3133
Peak Flowrate	(q_p)		l/s	4	41	114	167	204	240	275	313
24 hour Runoff Depth	(Q_{24})		mm	2.45	29.99	84.30	124.62	151.94	178.64	204.86	233.79
24 hour Runoff Volume	(V_{24})		cu mtr	19	237	666	984	1200	1411	1618	1847

Calculated Flows

			WQV $^1/_3$ 2yr	Ex. Det.	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
Peak Flowrate	(q_p)	cumecs	0.0048	0.0502	0.1688	0.2628	0.3278	0.3919	0.4553	0.5257
Peak Flowrate	(q_p)	l/s	5	50	169	263	328	392	455	526
24 hour Runoff Volume	(V_{24})	cu mtr	19	288	948	1485	1861	2233	2603	3015

2a Wesley Street
PO Box 475
Pukekohe 2340

BIRCH SURVEYORS LTD
Land Surveyors • Resource Consultants • Planners

ph: 09 237 1111
fax 09 238 0033

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Pre Development Pervious Area, Stormwater Catchment E

Hydrological Soil Group		Group_C	(B&C)
	CN	Area	Product
Grassed	69	1.8720	129.1680
	totals	1.8720	129.1680

% Impervious		0.00%	
CN weighted		69.0000	
Ia weighted		5.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.1900	km
Catchment Slope	(S_c)	0.1420	m/m
Runoff Factor		0.5267	
Time of Concentration	(t_c)	0.1196	hrs 7.2 min
Use	(t_c)	0.1667	min 10.0 min
Catchment Area		0.0187	km²
CN		69.0000	
Storage	(S)	114.1159	mm

Table 3.3 - Curve numbers for typical Auckland conditions

Land use	Group A Soil (volcanic granular loam)	Group B Soil (alluvial)	Group C Soil (mudstone/sandstone)
Bush, humid-climate, not-grazed	30	55	70
Pasture, lightly grazed, good grass cover	39	61	74
Urban lawns	39	61	74
Crops, straight rows, minimal vegetative cover	72	81	88
Sealed roads, roofs	98	98	98

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	5	34.50	89	130	157	184	210	239
c*			-0.0224	0.0969	0.2576	0.3438	0.3917	0.4321	0.4669	0.5007
q* from ARC		Approx	0.032	0.032	0.079	0.097	0.105	0.111	0.117	0.121
Peak Flowrate	(q_p)	cumecs	0.0030	0.0205	0.1318	0.2347	0.3087	0.3832	0.4579	0.5418
Peak Flowrate	(q_p)	l/s	3	20	132	235	309	383	458	542
24 hour Runoff Depth	(Q_{24})	mm	0.00	6.06	35.75	65.04	86.79	109.04	131.62	157.17
24 hour Runoff Volume	(V_{24})	cu mtr	0	113	669	1217	1625	2041	2464	2942

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Pre Development Impervious Area, Stormwater Catchment E

Hydrological Soil Group		Group_C	(B&C)
	CN	Area	Product
Building	98	0.0000	
Drive & Paths	98	0.0000	
	totals	0.0000	0.0000

% Impervious		100.00%	
CN weighted		0.0000	
Ia weighted		0.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.1900	km
Catchment Slope	(S_c)	0.1420	m/m
Runoff Factor		0.0000	
Time of Concentration	(t_c)	0.0000	hrs 0.0 min
Use	(t_c)	0.1667	min 10.0 min
Catchment Area		0.0000	km²
CN		0.0000	
Storage	(S)	0.0000	mm

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
c*			1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
q* from ARC		Approx	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169
Peak Flowrate	(q_p)	cumecs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Peak Flowrate	(q_p)	l/s	0	0	0	0	0	0	0	0
24 hour Runoff Depth	(Q_{24})	mm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24 hour Runoff Volume	(V_{24})	cu mtr	0	0	0	0	0	0	0	0

Existing Flows

			WQV $^1/_3$ 2yr	Ex. Det.	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
Peak Flowrate	(q_p)	cumecs	0.0030	0.0205	0.1318	0.2347	0.3087	0.3832	0.4579	0.5418
Peak Flowrate	(q_p)	l/s	3	20	132	235	309	383	458	542
24 hour Runoff Volume	(V_{24})	cu mtr	0	113	669	1217	1625	2041	2464	2942

2a Wesley Street
PO Box 475
Pukekohe 2340

BIRCH SURVEYORS LTD
Land Surveyors • Resource Consultants • Planners

ph: 09 237 1111
fax 09 238 0033

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Post Development Pervious Area, Stormwater Catchment E

Hydrological Soil Group		Group_C	
	CN	Area	Product
Grassed	74	0.2600	19.2400
totals		0.2600	19.2400

% Impervious		0.00%	
CN weighted		74.0000	
Ia weighted		5.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.0600	km
Catchment Slope	(S_c)	0.0750	m/m
Runoff Factor		0.5873	
Time of Concentration	(t_c)	0.0637 hrs	3.8 min
Use	(t_c)	0.1667 min	10.0 min
Catchment Area		0.0026 km²	
CN		74.0000	
Storage	(S)	89.2432 mm	

Table 3.3 - Curve numbers for typical Auckland conditions

Land use	Group A Soil (volcanic granular loam)	Group B Soil (alluvial)	Group C Soil (mudstone/sandstone)
Bush, humid-climate, not-grazed	30	55	70
Pasture, lightly grazed, good grass cover	39	61	74
Urban lawns	39	61	74
Crops, straight rows, minimal vegetative cover	72	81	88
Sealed roads, roofs	98	98	98

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	5.0000	34.50	89	130	157	184	210	239
c*			-0.0288	0.1207	0.3074	0.4012	0.4516	0.4932	0.5283	0.5618
q* from ARC		Approx	0.032	0.038	0.090	0.107	0.114	0.120	0.125	0.129
Peak Flowrate	(q_p)	cumecs	0.0004	0.0035	0.0208	0.0359	0.0467	0.0574	0.0681	0.0800
Peak Flowrate	(q_p)	l/s	0	3	21	36	47	57	68	80
24 hour Runoff Depth	(Q_{24})	mm	0.00	7.33	40.88	72.60	95.74	119.16	142.75	169.27
24 hour Runoff Volume	(V_{24})	cu mtr	0	19	106	189	249	310	371	440

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Post Development Impervious Area, Stormwater Catchment D

Hydrological Soil Group		Group_C	
	CN	Area	Product
Buildings/Impervious	98	0.1800	17.6400
Road/Footpath	98	0.9000	88.2000
totals		1.0800	105.8400

% Impervious		100.00%	
CN weighted		98.0000	
Ia weighted		0.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.0600	km
Catchment Slope	(S_c)	0.0750	m/m
Runoff Factor		0.9608	
Time of Concentration	(t_c)	0.0486 hrs	2.9 min
Use	(t_c)	0.1667 min	10.0 min
Catchment Area		0.0108 km²	
CN		98.0000	
Storage	(S)	5.1837 mm	

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	5.0000	34.50	89	130	157	184	210	239
c*			0.3254	0.7689	0.8959	0.9259	0.9380	0.9466	0.9529	0.9584
q* from ARC		Approx	0.093	0.150	0.161	0.164	0.164	0.165	0.166	0.166
Peak Flowrate	(q_p)	cumecs	0.0050	0.0561	0.1553	0.2289	0.2788	0.3276	0.3755	0.4283
Peak Flowrate	(q_p)	l/s	5	56	155	229	279	328	375	428
24 hour Runoff Depth	(Q_{24})	mm	2.45	29.99	84.30	124.62	151.94	178.64	204.86	233.79
24 hour Runoff Volume	(V_{24})	cu mtr	27	324	910	1346	1641	1929	2213	2525

Calculated Flows

			WQV $^1/_3$ 2yr	Ex. Det.	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
Peak Flowrate	(q_p)	cumecs	0.0054	0.0595	0.1761	0.2649	0.3255	0.3850	0.4435	0.5083
Peak Flowrate	(q_p)	l/s	5	60	176	265	325	385	444	508
24 hour Runoff Volume	(V_{24})	cu mtr	27	343	1017	1535	1890	2239	2584	2965

2a Wesley Street
PO Box 475
Pukekohe 2340

BIRCH SURVEYORS LTD
Land Surveyors • Resource Consultants • Planners

ph: 09 237 1111
fax 09 238 0033

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Pre Development Pervious Area, Stormwater Catchment F

Hydrological Soil Group — Group_C (B&C)

	CN	Area	Product
Grassed	65	0.9090	59.0850
totals		0.9090	59.0850

% Impervious		0.00%	
CN weighted		65.0000	
Ia weighted		5.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.1700	km
Catchment Slope	(S_c)	0.1760	m/m
Runoff Factor		0.4815	
Time of Concentration	(t_c)	0.1094	hrs 6.6 min
Use	(t_c)	0.1667	min 10.0 min
Catchment Area		0.0091	km²
CN		65.0000	
Storage	(S)	136.7692	mm

Table 3.3 - Curve numbers for typical Auckland conditions

Land use	Group A Soil (volcanic granular loam)	Group B Soil (alluvial)	Group C Soil (mudstone/sandstone)
Bush, humid-climate, not-grazed	30	55	70
Pasture, lightly grazed, good grass cover	39	61	74
Urban lawns	39	61	74
Crops, straight rows, minimal vegetative cover	72	81	88
Sealed roads, roofs	98	98	98

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	5	34.50	89	130	157	184	210	239
c*			-0.0186	0.0822	0.2245	0.3042	0.3495	0.3884	0.4223	0.4555
q* from ARC		Approx	0.032	0.032	0.071	0.089	0.098	0.105	0.110	0.115
Peak Flowrate	(q_p)	cumecs	0.0014	0.0099	0.0574	0.1049	0.1395	0.1745	0.2098	0.2495
Peak Flowrate	(q_p)	l/s	1	10	57	105	139	174	210	249
24 hour Runoff Depth	(Q_{24})	mm	0.00	5.23	32.08	59.40	79.98	101.21	122.90	147.56
24 hour Runoff Volume	(V_{24})	cu mtr	0	48	292	540	727	920	1117	1341

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Pre Development Impervious Area, Stormwater Catchment F

Hydrological Soil Group — Group_C (B&C)

	CN	Area	Product
Building	98	0.0000	
Drive & Paths	98	0.0000	
totals		0.0000	0.0000

% Impervious		100.00%	
CN weighted		0.0000	
Ia weighted		0.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.1700	km
Catchment Slope	(S_c)	0.1760	m/m
Runoff Factor		0.0000	
Time of Concentration	(t_c)	0.0000	hrs 0.0 min
Use	(t_c)	0.1667	min 10.0 min
Catchment Area		0.0000	km²
CN		0.0000	
Storage	(S)	0.0000	mm

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
c*			1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
q* from ARC		Approx	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169
Peak Flowrate	(q_p)	cumecs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Peak Flowrate	(q_p)	l/s	0	0	0	0	0	0	0	0
24 hour Runoff Depth	(Q_{24})	mm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24 hour Runoff Volume	(V_{24})	cu mtr	0	0	0	0	0	0	0	0

Existing Flows

			WQV $^1/_3$ 2yr	Ex. Det.	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
Peak Flowrate	(q_p)	cumecs	0.0014	0.0099	0.0574	0.1049	0.1395	0.1745	0.2098	0.2495
Peak Flowrate	(q_p)	l/s	1	10	57	105	139	174	210	249
24 hour Runoff Volume	(V_{24})	cu mtr	0	48	292	540	727	920	1117	1341

2a Wesley Street
PO Box 475
Pukekohe 2340

BIRCH SURVEYORS LTD
Land Surveyors • Resource Consultants • Planners

ph: 09 237 1111
fax 09 238 0033

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Post Development Pervious Area, Stormwater Catchment F

Hydrological Soil Group: Group_C

	CN	Area	Product
Grassed	74	0.7300	54.0200
totals		0.7300	54.0200

% Impervious		0.00%	
CN weighted		74.0000	
Ia weighted		5.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.0200	km
Catchment Slope	(S_c)	0.5000	m/m
Runoff Factor		0.5873	
Time of Concentration	(t_c)	0.0175	hrs
Use	(t_c)	0.1667	min
Catchment Area		0.0073	km²
CN		74.0000	
Storage	(S)	89.2432	mm

1.0 min
10.0 min

Table 3.3 - Curve numbers for typical Auckland conditions

Land use	Group A Soil (volcanic granular loam)	Group B Soil (alluvial)	Group C Soil (mudstone/sandstone)
Bush, humid-climate, not-grazed	30	55	70
Pasture, lightly grazed, good grass cover	39	61	74
Urban lawns	39	61	74
Crops, straight rows, minimal vegetative cover	72	81	88
Sealed roads, roofs	98	98	98

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	5.0000	34.50	89	130	157	184	210	239
c*			-0.0288	0.1207	0.3074	0.4012	0.4516	0.4932	0.5283	0.5618
q* from ARC		Approx	0.032	0.038	0.090	0.107	0.114	0.120	0.125	0.129
Peak Flowrate	(q_p)	cumecs	0.0012	0.0097	0.0584	0.1009	0.1310	0.1611	0.1912	0.2247
Peak Flowrate	(q_p)	l/s	1	10	58	101	131	161	191	225
24 hour Runoff Depth	(Q_{24})	mm	0.00	7.33	40.88	72.60	95.74	119.16	142.75	169.27
24 hour Runoff Volume	(V_{24})	cu mtr	0	54	298	530	699	870	1042	1236

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Post Development Impervious Area, Stormwater Catchment F

Hydrological Soil Group: Group_C

	CN	Area	Product
Buildings/Impervious	98	0.3500	34.3000
Road/Footpath	98	0.1700	16.6600
totals		0.5200	50.9600

% Impervious		100.00%	
CN weighted		98.0000	
Ia weighted		0.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.0200	km
Catchment Slope	(S_c)	0.5000	m/m
Runoff Factor		0.9608	
Time of Concentration	(t_c)	0.0133	hrs
Use	(t_c)	0.1667	min
Catchment Area		0.0052	km²
CN		98.0000	
Storage	(S)	5.1837	mm

0.8 min
10.0 min

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	5.0000	34.50	89	130	157	184	210	239
c*			0.3254	0.7689	0.8959	0.9259	0.9380	0.9466	0.9529	0.9584
q* from ARC		Approx	0.093	0.150	0.161	0.164	0.164	0.165	0.166	0.166
Peak Flowrate	(q_p)	cumecs	0.0024	0.0270	0.0748	0.1102	0.1343	0.1577	0.1808	0.2062
Peak Flowrate	(q_p)	l/s	2	27	75	110	134	158	181	206
24 hour Runoff Depth	(Q_{24})	mm	2.45	29.99	84.30	124.62	151.94	178.64	204.86	233.79
24 hour Runoff Volume	(V_{24})	cu mtr	13	156	438	648	790	929	1065	1216

Calculated Flows

			WQV $^1/_3$ 2yr	Ex. Det.	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
Peak Flowrate	(q_p)	cumecs	0.0036	0.0367	0.1332	0.2111	0.2652	0.3188	0.3719	0.4310
Peak Flowrate	(q_p)	l/s	4	37	133	211	265	319	372	431
24 hour Runoff Volume	(V_{24})	cu mtr	13	209	737	1178	1489	1799	2107	2451

2a Wesley Street
PO Box 475
Pukekohe 2340

BIRCH SURVEYORS LTD
Land Surveyors • Resource Consultants • Planners

ph: 09 237 1111
fax 09 238 0033

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Pre Development Pervious Area, Stormwater Catchment G

Hydrological Soil Group		Group_C	(B&C)
	CN	Area	Product
Grassed	68	1.4058	95.5944
	totals	1.4058	95.5944

% Impervious		0.00%	
CN weighted		68.0000	
Ia weighted		5.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.1310	km
Catchment Slope	(S_c)	0.2060	m/m
Runoff Factor		0.5152	
Time of Concentration	(t_c)	0.0847	hrs
Use	(t_c)	0.1667	min
Catchment Area		0.0141	km²
CN		68.0000	
Storage	(S)	119.5294	mm

			5.1	min
			10.0	min

Table 3.3 - Curve numbers for typical Auckland conditions

Land use	Group A Soil (volcanic granular loam)	Group B Soil (alluvial)	Group C Soil (mudstone/sandstone)
Bush, humid-climate, not-grazed	30	55	70
Pasture, lightly grazed, good grass cover	39	61	74
Urban lawns	39	61	74
Crops, straight rows, minimal vegetative cover	72	81	88
Sealed roads, roofs	98	98	98

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	5	34.50	89	130	157	184	210	239
c*			-0.0214	0.0930	0.2489	0.3335	0.3807	0.4208	0.4554	0.4891
q* from ARC		Approx	0.032	0.032	0.077	0.095	0.103	0.110	0.115	0.120
Peak Flowrate	(q_p)	cumecs	0.0022	0.0154	0.0964	0.1727	0.2278	0.2833	0.3390	0.4016
Peak Flowrate	(q_p)	l/s	2	15	96	173	228	283	339	402
24 hour Runoff Depth	(Q_{24})	mm	0.00	5.84	34.80	63.59	85.06	107.06	129.43	154.76
24 hour Runoff Volume	(V_{24})	cu mtr	0	82	489	894	1196	1505	1819	2176

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Pre Development Impervious Area, Stormwater Catchment G

Hydrological Soil Group		Group_C	(B&C)
	CN	Area	Product
Building	98	0.0000	
Drive & Paths	98	0.0000	
	totals	0.0000	0.0000

% Impervious		100.00%	
CN weighted		0.0000	
Ia weighted		0.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.1310	km
Catchment Slope	(S_c)	0.2060	m/m
Runoff Factor		0.0000	
Time of Concentration	(t_c)	0.0000	hrs
Use	(t_c)	0.1667	min
Catchment Area		0.0000	km²
CN		0.0000	
Storage	(S)	0.0000	mm

			0.0	min
			10.0	min

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
c*			1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
q* from ARC		Approx	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169
Peak Flowrate	(q_p)	cumecs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Peak Flowrate	(q_p)	l/s	0	0	0	0	0	0	0	0
24 hour Runoff Depth	(Q_{24})	mm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24 hour Runoff Volume	(V_{24})	cu mtr	0	0	0	0	0	0	0	0

Existing Flows

			WQV $^1/_3$ 2yr	Ex. Det.	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
Peak Flowrate	(q_p)	cumecs	0.0022	0.0154	0.0964	0.1727	0.2278	0.2833	0.3390	0.4016
Peak Flowrate	(q_p)	l/s	2	15	96	173	228	283	339	402
24 hour Runoff Volume	(V_{24})	cu mtr	0	82	489	894	1196	1505	1819	2176

2a Wesley Street
PO Box 475
Pukekohe 2340

BIRCH SURVEYORS LTD
Land Surveyors • Resource Consultants • Planners

ph: 09 237 1111
fax 09 238 0033

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Post Development Pervious Area, Stormwater Catchment G

Hydrological Soil Group: Group_C

	CN	Area	Product
Grassed	74	1.0300	76.2200
totals		1.0300	76.2200

% Impervious		0.00%	
CN weighted		74.0000	
Ia weighted		5.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.2350	km
Catchment Slope	(S_c)	0.0700	m/m
Runoff Factor		0.5873	
Time of Concentration	(t_c)	0.1602	hrs
Use	(t_c)	0.1667	min
Catchment Area		0.0103	km²
CN		74.0000	
Storage	(S)	89.2432	mm

				SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})		mm	5.0000	34.50	89	130	157	184	210	239
c*				-0.0288	0.1207	0.3074	0.4012	0.4516	0.4932	0.5283	0.5618
q* from ARC			Approx	0.032	0.038	0.090	0.107	0.114	0.120	0.125	0.129
Peak Flowrate	(q_p)		cumecs	0.0016	0.0137	0.0824	0.1423	0.1848	0.2273	0.2697	0.3171
Peak Flowrate	(q_p)		l/s	2	14	82	142	185	227	270	317
24 hour Runoff Depth	(Q_{24})		mm	0.00	7.33	40.88	72.60	95.74	119.16	142.75	169.27
24 hour Runoff Volume	(V_{24})		cu mtr	0	75	421	748	986	1227	1470	1743

Table 3.3 - Curve numbers for typical Auckland conditions

Land use	Group A Soil (volcanic granular loam)	Group B Soil (alluvial)	Group C Soil (mudstone/sandstone)
Bush, humid-climate, not-grazed	30	55	70
Pasture, lightly grazed, good grass cover	39	61	74
Urban lawns	39	61	74
Crops, straight rows, minimal vegetative cover	72	81	88
Sealed roads, roofs	98	98	98

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Post Development Impervious Area, Stormwater Catchment G

Hydrological Soil Group: Group_C

	CN	Area	Product
Buildings/Impervious	98	0.5000	49.0000
Road/Footpath	98	0.1700	16.6600
totals		0.6700	65.6600

% Impervious		100.00%	
CN weighted		98.0000	
Ia weighted		0.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.2350	km
Catchment Slope	(S_c)	0.0700	m/m
Runoff Factor		0.9608	
Time of Concentration	(t_c)	0.1222	hrs
Use	(t_c)	0.1667	min
Catchment Area		0.0067	km²
CN		98.0000	
Storage	(S)	5.1837	mm

				SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})		mm	5.0000	34.50	89	130	157	184	210	239
c*				0.3254	0.7689	0.8959	0.9259	0.9380	0.9466	0.9529	0.9584
q* from ARC			Approx	0.093	0.150	0.161	0.164	0.164	0.165	0.166	0.166
Peak Flowrate	(q_p)		cumecs	0.0031	0.0348	0.0964	0.1420	0.1730	0.2032	0.2329	0.2657
Peak Flowrate	(q_p)		l/s	3	35	96	142	173	203	233	266
24 hour Runoff Depth	(Q_{24})		mm	2.45	29.99	84.30	124.62	151.94	178.64	204.86	233.79
24 hour Runoff Volume	(V_{24})		cu mtr	16	201	565	835	1018	1197	1373	1566

Calculated Flows

			WQV $^1/_3$ 2yr	Ex. Det.	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
Peak Flowrate	(q_p)	cumecs	0.0048	0.0485	0.1788	0.2843	0.3578	0.4305	0.5027	0.5828
Peak Flowrate	(q_p)	l/s	5	48	179	284	358	431	503	583
24 hour Runoff Volume	(V_{24})	cu mtr	16	276	986	1583	2004	2424	2843	3310

2a Wesley Street
PO Box 475
Pukekohe 2340

BIRCH SURVEYORS LTD
Land Surveyors • Resource Consultants • Planners

ph: 09 237 1111
fax 09 238 0033

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Pre Development Pervious Area, Stormwater Catchment H

Hydrological Soil Group: Group_C

	CN	Area	Product
Grassed	74	1.0376	76.7824
totals		1.0376	76.7824

% Impervious		0.00%	
CN weighted		74.0000	
Ia weighted		5.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.1330	km
Catchment Slope	(S_c)	0.2180	m/m
Runoff Factor		0.5873	
Time of Concentration	(t_c)	0.0782	hrs
Use	(t_c)	0.1667	min
Catchment Area		0.0104	km²
CN		74.0000	
Storage	(S)	89.2432	mm

Time of Concentration	(t_c)	4.7	min	
Use	(t_c)	10.0	min	

Table 3.3 - Curve numbers for typical Auckland conditions

Land use	Group A Soil (volcanic granular loam)	Group B Soil (alluvial)	Group C Soil (mudstone/sandstone)
Bush, humid-climate, not-grazed	30	55	70
Pasture, lightly grazed, good grass cover	39	61	74
Urban lawns	39	61	74
Crops, straight rows, minimal vegetative cover	72	81	88
Sealed roads, roofs	98	98	98

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	5	34.50	89	130	157	184	210	239
c*			-0.0288	0.1207	0.3074	0.4012	0.4516	0.4932	0.5283	0.5618
q* from ARC		Approx	0.032	0.038	0.090	0.107	0.114	0.120	0.125	0.129
Peak Flowrate	(q_p)	cumecs	0.0016	0.0138	0.0830	0.1434	0.1862	0.2290	0.2717	0.3194
Peak Flowrate	(q_p)	l/s	2	14	83	143	186	229	272	319
24 hour Runoff Depth	(Q_{24})	mm	0.00	7.33	40.88	72.60	95.74	119.16	142.75	169.27
24 hour Runoff Volume	(V_{24})	cu mtr	0	76	424	753	993	1236	1481	1756

STORMWATER FLOWS - Smith - Lisle Farm Drive - 4553 - Rev C

Pre Development Impervious Area, Stormwater Catchment H

Hydrological Soil Group: Group_C BATCH

	CN	Area	Product
Building	98	0.0000	
Drive & Paths	98	0.1000	9.8000
totals		0.1000	9.8000

% Impervious		100.00%	
CN weighted		98.0000	
Ia weighted		0.0000	
Channelisation factor	(C)	1.0000	
Catchment Length	(l)	0.1330	km
Catchment Slope	(S_c)	0.2180	m/m
Runoff Factor		0.9608	
Time of Concentration	(t_c)	0.0597	hrs
Use	(t_c)	0.1667	min
Catchment Area		0.0010	km²
CN		98.0000	
Storage	(S)	5.1837	mm

Time of Concentration	(t_c)	3.6	min	
Use	(t_c)	10.0	min	

			SMAF	99%ile	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
c*			0.7415	0.7689	0.8959	0.9259	0.9380	0.9466	0.9529	0.9584
q* from ARC		Approx	0.148	0.150	0.161	0.164	0.164	0.165	0.166	0.166
Peak Flowrate	(q_p)	cumecs	0.0044	0.0052	0.0144	0.0212	0.0258	0.0303	0.0348	0.0397
Peak Flowrate	(q_p)	l/s	4	5	14	21	26	30	35	40
24 hour Runoff Depth	(Q_{24})	mm	25.32	29.99	84.30	124.62	151.94	178.64	204.86	233.79
24 hour Runoff Volume	(V_{24})	cu mtr	25	30	84	125	152	179	205	234

Existing Flows

			WQV $^1/_3$ 2yr	Ex. Det.	50% AEP 2yr ARI	20% AEP 5yr ARI	10% AEP 10yr ARI	5% AEP 20yr ARI	2% AEP 50yr ARI	1% AEP 100yr ARI
24 hour rainfall depth	(P_{24})	mm	29.7333	34.50	89	130	157	184	210	239
Peak Flowrate	(q_p)	cumecs	0.0060	0.0190	0.0974	0.1646	0.2120	0.2593	0.3065	0.3591
Peak Flowrate	(q_p)	l/s	6	19	97	165	212	259	306	359
24 hour Runoff Volume	(V_{24})	cu mtr	25	106	508	878	1145	1415	1686	1990

SURVEYORS | RESOURCE CONSULTANTS
LAND DEVELOPMENT ENGINEERS | PLANNERS

Birch
LAND DEVELOPMENT CONSULTANTS

SMAF CALCULATIONS - Post catchment B except roof area

Client	Smith	**Analysis Date**	13-Dec-24
Address	70 Lisle Farm	**SMAF Zone**	1
Project Number	4553	**10% AEP Flood Mitigation Required**	Yes
Revision	Rev B		

SMAF 1 Requirements:

Provide Retention (Volume Reduction) of a 5mm 24hr rainfall event for the impervious area for which hydrology mitigation is required

Provide Detention (Temporary Storage) with a volume equal to the increase in runoff volume from the 95th percentile 24hr rainfall event for the impervious area for which hydrology mitigation is required

Site Data

New and Redeveloped Impervious Area	55349	m²	Total Site Area	85196	m²
Percentage of Total Site Area	65%		Total Post Development Impervious Area	55349	m²
Hydrographical Soil Group	Group_C		Impervious Area required to be Mitigated	55349	m²
95th %ile 24hr Rainfall Depth	34	mm	Pervious Area required to be Mitigated	29847	m²

Pre Development

Pre Developed Area to be Mitigated		85196	m²
Curve Number	(CN)	74	
Initial Abstraction	(Ia)	5	mm
Storage	(S)	89.24	mm

ARI		Design Storm 95th %ile 24hr Rainfall	
24 Hr Rainfall depth	(P_{24})	34	mm
Runoff Depth	(Q_{24})	7.11	mm
Runoff Volume	(V_{24})	605.95	m³

Table 3.3 - Curve numbers for typical Auckland conditions

Land use	Group A Soil (volcanic granular loam)	Group B Soil (alluvial)	Group C Soil (mudstone/sandstone)
Bush, humid-climate, not-grazed	30	55	70
Pasture, lightly grazed, good grass cover	39	61	74
Urban lawns	39	61	74
Crops, straight rows, minimal vegetative cover	72	81	88
Sealed roads, roofs	98	98	98

Post Development

Areas to be Mitigated		Impervious	Pervious	Total	
Area	m²	55349	29847	85196	m²
Curve Number	CN	98	74		
Initial Abstraction	(Ia)	0	5		
Storage	(S)	5.18	89.24		
24 Hr Rainfall depth	(P_{24})	34	34		
Runoff Depth	(Q_{24})	29.50	7.11	21.66	mm
Runoff Volume	(V_{24})	1632.91	212.29	1845.20	m³

Storm Event (ARI)		Storm Event Retention Storm 5mm	Storm Event Detention Storm 95th %ile 24hr Rainfall	
24 Hr Rainfall depth	(P_{24})	5	34	mm
Runoff Depth	(Q_{24})	5	21.66	mm
Runoff Volume	(V_{24})	276.75	1845.20	m³

SMAF Volume Requirements

Total Detention & Retention Volume Required	1239.24	m³	(Post Dev - Pre Dev)
Minimum Retention Volume Required	276.75	m³	Reuse
Minimum Detention Volume Required	962.50	m³	
Average Outflow to Detention Volume in 24 hours	11.14	l/s	for Pipe Tank use 0.86 reduction in flow
Peak Orifice Outflow (2x Average Flow)	22.28	l/s	19.16 l/s
Head above Orifice	0.10	m	0.10 m
Orifice discharge coefficient	0.62		0.62
Orifice Diameter (Orifice 1)	181.0	mm	167.8 mm
(use	181.0	mm as minimum orfice diameter)	